NEW METHODOLOGIES FOR COMMODITY PROMOTION ECONOMICS

PROCEEDINGS FROM THE NEC-63 CONFERENCE

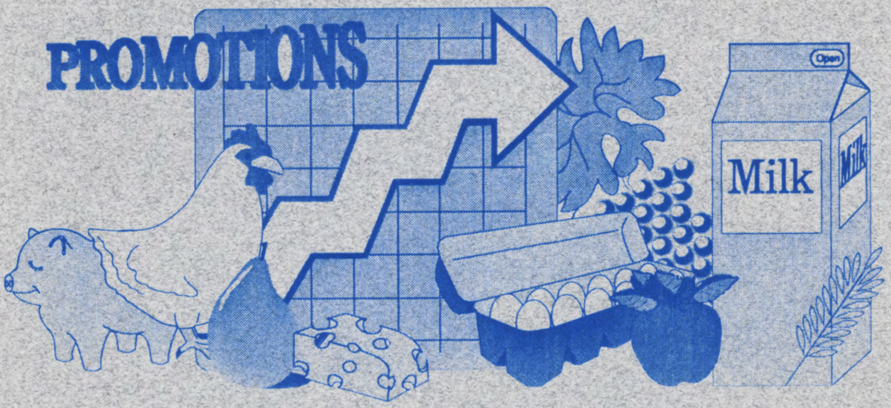
Red Lion Inn ❖ Sacramento, California ❖ October 5-6, 1995

Edited by:

Harry M. Kaiser
Henry W. Kinnucan
Jennifer L. Ferrero

SPONSORED BY AND PUBLISHED WITH THE SUPPORT OF:

The Research Committee on Commodity Promotion (NEC-63)
and
The National Institute for Commodity Promotion
Research and Evaluation



Application of Experimental Economics to Problems in Commodity Promotion

Robert G. Nelson

It seems an understatement of Britannic proportions to say that the methodology of experimental economics has not been exhaustively applied to problems in commodity promotion, much less to the topic of this conference, the evaluation of mandated commodity promotion programs. Nevertheless, I will endeavor to show that there are some fertile opportunities for a mutually beneficial association between commodity promotion programs and experimental economics, particularly in the area of institutional designs that may mitigate the problem of free-riding and facilitate a return to voluntary assessment mechanisms for those desirous of such a consummation. Figure 1 illustrates a simplistic conceptualization of the evolution of legal challenges to commodity marketing programs from my viewpoint.

Let me first constrain the scope of my topic in order to keep the discussion manageable. I propose to exclude the vast area of experimental methods used in marketing research. I do this not to minimize their importance but rather to acknowledge that no brief overview could possibly do justice to the complexity, sophistication, and relevance of this area of research. Furthermore, since experimental economics has much in common methodologically with "true" marketing experimentation (Green, p. 199) such as statistical design, manipulation of variables, random assignment of subjects, etc., I feel obliged to concentrate only on the characteristics unique to experimental economics.

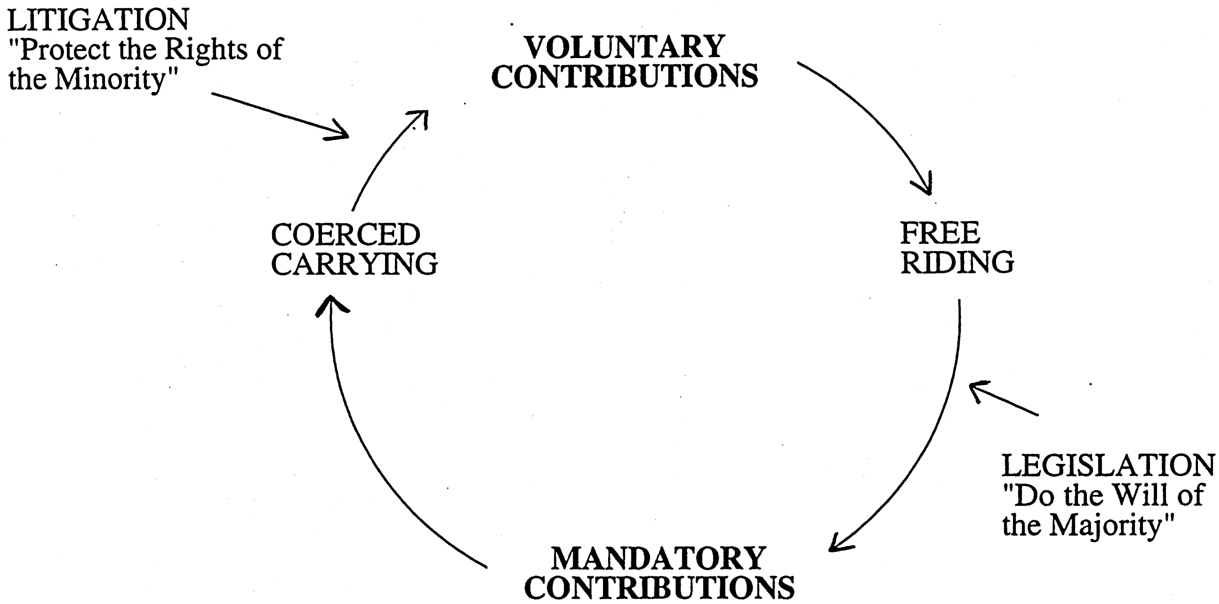


Figure 1. Evolution of commodity assessment institutions

I will also attempt to limit discussion to a classification of areas in which experimental economics has contributed, rather than to catalog isolated appearances of experimental methods in agricultural economics literature. In the spirit of this conference, it seems more productive to explore the potential of experimental economics rather than to dwell on past accomplishments.

