Experimental Economics: Putting Markets under the Microscope

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There is a famous joke about a physicist, an engineer, and an economist shipwrecked on a desert island with only a can of beans to eat. "I can help open it," volunteers the physicist. "I'll start a small fire, put the can in it, and compute how long it will take for the can to explode." "Great!" says the engineer, "I can calculate the trajectory that the beans will take and where we should stand to catch them." "Wait a minute!" the economist interrupts. "You fellows are approaching this whole thing the wrong way...First, assume we have a can opener..."

Economists are notorious for making assumptions—assumptions that are at once crucial to their analysis and completely unrealistic. An economist discussing the bond market assumes that all market participants are "perfectly rational"; an economist analyzing the oil industry assumes that energy markets are "in equilibrium." Even

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economists recognize that not everyone is perfectly rational and that markets are probably never in equilibrium. Yet they stand by analyses based on such assumptions. Why?

Economists contend that it is pointless to argue over the realism of their assumptions. First of all, developing a theory always requires making some simplifying assumptions, and economists theorizing about complex human interactions are bound to make simplifying assumptions that seem exceptionally "unrealistic." But economists have a logistical problem as well. More realistic assumptions—"some people are rational" or "markets eventually settle at an equilibrium under the right circumstances"—will not improve economists' analysis unless economists can be more specific. How many people is "some"? How do the "irrational" people behave? How long is "eventually"? What are "the right circumstances" for an equilibrium? And for economists to go out into the marketplace and collect the data they need to answer these questions is a hopeless task. They cannot assemble enough information about how market participants think, choose, act, and react. They cannot control for the many factors that make one market different from another, and each market different from one day to the next. So it would seem that economists have little choice but to stick with admittedly unrealistic assumptions and hope that they are reasonable enough to produce some realistic conclusions and predictions about the way the economy performs.

Now some economists are trying a fresh approach to evaluating the assumptions economists so routinely make about the way markets operate. By constructing and observing relatively simple "experimental" markets operating under controlled conditions, they can see and test and measure the impact that different economic environments and different institutional arrangements have on market performance. Experimental economics is still young, but it has already demonstrated that taking a closer look at simpler structures opens up new ways to improve and refine economists' analyses and predictions.

ECONOMISTS ENVISION HOW MARKETS WORK IN PRINCIPLE...

Think of any good or service—Ford Escorts or visits to the dentist. Over any time period, we can observe some quantity of this product being bought at some average price. For instance, we may find that in February, 2,127 Escorts were sold at an average price of $11,359. In the mind of an economist, both the price and the quantity that we see result from the workings of "the market" for Escorts in February. But what is this "market" and how does it work to determine the price and quantity sold?

The market for a product is comprised of those considering buying the product (the demanders), those willing to provide it (the suppliers), and the social arrangements and institutions that bring them together (the market mechanism). Typically, economists' analysis of the market includes a discussion of the factors affecting the overall demand for the product, the overall supply of it, and how the two are reconciled.

Generally the public's demand for a product is held to depend on its price, prices of related products, the income level of potential customers, and their tastes and preferences. The demand curve (Figure 1) illustrates a basic idea about market demand—the higher the price of a product, the smaller the quantity consumers will want to buy.

Suppliers' willingness to make a product available is usually held to depend on the price they can get for the product, the cost of the labor, raw materials, and other factors needed to produce it, and the available technology. The supply curve (Figure 1) illustrates a basic notion about market supply—the higher the price of a product, the larger the quantity producers will be willing to make available.

Having laid out demand and supply conditions in the market, economists add the assumption that the market settles at a price which clears it of any unmet demands or unwanted supplies. This assumption gives economists a theory about the price and quantity of the pro-

duct that we observe. The price we observe is the market-clearing price; the quantity we observe is the quantity that people want to buy and sell at that price (P^* and Q^* in Figure 2).

