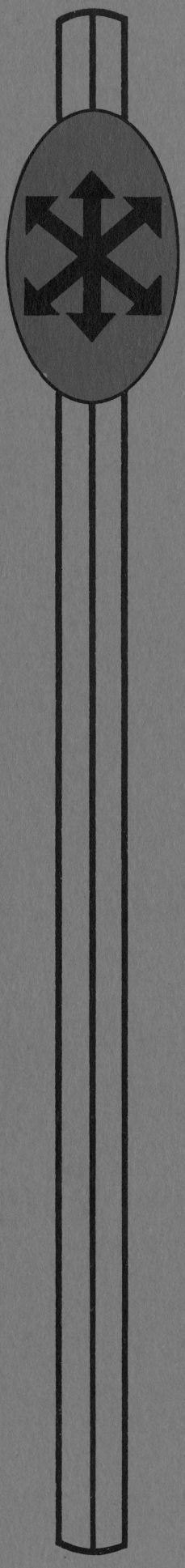

Staff Papers

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Some Further Explorations in Contingent Valuation: The Value of Wildlife-Related Amenities

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Abstract

Contingent valuation techniques were applied to wildlife-related amenities. The iterative bidding approach used, permitted testing for several types of bias and interpretation of value data in terms of Hicksian welfare change measures. Contingent valuation formats are evaluated for effectiveness, and estimates of activity, option, and preservation values are presented.

For the past decade and a half economists have witnessed the creation of a small but, now, rapidly increasing literature dealing with contingent valuation techniques. These techniques involve the determination of economic values from the responses of economic actors when posited with contingent environments. Two major types of contingent valuation are the iterative bidding technique and the household substitution technique.[1]

Following its inception (Davis), the iterative bidding approach to contingent valuation was applied to problems of non-market valuation in several pioneering efforts (Randall, et al., 1974, Brookshire et al., 1976).[2] More recent work with this approach has been devoted to the examination of its theoretical underpinnings, conditions for valid application, and expansion of its use to new types of problems (Ben-David, et al., 1977; Brookshire, et al., 1977; Gramlich, F.W., 1977; Randall, et al., 1977).

Focusing largely on the conceptual foundations of this contingent valuation approach, we will herein report some results of a preliminary application to the valuation of wildlife-related amenities.[3] In the process of obtaining these results, improved formats were used for deriving not only user values but also option and preservation values. These formats incorporated tests for various types of bias, some of which will be discussed below.

Conceptual Framework

The category of good under evaluation is, in all cases but one, the wildlife-related experience. Specific goods discussed here include the elk hunting experience, the option of bighorn sheep and grizzly bear hunting and the preservation of wildlife ecosystems.[4] Enjoyment of the latter amenity does not require an actual wildlife-related experience.

The wildlife-related experience and the preservation of wildlife are conceptualized as pure public goods.[5] Such goods may be valued using the aggregate bid methodology proposed by Bradford. Individual bid curves are simply indifference curves passing through a given initial state, with the numeraire good (i.e. the measure of value, which can be money) in decreasing quantities on the vertical axis and the public good in increasing quantities on the horizontal axis. The aggregate bid curve is obtained by algebraic or vertical summation of individual bids over the relevant population.

Each obtained bid is a measure of one of the four welfare change measures first described by Hicks; the particular Hicksian measure, in each case, depends upon the specific set of contingent circumstances posited to the respondent.[6] In this study, involving changes in a public good component of the individual's opportunity set, the Hicksian compensating and equivalent surpluses are the relevant measures of value.

When a change in the bundle of goods will benefit an individual, he has a WTP (willingness to pay) to obtain it or a WTA (willingness to accept) to forego it, and vice versa for a harmful change. A notation was developed, relating WTP and WTA with the Hicksian compensating and equivalent measures.[7] For example, in comparing two bundles, Q' and Q", of a good Q (where Q" is larger i.e. preferred), WTP to avoid a reduction from Q" to Q' is

$$WTP^{E}_{Q',Y;Q",Y;Q"}$$

where the

superscript E or C indicates the compensating or equivalent measure; and

subscripts (Q ,Y) indicate the individual's position in terms of his holdings of the good (Q) and numeraire (Y). In order, the three subscripts are the individual's right, initial position, and quantity he is obtaining or accepting (i.e. his subsequent position).

