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The Role of Experimental Economics in Tax Policy Research

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THE ROLE OF EXPERIMENTAL ECONOMICS IN TAX POLICY RESEARCH

Abstract

This paper describes the application of experimental economics to research examining the impact of tax policies on individual and aggregate behavior in an economic setting. The paper discusses the benefits and limitations that arise from using experimental economics as a supplement to existing methods in tax policy research. In addition, with the aim of providing guidance to tax researchers interested in adopting the method, various methodological issues are examined, including a description of how markets are created in the laboratory and a survey of practices commonly applied in experimental economics research. Last, a review of the limited tax research to date that has utilized the method is presented, along with a discussion of some tax policy issues that experimental economics can be used to address.

THE ROLE OF EXPERIMENTAL ECONOMICS IN TAX POLICY RESEARCH

INTRODUCTION

A principal goal of tax policy research performed by accounting academicians is to facilitate the understanding and prediction of effects of tax policy on individual and aggregate behavior. This research has, to date, utilized an array of research methods commonly employed by researchers in other disciplines such as economics (e.g., econometric analysis of market and IRS data and analytical model building) and psychology (e.g., surveys and laboratory experiments)[1].

Despite the wide range of tools adopted by researchers addressing tax policy issues, growth of knowledge in the area is hindered by difficulties encountered in attempts to empirically test economic theories of behavior in response to taxes. Direct tests of economic theory using field data are limited by the difficulties encountered in separating the effects of auxiliary assumptions (e.g., assumptions regarding production functions, returns to scale, etc.) from tests of theory. In addition, field data may be so noisy that the effects of a tax policy are not readily discernable to researchers using econometric techniques.

A method becoming widely accepted in economics research known as experimental economics has the potential to supplement existing empirical approaches. Experimental economics provides a means to directly test economic theory concerning the effects of taxes under rigorous, controlled conditions. In addition, experimental economics provides a low cost means to gather evidence on the qualitative effects of alternative tax policies in a real market setting.

Given the potential benefits available to tax policy research from experimental economics, this paper's purposes are to describe the method to tax researchers, to review the few tax studies that have used the method to date, and to discuss areas where application of experimental economics methods might be particularly fruitful.

The remainder of the paper begins with a discussion of the role of experimental economics in tax research. This discussion is followed by a description of experimental economics, with an emphasis on the method's best developed tool: laboratory markets. Next, a brief "handbook" of procedures commonly used in experimental economics research is presented, to serve as a guide for those interested in adopting the method to address tax policy issues. The paper then reviews the limited number of tax policy studies that employ experimental economics. Last, the application of the method to several areas of tax policy research is discussed.

THE ROLE OF EXPERIMENTAL ECONOMICS

To clarify the additional contribution that experimental economics can provide to research in the tax policy arena, we begin by discussing its domain relative to experimental psychology and other methods in economics research. Following the discussion, specific advantages provided by experimental economics are enumerated and a typology of research objectives available to researchers when examining tax policy issues is presented.

Experimental Economics and Experimental Psychology

The psychological approach, which relies principally on laboratory experimentation and survey methods, has provided valuable insights into the impact of tax policy on taxpayer compliance (see Jackson and Milliron [1986] for a review). This approach to tax policy research usually addresses

individual behavior in a wide range of settings and often is characterized by the absence of realistic economic incentives. By comparison, experimental economics takes a narrower focus, and is guided by the traditional concerns of economists. For example, psychological research tends to tends to focus on adaptive processes, or the ways in which subjects learn (or adapt behavior) over time to secure better outcomes, while economics research concerns itself with equilibrium behavior (or behavior after learning is complete in a stable environment). This concern over equilibrium behavior is reflected through the many repetitions of experimental tasks required of subjects in economic laboratory experiments.

Experimental economics is also affected by economists' tendency to be concerned with behavior in competitive environments (one exception is the large body of literature on individual decision making that overlaps work in psychology). The underlying force directing an interest in competitive situations is the belief that, through competition, the actions of economic agents are subject to feedback that either forces rational behavior or failure and exit from the market. In contrast, experimental psychology examines decision making in a variety of contexts, noting that many important decisions are made in settings where market discipline or other competitive forces do not apply.

Finally, experimental economics places a heavy emphasis on tight control over subject preferences in the laboratory setting, with the objective of mitigating the effects of noneconomic incentives on behavior. Therefore, the application of experimental economics is constrained to settings where economic incentives play the dominant or principal role. In contrast, experimental

psychology has a much broader concern, addressing social and psychological aspects of behavior.

The Role of Experiments in Economics

Academicians adopting the economic approach to tax policy research focus on the impact of economic incentives generated by tax law on taxpayer behavior and on the aggregation of individual behavior to the market level. A significant body of literature provides evidence of the substantial effort by builders of economic theory to describe individual and market behavior in response to taxes. However, since a priori theory building alone cannot accomplish the objectives of scientific research in tax (to explain and predict individual and market behavior in response to tax policy), it is necessary to temper theory and its predictions with insight provided by empirical testing. As pointed out by Kaplan [1964, p. 35]:

> It is in the empirical component that science is differentiated from fantasy. An inner coherence, even strict self-consistency, may mark a delusional system as well as a scientific one. Paraphrasing Archimedes we may each of us declare "Give me a premise to stand on and I will deduce a world!" But it will be a fantasy world except in so far as the premise gives it a measure of reality. And it is experience alone that gives us realistic premises.

Likewise, just as empirical research can provide important feedback for theory revision, extant theory serves as a guide for empirical researchers, who aim to gather evidence to support or contradict existing models of behavior. Ideally, a dialogue between theoretical and empirical research should exist. Theories are refined in response to empirical evidence, while refinements invite further empirical testing.

A partial answer to the need for empirical research is the econometric analysis of field data. There is a plethora of research that uses field data to test economic models of the impact of tax policies on the marketplace or

that uses such models to estimate the impact of various tax policies. Unfortunately, tests of theory using field data are sometimes inconclusive. Econometric analysis of data from naturally-occurring markets requires introduction of auxiliary assumptions about the marketplace including (but not limited to) production functions, returns to scale, the probability functions of stochastic variables, etc. Separation of the veracity of auxiliary assumptions from tests of theory is impossible. Therefore, econometric analysis of field data is perforce a joint test of the theory and the auxiliary assumptions not essential to the theory. Since auxiliary assumptions are not easily refuted, theories often outlive their creators.

Even ignoring the confounding introduced by auxiliary assumptions, conditions in naturally-occurring markets often do not allow critical tests of theory. For example, a critical test may be impossible because predictions of competing theories are not sufficiently different under existing market conditions to clearly distinguish between them. In addition, there may be so much noise in the market that effects of a tax policy are not readily discernable to the researcher using econometric techniques, thus rendering tests of theory inconclusive. Likewise, if a theory predicts different effects with different tax policies, it is usually difficult to test the prediction by changing tax policies in the field[2].

