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COMPILED BY

John B. Loomis
University of California, Davis
Davis, CA 95616

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CONTINGENT VALUATION AS AN EXPERIMENTAL SCIENCE

BY

JOHN C. BERGSTROM
ASSISTANT PROFESSOR
UNIVERSITY OF GEORGIA
ATHENS, GA

AND

JOHN R. STOLL
ASSOCIATE PROFESSOR
TEXAS A & M UNIVERSITY
COLLEGE STATION, TX

INTRODUCTION

Although widely accepted as a viable nonmarket valuation technique, concerns over the accuracy and reliability of contingent valuation results persist (Cummings, Brookshire, and Shulze). Many of these concerns focus on contingent valuation methodology; that is, the empirical process by which willingness-to-pay (WTP) and willingness-to-accept compensation (WTA) measures are elicited. The credibility of the contingent valuation method (CVM), it is argued here, is threatened by the fact that the method is relatively easy to use, but difficult to use well. Many authors have emphasized the importance of careful design and conduct of CVM surveys (Arthur D. Little, Inc.; Cummings, Brookshire, and Shulze; 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 (ROC's)" (Cummings, Brookshire, and Shulze.)

The ROC's, in general, are based on observations of "what has worked well in the past". Although providing a useful compilation and summary of past research, the ROC's do not provide an overall analytical framework for CVM methodology. Such an analytical framework, in addition to the ROC's, is needed in order to judge the validity of individual CVM applications.

In this paper, an experimental economics approach is taken to CVM methodology. Experimental economics terms and concepts are introduced first. The relationships between experimental economics objectives and contingent valuation research are then considered. After this discussion, contingent markets are argued to be microeconomic systems and properties of contingent valuation experiments are presented. The contingent market microeconomic system and properties of contingent valuation experiments provide an analytical framework for CVM methodology. It is argued in the last section that this framework may enhance the validity and credibility of the contingent valuation method.

EXPERIMENTAL ECONOMICS CONCEPTS

Experimental economics methodology attempts to examine economic phenomena and behavior in controlled settings. These controlled settings fall into two general categories, field experiments and laboratory experiments. Field experiments involve some perturbation and monitoring of a naturally occuring 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 perturbed, and the resulting changes in electricity demand were observed and analyzed (Battalio, Kagel, Winkler and Winette).

Laboratory experiments are standard research techniques in the physical sciences. In resource and environmental economics, however, laboratory experimental methods are seldom employed. Unlike field experiments, laboratory experiments do not involve the use of a naturally occuring 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. As with field experiments, the researcher can 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 are also 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-occuring 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 only be possible in an economic experiment.

Establishing control in an economic experiment requires that the experiment be carefully designed and conducted. 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. As stated by Smith (1985), replication and control are the two primary means by which the error in researchers' shared knowledge of economic systems is reduced.

MICROECONOMIC SYSTEMS

Experimental economics methodology has been applied primarily in the area of applied microeconomics. A fundamental component of the methodology as it relates to applied microeconomics is the use of microeconomic systems. First, it is necessary to define what is meant by a microeconomic system. Microeconomic systems are defined in two recent articles (Smith 1982, 1985). The conceptual model presented in these articles is summarized in this section.

Microeconomic systems are defined as having two general components; an environment and an institution. The environment consists of K economic agents $\{1,\ldots,K\}$, a set of commodities and resources $\{1,\ldots,L\}$, and certain features of each agent k, such as preferences, U^k, technological endowment, H^k, and initial endowments, Z^k. An economic agent is therefore described by the set, $R^k = \{U^k, H^k, Z^k\}$. The features of R^k are assumed to be defined over the L dimensional commodity space. The collection of agent features, $R = \{R^1,\ldots,R^k\}$ is defined as a microeconomic environment. The microeconomic environment defines "a set of initial circumstances that cannot be altered by the agents or the institutions within which they interact" (Smith 1982). A distinguishing element of these initial circumstances is that they are essentially private and agent-specific.

