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Valuing Environmental Preferences

Theory and Practice of the Contingent Valuation Method in the US, EU, and Developing Countries

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The Theory and Measurement of Passive-Use Value

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4.1. INTRODUCTION

Essays on passive-use values rarely, if ever, fail to mention contingent valuation.[1] Primary reliance upon contingent valuation as a means of including passive-use values in valuation estimates makes it difficult to disentangle passive-use value issues from contingent valuation issues in any discussion or analysis of either. Authors seldom emphasize that passive-use values and contingent valuation are separate, although related issues. In particular, passive-use values can be discussed independently and few, if any, contingent valuation issues are specific to passive-use values. Moreover, passive-use values apply to a more inclusive set of goods than environmental goods only. A wide variety of public projects such as education, family assistance, and national defence can all be viewed as potentially generating substantial passive-use values.[2] Although our analysis is relevant to a more general set of goods, we will confine our discussion to environmental goods. In this chapter we attempt to disentangle passive-use value and contingent valuation and present them in what we believe is a useful perspective.

In Section 4.2 we provide a theoretical exposition of passive-use values. We begin by introducing a definition of passive-use value that is oriented toward the researcher in that it relates to what is potentially observable or estimable. Our approach differs from earlier definitions that rely on motives; relying on motives to define passive-use values results in an *ad hoc* taxonomy

[1] 'Passive-use value' is the term adopted by the 1989 US Federal Court of Appeals decision in *Ohio* v. *US Department of Interior* to refer to what many authors in the environmental economics literature call non-use or existence value. Other terms which have been used include 'preservation value', 'stewardship value', 'bequest value', 'inherent value', 'intrinsic value', 'vicarious consumption', and 'intangibles'. 'Option value' in the sense of possible future use is also included in the Court's definition of passive-use values, although it has often been categorized as a special type of direct-use value.

[2] One of the earliest papers suggesting that the set of valuers be expanded to a larger set than current users (Weisbrod, 1964) was based on a public transportation example.

because values are generally driven by multiple motives which are inseparable. Furthermore, researchers are generally ignorant of consumers' motives in any given economic decision, market or non-market. When motives are elicited, the way in which these motives interact while influencing values is indeterminable.

Our analysis emphasizes different levels of error that may occur from relying exclusively on indirect techniques. One level of error is the failure to identify correctly the population of all relevant resource valuers.[3] This failure may result from valuers lacking a behavioural trail from which to infer values or from researchers' inability to identify relevant linkages when they do exist. A second level of error concerns those individuals whose market demands exhibit responses to resource changes.

In Section 4.3, we address six issues concerning the measurement of total value which are frequently advanced as criticisms of contingent valuation and are thought to be related to passive-use value. The first issue is commodity definition. We begin by outlining the challenge facing contingent valuation researchers: portraying projects in a way that is meaningful to respondents and that provides the information that is important to respondents. We then explain how commodity definition may influence researchers' interpretations of how sensitive respondents are to the good being provided. The second issue is the effect of different means of project provision and payment aspects on goods' values. By recognizing that contingent valuation studies generally provide public or quasi-public goods, one can easily understand how a project's implementing details might influence respondents' values. The third issue is resource familiarity. We analyse the reasoning in support of the claim that agents' values for environmental projects lack content when they have limited knowledge of the affected resource. The fourth issue is the claim that passive-use values are an issue only in cases of irreversible changes to unique resources. While uniqueness and irreversibility are important factors, the terms 'irreversible' and 'unique' are relative in that their meanings are contextually derived. The fifth issue is how to deal with substitutes in a valuation analysis. We point out that substitutes can be viewed from three perspectives which make this issue manageable: (1) the opportunities available to the public; (2) the information that respondents already possess; and (3) the amount of information which can realistically be conveyed to the respondent by the survey. Finally we discuss incentive compatibility structures of contingent valuation questions and note that only by carefully considering the incentive structures of a given contingent valuation question can we accurately evaluate the study's results. We reflect on the salience of this issue with respect to recent experiments claimed to have demonstrated biases in contingent valuation surveys.

[3] Kopp and Smith (1993) refer to this error as failure to recognize the extent of the market; Mitchell and Carson (1989) refer to this error as population choice bias.

4.2. A THEORETICAL INVESTIGATION OF PASSIVE-USE VALUES

We begin by considering the individual value that we would like to measure. At a general level, broadly defined environmental goods are acted upon collectively and therefore the level or quality of environmental goods is outside of the consumer's choice set. In the environmental goods valuation problem, we are interested in the value, in monetary terms, of changing the level or quality of environmental goods. The measures of individual value that we adopt in this chapter are the maximum amount of money an individual is willing to pay for an increase and the minimum amount of money an individual is willing to accept for a decrease in the environmental goods.[4] These are the standard utility-constant measures of value described in standard texts on applied welfare economics such as Just *et al.* (1982). In order to keep notation and terminology simple, we will consider only the willingness to pay for an increase in the environmental good.

Taking as given the improvement as understood by the individual, we would like to know at what price the individual would no longer desire the improvement.[5] What we wish to measure is not a philosophically deep concept and in principle is no more enigmatic than in the case of private goods, with the exception of the lack of a market.[6] In a market one can observe the point of trade-off and then infer an economic value. However, there is no absolute value for a market good, as some claim should be the case for an environmental good. Rather the specific context (income, other prices, and other factors) motivates the choice. As economic theory predicts, measures of value (consumer surplus) for market goods will differ under different circumstances, which is also true for measures of value for environmental goods. These differences can be with respect to prices of market goods, levels of other environmental goods, and a host of other factors. If a market in environmental goods existed which had proper incentives, value could be revealed similarly to a market good. Instead we are faced with either inferring value for the environmental good from market purchases which may be related to the levels of environmental goods or constructing a market with proper incentives. The fundamental question that makes

[4] One can also consider willingness to pay to avoid a loss and willingness to accept compensation in order to forgo an increase, which are analytically equivalent to those defined above. The willingness-to-pay measures fix utility at the level obtainable with the lower level of environmental goods and unadjusted income; the willingness-to-accept measures fix utility at the higher level with unadjusted income. The two differ only in their reference utility levels.

[5] Part of this choice is an explicit (implicit) set of rules regarding provision and payment. Included in these rules are issues such as the distribution of costs (perceived distribution of costs) and enforcement procedures (perceived enforcement procedures). These issues are discussed at greater length in S. 4.3.

[6] Some authors (e.g. Sagoff, 1994) reject the approach of using pecuniary measures for changes in environmental goods to make decisions. However, environmental changes generally *do* involve economic trade-offs and policy-makers are generally interested in how much the relevant population is willing or not willing to pay.

passive-use value an issue is: How accurately can we measure the value described above without actually constructing a market for the environmental good? While there is no definitive answer, our theoretical exposition is directed toward understanding this question.

In the two most influential papers on passive-use values, Weisbrod (1964) and Krutilla (1967), considerable space is devoted to a discussion of motives. Both papers tell their economic stories without the aid of specific models predicted on particular sets of assumptions.[7] Essentially their forte lies in their choices of examples, which proved sufficiently thought-provoking to illuminate a new line of enquiry in environmental economics. These motivational examples struck a chord with many readers, who may personally identify with these motives. Motives provide a necessary story-line when arguing in favour of expanding the population of valuers, but at the same time cannot be considered the cornerstone of a positive theory of passive-use values.

In the literature, a tradition of defining passive-use value by motivation or lack of motivation has emerged.[8] However, from an operational stand-point, using motivations as a means of defining passive-use values results in an *ad hoc* taxonomy since motivations in any economic decision are generally multifold, inseparable, and unavailable to the researcher.[9] We instead propose a definition that is understandable and operational from the researcher's perspective and does not require knowing agents' motives.

Definition: Passive-use values are those portions of total value (*WTP* or *WTA*) that are unobtainable using indirect measurement techniques which rely on observed market behaviour.

Our definition encompasses the motivational examples provided in the literature while avoiding certain inconsistencies such as whether today's value for future use is a use value or a non-use value.[10] More importantly, the definition has meaning to the researcher who will never have knowledge of all of the many motivations that influence individuals' preferences.

