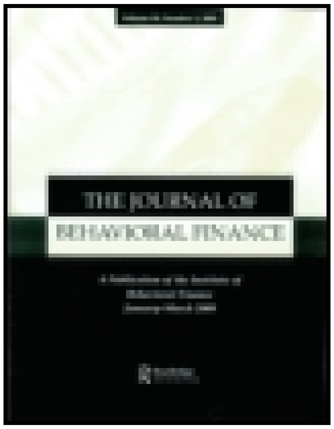

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The Foundations of Experimental Economics and Applications to Behavioral Finance: The Contributions of Nobel Laureate Vernon Smith

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EDITORIAL COMMENTARY

The Foundations of Experimental Economics and Applications to Behavioral Finance: The Contributions of Nobel Laureate Vernon Smith

The Nobel Prize for Economics announced in October 2002 has a special significance to our journal and those associated with it. The Nobel committee awarded the prize to Vernon Smith and Daniel Kahneman, citing their contributions to the foundations of experimental and behavioral economics. In this issue's editorial we discuss the research work of Vernon Smith, a member of the Editorial Board of the Journal of Behavioral Finance since its inception and a frequent contributor. Our next editorial will focus on the work of Daniel Kahneman.

Experimental Economics

More than any other individual, Vernon Smith has shaped the evolution of experimental economics and has been the primary exponent for the development of economics as an experimental science. As noted by the Royal Swedish Academy of Sciences [2001], economics has been viewed as a "non-experimental" science that can only rely on field data. In particular, they quote the basic economics text (Samuelson and Nordhaus, [1985], p. 8):

> Economics…cannot perform the controlled experiments of chemists or biologists because [it] cannot easily control other important factors. Like astronomers or meteorologists, [it] generally must be content largely to observe.

Of course, meteorology does rely on experiments on physical concepts like fluid flow and pressure that can be tested in the laboratory. There is a complex process, usually involving differential equations, which transforms laboratory results into equations that can be used in large-scale computations to render predictions on the weather. A similar process applies to astronomy. In both cases there are scientific procedures that enable researchers to make the transition between the laboratory size and that of the Earth or the universe.

The early development of experimental economics has already given us insights into markets and the behavioral aspects of trading as well as important specific predictions. For example, Smith observed from experiments that daily limits on price changes as well as circuit breakers (the measures instituted by exchanges to suspend market activity when the price change exceeds a designated amount) fail to stabilize a market and may, in some cases, aggravate collapsing prices.

The Early Years of Experimental Economics

Smith's early work in experimental economics was motivated by a classroom experiment of one of his professors, Edward Chamberlain. The story of the first economic experiments is described in a very interesting and detailed manner by Ross Miller [2002] in his recent book, Paving Wall Street. In the 1940's Chamberlain sought to simulate market mechanisms by designing an experiment in which about 30 buyers and 30 sellers walked around the room and made deals based upon each seller's cost and each buyer's value for the goods. No monetary or grading rewards were awarded to the students based upon the outcome. Although Chamberlain did not analyze the results in detail, it was clear that the market was not completely efficient, and appeared to confirm his theory of monopolistic competition (Miller [2002]).

A few years later, in 1956, as Vernon Smith taught an introductory economics class, he performed an experiment that was philosophically similar. However, instead of having students walk around the room and miss potentially useful trades, he used a blackboard and structured the market like a stock exchange. Using an open order book, and repeating the auction process, Smith observed that participants gradually learned the rules and were able to trade at near-optimal prices. In fact, a market for goods yielded near equilibrium prices with as few as eleven buyers and eleven sellers (Miller [2002]).

Thus, an early discovery Smith made is that theoretical equilibrium for goods can be attained by a fairly small number of buyers and sellers in a reasonable time frame. This is significant in terms of the foundations of experimental economics since it indicates that markets do not require thousands or millions of participants in order to achieve equilibrium predictions. Smith continued his work on different types of auctions (e.g., English, Dutch) and their ramifications on resulting prices.

As this new area of economic science developed, Smith considered the basic requirements in terms of methodology. A key component of experiments in economics is the sufficient monetary incentives given to the subjects. Moreover, the experimentalist designs the trading mechanism and rules and an asset or good, and allows the subjects to trade. The initial endowment given to the subjects can be augmented or lost, so the real incentives and risks are present as they would be in field markets. Unlike laboratory experiments in most of psychology and decision theory, the economics experiment is more like a small market that can resemble the large field markets but has the advantages of repeatability and the possibility to modify conditions to test hypotheses as they are refined.