Behind the assumption that the market for a product always clears is the economists' vision of a market as a place swarming with potential buyers and sellers, each well-informed, each operating independently, and each bidding against all others in an effort to make trades. In such a competitive environment, a product's price is persistently pushed toward its market-clearing level. A price above the market-clearing level (say at P^a in Figure 3) induces suppliers to produce more of the product than consumers want to buy, and the competition for customers forces suppliers to cut their prices. A price below the market-clearing level (say at P^b in Figure 3) makes consumers want to buy more of the product than producers are willing to make available, and competition for the relatively scarce product induces some potential customers to offer a higher price for it. Only at the market-clearing price, where consumers want to buy exactly as much of the product as suppliers want to produce, do the incentives for buyers and sellers to adjust prices disappear.

...BUT IT'S HARD TO SEE HOW MARKETS WORK IN REALITY

If market competition were really keen enough to bring markets quickly into equilibrium at the competitive price, then assuming that markets were always at their competitive equilibrium would be no problem. But real world markets are not the all-out bidding wars among teeming numbers of competitors that economic theory posits. A few products are indeed offered by large numbers of small producers, but many—like autos and breakfast cereals—are supplied by a handful of large producers, and some—like computers and fast-food hamburgers—are provided by a few small producers and one giant. Trading practices and procedures often differ from the theoretical ideal, too. In the stock market traders bombard each other with bids and

Figure 1

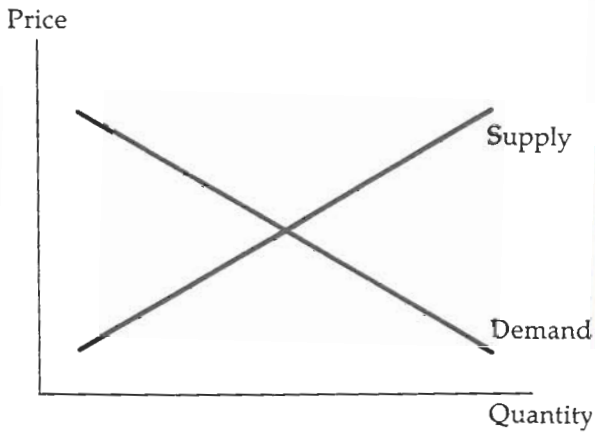


Figure 2

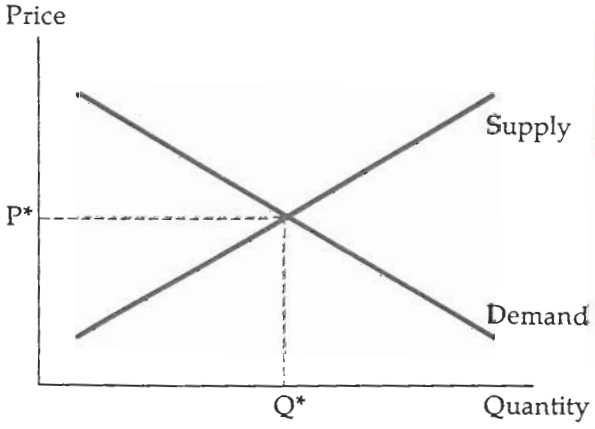
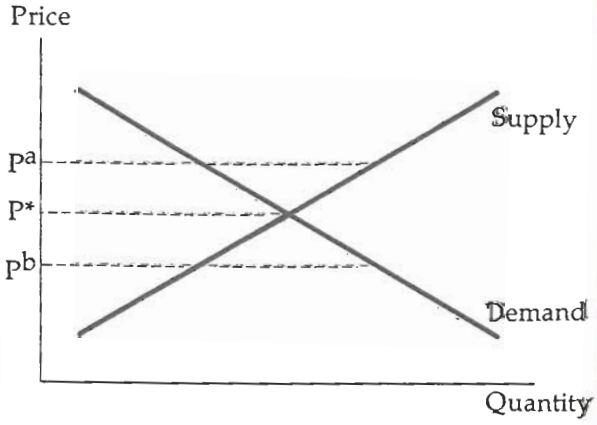


Figure 3



offers; but in the retail car market a salesman and a customer negotiate a price one-on-one; and in the grocery market the store clerk simply posts the price, leaving shoppers to choose between buying at that price and not buying at all. Competition may ultimately push most markets toward a competitive equilibrium. But undoubtedly some features of real world markets slow the adjustment process, and some may even block it entirely. If so, then economists could improve their analysis by developing more realistic theories about how markets work.