Compensating measures assume the individual has a right to his initial welfare position (i.e. he can keep what he has or trade for changes), while equivalent measures assume he has only a right to his subsequent welfare level (i.e. he takes what he gets or trades to remain at his initial position). The following is the empirical relationship among the four measures of value expressed in absolute value terms:

$$WTP^{E}_{Q',Y;Q'',Y;Q''} = WTP^{C}_{Q',Y;Q',Y;Q''} \leq WTA^{C}_{Q'',Y;Q'',Y;Q'} = WTA^{E}_{Q'',Y;Q',Y;Q'} \quad \ldots\ldots\ldots (1)$$

Thus, the empirical question raised by this relationship is not the relative size of the compensating and equivalent measures but the relative size, in absolute value terms, of WTP and WTA.

Willig has shown that, for price changes, the difference between the WTP and WTA measures is quite small if the income effect is small. Given data on the income elasticity of demand for the good, the individual's income, and the proportion of his income spent on the good, the bounds on the difference between WTP and WTA can be rigorously calculated using formulae developed by Willig. Randall and Stoll (1978) have modified Willig's analysis to permit its use for evaluating changes in the bundle of goods.

The General Model

The general model for valuation of wildlife-related experiences via the iterative bidding approach to contingent valuation is presented in equation (2) and Figure 1. Let Y° represent an individual's initial level of income when his wildlife-related experience is set at the level $\bar{N}$ (non-participation). Let Q' represent his participation in the experience, with the frequency of encounter Q', and Q'' represent his participation with a frequency of encounter Q''. Letting U denote his level of utility,

$$U(Y^\circ,N) = U(Y^*,Q') = U(Y^{**},Q'') \quad \ldots\ldots\ldots (2)$$

where

$$Y^\circ - Y^* = WTP^E_{N,Y^\circ;Q',Y^\circ;Q'}$$

$$= WTP^C_{N,Y^\circ;N,Y^\circ;Q'}$$

$$= WTA^C_{Q',Y^*;Q',Y^*;N}$$

and

$$Y^\circ - Y^{**} = WTP^E_{N,Y^\circ;Q'',Y^\circ;Q''}$$

$$= WTP^C_{N,Y^\circ;N,Y^\circ;Q''}$$

$$= WTA^C_{Q'',Y^{**};Q'',Y^{**};N}$$

Equation (2) defines the Bradford bid curve, I°, passing through the income level Y° and the participation level N (Figure 1). Bidding questions were designed to directly obtain the following measures of value:

(a) $WTP^E_{Q',Y^\circ;Q'',Y^\circ;Q''}$ (i.e. FQ'' in Figure 1);

(b) $WTP^E_{N,Y^\circ;Q',Y^\circ;Q'}$ (i.e. BQ');

(c) $WTP^E_{N,Y^\circ;Q'',Y^\circ;Q''}$ (i.e. DQ''); and

(d) $WTA^C_{Q'',Y^\circ;Q'',Y^\circ;Q'}$ (i.e. Q'C).