It has been recognized in many fields of economics that institutions are an integral part of economic systems. Institutions are defined as ordered relationships between 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 <u>messages</u> which agents can communicate in an economic system, as well as the physical exchange and transformation of goods and commodities. In other words, institutions determine a language, $G = \{G^1,\ldots,G^k\}$. This language specifies the messages that agents are permitted to communicate in an economic system. For example, G^1 represents the set of messages that can be sent by agent 1. The final set of messages which are actually sent by all agents in an economic system is defined by $m = (m^1,\ldots,m^k)$. For example, m^1 represents the messages that agent 1 sends. Final messages may include bids, offers and acceptances.

Institutions also specify allocation and cost assignment rules. The allocation rule for a particular agent is given by $h^k(m)$. Because it is a function of m, the allocation rule indicates that the final commodity allocation to a particular agent is determined by the messages of all agents. Since each agent faces an allocation rule, the total set of allocation rules is given by $H = \{h^1(m).,...,h^K(m)\}$. Agents in microeconomic systems also face cost assignment rules. The cost assignment rule for a particular agent is given by $c^k(m)$. The argument m implies that the final costs imposed on a particular agent is also 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 $C = \{c^1(m),...,c^K(m)\}$.

Finally, institutions specify adjustment process rules faced by each agent. These rules include a starting rule, a transition rule, and a stopping rule. The starting rule, denoted by $b(t^o, . , .)$, 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 particular agent's message communication and commodity exchange are defined by $W^k = \{G^k, h^k(m), C^k(m), b(t^o, t, T)\}$. The set of institutions faced by all agents, denoted by $W = \{W^1,...,W^K\}$, defines a <u>microeconomic institution</u>. Having defined both a microeconomic environment and a microeconomic institution, microeconomic system can be formally defined. A <u>microeconomic system</u> is defined by S = {R, W}, where R is the microeconomic environment, and W is the microeconomic institution.

The performance of the microeconomic system, S = {R, W}, depends upon the conduct or choice behavior of economic agents. Observable choice behavior, or final agent messages, are determined by the function $m^k = f(R^k, W)$. This function indicates that agent's messages are determined by an agent's features (e.g., preferences) and the set of institutions inherent in the microeconomic system. Given the messages sent by each agent, the final outcomes of the microeconomic system are determined by W. That is, commodity allocations and cost assignments are not directly determined by agents. 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, $h^k(m) = h^k[f(R^1,W),...,f(R^K,W)]$, and final cost assignment rules are determined by the function, $c^k(m) = c^k[f(R^1,W) ,..., f(R^k,W)]$. Thus, final-outcomes of the microeconomic system are dependent upon institutions, endowments, and features of individual agent's which impact their choice behavior.

MICROECONOMIC EXPERIMENTS

In this section, the basic features of a microeconomic experiment are summarized. Microeconomic experiments examine economic behavior and phenomena in microeconomic systems. The microeconomic system of interest is almost always some sort of economic market. Smith defines economic markets as "...,institutions of exchange that use price to guide resource allocation and human economic action" (Smith 1985). As Smith argues, markets operate because of a basic human desire to improve initial circumstances through exchange.

Markets provide an ideal medium for examining economic behavior and phenomena experimentally. Whether naturally-occuring or researcher-constructed, markets used in microeconomic experiments are "real" microeconomic systems. That is, a fundamental proposition supporting microeconomic experiments is that economic principles which apply to "real-world" markets, also apply to experimental markets (Plott 1982). Thus, all of the theoretical and empirical tools at an economist's disposal are readily applicable to properly designed experimental markets. Within the context of experimental settings, the research results are just as valid as any other market-oriented research. For a more detailed defense of the validity of microeconomic experiments, see Plott 1982.

Once the microeconomic system (e.g., market) 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 <u>instructions</u> given in an economic experiment 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 agents how they "should" behave or how the researcher expects them to behave unless such instructions are included as deliberate treatment variables (Plott, 1982).

Several sufficient conditions for a valid, controlled microeconoic 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 condition 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}. 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.

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 of 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 environment and institutions 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.

