

## SOE 25: Economic Networks

Time: Friday 11:00–11:45

Location: MA 001

SOE 25.1 Fri 11:00 MA 001

**Rethinking the Lotka-Volterra equations as a model of inequality** — ●FABIAN AGUIRRE LOPEZ — Ecole Polytechnique, Paris, France

We recast the Lotka-Volterra model as an effective model for the interaction between the wealth of agents in an economy. The model is chosen to have a single parameter that controls whether agents are competing or cooperating. And, most importantly, the agents interact through a random network with a prescribed degree distribution.

In the competitive case, the effect of the network of interactions is negative. For some agents this only means relaxing to a small value, but interestingly, for some agents with high degree it implies that they go extinct. We can calculate exactly both the critical degree for extinction and the fraction of survivors. In the cooperative case, there is no extinction, but interestingly there is a regime where the global wealth diverges. It is determined by the network structure and we refer to it as the "wealth creation regime". Amazingly, we find that in this new scaling we have relative extinctions in the system, but now for the low degrees. The meaning of these extinctions is that low enough degree nodes have a vanishing fraction of the total wealth. We can also calculate exactly both the critical degree and the fraction of survivors.

We have shown that in this minimal model, wealth creation goes hand in hand with increasing inequality, as nodes with higher number of interactions will benefit more and more as the total wealth diverges. This phenomenon is strongly dependent on the network structure as all of these results trivialize if the graph has no degree heterogeneity.

SOE 25.2 Fri 11:15 MA 001

**Integrated model of B-to-B trade network reproducing all major empirical laws: from structural evolution to monetary flows** — ●JUN'ICHI OZAKI<sup>1</sup>, EDUARDO VIEGAS<sup>1,2</sup>, HIDEKI TAKAYASU<sup>1,3</sup>, and MISAKO TAKAYASU<sup>1</sup> — <sup>1</sup>Tokyo Institute of Technology, Yokohama, Japan — <sup>2</sup>Imperial College London, London, United Kingdom — <sup>3</sup>Sony Computer Science Laboratories, Inc., Tokyo, Japan

This study presents a novel two-layered model framework designed to comprehensively capture and replicate both the statistical properties

of networks and the intrinsic quantities of interacting agents. Departing from traditional isolated investigations, our framework seamlessly integrates methods associated with temporal network structures and those related to transport flows.

Our approach enables the simultaneous emergence of tent-shaped distributions in agents' growth rates and scaling properties within the network. To validate our model framework and dynamics, we apply them to the real-world context of the inter-firm trading network in Japan. Comparative analysis of statistical distributions at both network and agent levels over time is strongly consistent with seven empirical laws observed in empirical data: degree distribution, mean degree growth rate over time, age distribution of firms, preferential attachment, sales distribution in steady states, and growth rates, as well as scaling relations.

SOE 25.3 Fri 11:30 MA 001

**Hysteresis of Activities of the Network of Firms During the Economic Downturns** — ●ALI HOSSEINY — Department of Physics, Shahid Beheshti University, Tehran, Iran

During the great recession in 2008 and 2009, when Obama's administration proposed its stimulation bill, some prominent economists such as Noble laureates, Joseph Stiglitz and Paul Krugman claimed that Obama's bill might not be big enough to lead the economy to overcome the recession. Now, a question arises: Does the economy show hysteresis over recession so that a minimum size of stimulation is needed to overcome recession? To answer this question we state that the activity of firms in their trade network is correlated. If a firm decreases or increases its activity, then its trade partners are forced to do so.

It can be shown that the interaction of firms results in hysteresis. Such a hysteresis resists government stimulation of the economy. Hysteresis analysis provides a correct prediction about the outcome of the fiscal stimulation in the US and the EU. In the aftermath recession of the economic crisis of 2009, the bill imposed by Obama was greater than the hysteresis of the market and thereby successful. The European Union's bill however was below the hysteresis of the market and unsuccessful.