1 Introduction

- Instructor: So Kubota
- e-mail: gkubotaso@gmail.com
- office hour: by email.
- lecture style
  - in-person, building 3, room 404
  - I'll also record video and upload on Moodle
  - Do you prefer real-time zoom lecture?
- Textbook
  - Jianjun Miao *Economic Dynamics in Discrete Time*, 1st edition, MIT press, 2014.
  - available online in Waseda library!
  - 2nd edition is expensive
  - Simulation programs also available https://sites.google.com/site/jianjunmiaobook/
  - I'll also provide some other free materials.
- Topic: Dynamic Stochastic General Equilibrium (DSGE) model
  - Macroeconomics based on general equilibrium
  - Quantitative method, simulation, data $\leftrightarrow$ model '
  - The standard model of macroeconomics.
- theory
  - advanced level microeconomics required. What is the fundamental theorem of welfare economics? How to solve monopolist's profit maximization problem?
  - Math: at least be familiar with Lagrangian. We'll also use Matrix operations.
  - No macroeconomics knowledge
- Simulation
  - programming skills are helpful, but not requirement.
  - Matlab: engineering software. Waseda has licenses.
  - We'll also use Dynare, a package running on Matlab.
- Grading
  - No homework, no exam. final report only.
  - Three options

1. Solve problem sets
2. Individual research applying the models and simulations you learn in this class.
3. Individual research about different topics.

- If you choose the third option, contact me until December.

Homework

- Install Matlab and Dynare.
- https://www.waseda.jp/navi/rental/soft/matlab.html
- https://www.dynare.org/

History of macroeconomics

- Before 1930: only microeconomics
- John Maynard Keynes published *The General Theory of Employment, Interest and Money* in 1936.
  - Construct models using macro variables
  - Economy may deviate from equilibrium. it may be inefficient
- John Hicks invented the IS-LM model in 1937 as an interpretation.
  - Good simple model for practical policy issues.
  - Agents follow ad-hoc assumptions. For example, $C = cY$
- Monetarist or Chicago school gained power in 1970s
  - criticized ad-hoc assumptions. In-particular about people's expectation.
    - $MV = PY$
    - Keynesian: $M \uparrow \Rightarrow$ P unchanged by price rigidity $\Rightarrow Y \uparrow$
    - Monetarist: $M \uparrow \Rightarrow$ people expect inflation $\Rightarrow P \uparrow$ and Y unchanged
  - But still ad-hoc models
- Rational expectation in 1970s - 1980s
  - Mathematically formulate people's future expectation.
  - Construct micro founded theory
- DSGE 1, Real Business Cycle, 1980s-1990s

  - General equilibrium + rational expectation
  - Numerical solution & quantitative simulation
  - TFP shocks explains Data
  - perfect market, no room for policy
- DSGE 2, New Keynesian (2000s-)
  - Add Keynesian style market friction into RBC model
  - Economy is solved as general equilibrium, but efficiency incorporated, policy matters
- DSGE 3, Heterogeneous-Agent (2010-)
  - Different people by income, wealth, family-type. Different companies by sector, size
  - Macro = interaction of many different agents. Inequality matters
  - very difficult. computationally heavy. Let me skip in this class.

Macroeconomic research

Steps

1. Big Idea. Think about important issues in our society.
2. Data. It's for overview. rigorous empirical research is optional.
3. Model. Based on microeconomic theories.
4. Calibration. Setting parameters of the models. Sometime borrows from empirical research. Sometime adjust to fit data
5. Simulation. Evaluate how much the model can explain data. If not, rebuild the model & recalibrate parameters.
6. Policy exercise. We can conduct any experiments in computer.

Example. My research about COVID-19 infection and economy in Japan.