In summary, microeconomic experiments involve the study of economic behavior and phenomena in microeconomic systems. Economic agents operate in these microeconomic systems (e.g., experimental markets) by following a set of well defined instructions. The behavior of agents is influenced by their economic environment (e.g., preferences, household technology, endowments) and the institutions of the microeconomic system. Experiments generally involve some perturbation of the system and subsequent observation and analysis of the resulting impact on the conduct and performance of the system. Sufficient conditions for a microeconomic experiment are nonsatiation and saliency. A controlled microeconomic system requires two further conditions; dominance and privacy. Control in a microeconomic experiment is important for internal-validity (e.g., the experiment and its results can be replicated). If an objective of an experiment is to draw inferences concerning the performance of some microeconomic system besides the one used in the experiment, the condition of parallelism must hold. Parallelism is important for external-validity (e.g., experimental results can be extended to "real-world" settings).

CONTINGENT VALUATION EXPERIMENTS

Contingent valuation is part of the broader field of applied welfare economics. Welfare economics is concerned with determining the relative desirability of alternative economic states. A natural application of welfare economics is cost-benefit analysis of public policies because these policies alter the allocation of resources to groups and individuals. Cost-benefit analysis, by and large, is an a priori method for evaluating the impacts of public policies. That is, cost-benefit analyses are conducted before a public policy is actually carried out.

Perhaps the greatest difficulty encountered in the application of cost-benefit analysis is the measurement of all relevant benefits and costs. A

persistent problem is the lack of historical data upon which to base quantification of policy impacts. This problem is particularily acute with regard to public policies which impact natural resource service flows. Many types of natural resource service flows are classified as nonmarket goods, i.e., goods or commodities for which no markets exist. Hence, the value of these goods cannot be estimated directly from market data. Changes in nonmarket goods (quantity or quality) often account for a major portion of public policy costs and benefits. However, without market prices the valuation of such costs and benefits is hindered.

Sometimes it is possible to estimate the economic value of changes in nonmarket goods indirectly from market data. Such indirect techniques include the travel cost method and various hedonic price methods. Indirect nonmarket valuation techniques, however, have limited applicability. One major limitation of these techniques is that they rely upon the availability of related, market-generated data which is applicable to the valuation problem at hand. Many times such data is simply not available. One particular reason why these data may be unavailable is that the state or scenario which will result from a public policy has never existed before. Thus, in this case, history does not provide a set or data for comparing "with" policy states to "without" policy states. Sometimes it is possible to find an historical situation which closely approximates the impacts of a proposed public policy. For example, the U.S. Army Corps of Engineers sometimes values new water projects by estimating the value of similar, existing water projects. Most public policies, however, have unique impacts determined by features of affected resources and parties, institutional settings, and the particular objectives of the policy. In many cases these policy impacts are sufficiently unique that "similar policy or project" cost-benefit analysis is not valid.

When market-generated data are unavailable or inadequate for valuing policy impacts, what options are left open for conducting a priori cost-benefit analysis? It is argued here that one of the most viable options is the use of experimental economics methodology, which includes contingent valuation experiments as a special case.

MEASUREMENT OBJECTIVES

One of the main uses of experimental economics methodology is measurement. Economic experiments are used to accomplish two specific types of measurement objectives (Plott 1981). The first objective is to measure the sensitivity of economic system outcomes to changes in the system's institutions. For example, a number of studies have been conducted on the sensitivity of auction market results to the particular type of auction mechanism employed (Coppinger, Smith, and Titus; Cox, Roberson, and Smith; Vickrey). The second measurement objective is to provide data on the parameters of economic models (e.g., values).

The measurement objectives for economic experiments are quite consistent with the measurement objectives of applied cost-benefit analysis. That is, a major objective of applied cost-benefit analysis is to measure public policy impacts. Economic experiments can help meet this objective by providing data on the parameters of value estimation models. Persons involved in the policy process are also often interested in the sensitivity of values to changes in institutions. For example, the question may be asked. "Are policy impacts greater or lower under institutional arrangement B vs. institutional arrangement A?" Because control can be exerted over institutional structures, experimental economics seems particularly relevant for addressing such questions. For collaborating arguments, see Coursey and Schulze; Plott 1979; and Plott 1981.

