Application of Experimental Economics Concepts and Precepts to CVM Field Survey Procedures

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Experimental economics (EE) axioms are directly applied in this paper to contingent valuation method (CVM) field survey procedures. The implications of EE concepts and precepts for conceptualizing and handling potential CVM biases and framing effects also are discussed. It is concluded that EE concepts and precepts provide useful principles and guidelines for CVM field survey procedures.

Key words: contingent valuation method; experimental economics; field survey procedures, principles, and guidelines.

Although widely accepted as a viable nonmarket valuation technique, concerns over the accuracy and reliability of the contingent valuation method (CVM) persist (Cummings, Brookshire, and Schulze). Many of these concerns focus on CVM field survey procedures. Many authors have emphasized the importance of careful design and conduct of CVM surveys (Arthur D. Little, Inc.; Cummings, Brookshire, and Schulze; Randall, Ives, and Eastman). As a result, recommendations and guidelines for application of CVM have been proposed. An example of these recommendations and guidelines are the "Reference Operating Conditions (ROCs)" (Cummings, Brookshire, and Schulze).

In a recent article, Coursey and Schulze discuss the relevance of experimental economics (EE) methodology for improving the CVM. The authors argue that EE methodology provides a means for testing CVM formats in controlled, laboratory settings. Formats which perform well in the lab can then be extended to the field. In addition, the authors argue that controlled laboratory experiments provide a viable means for establishing "benchmark" values for nonmarket commodities.

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The authors would like to thank two anonymous reviewers for helpful comments and suggestions.

The ROCs and suggestions made by Coursey and Schulze for applying EE methodology to CVM research provide useful principles and guidelines for improving CVM field survey procedures. In this paper, the work of Cummings, Brookshire, and Schulze and Coursey and Schulze is extended by surveying EE axioms and relating these axioms directly to CVM field survey procedures. EE concepts are reviewed in the first section. After this review, the properties and precepts of a valid CVM experiment are discussed. The implications of EE concepts and precepts for CVM biases and framing effects then are discussed. Conclusions are presented in the final section.

Experimental Economics Background

EE methodology attempts to examine economic phenomena and behavior in controlled settings. These controlled settings include field experiments and laboratory experiments. Field experiments involve some perturbation and monitoring of a naturally occurring economic system (Plott 1981). For example, a field experiment was conducted to test for the effects of changes in relative prices on residential electricity demand. In the experiment, electricity prices faced by actual residential electricity customers were changed, and the resulting changes in electricity demand were observed and analyzed (Battalio et al.).

Laboratory experiments are standard research techniques in the physical sciences. In applied economics, however, laboratory experimental methods are seldom employed. Unlike field experiments, laboratory experiments do not involve the use of a naturally occurring economic system. Rather, economic systems are constructed by the researcher in a controlled, laboratory setting. A sample of respondents are then invited to participate in the researcher-constructed economic system. The researcher can then perturb the system and analyze the resulting effects on economic behavior and phenomena.

As a research technique, experimental economics has several noteworthy advantages. First, economic behavior can be observed and tested directly. Thus, the need for abstract inferences concerning the influence of certain variables on economic behavior, which often hinders econometric analysis of field data, is minimized (Smith 1985). Economic experiments also provide a relatively inexpensive means of gaining knowledge and insight into complex economic systems and processes. Economic experiments also are very flexible in the types of economic systems and processes which can be examined. For example, an economic experiment can be designed to analyze the impacts of alternative policy proposals on an economic system before these policies are actually implemented. The results of such experiments may provide policy makers with valuable insight regarding the performance of alternative policies (Plott 1979).

One of the major advantages of experimental economics methodology is control. That is, because the researcher constructs an economic system in which economic agents operate, control can be exercised over the amount and type of variables (e.g., institutions) which impact economic behavior. The independent effect of individual treatment variables is often very difficult to observe in naturally occurring economic systems where a multitude of uncontrolled variables may impact economic behavior. Thus, the control which is needed to adequately address many economic questions of interest may be possible only in an economic experiment.

Establishing control in an economic experiment requires that the experiment be designed and conducted carefully. This careful formulation of procedures facilitates replication of experimental results. The possibility of replication is a further advantage of economic experiments, because replication is a convenient and widely accepted means of validation (Smith 1985).

CVM Experiments

Rigorous principles and guidelines have been developed for economic experiment procedures (Smith 1982, 1985). CVM exercises are argued to be a type of economic experiment (Plott 1981). Thus, principles and guidelines which have enhanced the conduct of controlled laboratory experiments may also provide a means for improving CVM field survey procedures.

