SOE 18: Economic Models II

Time: Thursday 15:00–16:15 Location: GÖR 226

SOE 18.1 Thu 15:00 GÖR 226

Sector-Coupling of a Highly Renewable German Energy System — •Clara Steinebach, Tom Brown, and Stefan Schramm — Frankfurt Institute for Advanced Studies, Frankfurt, Germany

Energy consumption is made up of four major sectors – electricity, heat, transport and industry, each of which contribute about one-fourth of the final energy consumption in Europe. In order to reduce the CO2 emissions, synergies from coupling these sectors have to be investigated and used. The coupling of electricity to other sectors, such as transport and heating, offers new cost-effective options for evening out seasonal- and synoptic-scale fluctuations of renewables like wind and solar, particularly given the low cost of long-term thermal energy storage. This work focuses on the German energy system. The cost-optimal low-carbon system is calculated, incorporating electricity demand, electrified transport and partially-electrified heating demand. By coupling these energy sectors and using battery storage from battery electric vehicles (BEV) and the thermal storage possibilities from the heating sector, stationary electricity storage needs can be reduced or even be eliminated.

SOE 18.2 Thu 15:15 GÖR 226

A pure optimization paradigm is not sufficient to account for sustainable policies — •Wolfram Barfuss[1,2], Jonathan F. Donges[1,3], Steven Lade[3], and Jürgen Kurths[1,2,4] — [1]Potsdam Institute for Climate Impact Research, GER — [2]Humbold University, Berlin, GER — [3]Stockholm Resilience Centre, Stockholm University, SWE — [4]University of Aberdeen, UK

Optimization is a widely used paradigm to deduce the course of action in many sustainability contexts, from integrated assessment models to natural resource management. Simultaneously, a wide range of criticisms and refinements of the optimization approach exist. These include aspects involving the discounting of future rewards and the treatment of multiple kinds of uncertainty. Here we demonstrate by a counterexample that a pure optimization of accumulated discounted rewards is not sufficient to reach a sustainable policy. This is done by introducing a conceptual model example based on a Markov decision process, formalizing a social-ecological tipping interaction. We translate the notion of sustainability into a definition of sustainable policy, which is capable of 'meeting the needs of the present without compromising the ability to meet those of the future' by introducing a minimum acceptable reward value. We further introduce a general return function, unifying a discounted with an average reward setting. The simplicity of our model allows a full analytical treatment, including a discussion of the discount factor as a free parameter. Overall, this suggests that care should be taken under what conditions an optimization approach is used to not result in undesired outcomes.

SOE 18.3 Thu 15:30 GÖR 226

Explosive Transitions and Hysteresis in Economically Driven Percolation — •Malte Schröder[1], Marc Timme[1,2], and Dirk Witthaut[3,4] — [1]Network Dynamics, Max Planck Institute for Dynamics and Self-Organization (MPIDS), 37077 Göttingen — [2]Department of Physics, Technical University of Darmstadt, 64289 Darmstadt — [3]Forschungszentrum Jülich, Institute for Energy and Climate Research - Systems Analysis and Technology Evaluation (IEK-STE), 52428 Jülich — [4]Institute for Theoretical Physics, University of Cologne, 50937 Köln

The evolution of connectivity fundamentally underlies the function of many networked systems, with particular impact in social and economic networks. Standard percolation models describe how globally connected structures emerge when new local connections are formed based on random processes. In most social and economic systems, however, connections are established deliberately by the individuals in the network and are thus inherently not random. Here, we study network percolation for links established on the basis of economic decisions. We show that the underlying, global optimization problems can be mapped *exactly* to a local percolation problem that allows an efficient solutions. This new class of non-random percolation processes exhibits parametric changes from continuous to discontinuous features akin to explosive percolation transitions as well as hysteresis precisely because link addition is not random but directly driven by optimization.

SOE 18.4 Thu 15:45 GÖR 226

Non-Ergodicity and Symmetry Breaking in Time — •Mark Kirstein — TU Dresden, Germany

Complexity science harnesses tools from complexity science among others dynamical systems theory, network theory or cellular automata (CA). CA are one such tool, they are comprised of identical components, each interact following simple rules. 4 universality classes of pattern formation are identified in CA. The first three classes can all be handled by dynamical systems theory, whereas in class 4 ever evolving unpredictable patterns emerge. Questions relating to the long-term evolution of most of the interesting variables in economics are undecidable (e.g. What is the value of an asset prices in x days in the future?). Long-term prediction is out of reach for class 4. That is because class 4 entails computational irreducible evolutions. To answer such questions, time has to elapse. The history of economics and finance reveals no systematically successful prediction systems of such class 4 processes, although many economic processes fall into class 4.

I present a framework which uses a property of mathematical systems called broken ergodicity to explain broken symmetries in time. Broken time symmetry is one of the most fundamental broken symmetries that can occur. Broken symmetries in time question the nature of causality. I will elaborate how this leads to a quantum-like observer effect of economics and provide interesting relationships how this connects to black swans, the Lucas' critique, Goodhart's law and reflexivity.

SOE 18.5 Thu 16:00 GÖR 226

Solving Europe's most critical problems — •Hans G Danielmeyer and Thomas Martinetz — INB Uni Luebeck

Under SOE's umbrella we discovered and described the industrial society's natural long-term dynamics. The complexity of its main subsystems is prohibitive, but all constructive interactions of human nature and systems engineering reduce to six physical relations with three inherited time constants of the human species. Six unique analytic solutions reproduce the main G7 level data without fitting parameter. This includes per capita saturation and aging.

Unfortunately, zero interest and financial instability prevent reaching the natural final states. We suggest now long-term correction paths for Europe's 10 G7 level nations. In 2100 they may be dominated by healthy seniors unless retirement age increases by 1 year every 6 years. The money meant for subsidizing growth arrived in the top decile's 55 and 90% total income and wealth. This must be corrected because it forms a transnational class and a weakened middle class with the corresponding public debt. When the middle is lost as national stronghold extreme wing parties challenge democratic governments successfully as observed.