SIMULATION OBJECTIVES

A second objective of experimental economics methodology which is relevant to applied cost-benefit analysis is simulation (Plott 1981). Simulation, for example, involves constructing an experimental market which mimics the operation of some actual market. Economic behavior and outcomes observed in the experimental market are then used to draw inferences concerning economic behavior and outcomes in the actual market. That is, an experimental market is constructed to capture the essential features of an actual market and experience with the impacts of proposed public policies can then be gained. For example, the experimental market might be used to simulate changes in consumer's surplus as a result of different resource allocations in the actual, or potentially actual, market. Notice that this example of the use of experimental economics actually combines the objectives of measurement and simulation.

APPLICATION OF CONTINGENT VALUATION EXPERIMENTS

In applied cost-benefit analysis, measurement and simulation objectives are often accomplished using contingent valuation method (CVM). CVM is defined here as any valuation technique which elicits 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 market. Because of the use of contingent allocations and payments, these experimental markets are referred to as <u>contingent markets</u>. Contingent markets, if properly designed, are microeconomics systems as described by Smith, 1982. The distinguishing feature of contingent markets is the use of <u>contingent</u> payments, rather than actual cash payments.

The classification of contingent markets as microeconomic systems is illustrated in the following example. A common usage of contingent markets is to elicit individual valuations of changes in the quantity or quality of some public good. The contingent market would present {1,...,K} respondents with a scenario describing the public good's initial quantity, quality, location, and time dimension (Coursey and Schulze). Information concerning the services which the public good supports may be given to subjects as well. Preferences (U^k), household technology (H^k), individual information sets (I^k), attitudes and values (A^k), and initial endowments of private goods, public goods, and income (Z^k) describe each respondent, e.g., $R^k = \{U^k, H^k, I^k, Z^k\}$. The contingent market environment is therefore defined as $R = \{R^1,...,R^K\}$. The contingent market would also have a detailed description of allowable messages and how these messages would impact public good allocation, cost assignment, and adjustments, should the market actually be implemented. The set of allowable messages, allocation rules, cost rules, and adjustment rules make up the institutions of the contingent market. These institutions, for example, could specify initial rights to the public good, and the method of compensation or payment for increments or decrements in the public good. This combination of institutions and environment defines the complete contingent market microeconomic system (Coursey and Shulze; Cummings, Brookshire, and Shulze).

Operation of the contingent market is initiated by messages sent from the researcher to respondents. Respondents then respond to these messages with messages of their own. For example, the researcher may send a message to respondents asking them to submit a bid for a given increment in the public good. Such bids would be contingent upon the increment in the public good 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 the public good are interpreted as contingent payments. That is, the bids are an approximation of how much participants would pay for the public good should the microeconomic system described by the contingent market actually be implemented.

Establishment of the general microeconomic properties of nonsatiation, saliency, dominance, privacy, and parallelism, and incentive-capability in contingent valuation experiments is discussed next. Three types of rewards in contingent markets are participation rewards, altruistic rewards, and expected commodity allocation rewards. The property of nonsatiation, it is argued here, applies to all three of these reward types. Participation rewards are the subjective value participants attach to the process of evaluating and making a decision (Smith 1979). Altruistic rewards refer to the satisfaction that a participant receives from providing requested information and (or) from participation in the public policy process (e.g., feelings of "civic duty"). Finally, subjective rewards take the form of expected allocations of real commodities. That is, in a well designed contingent market, participants are told that their responses may be used to determine the future allocations of real commodities. Thus, if participants value the commodities addressed in the contingent market, they have a vested interest in completing the exercise. Moreover, it is argued 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 the future allocation of commodities. The saliency of the expected commodity allocation reward may therefore be lost. Consequently, the value that participants place on their messages would be reduced, perhaps to the point where they refuse to send valuation messages, or they send valuation messages which are frivolous and unreliable (Coursey and Schulze).

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 do not exceed these subjective costs (e.g., it the net benefits of participating in the contingent market are not greater than zero), control in the experiment will be lost. This loss of control may manifest itself in a refusal to send messages, or the sending of messages which could be unreliable (Coursey and Schulze).