Unfortunately, as a practical matter, economists have not made a great deal of progress in assessing how a market's characteristics affect its performance. It is not that they haven't thought long and hard about such issues. The theory of how a monopoly producer would restrict the supply of a product to keep its price above competitive levels dates back to the 1830s. Over the years, economists have also considered how markets supplied by just a few producers (oligopolists) might behave, and they have developed many alternative theories along the way. And recently economists have gone on to develop whole new theories of how different auction formats and negotiating strategies might affect market outcomes as well.[1] But it has proven difficult for economists to assess the accuracy of these theories or to choose among the competing ones. And they have been able to offer few answers to questions like how other trading rules affect market performance, or how long it takes for a market to come to an equilibrium, or what path prices take on the way.

The problem is that economists have been trying to improve and refine their ideas about how markets work solely on the basis of what they observe in real world markets. These markets are usually so large and complicated that it is difficult—and sometimes impossible—for economists to collect the information or exercise the control that they need to test their ideas. Picture an economist trying to learn more about how product markets work by focusing on the burger business. She cannot hope to survey every fast-food producer and potential fast-food customer closely enough to get an accurate picture of supply and demand conditions in the market, so she cannot be sure what the competitive burger price would be. And she cannot add two new burger chains to the industry or temporarily switch from a posted-price to an auction format at McDonald's to see how such changes affect a market's performance.

CONTROLLED EXPERIMENTS BRING PRODUCT MARKETS INTO SHARPER FOCUS...

Economists trying to learn about how markets operate by observing existing real world markets are hobbled by their inability to observe or control the many factors at work there. Experimental economists get around the problem by setting up small markets with simple structures in which they can control for all of the relevant factors and then observe how people act in these controlled economic environments.

Setting up an Experimental Product Market. The key to researchers' control over supply and demand conditions in experimental markets is their ability to establish trade in an abstract commodity—one with no physical characteristics. Such a commodity is itself worthless; its only value is the value that the researchers induce by offering to redeem units of it for cash after the market closes. Using this "induced value" approach, a researcher can control exactly how many units of the commodity participants will want to buy and sell at any price.[2]

[1]For a more complete discussion of auctions and other trading arrangements, see Loretta Mester's "Going, Going, Gone: Setting Prices in Auction Markets" in *This Issue.*

[2]The induced value theory upon which the design of experimental markets is based is presented by Vernon L. Smith in "Experimental Economics: Induced Value Theory," *American Economic Review* (May 1976) pp. 274-279. Smith's "Microeconomic Systems as an Experimental Science," *American Economic Review* (December 1982) pp. 923-955 is a presentation of the experimental markets methodology and results which is considered the standard.

In a typical experiment, the researcher divides the market participants into demanders and suppliers. Before the market opens, she tells the demanders that any units of the commodity they buy during the trading period can be turned in for cash after the market closes. She then gives each demander a schedule indicating the redemption value of each unit he purchases in the market. Demander A's redemption schedule, for example, may indicate that the first unit of the commodity that he buys in the market can be redeemed for $.60, the second can be redeemed for $.50, the third for $.40, and so on. Likewise, the researcher informs the suppliers that after the market closes she will charge them for any units of the commodity that they sell during the trading period. She then gives each supplier a schedule indicating how much each unit he sells in the market will cost him afterwards. Supplier Z's cost schedule, for instance, may tell him that he will be charged $.20 for the first unit he sells, $.40 for the second unit, $.60 for the third, and so on. In markets for real world commodities, each market participant knows the value that he himself puts on the commodity, but not the value others put on it. To mimic this feature in experimental markets, each demander knows only his own redemption schedule and each supplier only his own cost schedule. Setting the redemption and cost schedules in this way establishes precisely the supply and demand conditions in the market. (See CONTROLLING THE MARKET WITH THE "INDUCED VALUE" APPROACH, pp. 20-21.)