Classifying Applications of Experimental Economics

Attempts to classify various applications of experimental economics have been made by Plott, Smith (1989), Roth, and Friedman and Sunder. Table 1 cross-references their various taxonomies. Most of the applications relate to the dialogue between theorists and experimentalists. Only the last category, Simulation, relates experimental economics to policy making. The Field Test is the large-scale extension of Simulation. Pedagogy is included in the list because it relates to efforts by commodity associations to educate their members about the benefits of collective action.

Improving on the creditable efforts of these earlier authors, Davis and Holt provide a useful framework for classifying experiments in two dimensions: institutional complexity and environmental complexity. Since a large body of specialized terminology is used by the experimental community, an elaboration of the terms "institution" and "environment" is perhaps warranted to avoid confusion. The term *institution*, in the lexicon of experimentalists, refers specifically to "rules governing economic interactions." Institutions are of central -- some might say transcendent -- importance to the discipline. Such rules include the nature and timing of messages allowed between agents (can agents communicate face-to-face? who can make offers? when can a side deal be made? etc.), the na-

Table 1. Classification Schemes for Applications of Experimental Economics

PLOTT	SMITH (1989)	ROTH	FRIEDMAN & SUNDER
1. Theory Rejection	Nomotheoretical	"Speaking to Theorists"	Mapping the range of applicability of competing theories
2. Theory Competition	Boundary		
3. Model Robustness	Exploratory Heuristic	"Searching for Facts"	Testing for Robustness
4. Measurement		"Searching for Meaning"	Test-Bed for New Institutions
5. Simulation	Parallel Nomoempirical	"Whispering in the Ears of Princes"	Institutional Engineering
FIELD TEST (Marketing Research)			PEDAGOGY Education Public or Grower Relations

ture of decisions or actions that are observable (such as bids, offers, contracts, forecasts, side payments, etc.), the mapping of these decisions into the payoff or incentive structure (the reward a subject gets for making a certain decision), and rules for ending the session or trading period. Precision in specifying institutional complexity is of mutual interest to both experimental economists and game theorists, although the domain available -- or perhaps expedient -- for exploration by experimentalists is much more extensive.

The term *environment* refers to the structural characteristics of the economic setting, such as the number of agents, their initial endowments (money, information, market power, etc.), supply schedules derived from production costs, demand structures derived from redemption values, production technologies (constant vs. variable costs; stock vs. flow markets), and the number of periods for continued interaction ("one-shot" games vs. repeated contact, with fixed or random endpoints).

A typical example of an institution with a high degree of complexity might be that of decentralized negotiation between buyers and sellers connected by telephone. An institution of modest complexity might be that of a Dutch auction where the price for an item falls sequentially until sold to the first buyer who makes an offer. Closer to home, an institution of low complexity is the mandatory assessment mechanism which, under the police powers of the state, is functionally equivalent to an excise tax. Voluntary assessment mechanisms are far more complex institutions, and consequently of interest to experimental economists.

Environments of varying complexity could range from a market with five buyers and five sellers each with multiple units, to