A symptom of the loss of dominance in a contingent valuation 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 and complexity of information presented in the 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 in the experiment to rise above own rewards. Consequently,

dominance and control would be lost. As a result, participants' decision-making behavior may become "confused and dysfunctional".

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 and credibility, and 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 contingent markets. Computerized markets, for example, may substantially reduce the time costs associated with iterative bidding methods (Bergstrom and Stoll).

In order for a contingent valuation experiment to satisfy privacy, an individual participant cannot receive information on other participants' reward schedules. That is, each participants' preferences should be private, and nonobservable to others. If this condition is not met, control can quickly be lost. 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. Thus, steps should be taken to ensure that contingent markets satisfy the privacy condition. Such steps may 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 may also pose privacy problems if participants react strongly to perceived preferences of the interviewer. The use of computerized contingent markets may provide one of the most 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 is properly designed.

An illustration may help make the point clear. Consumers often make contingent decisions. For example, suppose Mr. A is considering purchasing a yearly membership to a health club. Suppose that without yet visiting the club, he sends away for a package of information which describes the facilities and services offered by the club and the annual membership fee. Now, suppose on the basis of this information, Mr. A decides he would like to join the club. Note that this is a contingent decision. Mr. A has decided that he is willing to pay the stated membership fee, contingent upon the actual allocation of the club's facilities and services to himself during the open membership period. Thus, when it comes time to actually join the club, even if it is six-months later, Mr. A should be willing-to-pay the stated membership fee, provided that the facilities and services described in the package of information and everything else (e.g., his preferences, income) have remained the same as when he originally decided it was worthwhile to join.

This example captures the essence of the type of parallelism which is argued to exist with respect to well designed contingent markets. That is, participants are presented with a package of information describing some nonmarket good of interest. Participants are then 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.

Strictly speaking, there will always 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 in an attempt to capture a surplus equal to the difference between their true maximum WTP and their stated WTP. This understatement of WTP represent 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. This cost is the surplus foregone by not stating a bid lower than the maximum WTP.

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 in a contingent market, they run the risk that the good will be underprovided. Also, if participants overstate their bid for a good in a contingent market, 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 Brookshire, strategic misrevelation of preferences by CVM participants requires certain information in order to be effective. The typical CVM respondent, they argue, probably does not have access to such information.

Given that there are benefits from revealing one's true preferences, and often few directly controllable costs, contingent markets may give proper incentives for true demand revelation. Thus, suppose a contingent market and an actual market with a similar environment and similar institutions produce different results. One explanation for this divergence could be that in the contingent market participants have incentives to reveal their actual preferences, while in the actual market there may be strong economic incentives to misreveal, or at least hide true preferences. Other conjectures about the incentives and disincentives for misrevelation of preferences in contingent

markets can be formulated, or possibly parallelism was not as strong as initially believed. The point to be made, however, is that a case can be made that with proper attention to design and administration, contingent markets are capable of generating data which are demand revealing (for collaborating arguments and a specific example, see Hoehn and Randall). Indeed, a number of recent studies designed to test for the demand revelation properties of contingent markets have supported the use of these markets for directly eliciting valuations for nonmarket goods (Brookshire and Coursey; Brookshire, Thayer, Schulze, and d'Arge; Coursey and Schulze; Cummings, Brookshire, and Schulze; Hovis, Coursey, and Schulze; 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 the value judgement is made that a move from State A to State B is a social improvement if the gainers from the move could compensate the losers, and still be better off. That is, the move from State A to State B must pass the Potential Pareto Improvement criterion (PPI).

For simplicity, suppose that the move from State A to State B represents a transfer of some nonmarket good, Q, from Party A to Party B. Following the PPI criterion, the value of Q in its current use is equal to Person A's willingness-to-accept compensation for losing Q. Willingness-to-accept 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 for gaining Q. This willingness-to-pay, is also a Hicksian compensated measure of welfare change, denoted by WTP^C. If $WTP^C > WTA^C$, then the gainers (e.g., Party B) of the move from State A to State B could compensate the losers 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 1980).

