Contingent Valuation in Fisheries Management: The Design of Satisfactory Contingent Valuation Formats

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March 6, 1987

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Staff Paper 87-17
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March 9, 1987

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*To appear in Transactions of the American Fishery Society.

Fishery resources produce a wide range of recreational, commercial, and aesthetic goods. Fisheries management guides the production of these goods and allocates them to different uses. These production and allocation decisions involve difficult tradeoffs that are induced by the scarcity of both natural and fiscal resources. For instance, resource scarcity would force a management agency to make tradeoffs across resources directed to fisheries rehabilitation and resources directed to fisheries enhancement. Resource scarcity also forces an agency to decide how to distribute resources across the often conflicting demands of recreational, commercial, and aesthetic interests.

Economic information assists in quantifying the tradeoffs that individuals are willing to make across different resource services (Brown 1985). Commercial resource values quantify tradeoffs in the commercial sector. Commercial values are readily measured using market prices, quantities, and ordinary statistical methods of demand and supply analysis.

Measurement of recreational and aesthetic values is more elusive. Markets for recreational services are typically incomplete or nonexistent. Adequate assessment of these latter values presents a challenge to both economics and fisheries management agencies. Failure to assess recreational and aesthetic values results in a biased picture of management tradeoffs.

Three sets of techniques are used for measuring the values of services not explicitly priced by markets. The hedonic technique measures the value of resource services that are obtained through the purchase of some market good (Freeman 1979). The travel cost technique measures values using the travel costs that individuals incur to access a resource service (Freeman 1979). Finally, contingent valuation elicits values directly from the individuals who are potentially affected by a change in management policy (Randall et al. 1974;

Brookshire and Crocker 1981).

Three characteristics make contingent valuation particularly useful in measuring resource values. First, it is flexible enough to value a wide range of policy impacts; an analyst is not limited to historical variations in resource services and markets (Brookshire and Crocker 1981). Second, with adequate research design, contingent value data are entirely comparable to the value results obtained using other valuation techniques (Schulze et al. 1981; Cummings et al. 1986; Smith et al. 1986). Finally, where rigorous hypothesis tests are possible, outcomes are consistent with the validity of contingent value data (Brookshire et al. 1982; Randall et al. 1983; Hoehn in press).

The purpose of this paper is to identify the features of reliable contingent valuation formats. The first section of the paper outlines five important elements of a contingent valuation format. The second section examines the relationship of these elements to potential sources of error in contingent value outcomes. The third section discusses a conceptual framework that can be used to control valuation errors. The final section suggests five key features of reliable contingent valuation formats.

Contingent Valuation Formats

A contingent valuation of policy change is typically implemented in a survey sample setting. The objective of the contingent valuation format is to set up an exchange situation in which an individual may price policy impacts. A contingent valuation format poses a conditional choice: "If a policy were to change environmental services from an initial s^0 to subsequent s^1 at a cost of $x, would you accept or reject the policy change?" The conditional choice context is adaptable to virtually any set of policy impacts that can be

communicated to respondents and to value concepts such as option price, option value, and existence value.

The design of a contingent valuation format involves a choice of five elements: (1) presentation medium, (2) description of policy impacts, (3) method of provision, (4) method of payment, and (5) value elicitation section. Each element may be modified to fit a particular valuation context. Each element constitutes a potential source of error in the elicited valuations. To enhance the accuracy of value responses, format elements should be formulated in a way that is consistent with the policy being valued.

The presentation medium is the mode of communication between the researcher and a respondent. The most common presentation medium is the personal interview. In this form, a sample of households potentially affected by a policy change is drawn and the heads of those households are contacted. Questionnaires usually contain an extensive verbal narrative to describe the policy change. Self-directed formats have also been used in mail surveys (Bishop and Heberlein 1979; Randall et al. 1985). Computer assisted formats appear also promising as a means for describing complex policy impacts but have, as yet, received only limited application (Randall et al. 1985).

