HO-450: Agent-Based Macroeconomics

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Objectives:

The course introduces and discusses the application of agent-based model (ABM) methodology[1] in macroeconomics. This is a recent and promising stream of research especially taking into account that the recent crisis has showed the problems of standard mainstream macroeconomics grounded on representative agent and optimizing DSGE models. It is based on sound evolutionary micro-foundations that consider both agents' heterogeneity and interactions, leading to history-oriented models that are close in the spirit to the (genuine) Keynesian and Schumpeterian traditions. In that, macro ABMs are an alternative to the dynamic stochastic general equilibrium (DSGE) models for both research and policy applications, solving several of the limitations presented by the later.

At the end of the course, the participant is expected to understand the main concepts involving DSGE models and macroeconomic ABMs, as well their limitations/advantages, to have a general perspective on the current literature of the field and to master (at a basic level) the required computational tools.

Target audience and prerequisites:

Typical participants are doctoral/PhD and advanced mestrado/masters students in Economics and other professionals in the macroeconomics field.

Undergraduate micro/macroeconomics is a prerequisite. Graduate micro/macroeconomics and knowledge of and/or familiarity with computational analysis tools are useful but *not* required.

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[1] Agent-based models are based on contemporary computing ideas and technologies. They are employed to build models that are closer to real economies by employing software elements to represent (potentially) heterogeneous individual economic agents with chosen degrees of cognition. Agents are modeled based on behavioral rules that shape their decisions and direct their local interactions with other agents. The models are run over time in the micro-level to allow for the emergence of structures at the meso- and macro-levels as aggregate properties, in a far-from-equilibrium setup. Under adequate specifications, they offer a formal alternative to the usual premises of neoclassical models, in particular the adoption of representative agents, unbounded rationality, indirect "interactions" and equilibrium conditions.

Time allocation and organization:

The course is full-time with 60 hours allocated (4 créditos). Course time is distributed among lectures, laboratory training and students group activities and will be conducted in English and Portuguese.

The course is divided in two parts. The first one (15-16/Feb) provides a brief overview of the state-of-the-art of the neoclassical macro models, in particular the DSGE formalism, and some of the problems with this approach. The theoretical and empirical foundations of DSGE models will be briefly reviewed, as well as the techniques employed for their solution, estimation and simulation. The second part (19-23/Feb) reviews the methodological basis of macro ABMs and presents a selection of relevant models in the literature. In parallel with both parts the students will be introduced to the computational tools used to create and analyze macro DSGE and agent-based models in the computer lab. Some simple applications of both DSGE and ABM models will be presented and used by the students, by means of tools like Dynare/Matlab and LSD/R.

Registration:

All interested students **must pre-register** by e-mail to posgrad@eco.unicamp.br (Secretaria de Pós-Graduação, Instituto de Economia) **until Dec. 10th 2018**. UNICAMP regular students should *also* register at DAC as usual (Curso de Verão). All registered participants will apply for a course certificate. The course is free of charges.

Due to the lab size, a limited number of students can be accepted. Students not requiring full-time allocation/equivalence (créditos) may participate in just one of the two parts of the course if there are places available after regular (full-time) student registration.

Program:

Part I. Introduction to the DSGE modeling methodology (2 days)

Introduction and motivation: basic elements of DSGE models

The basic RBC model, its extensions, and the basic New-Keynesian model

> King and Rebelo 1999

> Schmidt and Wieland 2012

LAB: A midsize New-Keynesian model: welfare analysis and optimal policies

> Gali 2008

Estimation of DSGE models

> Castro et al. 2015

Advantages, disadvantages and limitations of the DSGE models

Part II. Macroeconomic ABM methodology (1 day)

The limits of DSGE models

Agent-Based Computational Economics

> LeBaron and Tesfatsion 2008

> Pyka e Fagiolo 2007

Macroeconomic policies in agent-based models

> Fagiolo and Roventini 2016

LAB: Agent-based hands-on introduction: Sugarscape

> Epstein and Axtell 1996

LAB: Agent-based modelling tools and LSD

> Valente and Andersen 2002

Part III. Exploring the role of heterogeneity and interactions with "simple" macro ABMs (1 day)

Endogenous growth (the Island Model)

> Fagiolo and Dosi 2003

Macroeconomic fluctuations

> Guerini, Napoletano and Roventini 2016

LAB: Exploring sample LSD models: configuration and analysis

> Arthur 1989

> Nelson and Winter 1982

Part IV. The family of Keynes meets Schumpeter models (2 days)

The core model and empirical validation

> Dosi et al. 2010

Exploring the effects of different ensembles of innovation, industrial, fiscal and monetary policies

> Dosi et al. 2013, 2015

The role of expectations

> Dosi et al. 2016a

Decentralized labor market interactions and the effect of structural reforms

> Dosi et al. 2016b

Climate change, energy and environmental policies

> Dosi et al. 2016c

LAB: Exploring the K+S model in LSD

> Dosi et al. 2010

LAB: Extending the K+S model: adding a decentralized labor market

>   Dosi et al. 2016b

Part V. Topics in agent-based macroeconomics (1 day)

Endogenous growth and economic divergence

>   Dosi et al. 1994

Macroprudential and monetary policies interactions

>   Popoyan, Napoletano and Roventini 2015

LAB: Data analysis of LSD models in R

References:

Part I

Castro, M.; Gouvêa, S.; Minella, A.; Santos, R.; Souza-Sobrinho, N. (2015), "SAMBA: Stochastic Analytical Model with a Bayesian Approach", Brazilian Review of Econometrics, vol.35, n.2

J. Gali, "Monetary Policy, Inflation, and the Business Cycle: An Introduction to the New Keynesian Framework". PUP, 2008.