An example of the limitations of econometric methods in tax policy research is provided by empirical research examining tax incentives to encourage investment in depreciable assets. These tax incentives include the liberalization of depreciation rules in 1954 and again in 1980, and the installation of the investment credit in 1963. Since the pioneering work of Hall and Jorgenson [1967], numerous econometric studies have examined the

impact of these tax policies on investment decisions. This body of literature was reviewed by Chirinko [1986], who found a variety of conflicting results due to numerous factors, including differing theoretical frameworks, model specifications, data bases and various econometric difficulties. Chirinko [1986] concludes: "While investment may respond significantly to variations in tax parameters, it appears to this author that the supporting empirical evidence has yet to be generated." What is missing in the economics approach to tax policy research is a method that controls for the above difficulties, thereby allowing direct tests of theory.[3]

The importance of econometric analysis of field data in current research is not understated. Substantial insight has been provided by field empiricism in a variety of areas. The method has provided evidence to theorists despite the limitations noted above. Econometric analysis has also proven useful in the determination of whether theory is a reasonable abstraction from the naturally-occurring markets it is meant to model. Furthermore, assuming the veracity of a theory, econometric studies are useful in estimating the impact of a tax policy on the economy after it has been implemented.

The shortcomings of the econometric approach and a need for direct tests of economic theory point to a gap in tax policy research that may be filled by experimental economics. This method allows for the creation of a real microeconomy in the laboratory and permits the researcher to directly test the theory in an operationalized setting[4] which controls for confoundings introduced in the field. Tests of an economic theory in such simplified environments allow evidence to be gathered concerning the theory's usefulness in predicting human behavior. If predictions are not supported in a simple laboratory setting that gives a theory its best chance of success, then it is

unreasonable to expect the theory's performance to improve in the increased complexity of the "real world."

The use of laboratory experiments to test economic theory might be dismissed on the grounds that, if the theory's assumptions are appropriately captured in the laboratory setting, human subjects cannot help but to behave in accord with predictions. However, there are at least three ways (suggested by Isaac [1983]) in which economic theory may fail to predict human behavior, even in a simple laboratory setting. First, the theory may fail to specify some important feature of the economy (e.g. the nature of the institution[5], the knowledge endowments of the participants, etc.). It is well documented in the literature that institutions affect behavior [Smith, 1982]. Second, economic theories tend to make strong assumptions regarding unobservable characteristics of the economic agent (e.g., strict maximizing behavior, risk neutrality, etc.) and the theory's predictions may be sensitive to the deviations from these assumptions typically observed in human behavior. Third, theoretical predictions usually depend upon assumptions about group interaction (e.g., Nash equilibrium, perfect equilibrium, etc.) which may not achieve in an actual market with human subjects.

Besides permitting critical tests of theory, experimental economics provides several other advantages. Attempts to capture the theoretical setting in the laboratory often indicate omissions or vagueness in assumptions, which can provide direction for respecification of the theory. Furthermore, experimental economics provides a vehicle to examine the qualitative effects of alternative tax policies in an economy at low direct and opportunity cost. Additional benefits of the method are the ease of replicability and the ability

to scrutinize, in the presence of economic incentives, both individual and market behavior resulting from tax policy changes.

In addition to the benefits enumerated above, experimental economics has been frequently used as a tool in public policy analysis. Laboratory experiments have addressed a wide range of "real-world" regulatory issues including market constestability in the presence of entry costs (Coursey, Isaac, Luke and Smith [1984]), allocation of airport landing rights (Grether, Isaac and Plott [1974, 1981]), rate filing policies for inland barge transportation (Hong and Plott [1982]), incentive mechanisms for public utility pricing (Cox and Isaac [1986]) and alternatives to the existing program acquisition process used by the Public Broadcasting System (Ferejohn, Forsythe and Noll [1979]). Several of these studies have been funded by regulatory bodies such as the Federal Trade Commission, the Civil Aeronautics Board, the Federal Communications Commission and NASA. Given the hope expressed by the American Taxation Association's 1985-86 Committee on Tax Research Methodology (Seago, et al. [1987, p. 91]) that future research by tax accounting academicians have influence on policy-makers (e.g., Congress), the past usefulness of experimental economics for public policy analysis portends well for its application to tax policy questions.

A typology of research objectives for economic laboratory experiments examining public policy issues was developed by Isaac [1983, p. 50] (see also Plott [1981] who provides an alternative typology). Experimental economics methods may be used in "shakedown experiments" in which the researcher tests "core" theories of interest to policymakers. The objective in this approach is to first give the theory its "best shot" in a laboratory setting. If the theory fails in a "best shot" setting, then substantial doubt is cast on its

ability to predict behavior in a more complex environment (e.g., naturally-occurring markets). Likewise, if the theory is supported, later tests of the theory typically are designed to test boundary conditions to determine the robustness of the theory. Shakedown experiments could prove useful in tax policy research for testing basic theories of economic behavior in the face of taxes (e.g., see Swenson [1987b, 1988], reviewed below). Second, experimental economic methods may be used in "horse race" experiments, where the researcher attempts to evaluate the relative performance of two or more competing institutions (e.g., see Hong and Plott [1982]). Such experiments could be nomothetic (guided by well-developed theory) or guided only by hypotheses maintained in the popular literature. The application of this approach to tax policy issues is clear: evaluation of competing tax systems (e.g., alternative approaches to creating incentives for R&D through taxation and Meade's [1987] examination of alternatives to the current capital gains tax to mitigate lock-in effect). Last, researchers can use laboratory experiments to design and evaluate new institutions of interest to policymakers with "design" experiments (e.g., see Cox and Isaac [1986]). This approach could be used to develop and compare alternatives to existing tax policy at a very low cost.

EXPERIMENTAL ECONOMICS AS A METHOD

Experimental economics research was established 40 years ago by Chamberlin [1948], who was the first to test economic theory with a laboratory market. Despite Chamberlin's pioneering efforts, the use of experimental methods in economics only began to develop around 1960 with the work of Hoggatt [1959] in oligopoly, Smith [1962] in competitive market behavior, and Fouraker and Siegel [1963] in bilateral monopoly bargaining. Progress was relatively slow until a critical stage in the maturation of the method was achieved in the late 1970's

and early 1980's with the work of Plott [1979], Smith [1976, 1982] and Wilde [1980]. This work resulted in the development of a widely accepted framework to guide laboratory market research. Over the last 10 years, use of the method has seen explosive growth, with experimental economics research now appearing in most major economics journals[6] and the recent creation (1986) of a separate bibliographic category in the Journal of Economic Literature devoted to "Experimental Economic Methods."[7]

The experimental economics method encompasses a variety of techniques that address economic questions in a laboratory setting. Some studies have focused on individual behavior and decision making in the presence of real economic incentives with human subjects (e.g., Grether [1980] who examined the representativeness heuristic in a setting with real economic incentives) or with animals[8] as subjects (e.g., Battalio, Kagel and Green [1979] who examined the labor-leisure preferences of pigeons in a controlled experiment and Battalio, Kagel and MacDonald [1984] who tested von Neumann-Morgenstern decision theory using rats). Other experiments have examined two-party bargaining situations and principal-agency theory with pairs of subjects (e.g., Roth and Malouf [1980] and Berg, Daley, Dickhaut and O'Brien [1985]). Finally, a set of studies (termed "laboratory market" research) has successfully created real microeconomies in the laboratory, permitting investigation of market behavior under differing institutional settings.

