

## AKSOE 12 Economic Models and Evolutionary Game Theory II

Time: Thursday 10:15–12:45

Room: BAR 205

AKSOE 12.1 Thu 10:15 BAR 205

**A Network Model of Company Growth** — ●MICHAEL KOENIG, STEFANO BATTISTON, and FRANK SCHWEITZER — Chair of Systems Design, ETH Zurich, CH-8092 Zurich, Switzerland

We study a network model of company growth in which each node represents a company. Growth of a company is described by means of a differential equation that includes a stochastic auto-catalytic term as well as terms for the interaction with other companies. These interactions contribute positively to growth and can be interpreted as the sharing of knowledge. Global couplings stand for limited resources and external conditions, e. g. market restrictions imposed by governmental institutions.

We test several local rules of network formation which specify how companies choose other companies to cooperate with. All these rules assume selfishness and bounded rationality, the latter meaning that each company has only local information on the network topology and makes decision on a trial and error basis.

By means of computer simulations we investigate the conditions for the emergence of non-random structures. We observe that some specific rules lead to the appearance of alliances of cooperating companies, the formation of hubs (companies that are highly connected) and structures with a hierarchy of size levels. We find that during the evolution of the network starting from a random graph, the clustering coefficients and other quantities related to the length of cycles display abrupt changes reflecting the appearance of hierarchical structures.

AKSOE 12.2 Thu 10:45 BAR 205

**Stock markets as adaptive controllers** — ●KLAUS PAWELZIK and ROLAND ROTHENSTEIN — Inst. f. Theor. Physik, Otto-Hahn Allee, D-28334 Bremen

Price time series from large speculative markets exhibit power law distributions of returns and temporal correlations of fluctuation amplitudes (volatility clusters). These 'stylized facts' appear to reflect 'irrationalities' of the market's participants which challenges the hypothesis that the price dynamics cannot be exploited for making arbitrage profits. We reformulate this 'efficient market hypothesis' as successful control. Our investigations of a simple market model with nonadaptive agents indeed demonstrate that already the redistribution of goods by trade via an order book suffices to realize adaptation of the overall system which rapidly compensates the effect of predictable external drives on the price. The residual fluctuations, however, are found to remain non-gaussian if the market is dominated by speculative agents. To understand the origin of these power law fluctuations we analyse the dynamics of an optimal adaptive controller with very short memory when applied to an unstable one-dimensional system. We find that this system is attracted to a state in which the external noise is critically amplified. Analysis demonstrates that this 'self-organized critical control' generally causes power law fluctuations of the residuals. Our results suggest that the large fluctuations of returns observed in real markets rather are the necessary consequence of successful control than reflecting inefficiencies.

AKSOE 12.3 Thu 11:15 BAR 205

**Individual strategies and group dynamics in complementarity games** — ●JUERGEN JOST and WEI LI — Max Planck Institut fuer Mathematik in den Naturwissenschaften, Inselstr.22, 04229 Leipzig

We introduce and study a complementarity game where members of a population play repeated games with different, randomly drawn members of the opposite (symmetric population), and the populations are recomposed according to evolutionary schemes like genetic algorithms after fixed numbers of rounds. We can then break the symmetry between the two populations by assigning them different strategy spaces, for example building their move upon the outcomes of their previous encounters or rather on the experience of their successful neighbors in a specified or evolvable network. This leads to an interesting interplay between individual strategy adaptation and group level dynamics. the rules of the game are the following: A member of population A (called buyers) and one of member B (sellers), randomly drawn from their respective population, make each an offer  $k_A$  and  $k_B$ , between 0 and some  $K$  (e.g.=100). When  $k_A > k_B$ , a deal is concluded, and the buyer pays  $k_A$  and the seller receives  $k_B$ . If not, the seller pays  $K$ , and the buyer receives 0. When, for example, the members of A play a consis-

tent strategy of making low offers, they can force a less organized seller population into accepting such low offers eventually. The question then is how such a strategy that is good for the population as a whole can evolve from the individual gain maximizing strategies of the individual members. We present systematic comparisons and results.

AKSOE 12.4 Thu 11:45 BAR 205

**Inverse Statistics in the Stock Market: The gain/loss asymmetry.** — ●MOGENS H. JENSEN — Niels Bohr Institute, Blegdamsvej 17, DK-2100 Copenhagen.

We have consider inverse statistics of the Dow Jones Industrial Averaged (DJIA) and argue that the natural candidate for such statistics is the investment horizons distribution. This is the distribution of waiting times needed to achieve a predefined level of return obtained from detrended historic asset prices. By considering equal positive and negative levels of return, we have found a quantitative gain/loss asymmetry which is most pronounced for short horizons. In the case of individual stocks in the DJIA, we show that this gain/loss asymmetry established for the DJIA surprisingly is not present in the time series of the individual stocks. The most reasonable explanation for this fact is that the gain/loss asymmetry observed in the DJIA as well as in the SP500 and Nasdaq are due to movements in the market as a whole, {it i.e.}, cooperative cascade processes (or synchronization) which disappear in the inverse statistics of the individual stocks. We present an asymmetrical synchronous model for this observation where the market as a whole exhibits a gain/loss asymmetry but where all the individual stocks are symmetric.

AKSOE 12.5 Thu 12:15 BAR 205

**The working of circuit breakers within percolation models for financial markets** — ●GUDRUN EHRENSTEIN<sup>1</sup> and FRANK WESTERHOFF<sup>2</sup> — <sup>1</sup>Institute for Theoretical Physics, Cologne University — <sup>2</sup>Department of Economics, University of Osnabrueck, Rolandstrasse 8, D-49069 Osnabrueck, Germany

We use a modified Cont-Bouchaud model to explore the effectiveness of trading breaks. The modifications include that the trading activity of the market participants depends positively on historical volatility and that the orders of the agents are conditioned on the observed mispricing. Trading breaks, also called circuit breakers, interrupt the trading process when prices are about to exceed a pre-specified limit. We find that trading breaks are a useful instrument to stabilize financial markets. In particular, trading breaks may reduce price volatility and deviations from fundamentals.