WTP^C and WTA^C can both 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 Potential Pareto Improvement. Thus, in this case, the contingent market is incentive compatible, at least in terms of the PPI criterion.

The previous example illustrates that incentive compatibility is attainable in contingent markets. Incentive compatibility, however, is not an inherent property of contingent markets. Rather, it must be established through proper attention to the conceptual basis of valuation questions, and incentives provided for "true" demand revelation. The incentive compatibility of contingent markets, in terms of the PPI criterion, is discussed in more detail by Hoehn and Randall.

DISCUSSION AND IMPLICATIONS

In the past two decades, application of the contingent valuation method has exploded. Design and implementation procedures, however, vary widely across individual applications. As a result, replication of results is difficult if not impossible.

In applications of the contingent valuation method, control and replication would be facilitiated by regarding CVM as a branch of experimental economics methodology as implied by Plott. Control is established in an economic experiment if the properties of non-satiation, saliency, dominance, and privacy are met. Thus, in order to have a controlled contingent valuation experiment, it must satisfy these properties. 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 saliency and dominance. If respondents are faced with a highly unrealistic contingent valuation scenario, they are not likely to take the valuation exercise seriously and perceived rewards from participation will decrease. If perceived participation rewards decrease below perceived participation costs, the dominance property will not be satisfied. As a result, control would be lost and respondents may react by sending unreliable responses or no responses at all.

Researchers can take a variety of steps to facilitate control in contingent valuation experiments. Several of these steps have been mentioned previously in various places, but not in the analytical framework of experimental economics methodology. Nonsatiation and saliency require that the increment or decrement in the nonmarket commodity of interest be presented to respondents in a clear and unambiguous manner with well-defined property rights and other institutional arrangements (e.g., commodity and cost allocation mechanisms). Dominance can be facilitated by providing respondents with information which helps them to recognize own participation rewards. In addition, any steps taken to reduce subjective participation costs (e.g., provision of calculation information) will facilitate dominance. In order to establish privacy, the contingent market structure should be consistent with

elicitation of private, confidential values. For example, communication between resondents should be discouraged and an individual respondent should not be provided with information on other respondents' valuations (which could occur, for example, through news media coverage of a CVM survey).

Establishing control in a contingent valuation experiment by satisfying the properties of nonsatiation, saliency, dominance, and privacy is a necessary, but not sufficient, condition for internal-validity. Internal validity implies that the results of a contingent valuation experiment 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. Several recent studies, for instance, suggest that CVM results are quite sensitive to the type, quantity and complexity of information presented in contingent markets (Bergstrom and Stoll; Rowe and Chestnut; Samples, Dixon, and Gowen; Shulze, d'Arge, and Brookshire). These results suggest that in order to replicate or compare CVM results, the informational structure of contingent markets would have to be held constant across 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.

In most CVM applications, external validity is an important consideration as well as internal-validity. External-validity implies that CVM results can be extended to actual "real-world" scenarios. A necessary condition for external-validity is that the property of parallelism be satisfied. In the case of CVM, parallelism requires that the environment (e.g., respondent characteristics) and institutions (e.g., commodity allocation mechanisms) 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. Thus, if parallelism is satisfied, it is legitimate to extend CVM results to 'real world' scenarios.

If the purpose of a CVM application is to provide input into public policy decisions the property of incentive compatibility, as well as all other properties, should hold. For example, suppose a public policy decision will be based on application of the potential Pareto improvement (PPI) criterion. In this case, a contingent market is incentive compatible if it provides values which are consistent with the PPI criterion. Establishing this consistency requires that the contingent market structure (e.g., wording of questions) be consistent with Hicksian compensated measures of welfare change. A further requirement is that the bidding method be demand-revealing. That is, the bidding method must provide incentives for calculation and statement of "true" values. The iterative bidding method and dichotomous choice questions, for example, are argued to be demand-revealing (Brookshire and Coursey; Hoehn and Randall).

In conclusion, experimental economics methodology is argued to provide a useful analytical framework for the design and administration of contingent markets. 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 contingent valuation method. 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.

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