The description of policy impacts is the respondent's only direct source of information about the issue at hand. If the description is incomplete, misleading, or inconsistent with actual alternatives, misleading valuations may be produced. A respondent's comprehension is likely to be enhanced if descriptions are oriented toward perceived elements of the environment. Verbal description is usually supplemented with photographs, diagrams, or tables. The challenge is to develop a policy description that is both technically accurate and intelligible in terms of routine experience.

The method of provision is the way in which a policy change would actually be implemented. If the investigator suggests that a particular agency would implement a policy, the value response could be colored by the respondent's attitude toward the agency. To avoid this agency-specific effect, contingent valuation questionnaires tend to avoid references to specific agencies and refer, if necessary, to a non-specific regional or local program (Tolley, et al. 1984; Randall et al. 1985). With this type of format, the emphasis is placed on the feasibility of policy change rather than on a specific agency of change.

The method of payment is the means by which the costs or savings arising from a policy are passed to the affected members of the public. Examples are surcharges, sales taxes, and user fees. In early valuation experiments, it appeared that specific payment vehicles had to be posed to make the exercise real and credible (Randall et al. 1974), but valuation results proved difficult to interpret if all respondents were not equally susceptible to the payment vehicle. More recent experiments have stressed the lump sum "cost" of policy change--perhaps in the form of generally higher taxes and prices--and have avoided references to specific payment vehicles (Tolley et al. 1984; Randall et al. 1985).

The value elicitation section is the element of a format that actually obtains the value data from respondents. Though the narrative of a value elicitation section is usually rather brief, its development involves rather subtle and difficult choices. In developing this section, an investigator must (1) clarify the entitlements or property rights implicit in a policy change and (2) select a procedure for eliciting values.

The entitlements implicit in a policy determine whether a valuation

should be based on willingness to pay or willingness to accept compensation. If respondents are entitled to the initial policy situation, a Hicksian compensating format is appropriate. A Hicksian compensating format obtains willingness to pay for policies that improve on an initial situation and willingness to accept compensation for policies that make respondents worse off. If respondents are not entitled to the initial policy situation, a Hicksian equivalent format is appropriate. A Hicksian equivalent format forces respondents to pay to avoid a policy change that would make them worse off and asks their willingness to accept compensation to forego a change that would make them better off [Brookshire et al. 1980).

Where policy entitlements are unclear, an investigator may incorporate the compensating and equivalent forms into single format or into different subsamples. For instance, for a policy the would reduce the quality of a fishery, a questionnaire may elicit both a willingness to accept compensation and a willingness to pay to prevent the reduction.

Procedures for actually eliciting value data vary along three dimensions. Specific elicitation procedures are developed by selecting features from each of these three dimensions.

The first dimension is the form of a value response. The response may be (1) an actual statement of maximum willingness to pay or minimum willingness to accept compensation or (2) a respondent's accept or reject response to fixed pairing of policy impacts and cost. The accept-reject responses are relatively easy to elicit from respondents and can be analyzed using the methods of Hanemann (1984) and Seller et al (1985).

Second, values may be elicited (1) as a single response or (2) in an iterated procedure which bases subsequent valuation questions on preceding

responses. Iterative procedures are described by Randall et al. (1974) and may encourage a respondent to undertake a more complete consideration of policy.

Third, a starting point for valuation may be posed by the questionnaire or elicited directly from the respondent. However, value responses are occasionally influenced by poorly constructed questionnaires that pose starting points (Boyle et al. 1985). If starting points are posed by the questionnaire, multiple regression analysis should be used to determine whether starting point effects are present in the value data (see Thayer 1981; Boyle et al. 1985).