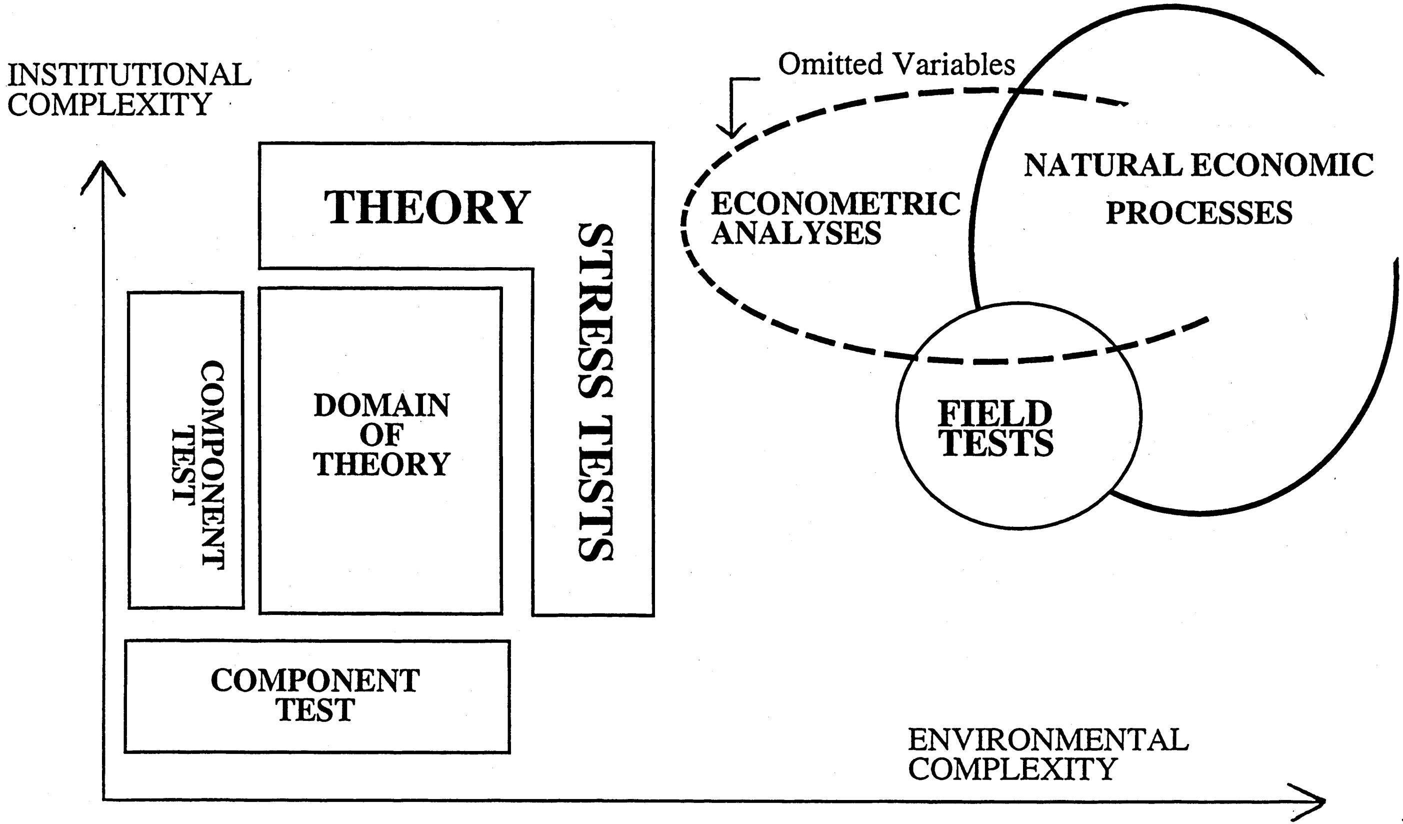


Figure 2. Spatial orientation of applications of experimental economics (adapted from Davis and Holt)

one with a single seller facing a buyer population that is simulated by a computer with a fixed demand curve, a setting useful for teaching the strategic pricing decision of the monopolist (Nelson and Beil, 1994a). In terms of commodity promotions, a simple example of environmental complexity is the varying benefit to growers of generic advertisements. A lavish return on a grower's assessment, say over 100 percent, would likely have a different effect on the status quo of the commodity association than the return from a more commonplace investment, such as a 5 percent savings account. This is one justification for conducting commodity promotion evaluation research.

Figure 2, adapted from Davis and Holt, illustrates these relationships and makes a stylistic attempt to position various research approaches in the plane relative to one another. Thus, natural "real world" economic processes are barely included in the upper right corner, displaying maximal institutional and environmental complexity. The dotted line symbolizes efforts to model these processes by econometric methods. Such models are sometimes made tractable only by suspending some credibility as to whether the dimension of environmental complexity has been adequately portrayed. And, for the econometrician who sleeps too easily for doing so, recall that inadequate modeling of environmental complexity is equivalent to omitting relevant independent variables. This omission violates the classical regression assumptions that produces biased and inconsistent estimators and makes any inference based on such estimators spurious.

Moving to the lower left corner of the graph, note that the "domain of theory" need not extend to the origin if we leave room to consider "component tests," in which the elements of a theory are

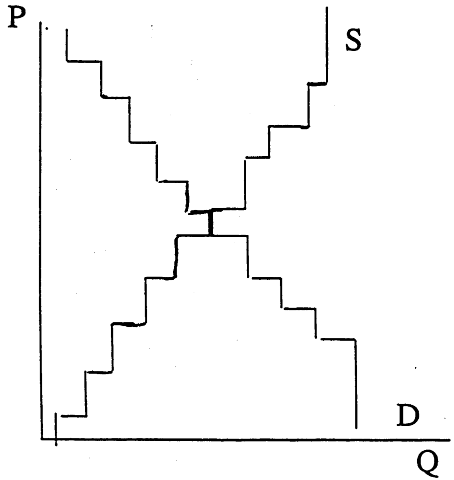


Figure 3a. Conventional structure for an experimental market

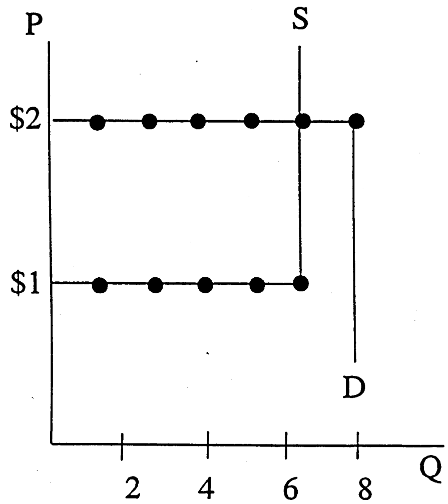


Figure 3b. Unconventional "rectangular market" for component testing of market behavior under extreme earnings inequities

tested in an even simpler setting than originally specified by the theorist. An example of this might be the contrast between a standard market (with a downward-sloping demand curve and an upward-sloping supply curve, as in Figure 3a) and a "rectangular market" consisting of a horizontal supply curve with five units produced for $1 each and a horizontal demand curve with eight units of $2 redemption value each (Figure 3b). Theory says that in perfect competition all five units should trade for $2, but most of us would shamelessly concede the possibility that some units might trade at lower prices. It turns out that the result depends rather critically on the institution used (compare Holt, Langan, and Villamil using the double auction market to Cason and Williams using a posted-offer market).