R. King; S. Rebelo, "Resuscitating real business cycles", in J.Taylor e M.Woodford, Handbook of macroeconomics, 1999.

Schmidt, Sebastian; Wieland, Volker (2012), "The new keynesian approach to dynamic general equilibrium modeling: Models, methods, and macroeconomic policy evaluation", IMFS Working Paper Series, No. 52, http://nbn-resolving.de/urn:nbn:de:hebis:30:3-252562

Part II

Epstein, J., Axtell, R. (1996), "Growing artificial societies: social science from the bottom up", MIT Press: Cambridge, ch. I (Introduction)

Fagiolo, G. and Roventini, A. (2016), "Macroeconomic Policy in DSGE and Agent-Based Models Redux: New Developments and challenges ahead", LEM working paper series 2016/17, Laboratory of Economics and Management (LEM), Scuola Superiore Sant'Anna, Pisa, Italy (http://www.lem.sssup.it/WPLem/files/2016-17.pdf)

LeBaron, B. and Tesfatsion, L. (2008), "Modeling Macroeconomies as Open-Ended Dynamic Systems of Interacting Agents", American Economic Review, 98:246-250

Pyka, A. and Fagiolo, G. (2007), "Agent-Based Modelling: A Methodology for Neo-Schumpeterian Economics", in H. Hanusch and A. Pyka, (eds.), The Elgar Companion to Neo-Schumpeterian Economics, E. Elgar

Valente, M.; Andersen, E. S. (2002) "A Hands-on Approach to Evolutionary Simulation: Nelson and Winter Models in the Laboratory for Simulation Development", Electronic Journal of Evolutionary Modeling and Economic Dynamics, 1003 (http://www.business.auc.dk/evolution/esapapers/esa99/NelwinSim.pdf)

Part III

Fagiolo, G. and Dosi, G. (2003), "Exploitation, exploration and innovation in a model of endogenous growth with locally interacting agents", Structural Change and Economic Dynamics, 14:237-273

Guerini, M. Napoletano, M. and Roventini A. (2016), "No Man Is an Island: The Impact of Heterogeneity and Local Interactions on Macroeconomic Dynamics", LEM working paper series 2016/24, Laboratory of Economics and Management (LEM), Scuola Superiore Sant'Anna, Pisa, Italy (http://www.lem.sssup.it/WPLem/files/2016-24.pdf)

Part IV

Dosi, G., Fagiolo, G. and Roventini, A. (2010), "Schumpeter Meeting Keynes: A Policy-Friendly Model of Endogenous Growth and Business Cycles", Journal of Economic Dynamics and Control, 34:1748-1767

Dosi, G., Fagiolo, G., Napoletano, M. and Roventini, A. (2013), "Income Distribution, Credit and Fiscal Policies in an Agent-Based Keynesian Model", Journal of Economic Dynamics and Control, 37:1598-1625

Dosi, G., Fagiolo, G., Napoletano, M., Roventini, A. and Treibich, T. (2015), "Fiscal and Monetary Policies in Complex Evolving Economies", Journal of Economic Dynamics and Control, 52:166-189

Dosi, G., Fagiolo, G., Napoletano, M., Roventini, A. and Treibich, T. (2016a), "The Short- and Long-Run Damages of Fiscal Austerity: Keynes beyond Schumpeter", in Stiglitz J. And Guzman M. (eds.), Contemporary Issues in Macroeconomics, Palgrave Macmillan

Dosi, G., Fagiolo, G., Napoletano, M., Roventini, A. and Treibich, T. (2016b), "Micro and macro policies in the Keynes+Schumpeter evolutionary models", Journal of Evolutionary Economics, DOI 10.1007/s00191-016-0466-4

Dosi, G., Pereira, M. C., Roventini, A. and Virgilito, M. E. (2016), "When more flexibility yields more fragility: searching for the microfoundations of Keynesian aggregate unemployment and fluctuations", LEM Working Paper Series 2016/12, Laboratory of Economics and Management (LEM), Scuola Superiore Sant'Anna, Pisa, Italy (http://www.lem.sssup.it/WPLem/files/2016-12.pdf)

Part V

Dosi, G., Fabiani, S., Aversi, R. and Meacci, M. (1994), "The Dynamics of International Differentiation: a Multi-Country Evolutionary Model", Industrial and Corporate Change, 3:225-242.

Popoyan, L., Napoletano, M. and Roventini, A. (2015), "Taming Macroeconomic Instability: Monetary and Macro Prudential Policy Interactions in an Agent-Based Model", LEM Working Paper Series 2015/33, Laboratory of Economics and Management (LEM), Scuola Superiore Sant'Anna, Pisa, Italy (http://www.lem.sssup.it/wplem.html)