Potential Sources of Error

Researchers have proposed several different ways to catalog potential sources of error in the contingent valuation. One can find references to four rather loosely defined sets of effects: (1) the hypothetical context of contingent valuation; (2) the information conveyed by the format to respondents, (3) strategic behavior by respondents as they try to affect policy outcomes, and (4) larger than anticipated differences in the value outcomes of willingness to pay and willingness to accept formats (cf., Rowe et al. 1980; Schulze et al. 1981; Rowe and Chestnut 1983; Cummings et al. 1986). Evidence regarding these effects are reviewed in this section.

Hypothetical Context

Hypothetical effects may arise as individuals evaluate the gains and losses that are posed by a prospective policy (Brookshire and Crocker 1981). Bishop and Heberlein (1979) compared contingent and simulated markets and found that contingent valuation gave smaller willingness to pay and larger willingness to accept values than the simulated markets. However, later

research by Bishop and Heberlein (1986) questioned the strength of their earlier conclusion. In a broad review of the psychological literature, Cummings et al. (1986) found evidence of significantly different outcomes between actual and hypothetical payment situations.

There appear to be three possible reasons for possible hypothetical effects in contingent valuation. First, the choice context described by the contingent valuation questionnaire may fail to correspond to the actual choice context. This problem of context correspondence is widely recognized by social psychologists (Ajzen and Fishbein 1977). This source of error can be avoided by recognizing that contingent values are conditioned on the structure of the contingent valuation format and by developing formats that accurately describe intended policies.

A second source of hypothetical error arises in communicating complex policy information to a respondent. The format's description of policy may be accurate, but errors in the respondent's perception and comprehension may occur. Policy impacts are often complex and unfamiliar. The time constraints of an interview restrict repetition and review. Given these constraints, flawed perception or comprehension may result in a flawed valuation of the proposed change.

Third, the contingent valuation setting may allow too little time for respondents to complete their decision processes. Research by Smith (1980), Pommerehne et al. (1982), and Coursey et al. (in press) underscores the correlation between time and improved decisions. The time constraints of a typical contingent valuation interview may cut short a respondent's decision processes and introduce errors into the value response.

Information Bias

Information bias may arise as individuals formulate an expectation of policy impacts subject to the information conveyed by a contingent valuation format (Rowe, et al. 1980). In a general sense, information effects overlap the problem of context correspondence discussed with respect to hypothetical effects (cf. Cummings et al. 1986). However, as used in the contingent valuation literature, information bias tends to refer to the effect of procedural elements of the contingent format such as starting points that are not necessarily a feature of the proposed policy.

Careful design, pretesting, and analysis can at least detect if not eliminate the impact of information bias. For instance, starting point effects may stem in part from respondent fatigue due to a lengthy questionnaire or a lengthy sequence of iterative valuations (Rowe et al. 1980). Pretesting of the questionnaire can detect formats that are sensitive to these effects and appropriate modifications can be made. If starting points effects are not detected until the final analysis, the sensitivity of the value results to these effects should be examined. With auxiliary assumptions, it may be possible to measure the size of starting point effects and estimate an unbiased valuation (Thayer 1981).

Payment vehicles such as sales taxes and user fees have also been identified as a source of information bias (Rowe et al. 1980; Cummings et al. 1986). It seems more appropriate, however, to view payment vehicles not as biasing factors but as a potentially important feature of a policy change. Rowe et al. (1980), Daubert and Young (1981), and Greenly et al. (1981) found significant differences in valuations associated with different payment vehicles though Brookshire et al. (1980) and Brookshire et al. (1982) found no

significant effects. Recent format designs avoid the use of specific payment vehicles (Tolley et al. 1984; Randall et al. 1985).

Strategic Effects

Strategic effects stem from an individual's attempt "to influence the outcome or results of the [evaluation] by not revealing a true valuation" (Rowe et al. 1980). Strategic behavior in public decision making has been recognized at least since the eighteenth century and Hume (1888). Recent research, however, shows that it is possible to control the incentives for truth-telling through an appropriate design of the decision making context (Clarke 1971; Groves 1973; Green and Laffont 1977; Groves and Ledyard 1977).

