SOE 21: Economic Models and Evolutionary Game Theory II

Time: Thursday 15:30–17:00 Location: H 0110

SOE 21.1 Thu 15:30 H 0110

Financial bubbles from opinion formation with feedbacks — •Sebastian M. Krause and Stefan Bornholdt — Institut für Theoretische Physik, Universität Bremen, Otto-Hahn-Allee, 28359 Bremen

Herding behavior is at the basis of financial bubbles and crashes. Opinion formation mechanisms in this field (ranging from conversation among investors to political regulation) are affected by the overall system state. An illustrative example is the influence of panic on discussions.

The modified Ising model in [1] incorporates a global feedback as a plausible representation of reactions to market imbalances [2]. Such global feedbacks are missing in most opinion formation models. However, in markets there are macroscopic quantities visible for every agent as, for example prices of assets. We here present an opinion formation model related to the voter model and introduce a feedback representing the response behavior of single agents to their neighbors. Despite its simplicity, our model shows a rich dynamics. We observe metastable, balanced, and ordered states which are absent in the system without feedback.

[1] S. Bornholdt, Expectation bubbles in a spin model of markets: Intermittency from frustration across scales; Int. J. Mod. Phys. C 12 (2001) 667-674.

[2] S. M. Krause and S. Bornholdt, Spin models as microfoundation of macroscopic financial market models (2011) arXiv:1103.5345v1.

SOE 21.2 Thu 15:45 H 0110

An approach to stochastic social modeling: the second moment variables — •Felipe Lara-Rosano — Universidad Nacional Autonoma de Mexico, Mexiko Stadt, Mexiko

In this paper we introduce the second moment probabilistic approach as a way to model uncertainty in social phenomena like risk management. In order to express uncertainty in second moment terms, we will adopt a subjective or Bayesian probabilistic approach.

A second moment random variable (vector), SMRV, is a random variable (vector) for which the mean value (vector) and the variance (covariance matrix) have been assigned. Different random variables having different probability distributions but identical mean value and variance are then identical as second moment random variables. Also a SMRV defines a random vector only to within the class of random vectors that have the given mean vector and covariance matrix. This approximation is often sufficient for social and management applications. In fact in economic forecasting and decision making it is usual to consider only expected values as a first approximation.

Considering the fact that most social data are collected in a discrete way, for instance, from year to year, we will refer in this paper to time series analysis. We will show how a second moment markovian sequence can be used to model vector time series and how it can be manipulated as the state vector of a linear discrete dynamic system, offering a wide field of applications.

SOE 21.3 Thu 16:00 H 0110

Universality in time-lagged return correlations - a generalization of the Epps effect — •Jürgen Stockburger and Daniel Jaschke — Institut für Theoretische Physik, Universität Ulm

Statistical correlations of asset returns are essential parameters of portfolio theory. However, correlation coefficients generally decrease considerably when very short return intervals are considered [1,2,3]. The dual constraints of a large enough return interval and a maximum time interval compatible with the assumption of stationarity therefore appear to pose a fundamental constraint on the accuracy of empirically determined correlations. Here we propose to circumvent this constraint by including time-lagged correlations of short-time returns in the analysis, allowing the consideration of arbitrarily small time intervals as well as tuning the analysis for the specific time horizon of an investment decision. Extensions of the procedure at ultrashort times due to a transition from classical, correlation-based analysis to microstructure-based strategies are discussed.

[1] Epps, T. W., J. Am. Statist. Assoc., **74**, 291 (1979)

[2] Tóth, B. and Kertész, J., Quant. Fin. Routledge, **9**, 793 (2009)

[3] Münnix, M. C., Schäfer, R. and Guhr, T., arXiv:1009.6157

SOE 21.4 Thu 16:15 H 0110

Microscopic herding model leading to long-range processes and 1/f noise with application to absolute return in financial markets — •Bronislovas Kaulakys, Vygintas Gontis, Aleksejus Kononovicius, and Julius Ruseckas — Institute of Theoretical Physics and Astronomy, Vilnius University, A. Gostauto 12, LT-01108 Vilnius, Lithuania

Starting from agent-based Kirman's herding model we obtain and analyze the nonlinear stochastic differential equations (NSDE) for the ratio of number of agents [1]. We provide evidence that for some value of the parameters the strong herding behavior yields NSDE of the form of Refs. [2] for the long-range processes with the $1/f^{\beta}$ noise. The nonlinear terms in the transition probabilities are crucial for the herding dynamics and for appearance of the long-range power-law correlations and distributions with the diverging variance [2]. Application of the model for description of the absolute return in financial markets [3] will be presented.

[1] J. Ruseckas, B. Kaulakys and V. Gontis, EPL, *Herding model and 1/f noise* (Accepted).

[2] B. Kaulakys and M. Alaburda, J. Stat. Mech. P02051 (2009); J. Ruseckas and B. Kaulakys, Phys. Rev. E **84**, 051125 (2011).

[3] A. Kononovicius and V. Gontis, Physica A **391**, dx.doi.org/10.1016/j.physa.2011.08.061 (2012).

SOE 21.5 Thu 16:30 H 0110

Fundamental proof of S-functional trade-offs in long term economic growth — •Hans Danielmeyer and Thomas Martinetz — Institut für Neuro- und Bioinformatik, Uni Lübeck

There is only one and the same time passing by. Either mankind produces more with more working time, or has more spare time at home for enjoying whatever is produced. In three lines of straight physics we show that just this fundamental trade-off leads to the observed S-functional growth and to inevitable final trade offs between the per capita quantities and their growth rates: increasing annual output (GDP, G7 current mean at 30.000 € p. a. per capita) with decreasing growth rate since 1950, and increasing national wealth (physical capital PC, G7 current mean 120.000 € p.c.) with decreasing growth rate. Not knowing anything about these trade-offs caused the accumulation of public debt, private fortunes, and the banking disaster with surplus investment capital.

There are still no adjustable parameters, just the national saving constant and three constants of the human species. Easily measurable time shifts between the normalized national pairs of GDP and PC confirm the effective lifetime of the destructible PC (25 years according to EU's Central Bank) and the existence of a second but per capita indestructible storable quantity with a lifetime of 62 years. They correspond to national recoveries and the collective industrial evolution.

SOE 21.6 Thu 16:45 H 0110

Modelling of annual European Union household incomes by using an equilibrium solution of the threshold Fokker-Planck equation — •Maciej Jagielski and Ryszard Kutner — Institute of Experimental Physics, Faculty of Physics, University of Warsaw, Hoża 69, PL-00681 Warszawa, Poland

We derived, in the frame of the threshold nonlinear Langevin dynamics and its threshold Fokker-Planck counterpart, a unified formula for description of the annual income of households, for instance, for the European Union in 2006 and 2008. Our formula is more generic than the well known that of Yakovenko as it is valid (by varying driving parameters) for all society classes, including the high-income class. This single unified formula well describes known stylised income facts. That is, it gives the Boltzmann-Gibbs income distribution for the low-income society class and the weak Pareto law for the middle-income class as it expected, while it predicts (to satisfactory approximation) the Zipf law, as expected, for the high-income class.