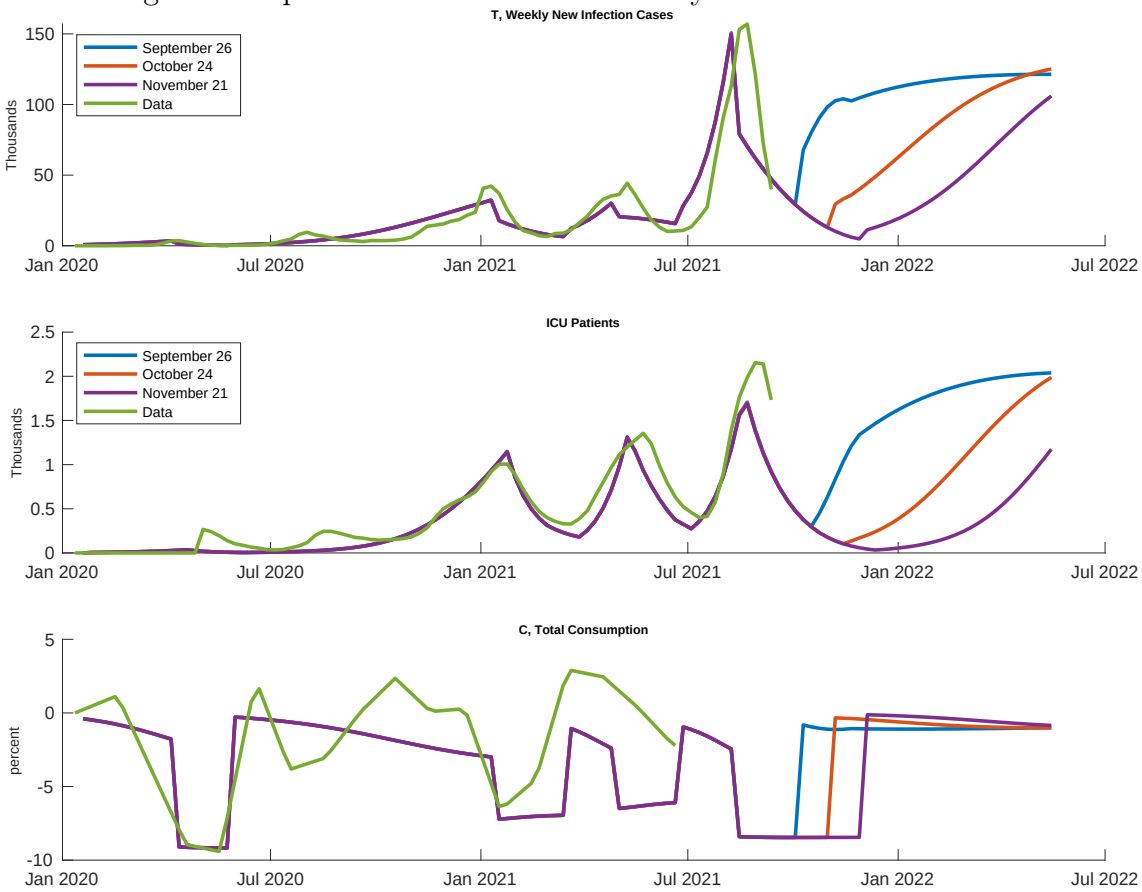
1. infection, economic damage, state of emergency, alpha and delta variants, vaccine, etc.
2. Epidemiological and economic measures, mobility index.
3. General equilibrium model with each person's dynamic optimization problem about the trade-off between fear of infection and activity.

4. infection parameters from medical studies. others to roughly match 2020 data & simulation results

5. simulated path fits the first half of 2021

6. When the government should lift the current state of emergency?

Figure 1: Japan's COVID-19 and Economy Model



Topics

- Household optimization over time: three periods & infinite periods
  - Sequential problem: extension of utility maximization problem
  - Dynamic programming: another of mathematical formulation
- Numerical solution and simulation
  - Analytical solution is rare. Use computer algorithms to find model's solutions.
  - solving non-linear system of equations. Can be applied to many applied models.
  - special solution method of dynamic programming
- Ramsey-Cass-Koopmans model (or Optimal Growth Model)
  - Incorporate household dynamic model to general equilibrium.
  - Dynamics represented by hand-written diagrams
  - Numerical solution using Dynare. Method called deterministic simulation.
- Eichenbaum-Rebelo-Trabandt model
  - Add COVID-19 infection to Ramsey model
  - deterministic simulation using Dynare. Study lockdown policy.
- Real Business Cycle (RBC) model
  - Add stochastic shock to Ramsey model.
  - Numerical solution and simulation using Dynare. New method called stochastic simulation if linearized system.
  - Quantitative method to compare with data
- New Keynesian model
  - Add monopolistic competition and price stickness.
  - Numerical solution and simulation using Dynare. Moneary policy analysis
- Kiyotaki-Moore model
  - Add imperfect contract in financial sector.
  - Bubble & Burst