Before the trading period begins the researcher also announces the trading rules. Prices may be established in one of three basic ways: auction, negotiation, or posting. Auctions allow the most interaction between buyers and sellers, negotiation somewhat less, and posted prices the least. The auction format most often used in experimental markets is the "double" auction, where both buyers and sellers are free to announce bids and offers to the market at any time. In the negotiated price format, buyers and sellers bargain with each other one-on-one. A seller may deal with a number of potential customers during the marketing period, but he must deal with them one at a time. Usually in a posted-price market, each seller decides on the price he will charge before the market opens and he cannot change it during the market period. In some posted-price experiments, the buyers of the commodity are required to decide what price they will pay in advance and they cannot change during the market period.

Once the trading rules are settled, trading begins. A trading period can last anywhere from five to twenty minutes. Usually there are eight or so participants in the market, sometimes more. Often they are college students, though working businesspeople have participated. Sometimes trading takes place in a single room; many times participants are scattered around at different locations and communicate over computer terminals. Negotiated-price markets have been conducted both using private booths to allow face-to-face contact and using telephones.

During a trading period, no money or commodities actually change hands. When a demander and supplier come to an agreement, the researcher records the price and quantity at which the transaction is completed. When the market closes, the researcher computes each participants' gains for the session. For instance, if Demander A and Supplier Z above happened to make their first transaction of the market period with each other, with Z selling A one unit at $.45, then at the end of the period A would be credited with $.15 (=$.60 − $.45) on the deal and Z would be credited with $.25 (=$.45 − $.20). If Z agreed to sell A a second unit at that price, A would be credited with an additional $.05 (=$.50 − $.45) and Z would gain with an additional $.05 (=$.45 − $.40) as well.

Once the gains from the first trading session have been computed, the researcher usually runs several more trading periods under the same market conditions to see how market behavior evolves. The researcher then may alter some aspect of the market's structure in order to observe the impact of that change on the market

Controlling the Market with the "Induced Value" Approach

Creating Demand and Supply Schedules

Participants in experimental markets are trading an abstract commodity of no intrinsic value. The researcher creates market demand for the commodity by giving each designated demander a redemption schedule and creates market supply by giving each designated supplier a cost schedule.

To create the typical looking experimental market demand schedule, the researcher could give three demanders the following redemption schedule:

Redemption Schedule

for the:	the researcher will pay you:
1st unit you buy	$.60
2nd unit you buy	$.50
3rd unit you buy	$.40
4th unit you buy	$.30

The researcher now knows that if the commodity is available in the market at a price between $.50 and $.60, each demander will make a profit on the first unit he buys, but he will lose money on the second. So, presuming that demanders prefer more money to less, each will demand exactly one unit of the commodity at a market price in that range. Market demand, then, will be exactly three units in the $.50 to $.60 price range. Similar reasoning produces the rest of the market demand schedule.

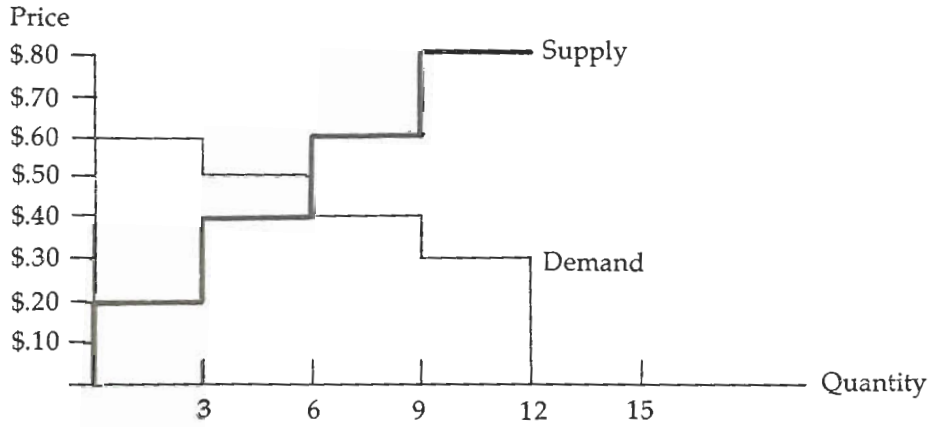
To create the typical-looking experimental market supply schedule, the researcher could give three suppliers the following cost schedule:

Cost Schedule

for the:	the researcher will charge you:
1st unit you sell	$.20
2nd unit you sell	$.40
3rd unit you sell	$.60
4th unit you sell	$.80

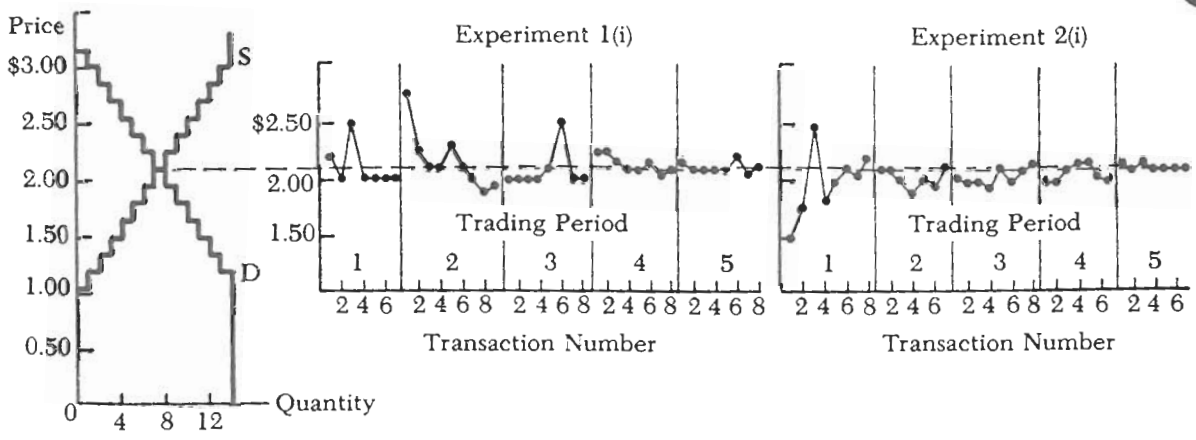
The researcher now knows that if the market price of the commodity is between $.20 and $.40, each supplier makes a profit on the first unit he sells, but he loses money on the second. So as long as the suppliers prefer more money to less, each will offer exactly one unit of the commodity for sale at a market price in that range. Market supply is therefore three units in the $.20 to $.40 price range. Similar reasoning produces the rest of the market supply schedule.

The demand and supply schedules created by the researcher for this hypothetical experimental market establish a competitive equilibrium price range of $.40 to $.50, indicated by the intersection of the two schedules in that range.



The Results of a Typical Market Experiment

In this particular experiment, the researcher, Vernon Smith, used the induced value approach to create the supply and demand conditions shown in the far left panel below. Under these conditions, the competitive market theory predicts that eight units of the commodity will be exchanged at a price of $2.10. The next two panels report what actually happened when the market was put into operation in two separate experiments of five trading periods each. In these experiments market participants bought and sold one unit of the commodity per "transaction". The number of units exchanged, as measured along the horizontal axis by the number of transactions, turned out to be somewhere between seven and nine in every period. The prices at which buyers and sellers transacted, as measured along the vertical axis, varied widely during the early trading periods of each experiment; but by the last period of each experiment, all transactions were at or near the $2.10 equilibrium price.



NOTE: These results were originally reported in Vernon Smith "Bidding and Auctioning Institutions: Experimental Results," *Bidding and Auctioning for Procurement and Allocation,* ed. Yakov Amihud, New York University Press (1976) pp. 43-63. The figure appears with the permission of New York University Press.

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outcome, everything else constant. When all of the market experiments have been run, the market participants are paid their total gains from the session in cash.

Some Results of Market Experiments. Perhaps the most comforting result to come from experimental market studies is the strong tendency for auction markets to achieve the market-clearing price and quantity predicted by the competitive market model. A double auction market with a few buyers and sellers usually provides enough competition to drive the commodity price to its theoretical equilibrium price within a couple of trading periods. It seems that only a monopoly supplier can prevent the price of a product from declining to the competitive level in an auction market.[3]

On the other hand, results from experimental markets operating under different trading rules are less supportive of the competitive market paradigm. Negotiated price markets seem to converge less quickly and less directly to the competitive equilibrium than auction markets. Posted-price markets are even slower to adjust and may not converge to the competitive outcome at all. Generally when suppliers post the prices at which they will sell, the average price tends to stabilize above the competitive equilibrium level. When demanders post the prices they will pay, prices tend to stay below their competitive equilibrium level.

