Hands-On Heterogeneous Agent Macroeconomics

Using the Econ-ARK/HARK Toolkit

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Because Representative Agent ('RA') models were not useful for understanding much of what happened in the Great Recession, policymakers including Larry Summers (2011), Fed Chair Janet Yellen (2016), former IMF Chief Economist Olivier Blanchard (2016), ECB Governing Board Member Benoit Coeure (2013), and Bank of England Chief Economist Andy Haldane (2016) have suggested that incorporation of heterogeneity (for example, across borrowers and lenders) must be an essential part of the agenda in developing new and better models. In confirmation of that intuition, a number of recent papers, most notably Kaplan, Moll, and Violante (2018) and Krueger, Mitman, and Perri (2016), have developed models that include a realistic description of microeconomic heterogeneity, and have shown that such models can generate more sensible macroeconomic implications than RA models for important questions like the operation of fiscal and monetary policy.

This course will provide a hands-on introduction to the construction of models with 'serious' heterogeneity (that is, heterogeneity that matches the microeconomic facts that theory suggests *should* matter for macroeconomic outcomes like consumption dynamics); why such heterogeneous agent ('HA') models have implications different from those of RA models; and how existing HA models can be adapted to new questions. ('Hands-On' means that students with their own laptops will run the and experiment with the code that solves these models in class.)

The course will have two main elements: Lectures explaining the conceptual foundations of the models work; and hands-on demonstrations of live working versions of such models using the open-source Econ-ARK/HARK toolkit.

Students should bring a laptop on which they have permissions to install and run new software. Prior to class, on that laptop, students should have installed the anaconda3 stack, which is a distribution of python 3 that includes a robust set of extra tools that are useful for doing computational work. A good guide to installing anaconda is here.

1 Preliminaries

I have hired a team of people from Alphacruncher to help with some of the technical and communications setup for the course, and a team member will be present at the beginning of the first day of classes, so we will begin the "hands-on" aspect of the coruse from the very beginning.

To minimize problems that can crop up with differences across computing platforms and security, we will be doing most of the work for the class "in the cloud" – using a virtual machine configuration set up by Alphacruncher.

But everything we do should be replicable by students on their own laptops if they install HARK and the free "Anaconda" python stack (set of compuataional tools).

Steps:

1. Install Anaconda: `https://docs.anacondacom/anaconda/install`

2. Get Git

   > Get the command-line tool: `https://atlassian.com/git/tutorials/install-git`
   >
   > Get a GitHub Account
   >
   > Download the GitHub Desktop App
   >
   > – And connect it to your online GitHub account

3. Install HARK: Go to "Quick Start" in the README.md
   - Follow the instructions for installing HARK for Anaconda

4. Clone the DemARK and REMARK repos

   > `git clone https://github.com/https://github.com/econ-ark/DemARK`
   >
   > `git clone https://github.com/https://github.com/econ-ark/REMARK`

5. Using the python command line:

   ```
   cd [directory where you installed the DemARK repo]/notebooks
   python -m nose
   ```

2 Motivation

2.1 Motivation

Models with serious microfoundations yield fundamentally different conclusions than RA models about core questions in macroeconomics.

1. How monetary policy works
   - HA channels account for most of the mechanism of monetary transmission

2. What made the Great Recession Great

- RA models: Mostly a supply shock
- HA models: Mostly a demand shock

Slides:

  Intro to Monetary Policy with Heterogeneity, Crawley (2019)

  Bayer and Luetticke: Intro to Monetary Policy with Heterogeneity, Crawley (2019)

Readings:

  * Ahn et al (2017), Introduction, Conclusion
    - Provide a compact and well written discussion of the state and progress of HA macro.

  * Carroll and Crawley (2017), Sections 1, 2, and 4
    - This discussion of that paper puts the relationship of HA to RA models in context.

2.2 Micro Consumption Theory Refresher

2.2.1 The Infinite Horizon Perfect Foresight Model

Notes:

- Consumption Under Perfect Foresight and CRRA Utility

2.2.2 Consumption With Labor Income Uncertainty
- Notebook: Theoretical Foundations of Buffer Stock Saving

2.2.3 The Special Case of Rate-Of-Return Uncertainty

Notes: Consumption out of Risky Assets
Origins: Merton (1969), Samuelson (1969)

2.2.4 Habits

Notes:

- Consumption Models with Habit Formation

3 Computational Tools

3.1 Vision for the Econ-ARK Project
- Intro-To-Econ-ARK

4 Hands-On Introduction

Here we will explain how to begin using the Econ-ARK toolkit for heterogeneous agent macro modeling, and will guide students through the use of the toolkit to solve increasingly sophisticated models, starting with partial equilibrium perfect foresight models and ending with some exercises using a full general equilibrium micro-macro model with idiosyncratic and aggregate risks.

4.1 A Gentle Introduction

Notebook: A Gentle Introduction to HARK

4.1.1

4.1.2 Adding 'Serious' Income Uncertainty