At the core of any prospective model of environmental goods is an examination of the trade-off between those goods to which agents are able

[7] The longevity of these two papers is undoubtedly enhanced by their lack of formal details and their focus on sensible, realistic examples.

[8] For examples see Mitchell and Carson (1981), Randall and Stoll (1983), Fisher and Raucher (1984), Smith and Desvousges (1986), Madariaga and McConnell (1987), Bishop and Welsh (1990), and Shechter and Freeman (1994).

[9] Many contingent valuation researchers ask respondents to apportion elicited total value by motivation. Carson and Mitchell (1991) and Cummings and Harrison (1995) point out that in addition to being cognitively difficult, such decompositions are generally not unique, as the portion of value assigned to a particular motivation may differ depending on the other elicited motivations. Moreover, given all of the potential motivations, no list could ever be exhaustive for *all* individuals. McConnell (1997) addresses a number of technical issues specifically related to welfare economics and altruism.

[10] After completion of our initial draft of this chapter, we discovered that in their discussion of the limitations of the household production function valuation methodology, Miller *et al.* (1994) employ an approach identical to ours in defining use values.

to allocate scarce resources and environmental goods. In order to represent this trade-off mathematically, assume that preferences over environmental goods, Q, and market goods, X, can be represented by a utility function, $U = f(X, Q)$, where f is increasing in both arguments.[11] Income, y, is allocated toward the purchase of market goods in a way that obtains the highest level of utility given market price vector, p, and the level of environmental goods, Q. The choice of X that maximizes U can be thought of as a function of prices, income, and the level of Q: $X(p, Q, y)$. The highest level of obtainable utility given income, prices, and level of Q can now be written as $v(p, Q, y) = f[X(p, Q, y), Q]$, which is called the indirect utility function. Willingness to pay for an increase in environmental goods from Q^0 to Q^1 satisfies the equation $v(p, Q^0, y) = v(p, Q^1, y - WTP)$. In words, willingness to pay is the most income that would be forgone in order to get the environmental improvement before preferring to keep Q at the initial level, Q^0, with income y. Although this model is very stylized and does not explicitly address important elements such as uncertainty and time, it captures the essential trade-offs (market goods for Q) at a very simplistic level.[12]

Another mathematical concept that is useful in analysing changes in environmental goods is the set of compensated or Hicksian demands. Recall that in the maximization problem, maximum obtainable utility was given by the indirect utility function, $v(p, Q, y)$. If we redefined the objective as minimizing expenditures on market goods while maintaining the utility level $v(p, Q, y)$, then the same combination chosen in the utility maximization problem, $X(p, Q, y)$, will be chosen in the expenditure minimization problem, with the minimum amount of expenditures equal to y. We could consider changing Q or p while maintaining the same utility level $v(p, Q, y)$ and again solve for the minimum expenditures. The bundle of market goods that solves this minimization problem is called the set of compensated or Hicksian demands, which are functions of prices, environmental goods, and the level of utility: $X^h(p, Q, U)$.[13] Total minimized expenditures (the analogue to indirect utility) are given by $e(p, Q, U) = p \cdot X^h(p, Q, U)$. Introduction of the compensated demand/expenditure minimization framework is useful because if we refer back to the equation that defined willingness to pay, $v(p, Q^0, y) = v(p, Q^1, y - WTP)$, we have a utility-constant world. Willingness to pay can be written $WTP = e(p, Q^0, U) - e(p, Q^1, U)$ where $U = v(p, Q^0, y)$. In the utility-constant world, compensated demands respond *even* in cases when the ordinary demands do not.

[11] Q and X are vectors of environmental goods and market goods respectively. We assume that U is quasi-concave in X.

[12] Although our model does not explicitly address time and uncertainty, the utility-constant concepts used with respect to uncertainty in the option value literature (see Smith, 1987) and time with uncertainty found in the quasi-option value literature (Arrow and Fisher, 1974; Hanemann, 1989) can be handled by adapting U and the income constraint set.

[13] We will denote compensated demands by the h superscript $X^h(p, Q, U)$; ordinary demands will contain no superscript, $X(p, Q, y)$.

In most applications, we are interested in the values of a population whose members may have very different positions *vis à vis* the resource being affected. While some differences in the choices of market goods may be explained by differences in income, the decision to use or ability to appreciate an environmental resource is undoubtedly influenced by resource proximity and other factors such as socialization. These differences translate into different utility representations and implicit in our analysis is the notion that there are possibly as many utility representations as individuals in the population.

In applications of economic theory where Q is not being varied, measurements of welfare changes (for example for a price change) are possible via the informational triad: prices, income, and market goods chosen. The environmental goods problem is inherently more difficult because we are interested in the inverted relationship (Flores, 1994) of how individual prices respond to changes in the level of Q, or at least a specified change.[14] Note that in the formulation given above, observable market demands are functions of Q. Therefore, at least in theory, it seems that valuing the change in Q may be possible via reflections in the changes in purchases of market goods. From a theoretical stand-point, the ability to pick up reflections of the value of Q from the observation of an individual's market goods choices is the essence of the passive-use value puzzle.

To help illustrate this point, we consider a simple example. Suppose that we are considering improving the environmental quality of a given recreational site. Even though this example deals with a very specific resource, a recreation site, it generates the interesting elements in the passive-use value problem. One subset of the population, site users, leaves behind an easily identified behavioural trail which provides a reflection of the value of Q through market responses—they visit the site. Users of a nearby site may value the site on which quality is being improved not for their own use, but as a way of reducing congestion at their preferred site, enhancing their preferred site through ecosystem linkages, or because the improved site will provide habitat for species important to them. Inferring values from observable behaviour is possible for this group as well, but identification must precede measurement. There may also be other individuals who value the site for a variety of reasons, but it is not possible to identify the behavioural link or there simply is no behavioural link. The modelling strategy and degree of measurement success when using observable behaviour will differ in each case. Taking these cases in reverse order, consider those individuals whose observable decisions are not readily linked to Q.

[14] Major difficulties arise because there is rarely much variation in Q to which agents may respond (historical observations) and the agents' private prices (WTP) are unobservable. Even in cases where resource-use demand is observable, such as travel-cost modelling, prices inferred for usage by the researcher may be poor estimates of the price inferred by the agent (Randall, 1994).

This case can be represented mathematically as the f function being separable in Q and X.[15] Utility takes the form $f(X, Q) = T[g(X), Q]$, where $g(X)$ is increasing and quasi-concave in X; T is increasing in $g(X)$ and Q. Note that maximization with respect to g is the same as maximization with respect to T because Q is not in the agent's choice set. Therefore the observable demands are not affected by changes in Q.[16] Because T is increasing in Q, the change in Q is still valued although undetectable in the observable demands.

Now consider the second group, users of a nearby site who do not use the site for which quality is being changed, but have positive values due to congestion externalities and other possible considerations such as ecosystem linkages. The utility function for this group has the form $f(X, Q) = T[g(X, Q), Q]$.[17] In this case, Q enters the utility function twice, once in g and once as the second argument of T.[18] This form implies that some of the value is detectable though interactions with market goods, such as costly trips to their preferred site, and some of the value is not detectable from market goods due to the second, separable entry of Q in T. The separable portion precludes ruling out the possibility of value in addition to the congestion externality value, such as ecosystem values related to the site to be improved. Some of the value with utility increment related to g may be obtained by indirect techniques such as the travel-cost method if there is sufficient variation in existing data and, more importantly, if the linkage is recognized. Even when linkages between the change in Q and market goods exist, failure of the researcher to identify the set of goods that interact has the effect of reverting back to the completely separable case for practical purposes.

For the last group, recreational site users, utility takes the same general form as for nearby site users: $f(X, Q) = T[g(X, Q), Q]$. The primary difference between the two groups is that some of the linkages are much easier to identify and the population of users is easier to access. Even for the group of users, there may be values in addition to those picked up through the interaction of Q with the market goods due to the second argument in T. With respect to the values resulting from g (those possibly detectable through market responses), as in the case of nearby site users, failure to recognize all relevant market linkages may lead to over- or underestimation.[19]

[15] For a discussion of the role of separability, see Deaton and Muellbauer (1980) or Varian (1992). Examples of separable preferences are the linear-logarithmic class of utility functions (Cobb-Douglas) and the Stone-Geary class.