Because the range of techniques is too great for each to be addressed individually, the remainder of this section focuses on "laboratory markets" (the creation of a microeconomy in the laboratory). Laboratory market methods are chosen for two reasons. First, a variety of tax policy issues may require consideration of market behavior in the presence of differing tax institutions.

Second, the creation of a microeconomy in the laboratory is the most highly developed application of experimental economics and the precepts it introduces for controlling subject preferences represent a cornerstone on which the rest of the method is built.

Creating a Microeconomy in the Laboratory. The basic idea behind a laboratory market experiment is to create a real, well-defined microeconomy in the laboratory. The definition of a microeconomy and necessary conditions for creating one in the laboratory have been discussed in several papers, most notably Plott [1979], Smith [1976, 1980] and Wilde [1981]. This literature was summarized and extended in a seminal work by Smith [1982]. The following discussion borrows heavily from Smith's work.

The definition of a microeconomy in the laboratory markets literature relies on Reiter's [1977] description. This characterization presents a microeconomy as consisting of an environment and an institutional setting. The economic environment consists of a list of agents $\{1,\ldots,N\}$ and a list of commodities $\{1,\ldots,K\}$. Each agent is characterized by a preference relation α^i (usually represented by a utility function u^i), a technological (knowledge) endowment T^i, and commodity endowment w^i. The ith agent is thereby described by a triple, $E^i = (\alpha^i, T^i, w^i)$ defined on the K dimensional commodity space. The microeconomic environment is then defined by Smith [1982] to be the collection $E = (E^1,\ldots,E^N)$ of these triples. The superscripted i indicates not only a particular agent, but also that each of the three characteristics are private to the individual agent.

To illustrate the creation of an economic environment in the laboratory, consider Swenson's [1987b] study of the effects of various tax regimes on risky investment. In these experiments, each environment contained seven agents--

four were designated as buyers of commodities and three were designated as sellers. Two commodities were present in the environment: cash and a risky asset with two equiprobable (strictly positive) returns available. The risky commodity was imaginary, but the post-return after-tax value of units held at the end of a market were paid to the subjects in cash. The initial commodity endowment, w^i, provided to agents depended on their classification. Sellers were endowed with seven units of the risky commodity while buyers were endowed with \$25 in cash. Each agent's utility, u^i, for the risky commodity depended on his risk preferences, r^i, and a tax regime, τ, implemented by the experimenter (e.g., proportional tax rates, progressive tax rates, or a tax credit), i.e., $u^i = v^i(r^i,\tau)$. The remaining element of each agent triple, the technology endowment, was represented by each agent's uncertain knowledge regarding the value placed on the risky assets by others (represented by a probability distribution, P(v)), and the knowledge that there was at least one other agent of the same type (represented by $N \geq 1$). Thus, the triple characterizing agent i in Swenson's [1987b] experiment is defined by $E^i = (v^i(r^i,t);\ P(v),\ N \geq 1;\ w^i)$, where w^i is \$25 for buyers and seven units of the risky commodity for sellers.

In addition to an environment, a microeconomy requires the existence of an institution. An institution is the medium through which agents communicate and exchange commodities, subject to the limitations of the environment. Smith [1982] defines an institution through a language M, a set of adjustment process rules G, a set of allocation rules h, and a set of cost imputation rules c. Together, these characteristics represent the individual property rights of each agent.

Since in an economy, all commodity exchange must be preceded by communication between agents, the rules of communication are as important as rules defining property rights in exchange. These communication rules are represented by the language, consisting of message elements $m = (m^1,\ldots,m^N)$ where M^i is the set of allowable messages available to be sent by agent i. These messages typically are prices (and/or quantities) at which agents wish to buy or sell commodities. Allowable messages depend on an agent's role in the microeconomy. The exchange of messages in the microeconomy is governed by each agent's adjustment process rules, which include a starting rule $g^i(t_0,.,.)$ (specifying the time or conditions when the exchange of messages begins), a transition rule $g^i(.,t,.)$ (governing the sequencing of messages, e.g., a rule to settle ties), and a stopping rule $g^i(.,.,T)$ (that determines when the exchange of messages terminates and the allocation of commodities begins). The set of adjustment process rules is thus represented by $G = (g^1(t_0,t,T), \ldots, g^N(t_0,t,T))$.

The allocation of commodities to each agent and the payment made by each agent for the allocation (i.e., outcome rules) are a function of the messages sent by all agents. These functions are defined by the set of allocation rules, $h = (h^1(m), \ldots, h^N(m))$ and the set of cost imputation rules, $c = (c^1(m), \ldots, c^N(m))$, respectively.[9] Thus, each agent's property rights in communication and exchange are defined by $I^i = (M^i, h^i(m), c^i(m), g^i(t_0, t, T))$. A microeconomic institution is defined by the set of these property rights, $I = (I^1, \ldots, I^N)$.

To illustrate the creation of an institution in the laboratory, we again refer to Swenson's [1987b] study which used a double auction[10] institution, which can be characterized by its similarity to the over-the-counter stock

market. In Swenson's double auction institution, the messages sellers (buyers) could communicate were offer (bid) prices at which they were willing to sell (buy) a single unit of the commodity at any time from the start of the market, t_0, until the closing of the market several minutes later, T. In addition, sellers (buyers) could accept the standing bid (offer) to buy (sell) at any time, resulting in a sale. Last, messages were constrained by a convergence rule which required any new offer (bid) to be less (more) than the standing offer (bid). The transition rule, t, used in the double auction decided between tie bids or offers (sent at the same time for the same price) randomly. Last, outcome rules for each contract sale (requiring an offer or bid and a corresponding acceptance) provided for an exchange of cash from the buyer for one unit of the commodity from the seller. At the end of the market, buyers incurred an additional cost, in the form of a tax on the earnings of the risky assets held. Only the two parties to the contract engaged in an exchange. The representation of the cost imputation rule and the allocation rule is dependent on whether the seller or buyer in the exchange is used as a reference point.

Finally, within the framework of an environment and an institution, the behavior of the agents (i.e., their message choices) activate the microeconomy. Agent behavior is defined as a mapping of the agent's characteristics into the message choice of the agent, conditional on the property right specifications of the institution. Since agent behavior is limited to message choices, it follows that they cannot choose the allocation of commodities directly. Rather, conditional on the message behavior function of each agent, the operant institution determines the outcomes. Since outcomes are mediated by the allocation and cost imputation rules in the market, the institution (including

any tax system) may have important incentive effects on behavior (message choice).

