A Course on DSGE Models with Financial Frictions
Part 1: Introduction

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About The Course (and myself)

- Stelios Tsiaras, email at stylianos.tsiaras@eui.eu
- Working on macro-finance, unconventional monetary policy, macroprudential policy
- Feel free to ask me anything on research!

The Course

- An introduction to the main financial frictions DSGE models
- Together with models of simple heterogeneity
- And a short view on models with unconventional monetary policy and macroprudential policy
- Usually, if you have the FF set-up, everything else adds up easily

Overview

- This lecture: Introduction on DSGE models, solution techniques, RBC refresher and how to solve models in Dynare
- Lecture 2: Models with asymmetric information: Essentially the Bernanke *et al.* (1999)
- Lecture 3: Models with moral hazard problems: Essentially the Gertler and Kiyotaki (2010); Gertler and Karadi (2011)
- Lecture 4: Models with simple form of heterogeneity: Bilbiie (2008), Mankiw (2000)
- Lecture 5: Models with unconventional MP and macroprudential policy (building on the previous blocks)

Take-Home Exercises

- After every lecture, I will provide you with an exercise
- It will be some coding work in Dynare or Matlab built on what we saw in the lecture
- These will add to a total of 20% (=4*5%) of your final grade

Final Exercise

- Optimistic Option for those that want to continue with this in their PhD
- Choose a paper of your choice with some financial friction component
- Solve it in Dynare
- Ideally, extend in in some dimension (e.g. add macroprudential regulation policy)
- Write up a 3-4 pages report with results, analysis etc.
- Normal Option
  - Choose a recent working paper of your choice (or from the course outline) and write a referee report
  - Write a research proposal related with financial frictions models

DSGE models

- Real Businesses Cycles
- New Keynesian models

$\left.\begin{array}{l}\text{Real Businesses Cycles}\\ \text{New Keynesian models}\end{array}\right\}$ DSGE models

- Dynamic Stochastic General Equilibrium
- RBC & NK (plain vanilla) models assume perfect financial markets
  $\rightarrow$ DSGE models with financial frictions go a step further

Summary

- DSGE models are micro-founded
- They make assumptions regarding:
  (1) Preferences (log utility, CRRA, GHH...)

  (2) Technology (Cobb Douglas PF, CES...)

  (3) Market structure (Complete-incomplete markets, heterogeneity, FF...)

Background Literature

- Seminal RBC models: Kydland and Prescott (1982) & Long Jr and Plosser (1983)

- New Keynesian main textbooks:
  - Galí (2015) *Monetary Policy, Inflation, and the Business Cycle: An Introduction to the New Keynesian framework and Its Applications, Second Edition.* Princeton University Press
  - Woodford (2011) *Interest and Prices. Foundations of a Theory of Monetary Policy.* Princeton University Press

- General DSGE
  - Miao (2020) *Economic Dynamics in Discrete Time.* MIT press

- State of the art multi-shock and frictions NK-DSGE model: Smets and Wouters (2007)

RBC to NK to FF DSGE

- RBC: Neoclassical model where agents optimize with rational expectations
- New Keynesian environment adds price and/ or wage stickiness
- Financial frictions eliminate complete markets
    - Sometimes these frictions are very specific, derived from micro-founded behaviour, while sometimes they are more ad-hoc (reduced form)
- Next: From the model set up to the model solution

Models' Solution

- What characterizes the solution of a DSGE model?
  - The optimality conditions obtained through the various maximizations
  - The constraints
  - The shock processes
- The steady state equilibrium is obtained by transforming all equations from dynamic to static

Models' Solution

- What is the solution of a DSGE model?
  - A set of policy functions

- A simple RBC model example
  - $C_t = g_c(K_t, Z_t)$
  - $K_t = g_k(K_{t-1}, Z_t)$

- Finding the policy function can be a very difficult problem: there is rarely an analytical solution and we therefore use numerical techniques

- The general idea is to approximate the policy function with a polynomial

$$\hat{g}_c(K_t, Z_t) \approx g_c(K_t, Z_t)$$

  where

$$\hat{g}_c(K_t, Z_t) = \alpha_c + \alpha_{c,k} K_t + \alpha_{c,z} Z_t$$

  [here a first order polynomial approximation]

Solution Methods

- A large number of solution methods have been proposed to solve DSGE models
  - See Fernández-Villaverde *et al.* (2016) for an almost complete characterization

- Perturbation algorithms build Taylor series approximations to the solution of a DSGE model around its deterministic steady state
  - This is what Dynare does, $g(x_t) \approx g(\bar{x}) + (x_t - \bar{x})g'(\bar{x}) + \frac{1}{2}(x_t - \bar{x})^2 g''(\bar{x})$...
  - We will focus on this

- Projection methods handle DSGE models by building a function indexed by some coefficients that approximately solves our set of functions
  - The coefficients are selected to minimize a residual function that evaluates how far away the solution is from generating a zero residual
  - Example: Parametrized Expectations Algorithm by: Den Haan and Marcet (1990)

- Value function iterations

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Bilbiie, F. O. (2008). Limited asset markets participation, monetary policy and (inverted) aggregate demand logic. *Journal of Economic Theory*, **140**(1), 162–196.

Den Haan, W. J. and Marcet, A. (1990). Solving the stochastic growth model by parameterizing expectations. *Journal of Business & Economic Statistics*, **8**(1), 31–34.

Fernández-Villaverde, J., Rubio-Ramírez, J. F., and Schorfheide, F. (2016). Solution and estimation methods for dsge models. In *Handbook of macroeconomics*, volume 2, pages 527–724. Elsevier.

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Gertler, M. and Kiyotaki, N. (2010). Financial intermediation and credit policy in business cycle analysis. In *Handbook of monetary economics*, volume 3, pages 547–599. Elsevier.

Kydland, F. E. and Prescott, E. C. (1982). Time to build and aggregate fluctuations. *Econometrica*, pages 1345–1370.

Long Jr, J. B. and Plosser, C. I. (1983). Real business cycles. *Journal of Political Economy*, **91**(1), 39–69.

Mankiw, N. G. (2000). The savers-spenders theory of fiscal policy. *American Economic Review*, **90**(2), 120–125.

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