[16] Freeman (1979) refers to this as the hopeless case.

[17] This specification is suggested in McConnell (1983) and Hanemann (1988, 1995).

[18] This form is sufficiently flexible in that it encompasses the separable case discussed above (g constant in Q) as well as the common representation $f = h(X, Q)$ (T constant in the second entry).

[19] The evolution of travel-cost models has been greatly influenced by recognizing the importance of including all linkages, such as shifts in demand at other sites (Bockstael *et al.*, 1991; Smith, 1991). Multiple-site models such as random-utility models evolved in response to this issue.

With these three groups in mind, we now turn to some of the theoretical issues involved in the measurement of value with respect to each group. We begin by considering the class of preferences for which some value is recoverable through market responses, utility of the form $f(X, Q) = T[g(X, Q), Q]$. Considering this class allows us to discuss the theoretical basis of some of the measurement techniques used in the literature, address theoretical definitions of passive-use value, and consider potential errors associated with the techniques.

With respect to measuring values for changes in environmental goods from observable market behaviour, we introduce the time-honoured price/quantity decomposition found throughout the literature.[20] Recall that willingness to pay can be written using the expenditure representation: $WTP = e(p, Q^0, U) - e(p, Q^1, U)$. One can add and substract the terms $e(p^*, Q^0, U)$ and $e(p^*, Q^1, U)$ to rewrite WTP:

$$WTP = e(p, Q^0, U) - e(p^*, Q^0, U) + e(p^*, Q^0, U) - e(p^*, Q^1, U) + e(p^*, Q^1, U) - e(p, Q^1, U), \tag{4.1}$$

which holds for any price vector, p^*. Using this mathematical trick allows one to express the change in expenditure in three moves: $(p, Q^0) \rightarrow (p^*, Q^0)$; $(p^*, Q^0) \rightarrow (p^*, Q^1)$; $(p^*, Q^1) \rightarrow (p, Q^1)$. Using the fundamental theorem of calculus and Shephard's Lemma, WTP can be rewritten as

$$WTP = \int_p^{p^*} \sum_{i=1_j}^{nj} [X_i^h(s, Q^1, U) - X_i^h(s, Q^0, U)]ds + [e(p^*, Q^0, U) - e(p^*, Q^1, U)] \tag{4.2}$$

X_i^h are elements of the vector of Hicksian demands X^h; s represents the level of prices; the goods that coincide with the price changes in the integral term are denoted by the j subscript, with n_j the number of prices being changed. This first term measures the difference in the area under the compensated demand curves, between the old price and new price, at the initial and subsequent levels of Q. The second term is willingness to pay for the change in Q, but when facing higher prices, p^*. When p^* is high enough to choke off demand in the j subset of goods (assuming they are non-essential), the first term is the change in consumer surplus for each good in subset j resulting from the change in Q.[21]

Early work concerning the measurement of economic value of non-market goods used the weak complementary condition (Clawson, 1959; Mäler, 1974) to derive WTP exclusively from observable goods. Some subset j of market goods is weakly complementary to Q if the marginal utility of Q is

[20] Prominent examples include McConnell (1983) and Freeman (1993*a*, *b*).

[21] For the different levels of environmental goods, Q^0, Q^1, the choke price may differ. It suffices that p^* be the higher choke price which will choke off demand at both levels of Q.

zero when the complementary goods are not consumed.[22] In our example, travelling to the site for users of the site for which quality is being varied and travelling to the nearby site for its respective users would be candidates for the j subset for the two groups respectively. Suppose that the goods associated with travelling to the two sites became prohibitively expensive and at price p^* demand before and after the quality change at the first site was driven to zero. Then in such a case, (4.2) can be rewritten as the change in consumer surplus for the weakly complementary set before and after the change in the first site's quality:

$$WTP = \int_p^{p^*} \sum_{i=1_j}^{nj} [X_i^h(s, Q^1, U) - X_i^h(s, Q^0, U)]ds \tag{4.3}$$

The second term disappears due to the weak complementary condition. The consumer surplus change above is a Hicksian (compensated) measure which, when estimating from observable behaviour, leads to some difficulty because the Hicksian demands are unobservable. Recovering the Hicksian measure from the ordinary demands requires that one first estimate the ordinary demands as functions of prices, income, and Q, and then derive the constants of integration for each complementary good (Hanemann, 1980; Hausman, 1981).

Several observations are in order with respect to weak complementarity. First, the weak complementary condition is an unverifiable assumption (LaFrance, 1993) and when the assumption is incorrect, some value is neglected. Second, even if such a weak complementary set exists, the researcher must correctly identify the set in order to avoid incorrect estimation. Third, if preferences are represented by a utility function of the form $f(X, Q) = T[g(X, Q), Q]$, the estimated Hicksian demands will correspond to $g(X, Q)$ rather than the entire utility function because value associated with the second argument in T is undetectable. Therefore there can be a correctly identified, weakly complementary set and yet the separable part of T still leaves a portion that is immeasurable from market demand data. The usage of the T function, which allows for both separable and non-separable characteristics in Q, has important implications for interpreting earlier definitions of passive- or non-use values. By allowing for both of these characteristics, values arise in addition to those identified by the definitions presented below. We turn now to a brief discussion of three suggested passive-use value definitions that use decompositions and forms of utility in defining these values.

First, McConnell (1983), Freeman (1993*a*), and others use the price/quantity decomposition of WTP as a way of defining passive-use value. This

[22] Perfect complementarity is said to occur when the subset j of market goods and Q must be consumed in fixed proportion to provide utility.

approach defines the integral term of the decomposition as use value and the second term as passive-use value.

$$\begin{aligned} WTP &= [e(p^*, Q^1, U) - e(p, Q^1, U)] - [e(p^*, Q^0, U) - e(p, Q^0, U)] \\ &\quad + [e(p^*, Q^1, U) - e(p, Q^1, U)] \\ &= UV + PUV. \end{aligned} \tag{4.4}$$

This approach explicitly rejects the weak complementary assumption as a means of determining value. The j subset is given by the goods that differ with Q and are non-essential. The non-essential condition allows for choking off demands and examining changes in consumer surplus resulting from the change in Q. The estimation problems concerning the T utility form still apply. Therefore, after estimating the use term from observable behaviour, part of the use value (as defined by the price/quantity decomposition) is overlooked since estimation will reflect g-compensated demands rather than T-compensated demands. This leaves researchers that are exclusively using indirect methods to measure WTP with two sources of error (for the group with market responses): error from the PUV term and errors associated with measuring Hicksian consumer surplus from g rather than T; both errors are positive.

Larson (1992) introduces the Hicks neutral condition as a way of measuring the PUV term in the price/quantity decomposition from market information. A good is Hicks-neutral to Q if the derivative of its compensated demand with respect to Q is zero. By using the rationed-quantity analogue of the Slutsky equation and budget constraint adding-up conditions, Larson shows how the PUV term can be recovered from market responses. Flores (1996) shows that the condition itself requires a very delicate balance of income and quantity effects which are rarely satisfied, and exact measures are only possible for very restrictive sets of demand systems.[23] Despite these failings, the method may be useful because in some cases the resulting biases are recognizable (ibid.). Therefore by using Hicks neutral techniques, some of the downward measurement bias from the PUV term may be recoverable.