Smith's work over four decades has had enormous implications for a broad spectrum of economic theories. These include the design of markets in areas like utilities deregulation, privatization, and the provision of public goods. This work in collaboration with Rassenti and Bulfin [1982] has spawned a new field in economics called Economic Systems Design. It is now possible to design new exchange systems for a variety of assets (e.g. emissions, landing slots, spectrum) and test them in the laboratory where errors in design are less expensive to repair than in the field. For example, ordinary limits on emissions and industrial pollutants are inadequate in that they do not account for growth of the number of factories, and there is no mechanism for deciding whether the total emissions exceed safe limits. The introduction of a market for trading the portions of the total allowable emission resolves these problems. Furthermore, such a market ensures that the utilization of the emission rights is not done wastefully, i.e., one does not emit a large amount of pollution for a small economic benefit. Similar markets are in the early stages of implementation in airport landing sites and airwave auctions. The era of the economist as engineer has just begun with Vernon Smith as the founder and leader.

The Bubbles Experiments

In recent years, a large part of Smith's attention has also been focused on the psychology and decision making process that accompanies trading. One of the most interesting of the experiments that Smith has designed are undoubtedly those that induce price bubbles. In a typical bubbles experiment, an asset is traded that is known to have expected payout of $1 at the end of each of 15 trading periods. Hence, the fundamental value is represented by a straight line with values of $15 during period one, to $1 in period 15. With the asset defined so transparently in this way, any believer in the efficient market hypothesis (EMH) cannot expect anything but a declining trading price that is just random noise plus the fundamental value. This expectation becomes even stronger if one removes any randomness involving the payout by defining the payout to be exactly $1. By now experiments such as this have been repeated hundreds of times under numerous modifications by different researchers. In a typical experiment, the asset usually begins trading well below the fundamental value of $15. Prices start rising soon thereafter, and after several periods, the trading price is at the level of the fundamental value.

At this point the real puzzle begins. After all, there may be several ways of explaining the undervaluation for several periods. But once the fundamental value has been reached, anyone with faith in the EMH would certainly expect the trading price to evolve toward the fundamental value, i.e., decline by $1 during each of the remaining periods. The paradox, however, is that the trading price generally continues to increase and appears oblivious to the decline in the fundamental value. Thus traders are paying for example $12 for an asset that, by definition, will only pay them at most $7. The trading price generally increases until a few periods are left in the experiment. At this time the bids become more scarce and the price drops precipitously.

This challenge to classical economics received considerable attention from a broad spectrum of economists. The response of the classical theorists centered around assertions that the experiments were somehow different from financial markets. These included (i) the use of students rather than professional traders or business people; (ii) the absence of short selling, (iii) the absence of margin trading, and the absence of a futures market. As discussed in the Porter and Smith article reprinted in this issue, experiments were performed to address each of these issues. It was observed that short selling and margin trading resulted in a larger bubble. One of the largest bubbles occurred when professional traders were participants in the experiment.

While none of these factors diminished to bubble, an important observation was made by Smith, Suchanek and Williams [1988]. There is little uncertainty regarding the asset, so that any uncertainty must be related to the anticipated behavior of the other traders. This suggests the insight that using the same group of traders in a second and third experiment will diminish the size of the bubble. In fact experimentation showed that this is one factor that will essentially eliminate the bubble by the third round. While this result appears to be a comfort to the EMH, it is muted by the fact that new participants are entering the world's financial markets each year. Thus experience as a group allows the participants to relate the orders and price changes to the intentions of the other players, and understand that there may not be a buyer for every seller. The enticing idea of buying an overvalued asset with the hope of selling it at an even more overvalued price becomes less appealing once it becomes clear that the group of participants does not include a "greater fool."

The general perspective in the asset market experiments is that the experimenter defines a market, and the observations created by the market participants lead to directions for research. In the bubbles experiments, Vernon Smith initially sought to establish baseline experiments in which trading would be close to the expected payout (fundamental value) at each stage in time. To his surprise the experiments bubbled without any additional ingredients. The completely endogenous nature of the bubble and ensuing crash led Smith to an important insight: traders' reactions to their own profits and losses, and the reaction of other players is a key component of price dynamics in markets.