The CVM is defined here as the elicitation of individual values for commodity allocations in experimental markets where allocations, costs, and adjustments are contingent upon actual operation of the microeconomic system described by the experimental markets. Because contingent allocations and payments are used, these experimental markets are referred to as contingent markets. Contingent markets, if properly designed, are microeconomic systems as described by Smith 1982, 1985.

As suggested by Coursey and Schulze, the theory of microeconomic systems as put forth by Smith 1982, 1985 can be extended to contingent markets. For example, a common usage of contingent markets is to elicit valuations of changes in the quantity or quality of a nonmarket commodity, say Q. The contingent market would present participants with a scenario describing Q's initial quantity, quality, location, and time dimension (Coursey and Schulze). Information describing Q and the services it supports may be given to participants as well.

Participants in the continent market are denoted by R^k, $k = 1, 2, \ldots, K$. Each participant is described by preferences (Z^k), household technology (H^k), attitudes and values (A^k), initial endowment of the nonmarket commodity (Q^k), and all other goods or income (Y^k), e.g., $R^k = (Z^k, H^k, A^k, Q^k, Y^k)$. The contingent market microeconomic environment is therefore defined as $R = (R^1, \ldots, R^K)$. The contingent market microeconomic environment defines "a set of initial circumstances that cannot be altered by the agents or the institutions within which they interact" (Smith 1982).

These initial circumstances are agent or respondent specific and private (Smith 1982).

It has been recognized in many fields of economics that institutions are an integral part of economic systems. Institutions are defined as ordered relationships among agents which define rights, privileges, and responsibilities (Schmid). In a microeconomic system, institutions include the rules which govern the communication, exchange, and transformation of commodities subject to the initial economic environment given by R. An important point concerning institutions is that they govern the messages which agents can communicate in an economic system as well as the physical exchange and transformation of goods and commodities (Smith 1982, 1985). In a continent market, institutions determine a language, $G = (G^1, \ldots, G^K)$. This language specifies the messages that respondents are permitted to communicate in the contingent market. For example, G^1 represents the set of messages that can be sent by respondent 1. The final set of messages in the contingent market is defined by $M = (M^1, \ldots, M^K)$. For example, M^1 represents the messages that respondent 1 sends. Final messages may include bids, offers, and acceptances (Coursey and Schulze; Smith 1985).

Institutions also specify allocation and cost assignment rules. The allocation rule for a participant is given by $h^k(M)$. Because it is a function of M, the allocation rule indicates that the final commodity allocation to a participant is determined by the messages of all participants. Since each participant faces an allocation rule, the total set of allocation rules is given by $H = [h^1(M), \ldots, h^K(M)]$. The cost assignment rule for a participant is given by $c^k(M)$. The argument M implies that the final costs imposed on a participant also are determined by the messages of all agents. Since each agent faces a cost assignment rule, the total set of cost assignment rules is given by $C = [c^1(M), \ldots, c^K(M)]$.

Finally, institutions specify adjustment process rules faced by each respondent. These rules include a starting rule, a transition rule, and a stopping rule. The starting rule, denoted by $b(t_0, ., .)$, specifies the time or conditions under which the exchange of messages can begin. The transition rule, denoted by $b(., t, .)$, regulates the sequence and exchange of messages. The stopping rule, denoted by $b(., ., T)$, specifies the time or conditions under which the exchange of messages must end. Thus, the institutions which govern a participant's message communication and commodity exchange are defined by $W^k = [G^k, h^k(M), c^k(M), b(t_0, t, T)]$. The set of institutions faced by all respondents, denoted by $W = (W^1, \ldots, W^K)$, defines the contingent market microeconomic institution.

In Smith 1982, 1985, a microeconomic system is defined as the combination of the microeconomic environment and institution. In contingent markets, it is often necessary to present respondents with information describing Q and the services it provides. Let this set of information be denoted by I. A contingent market microeconomic system is therefore defined as the combination of the microeconomic environment (R), the microeconomic institution (W), and the Q information set (I). In notational form, the contingent market microeconomic system is denoted by $S = (R, W, I)$.