Hanemann (1988, 1995) suggests another way of partioning total value into a use and passive-use component. Considering the increase from Q^0 to Q^1, we can use a sequence approach to separate out the values as follows:

$$C^p \text{ solves } T\{g[X(p, Q^0, y - C^p), Q^1]\} = T\{g[X(p, Q^0, y), Q^0]\} \tag{4.5}$$

and

$$C^u \text{ solves } g[X(p, Q^1, y^* - C^u), Q^1 = g[X(p, Q^0, y), Q^0], \tag{4.6}$$

[23] As in the case of weak complementarity, the inability to verify the Hicks neutral assumption (LaFrance, 1993) applies here as well.

where $y^* = y - C^p$. Note that $WTP = C^p + C^u$. As Hanemann points out, C^p is a reasonable candidate for passive-use value since it is the portion of total value that is not at all detectable from market goods; C^u is use value or the value that interacts with market goods and generates a market goods response. Hanemann's definition differs from the use value as defined by the price/quantity decomposition. Use value from the decomposition is Hicksian consumer surplus for T although estimation will yield consumer surplus for g. Hanemann's C^u explicitly takes into account that from observable behaviour, the T consumer surplus is unobtainable; C^u is related to g only. Hence Hanemann's use/passive-use value definition is derived in relation to the extent that Q interacts with market goods and therefore the theory coincides more closely with our definition than does the price/quantity definition. In relation to our own definition, Hanemann's definition of use value may still have a passive-use value error.[24]

A third way of defining passive-use values is to consider the value of a proposed change given that access to the resource is denied.[25] This definition, proposed by Bohm (1977) and elaborated on by Gallagher and Smith (1985), coincides with the notion of existence values discussed in the literature since usage is not possible for some or perhaps all individuals.[26] Therefore it seems reasonable that all value must be attributable to considerations other than usage. The conditioning of *whose* access is denied is important, as the following example illustrates.

Suppose that a federal project for wilderness preservation is being considered; currently the land is privately held, inaccessible to the public, and logging is imminent. One possibility is to propose a project X that will preserve the area, but keep it inacessible to all. Since no one may potentially use the area, we are valuing a good that has no direct service to humans. In the traditional sense, individuals who value the programme do so because they value the mere existence of the area. Another possibility is to preserve the area with access limited to hikers, project Y. This would effectively deny access to all non-hikers. Some non-hikers may value both projects. However, the values they hold for the good provided by X may differ from those they hold for the good provided by Y. Group A non-hikers may believe that preservation of species found in the area is important, but prefer preservation with sensible access for hikers. Group B non-hikers may prefer preservation with access over logging, but prefer preservation without access over preservation with access. The values for both projects are passive-use

[24] Although C^u is defined by interaction with market goods, this does not imply that all of C^u can be recovered from indirect techniques. If one thinks of optimization in g only, there would still be a second term as in the price/quantity decomposition; the second term will generally not be recoverable.

[25] See Zhang (1993) for an empirical application that uses this approach.

[26] Some of the 'existence' value in this case may be detectable through secondary market responses due to linkages with the preserved area. Therefore some of the value may not be passive-use value by our definition.

values for both groups A and B, but group A will have a greater project-X value than project-Y value while for group B project-Y values will be greater.[27]

We raise this issue to emphasize that individuals can have legitimate 'existence' values for a particular good which differ because the access attributes differ. The fact that the attributes differ makes this definition more difficult to represent theoretically than either the price/quantity decomposition or Hanemann definitions. In contrast to these definitions, which basically decompose a single value, the access definition compares values for what are essentially two distinct projects. For example, the access definition should be modelled as different changes in $Q: Q \rightarrow Q^{na}$ in the case of no access, and $Q \rightarrow Q^{ha}$ in the case of hiking access. It is particularly important to recognize that hikers' non-access passive-use value (value of project X) may have nothing to do with non-hikers' hiker-access passive-use value (project Y). In defining existence values by access, one must concede that, while the values of both projects are of interest, the values are for different projects.

The definitions provided above are useful in examining and understanding potentially overlooked values that result from exclusively using indirect methods for measuring *WTP*. Ideally we would like to know what each individual would be willing to pay for the change in Q in the manner in which it is being provided.[28] By examining the problem using simple mathematical representations, it is apparent that there are multiple sources of error (missed value) that may result when exclusively using indirect techniques to measure total value.

The first and most potentially significant error is the failure to identify correctly the relevant population of valuers. Although it is not always the case, passive-use values can be crucial in decisions involving the allocation of environmental goods, particularly when the number of individuals holding passive-use values is very large. The insight provided by Weisbrod (1964) and Krutilla (1967) emphasized the importance of searching for all resource 'valuers' as a means of enhancing efficiency; this is the population issue. The exclusive use of indirect techniques equates the values for this segment of the population with zero.

The second source of error results from the last term in the price/quantity decomposition given in equation (4.2). This error applies only to the population whose market demands are sensitive to changes in Q. Referring to this term as passive-use value fails to recognize the failure to identify relevant

[27] One could conduct similar analyses using other conditions that would have different effects on values for some individuals, such as: no access to all, access to hikers, access to hikers/bikers/off-road vehicles.

[28] The manner in which the change is being provided is important because alternatives to what is being proposed matter as well as the means of provision and the subsequent distributional effects.

non-users, the first source of error discussed above, and has been a source of confusion in the literature. The third source of error results from failing to recognize that there may be separable and non-separable characteristics of preferences. Mixed preferences that possess both characteristics will result in the incorrect estimation of compensated demands because part of the value is not reflected in the observable market response.

The simple mathematical representations of preferences used above capture the essential elements in the passive-use value problem. Preferences which are separable in Q or contain a separable element in Q (mixed preferences) produce the behaviour suggested by Weisbrod and Krutilla. If researchers rely exclusively on estimating value from behaviour observed in the past, they will undoubtedly overlook relevant values, which may lead to inefficient decision-making.[29] In order to pursue efficient environmental resource-allocation decisions, researchers and policy-makers need to utilize the total-value concept for all relevant valuers.

4.3. THE MEASUREMENT OF PASSIVE-USE VALUE

4.3.1. Background

Much of the early history of cost–benefit analysis of environmental projects can be written in terms of searching for ways to measure projects' total benefits, benefits that often involve a significant passive-use value component.[30] To many resource economists, the development of a method by which to construct a previously non-existent market in a survey context – the contingent valuation method – effectively ended this search. Although some economists (e.g. Desvousges *et al.*, 1993) continue to question the contingent valuation method's effectiveness, especially its ability to measure passive-use values, its development during the past two decades has removed discussions of estimating economic values for environmental goods from the intangibles or inherently immeasurable category to that of guide-lines for conducting such studies (Arrow *et al.*, 1993).

Although contingent valuation is by far the most popular current technique for measuring total value for goods having significant passive-use values, any technique capable of constructing the missing market for these types of goods is potentially capable of obtaining total-value estimates. The two other approaches which have been used and are capable of measuring total value are the examination of the results of an actual referendum concerning the good (Deacon and Shapiro, 1975) and the construction of a

[29] The term 'may lead' is used instead of 'will lead' because in many cases, users' values alone will lead to the same decision as including all relevant values; that is to say, often passive-use values are not decisive.

[30] See Hanemann (1992) for an interesting overview of the development of cost–benefit analysis for environmental projects.

simulated market in which actual purchases of the good can be made (Bishop and Heberlein, 1979).[31] Both of these approaches have substantial drawbacks relative to contingent valuation. Referenda on environmental goods involve only a small subset of the goods for which society would like to have values; they are infrequently held; and when they are held, there is generally an insufficient variation of price for drawing inferences regarding the underlying distribution of *WTP*. Realistic simulated markets are difficult to construct and their effective use with a random sample of the general public is difficult to accomplish and implement. Furthermore, as Kopp (1992) notes, goods with substantial passive-use values have the characteristics of a very pure public good. Therefore implementation of an appropriate incentive structure in a simulated market is substantially more difficult than in the case of quasi-public goods where possible exclusion (Moulin, 1994) makes the task feasible.[32] Contingent valuation's relative flexibility and range of use has made it a more attractive technique and as a result, most of the evidence on passive-use values has been generated using this approach.