Conversely, "stress tests" explore the tenacity of a theory applied outside its traditional boundaries or the maximum limits of its expressly defined domain. An example is Smith's (1982) test of the Hayek hypothesis. Hayek surmised that the competitive equilibrium might still be observed even when "perfect" information is not available to buyers and sellers; that is, when buyers and sellers know only their own redemption values and production costs respectively, and no one else's. Indeed, Hayek suggested that strict *privacy* of such information might well be important to the functioning of competitive markets. This can be viewed as a more environmentally complex or more "realistic" situation since market structure (here, the shape of the supply and demand curves) is less certain than assumed by theory. Smith showed that Hayek was in fact correct and that competitive equilibrium was consistently achieved in experimental double auction markets with as few as five buyers and five sellers having only private information.

An archetypal series of experiments would begin with a test of theory within its accepted domain. If a series of tests consistently confirmed the theoretical predictions then the researcher might try some stress tests to explore the limits of the theory's predictive capacity in either the institutional dimension or the environmental dimension, or both. On the other hand, if the theory failed a crucial test then a series of component tests might be undertaken to determine if the components might be misspecified, or otherwise how much more simple the conditions would have to be to satisfy the predictions of theory. This sort of research agenda might seem straightforward, logical, and appropriate to the research enterprise. Unfortunately, the economics profession is not as familiar nor as comfortable with the experimental approach as are the natural sciences. More than a few experimental economists who have had the temerity to disconfirm a theory have received comments from Philistine reviewers to the effect that "it wasn't a fair test," or "you can't test an economic theory in a laboratory." Still others have corroborated a theory only to be told "you have wasted time and money since we knew it was true already."

Field tests, as characterized in Figure 2, are an extreme form of experiment -- large, costly, and often difficult to control and analyze. Excluding marketing research in full-scale test markets, few economic field tests have been attempted. In the context of commodity marketing programs, field tests could be designed to try out a new institution on a pilot basis involving the entire grower constituency.

Let us turn now to a specific example of how a long history of experiments in the area of public goods has implications for today's commodity associations.