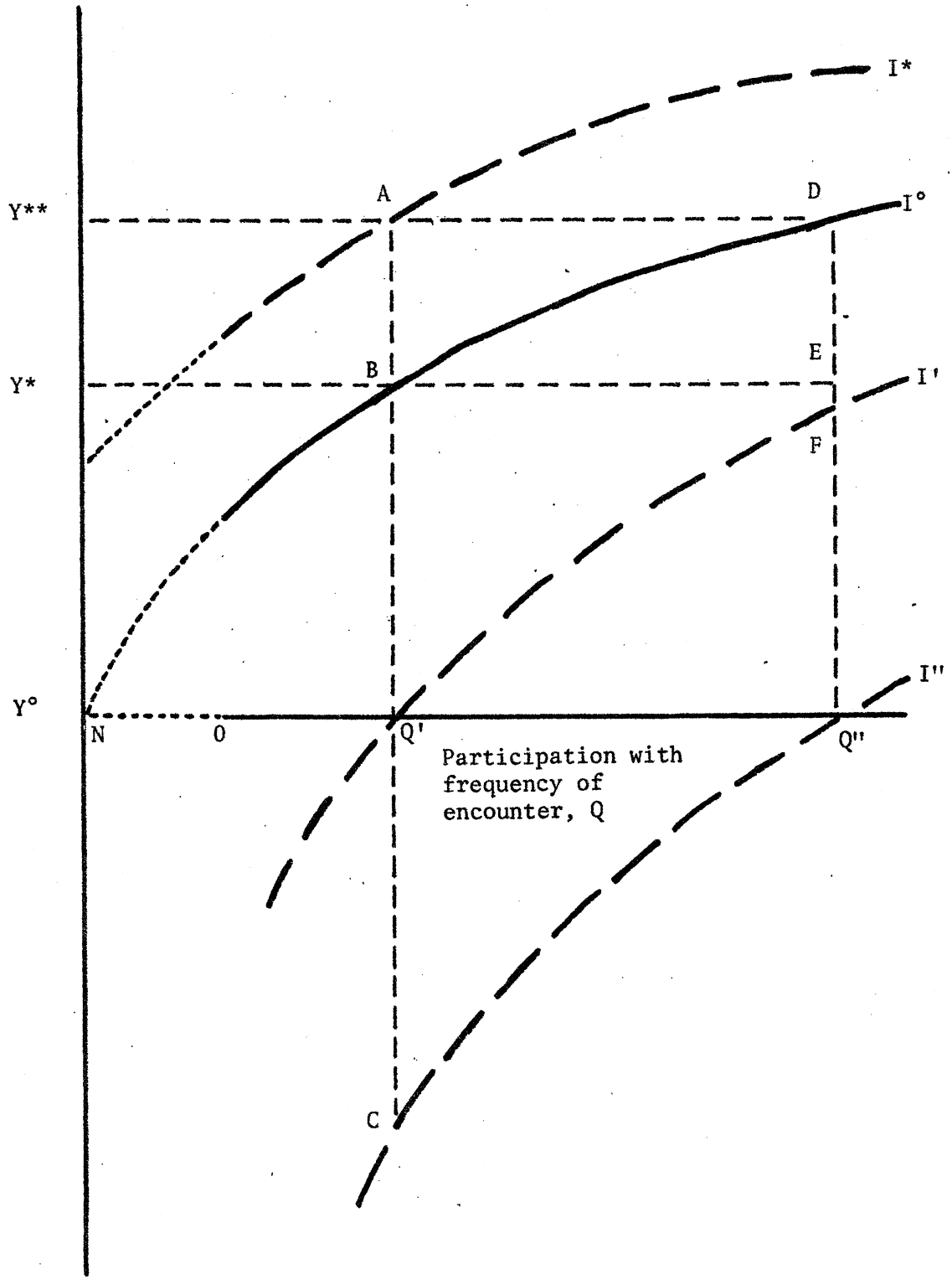

Figure 1. The General Valuation Model

Testing for Biases

It has been suggested (e.g. by Maler) that iterative bidding results may be subject to several sources of bias. In this study, opportunities were provided to test for the following types: payment vehicle bias; starting point bias, by providing a broad range of starting points; information bias, by providing alternative wordings for crucial passages in the survey instruments; strategic bias, by including Clarke tax versions (Tideman and Tullock) of certain bidding formats; and the hypothetical bias introduced by directly asking WTA in circumstances where compensation is never offered "in the real world", by the tests of observed WTA versus derived WTA as outlined below.

Testing for hypothetical bias is accomplished by (a) calculating derived WTA from WTP questions as follows:

subtracting the responses to two WTP questions to obtain

$$DQ'' - BQ' = DE = AB = WTA^{C}_{Q'',Y^{**};Q'',Y^{**};Q'}$$

and adjusting this measure for an income effect (Randall and Stoll, 1978) to arrive at

$$WTA^{C}_{Q'',Y^{\circ};Q'',Y^{\circ};Q'} \text{ (i.e., } Q'C)$$

and (b) testing the null hypothesis that observed $WTA^{C}_{Q',Y^{\circ};Q'',Y^{\circ};Q'}$ is equal to derived $WTA^{C}_{Q',Y^{\circ};Q'',Y^{\circ};Q'}$, where the derived values are obtained from a different subsample of respondents. If the null hypothesis is rejected, there is evidence that hypothetical bias is caused by positing circumstances to the respondent which do not conform to "the real world".