The Randall *et al.* (1974) study of air quality improvements in the Four Corners area of the south-western United States is recognized as a landmark because it is the first major study that measured a significant passive-use value benefit. Other contingent valuation studies that measured benefits with a significant passive-use value component quickly followed in the late 1970s and early 1980s.[33] These include studies of air quality issues in national parks (Schulze *et al.*, 1983), air quality issues in national forests (Crocker and Vaux, 1983), regional water quality issues (Greenley *et al.*, 1982; Desvousges *et al.*, 1983), national water quality (Mitchell and Carson, 1981),

[31] Another approach discussed in the public finance literature is to infer public preferences for a good from government decisions (Borcherding and Deacon, 1972). While possible in some instances where an electoral campaign is essentially run on the issue in question, inference often involves a circular logic: the politician or bureaucrat assigns the social scientist the task of determining public preferences about an issue under consideration; a decision is made on that information; preferences are determined on the decision. A recent set of papers by Cropper (1994), Oates (1994), and Shapiro and Deacon (1994) examine the relationship between the public finance literature and contingent valuation. The stated-preference approach (Adamowicz *et al.*, 1994) is sometimes mentioned as another possibility. A stated-preference model cast in terms of some collective action to provide the good directly, such as a vote, does allow one to obtain a welfare estimate which incorporates passive-use values. However, in this case, the stated-preference and contingent valuation approaches are essentially identical. The stated-preference approach, cast in terms of some contingent private behaviour, does not allow one to obtain a welfare estimate which incorporates passive-use values.

[32] The importance of incentive structure when providing public goods is noted in the early public goods literature (Samuelson, 1954). As a result, a real (simulated) market for a pure public good with a non-coercive payment scheme should underestimate, and often grossly so, willingness to pay for the good. This issue is discussed at more length below with respect to specific empirical examples.

[33] Particularly informative is the title of a conference volume, *Proceedings of a Workshop on the Measure of Intangible Environmental Impacts*, in which a 1977 paper by the prolific contingent valuation researcher David Brookshire appears.

protection of ecosystems from acid rain (Bishop and Heberlein, 1984), and preservation of wilderness areas in the United States (Barrick, 1983) and in other countries (Bennett, 1984).

The method's use for policy-making purposes was advanced by official acceptance. In 1979, the US Water Resources Council explicitly allowed for the use of contingent valuation in project evaluation to measure passive-use values and prescribed procedures for doing so. These and the subsequent 1983 US Water Resources Council guide-lines had a substantial influence on the US Department of Interior's (DOI's) development of rules for valuing damages to natural resources. However, after receiving industry comments opposing the use of contingent valuation, DOI (1986) promulgated rules placing contingent valuation at the bottom of a hierarchy of valuation methods and allowed for the measurement of passive-use values only in instances where there were no measurable use values. The 1989 US Federal Appeals Court decision in *Ohio* v. *US Department of Interior* subsequently rejected DOI's limitations on the use of contingent valuation, saying that Congress had clearly intended for the Government to collect lost interim-use values, including passive-use values, in natural resource damage cases if they could be reliably measured.[34] Congress later passed the Oil Pollution Act of 1990 and signalled its agreement with the Court's interpretation by directly quoting the language from the *Ohio* decision on this point in the preamble to the bill. In 1992, the US National Oceanic and Atmospheric Administration (NOAA) convened a panel of prominent academic experts chaired by Kenneth Arrow and Robert Solow to examine the issue of whether passive-use values could be reliably measured using contingent valuation. The panel concluded 'that contingent valuation studies can produce estimates reliable enough to be the starting point for a judicial or administrative determination of natural resource damages—including lost passive-use value' (Arrow *et al.*, 1993: 4610).

In what follows, we address a number of key issues regarding the estimation of total value when passive-use considerations may be involved. First we take up the issue of commodity definition. Next we consider the influence of a project's payment and provision characteristics on the estimated total value of the provided good. We then take up two issues which are sometimes said to restrict the measurement of goods with passive-use value: lack of familiarity with the good, and a requirement that the good must be unique and the change must be irreversible for passive-use values to be present. We then address the issue of which substitute goods, if any, should be considered in a contingent valuation survey. Finally, we look at the incentive structure of contingent valuation questions when substantial passive-use values are involved.

[34] A comprehensive discussion of the *Ohio* decision and its implications can be found in Kopp and Smith (1993).

4.3.2. Commodity Definition

Much of the 'art' in designing a contingent valuation survey is taking the physical changes of an environmental project, usually given to the survey designer in biological and engineering terms, and translating those into a form understandable to survey respondents. This challenging task is sometimes referred to as the commodity definition problem. One aspect of this problem is the difficulty of portraying the commodity in the survey in a way in which respondents can grasp its relevant attributes. First, the physical changes are often expressed in a highly technical manner and cannot be used in a contingent valuation survey without being first expressed in lay terms. Second, they are typically depicted with respect to what will actually be built or restored and not in terms of the flow of services from the project that respondents are likely to understand and potentially care about.

Another aspect is that once an adequate translation is made and the changes are described in terms of service flows, the interpretation of the change in environmental resources, denoted as a change in Q in our theoretical section, can be problematic. Specifically, what the respondents perceive as the change in Q does not always coincide with what the researcher has in mind. The source of this problem is that Q is typically a multi-attributed object. Consider a project that enhances a degraded wetland area by increasing fresh water flows by 100 per cent in times of drought. Scientists believe that the increased water flows will reduce the probability of extinction of two sensitive bird species and several sensitive plant species to near zero. An alternative enhancement project will increase water flows by only 50 per cent in times of drought. Scientists believe the alternative project will still reduce the probability of extinction of the two sensitive bird species to near zero, but the non-trivial probability of extinction for the plant species will be unchanged. What is the relevant interpretation of the change in Q to which the respondent is expected to be sensitive? For instance, should the change in Q be defined as the change in water flow, which differs by a factor of two under the two projects? Or should the change in Q be interpreted in terms of the number and types of affected species?

Another consideration is how damage actually occurs. For instance, in the wetland enhancement project presented above, it may matter to respondents that water shortages are occurring due to drought or that water shortages are occurring due to the diversion of water for water-intensive crops grown under a federal subsidy programme.[35] Which case requires a more expeditious response depends upon respondents' perspectives. Differing perspectives will in turn elicit potentially different value responses under the two scenarios.

[35] A market analogy is the purchase of products made with child labour (or labour from political prisoners). Although a given product can be physically non-differentiable, some consumers avoid the purchase of such goods even when this choice is costly. Essentially the product is differentiated by the labour characteristic, which matters little to some and very much to others.

Projects that affect environmental resources are often complex and respondents are likely to vary in how they weigh the importance of a project's purported accomplishments. Some may care little about any aspect of the project; some may value saving the bird species only; and others may be concerned about birds, plants, and water flow. There are no apparent reasons why understanding respondents' interpretations of the change in Q will necessarily be more difficult for individuals whose values are primarily or exclusively passive-use value than for those who use the resource on a regular basis. However, the factors involved may vary and require different approaches in conveying a project's attributes.

The multi-attribute character of Q can lead to other complications. The choice of which attributes should receive a full description in a contingent valuation scenario requires careful attention, because if the researcher downplays or does not mention attributes that are important to some respondents, the study may either undervalue or overvalue the good. Although this problem can never be completely avoided, the risk of such an error can be reduced by studying respondent beliefs and concerns about the good and its provision during the development of the survey instrument.

Additional issues arise in conducting a benefits transfer. Here judgement on the part of the analyst is required about which attributes of a Q whose benefits are measured in a contingent valuation survey map on to some new Q. If the coverage is imperfect, as is usually the case, then judgements must be made and defended about how the benefits measured in the contingent valuation survey should be allocated to the shared attributes. Yet another complication, which we will discuss in the next section, results from the fact that characteristics of the institutional setting in which the Q is offered to respondents in a contingent valuation survey are also a legitimate part of its multi-attribute set.

4.3.3. Project Provision and Payment Aspects

A common misconception held by some contingent valuation critics is that a respondent's willingness to pay for an environmental good should be unaffected by the manner in which that good is provided and the means of payment. This line of reasoning, although appealing in the abstract, is not true of private consumer goods or public goods. The principal problem with this reasoning is that no consumer good is sold in the abstract and no public good is provided in the abstract. Consumers care about the convenience and reputation of the store where they purchase many of their market goods. They also care about the manner in which they are required to pay for the good. Similarly for environmental goods, the Government usually cannot provide the good directly, such as increasing a bird population. Instead, the

Government undertakes a project which increases the bird's habitat. This action in turn is expected to lead to an increase in the bird population.[36] The project that implements the change also carries with it a particular payment mechanism.[37] Both payment and provision mechanisms can substantially influence respondents' willingness to pay for the project (Mitchell and Carson, 1989).