Evidence of strategic effects in contingent valuation is unexpectedly weak. Bohm (1972), Scherr and Babb (1975), and Schneider and Pommerehne (1981) found little experimental evidence of pronounced strategic behavior. Smith (1980) tested the strength of strategic effects against a set of incentives designed to encourage a truthful statement of values; his results suggest that even weak incentives for truth-telling may be enough to counter the prospect of strategic behavior. Brookshire et al. (1976) and Rowe et al. (1980) find no evidence of strong strategic behavior in their contingent valuation experiments.

The absence of strong strategic effects in contingent valuation may be more problematic than their presence. The lack of strategic response may indicate that the respondent views the entire experiment as rather academic and remote from actual policy processes (Brookshire et al. 1976). Confidence in contingent valuation would be stronger if the operative incentives were more clear.

Willingness to Pay or Accept Compensation

Hammack and Brown (1974), Gordon and Knetsch (1979), Bishop and Heberlein (1979), Brookshire et al. (1980), Rowe et al. (1980), and Knetsch and Sinden (1985) all reported differences between willingness to pay and willingness to accept compensation that are much greater than would be predicted by existing theory as developed by Willig (1976) and Randall and Stoll (1980). The cause of such divergences remains unclear. Recent experiments by Coursey et al. (in press) suggest that the divergence may be due to a respondent's incomplete decision processes: measures of willingness to pay and willingness to accept diverged at the outset of an iterative bidding process but reconverged with successive iterations.

Improved Format Design

Improved design of contingent valuation formats requires a systematic understanding of contingent behavior. An explanatory model would encompass the potential sources of error and suggest their likely effect on valuations. The predicted relationships could then be used to assess the adequacy of contingent value data in economic analyses and (2) guide the design of improved contingent valuation formats.

Recent research by Alan Randall and I (Hoehn and Randall in press) suggests the possibility of a systematic explanation of contingent behavior. Our basic approach is to adapt the standard economic choice model of perfect information and instant optimization (Ferguson and Gould 1975) to the constraints of the contingent valuation context. Our analysis encompasses the primary potential sources of error identified in the last section: errors in communication, time-constrained decision processes, and incentives in value

statement. In this section, I outline the structure of our model.

Contingent Behavior and Value Outcomes

The typical contingent valuation context confronts an individual with the problems of value formulation and value statement. The value formulation problem arises to the extent that an individual is unfamiliar with a prospective policy change. Value formulation encompasses two potential sources of error: errors in communication as a respondent assimilates new information and errors in the time-constrained decision or search process. The value statement problem encompasses strategic behavior. Our analysis indicates that errors in both value formulation and value statement may have an impact on value outcomes.

The impact of value formulation depends upon whether the valuation procedure is posed in a Hicksian compensating or a Hicksian equivalent format. For simplicity, I discuss the impact of value formulation in terms of willingness to pay.

In a Hicksian compensating format, an individual seeks to determine the maximum amount of income that he/she is willing to pay in order to get the prospective policy change. Communication errors introduce uncertainty into the respondent's perception of this change. A risk averse respondent formulates a valuation that is less than the valuation that he/she would formulate for a certain policy. In addition, due to an incomplete decision process, the respondent fails to identify maximum willingness to pay and instead identifies something less than the maximum. Both communication error and the incomplete decision process imply that the valuation formulated in a Hicksian compensating format, denoted fHC, is something less than the ideal Hicksian measure, HC.

The formulated compensating measure, fHC, is a function of the time and effort spent in decision making. As the amount of effort allocated to the formulation process increases, fHC tends to increase (i.e., it does not decrease) toward HC. Eventually, if sufficient time and effort are allocated to the decision process, fHC approximates HC.