Data Collection

The study was conducted in Albany County, Wyoming, and for the most part in and near Laramie. For all wildlife-related activities, annual values per user were derived for the good under evaluation. A specified environment (presented by verbal description and carefully selected photographs) containing a wildlife population such that a specified number of encounters could be expected in a day's activity, was posited to the respondent. The iterative bidding procedure was used with questions phrased in a "hard-nosed" way (e.g., "If a hunting license cost $X, would you buy one, or would you quit hunting?", rather than "Would you be willing to pay .....?"), in order to ensure that true indifference curves (i.e., Bradford curves) were obtained. Final bids represent the net surplus value of the good to the respondent after all expenses associated with the experience had been met and all opportunity costs had been considered.

In the elk hunting schedules the typical number of daily elk sightings was used as a measure of frequency of encounter. For the option value of bighorn sheep and grizzly bear, the respondent was posited with uncertain future hunting conditions. Revenue for improvement of these conditions was to be raised through the sale of option stamps. Unless these option stamps were purchased on an annual basis, the individual would lose his option to participate

in these activities in the future. Preservation values were elicited by positing a fund payment to prevent specified types of environments from being altered.

Responses to feedback questions were encouraging to the researchers, indicating that (1) the encounter definition was acceptable to respondents, (2) most respondents believed their answers to be fairly accurate, and (3) the enumerators believed the majority of respondents participated in the interview experience seriously (data available on request).

Some Empirical Results

Elk Hunting Activity Values[8]

The mean bids for one year's elk hunting (Table 1) ranged from $30 to $152. Bids for 10, 5, and 1 expected sightings were significantly different from each other, while the bid for 0 expected sightings was not different from that for 1 sighting (statistical tests at the .05 level). Environment B, a semi-arid plain, elicited significantly lower bids than environments A and C (which were foothills and mountain environments, respectively).

Although widely differing starting points were tested (for example, $25, $75, and $200 for the elk license fee schedule), no statistically significant starting point bias was found. The existence of bidding vehicle bias was tested, using a WTP^E elk license fee question with one subsample and a WTP^C utility bill

question with another subsample, over the 5 to 10 sightings range. No vehicle bias was found in this test. Based on a license fee bidding vehicle, the income elasticity of bid for elk hunting was 0.345 and was significantly different from zero.

Asked $WTAC^C$ was about an order of magnitude greater than derived $WTAC^C$ (Table 1). It appears that asking $WTAC^C$ in a context in which payment of actual compensation is unfamiliar to respondents tends to bias results upward.

Option and Preservation Values

The mean bids for bighorn sheep and grizzly bear option stamps were $29.85/year (13 responses) and $21.95/year (22 responses) respectively. Respondents were willing to pay a mean of $263/year (27 responses) to guarantee that substantial areas of the state were preserved in their present ecological condition. If one high bidding respondent was arbitrarily eliminated, the mean preservation value would drop to $74 annually.

Conclusions Concerning this Application of Contingency Valuation to Wildlife-Related Amenities

1. WTP questions for hunting and fishing experiences, based on license fees or access fees to hunting or fishing reserves, were very effective.

2. WTP questions for hunting and fishing experiences, based on increments in utility bills, were noticeably less effective than license fee or access fee vehicles. There were more non-responses

to schedules using utility bill vehicles, and more negative responses to the respondent feedback questions. Nevertheless, mean annual values determined with utility bill formats were not significantly different from those determined using license or access fees.

3. WTP questions to measure option demand for bighorn sheep hunting and grizzly bear hunting, based on the concept of an option license (or stamp), were very effective. In fact, their effectiveness exceeded our prior expectations. Non-responses rates were less than 10%. Respondents found the option value schedules as credible as the schedules which focused on activities in which they currently participate.