One seemingly attractive way of dealing with this issue in the contingent valuation scenario is to adopt what appears to be a neutral position and not provide any details of provision and payment. When respondents receive inadequate information regarding the good's provision and payment, they are left to infer important details from the information that is provided or simply guess when no clues are provided. Inference and guessing may take one or both of two predictable forms.

The first form is constructing a subjective probability of provision and/or payment. Basically respondents who are not informed of provision and/or payment means may infer that the good may not even be provided or that they may not be required to pay for it. This inference occurs because respondents discount the possibility of payment and provision because the project is so nascent that the most important details have yet to be determined. The second form, which usually interacts with the first, is to respond according to the respondent's guess as to the most likely means of provision and payment. Therefore respondents may infer a subjective probability of provision/payment as well as the means of provision/payment. Because different respondents will draw different inferences, leaving out important implementing details makes it impossible to have confidence that the respondents are valuing the good that the researcher intends them to value. At some point the lack of details may cause the entire scenario to lose credibility with the respondent, in which case the answers to the contingent valuation questions are likely to become meaningless with respect to the question asked.

In order to avoid this ambiguity, the necessary information should be provided. However, it must also be recognized that the details themselves do and *should* influence values. For instance in our bird habitat example, it may matter to some respondents whether a privately held power company is providing the project or the Federal Government is providing the project. In such a case some respondents may believe that the Federal Government fails to live up to promises and that if it is the provider the probability of

[36] Such explanations are often given for the extremely wide range of prices observed in the same city for the same common private consumer goods (Pratt *et al.*, 1979).

[37] Projects presented in contingent valuation surveys often have negative as well as positive effects, at least for some respondents. If the negative impacts are well-known or easily discernible, many respondents will recognize and incorporate them into their decision. In such instances it will often be desirable to incorporate these explicitly into the scenario description so that it will be clear what good was valued. Telling respondents to ignore particular effects in their evaluation of a project is generally not a feasible contingent valuation design strategy.

implementation is low. An equally plausible scenario would be animosity toward a local utility which has been thought to engage in frequent unnecessary rate increases.

As these examples suggest, it is individually rational for the provision mechanism to affect respondents' values. With respect to the payment mechanism, the distribution of project costs may matter to individuals. Respondents generally have clear preferences over forms of taxation. This may be a fairness issue, a belief that some forms of taxation generate unnecessary costs in terms of economic efficiency, or a belief that a particular type of tax has the potential for diverting funds from other projects that are considered important. In any case, changing the payment mechanism may influence values for reasons which are well understood by the respondent, yet poorly understood by the researcher.

Currently unfolding in the United States is an example that stresses the importance of provision and payment mechanisms in a public project which has nothing to do with contingent valuation. The legislative and executive branches of the US Government have been contemplating the expansion of health-care coverage for US citizens. While most parties advocate the same goal, eventual universal health-care coverage for all, the debate revolves almost exclusively around the provision and payment mechanisms. Despite the shared goals, differences over the provision and payment mechanisms have created an impasse. Provision and payment mechanisms, such as those noted in the health-coverage debate, are important issues to citizens included in contingent valuation samples. Therefore it is naïve to expect values to be uninfluenced by the implementing project's details.

4.3.4. Resource Familiarity

The issue of resource familiarity is frequently represented as problematic for contingent valuation (Cummings *et al.*, 1986; Freeman, 1986; Diamond and Hausman, 1993).[38] The claim is often made that contingent valuation respondents cannot give meaningful values for unfamiliar goods and particularly for those whose values are primarily passive-use values. The supporting rationale for this claim is that consumers of market goods develop well-defined values for these goods by buying and using them. In contrast, many respondents in a contingent valuation survey have very limited or no direct knowledge of the good they are asked to value, nor do they have prior experience in making allocation decisions involving the resource. They therefore must lack well-defined values.

There are several weaknesses in this line of reasoning. First, they offer an idealized, yet incomplete, picture of consumer transactions. A multitude of

[38] A few authors such as Milgrom (1992) have advanced the extreme position that in such instances experts should be consulted on behalf of the public, even if it is known that experts' opinions diverge substantially from the public's preferences.

new products become available each year, creating completely new markets in which consumers regularly make purchase decisions involving goods for which they have no prior experience or even understanding.[39] Moreover for a significant portion of the population, each year's purchase of these new products constitutes a significant portion of disposable income expenditures.[40] The practice of cost–benefit analysis is of little practical import if its scope is to be limited to routine consumer purchases such as toilet paper and toothpaste.

Second, contingent valuation respondents' unfamiliarity is, in our opinion, exaggerated. For example, most respondents in the Exxon Valdez contingent valuation study (Carson *et al.*, 1992) who made judgements about preventing damage to Prince William Sound from another large oil spill had never been to Alaska, much less to Prince William Sound. However, with the help of visual aids and a carefully developed description of the situation, most, if not all, respondents were able to envision Prince William Sound, the bird species found there, the potential spill damage, and the project being presented.

Third, as it is information, not familiarity, which lies behind consumers making informed choices, these criticisms fail to appreciate the degree to which a well-designed contingent valuation scenario can inform respondents of the good's salient features. Provided care is taken in conducting sufficient pre-testing to understand the barriers to communication and test ways to overcome them, ways can be found to communicate most goods, even ones with which respondents are unfamiliar. This effort is facilitated by the fact that contingent valuation surveys are centred around the choice between having a good and not having it. This format serves to concentrate the respondent's attention on the distinguishing characteristics. In-person surveys can use visual aids such as photographs, maps, and diagrams, which we have found to be very helpful in conveying this information.

Fourth, the key feature which leads respondents to pay attention to the scenario in any contingent valuation survey is independent of familiarity. This feature is the *plausibility* of the choice situation. When asked to value a good that is presented in a vague, illogical, or excessively hypothetical way, respondents are unlikely to take the exercise seriously and may give a meaningless value no matter how much experience they have with the good.[41] Asked the same question in a survey that describes a credible market for the good, a method of providing it that has a good chance of succeeding, and a credible payment method, respondents are likely to be willing to expend the effort necessary to understand the implications of the choice and to search their preferences in making their decision. Provided it is plausible and understandable, a contingent valuation survey often communicates more information than respondents would typically use in making market or voting decisions involving comparable expenditures.

[39] With respect to economic theory, the modelling of new-product demand does not treat consumers' decisions as lacking content. For example, see Hausman (1994) for a discussion of consumer surplus resulting from the introduction of new products.

[40] 'New' can mean products newly introduced or products which the consumer has never purchased.

[41] In some cases, respondents familiar with the resource may have more difficulty understanding proposed changes than those unfamiliar with the resource. This occurs when the change is significant yet has not received public attention. Such a change may be less plausible to the person who is familiar with the resource and its routine provision.

It is often alleged by critics that responses to contingent valuation surveys where the good involves substantial passive-use values are somehow substantially different than those where the good involves only use values, with the former being unreliable and the latter reliable. As noted above, poorly conceived and improperly designed surveys can generate information that lacks content. However, our position is that *quality* contingent valuation surveys valuing goods with significant passive-use values are every bit as valid as *quality* contingent valuation studies valuing goods where little passive-use value is involved.

A related hypothesis that has received much attention is that contingent valuation respondents holding passive-use values are insensitive to the scope of the good they are being asked to value. The most conspicuous study which tests this hypothesis is the Exxon-sponsored study of Boyle *et al.* (1994). The authors base their claim mainly on a split-sample design in which different subsamples were told that different numbers of birds would be saved from death due to contact with open oil ponds in the US Rocky Mountain Flyway. The data used in the study was gathered in an Atlanta shopping mall using self-administered, intercept surveys.[42]

In order to evaluate the Boyle *et al.* and Kahneman and Knetsch (1992) claim that scope insensitivity is endemic in contingent valuation studies involving passive-use considerations, one must look at the existing body of contingent valuation studies. If the scope insensitivity hypothesis is true, then rarely should one see a contingent valuation study that rejects this hypothesis. Carson (1997) provides a review of the existing literature and notes over thirty studies that conduct split-sample tests and yet reject the scope insensitivity hypothesis. Over half of these studies involve goods where the total value is primarily passive-use value.[43] If one examines the studies which fail to reject the insensitivity hypothesis, most cases can be explained by details regarding survey design, implementation, or analysis.

