DSGE Models

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Introduction

- Macroeconomists study both long-run and short-run topics
  - Long-run: Economic growth, natural rate of unemployment
  - Short-run: Business cycle, stabilization (monetary, fiscal) policy
- We will focus on dynamic models of aggregate demand and supply to **quantitatively** analyze the business cycle and stabilization policy
  - Nominal vs real variables
  - Closed vs open economy
  - Finite vs infinite horizon
  - Continuous vs discrete time
  - Perfect foresight vs uncertainty
  - Endogenous vs exogenous variables

DSGE Models

- Mathematical representations of an economy subject to shocks
- Acronym stands for Dynamic Stochastic General Equilibrium
  - Dynamic: Agents make intertemporal decisions
  - Stochastic: Random shocks capture uncertainty
  - GE: All markets interact and prices adjust so that supply equals demand
- DSGE models are a central tool for macroeconomic analysis
  - Microeconomic foundations: Optimizing agents (utility, profits)
  - They are internally consistent, not subject to Lucas critique (1976)
- They are used by central banks and international organizations (IMF)
  - Simulate and forecast variables of interest
  - Policy and scenario analysis

Module Outline

- We will cover the canonical models
  - Real Business Cycle (RBC) - flexible prices without money
  - Money in the Utility Function - flexible prices with money
  - New Keynesian (NK) - price frictions
- RBC model (Kydland and Prescott, 1982) set standard for analysis of economic fluctuations
  - Productivity shocks, perfect competition, no role for monetary policy
- Building on RBC model, later models introduced new shocks and frictions in line with Keynesian principles
- We will not cover frictions used in more recent models
  - Habit formation, investment adjustment costs, financial, etc.

Canonical Models

- Steps we will follow for each model:
  - Assumptions
  - Agents' optimization problems (Lagrange's method)
  - Model's equilibrium (short-run)
  - Steady state (long-run)
  - Calibration
  - Log-linearization (Uhlig's method)
  - Dynare implementation
  - Impulse response functions
    - How endogenous variables respond to exogenous shocks

Representative Agents

- Agents in economy are heterogeneous
  - Consumers have different preferences, firms use different technologies
  - Households, firms, financial intermediaries, foreigners
- Any economic model is a simplified description of reality
- Canonical DSGE models make use of representative agents
  - **Simplifying assumption**: Large number of identical agents (firms, families) make decisions with infinite time horizons
- Assess macroeconomic policy by analyzing interactions of these agents

Calibration

- Dynamic macroeconomic models are a set of **parameters** and **equations** describing relationships between macroeconomic variables
  - Consumption, investment, output, trade balance (exports - imports), employment, prices, interest rate, exchange rate
- Parameters values are key inputs for numerical implementation of model
  - Estimation: Using actual data
  - Calibration: Assign values based on consensus and/or related papers
    - Proceed with caution and common sense
- **Important**: Match length of time period (quarterly, annually) in model

Dynare

- Free collection of routines for solving DSGE (and OLG) models
  - Rational expectations, perfect foresight, learning
- Developed by a team led by Michel Julliard
- Widely by academic and policy institutions
- A Matlab license is required to run Dynare
  - Alternatives: Octave (limited) and Julia (beta version)
- In practice:
  - Write text (.mod) file: variables, parameters, equations, shocks, output
  - Dynare's preprocessor translates the .mod file into Matlab code
  - Matlab numerically solves model and displays results