SOE 2: Dynamics of Social and Financial Networks

Time: Monday 10:15–12:00 Location: GÖR 226

SOE 2.1 Mon 10:15 GÖR 226

DebtRank-transparency: Controlling systemic risk in financial networks — •Stefan Thurner[1,2,3] and Sebastian Poledna[1] — [1]Section for Science of Complex Systems; Medical University of Vienna; Spitalgasse 23; A-1090; Austria — [2]Santa Fe Institute; 1399 Hyde Park Road; Santa Fe; NM 87501; USA — [3]IASA, Schlossplatz 1, A-2361 Laxenburg; Austria

Nodes in a financial network, such as banks, cannot assess the true risks associated with lending to other nodes in the network, unless they have full information on the riskiness of all other nodes. These risks can be estimated by using network metrics (as DebtRank) of the interbank liability network. With a simple agent based model we show that systemic risk in financial networks can be drastically reduced by increasing transparency, i.e. making the DebtRank of individual banks visible to others, and by imposing a rule, that reduces interbank borrowing from systemically risky nodes. This scheme does not reduce the efficiency of the financial network, but fosters a more homogeneous risk-distribution within the system in a self-organized critical way. The reduction of systemic risk is due to a massive reduction of cascading failures in the transparent system. A regulation-policy implementation of the proposed scheme is discussed.

Topical Talk SOE 2.2 Mon 10:30 GÖR 226

Statistical Mechanics of a Firm Growth Process — •Cornelia Metzig — Université Joseph Fourier, Grenoble, France

A stochastic process for firm growth is analyzed, which arises from competition for a scarce quantity. In its nonequilibrium stationary state, the model exhibits a tent-shaped growth rate distribution, a heavy tailed size distribution, and a growth rate variance which scales as a power of firm size. These results reproduce qualitatively three stylized facts found in firm databases. Market allocations of the quantity – like workforce or purchasing power of customers – happens such that every market realization has the same probability. Firms demand a quantity proportional to their actual size n, and the number of actually received resources is binomially distributed, with n dependent variance. Fluctuations of this process are described by the linear Langevin equation for the size n. A well-known case is a system with additive fluctuations, as in equilibrium systems, leading to a Gaussian stationary distribution, and multiplicative fluctuations, where the stationary distribution exhibits a power law tail. In the latter, superstatistics can be used, which can be seen as a way of mapping multiplicative noise onto n-dependent additive noise. In contrast, in this model, fluctuations are neither simply additive nor multiplicative, since the fluctuations scale as a power $\neq 1$ of n. Despite this difference, the concept of superstatistics can be applied to explain the aggregate growth rate distribution. Here, it consists of expressing the fluctuations as n-dependent multiplicative noise, and then integrate over all sizes. Theoretical an numerical results for firms' size and firms' growth rate distribution are given.

SOE 2.3 Mon 11:00 GÖR 226

A dynamical model of knowledge generation in scientific space — •Moritz Joseph[1] and Jens Christian Claussen[2,1] — [1]INB, Universität zu Lübeck, Germany — [2]Computational Systems Biology Lab, Research II, Jacobs University Bremen, Germany

How does the topological space of science emerge? Inspired by the concept of mapping scientific topics to a scientific space [1], we question which topological structure a dynamical process of authors collaborating and publishing papers can generate. We propose a dynamical process where papers as well as new groups receive topical positions embedded in a, e.g., two-dimensional euclidean space. The precise position of new papers depends on previous topics of the respective authors and is chosen randomly in a surrounding neighborhood including novelty and interdisciplinarity. Depending on parameters, the spatial structure resembles a simple Gaussian distribution, or spatial clusters of side-topics are observed. We quantify the time-evolution of the spatial structure and discuss the influence of inhomogenities.

[1] K.W. Boyack, R. Klavans and K. Börner, Mapping the backbone of Science, Scientometrics 64, 351 (2005)

SOE 2.4 Mon 11:15 GÖR 226

The rise and the fall of musical genres and the evolution of music publishing networks — •Gamaliel Percino[1], Peter Klimek[1], and Stefan Thurner[1,2,3] — [1]Section for Science of Complex Systems, Medical University of Vienna, Spitalgasse 23, A-1090, Austria — [2]Santa Fe Institute, 1399 Hyde Park Road, Santa Fe, NM 87501, USA — [3]International Institute for Applied Systems Analysis, Schlossplatz 1, A-2361 Laxenburg, Austria

A music style is defined by a community of musicians with different skills to play different musical instruments. We present an analysis of a collection of bipartite networks attaching music styles to musical instruments, artists to musical instruments, and artists to music styles. We study the evolution of these networks from 1969 to 2010. We investigate the dynamics of bipartite network measures for music styles such as their instrumental diversity and ubiquity, i.e. how many other styles use similar musical instruments. Based on these measures one can obtain a similarity network for music styles which undergoes complex dynamical transitions. We compare the average change of diversity and ubiquity with the commercial success of the style as measured by Amazon sales rank per number of records by style. We find that in the last seven years music styles with decreasing diversity had more commercial success. These results suggest that popular music becomes more simplistic as it gains mainstream success.

SOE 2.5 Mon 11:30 GÖR 226

Trade-off between virality and mass media influence in the evolution of online social networks — •Kaj Kolja Kleineberg and Marián Boguñá — Departament de Física Fonamental, Universitat de Barcelona, Martí i Franquès 1, 08028 Barcelona, Spain

We investigate the topological evolution of online social networks. To this end, we analyze empirical data from a large online social network. We observe a dynamical phase transition between a disconnected and a connected phase. We present a two-layer multiplex model which incorporates viral and mass media dynamics and is based on the real underlying social structure. We identify viral spreading and mass media influence as the underlying mechanisms for the evolution of online social networks. We show that the trade-off between these complementary principles governs the topological growth of the network. The comparison of the model results with empirical data allows us to provide new quantitative insights about the relationship between the importance of virality and mass media for the evolution process of the analyzed online social network. The investigation of the evolution of local topology leads to the conclusion that the formation of the online social network favors weak ties. We discuss this finding within the framework of Granovetters theory.

SOE 2.6 Mon 11:45 GÖR 226

Structure and Dynamics of the Bitcoin Transaction Graph — •Kay Hamacher — Depts. of Physics, Computer Science, and Biology, TU Darmstadt

Bitcoin is a decentralized, digital currency that is built upon a peer-to-peer (P2P) network. Monetary transactions are secured by a proof-of-work concept originating in cryptography. Due to this basis, all transaction need to be known to all participants. Therefore, the bitcoin transaction data set is a rich, complete, and consistent data set of a particularly interesting social network, namely one of economic transactions. In this contribution, I want to discuss recent results obtained in a comprehensive study on the structure and the time evolution of the transaction graph.