One can look at other possible comparisons between goods involving principally passive-use values and those believed to involve principally use values by considering reliability in the sense of replicability or test-retest. Carson *et al.* (1997) show that contingent valuation studies generally

[42] For a critique of this study, see Hanemann (1995).

[43] See Carson and Mitchell (1995) for a formal presentation of the framework for testing the scope insensitivity hypothesis as well as an empirical example that provides a rejection of this hypothesis in a case of substantial passive-use value.

perform well on this dimension and that there is no apparent pattern with respect to the passive-use value characteristic of the good valued. Another possible comparison is with respect to the construct validity of contingent valuation estimates, particularly in the estimation of valuation functions.[44] Two successful valuation functions of the authors can be found in the State of Alaska's contingent valuation study of the Exxon Valdez oil spill (Carson *et al.*, 1992) and in the Carson *et al.* (1994) paper reporting on the results of the Australian Resource Assessment Commission's Kakadu study. The valuation functions found in these papers have a large number of statistically significant predictor variables, which one would expect *a priori* should predict respondent willingness to pay. However, both studies used highly developed surveys and sample sizes which were large enough to yield statistical tests with reasonable power.

The only area where one can find consistent indications of a difference between goods with principally use and principally non-use values is with respect to comparisons between different response modes (e.g. Boyle *et al.*, 1996; Kealy and Turner, 1993). However, these differences are potentially explained by the questions' incentive structures, an issue which is discussed subsequently.

4.3.5. Irreversibility and Uniqueness

When Krutilla (1967) raised the issue of expanding the set of relevant valuers, he referred to an 'area with some unique attribute – a geomorphic feature such as the Grand Canyon, a threatened species, or an entire ecosystem'. Some authors (e.g. Cicchetti and Wilde, 1992) have inferred from this passage that if resources are not unique and changes are not irreversible, then Krutilla's concerns do not apply.[45] We first note that 'unique' and 'irreversible' are relative terms and it is necessary to consider how the relevant population is affected.

With respect to irreversibility, consider the example of an oil spill that kills 10 per cent of the spill area's sea-bird population. Scientists predict the population will completely recover in eight years. Some individuals from the spill area as well as some individuals outside of the spill area care about birds in the sense that it upsets them that *any* birds are unnecessarily killed by humans. Others in and out of the area are concerned only with the long-range prospects of the bird species' survival. The first group clearly considers the 10-per-cent bird kill irreversible (short of a miracle) since the birds are dead. The second group may consider the 10-per-cent bird kill as nothing to worry about as long as the number of birds killed is within the regenerative capacity of the population. Individuals from this group would consider the injury significant only if it adversely affected the bird's population in the future.

[44] In the case of passive-use valuers, one may see more heterogeneity of preferences than in the case of users because the motivating factors may be more diverse.

[45] Krutilla's analysis was not all-inclusive in that while it illuminated a line of enquiry by providing a powerful example, it did not address whether these concerns did or did not apply to non-unique resources.

Like reversibility, uniqueness is in the eye of the beholder. Consider the example of creating an urban park or green belt which may be unique to nearby residents and highly valued. Residents on the other side of the city who share the same tax-base may recognize this uniqueness and favour creating the park or green belt for a variety of reasons. However, from a global or even regional perspective, if one ignores location there will always be ample substitutes. If one were to issue an edict deeming passive-use values relevant only to irreversible changes of unique resources, the question is who defines the terms 'uniqueness' and 'irreversible'. Moreover, nothing in our theoretical analysis indicates that an irreversible change in a unique resource is either a necessary or sufficient condition for passive-use values to be present in any given situation. The question of whether or not passive-use values are important for a given resource can only be answered empirically. Both are better seen and easier understood in the context of substitute availability and possibilities.

4.3.6. Substitute Availability

An issue always facing the designer of a contingent valuation study is what substitute goods, if any, should be clearly discussed in the survey instrument.[46] In answering this question, it is useful to consider three perspectives: (1) the choice opportunities which are actually available; (2) the information that respondents already possess; and (3) the amount of information which can realistically be conveyed to the respondent by the survey. By considering these three perspectives, the question of which substitutes are relevant becomes manageable.

With respect to (1), once again consider the park/green belt example. One respondent may prefer upgrading the local sewage treatment facility in order to improve water quality over the preservation of the park. Another respondent may prefer providing light rail from downtown to a suburban area as a means of reducing air pollution over park preservation. One could plausibly think of as many projects preferred over provision of the park as there are residents. As economic theory predicts (Hoehn and Randall, 1989; Carson *et al.*, 1995), the simultaneous availability of other projects will generally affect the value for preservation of the park.[47] Neo-classical theory

[46] The issue of which goods should be considered as substitutes applies to any valuation analysis and is therefore not exclusively a contingent valuation issue. For instance, the number of substitute sites included in travel-cost analyses has received considerable attention (Bockstael *et al.*, 1991)

[47] In the rationed goods literature, this phenomenon is referred to as the existence of q-substitution or q-complementarity (Madden, 1991). In the public choice literature, it is called the bundling effect (Mackay and Weaver, 1983).

(Flores, 1994) predicts this effect can be quite large even if one is considering providing a few other goods which are not close substitutes at the same time.[48] The value of the project may become arbitrarily small if enough projects are considered and the projects are substitutes with respect to valuation.[49] Because any possible combination of projects could conceivably be considered, does this imply that values are demonstrably arbitrary, as Kahneman and Knetsch (1992) suggest when discussing this issue in the context of contingent valuation?

While Kahneman and Knetsch's conclusion has received much attention in the literature, we note that while it is true that any combination of projects may be considered, it is never the case that arbitrary combinations of projects are considered. Researchers need only consider other projects that will actually be undertaken at the same time, rather than all potential projects.[50] While researchers are always obliged to inform policy-makers of potential project interactions, practical considerations will usually serve as the best guide to deciding which other projects, if any, should be discussed.

With respect to (2), respondents considering the provision of the pocket park or green belt may not be aware of parks and green belts in other areas of the city. Therefore, other similar available resources are potentially crucial pieces of information that may affect respondents' values. This example emphasizes that these sorts of substitutes are part of the relevant information needed by respondents to make an informed decision. In some cases, respondents will possess most of this knowledge and in other cases, respondents will have hardly any of the requisite information.

Due to (3), this set should generally be limited to close substitutes of which respondents are unaware, because there are limitations to the information that respondents can absorb and more importantly want to have provided.[51] These limitations may differ according to survey mode. For example, in a telephone survey there are very real communicative limitations. Without in-person contact, it is difficult to adapt the interview to respondents' needs. In particular, it is difficult to gauge how well respondents are understanding the scenario. More importantly, telephone surveys rule out the use of the visual aids such as maps and photographs which are commonly used for emphasizing substitutes. Mail surveys are able to incorporate such aids, but are plagued by both literacy and question-ordering problems. Respondents often read ahead before answering questions and skip sections considered difficult to read, which can render a complex mail-survey instrument ineffective. Finally, even with the preferred in-person mode, there are limitations to how many substitutes can be effectively conveyed. In most cases, the number of potential relevant and unknown substitutes is small and as such represents little problem in designing and administering the survey. However, if one were to consider the extreme position that all potential projects (assuming a finite number) should be considered, then respondents will quickly be overwhelmed and lose interest.[52] In summary, the decision regarding which substitutes to include in a scenario is an important issue which any contingent valuation researcher must address. However, it does not represent a paralysing issue and is generally manageable.

[48] Flores (1994) shows that demand and virtual-price (e.g. willingness to pay) substitution elasticities are inversely related. Therefore goods which are poor demand substitutes may have large virtual-price substitution properties when quantity-rationed.