4. WTP schedules for preservation of wildlife ecosystems (used only with respondents who engaged in no wildlife-related activities and did not expect to do so in the future) were more effective than anticipated. Non-response rates were less than 20%.

5. Questions which directly ask WTAC for reductions in wildlife populations etc. encountered some difficulties. This was not unexpected, since previous work by Randall et al. (1974) had encountered similar problems. In this study, more than 30 per cent of respondents refused to answer WTA questions. An additional 20 per cent insisted that no finite amount of compensation would be sufficient to induce them to permit reductions in wildlife populations.

Thus, fewer than 50% of respondents to WTAC questions provided answers which could be included in calculations to determine values.

6. The "Clarke tax", a device claimed to be effective in eliminating strategic bias did not appear to have any great usefulness in this contingency valuation context. It is relatively hard to explain to respondents, and even harder to make credible. This does not obviate the use of the Clarke tax in other contexts.

Table 1. ELK HUNTING RESULTS

(a) Mean Bids, Number Respondents, Standard Error of Mean

ENVIRONMENTS	ENCOUNTERS				ALL ENCOUNTERS
	0	1	5	10	
A	56.79 N=14 (23.45)	65.38 N=13 (27.60)	128.46 N=13 (43.35)	152.08 N=12 (51.83)	98.85 N=52 (18.94)
B	35.63 N=8 (29.55)	31.43 N=7 (26.32)	30.00 N=7 (22.32)	86.67 N=6 (42.13)	44.12 N=28 (14.79)
C	40.68 N=22 (16.76)	56.14 N=22 (23.25)	98.18 N=22 (33.24)	106.95 N=22 (44.33)	75.49 N=88 (15.61)
All Environments	44.89 N=44 (12.21)	54.88 N=42 (15.31)	96.19 N=42 (22.47)	117.45 N=40 (29.30)	77.49 N=168 (10.41)

(b) Test for Hypothetical Bias

Reduction of Encounters	Observed $WTAC^C$	Derived $WTAC^C$
from 1 to 0	$358.67 N=9 (84.12)	$15.38 N=28 (----)
from 5 to 1	$297.36 N=10 (70.10)	$49.91 N=28 (----)
from 10 to 5	$237.40 N=6 (57.57)	$22.12 N=28 (----)

Footnotes

Our appreciation is extended to Larry S. Eubanks, as well as countless others at the University of Wyoming and University of Kentucky for help and encouragement provided in the course of this research.

1. The household substitution approach assumes that the consumer combines various private and public commodities to produce a set of activities that yield satisfaction or utility to him. Value estimates are derived from analysis of the manner in which perturbations in the opportunity set influence the selected combinations of commodities. [Blank et al., 1977 (in press); Brookshire et al., 1977].

2. Some, including Hammack and Brown (1974) and Charbonneau and Hay (1978) have used a direct question technique which does not use iterative bidding. Randall, et al. 1974, provide several reasons to prefer iterative bidding. However, there has yet to be a rigorous test of the relative efficacy of iterative vs. non-iterative questioning techniques.

3. This research was supported by U.S. Fish and Wildlife Service (under contract MON-76-206), the Kentucky Agricultural Experiment Station, and the Resource and Environmental Economics Laboratory of the University of Wyoming.

4. Attempts were made to administer 160 survey schedules to elk and small game hunters, fishermen, observers/photographers, persons interested in optioning future rights to grizzly bear and bighorn sheep hunting, coyote hunters, and (non-user) preservationists. For the sake of brevity, herein only user values for elk hunting will be presented (Table 1) along with the above mentioned option and preservation values.

5. The wildlife-related experience is actually a congestible public good rather than a pure public good. However, congestion is not a serious problem in the study area. Thus, little violence is done to reality by the treatment of the experience as a pure public good.

6. For detailed discussion of the Hicksian welfare change measures see Currie, et al., 1971. A more comprehensive discussion of these measures in the context presented and used herein is contained in Randall (1977) which laid the groundwork for this paper.

7. More detailed explanation is contained in Randall (1977) and two manuscripts by Randall and Stoll (1978) which are available upon request.

8. The empirical results reported below are preliminary results of a rather extensive pilot study. Additional empirical work to expand sample size is planned.

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