Overlapping Generations Modeling Training at the Joint Research Centre

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Intro Slides

Computational tools check

- Has everyone installed Anaconda distribution of Python?
- Can everyone run a script from terminal?
- Can everyone access and use Jupyter notebooks?

Schedule

- Schedule at https://github.com/rickecon/OG-JRC
- Schedule is tentative
  - May go faster, may go slower. Likely slower
  - Any material we don't cover will be available in Chapter form with code
- Days 1, 2, and 3 are fundamental
- We must get to demographics and tax functions

Standard Ramsey Infinite Horizon Model

$$\max_{\{c_t\}_{t=1}^{\infty}} E\Big[\sum_{t=1}^{\infty} \beta^{t-1} u(c_t)\Big]$$

- Subject to budget constraint
- Firms optimize
- Markets clear

We solve recursively using VFI or PFI

$$V(s_t) = \max_{c_t} u(c_t) + E\big[V(s_{t+1})\big]$$

OG model has finite lives

$$\max_{\{c_{s,t}\}_{s=1}^{S}} E\left[\sum_{s=1}^{S} \beta^{s-1} u(c_{s,s})\right]$$

- Subject to budget constraint
- Firms optimize
- Markets clear

Agents finitely lived, but economy infinite

$$V(s_t) = \max_{c_t} u(c_t) + E\left[V(s_{t+1})\right]$$

- This equation has a specific end
- One life doesn't determine path of w_t, r_t

A Visual Description of the OG Model

Birthday	Period					
	$\ldots$	t	$t+1$	$t+2$	$t+3$	$\ldots$
born $t-1$	$\ldots$	$c_{2,t}$				
born t		$c_{1,t}$	$c_{2,t+1}$			
born $t+1$			$c_{1,t+1}$	$c_{2,t+2}$		
born $t+2$				$c_{1,t+2}$	$c_{2,t+3}$	
					$\vdots$	$\ldots$

Some History of the OG framework

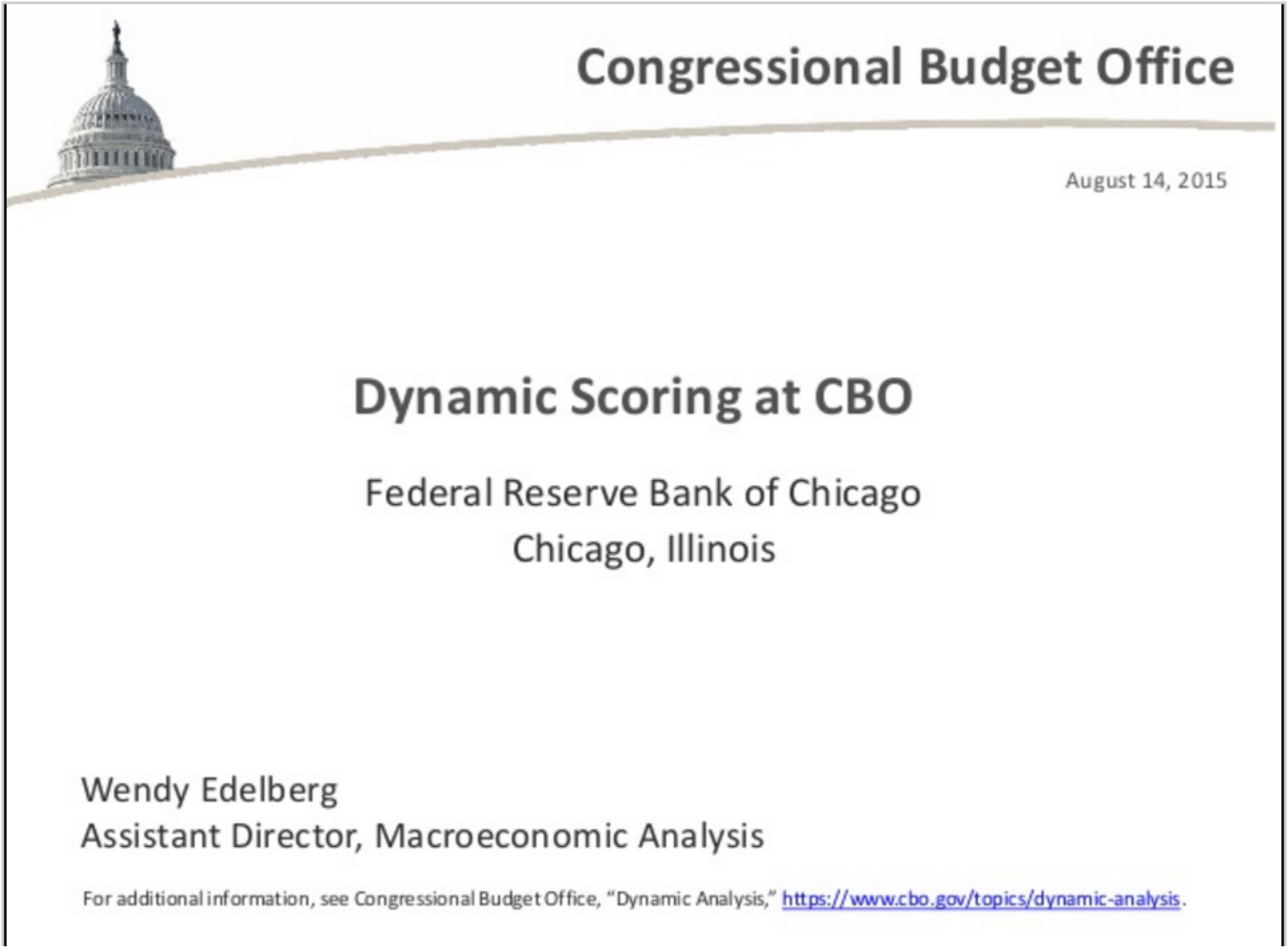
- Introduced by Samuelson (1958): monetary application
- Other key papers in the history:
  - Diamond (1965): optimal public debt
  - Shell (1971): theoretical results
  - Ball and Mankiw (2007): optimal policies
- Solow (2006) and Weil (2008) nice surveys