[49] It is important to note that this is a purely theoretical issue which does not involve either contingent valuation or passive-use values *per se*.

[50] While there are potentially very large numbers of projects that could be considered in a given year, only a handful of major projects are actually implemented even at the US federal level. Furthermore, for some of the largest government endeavours, the per-capita expenditure is often fairly small. For example, President Clinton's health-care plan would purportedly provide health care to all and will change health-care costs by less than $50 annually for most taxpayers.

[51] Included in this set are spatial as well as temporal substitutes, such as the quick recovery of an injured bird population.

4.3.7 Passive-Use Values and Incentive Structures

An examination of the incentive properties of a given contingent valuation question is crucial when evaluating the study's results. In the most general sense, for a contingent valuation question to be incentive-compatible, the respondent must be presented with a single binary discrete choice question offering a specified amount[53] and a credible mechanism for carrying out the project described. For users of many quasi-public goods, these two conditions are easily satisfied. However, this is not true of pure public goods, of which pure passive-use value is a special case. Pure public goods require the additional element of a coercive payment structure.

To see this, consider a camper who is offered a contingent valuation choice between the current *status quo*, paying a fee of $2 to camp at a forest site offering few amenities, and an alternative which involves improving the site by adding running water, toilet facilities, and cooking facilities while charging a $5 fee. The camper will pick the alternative offering the higher level of utility and will never pick the improved alternative unless the value of the improvements to the camper is at least $3. We know this because the unimproved campsite with a $2 fee and the improved campsite with a $5 fee will never simultaneously exist. Essentially the choice set has been altered so that, under the new regime, the camper will have to pay the additional fee

[52] For example, in their Exxon-sponsored study, Kemp and Maxwell (1993) require respondents to allocate expenditures in a top-down fashion into as many as thirty-two different categories of public expenditure.

[53] A number of other elicitation methods such as double-bounded discrete choice questions, payment cards, and open-ended questions offer the possibility of achieving more information about a respondent's willingness to pay at the expense of introducing a downward bias. This may be a desirable trade-off under a mean square error criterion if the reduction in variance is large and the bias small. See Alberini (1995) for an examination of the double-bounded elicitation method in this context. See also Langford *et al.* (1994) for a discussion of a triple-bounded dichotomous format.

in order to use the site.[54] Consider an alternative proposal that will provide a new site nearby with these amenities, assuming away congestion externalities, and the old site at the old price were still available. In this case, the incentive structure for provision of the new site is not the same, because the old choice is still available. The camper can increase the choice set at no cost by responding positively to the question of provision of the new site with a $5 fee.

Pure public goods are similar to the last example because one is almost always dealing with an addition to the existing choice set. As long as the respondent has the option of not paying and the addition to the choice set is desirable, then the agent should always prefer the addition.[55] As clearly laid out in his classic paper on public goods and free-riding, Samuelson (1954) shows that an agent typically has a clear incentive to misrepresent his or her preferences in the pure public goods case. With a payment mechanism such as a voluntary trust fund, the incentives underlying a request for an actual payment and a contingent valuation request will diverge in opposite directions.[56]

In the first instance, which Samuelson's analysis directly addresses, the agent has an incentive to say 'no' even if the provision of the good is worth the amount requested. This is done in hopes that other people will pay into the fund and provide the good at no personal cost to the respondent. Unfortunately, this strategy is available to all and mass underreporting may result, implying that the payment into the trust fund will underestimate actual willingness to pay.

For the contingent valuation request, saying 'yes' encourages the creation of the trust fund, thereby increasing the likelihood that the good will be eventually provided. However, because of the voluntary nature of the trust fund, the agent knows she can later renege on the response when the actual request comes if she believes the good will still be provided without her contribution. Basically, the respondent hopes to expand the choice set by including the option to free-ride later. Therefore in the case of a survey trust fund the incentive is to overreport, which is the opposite result of actual

[54] Another way to put this is that the respondent is indicating preferences over non-nested choice sets.

[55] A similar situation is seen in many marketing surveys where users of an existing product are asked if they would switch to a new product if it were available at a given price. The incentive structure of this question is to give whatever response increases the likelihood that the new product will be produced as long as the addition of that product to the choice set provides positive utility. As a result, such questions provide estimates of potential rather than actual demand.

[56] Voluntary trust funds have a number of other undesirable properties which may influence the amounts empirically observed in actual payment requests and in contingent valuation surveys. For example, respondents may perceive a lower probability that the good will be provided than with a tax mechanism (Bateman *et al.*, 1993) and in the extreme case, an insufficient amount will be paid into the fund to actually provide the good with any amount paid into the fund non-recoverable by the respondent (Twight, 1993).

payments into a trust fund. Neither the response to the actual payment request nor the response to the contingent valuation request will reveal the agent's true preference if agents take advantage of the incentives for misrepresentation offered by the two questions. This divergence in incentives is likely to lie behind the results of experiments such as those conducted by Duffield and Patterson (1992), Navrud (1992), Seip and Strand (1992), and Champ *et al.* (1997), who show hypothetical contingent valuation pledges to be larger than actual payments.

The condition necessary to restore incentive compatibility in the pure public goods case is a coercive payment mechanism. Many tax mechanisms such as income taxes, sales taxes, value-added taxes, and property taxes satisfy this requirement, as do increases in utility bills and increases in specific taxes on universally used commodities. As long as the Government's decision to provide the good and implement the payment is perceived by the respondent as increasing with the percentage who respond with a yes on an actual vote or to a contingent valuation question, the agent will have an incentive to indicate a yes response only if the good is preferred given the specified payment and to indicate 'no' otherwise. The enhanced incentive structure arises because there is a credible coercive mechanism by which to extract payments from all agents if the good is provided. As a result, there is no incentive to wait and see if others will first pay for providing the good.

4.4. CONCLUSION

When making environmental resource allocation decisions, the correct measure of economic welfare is total value aggregated over the entire relevant population. Assessment methods which are dependent on observable behaviour will fail to include passive-use values in their estimates of total value. We have chosen to base our definition of passive-use values directly on this property rather than to continue defining passive-use values by motivation. However, our analysis provides theoretical representations which are consistent with the behaviour described in the many motivational examples found throughout the literature. More importantly, these representations allow us to emphasize ways in which passive-use values can occur with respect to the population of interest.

Turning from economic theory to issues of empirical measurement, we have focused on six conceptual issues which have been advanced as problematic for contingent valuation when passive-use values are present: (1) commodity definition; (2) the effect of provision and payment aspects; (3) resource familiarity; (4) uniqueness and irreversibility; (5) substitute availability; and (6) the incentive structure of valuation questions involving passive-use values. Upon a careful examination of these issues, it can be seen that some have little to do with passive-use values *per se*, some have

little to do with contingent valuation *per se*, and others are neither contingent valuation issues nor passive-use value issues, but deeper philosophical concerns regarding the theoretical foundations and relevance of welfare economics. Problems related to commodity definition, resource familiarity, and substitute availability are essentially contingent valuation design issues which can be overcome or avoided by ensuring that the respondent clearly understands the nature of the good being offered and is thus able to make an informed decision. People making decisions in private goods markets and in the voting booth are typically forced to deal with these problems with less information than they receive in a high-quality contingent valuation survey. Economic theory provides relatively simple answers to issues regarding the uniqueness of a good and irreversibility of changes in its provision; neither are necessary or sufficient conditions for the presence of passive-use values. Economic theory also provides guidance on the issue of whether payment or provision aspects of the good can influence an agent's value for the good. The answer is yes—consumers are free to care about any aspect of the good. Such concerns are a major force behind much of the product differentiation seen in private goods markets. With respect to the last issue, the incentive structure of contingent valuation questions, one must endeavour to provide questions with a proper incentive structure that elicit a truthful response. Thus we would conclude that none of these conceptual issues should discourage the analyst who wants to stay within the standard cost–benefit framework of neo-classical economics from using contingent value of a valuation to measure the total non-marketed good. However, this is not the same thing as concluding that such an undertaking is an easy or inexpensive task if reliable estimates are to be obtained.

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