Controlling preferences. Since the purpose of laboratory market experiments is to uncover systematic relationships between individual preferences, institutional parameters (including a tax system) and outcomes [Plott, 1979], the experimenter must have control both over the parameters of the institutional setting created in the laboratory and the preferences of subjects participating in the experiment. A set of conditions sufficient for such control has been discussed by Wilde [1981], Smith [1976, 1980, 1982] and Forsythe [1986]. The conditions are based on induced demand theory [Smith, 1976], which accomplishes control by mapping final allocations of commodities in the laboratory market into a reward structure. If the rewards paid to subjects satisfy certain fundamental precepts, then adequate control over preferences and the creation of a well-defined microeconomy in the laboratory is guaranteed. Five precepts have been discussed in the literature: nonsatiation, saliency, dominance, privacy and, where outcomes are uncertain, expected utility.

A well-defined microeconomy requires that individual agents have consistent preferences over the commodity being traded and that they act to maximize their own well-being. The presence of nonsatiation guarantees that both of these conditions will be met. Nonsatiation requires that subjects always prefer more to less of the reward medium, or as stated by Smith [1982, p. 931], that:

> "given a costless choice between two alternatives, identical (i.e., equivalent) except that the first yields more of a reward medium (e.g., U.S. currency) than the second, the first will always be chosen (i.e., preferred) over the second, by an autonomous individual."

Since it is relatively easy to argue that subjects prefer more cash to less, it is the reward medium of choice for laboratory market experiments.

For demand to be induced over an imaginary commodity in the laboratory, rewards earned by individuals must be linked to their actions (message choices) through final commodity allocations in the economy. Subjects must further understand the link between their message choices and reward payments. This condition is embodied in the second precept, salience.

As noted by Wilde [1981], the use of induced demand (mapping final outcomes onto rewards paid to subjects) is not without its difficulties. The third and fourth precepts, dominance and privacy, control for these difficulties. First, subjects may place subjective value on their participation in the experiment distinct from the reward they receive from final allocation of commodities (e.g., subjects may place a subjective value on winning and may enjoy participation in the experiment, while others may find the task to be boring or cognitively difficult). The dominance precept is required to overcome this complication. The dominance precept is achieved by paying subjects sufficient quantities of the reward medium (e.g., cash) to dominate all other arguments in their utility functions that may operate during the experiment.

In addition to subjective valuations placed on participation in the experiment, some subjects may place subjective value on the rewards paid to other subjects in the experiment. This source of contamination may be controlled by privacy, i.e., ensuring that subjects are uninformed regarding the reward earnings of other subjects throughout the experiment.

When final allocations are uncertain, an additional difficulty arises with respect to control of subject preferences. In such an environment, control may

be lost over preferences because subjects may possess differing attitudes toward risk and may approach choices between risky prospects differently. Forsythe [1986] suggests a fifth precept to deal with the introduction of uncertainty. This precept, termed expected utility, requires that subjects use the expected utility model to evaluate risky preferences.[11] In addition to the precept of expected utility, most laboratory market research examining decision making under uncertainty requires either 1) a global assumption regarding subject risk preferences (e.g., that all subjects are risk-averse) or 2) an attempt to control risk preferences. A number of approaches have been adopted; they are discussed in the experimental procedures section later in this paper.

The five precepts addressed above are not limited to laboratory market experiments. The fundamental concern for use of real economic incentives and control of subject preferences common to all techniques used in experimental economics is answered by ensuring that salience, nonsatiation, dominance and privacy are satisfied.

Limitations of the method. Experimental economics has several limitations that can be classified on two dimensions -- scope of the method and administration. The scope of experimental economics is limited by the nature of the method. Experiments are subject to time limits; human subjects become tired and bored if the experiment is too long, resulting in loss of control over preferences. Thus, the method is not well-suited for examining complex microeconomic systems or lengthy convergence processes. In addition, the method requires prespecification of institutional parameters for adequate control of subject preferences. This constraint does not permit endogenous evolution of institutions in the marketplace. Last, the method is best suited for qualitative estimation of effects in naturally-occurring markets.

Questions of a quantitative nature (e.g., dollar estimates of revenue effects from changes in tax policy) are better answered with other methods.

Associated with administration of economic experiments is a relatively high cost incurred with payment of dominant rewards to subjects. Satisfaction of the dominance precept typically requires cash payments to subjects on the order of six to ten dollars per hour. It is therefore not unusual for a series of experiments to require several thousand dollars of subject fees. The result is a real limitation in the number of replications in a study and, by implication, limitations in applying statistical techniques due to limited degrees of freedom.

Generalizability. As noted by Smith, Schatzberg, and Waller [1987], the generalizability of experimental economics studies depends on two questions. First, is the theory a reasonable abstraction from reality (this question can be answered in part through the application of econometric analysis of field data)? Second, has the experimenter appropriately operationalized the theory's assumptions? If the answer to both questions is yes, then the results of the experiment are generalizable.

The key to the question of generalizability rests on the point that it is theory, and not results that are generalized to the "real world." Results from economic laboratory experiments provide evidence regarding the veracity of an economic theory in the abstract, without the noise introduced by uncontrolled events encountered in the field. If a theory's predictions are supported in a controlled laboratory environment then belief in the theory's ability to predict human behavior is enhanced. However, any attempts to generalize theory to the real world require that the theory captures the relevant aspects of the phenomena that it was meant to represent.

Often, critics of experimental economics are tempted to answer "no" to the second question above, regarding appropriate operationalization of assumptions, because laboratory markets are unrealistic. Such a view is simplistic because it fails to consider the relative importance of mundane and experimental realism. Addressing the issue of external validity in experiments, Smith, Schatzberg and Waller [1987] note that the generalizability criterion can be viewed as a restatement of Hume's [1748] dictum on inductive inference-similar causes always produce similar effects. Similarity between a naturally-occurring market and a laboratory market may be judged in terms of discernible features (mundane realism) or in terms of the degree to which subjects attend to, and take seriously, laboratory events (experimental realism). While economic laboratory experiments typically lack mundane realism (e.g., to control subject preferences, references to the "real world" are typically minimized), experimental realism is crucial to the methodology and is achieved through application of Smith's [1982] experimental precepts, described above. Swieringa and Weick [1982, p. 81] argue that lack of mundane realism or deliberate artificiality allows for more direct tests of theory, thereby improving generalizability because it is the theory rather than raw findings that is used to explain real world phenomena.

EXPERIMENTAL PROCEDURES

Although still a nascent methodology, several accepted practices have been adopted by those performing experimental economics research. These procedures, while not "required" to perform a laboratory market experiment, permit implementation of the five experimental precepts, discussed above, and thereby aid in controlling preferences and in ensuring internal validity.