There is little in the way of formal theory to explain why a market's performance varies with its trading rules, but experimental economists have ventured the hypothesis that information flows play a key role. As we move from a posted-price to a negotiated-price to an auction-price format, market participants have a greater and greater opportunity to observe the terms on which others are trading and offering to trade. Access to this type of information seems to speed the market's convergence to the competitive outcome. Nonetheless, the impact of information on market performance is subtle. In one experiment, for instance, market participants' knowledge of each other's cost and redemption schedules impeded the convergence to a competitive price. In another experimental market, the researcher's release of data on suppliers' profits seemed to help them keep prices above the competitive level.

Controlled market experiments are not only helping economists isolate the conditions under which markets achieve a competitive equilibrium, they are also helping economists sort out what is happening when they do not. For instance, monopolists in experimental posted-price markets seem to achieve the higher price and restricted quantity that traditional theory suggests a profit-maximizer should, though convergence to this situation may take quite a few trading periods. Other experiments with small numbers of suppliers in non-auction markets suggest that oligopolists sometimes find some arrangement for collusion so that they can boost joint profits. For instance, when researchers ran experiments designed to mimic the major features of a barge transportation market and the market for a gasoline additive in order to address some regulatory issues, they found that adherence to certain rules for posting prices in these industries enabled suppliers to maintain higher than competitive prices.

Researchers have also used market experiments to strike out in new directions as they try to refine economists' understanding of the way markets operate. In a very practical example, one study physically separated suppliers and demanders of the commodity and then introduced a group of "middlemen" who spent one period in the suppliers' room buying and the next period in the demanders' room selling. They found that a market with a number of "middlemen" was relatively quick to achieve a

[3]This summary of experimental results is based heavily on a classic review of the literature in this area by Charles R. Plott, "Industrial Organization Theory and Experimental Economics," *Journal of Economic Literature* (December 1982) pp. 1485-1527. Another, somewhat more technical, summary is by Vernon L. Smith, "Experimental Methods in the Political Economy of Exchange," *Science* (October 1986) pp. 167-173.

competitive equilibrium. Broader in their implications are the data from experimental markets which suggest that different supply and demand conditions produce different patterns of adjustment to equilibrium: when the market demand curve has a steep slope, for instance, prices tend to start out above the equilibrium price and then decline. Economists have just begun testing some rudimentary theories that attempt to explain these kinds of patterns.[4]

...AND HELP CLARIFY HOW ASSETS ARE PRICED IN FINANCIAL MARKETS

When economists turn their attention from product markets to financial markets, considerations like buyers' tastes and sellers' operating costs move into the background and expectations play the major role. In financial markets buyers and sellers are trading IOUs—promises of future money payments—and presumably the prices at which they are willing to trade are dictated by their expectations about the value of those future payments.

According to the efficient markets theory, competition among well-informed market participants always drives a financial asset's current market price to a level which reflects the best possible forecast of its future payment stream. So the current price of a share of IBM stock, for instance, presumably would represent the best available evaluation of the dividend stream that IBM will pay in the future. Likewise, if financial markets are efficient, then the current price of an AT&T bond represents the best possible evaluation of AT&T's promise to make the interest payments and pay the face value.

At least until recently, many economists maintained that financial markets were efficient, but the October stock market crash has created some doubts. It is hard to imagine that informed market participants' best estimate of all future stock dividends could plummet by 20 percent in one day. The crash helped resuscitate a competing theory that financial markets are subject to speculative bubbles that burst. An asset's price can be bid up above its intrinsic value—the value of its expected future payout—today because some market participants believe that others will be willing to pay still more for it tomorrow. For a while this belief is self-sustaining and the market booms, but eventually participants lose faith that prices can rise further and the market crashes.