The performance of a contingent market microeconomic system depends upon the conduct or choice behavior or participants. Observable choice behavior, or final messages, are determined by the function $M^k = f(R^k, W, I)$. This function indicates that a respondent's messages are determined by a respondent's features (e.g., preferences), the set of institutions inherent in the microeconomic system, and information describing Q and the services it provides. Given the messages sent by each respondent, the final outcomes of the microeconomic system are determined by W. That is, commodity allocations and cost assignments are not directly determined by participants. Rather, the choice behavior of agents leads to messages. These messages are incorporated into the institutional structure of the microeconomic system. The institutional structure then determines final commodity allocations and cost assignments. In notational form, final commodity allocations are determined by the function, $h^k(M) = h^k[f(R^1, W, I), \ldots, f(R^K, W, I)]$, and final cost assignment rules are determined by the function, $c^k(M) = c^k[f(R^1, W, I), \ldots, f(R^K, W, I)]$. Thus, final outcomes of the microeconomic system are dependent upon information, institutions, endowments, and features of participants which impact their choice behavior.

Operation of a contingent market is initiated by messages sent from the researcher to participants. Participants then respond to these messages. For example, the researcher may

send a message to participants asking them to submit a bid for a given increment in Q. Such bids would be contingent upon the increment in Q being provided and all other conditions described in the contingent market. Thus, the messages that participants send back to the researcher represent their assessment of how they would react to the circumstances posited in the contingent market. In the experiment itself, commodities and money do not actually change hands. Bids for Q are interpreted as contingent payments. That is, the bids are an approximation of how much participants would pay for Q should the microeconomic system described by the contingent market actually be implemented (Coursey and Schulze; Cummings, Brookshire, and Schulze).

Properties of CVM Experiments

A fundamental proposition supporting CVM experiments is that economic principles which apply to "real-world" markets also apply to experimental contingent markets. Thus, economic theory and empirical tools are applicable to properly designed experimental contingent markets. Within the context of experimental settings, the research results are just as valid as any other market-oriented research (Plott 1979, 1981).

Once the contingent market microeconomic system is in place, it can be utilized for conducting specific experiments. The design and conduct of any type of experiment, including economic experiments, requires strict attention to proper experimental procedures. Over the years, a number of procedural guidelines for economic experiments have been proposed. First, there is a need to word and present instructions in a clear, unambiguous, and defensible manner. The extreme care given to instructions is dictated by two concerns. First, other researchers must be able to follow the same procedures in order to replicate results. Second, the researcher must be capable of defending the instructions against the charge that they somehow bias the results of the experiment. For example, one must be able to argue that agents interpret instructions in a uniform manner. Also, one must be able to argue that the instructions do not tell participants how they "should" behave or how the researcher expects them to behave unless such instructions are included as deliberate treatment variables (Plott 1979, 1981).

Several sufficient conditions for a valid, controlled microeconomic experiment have been proposed (Smith 1982). The first condition is nonsatiation or monotonicity of reward. Nonsatiation implies that subject agents strictly prefer any increase in the reward medium (e.g., more is preferred to less).

The second sufficient condition for an experiment is saliency. Saliency means that the institutions of an experimental market give agents the unqualified right to outcomes (e.g., rewards, costs) resulting from their message choices. The conditions of nonsatiation and saliency are sufficient for establishing an experimental microeconomic system, $S = (R, W, I)$. If two further conditions are met, the system is said to be a controlled microeconomic system. The first of these additional conditions is dominance. Dominance means that own rewards dominate any subjective costs of participating in the experimental market. Subjective costs include, for example, the cognitive effort required to negotiate and complete transactions. The second additional condition for a controlled system is privacy. Privacy means that agents receive information only on their own individual reward schedules. The privacy condition provides control over interpersonal utilities (Smith 1982).

The conditions of nonsatiation, saliency, dominance, and privacy are sufficient for testing hypotheses from theory. Economic experiments, however, are sometimes used to provide insight into the structure and performance of "real-world" markets. In these cases, the condition of parallelism must also be met. Parallelism means that "propositions about behavior and/or the performance of institutions that have been tested in one microeconomy (laboratory or field) apply also to other microeconomies (laboratory or field) where similar *ceteris paribus* conditions hold" (Smith 1982). The parallelism condition is consistent with the standard economic belief that where the market environment, institutions, and information are the same, economic behavior should be the same. Thus, if an experimental market and a "real-world" market have similar *ceteris paribus* conditions, the outcomes of these systems should be comparable.

The properties of nonsatiation, saliency, dominance, privacy, and parallelism provide rigorous guidelines for enhancing the control and replication of CVM experiments. Establishing these properties in CVM experiments,

however, has not been explicitly considered in the CVM literature. An attempt is made here to define the conditions under which these properties may be satisfied in a CVM field survey.