A format designed to elicit a Hicksian equivalent valuation forces the respondent to determine the maximum amount of income that he/she is willing to pay in order to avoid the prospective policy change. The Hicksian equivalent format forces a respondent (1) to forecast his/her personal level of well-being under the prospective policy and (2) to determine his/her maximum willingness to pay to avoid that level of well-being. The forecasting problem tends to push the formulated value measure, fHE, upward while the payment formulation problem tends to push fHE downward. As a result, fHE may be greater, less than, or equal to the ideal equivalent value measure, HE.

The impact of additional time and effort on fHE is not clear. Whether fHE increases or decreases depends on the amount of time and effort allocated to forecasting the post-change level of well-being versus the amount of time allocated to payment formulation.

Once fHC or fHE is formulated, the respondent faces the choice of whether or not to actually report the formulated valuation. If it is in his/her long term best interest to respond truthfully to the valuation question, the respondent states fHC or fHE, whichever is relevant. However, an individual may perceive more immediate incentives to distort fHC or fHE and instead report a substitute measure, sHC or sHE.

Our model suggests that two, often implicit, elements of the contingent valuation context determine the immediate structure of incentives: (1) an

implementation rule and (2) the payment rule. The implementation rule defines the relationship between an individual's value response and the likelihood that the project will be implemented. The payment rule describes an individual's payment in the event that a prospective policy is actually implemented.

Three incentive structures are particularly relevant to contingent valuation. In the first incentive structure, a respondent believes (1) that the prospective policy will be implemented if benefits exceed costs and (2) that in the event of implementation his/her payment will be proportional to his/her stated valuation. The respondent weighs the probable personal benefits of implementation against the probable personal costs. The result is a compromise between a statement of the full fHC or fHE and stating nothing. The compromise implies that the respondent states something less than the full formulated valuation: $sHC \leq fHC$; $sHE \leq fHE$.

The second incentive structure involves a respondent who supposes that (1) the prospective policy will be implemented if benefits exceed costs and (2) that his/her payment is the average cost of project implementation. With this set of incentives, a respondent that behaves strategically would try to shift the stated sample mean valuation toward his/her own formulation valuation. A risk neutral respondent whose believes his/her formulated valuation is equal to the sample mean valuation states sHC equal to fHC and sHE equal to fHE. A risk averse individual with the same belief states something less than his/her formulated valuation. An individual who suspects that his/her formulated valuation deviates from the sample mean valuation reports sHC or sHE to exaggerate that deviation. Such behavior tends to increase the variance of the stated valuations but leaves the sample mean unaffected. On average, $sHC \leq fHC$; $sHE \leq fHE$.

In the third case, the respondent assumes that (1) the prospective policy will be implemented if a majority of individuals responds favorably to a impact-payment pair and (2) that his/her payment will be equal to the described per person costs of implementation. With this fixed-cost referendum, an individual can do no better than respond "accept" to a payment that is less than fHC_t or fHE_t and respond "reject" to a payment that is greater than fHC_t or fHE_t. Given an iterated schedule of prospective costs, an individual would accept all policy-payment pairs until the prospective payment exceeds fHC_t or fHE_t. In this manner, the individual identifies the stated valuations $sHC = fHC$; $sHE = fHE$.

The net effect of value formulation and value statement differs across the Hicksian compensating and equivalent formats. In a Hicksian compensating format, value formulation and value statement lead to an understatement of the ideal compensating value measures: $sHC \leq fHC \leq HC$. Benefit measures elicited in terms of stated willingness to pay, $sWTP^C$, do not overstate the ideal WTP^C. Costs measured in terms of stated willingness to accept, $sWTA^C$ (= -sHC) do not understate the ideal cost measure, WTA^C. A compensating format does not overstate the net benefits of policy change since $sWTP^C - sWTA^C \leq WTP^C - WTA^C$.

The net effect of value formulation and value statement on the stated Hicksian equivalent measures is less clear. Though the likely incentives suggest an understatement of fHE, the value formulation process itself leads to an ambiguous relation between fHE and HE.