Are financial markets efficient? Do real world asset prices simply reflect a well-informed market's expectation about assets' future payout stream? Or are financial markets subject to booms and busts unrelated to changes in assets' intrinsic values? Ironically, studies of real-world financial markets cannot offer much in the way of direct answers to these important real world questions. Measuring market expectations is at the core of the problem. There are too many market participants, the possible future contingencies they must evaluate are too complex, and the constant inflow of new information changes their outlook too quickly for all of their expectations to be measured. But experimental market methods can be used to get at some answers. In an experimental asset market, the researcher can specify the payout stream of the financial asset, control the flow of relevant information to market participants, and then observe both individual and market responses. Such experiments have been run and have produced some interesting results.

Constructing an Experimental Asset Market. Experimental asset market designs are essentially multiperiod versions of experimental commodity price designs. In a typical experiment, the researcher issues each market participant some certificates which entitle the holder to dividends to be paid out at the end of each "week" of the market "year." The market "week"

[4]Vernon L. Smith, "Experimental Auction Markets and the Walrasian Hypothesis," *Journal of Political Economy* (August 1965) pp. 387-393 reports on a study of convergence paths to equilibrium in an experimental market. The study involving middlemen is reported by Charles R. Plott and Jonathan T. Uhl in "Competitive Equilibrium with Middlemen: An Empirical Study," *Southern Economic Journal* (April 1981) pp. 1063-1071.

is actually a trading session lasting several minutes; a market "year" may consist of two, three, or more market "weeks." Each participant is told what the dividend payout will be on any certificate that she holds at the end of a period, or at least told the probability distribution of the dividends—for instance, trader C may be told that for any certificate she holds at the end of "week" two she has a 50-percent chance of receiving a $1.00 dividend and a 50-percent chance of receiving no dividend. Participants are not told what payouts the other traders can expect.

The experimenter also announces the trading rules: usually experimental asset markets are organized as double auctions, just as a real-world exchange would be. Trading then begins. The experiment usually runs for several market "years" with the researcher recording all bids, offers, and transactions. The experiment can then be repeated with some alteration in experimental design in order to provide data about the impact that changing some feature of the financial environment has on the market outcome.

Experimental Evidence about Asset Market Behavior. Results from simple asset market experiments are consistent with the idea that asset markets are efficient.[5] But efficiency seems to be a fragile attribute. Studies have shown that relatively minor modifications to a simple design can easily destroy efficiency in an experimental asset market.

In the most basic asset market designs, the experimental market is run for several "years" of two or three "weeks" each, with the same weekly distribution of dividends every year. In these cases, traders tend to pick up the pattern in market prices quickly. After a few market years, each week's asset prices settle at levels consistent with the expected value of market participants' dividend streams over the rest of the market year. But in an experiment where the dividend distributions are systematically shifted from year to year, asset prices do not converge to efficient levels and fail to follow any discernible pattern. More dramatically, a batch of experiments in which the market year was simply extended to fifteen or more weeks consistently produced a speculative "boom-bust" cycle for the first couple of years. It seems that when an asset's maturity is a long way off, market participants lose sight of the dividend payments the asset is expected to yield over its lifetime and focus instead on the potential for reselling the asset at a higher price later. Only when the asset's time of maturity draws near does its expected payout become the focus of traders' attention. So there is a pronounced tendency for asset price bubbles to arise early in the market year, and for these bubbles to burst at the end as prices plunge to the efficient market price. In some of these experiments the subjects were businesspeople, not students, suggesting that it is lack of experience with a particular market situation, not an overall lack of business experience, which contributes to the speculative market behavior.[6]

Variations in experimental asset market design have produced some other interesting pieces of evidence about the way financial markets work. In one set of experiments, some traders were given "inside information" about what future

[5]Two frequently cited studies of experimental asset markets are: Robert Forsythe, Thomas R. Palfrey, and Charles R. Plott, "Asset Valuation in an Experimental Market" *Econometrica* (May 1982) pp. 537-567; and Daniel Friedman, Glenn W. Harrison, and Jon W. Salmon, "The Informational Efficiency of Experimental Asset Markets" *Journal of Political Economy* 92(3) (1984) pp. 349-408. Both articles lay out their methodology very clearly and both present results which support the efficient markets hypothesis.