Satisfaction of Experimental Precepts in CVM Field Surveys

Nonsatiation requires that respondents clearly recognize the rewards of participating in a CVM experiment. Rewards in a CVM experiment are associated with the utility derived from making a decision (participation rewards), the utility derived from being involved in the public policy process (altruistic rewards), and the expected utility derived from a future allocation of Q (expected commodity allocation rewards). Recognition of participation rewards can be facilitated by attempting to make the questionnaire wording and design as interesting to respondents as possible. For example, participants can be provided with information and questions designed primarily to "spark" their interest in completing the CVM exercise. Previous research also suggests that participant interest may be increased by presenting a questionnaire in booklet form (Dillman). Different forms of pictures and graphics also may increase interest in the questionnaire.

Recognition of altruistic rewards may be facilitated by providing respondents with information which points out the importance of individual responses to the public policy process. For example, it may be pointed out that individual responses are needed to provide information which would improve resource management decisions. Recognition of expected commodity allocation rewards may be facilitated by providing participants with information which indicates that their responses may impact the actual future allocation of nonmarket commodities. For example, participants may be informed that their responses will provide input into the determination of the most desirable level of nonmarket commodity provision. Once participants clearly recognize the rewards of participating in a CVM exercise, it is argued that they always will prefer more of these rewards to less. That is, the property of nonsatiation will hold.

It is argued further that subject agents have the unqualified right to claim the rewards generated by the contingent market. This unqualified right is inherent in the participation and altruistic rewards (e.g., feelings of altruism or benefits from being altruistic). Thus, it is argued that these rewards meet the saliency property. The saliency of expected commodity rewards is not so straightforward. Expected commodity rewards are salient only if CVM participants actually feel that their messages may result in some expected future allocation of commodities to themselves. For instance, suppose the contingent market is highly unrealistic and outside the range of participants' actual experiences. In this case, participants may perceive very little or no connection at all between their responses and future commodity allocations. The saliency of the expected commodity allocation reward may be lost. Saliency requires that the link between messages and future commodity allocations be established and that information presented in the contingent market clearly delineates property rights to future subjective allocations.

The magnitude of own participation rewards relative to subjective participation costs determines whether dominance has been established in contingent valuation experiments. In a contingent market, as in other microeconomic systems, subjective costs are composed primarily of the time and cognitive effort required to process information, evaluate alternatives, and make final decisions. If own rewards exceed these subjective costs (e.g., if the net benefits of participating in the contingent market are greater than zero), control in the experiment will be established.

Several steps can be taken to establish dominance in contingent markets. First, perceptions of the own rewards of participating in a CVM exercise may be increased by providing participants with information related to reward recognition, realism, credibility, focus, and attention. Also, even though it is rarely used, participants could be paid a monetary inducement to help cover subjective (and real) costs of participating in the contingent valuation exercise. Second, instructions, information, and calculations should be presented as clearly and simply as possible in order to reduce subjective costs associated with information processing. Another way of reducing subjective costs is to provide participants with information designed to facilitate analytical calculations. Still another way of reducing subjective costs is the use of computerized con-

tingent markets. Computerized markets, for example, may substantially reduce the time costs associated with iterative bidding methods.

In order for a contingent valuation experiment to satisfy privacy, an individual participant cannot receive information on other participants' reward schedules. If participants somehow communicate their preferences to each other, the probability that messages reflect individual preferences (e.g., valuation of a commodity) is greatly reduced. Steps which may facilitate privacy in contingent markets include the use of moral suasion and ensuring that the CVM study and its objectives are not highly publicized before and during survey implementation. For example, newspaper articles covering a CVM survey may induce a participant to incorporate someone else's preferences (e.g., the article's author) into his or her answers to survey questions. It may be particularly difficult to establish privacy when employing a mail survey. A personal interview survey also may pose privacy problems if participants react strongly to perceived preferences of the interviewer. The use of computerized contingent markets may provide a viable means for facilitating privacy.

The overall credibility of the contingent valuation method rests upon the argument that if the microeconomic system described by the contingent market were actually implemented, behavior and outcomes would approximate behavior and outcomes observed in the experimental, contingent market. Thus it is important that contingent markets satisfy parallelism. It is argued here that parallelism between contingent markets and actual markets holds provided the contingent market environment, institutions, and information are realistic, credible, and unambiguous.

In a contingent market, participants are presented with a package of information describing some nonmarket good of interest. Participants are asked to reveal how much they would be willing to pay (or accept) for changes in the level of nonmarket good provision. Payments are contingent upon the actual provision of the stated changes. Thus, if all conditions posited in the contingent market remain unchanged, participants should be observed to pay approximately the same amount for actual changes in the commodity as observed for hypothetical changes in the contingent market. That is, parallelism between the contingent market and the actual market will hold.

