SYEF 1: Statistical Physics of Economic and Financial Systems

Time: Thursday 9:30–12:15 Location: H 0105

Invited Talk SYEF 1.1 Thu 9:30 H 0105

Economic Complexity Theory and the General Economic Theory: Applying Synergetics — •Wei-Bin Zhang — Ritsumeikan Asia Pacific University, Beppu city Japan

The speech shows how to deal with the complexity of socioeconomic evolution with the vision of synergetics (Synergetic Economics) and a broad socioeconomic theory (The General Economic Theory). First, I illustrate the importance of the contemporary advances in sciences for understanding complex phenomena of man and society. I developed synergetic economics, the generalization of Samuelson's Foundation, in the late 1980s under the influence of Prof. Hermann Haken's synergetics. Then, I illustrate the general economic theory which is composed of a set of mathematical equations that treats all the main economic theories from Adam Smith, Malthus, Karl Marx, and Keynes to the contemporary mainstreams of economic theory within a single comprehensive framework. Finally, I mention how to examine unlimited complexity of dynamic interdependence between macroeconomic growth, microeconomic behavior, science, and technology in the light of synergetics (complexity theory) and general socioeconomic theory.

Invited Talk SYEF 1.2 Thu 10:00 H 0105

Opinion Formation in the World Trade Network — •Dima Shepelyansky — Lab Physique Theorique, CNRS, Toulouse, France

An approach of opinion formation is applied to the world trade network (WTN) obtained from UN COMTRADE database for years 2010-2022. Also the Google matrix methods are used to determine trade relations between countries. The trade preference of countries to perform their trade in USD, EURO or CNY are determined. An effect of possible BRICS currency is analyzed and its dominance is established in the frame of mathematical analysis of WTM flows.

Ref.1) C.Coquide, J.Lages, and D.L.Shepelyansky, "Dollar-Yuan battle in the World Trade Network", MDPI Entropy v.25, p.373 (2023) Ref.2) C.Coquide, J.Lages, and D.L.Shepelyansky, "Prospects of BRICS currency dominance in international trade", Appl. Netw. Sci. v.8, p.65 (2023)

Invited Talk SYEF 1.3 Thu 10:30 H 0105

Transfer Entropy in financial stock markets — •Leonidas Sandoval — Insper, São Paulo, SP, Brazil

Transfer Entropy is a concept associated with information theory. It measures the amount of information about the time series of one variable that can be inferred from the time series of another variable. There are many applications of this concept, in neuroscience and a diversity of fields, including finance. It has the benefits of being causal (in the sense of Granger causality) and model independent. We will show how Transfer Entropy may be used in the building of networks of financial stock market indices, stocks and commodities, using the US stock market, the European stock market, and the German Stock market as examples. We will also explore how Transfer Entropy may be used in order to build more robust portfolios, and how it may be used in the study of the propagation of financial crises.

15 min. break

Invited Talk SYEF 1.4 Thu 11:15 H 0105

Statistical-Physics Theory of the Long Memory in Market-Order Flows and its Empirical Validation in the Tokyo Stock Exchange — •Kiyoshi Kanazawa — Kyoto University, Kyoto, Japan

In financial markets, the market-order flow ubiquitously exhibits persistence. In other words, if one observes a buy (sell) market order, it is likely that one observes a buy (sell) market order even in future. This property is called the long-range correlation (LRC) and can be quantitatively characterised by the order-sign auto correlation function (ACF). By writing a buy (sell) at time t as $\epsilon(t) = +1$ ($\epsilon(t) = -1$), the ACF obeys the power-law decay such that $C(\tau) := E[\epsilon(t)\epsilon(t+\tau)] \propto c_0\tau^{-\gamma}$ with the prefactor $c_0 > 0$ and the exponet $\gamma \in (0, 1)$.

In this talk, we study the microscopic origin of the LRC both theoretically and data-analytically. We first report on the theory of a generalised Lillo-Mike-Farmer (LMF) model as the microscopic statistical-physics model for the market-order flow. The LMF model was a theoretical model proposed by Lillo, Mike, and Farmer in 2005 based on the order-splitting hypothesis by assuming the homogeneity of trading strategies. We propose its generalised version by incorporating the heterogeneity of trading strategies and derive the theoretical formula predicting c_0 and γ. We then validate the theoretical predictions of the LMF model by studying the microscopic dataset in the Tokyo Stock Exchange.

Invited Talk SYEF 1.5 Thu 11:45 H 0105

Ergodicity Economics and the Insurance Problem — •Benjamin Skjold, Ole Peters, and Colm Connaughton — London Mathematical Laboratory

A key puzzle in economic theory is the spontaneous emergence of insurance arrangements. Here, entities agree on a contract whereby the buyer pays a known fee, and the seller (often an insurance firm) pays an uncertain payout contingent on some future event. Modelling this contingent payout as a random variable, it is clear that whatever fee is agreed upon, either the buyer or the seller will necessarily lower its expected financial future wealth by signing. Yet, such contracts have commonly been signed voluntarily, at least since Babylonian times. The solution to this puzzle which we explore is ergodicity economics: while it is true that one entity always lowers its expected wealth, expected wealth is often less relevant to the signatories than time-average growth. When, as is usually the case, the underlying wealth dynamic is not additive, the growth rate of expected wealth and the time-average growth rate of wealth differ. Time-average growth of wealth, as opposed to expected wealth, can increase for both parties, which resolves the basic puzzle.