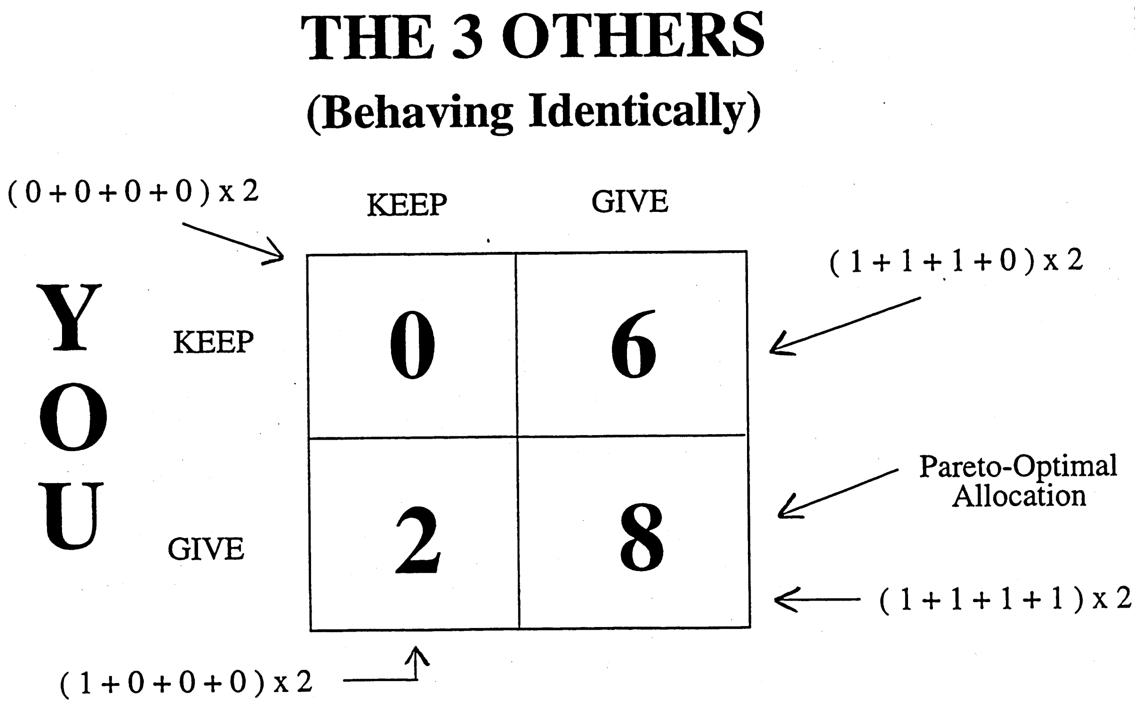


Figure 4. The collective payoff matrix

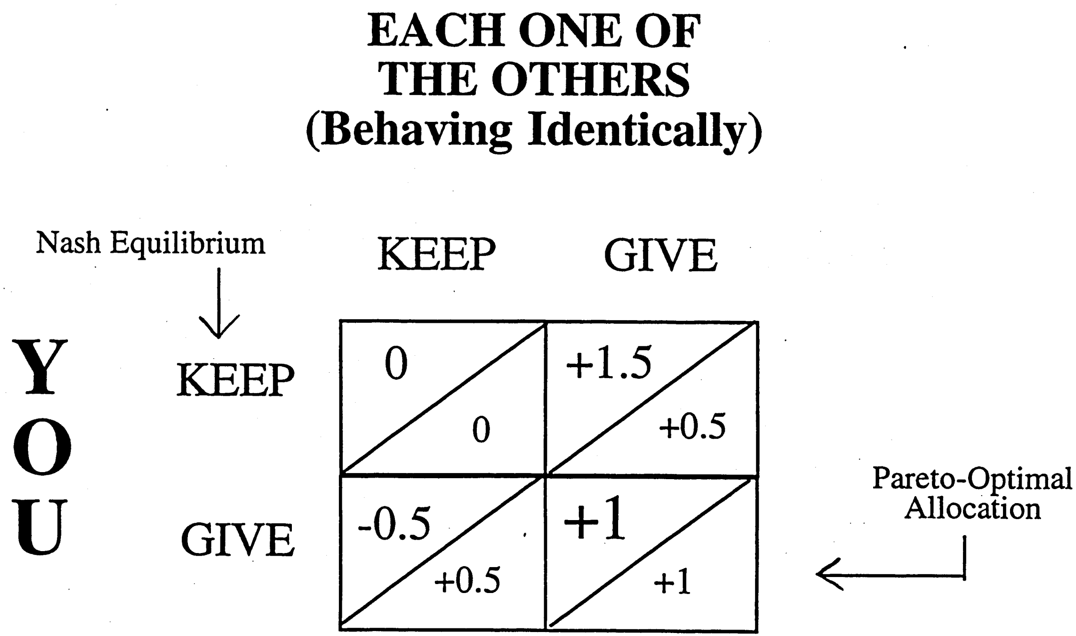


Figure 5. Individual's payoff matrix in the simple public goods game--net return per dollar invested ($yours/$his)

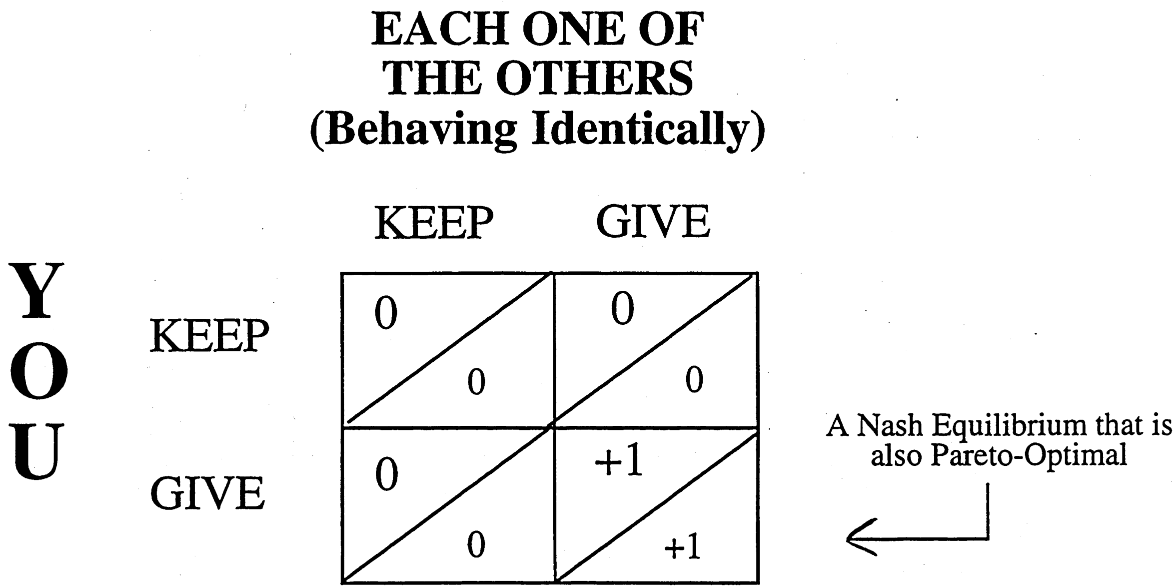


Figure 6. Individual's payoff matrix under provision point mechanism with money-back guarantee--net return per dollar invested ($yours/$his)

Public Goods Experiments and Commodity Promotion

The problems and opportunities inherent in organizing people to realize a cooperative benefit have been of interest to academics from many disciplines including economics, sociology, political science, psychology, law, management, and behavioral science. Indeed, a recent survey article by Ledyard, covering just the research related to experiments, cited more than 300 references on the subject. Among the general terms used to label the phenomenon are *public goods* (economics), *social dilemmas* (sociology), and *collective action* (political science). Specialized topics include such characterizations as the prisoner's dilemma, the problem of free-riders, the tragedy of the commons, coordination games, voluntary compliance, joint projects, altruism, preference revelation, incentive compatibility, the theory of teams, multilateral promising, decentralized decision-making systems, market failure, common pool resources, and cooperative oligopoly.

To gain an appreciation of the subject from an experimental perspective let us consider a simple public goods game. Say there are four people; you and three others. You can voluntarily contribute a dollar to a "pool." When everyone has had a chance to contribute to the pool the amount in the pool is doubled. The new enlarged pool is then distributed to all four players in equal shares. You are told you will play this game only one time.