Neutrality of instructions. Instructions provided to subjects prior to participation in the experiment should avoid suggestive statements or references to real-world phenomena which encourage role-playing. It is commonly believed that subjects' behavior is sensitive to such statements. For example, Holt and Villamil [1986] compare Plott's instructions [1982, p. 1524] which begin: "This is an experiment in the economics of market decision making" to those of a recently published study which begin with the sentence: "This is an experiment ... to study the operation of a competitive market." The mention of competitive markets in the latter instructions is inappropriate because it suggests a certain form of behavior (competition) to the subjects and may result in a loss of control over preferences. Similarly, in two tax policy studies, Swenson [1987b, 1988] avoids the use of the term "taxes" per se. The reader is referred to Plott [1982] for a more detailed discussion of proper attributes for instructions to subjects.

Understandability of instructions. It is critical that instructions are completely understood by subjects in order to achieve the precept of saliency. To enhance understanding, it is a common practice to provide subjects with sample calculations of profit and tax liability in the instructions. Likewise, for experiments involving exogenous uncertainty, most studies incorporate some form of probability training in the instructions (see Plott and Sunder [1982] for an example of such training). In addition to examples and training, it may be appropriate to test subject understanding prior to commencement of the experiment or through a post-experimental questionnaire. Finally, for complex institutions administered on networked personal computers, it is common to provide subjects with the opportunity to participate in a simulated market prior to commencement of the experiment. In addition, it has been suggested

(in personal discussion with Shyam Sunder) that, especially with experiments that utilize computers, it may be appropriate to have the reading level of instructions evaluated by a professional prior to administration of the experiment.

The use of examples. In an example of questionable experimental practice, Holt and Villamil [1986, p. 9] make note that a recently published paper in an economics journal provided subjects with an example in which the resulting market price was within a nickel of the competitive equilibrium price in the actual experiment. It could be argued in this circumstance that subject behavior was influenced by the example. To avoid anchoring by subjects, example calculations provided to subjects should avoid the use of parameter values near those to be used in the experiment.

Believability of experimental procedures. Where experimental procedures such as randomly determined outcomes are employed in an experiment, it is important that subjects believe that the procedure is actually followed by the experimenter.[12] Lack of belief on behalf of subjects will result in loss over control of preferences. This issue has been dealt with in several ways in the literature. Grether [1980] generated a probability distribution by drawing balls from a bingo cage that had balls of two colors. He attempted to enhance experimenter credibility by allowing subjects to elect a representative from their group to monitor the draws made by the experimenter.

In other experiments, the randomization device is not present during administration. In these instances, a preselected random sequence is typically used (e.g., DeJong, Forsythe and Uecker [1985], Davis [1987]). As noted by Forsythe [1986], a preselected sequence of random outcomes has several advantages and one potential disadvantage. Advantages include a reduction in

the time required to run an experiment and enhanced control over the parameters of the experiment (the random sequence becomes a part of the parameter set). One disadvantage may be introduced with a preselected random sample; subjects may not believe that the sample used in the experiment was randomly drawn from the population described. The result is loss of control over probabilities that the subjects are using in their decisions (for an example of this effect, see Plott and Aga [1983]).

To overcome the disadvantage and enhance believability in the random process, experimenters in the past have attempted to use a sequence of random draws that is "representative" of the probability distribution disclosed to subjects. It has also been suggested [King and Wallin, 1987b] that a videotaped random drawing be used, thereby achieving the benefits of preselected samples while preserving the believability of the random process. Last, the experimenter can enhance internal validity by using manipulation checks ex post to verify that subjects believed that the sample of random events in the experiment were drawn from the distribution described to subjects (e.g., see Davis [1987]).

Uniformity of administration. To facilitate replicability of results, experiments should be uniformly administered. Procedures followed and instructions provided to subjects should be consistent across all trials in the experiment. Uniformity of administration is facilitated by use of computers; an approach that is becoming more and more commonplace.[13] The use of computerized instructions insures that all subjects receive the same information (which may not be the case if instructions are verbal). Similarly, allowing subjects to communicate their message choices or decisions on a computer facilitates recording of data and minimizes errors (especially in the

case of tax policy experiments, where manual computation of earnings could become overly complex and time-consuming). Furthermore, for laboratory market experiments, the use of networked personal computers increases the speed of the market and can provide enhanced control over communication between subjects.

Dominant rewards. To achieve the precept of dominant rewards, subject payments usually average six to ten dollars per hour. However, the necessary level of payment (i.e., the quantity of cash necessary to dominate subject behavior) is typically determined through pilot studies, etc. In addition, it is important that all subjects are paid for their participation in the experiment (dependent on their decisions). Differences have been observed in subject behavior in settings where every participant is paid in cash for their decisions and where only a subset of subjects are paid (see Smith [1965, p. 392]). Economists have been critical of experiments in which adequate financial motivation does not exist. For example, the principal motivation for Grether's [1980] study of probability revision was criticism regarding the lack of economic incentives in Kahneman and Tversky's research into the representativeness heuristic.

Adequate financial compensation should be available to subjects for behavior predicted by all competing hypotheses. In an early experiment (Fouraker and Siegel [1964]), one of the equilibria of interest had zero earnings available to subjects. In addition, a condition of negative earnings is usually avoided in experiments by providing an initial endowment to each subject sufficient to offset any losses incurred or by allowing bankruptcy and exit from the experiment.[14] Negative earnings should be avoided because, if it were to become apparent to a subject that losses incurred will offset any future earnings, control is lost over preferences.

Length of experiments. Because subjects may become bored and tired in long experiments, the maximum length of a session is usually limited to two to three hours. If the duration of an experiment were to exceed the maximum, the dominance of rewards would be subject to question. This limitation has been dealt with in two ways. First, subjects have been allowed to participate in multiple experimental sessions over a number of days (e.g., King [1986]). The difficulty arising with this approach is the loss of control over privacy between experimental sessions and the possibility that some subjects may fail to return for subsequent experimental sessions. The second approach is to arrange for multiple experimental sessions during the same day, with scheduled breaks, during which subject communication is tightly controlled (e.g., Davis [1987]). While the second approach overcomes the difficulties arising in multiple day experiments, fatigue once again can become a factor.

Student versus "real-world" subjects. There is no documented difference in equilibrium behavior in laboratory markets between student and non-student subjects where adequate (dominant) compensation is available. However, the issue of dominant rewards can present significant problems in the case of non-student subjects. For example, Burns [1985] examined the wool traders market with both students and professional wool traders as subjects. She noted significant differences in the behavior of the two groups: students behaved according to theory, while the wool traders (who were acquainted professionally) engaged in rivalistic pricing, deriving more utility from "keeping the other guy honest" than from maximizing profits. A likely explanation for the differences in behavior observed between the two groups arises from the lack of a dominant reward payment to the wool traders. The reward schedule was identical across the student and professional markets,

despite the greater wealth and opportunity cost incurred by non-student subjects.