Characteristics of OG framework

- First Fundamental Welfare Theorem does NOT hold, in general
  - Weil (2008) story sketch of proof
  - Is this more realistic than Ramsey model?
- When is overlapping finite lives a better model?
  - Good for questions of inequality, demographics, and age heterogeneity
  - Macro questions?
  - Tractability?
  - Behavior of 20- or 40-year-old?
- Finite lives certainly realistic
  - 70-year-old behaves differently than 20-year-old

Cool Current: Dynamic Scoring at CBO

https://www.cbo.gov/publication/50730



Congressional Budget Office

August 14, 2015

Dynamic Scoring at CBO

Federal Reserve Bank of Chicago
Chicago, Illinois

Wendy Edelberg
Assistant Director, Macroeconomic Analysis

For additional information, see Congressional Budget Office, "Dynamic Analysis," https://www.cbo.gov/topics/dynamic-analysis.

Cool Current: Dynamic Scoring at JCT

file:///Users/rwe/Downloads/x-3-15.pdf

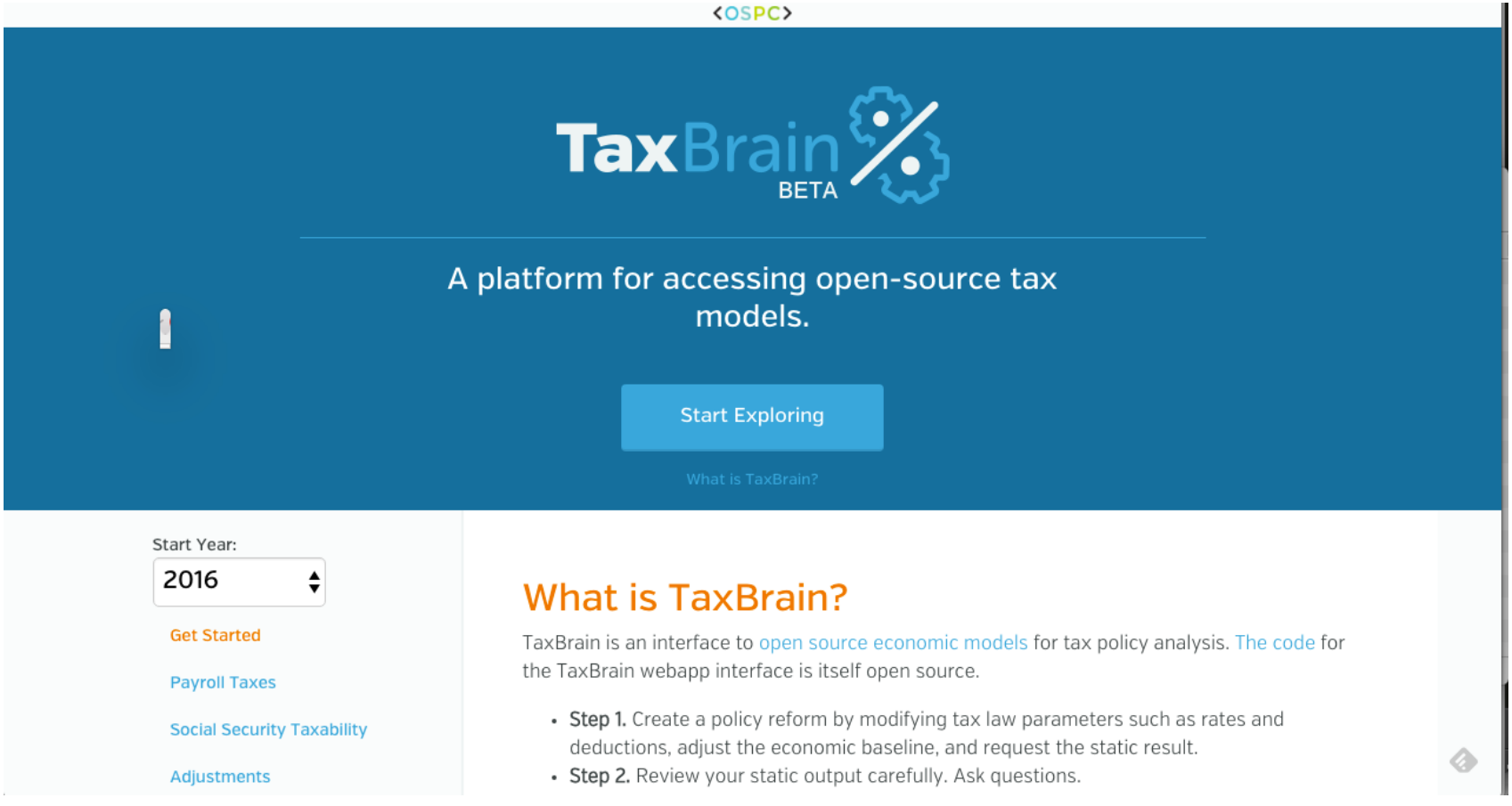
MACROECONOMIC ANALYSIS AT THE JOINT COMMITTEE ON TAXATION AND THE MECHANICS OF ITS IMPLEMENTATION

OUTLINE OF PRESENTATION OF THE JOINT COMMITTEE STAFF AT THE BROOKINGS INSTITUTION PROGRAM "DYNAMIC SCORING: NOW WHAT?"