New Directions in Behavioral and Experimental Economics

As noted above, none of the criticisms of the bubbles experiments actually led to elimination, or even reduction, of the bubble. Early on, Smith discovered that experience as a group led to diminishing bubbles. Since new participants are always entering financial markets, this factor is not very encouraging for the efficient market hypothesis. Subsequent research has focused on understanding the dynamics of bubbles based upon behavioral concepts (Caginalp, Porter and Smith [2001]). Momentum was hypothesized to have an important role in the bubble: an asset that was initially undervalued attracted value investors. As prices begin to rise, the uptrend attracts the attention of other players; prices move up and eventually, the prices move through the fundamental value. An experimental test of the momentum hypothesis was conducted by using collars to restrict trading during the first period only to be within a particular price interval. Thus, the momentum hypothesis that was borne out by experiment stipulates that the bubble will be larger when the collar is set lower.

Another key ingredient in the formation and magnitude of bubbles was found to be the level of cash endowment relative to share value. In other words, excess cash provides the fuel for the bubble. The experimental results showed that an additional dollar per share of excess cash raises the maximum price of the bubble by almost one dollar.

A third factor that may play a key role is the concept of an open bid–ask book. When traders can view the full list of bids and asks, there is some evidence that the bubble is diminished. In particular, the bid–ask book makes it apparent that the volume of bids is becoming thin, even as the bids become higher. Hence, the incomplete information in markets may be a significant factor in the magnitude of a bubble.

A discussion of these aspects of bubbles, and the motivation from the differential equations and statistical models can be found in see Caginalp, Porter and Smith [2001] and references contained therein.

Experiments in Game Theory

Much of the foundation of modern economics is built around game theory and the assumptions that each person optimizes his own opportunities, assuming in turn that all other players do the same. The asset market experiments suggest that the underlying assumptions such as reliance on others' optimization need to be reconsidered. An important component of experimental economics has involved the testing of such assumptions.

The simplest of these experiments (Davis and Holt [1993]) is called the ultimatum game in which player A is given a sum of money, say $100 and asked to distribute it between himself and player B. Player B does not have any say on the distribution, but has the choice of rejecting the arrangement and receiving nothing, or accepting the allocation. Under the standard assumptions of game theory, player B should accept any sum and thereby optimize his opportunities. Since player A recognizes this obvious optimization calculation for player B, player A can optimize his fortunes by offering the minimum allocation, say $1 to player B.

Another version of these experiments, pioneered by Berg, Dickhaut, and McCabe (1995) is called the investment game in which player A is given a sum of money, say $10 and given the opportunity to send some amount to player B with the common knowledge that whatever is sent will triple when it reaches player B. Player B can then choose to reciprocate by sending some of the tripled amount back to player A. Non-cooperative game theory predicts that player B should keep all the money, and player A realizing this should send nothing.

When real subjects played this game double-blind with real dollars, an average of $5 was sent with a number of players sending the whole $10. Did player B's keep all the money, as predicted? No. As many as 1/3 of the player B's reciprocated by sending back more to player A than was originally sent. Why do player B's behave this way? It is not simple benevolence as demonstrated by the double-blind dictator games published in Hoffman, McCabe, Smith [1996]. Instead, McCabe and Smith [2000] argue it is the reciprocal nature of the exchange that motivates subjects to commit to behavior that promotes mutual interests.

Many follow up experiments, see McCabe and Smith [2000] have shown that such reciprocity works best in conditions of personal (and better yet repeated) exchange, and is context dependent. Hoffman, McCabe, and Smith [1996] argue that reciprocal behavior in personal exchange is best explained as an evolutionary adaptation. Their argument can be further developed using the modern tools of evolutionary game theory, and computational agents.

Neuroscience and Economics

The magnitude of the deviations from classical expectations exhibited in both the bubbles and the game theoretic experiments suggest that the decision making process is considerably more involved than classical optimization would suggest. One perspective toward understanding this process is made possible by advances in brain imaging research that enable one to measure, using in vivo technology, both single cell firing in animals, and "Bold" activations in humans. These studies can be combined with individual case studies in humans who have experienced brain injuries resulting in the loss of certain brain regions, as well as in animals where lesions have been induced by the experimenter. In addition, newer techniques, involving brain stimulation that in turn produces certain neural outputs, or even behaviors, provide confirmation of computational models of the neural circuitry required for economic behavior.

Examples of such research which is evolving into the new field of neuroeconomics can be found in McCabe et al [2001] and references contained therein.

Conclusion

The Nobel Prize awarded to Vernon Smith honors a lifetime of accomplishments. It also recognizes that important new directions for future research have been created. As these fields develop, it is likely that new paradigms will be found, and both academicians and practitioners will begin to view economic phenomena from a profoundly different perspective. These paradigms will provide for a better integration of behavioral concepts in finance with psychology and neuroscience, as well as the design of markets. One can expect that the results will benefit many through more efficient and viable markets.

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