
BOOK REVIEWS

A Review of Microscopic Simulation in Financial Markets: From Investor Behavior to Market Phenomena and An Introduction to Econophysics: Correlations and Complexity in Finance

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Microscopic Simulation in Financial Markets: From Investor Behavior to Market Phenomena, Haim Levy, Moshe Levy and Sorin Solomon, 2000, New York: Academic Press, 300 pp.

An Introduction to Econophysics: Correlations and Complexity in Finance, Rosario Mantegna and H. Eugene Stanley, 1999, New York: Cambridge University Press, 148 pp.

These books are the latest and most relevant of a new genre demonstrating the application of techniques from Statistical Physics to the study of Financial Markets. Use of Statistical Physics concepts such as stochastic dominance, self-similarity and scaling and nonlinearity, etc. often permit the study of the global behavior of a system without first having to work out a detailed microscopic description of the system. A principal process discussed in these books involves the use of computer simulation to investigate the macro behavior of a financial system. This methodology is known under different names, such as microscopic simulation, microsimulation and agent-based simulation. The primary advantage of MS is that it does not require one to make simplifying assumptions for the sake of tractability. The technique is now widely used in the natural sciences but is new to the social sciences. The Santa Fe Institute has become a leader in the application of MS and other Statistical Physics techniques to economic problems.

Traditional financial modeling has employed differential equations solved by analytical means. This approach is limited as a device to understand the macro

behavior of financial markets for two reasons. First, such techniques incorrectly assume that financial markets exhibit continuous behavior. Second, and more importantly, these techniques generate invalid results where the microscopic agents are autocatalytic. Autocatalytic behavior leads to the generic emergence of phenomena that are not present in the microscopic agents themselves. Bubbles and crashes in stock prices are examples of emergent behavior related to autocatalytic processes. Much evidence now indicates that financial markets are characterized by formal complexity and autocatalytic behavior. The mathematical description of formally complex system behavior leads to equation systems that are intractable. Up to this point, most Economists and Finance researchers have been willing to sacrifice detailed quantitative confrontation with the empirical data for the sake of closed tractable models. This position now appears to be indefensible. Experimental Economists have attempted to deal with some of the shortcomings of existing modeling by conducting “controlled experiments” with subjects making decisions in artificial market settings. In general this procedure is subject to limitations related to sample size and the “reality” of the hypothetical market setting.

Naturally, successful application of the microscopic simulation technique still requires an accurate description of individual agent’s decision processes. However, it does not appear to require a very detailed set of descriptions in order to produce useful results. Thus, this type of modeling is not a substitute for Behavioral Economics or Finance research where the emphasis is on individual and small group behavior, since such research provides the “grist” used in the simulation process. As a rule, microscopic simulations of complex systems have shown that future states of such systems are only very imperfectly predictable, if predictable at all. This is not a good omen for those intent on accurately predicting stock market behavior.

Microscopic Simulation of Financial Markets by Levy et al. has three basic parts. First, it contains a de-

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scription of the current finance equilibrium models such as the CAPM, Arbitrage Pricing and Black Scholes Option Pricing Model. Also included is pertinent information about Prospect Theory. Second, it contains a not overly detailed description of the microsimulation process and brief discussions of microsimulation by other financial researchers. Third, it presents microsimulation results for the U.S. stock and option markets. The basic conclusion reached is that actual market behavior can be seen to be the natural outcome of the interaction of quasi rational investors with heterogeneous expectations. In particular, such market phenomenon as short term over reaction, longer term under reaction, excess volatility, the small firm effect and the tendency for investors to hold poorly diversified portfolios are simultaneous results of investor behavior that are not of the traditional expected utility variety. That is, investors tend to exhibit behavior more like that suggested by prospect theory, but with a tendency to engage in some affectively based herding.

An Introduction to Econophysics by Mantegna and Stanley is far more focused on statistical physics issues and techniques rather than on a description of market equilibrium per se. In particular, it discusses such topics as random walks, various stochastic models, ARCH and GARCH processes, correlation and system turbulence in detail. The point of view taken is that stock price dynamics arise out of a nonlinear process that results from complex feedback. This concisely written book is not a substitute for the Levy book. It should appeal to those with a more statistical bent who want a concise overview of the relevance of Statistical Physics for Economic issues.

If you are interested in the (market wide) equilibrium implications of behavioral finance, these two books are a great place to start. They are well written and edited with very complete references and citations. A lot of the original research has been scattered across non-economic journals and is difficult to otherwise locate.