Strictly speaking, there always will be one major institutional difference between contingent markets and actual markets which may impact parallelism. The difference is that in contingent markets consumers do not actually pay their stated bids, while in actual markets consumers do have to pay their stated bids. Thus, in contingent markets and actual markets consumers face different cost assignment rules which may influence valuation messages. For example, when participants actually have to pay stated bids, there is incentive for consumers to state bids lower than their maximum willingness to pay (WTP) in an attempt to capture a surplus equal to the difference between their true maximum WTP and their stated WTP. This understatement represents the "free-rider" problem (Samuelson). The possibility of free riding implies that when participants actually have to pay stated bids, there is a real cost imposed on revealing one's maximum WTP for a good.

In a contingent market, there is no real cost associated with stating one's maximum WTP for a nonmarket good if it is known that payments will not actually be collected. What an individual states he will pay is not actually what he has to pay. Thus, in this situation participants cannot earn a real surplus by stating a bid lower than their maximum WTP. Moreover, participants may assign subjective benefits to revealing their maximum WTP when asked to do so (e.g., "telling the truth" being viewed as desirable social behavior). Similarly, participants may assign subjective costs to misrevealing preferences.

In addition, since participants know that the results of the contingent market may influence future resource allocations and relative costs of other commodities (e.g., taxes, product prices, and wealth), they may perceive additional benefits associated with revealing their true preferences. If participants understate their bids for a nonmarket good, they run the risk that the good will be underprovided. Also, if participants overstate their bid for a nonmarket good, they run the risk that it will be overprovided and may end up costing them more than they are willing to pay. Thus, the risk-adverse strategy may simply be to state one's true valuation of the nonmarket good. In addition, as argued by Rowe, d'Arge, and Brook-

shire, strategic misrevelation of preferences requires certain information in order to be effective. The typical CVM respondent, they argue, probably does not have access to such information.

Thus, a case can be made that with proper attention to design and administration, contingent markets are capable of generating data which are demand revealing. Indeed, a number of recent studies on the demand-revelation properties of contingent markets strongly support the use of these markets for directly eliciting valuations for nonmarket goods (Brookshire and Coursey; Brookshire, Coursey, and Schulze; Brookshire et al.; Coursey; Coursey and Smith; Coursey, Hovis, and Schulze; Dickie, Fisher, and Gerking; Sellar, Stoll, and Chavas).

A final property of relevance to contingent markets is incentive compatibility. A microeconomic system is incentive compatible if "the information and incentive conditions that it provides are compatible with (i.e., support) the attainment of socially preferred outcomes such as Pareto optimality" (Smith 1982). In order to examine the incentive compatibility of microeconomic systems, including contingent markets, it is necessary to define exactly what is meant by a "socially preferred outcome."

For example, suppose that a move from State A to State B represents a transfer of some nonmarket good, Q, from Party A to Party B. Following the potential Pareto-improvement (PPI) criterion, the value of Q in its current use is equal to Person A's willingness to accept (WTA) compensation for losing Q. WTA compensation for a decrement in a good or service represents a Hicksian compensating measure of welfare change, denoted by WTA^c. The value of Q in its alternative (or State B) use is equal to Person B's willingness to pay (WTP) for gaining Q. This WTP is also a Hicksian compensated measure of welfare change, denoted by WTP^c. If $WTP^c > WTA^c$, then the gainer (e.g., Party B) of the move from State A to State B could compensate the loser of such a move (e.g., Party A) and still be better off. Hence, if $WTP^c > WTA^c$, the move from State A to State B satisfies the PPI criterion (Randall and Stoll).

Both WTP^c and WTA^c can be collected in contingent markets. In order to collect these values, the informational structure (e.g., wording of valuation questions) of the contingent market must be consistent with collection of WTP^c or WTA^c. In addition, the structure of the contingent market, in conjunction with individual behavior, must provide incentives for revelation of "true" WTP^c and WTA^c. If these conditions are met, the contingent market would provide valuation data (e.g., outcomes) which indicate the existence of the PPI. Thus, in this case, the contingent market is incentive compatible, at least in terms of the PPI criterion. In general, incentive compatibility must be established through proper attention to the conceptual basis of valuation questions and incentives provided for "true" demand revelation (Brookshire and Coursey; Coursey; Coursey and Schulze; Coursey, Hovis, and Schulze; Hoehn and Randall).