[6]The nonconvergence results are reported by Arlington W. Williams and Vernon L. Smith in "Cyclical Double-Auction Markets with and without Speculators," *Journal of Business* (January 1984) pp 1-33. The boom-bust cycles are reported by Smith, Gerry L. Suchanek, and Williams, "Bubbles, Crashes and Endogenous Expectations in Experimental Asset Markets," Working Paper No. 86-2, Department of Economics, University of Arizona (forthcoming in *Econometrica*). After the recent stock market crash, Professor Smith's experimental asset market work was discussed in *The Wall Street Journal* (November 16, 1987) p. 51.

dividends on the certificates would be. The researchers found that such information was quickly reflected in the asset's market price. In several experiments, futures markets were added to allow traders to buy and sell certificates for delivery one or two "weeks" in the future. Here researchers found that the addition of futures markets reduces price volatility and speeds the convergence to efficient pricing in the spot market. In another interesting twist, market participants were prescreened and divided into two groups, more risk averse and less. Each group participated in an experimental asset market of identical design. From this experiment, the researchers concluded that less risk averse traders, those who might be termed speculators, make prices more volatile, but also help the market achieve an efficient asset price more quickly.[7]

CONCLUSION

Experimental economics—observing the behavior of subjects in controlled market environments—is giving economists the opportunity to test their assumptions and theories about market outcomes in ways that the more traditional studies of "real world" markets cannot. Much of the experimental work that has been done so far is supportive of traditional economic theory. For instance, economists' standard assumptions that product markets are competitive and that asset markets are efficient are consistent with much of the evidence from experimental markets. On the other hand, experimental work has also demonstrated that there are some important gaps and shortcomings in standard economic theory. Observing the behavior of experimental markets underscores the fact that market adjustments are not always quick, smooth, or certain.

Taking a more positive perspective, experimental economics not only points out the need to develop economic theory, but also helps economists frame new theories and provides the tools for testing them. For instance, market experiments have demonstrated that market information influences individuals' expectations and decisions in complex ways. But experiments have also provided some data to help refine economists' theories about individuals' expectations formation and decisionmaking processes. Some of this work has taken a look at some of the traditional expectations hypotheses in economics; some has tapped into psychologists' and other social scientists' theories of learning and decisionmaking.[8]

Experimental economics is a relatively new tool that researchers have developed to take a closer look at the way markets operate. So far they have put some relatively simple market structures under this new "microscope," but seeing even these simple structures up close is changing their perspective on how real world markets function.[9]

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[7]Charles R. Plott and and Shyam Sunder, "Efficiency of Experimental Security Markets with Insider Information: An Application of Rational Expectations Models," *Journal of Political Economy* (1982) 90(4) pp. 663-698 investigate the impact of inside information. The previously cited studies by Forsythe, Palfrey and Plott and by Friedman, Harrison and Salmon introduce futures markets to their experiments. The role of risk-aversion was addressed by James S. Ang and Thomas Schwarz, "Risk Aversion and Information Structure: An Experimental Study of Price Variability in the Securities Markets," *Journal of Finance* (July 1985) pp. 825-844.

[8]Arlington W. Williams, "The Formation of Price Forecasts in Experimental Markets," *Journal of Money, Credit and Banking* (February 1987) pp. 1-18, reports on attempts to survey market participants' expectations and model them directly. The evidence of adaptive expectations formation that Williams found is consistent with the notion that repetition of a market situation facilitates achieving the efficient markets outcome. The *Journal of Business* 59(4) pt. 2 (October 1986), in a special issue containing the proceedings of a conference entitled "The Behavioral Foundations of Economic Theory," gives some indications of how experimental economists' work ties into that of other behavioral scientists.

[9]Alvin E. Roth, "Laboratory Experimentation in Economics," *Economics and Philosophy* 1986(2) pp. 245-273 presents an enlightening perspective on the potential contributions of experimental economics as well as a thought-provoking discussion of some recent experimental results. Ken Binmore, "Experimental Economics," *European Economic Review* (1987) pp. 257-264 makes a thoughtful case for the usefulness of experimental economics.