Given the greater cost incurred to ensure dominant rewards for non-student subjects, their use is usually infeasible. Furthermore, since the purpose of experimental economics is to test the veracity of economic theory in the abstract and not to address questions regarding the reasonableness of theory as an abstraction of the real world, the use of students as surrogates is not an issue. Plott [1982] has argued that so long as real people pursue real incentives, choice of subjects should not be critical.

Setting experimental parameters. Parameter settings are important when designing an experiment to provide a critical test of theory. The initial parameters are usually determined through the use of pilot studies, manipulation checks, etc. The values selected usually provide the theory with its "best shot" at success. As discussed above, if a theory fails in a setting which encourages success, the strength of falsification is great. Likewise, when competing theories are tested, it is important that a set of parameters are chosen that provide sets of predictions that can be clearly distinguished from each other.

Risk preferences. Several tactics have been adopted to deal with subject risk preferences in experiments with exogenous uncertainty. Unfortunately, some doubt has been cast on the effectiveness of many of the methods. The first approach attempts to induce utility functions in subjects by awarding subjects points (instead of cash) which are mapped (through a utility function) onto probability of winning a cash reward in a lottery. This technique is described in detail by Berg, Daley, Dickhaut and O'Brien [1986] and has been supported by evidence gathered in non-market settings. However, the robustness of the

technique has recently been questioned by Walker, Smith and Cox [1986] whose attempt to test the technique in a market setting did not provide support. Second, some experimenters attempt to control risk preferences through measurement (e.g., Swenson [1987b]) and occasionally, by preselecting subjects with appropriate risk preferences, (e.g., see Harrison [1986]). The difficulty encountered with this approach arises from the disputability of the various measurement techniques employed. Perhaps the least problematic approach to dealing with risk preferences has been to tentatively accept the theory's assumptions ex ante (e.g., that subjects are risk-neutral), and subsequently reformulate the theory with new assumptions regarding risk preferences if predictions are not supported (e.g., Cox, Smith, and Walker [1982]).

SOME APPLICATIONS TO TAX POLICY RESEARCH

This section begins with a brief review of four studies that can be classified as applications of experimental economics to tax policy research. The review of prior literature is followed with a brief discussion of potential applications of experimental economics methods to several areas in tax policy research. The applications discussed are by no means exhaustive; rather, they may act to elicit additional ideas for the reader.

Past Applications of Experimental Economics

In one of the first studies to use experimental economics in tax policy research, Swenson [1988] examined taxpayers' labor response to changing tax rates in a non-market setting. Because previous econometric and simulation studies had not provided convincing evidence on a variety of supply-side and neoclassical economics theories of taxpayer labor behavior, Swenson [1988] chose to investigate these theories in a laboratory setting with student subjects. Subjects could choose between a work-task (which required repeated

entry of a sequence of keys on personal computers) for which they were compensated, or a variety of leisure activities with no pecuniary rewards. After-tax earnings (cash rewards) from the work-task were a function of the number of key sequences performed by the subject and the tax rate assigned to the subject. Subjects received additional compensation in the form of tax redistributions, allocated to the subjects using their hypothetical tax payments.

Swenson reported that the results of the study were consistent with predictions of neoclassical and supply-side economic theories. That is, on an aggregate basis, labor supply and output followed a bitonic or backward-bending form (i.e., labor supply first increased as tax rates increased, and then decreased as tax rates became large) and tax collections (the "Laffer curve") were maximized at tax rates below 100%. However, on an individual-subject basis, varying degrees of conformity to the theory were found. Swenson argued that the results of the experiment were important since the theory tested underpins much of our current tax policy.

A laboratory market examination of the effects of various tax regimes on the demand for risky assets was performed by Swenson [1987b]. No prior econometric studies had examined the theoretical prediction that proportional taxes increase the incentive to invest in risky assets, that progressive taxes decrease this incentive, and that tax credits increase the incentive.

The results indicated that when a progressive tax was imposed (with 20% and 50% tax rates), demand for risky assets was lower than corresponding demand in both the no tax and proportional tax regimes. When an income tax accounting subsidy was given for the purchase of a risky asset, demand was higher than demand under each of the other three tax regimes, and the market mechanism

shifted some of the subsidy to sellers. When a proportional (flat) 30% tax with full loss offset was imposed, demand was not significantly higher than where there were no taxes. The theoretical predictions were generally supported; the results provided strongest support for four of six hypotheses examined and weak support for the remaining two hypotheses. The evidence was encouraging in light of the counteracting effects made by the market mechanism and the literature's assertions that the model of individual behavior under uncertainty underpinning the theory does not always hold.

Following Swenson's [1987b] laboratory market study of the effects of tax regimes on risky investments, King and Wallin [1987a] examined the same issue in an individual choice setting. In their experiment, risk preferences were induced using the Berg et al. [1986] procedure in a portfolio selection task performed by individual subjects on personal computers. As in the Swenson studies, the research was concerned with equilibrium behavior and all of the experimental precepts were met (e.g., dominant cash rewards tied to investment decisions).

The results in King and Wallin [1987a] were mixed with respect to theory. While portfolios were not constructed with the predicted percentage of risky assets, the adjustments made by subjects in their portfolios when tax regimes changed were consistent with theoretical predictions. Specifically, implementation of a proportional tax caused an increase in the holdings of the risky asset when compared to holdings under a progressive tax or under no tax. Similarly, the percentage of risky assets in portfolios decreased under a progressive tax regime. Finally, the observed effect of taxes was much smaller than suggested by theoretical predictions.

Meade [1987] experimentally examined the capital gains tax lock-in effect (i.e., the contention that the capital gains tax decreases investors' willingness to undertake risky new investment) and various policy proposals to eliminate the lock-in effect. The experiment required subjects to make a series of investment decisions (allocating an initial cash endowment to two available investments) under several capital gains tax conditions, with two possible tax rates. As with the other studies reviewed here, the experiment can be classified as falling under the purview of experimental economics; the experiment was concerned with equilibrium behavior (after several repetitions of the experimental task), and the precepts addressed earlier in this paper were satisfied (although the use of real investors raises the question of whether the $23 average payment satisfied the dominance precept). The results of the experiments support the existence of a lock-in effect. Additionally, the study provides important insights regarding the efficacy of alternative approaches to taxing capital gains in mitigating the lock-in effect.

Future Applications of the Method

Simulations. Simulation analysis (e.g., Monte Carlo simulation) is a useful method that can be used to test various propositions in a complex environment while holding a variety of factors constant. Unfortunately, the decision rules examined are usually arbitrary and frequently assume that the decision makers behave in strict accordance with expected utility maximization, profit maximization, etc. Experimental economics can provide evidence on the reasonableness of assumptions made in simulation studies, in that the method permits an examination of what human beings chose to do in light of incentives and in the absence of any presumptive constraints on their behavior such as those provided by economic models.