Implications for CVM Biases and Framing Effects

Many concerns over CVM methodology relate to field survey biases and framing effects. Potential biases include starting point bias, payment vehicle bias, strategic bias, information bias, and hypothetical bias. Potential framing effects include various forms of value measure effects; e.g., disparities between WTP and WTA compensation (Cummings, Brookshire, and Schulze; Knetsch and Sinden; Rowe and Chestnut). Implications of EE concepts and precepts for CVM biases are considered first.

Starting Point, Payment Vehicle, and Information "Bias"

Starting point, payment vehicle, and information bias are often interpreted as structural biases. That is, these biases are directly influenced by structural elements of contingent markets (Cummings, Brookshire, and Schulze). In the previous section, properly designed contingent markets were argued to be microeconomic systems. In these microeconomic systems, messages (e.g., bids) from a participant, k, are determined by the message behavior function $M^k = f(R^k, W, I)$. The function, $f(.)$, indicates that the message behavior of respondent k is subject to his or her environment (R^k), contingent market institutions (W), and contingent market information (I).

The payment vehicle and bidding exercise starting point specified in a contingent market are components of W. The payment vehicle

contributes to the cost assignment rule faced by respondent k, or $c^k(M)$. The starting point in a CVM bidding exercise is part of the starting rule faced by respondent k, or $b(t_0, ., .)$. As argued extensively in the EE literature (e.g., Smith 1982, 1985), changes in the institutions of a microeconomic system are expected to influence messages. Similarly, changes in the payment vehicle and starting point are expected to influence messages through the effect of W on the message behavior function, $f(.)$.

Information is a separate argument in the $f(.)$ function. In CVM exercises, it is necessary to present respondents with information which describes the contingent market and the nonmarket commodity to be valued. It is well known in standard neoclassical economic theory that information is an important determinant of consumer behavior. In a contingent market, changes in information are expected to influence consumer or respondent bidding behavior through the effect of I on the message behavior function, $f(.)$.

A fundamental methodological question is: "Should changes in message behavior induced by changes in W or I in a contingent market be automatically interpreted as biases?" A "no" response to this question is supported by the EE literature and recent arguments found in the CVM literature. A number of controlled microeconomic experiments have shown that message behavior may be very sensitive to changes in the institutions of the microeconomic system. For instance, EE studies have shown that alternative auction mechanisms (e.g., Dutch vs. English auction) may result in different message outcomes (Coppinger, Smith, and Titus; Cox, Roberson, and Smith). However, the effects of alternative auction mechanisms are not generally interpreted as inducing biases.

A number of CVM studies have shown that final CVM valuations may be very sensitive to different information presented in contingent markets (Bergstrom and Stoll 1987; Cummings, Brookshire, and Schulze; Rowe and Chestnut; Schulze, d'Arge, and Brookshire). However, as argued by Randall in Chapter 8 of Cummings, Brookshire, and Schulze, contingent market choices should be sensitive to information important to the contingent decision-making process. Thus, unless information presented in contingent markets is deliberately false or misleading, changes in message behavior attributable by the effect of I on $f(.)$ should be viewed simply as information effects rather than information biases. Similarly, unless the starting point and payment vehicle are designed to be false or misleading, the effects of changes in these structural elements on W and message behavior should not be viewed as biases.

It appears to be a well established conclusion that starting points, payment vehicles, and information can influence the final results of CVM exercises. Thus, it is important to understand how alternative starting points, payment vehicles, and information types and presentation impact bidding behavior and, in turn, final revealed valuations. As argued by Coursey and Schulze, EE methodology provides an ideal means for gaining such understanding.

Coursey and Schulze argue that CVM field survey procedures can be improved by testing alternative CVM questionnaire formats in controlled laboratory experiments. For example, laboratory experiments could be designed to test for the effects of different payment vehicles, starting points, and information on valuation responses. Test results would provide insight on the "best" combination of payment vehicles, starting points, and information to use in CVM field survey questionnaires.

Alternatively, starting point, payment vehicle, and information effects can be tested directly in the field. A number of previous studies have used CVM field surveys to directly test for starting point, payment vehicle, and information effects (Schulze, d'Arge, and Brookshire; Rowe and Chestnut). The results of these field survey tests have important implications for the design of CVM field survey questionnaires. For example, field survey test results suggest that bids tend to be induced upwards by higher starting points (Boyle, Bishop, and Welsh). The implication is that it is important to adjust for this "anchoring" effect when designing and conducting CVM field surveys. A problem with CVM field survey tests is that these tests may not follow rigorous experimental procedures. CVM field survey tests can be improved by satisfying the experimental properties discussed previously, e.g., nonsatiation, saliency, privacy, dominance, parallelism, and incentive compatibility.