Empirical Evidence

The analytical results are consistent with a range of existing empirical evidence. The model also appears to "explain" empirical anomalies such as the

initial divergence of willingness to pay and willingness to accept compensation. In this section, I discuss the analytical results as empirical hypotheses. These hypotheses can be used to understand existing data and to direct further research.

The model suggests the respondents learn about their preferences as more time and effort are allocated to value formulation. This learning process implies that the stated compensating value, sHC, does not decrease with more time and effort. This result is consistent with Randall et al. (1985) and Coursey et al. (in press).

Willingness to pay and willingness to accept compensation diverge unless respondents have prior experience in valuing the proposed policy change. This hypothesis follows from the fact that extant theory suggests that $WTP^C \leq WTA^C$ and our model implies that $sWTP^C \leq WTP^C$ and $sWTA^C \geq WTA^C$. Within our model, value formulation and value statement drive an additional wedge between willingness to pay and willingness to accept. This divergence is consistent with the empirical evidence discussed above.

Willingness to pay and willingness to accept tend to converge as more time and effort are given to valuation. The model predicts that $sWTP^C$ tends to increase and $sWTA^C$ tends to decrease with more time and effort. This prediction is consistent with the recent results of Coursey et al. (in press).

Results of an accept-reject, fixed cost elicitation procedure dominate the outcomes of a "how much are you willing to pay?" format. This hypothesis follows since the structure of the accept-reject format simulates the incentives of the fixed-cost referendum. This hypothesis is consistent with the empirical findings of Tolley et al. (1984). This hypothesis may also help to explain the relative immunity of contingent valuation to strategic behavior.

With referenda and their informal equivalent, opinion polls, a common feature of public decision making in the United States, respondents may simply assume that the referendum incentives are relevant to contingent valuation. This ingrained response would support the generally weak existing evidence of strategic behavior.

Finally, an iterated accept-reject, fixed cost elicitation procedure results in stated valuations that are closer to the true valuation, HC, and that dominate the valuations of any other payment rule. An iterative process encourages the respondent to take more time and effort with value formulation. The accept-reject, fixed cost procedure implies sHC equal to fHC. This hypothesis is consistent with the tentative evidence of Sorg (1982).

Features of Reliable Formats

Contingent valuation encompasses a large class of alternative format designs. These format designs do not all perform equally well. However, from the preceding discussion, it is clear the performance of contingent valuation can be controlled. In this section, I suggest five conclusions regarding format design.

First, valuation results obtained with a Hicksian compensating format are more conservative, sHC, than the ideal compensating measures, HC. A compensating format does not overstate the net benefits of policy change. Used in benefit cost analysis, the stated compensating measures may not be ideal but they are pragmatically useful. Stated compensating values correctly identify detrimental policies as having net benefits less than zero. Policy changes that are truly beneficial are likely to show net benefits greater than zero. In a policy setting with many competing proposals, stated value information can

be used to weed out detrimental policies and narrow the focus of public decisions to the few most beneficial policy alternatives.

Second, Hicksian equivalent formats appear to yield generally unreliable value results. Further research may indicate cases where the degree or sign of the error is clear. In the meantime, Hicksian compensating formats give the most satisfactory value outcomes.

Third, the implicit implementation rule and payment rules determine the incentives for value statement. The theoretical evidence suggests that an accept-reject, fixed cost elicitation procedure yields the best value estimates. The accept-reject procedure reduces the possibility that a benefit cost analysis would reject a truly beneficial policy.

Fourth, an iterated accept-reject procedure is likely to increase the amount of time devoted to value formulation and, in a Hicksian compensating format, yield value estimates that are closest to the ideal measures.

Finally, format design should be reviewed with respect to four features: (1) the description of policy that is conveyed to a respondent; (2) the implicit implementation rule; (3) the implicit payment rule; and (4) the complexity of the valuation problem. A change in one of these features is likely to shift the stated valuations. Increased complexity may require more time and effort on the part of the respondent. Tables, graphs, or computer assisted formats may speed the assimilation of information and assist in repetition and review.

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