An example of this application of experimental economics is provided by Isaac and Reynolds' [1986] examination of research and development (R&D) activity, which compared experimental results to the results of simulations. It was observed in the study that individual behavior in a gaming setting did not completely conform to simulation results. A potential application of this approach to a tax issue might be a comparison of laboratory market results to Swenson's [1987a] Monte Carlo simulation of the effects of inflation on corporate taxation. Swenson's study implicitly assumed that, during inflationary periods, investors shifted portfolios away from capital intensive firms and that management would (inefficiently) alter factor input mixes and capital inventories. These maintained hypotheses were never empirically tested. Such tests could be done in an experimental market where subjects invest in assets in an inflating market, with a rational expectations or an adaptive expectations model used as a theoretical guide.

Instability of Tax Policy. To the extent taxpayers are risk-averse (a standard assumption regarding investors and manager-agents), as uncertainty regarding future tax policy increases, the predominant view in the literature is that investments are either shorter-lived or that there is a decrease in investments in assets subject to uncertain tax policy. This maintained hypothesis (see Atkinson and Stiglitz's discussion of investment in depreciable assets [1980, Chapter 5], and Halperin's [1983] discussion of corporate investment) has never really been tested. An experiment could provide useful evidence as to whether such uncertainty induces the predicted investment behavior in a multi-period setting. Portfolio theory (using mean-variance analysis) could be used to guide the experimental tests of the tax uncertainty hypothesis.

Efficient sharing of tax benefits. The concept of efficient sharing of tax benefits is amenable to a laboratory market setting. In a world of differing tax status, a tax sharing contract can be reached that benefits both parties. One example is leasing [cf., Schall and Sundem, 1982] where under prior law ITC could be passed from a low bracket taxpayer to a high bracket taxpayer, and in return the high bracket taxpayer could pass on part of the tax benefit in the form of decreased rental payments. It has been maintained that such a policy allows for efficiency in that needed capital goods can be purchased by the low bracket taxpayer with the knowledge of decreased cost will be achieved through tax benefit sharing. This hypothesis could be tested in an laboratory setting where buyers and sellers are endowed with different tax rates and are given a credit for holding an asset at the end of a period. Seller versus buyer surplus (i.e., efficiency) could be measured with the credit effectively passed through to high bracket buyers. The sensitivity of the theory to various market structures could also be tested. For example, a monopolistic buyer would be expected to extract more credit benefit than would perfectly competitive buyers.

Tax incidence. A time-honored general equilibrium theory of tax incidence was developed by Arnold Harberger. Harberger's [1962] model examines the long-run shifting of tax incidence as taxes are imposed on capital, labor, and products[15]. While a test of the complete Harberger model is currently beyond the scope of experimental economics technology, parts of the theory can be tested. For example, suppose that tax depreciation benefits accrue solely to one industry. For that one industry, returns are predicted to increase as average costs decrease and as output increases. Investors should then shift their portfolios to hold more investments in this industry until rates of

return among all industries are equalized. This partial Harberger model is amenable to a market setting with two dividend-paying assets, one of which is tax-favored.

A similar long-run tax effect is suggested by Scholes and Wolfson's [1984] implicit tax hypothesis which suggests that implicit taxes in the form of pre-tax differences in cash flows between investments will arise when the investments are taxed differently (e.g., municipal bonds versus taxable bonds). Again we have a situation amenable to laboratory market testing, where sellers of one type of asset (eligible for, say, a tax credit) can offer and receive higher selling prices (viz., buyers get lower pre-tax returns on their investments) than do sellers of bonds not so tax-favored. This line of research might also involve a test of Scholes and Wolfson's "tax clientele" hypothesis in which buyers are predicted to form tax-favored versus non-tax-favored asset portfolios in direct relationship to their tax rates.

Experimental markets may also be useful in examining short-run partial equilibrium tax incidence. For example, suppose that a 25% credit was given for the purchase of widgets. In the short-run, demand and price for widgets is predicted to increase, as the equilibrium point of widget supply and demand moves along the supply curve. Thus, in the short run, the quantity of widgets demanded would be lower than predicted in the absence of market effects as sellers extract a share of the credit. In the long run, additional widget suppliers are expected to enter the market, with a corresponding decrease in price. Whether this occurs is undoubtedly a function of barriers to entry and expectations of the permanency of tax policy. In any event, any type of tax or subsidy is amenable to such short-run analysis in an experimental market. Further, the sensitivity of the results to the degree of competition in the

marketplace could be tested, e.g., use of a monopolist seller to see if less of the tax benefit accrues to the seller than when competitive sellers are present.

Agency relationships. Fellingham and Wolfson [1985] analytically examined the role of taxes and risk sharing in a principal-agent relationship, similar to that of a limited partnership situation. The authors explored a variety of situations, including the creation of a monitoring need where a risk-neutral partner was subjected to a progressive tax, and where risk-sharing contracts selected were not tax-minimizing contracts. Most of Fellingham and Wolfson's propositions appear to be testable in a laboratory setting, using an approach similar to one of the earlier experimental agency studies (cf., Berg, Daley, Dickhaut and O'Brien [1985], DeJong, Forsythe, Lundholm, and Uecker [1985], or Baiman and Lewis [1987]) with the addition of a tax regime for both principals and agents.

Tax compliance. Although apparently adaptable to compliance issues because of the traditional laboratory orientation of such studies, it is not clear that experimental economics can dramatically add to the compliance literature. This limitation arises principally because experimental economics methods attempt to remove all non-economic aspects of behavior from the laboratory environment through the application of the experimental precepts described above. Thus, any use of the method to examine tax evasion behavior would be limited to the extent that other aspects of the environment play a role in compliance decisions (e.g., perceptions of fairness, group norms, etc.).

However, as Jackson and Jones [1985, p. 13] note, traditional compliance studies have had the potential drawback of examining attitudes toward evasion which may not always be indicative of behavior. It may be possible to design

an experiment in which a reward structure could induce the essence of evasion behavior in the laboratory. The introduction of certain aspects of the experimental economics method (e.g., the presence of large cash rewards) in a more traditional psychological setting (which recognizes the importance of nonpecuniary aspects of evasion behavior and framing effects) may enhance the ecological validity of such a study.

One possible application of experimental economics could be an extension of Friedland et al.'s [1978] study which induced 15 subjects to evade taxes in return for a small prize in proportion to each person's net income. Large fines were found to be a more effective determinant than frequent audits, a result not necessarily consistent with theory. One wonders what the effect of a reward structure where subjects earned, say, $10 per hour and kept all of their evaded taxes would have had on the results of the study.

Another possible application is related to Spicer and Becker's [1977] examination of the effects of perceived fiscal inequity on evasion. Perceived fiscal inequity was manipulated by privately telling subjects what their tax rates were and whether they were above or below those of others. As in Friedland et al. the reward structure was a small cash prize. In addition to providing a reward structure consistent with the experimental precepts detailed above, an experimental economics setting could directly manipulate fiscal inequity by collecting taxes and redistributing them to participants. Fiscal inequity would be directly measurable as the difference between taxes paid and benefits received, and evasion attributable to fiscal inequity (ignoring for the moment the effects of fines, probabilities of detection, attitudes toward risk, etc.) should be directly related to the gap.