In experimental parlance, making the contribution fixed rather than variable is an "institutional parameter." Increasing the value of the pool "creates the public good"; functionally equivalent to the increased sales realized from a generic advertising campaign. That the amount is doubled and not tripled or increased by 20 percent is

Table 2. Environmental and Institutional Parameters that Influence Cooperation

I. ENVIRONMENTAL	EFFECT
A. marginal payoff	++
B. repetition (without experience)	- -
C. common knowledge (privacy)	+
D. unequal shares in contributions and benefits	-
E. group identification/friendship	+
F. experience (played before)	- -
II. INSTITUTIONAL	
A. communication	+ +
B. provision point	+
C. money-back guarantee	+
D. unanimity	-

an "environmental parameter." Distributing the pool to all players -- the institutional condition of "non-excludability" -- is what makes it a public good rather than a private good (although *equal* distribution is not essential). Use of the one-shot game rather than continuous play is another environmental parameter.

There are at least two predicted outcomes of this game. Most economists would say: "no rational person will contribute." Most sociologists would say: "some people will contribute," and some sociologists I know would add: "especially if they are ethical." The action with the highest social welfare is obvious from the collective payoff matrix in Figure 4. If everybody gives one dollar, for a total contribution of four dollars, the combined return is eight dollars. If one person keeps his dollar, the combined return drops to six dollars. If everyone gives the outcome is said to be Pareto-optimal, yielding maximum social welfare. So why would anyone refuse to give? Figure 5 shows the game-theoretic reason why the economist says no one will give. If your choice is to keep your dollar, then you will either make nothing, if the other three players also keep, or gain $1.50 (at no cost to you), if the others all give. On the other hand, if your choice is to give, you would only make an extra $1.00 if you give and so do the others, but you could *lose* $0.50 if you give and the others don't. So you can be no worse off if you keep, and you can be better off if you keep and anyone else gives. Another way to look at it is that for every dollar you contribute to the pool, you only get back 50 percent of your investment *regardless of what the others do*, because your dollar is doubled and then divided by four. Possibly more bothersome is the thought that each dollar you contribute returns $1.50 to the rest of the group, whether they contribute or not. So no self-interested or "rational" person should give, and we have the paradox that self-interest is self-defeating. Keeping is the

