

# Market Research in the Lee Center

by Charles R. Plott

**U**nder Lee Center support, we have conducted three related research projects relating to markets. The first contribution is a new function for market-like institutions that exists on the perimeter of information and complex systems. Its success is supporting the development of new businesses. The second is basic science, illustrating the close relationship that exists between economics and network systems. It is a step towards solving one of the oldest mysteries in economics. The third is a contribution to methodology and procedures, demonstrating how to create and study a phenomenon that has been elusive in both laboratory and field studies.

## Information Aggregation Mechanisms

Information aggregation mechanisms are “market like” processes that collect “soft” information held by dispersed individuals in the form of intuition and hunches and then transform it to quantitative form. The basic principles of behavior can be seen working daily in the stock market as well as other markets that have widely recognized capacities to predict events. Terms like “the market thinks that X” reflect the fact that underlying economic events known or suspected by only a few, such as the health of a business, the outcome of a pending law suit, company earnings, etc., are frequently forecast by market activity. Research funded by the Lee Center contributed to the identification and characterization of these principles and their application to the design of new types of mechanisms that have only a single purpose, the gathering of targeted information that is otherwise widely dispersed in the form of hunches and intuition by many individuals.

This research has resulted in a substantial characterization of the principles at work in the information aggregation mechanism. The characterization has led to theories of the types of processes that might be successful, the circumstances under which the mechanism might be successful, the measurement of the reliability of the information produced by the mechanism and procedures for managing the application of the mechanism so as not to diminish performance.

Examples of applications include forecasting: future product sales based on the opinions of sales force, the revenue of upcoming movies, the price of plywood, economic indicators, and even the proposals for the U.S. Treasury bailout auction. The research supported by the Lee Center has evolved into a broad range of activities that involves other researchers and other fields. A journal and professional meetings have emerged specializing in the area. A popular book, *The Wisdom of Crowds*, has also drawn attention to the area. Businesses that were specialized in closely related activities have altered their business plans to more closely mirror findings of the scientific community. Examples are Intrade Prediction Markets and the Hollywood Stock Exchange.

## The Dynamics of Price Discovery in Markets

A second research project was focused on the dynamics of market price discovery. For decades the science has been challenged by a fundamental problem. How is it that prices evolve through competition in a market?

Typically, market systems are modeled as a large set of simultaneous equations that no one knows. From this view three questions emerge. Can markets solve the system of equations? When it happens, how does it happen? Is the phenomenon robust? Technology developed with the support of the Lee Center facilitated experiments with multiple, interacting markets and demonstrated that “numerous” and “interdependent” markets tend to converge to the equilibria of the competitive model. The most fundamental discovery is that within certain market organizations, the dynamics of the price discovery process for converging to the stable equilibria, appears to be similar to the Newton method of finding solutions to systems of equations. Information about derivatives needed for the Newton method enter through the order book.

The demonstration that the mystery of market price discovery resides in the dynamics of the price formation process immediately calls forth another question. Do these basic principles continue to apply when parameters that influence buyers and sellers change

randomly? Experiments were conducted in which markets were subject to continuous shocks, as if traders randomly appear, do their business and disappear. The results are that two different, but related laws of supply and demand operate. First, there is a temporal equilibrium, resulting from the classical law of supply and demand applied to traders who are in the market at any instant. Prices will be higher if a large number of buyers together with a small number of sellers happened to show up. This temporal equilibrium, which reflects the buyers and sellers who are in the market at the moment, is biased toward a flow equilibrium (a price that balances the expected demand and supply given the stochastic structure of parameter changes). The flow equilibrium can be viewed as a type of “long run” equilibrium even though prices never stabilize at the flow equilibrium level. The two laws interact such that “on average” prices equal the long term equilibrium but at any instant prices are closely related to the temporal equilibrium, with a bias away from the temporal equilibrium in the direction of the long term.

## Tacit Collusion and Collusion Breaking Institutions

A concept of “tacit collusion” preoccupies economics, the legal (anti-trust) profession and the courts. It is a type of breakdown in competition that economic theory seeks to define and characterize and for which the law seeks legal remedies. The theory is that competitors can “tacitly” collude by simply recognizing their common interest and acting accordingly to restrain competition, as if they had actually participated in a conspiracy. The outcome of tacit collusion will not be the competitive, Nash equilibrium but will instead be a collusive equilibrium in which competitors will be better off and consumers will be worse off.

From a scientific point of view it is a rather mysterious phenomenon. Prior to the Lee Center project, it had not been observed directly and had been measured/detected only in terms of deviations from what would be expected if tacit collusion did not exist. Indeed, tacit collusion had never been convincingly observed in experiments.

The Lee Center project stems from the insight that complexity and interdependencies of markets might be a contributing factor to tacit collusion since coordination and specialization of competitive functions, key features of tacit collusion, evolve naturally as part of competitive interactions. The study called for the creation of an environment in which tacit collusion would

readily emerge by putting together all factors thought to contribute. Then, if tacit collusion emerged and began operating, institutional changes that would make the collusion dissolve would be introduced—an example of “remedies” as sought by the courts.

The effort to create tacit collusions in the laboratory was extremely successful, with tacit collusions emerging readily in the context of multiple, simultaneous, ascending price auctions in which different items are sold to the competitors. The interdependence of the system allows the targeting of punishment strategies that participants aggressively and selectively employ to shape individual competitors into collusive conformity. The set of conditions is termed “the collusion incubator environment” and has been used repeatedly in the experimental literature to study the process of collusion formation and the conditions that might produce collusion.

The research has also considered ways to stop collusion and return the system to the competitive equilibrium. It was found that almost all remedies suggested by popular theory and the law fail to restore the system to a “competitive” mode of behavior. Guided by subtle aspects of theory, attention then moved to the implementation of a structural change from simultaneous increasing price auctions to simultaneous descending price auctions. The decreasing price auction (first to take as price goes down) removes the ability for competitors to “punish” (or even react to) those who do not conform to collusive practices. This institutional change immediately destroys the collusions. Current analysis is focused on the processes and mechanisms through which the collusion is controlled in the hope that new tools and insights are provided to businesses that must be sensitive to the possibility of collusion within those with whom they deal; as well as the government that is responsible for protecting the public by maintaining competition. ■ ■ ■



*Charles R. Plott is Edward S. Harkness Professor of Economics and Political Science.*