One of the more recent approaches to tax evasion is from a game-theoretic perspective. Graetz et al. [1986] model the dynamic role of the taxpayer's choice of an evasion strategy and the IRS's choice of an audit strategy. Such strategies continue to evolve until a Nash equilibrium solution obtains. In a related setting, Beck and Jung [1987] examine sequential equilibrium solutions of a game in which taxpayers are uncertain about tax liabilities and the taxing authority's audit investigation decision. Game theoretic situations are generally well-suited for experimental economics studies; several experimental tests of game theoretic models exist in the literature (e.g., Isaac and Reynolds [1986], Roth and Malouf [1980]). The analytic predictions of the Graetz et al. model or the Beck and Jung model could thus be put to the test with real human beings who do not necessarily conform to the behavior presumed by economic models.

CONCLUSION

This paper has described the methods that encompass experimental economics and discussed the role that experimental economics can play in tax policy research. In addition, four studies employing experimental economic methods were reviewed and the application of experimental economics to several other tax policy issues was discussed.

The use of experimental economics in tax research should be tempered with two caveats. First, it is not intended to replace behavioral tax research in the psychological-sociological paradigm. Rather, it is meant to supplement such research only where appropriate, i.e., where an issue requires consideration of market behavior or the effect of market incentives on individual behavior. Second, experimental economics is designed to complement empirical ex post data base studies, viz., those using econometric methods.

Econometric analysis of field data and laboratory markets have benefits and limitations which offset each other. Laboratory experiments can provide critical tests of theory, provide a vehicle for observation of the effects of different allocative institutions (e.g., changes in tax policy) and permit direct observation of variables not readily observable in the field. On the other hand, field studies provide evidence of the reasonableness of abstractions made by theory in naturally-occurring markets and permit quantitative estimation of the impact of tax policies. Thus, we advocate a multi-method approach to empirical tax policy research.

ENDNOTES

1. In addition to methods borrowed from economics and psychology, several other approaches have been adopted by tax researchers, such as simulation and court-case analysis. The reader is referred to Kramer [1984] for a review of the various techniques currently used in tax research.

2. Such non-laboratory experiments have been performed in taxation (see, for example, Keely, Robins, Spiegelman and West [1978] who attempted to ascertain the impact of a negative income tax on labor supply), but they tend to be very expensive, and they require the cooperation of individuals whose principal concerns are more pragmatic than contributing to the economics of tax policy at a basic scientific level. Furthermore, it is usually impossible and economically undesirable to make the sweeping tax policy changes necessary to test theory in naturally-occurring markets.

3. An study underway by Swenson and Davis [1987] attempts to provide controlled tests of theoretical predictions regarding the effects of tax depreciation on capital investment in an experimental market.

4. In testing economic theory, it is important to distinguish between different levels of theory. At one level is the "core" theory (proven by its internal logical consistency). At another level is the operationalized theory which is supposed to have interesting predictive power in an actual economic environment which may be represented by the "real world" or by a laboratory economy. The usefulness of any "core" theory in describing behavior is limited to its ability to predict behavior in an operationalized setting. The suggestion that a "core" theory is useful in predicting human behavior draws on a "constellation of meta-assumptions which connect the core theory to the operationalization" (Cox and Isaac [1986, p. 136]). Thus, testing the predictions of a "core" theory in a laboratory operationalization can provide important evidence regarding the theory's ability to predict human behavior in the abstract, without the obscuring effect of "noise" usually present in the real world. For additional discussion of the defensibility of testing logically consistent theories, see Lakatos's [1978, p. 48] discussion of "hard core" versus "protective" theories.

5. The term "institution" has a special meaning in experimental economics. It encompasses the exchange and communication rules in the economy, including the tax system.

6. Several excellent reviews of laboratory market research in economics have been written. The interested reader is referred to Forsythe [1986], Plott [1979] and Smith [1980, 1982, 1986b]. An overview of topics addressed with laboratory market methods can be obtained through an examination of the continuing series Research in Experimental Economics, edited by Vernon Smith.

7. Along with increasing acceptability in economics, laboratory market research has begun to be used in related disciplines, including accounting. The method has recently been applied to issues in auditing (see Smith,

Schatzberg and Waller [1987] for a review), in financial economics (e.g., King [1986], King and Wallin [1987b], Plott and Sunder [1982, 1984] and Sunder [1984]) and in agency theory (Baiman and Lewis [1986], Berg, Daley, Dickhaut and O'Brien [1985], Conn and Young [1987]).

8. The use of animals as subjects is viewed as valid by some economists, who argue that economic theories should apply across species. However, the use of animals as subject are beyond the scope of this paper. Readers are referred to Kagel, et al. [1975] for additional discussion.

9. To examine tax policy issues it is also necessary to include a tax system in the economy. Such a tax system would be reflected in the allocation and cost imputation rules. For example an income tax could be impounded in the cost imputation rules as a function of final allocations.

10. A variety of institutions have been created and examined in the laboratory, including (but not limited to) first and second price sealed bid auctions, posted offer auctions, english and dutch auctions and negotiated price institutions. Smith [1982] describes several of these institutions and reviews research examining their relative efficiency in a simple setting.

11. While evidence from experiments examining <u>individual</u> choice suggests that subjects violate the axioms of expected utility theory, the results of most studies that examine <u>market</u> equilibrium behavior under uncertainty are remarkably consistent with the predictions of theories that rely on the expected utility model of individual decision making (see Forsythe's [1986] review of the literature for examples). Thus, despite the controversial nature of the precept, for allocations under uncertainty in <u>market</u> experiments, the presumption is reasonable.

12. This is particularly a concern if subjects have participated in, or have some previous knowledge or experience with experiments that involve subject deception.

13. Using computers in economic experiments requires some knowledge of programming languages (Pascal and C are most popular). A rudimentary knowledge is sufficient for most experiments, but for some complex market institutions it may be less costly to modify existing software. Several laboratory market packages are becoming available at little or no cost. Available programs include David Wallin's Arizona Experimental Market Laboratory System (available at the University of Arizona Department of Accounting), the University of Minnesota laboratory market system and Charles Plott's double auction program (from the California Institute of Technology Jet Propulsion Laboratory). In addition, at institutions where the PLATO network is available, a library of programs representing numerous institutions are available.

14. Providing subjects with an initial endowment may result in behavior that differs from a setting where the subject brings his own money to the experiment. While this is an inherent limitation in the method, it may be possible to overcome through consideration of framing effects, such as those

discussed by Thaler [1985].

15. The interested reader is referred to McClure and Thirsk [1975] for an excellent discussion of the Harberger model.

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