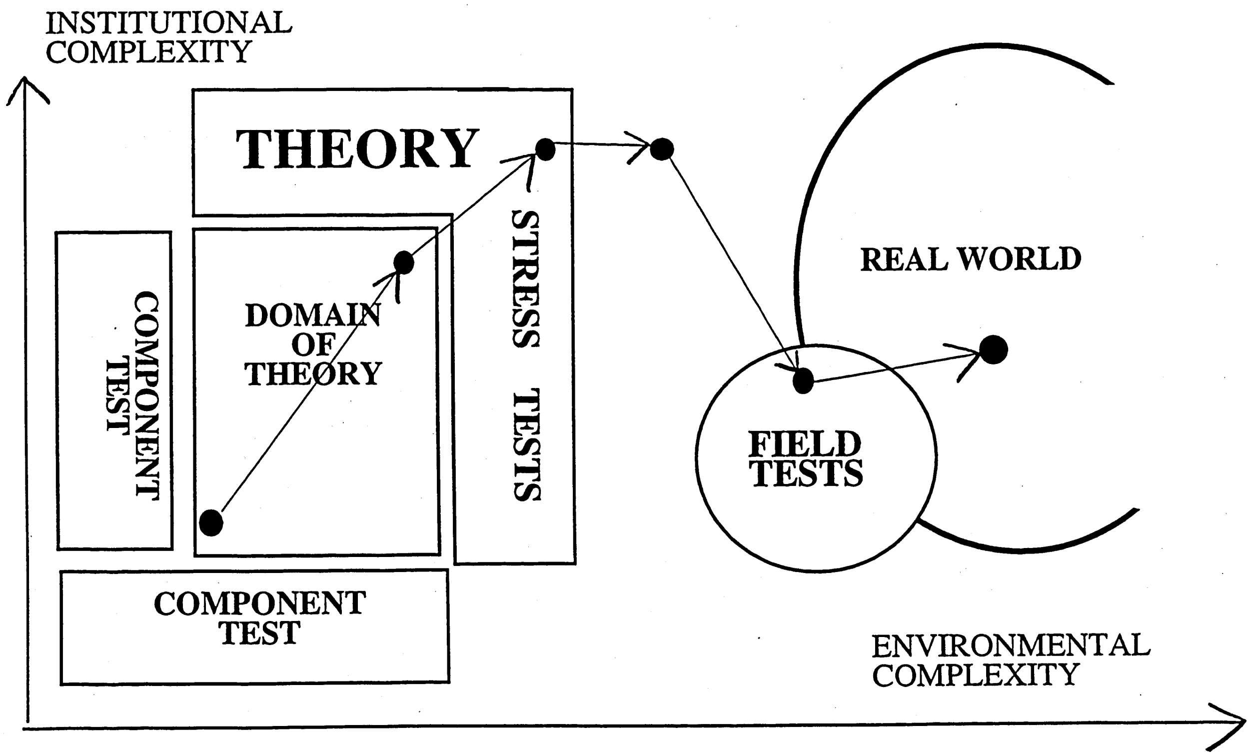


Figure 7. Path for improving mechanism designs

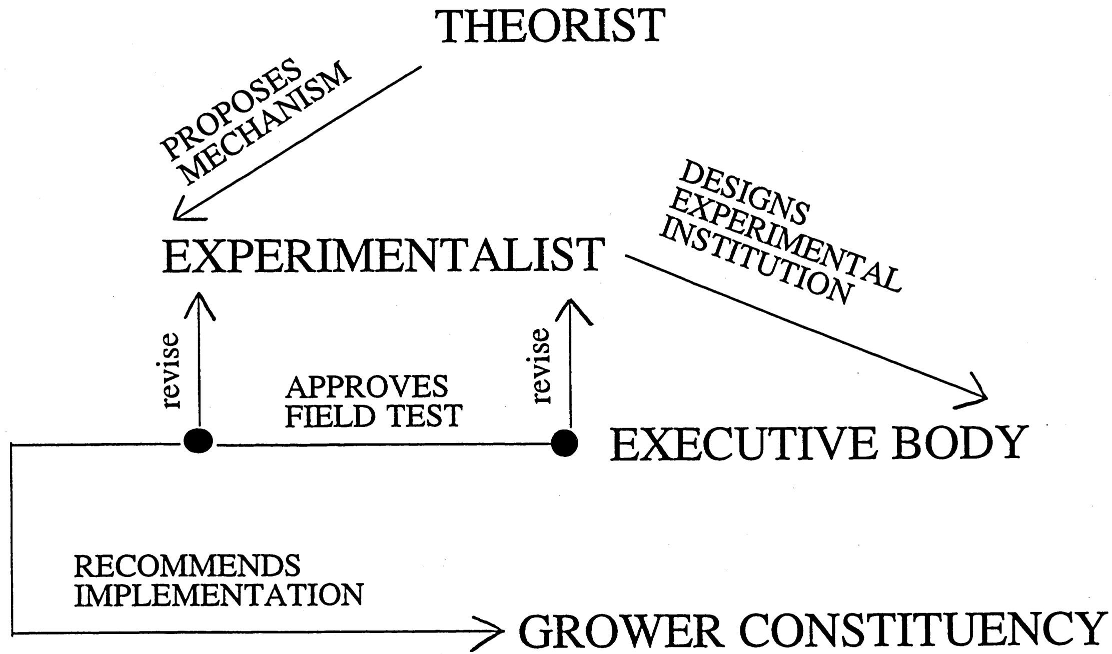


Figure 8. Path of development for new voluntary contributions mechanism

individual's Nash equilibrium choice, even though giving is Pareto-optimal for the group.

With subjects who have not played before, games like this typically yield 40-60 percent contributions for a one-time game so, strictly speaking, economists' predictions are wrong. But if the game is played a number of times (environmental parameter = repetition), contributions often fall off to zero near the end. Then if the same players come back another day (environmental parameter = experience) and play one time, contributions are usually zero to start with, so maybe economists are right. From this we might be tempted at least to assert that free-riders will always be with us, and even go so far as to assert that instituting a mandatory assessment seems to be the only "fair" solution. But first we should ask how sensitive these outcomes are to changes in institutional and environmental complexity. Is there any other set of rules or conditions that would elicit a sustained high level of contributions and still be voluntary? At least one simple change in the rules warrants examination.

Suppose that a new game is played by the same rules except this time it is announced that unless a certain threshold of contributions is reached (a "provision point") then everyone's contribution will be returned (a "money-back guarantee") and there will be no public good produced in that round. This changes the payoff table substantially (Figure 6). If the contribution provision point is set at four dollars and *anybody* keeps, then the payoff is zero. Only if everybody gives will the provision point be reached and everyone will make an extra dollar. This outcome is both the Pareto-optimal allocation *and* the Nash equilibrium.

Would it make a difference if there were 400 players instead of four? What if the pool was increased by a factor of 10? What if the players could talk to each other, or could conduct a "straw poll" to signify intentions, before they contributed? What if it was publicized who was giving and who wasn't? What happens if you can contribute any amount and get back from the pool a return proportional to your contribution? Many of these conditions have been examined in experimental settings. Table 2 is a summary of these findings, modified from Ledyard (p. 143) who judiciously referred to them as "stylized facts."

The two factors in Table 2 that have strong positive effects on contribution are marginal payoff and communication. Marginal payoff refers to the individual's net benefit of giving to the public good relative to keeping that same amount. The marginal payoff is only interesting if it is greater than zero and less than one. If it were greater than one, then a dollar contributed would return more than a dollar no matter what the others did. In our example above it would be equivalent to multiplying the pool by a factor greater than four and then dividing it by four. This would represent an unrealistic rate of return on generic advertising, implying a multiplication factor greater than the number of growers.

The other factor that strongly increases contributions -- communication -- generally refers to the ability of members to discuss their intentions and advocate their positions face-to-face. Experimentalists admit that the concept of communication is neither specified nor controlled, but it does increase contributions, perhaps by improving coordination or reducing uncertainty.

Two factors from Table 2 strongly reduce contributions -- repetition and experience. It is well documented that contributions rarely increase and usually decline over successive periods of association. For first-time players this probably leaves them with an unfavorable view of the exercise, which they bring to the table next time as "experience." In any case the lesson to be learned is that continuous organizational energy must be put into grower relations to ensure that ongoing fund-raising efforts are a positive and rewarding experience that leaves members feeling good about themselves and their fellow members. The history of labor union relations probably has something to contribute here.