Strategic Bias

Strategic bias has been extensively analyzed by CVM researchers. The general conclusion

of this research is that strategic bias does not appear to be an overriding problem in CVM exercises (Cummings, Brookshire, and Schulze). In one particular study, strategic bias was detected when respondents were presented with information that gave incentives for misrevelation of preferences. It was noted, however, that the observed strategic behavior could be avoided simply by not exposing respondents to the strategic behavior-inducing information (Rowe, d'Arge, and Brookshire).

Strategic behavior would be determined in a contingent market microeconomic system by the message behavior function, $f(R^k, W, I)$. The available evidence to date suggests that if the structure of W and I do not create incentives for misrevelation of preferences, strategic bias will not be caused by a respondent's microeconomic environment (R^k). That is, R^k combined with a properly designed institutional structure (W) and information structure (I) results in message behavior which is at least approximately demand revealing. Under these conditions, the contingent market microeconomic system is incentive compatible.

EE methodology provides a viable means for developing and testing specific incentive-compatible CVM questionnaire formats. In a controlled laboratory experiment, preferences over commodities can be controlled. Once preferences are controlled, the relationship between bidding mechanisms and bidding behavior can be accurately observed. Thus, it becomes possible to test the incentive compatibility of alternative bidding mechanisms. Laboratory experiments, for example, have identified the Vickrey second-price auction as an incentive-compatible bidding mechanism for private goods and the Smith auction process as an incentive-compatible bidding mechanism for public goods (Brookshire and Coursey; Brookshire, Coursey, and Schulze; Coursey; Coursey and Schulze; Vickrey).

Incentive-compatible bidding mechanisms identified in laboratory experiments provide guidance for the design of incentive-compatible CVM field survey questionnaires. For example, Brookshire and Coursey developed a CVM field survey instrument based on the Smith auction process. This instrument was applied in the field to measure WTP and WTA compensation valuations of a public good. The results of the field survey were compared to the results of a laboratory experiment which used the Smith auction process to measure WTP and WTA valuations for the same public good.

The comparison of results suggested that a CVM mechanism based on the Smith auction process is demand revealing when measuring WTP but perhaps not when measuring WTA. Thus, in order to avoid problems related to demand misrevelation and strategic bias, the Brookshire and Coursey study suggests that CVM field survey instruments should measure WTP using an incentive-compatible bidding mechanism such as the Smith auction process. Another potential incentive-compatible CVM bidding mechanism is the policy referendum process analyzed conceptually by Hoehn and Randall. Coursey and Schulze also suggest that the iterative bidding process first used by Randall, Ives, and Eastman has strong demand-revealing properties.

Hypothetical Bias

Perhaps the most problematic CVM bias is hypothetical bias. The extent of hypothetical bias is related to the procedures used to conduct a CVM exercise. Hypothetical bias is defined here in terms of message behavior functions discussed previously. Define a message behavior function $M^k = f(R^k, W, I)$ which determines messages sent in a hypothetical market. Suppose that the respondent's environment (R^k), the market institutional structure (W), and market information structure (I) were reproduced in an actual market. Messages in this actual market are determined by the function $M^k = g(R^k, W, I)$. Hypothetical bias is argued to occur if $M^k = f(R^k, W, I) \neq g(R^k, W, I)$. That is, hypothetical bias is defined as a divergence between the message behavior of respondent k observed in a hypothetical market and actual market, assuming R^k, W, and I are equivalent in both markets, and an identical good is valued in both markets.

Hypothetical bias must be caused by differences in the two message behavior functions, $f(.)$ and $g(.)$. That is, a respondent described by R^k reacts differently to W and I in a hypothetical market as compared to an actual market. One reason $f(.)$ and $g(.)$ may differ is because of the lack of control in CVM exercises. Control is established in a CVM experiment if the properties of nonsatiation, saliency, dominance, and privacy are met.

For example, Randall, Ives, and Eastman recommend that a contingent market be designed to be as realistic and credible as possible. Such realism and credibility is important for establishing the properties of salience and dominance. If respondents are faced with a highly unrealistic contingent valuation scenario, they are less likely to take the valuation exercise seriously and perceived rewards from participation will decrease. If perceived own rewards decrease below perceived subjective costs, the dominance property will not be satisfied. As a result, control would be lost and respondents may react by sending "frivolous" responses or no responses at all (Coursey and Schulze; Gregory and Furby).

