Introducing the Econ-ARK: Economics "Algorithmic Repository and toolKit"

Generic Presentation

May 23, 2018

Goal: Tool like DYNARE for Models With Heterogeneity

State-of-the-art set of tools for:

1. Solving dynamic stochastic optimization problems
   - 'Hard' Bellman problems with uncertainty, 'kinks,' nonconvexities
2. Simulate behavior of populations of agents
3. Finding equilibria for markets/economies populated by such agents

Who Has Produced It?

Name	TLA	Affiliation
Christopher D Carroll	`CDC`	JHU, CFPB
David C Low	`DCL`	CFPB
Nathan M Palmer	`NMP`	OFR
Matthew N White	`MNW`	UDel, CFPB
Alex Kaufman	`ABK`	CFPB → ? (Timbuktu?)
Jiaxiong Yao	`JXY`	JHU → IMF

Nothing herein may be interpreted as reflecting opinions of

CFPB	-	United States Consumer Financial Protection Bureau
JHU	-	Johns Hopkins University
IMF	-	International Monetary Fund
OFR	-	Office of Financial Research, U.S. Treasury
UDel	-	University of Delaware

Major credit to CFPB

- Hired CDC as Chief Economist with this as a key priority
- Hired NMP as intern to get started
- Hired MNW as Visiting Scholar to work on it
- Hired DCL as new economist last year
- Hired ABK as RA

Just Received Big Grant from Alfred P. Sloan Foundation!

Three Years

- Hire Programmers, RA's, Open Source Project Managers, etc etc

What Is It Good For?

- Heterogeneous Agent Macro Models
  - Original name: **H**eterogeneous **A**gent **R**esources and tool**K**it
  - HARK!
- Structural Micro Models (e.g., labor, health)
- IO models with equilibrim between consumer agents and firm agents
  - Unlike Noah's, our ARK can hold more than two of each kind!
  - Ultimate goal: Get examples on the ARK of all types of animal (model)

Why Have We Created It?

1. Micro Structural Modeling 2017 $\approx$ Econometrics circa 1970
   - 1970 econometrics: Write your own matrix inversion package!
   - 2017 structural: Write your own numerical convergence alogrithms
2. In principle, we know how to do this
3. In practice:
   - Each paper is hand-crafted work of art involving years of work
     - Impenetrable spaghetti code, derived from generations of copy-and-paste
   - Progress very slow
   - Confidence is not very high

Why: Goals

Make it *much* easier:

- To get started doing structural Heterogeneous Agent modeling
- To teach (with hands-on, problem-set-assignable exercises)
- To *compare* models to each other
- To add new capabilities
- To mix-and-match components/modules/agent types

Remove the excuse 'Structural model was not worth the effort'

Why Are Policy Institutions So Interested?

Who?

- Participation: CFPB, OFR, IMF
- Interest From: FRB, ECB, BLS

RA models unable to address key questions in Great Recession

- U.S. NEC Chair Larry Summers (2011), Fed Chair Janet Yellen (2016), former IMF Chief Economist Olivier Blanchard (2016), ECB Governing Board Member Benoit Coure (2013), Bank of England Chief Economist Andy Haldane (2016), etc etc
- Heterogeneity (say, between borrowers and lenders) desperately needed

Policymaking = Applied Theory. Options:

1. Informal, intuitive, "wetware" theory
2. Formal, structural, "software" theory

Why? Welfare Analysis With Heterogeneity

Sensible cost-benefit analysis requires:

- Estimates of distribution of heterogeneous outcomes
- Utility or other weighting of those outcomes
- $\rightarrow$ Structure

How: What Makes Us Think This is Feasible?

- Has been done already in many other scientific/technical fields
  - AstroPy
  - Statistics: 'R' and the Journal of Statistical Software
  - Many open-source resources in other sci/tech fields

How: *The Invention of Science* by David Wootton

Wrong explanations for the Scientific Revolution:
- Invention of 'the experiment'
- Invention of the printing press
- …

Right explanation:
- Creation of community of scholars
- … whose methods and results were 'open source'
- … who critcized and improved and debugged each other

Alchemy $\rightarrow$ Chemistry

17th and 18th century version of github.com!

How: Github+Python=Gutenberg

Suite of powerful modern tools developed by software engineers:

- Almost-Automatic Integrated Documentation
- Robust Built-In Testing
- Continuous Integration
- Version Control
- Object-Oriented Programming (Python!)
- Integrated Development Environments
- Apache License
- ...

Will We Succeed?

A *lot* of enthusiasm from deep-pocketed policy institutions

- CFPB - Lion's Share of the Credit For Getting Here
  - Hired CDC As Chief Economist
    - On Specific Premise that Toolkit Would Be Priority
  - Hired MNW (leave of absence from UDel) To Create It

- Central Banks
  - So far: Fed (Board and Banks), ECB, BoE, RBA, RBNZ
- IMF
- OFR

References I

BLANCHARD, OLIVIER (2016): "Do DSGE Models Have a Future?," Discussion paper, Petersen Institute for International Economics, Available at https://piie.com/system/files/documents/pb16-11.pdf.

COEURE, BENOIT (2013): "The relevance of household-level data for monetary policy and financial stability analysis," .

HALDANE, ANDY (2016): "The Dappled World," Discussion paper, Bank of England, Available at http://www.bankofengland.co.uk/publications/Pages/speeches/2016/937.aspx.

SUMMERS, LAWRENCE H. (2011): "Larry Summers and Martin Wolf on New Economic Thinking," *Financial Times interview*, http://larrysummers.com/commentary/speeches/brenton-woods-speech/.

YELLEN, JANET (2016): "Macroeconomic Research After the Crisis," Available at https://www.federalreserve.gov/newsevents/speech/yellen20161014a.htm.