Other parameters with weak positive effects are incomplete information (about others' endowments and payoffs), group identification and unity, provision points, and money-back guarantees. Information conditions are about as poorly specified as the concept of communication but generally seem to favor less information over more. Group solidarity should be fairly high among growers, compared to the randomly-chosen college students used in most experiments. Previous unpleasant experience could erode such solidarity; apparently it has been strained in past voluntary funding of commodity programs. Provision points and money-back guarantees may produce stronger positive effects when institutional disincentives to contribute are minimized and environmental parameters are given their most favorable expression.

Two parameters with weak negative effects are heterogeneity (inequalities in contributions and benefits) and, surprisingly, unanimity requirements. The former seems to be inherent in generic promotions since larger growers receive larger benefits from promotion. Unanimity requires that all members agree on a proposed action (for example to set a provision point below full contributions) and confers veto power on any member who disagrees with the action. When it works, it works well to increase contributions, but vetoes tend to become more frequent with time, and proposed collective actions increasingly fail to materialize. Unanimity simply allows no flexibility (Banks, Plott, and Porter).

To conclude this section, I can say with confidence that the provision-point-with-money-back-guarantee institution that I used as an illustration, while intended to be thought-provoking, is certainly not the last word on alternative mechanisms for funding commodity promotions on a voluntary basis. A host of issues peculiar to generic advertising of agricultural commodities would have to be addressed including: what to do with excess contributions, how far into the future the funding commitment will extend (an annual reallocation might be too frequent to be efficient), how expected benefits will be determined in order to give potential contributors an accurate estimate of their marginal payoff, how to handle the "brand credit" and other side payments, and so on. With so many factors to consider in such a dynamic environment is it any wonder that mandatory contribution has become such an unyielding status quo?

Conclusion

What I envision as a plausible path toward achieving an acceptable voluntary mechanism is a series of experiments, systematically increasing in institutional and environmental complexity, such as illustrated in Figure 7. Figure 8 illustrates the association between the theorist (who proposes a Pareto-optimal, non-dictatorial, strategy-proof mechanism), the experimentalist (who designs a practical experimental institution to function under realistic environmental conditions), the executive body (who suggests revisions or further testing), and the grower constituency (who ultimately determine the acceptability of the mechanism).

Practical, industry-oriented designs would pass quickly out of the realm of theory but could still use inexpensive student subjects to reveal the limitations of precursory mechanisms. Once a design has been thoroughly tested in the laboratory, it could be introduced to growers on an experimental basis. For example, interested growers could participate in a laboratory simulation of the new mechanism covering many rounds in a few hours (see Nelson and Beil 1994b for a similar application in the undergraduate classroom). Or a sample of growers could test the design for a year or more of real time before introducing it to the whole association on a trial basis. To be sure, further refinements would be expected in the early years after adoption of any new mechanism. However, more importantly, grower relations must become and remain a dynamic and effective activity within the association in order to give all members a sense of participation and empowerment.

References

Banks, J., C. Plott, and D. Porter. "An Experimental Analysis of Unanimity in Public Goods Provision Mechanisms." *Review of Economic Studies* 55(1988):301-22.

Cason, T.N. and A.W. Williams. "Competitive Equilibrium Convergence in a Posted-Offer Market with Extreme Earnings Inequities." *Journal of Economic Behavior and Organization* 14(1990):331-52.

Davis, D.D. and C.A. Holt. Experimental Economics. New Jersey: Princeton University Press, 1993.

Friedman, D. and S. Sunder. Experimental Methods: A Primer for Economists. Cambridge: Cambridge University Press, 1994.

Green, P.E. Research for Marketing Decisions, 5th ed. New Jersey: Prentice Hall, 1988.

Holt, C.A., L. Langan, and A.P. Villamil. "Market Power in Oral Double Auctions." *Economic Inquiry* 24(1986):107-23.

Ledyard, J.O. "Public Goods: A Survey of Experimental Research." *The Handbook of Experimental Economics*. J.H. Kagel and A.E. Roth, eds., pp. 111-94. New Jersey: Princeton University Press, 1995.

Nelson, R.G. and R.O. Beil, Jr. "Pricing Strategy Under Monopoly Conditions: An Experiment for the Classroom." *Journal of Agricultural and Applied Economics* 26(July 1994a):287-98.

Nelson, R.G. and R.O. Beil, Jr. "When Self-Interest is Self-Defeating: The Public Goods Experiment as a Teaching Tool." *Journal of Agricultural and Applied Economics* 26(December 1994b):580-90.

Plott, C.R. "An Updated Review of Industrial Organization: Applications of Experimental Methods." *Handbook of Industrial Organization, Volume II.* R. Schmalensee and R.D. Willig, eds., pp. 1109-76. Amsterdam: North-Holland, 1989.

Roth, A.E. "Laboratory Experimentation in Economics." *Advances in Economic Theory, Fifth World Congress*. T. Bewley, ed., pp. 269-99. Cambridge: Cambridge University Press, 1987.

Smith, V.L. "Experimental Methods in Economics." *The New Palgrave: Allocation, Information, and Markets.* J. Eatwell, M. Milgate, and P. Newman, eds., pp. 94-111. New York: W.W.Norton and Company, Inc., 1989.

______. "Markets as Economizers of Information: Experimental Examination of the Hayek Hypothesis." *Economic Inquiry* 20(April 1982): 165-79.