Prepared by the Staff
of the
JOINT COMMITTEE ON TAXATION

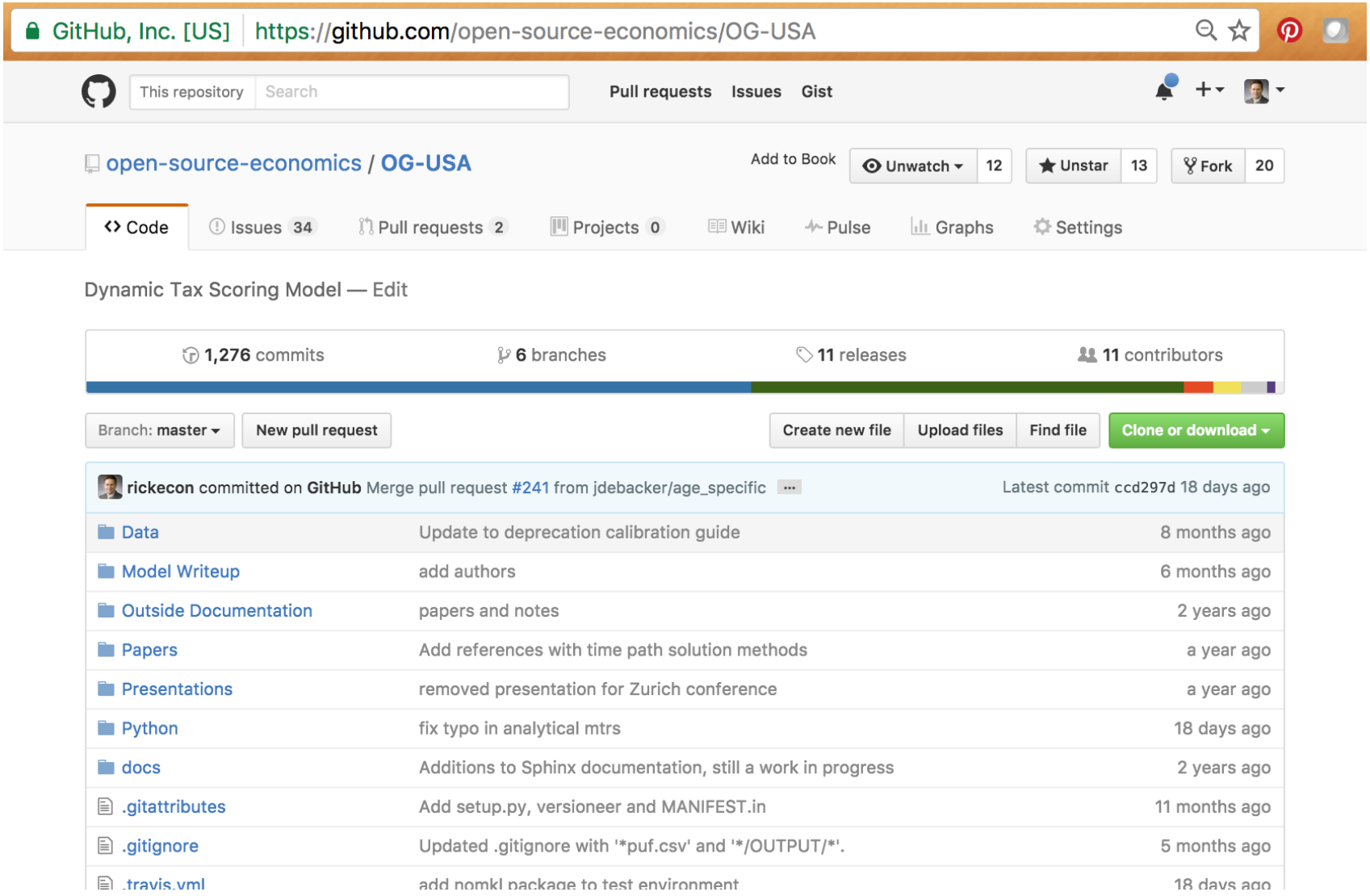
Cool Current: Tax Brain by OSPC

http://www.ospc.org/taxbrain/



Cool Current: OG-USA

https://github.com/open-source-economics/OG-USA/



Time path is usually essential

- Some studies only compare steady-states
- Solving for time path is harder, but usually essential
  1. Demographics usually take 100+ years to hit steady-state
  2. Government budget constraint rule kicks in long after initial period
  3. Policy windows usually only 10 years out
  4. Rich distributional dynamics along transition

Open Source is important

- Open Source is important for policy models

More Fundamental

Open Source tools/workflow are essential for broad model programming collaboration

- See GitHub issue in OG-USA (link)

Solution techniques and robustness

- 2 quotes from *Numerical Recipes* (Press, et al, 2007)

  "...you can never be sure that the root is there at all until you have found it.... It cannot be overemphasized, however, how crucially success depends on having a good first guess for the solution,...." [Press, et al (2007, pp. 442-443)]

  "We make an extreme, but wholly defensible statement: There are no good, general methods for solving systems of more than one nonlinear equation. Furthermore, it is not hard to see why (very likely) there never will be any good, general methods." [Press, et al (2007, p. 473)]

The end from the beginning

- Multiple versions of models
- Each with thousands of lines of code, multiple modules

Essential characteristics

- Code modularity
- Careful commenting, docstrings
- See OG-USA demographics.py