A further symptom of the loss of control and hypothetical bias in a CVM exercise may be information overload. Information overload refers to the emergence of confused or dysfunctional consumer choice behavior resulting from an increase in information quantity or complexity (Grether and Wilde). As the quantity or complexity of information presented in a contingent market increases, the subjective costs of information processing increase as well. At some point, increases in subjective information processing costs may cause total subjective costs to rise above own rewards. Consequently, dominance and control would be lost. As a result, participants' decision-making behavior may become confused and dysfunctional.

EE methodology also provides a means for developing CVM field survey procedures for increasing control and reducing the potential for hypothetical bias. First, laboratory and field experiments can be conducted to test methods for reducing information overload (Bergstrom and Stoll 1988). Proven methods for reducing information overload then can be applied to CVM field surveys in general.

Second, years of experience with laboratory experiments provides strong evidence that bidding behavior is best controlled in a market-like setting where incentives are provided for participants to think hard and seriously about their valuation messages. The implication for CVM field survey procedures is that the survey instrument should establish a market-like setting and attempt to increase the rewards, as well as decrease the costs, of participating in the survey. These steps will help to establish control in the CVM exercise and reduce hypothetical bias. Other specific suggestions for increasing own rewards and decreasing subjective costs were discussed previously.

Framing Effects

Framing effects refer to the effects of bidding question framing on CVM results. Currently, the framing effect of most concern appears to be the divergence in valuations caused by asking a WTA compensation question instead of a WTP question. Previous CVM studies suggest that WTA values tend to greatly exceed WTP values for the same commodity (Bishop and Heberlein; Knetsch and Sinden). The validity of WTA values elicited by the CVM has been seriously questioned (Cummings, Brookshire, and Schulze).

EE methodology is well suited to the task of analyzing the disparity between WTA and WTP. The results of recent laboratory and CVM field survey experiments suggest that the observed disparities between WTA and WTP are sensitive to the bidding mechanism used to elicit these values. In particular, the disparity appears to diminish dramatically when a market-like bidding mechanism is used which is incentive compatible and allows for "preference learning" through multiple bidding trials. Moreover, the results suggest that over multiple bidding trials, WTP remains relatively stable, whereas WTA starts out very high and eventually converges to WTP (Brookshire and Coursey; Coursey; Coursey, Hovis, and Schulze). Thus, in order to elicit accurate measures of WTA in a CVM field survey, it may be necessary to use an incentive-compatible bidding mechanism which provides opportunities for respondents to "learn" their preferences and values (Brookshire and Coursey; Coursey and Schulze). Incentive-compatible bidding mechanisms which CVM participants are already familiar and experienced with, such as the policy referendum process proposed by Hoehn and Randall, may provide another viable means for eliciting WTA values.

Conclusions

Establishing the properties of nonsatiation, saliency, dominance, privacy, and incentive compatibility facilitates the internal validity of

the CVM. Internal validity implies that the results of a CVM field survey can be replicated. For replicability, it is also necessary that treatment variables such as instructions, information, and bid elicitation procedures be held constant across CVM applications. In general, it is recommended that much closer attention be paid to instructions, information, and bid elicitation protocol with an overall objective of standardizing procedures across CVM applications.

The use of the CVM as an input into public policy decisions implies that external validity is an important consideration as well as internal validity. External validity implies that CVM results can be extended to "real-world" scenarios. A necessary condition for external validity is parallelism. In the case of CVM, parallelism requires that the environment (e.g., respondent characteristics), institutions (e.g., commodity allocation mechanisms), and information structure of the contingent market be similar to an actual, or potentially actual, market. Parallelism implies that consumer behavior in a contingent market would in fact be observed should the market actually be implemented.

In sum, EE methodology provides a useful framework for CVM field survey procedures. A distinct advantage of using this framework is an increased potential for control and replication. Control and replication are the primary means by which researchers' shared misunderstanding of economic systems is reduced (Smith 1985). Lack of control and replication contribute to persistent fundamental questions concerning the validity of the CVM. As the scope and complexity of a valuation problem increase, such questions are likely to intensify. CVM methodology is being subjected to closer scrutiny from expanded sources including agencies, public interest groups, lawyers, judges, and Congress. Thus, reduction of "shared misunderstandings" of the contingent valuation method through sound, scientific methodology is not only desirable from an academic standpoint, but is perhaps essential for firmly establishing and maintaining the credibility of the method among clientele groups.

[*Received May 1988; final revision received November 1988.*]

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Invited Papers

The following section contains invited papers and discussions which were presented at the Western Agricultural Economics Association meetings in Honolulu, Hawaii, July 10–12, 1988. These papers were submitted to a special external review and were revised by authors prior to publication.