Leigh Tesfatsion, Guest Lecture
Econ 509, Heady 272, 10-10:50
April 15, 2016

Guest Lecture Topic:

"Economic Systems as Constructively Rational Games: Oh, the Places We Could Go!"

Recommended Background Readings:

[1] Ekaterina Sinitskaya and Leigh Tesfatsion, "Macroeconomies as Constructively Rational Games," *Journal of Economic Dynamics and Control*, Vol. 61, December 2015, 152-182. Working Paper Preprint: http://www2.econ.iastate.edu/tesfatsi/MacroConstructiveRationalityWP.SinitskayaTesfatsion.pdf

[2] Leigh Tesfatsion, "Elements of Dynamic Economic Modeling: Presentation and Analysis," *Eastern Economic Journal*, 2016, to appear. **Main Focus: Agent-Based Modeling Sections 8-11**. http://www2.econ.iastate.edu/tesfatsi/DynamicEconomicModelingBasics.WPVersion.pdf

Guest Lecture Overview:

"You have brains in your head. You have feet in your shoes. You can steer yourself any direction you choose. You're on your own. And you know what you know. And YOU are the one who'll decide where to go…" — Dr. Seuss, Oh, The Places You'll Go!

Real-world economic systems are historical processes moving forward through time without the support of externally-imposed coordination conditions, such as rational expectations and simultaneous market clearing. Moreover, the decision makers in these systems are forced to be locally constructive; that is, their actions at any given time must be based solely on their own information, beliefs, and physical states.

Consider the following experiment: First, take any standard dynamic macroeconomic model and remove from this model all externally-imposed coordination restrictions, thus breaking the circular flow among consumers and firms. Second, re-establish a circular flow among consumers and firms by introducing locally constructive strategies for all decision-making agents together with supporting institutional arrangements. This transforms the macroeconomic model into a *constructively rational game*. Third, consider what decision strategy you, yourself, would choose to follow over time were you to assume the role of any particular consumer or firm, constrained to be locally constructive. How would you guarantee your survival, let alone your prosperity? If economists are unable to pass this relatively simple test, to what extent can we be said to understand how actual macroeconomies work?

This guest lecture will discuss how *Agent-based Computational Economics (ACE)* can be used to develop and explore economic models as constructively rational games to facilitate understanding of real-world economic systems, with a particular stress on macroeconomies. The following aspects of ACE modeling will be highlighted, with pointers to relevant literature and resources:

- Economic systems are directly modeled as software programs using either general programming languages or specially designed agent-based toolkits (constructive mathematical modeling)
- Economic systems are modeled as collections of interacting agents, where an "agent" can refer to a physical, biological, institutional, and/or social entity (heterogeneity of agent types)
- Economic systems are modeled as open-ended dynamic processes akin to cultures developing in petri dishes (endogenous heterogeneity)
- Successive events in the modeled economic system are driven solely by agent interactions, starting from initial conditions (economic systems as historical processes)
- The decision modes of decision-making agents (DMAgents) are based solely on local information, beliefs, and physical conditions (local constructivity)
- The decision modes of DMAgents can range from simple fixed rules to sophisticated learning involving intertemporal planning (DMAgents can be as rational or irrational as real people)
- DMAgents can talk with each other at event triggered times using adaptively scripted messages (beyond cheap talk and pre-scripted games)
- DMAgents can decide not only what actions to take with current trade partners but also with whom they will attempt to trade in the future (game theory combined with matching theory)
- DMAgents can hide or protect their data and methods from other agents (increased DMAgent autonomy through encapsulation)
- DMAgents can use local pseudo-random number generators or imported "true" random numbers to randomize their behaviors (increased DMAgent autonomy through increased unpredictability)
- Institutional arrangements can be modeled with increased verisimilitude and subjected to systematic sensitivity testing (institutions as social scaffolding)
- Agent birth and death (entry and exit) can be modeled as endogenous processes (endogenous evolution of agent populations)
- Economic processes can be modeled as key components of coupled natural and human systems operating through time over spatial landscapes (broadened range of potential causal factors)