Lecture 0: Introduction

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The Modern Macroeconomist

- A jack of all trades:
  - Simple theoretical models.
  - Quantitative models.
  - Cross-sectional identification.
  - Time-series identification.
- Why? Identification problems massive:
  - Fed lowers interest rates in 2008. What do we learn about effects of monetary policy?

$\Rightarrow$ Attack problem from many different angles.

This Class

Spirit of the class.

- Research advice & econometrics review, & identification in macro (0.125 class)
- Cross-sectional identification and aggregation
- Macro models with micro heterogeneity
- Student presentations

Topics

- One lecture on C
- One lecture on G
- One lecture on I
- No lectures on $X - M$ since you are learning about that with F^2.
- That gives you a good understanding of aggregate demand $Y = C + G + I$
- One lecture on π
- Good understanding of quantities and prices

Course Requirements

- Required reading, idea generation, and participation (44%).
  - Read * papers on syllabus before class.
  - Write up two ideas in advance of each class. (24%)
  - Participate in discussion, ask questions. (20%)
  - Insufficient participation $\Rightarrow$ Midterm / Final
- Paper draft (56%)
  - Paper should connect micro data with macro model.
  - Does not have be a completed paper.
  - Needs to be original.

Idea Generation

- One of the most important part of the research process.
  - You need to start now.
  - Each week we ask you to submit two research ideas related to the readings.
  - Roughly two paragraphs each, explaining:
    - What is the research question?
    - How would you answer it? (E.g., data, model, identification strategy.)
    - Why is it important?
  - Idea generation is hard and most ideas are either not interesting, infeasible, or already done. This is normal!
  - A general problem of our students is that they get attached to ok ideas, only present one idea, stop sampling.
  - Knowing this, you should start the sampling process now and it is our job to help you triage your ideas.
- Write up ideas in markdown and upload to your GitHub repository.
  - Submit by giving us read access to your GitHub repository.

Paper draft

- The paper should contain two parts:
  - A new micro data fact or causal effect.
    - Ok to build on (but not copy!) other work.
  - A (simple) macro model that connects the micro data fact to macroeconomic outcomes.
    - Simple models > complicated models.
- At the end of class you need to submit the paper and code.
  - If we cannot replicate the paper figures and tables with one click or command, we will ask you to resubmit.
  - Submit by giving us read access to your GitHub repository.

Outline

Outline

Seminars, Lunches, etc[1]

- Attending seminar and lunch is an important part of your PhD.
  - Allows you to see cutting edge research, help improve peer's research, become part of research community.
  - See how the sausage is made.
  - In grad school I learned a lot from others' questions.
  - Even if the topic is outside your immediate research area there are large spillovers from learning about techniques, data, and presentational skills.
- If macro is a secondary field, fine to only attend seminar and lunch for your primary field. But should attend something!

Research Advice

- Becoming a researcher is hard.
  - Requires learning by doing. Only so much one can explain.
  - Also requires a lot of time. We attach value to your output (quality of papers), not your input (number of hours in the office).
  - However, the job is objectively very hard. Unlikely to have a breakthrough without working hard
- *Persistence* is key.
  - *Every* paper hits a roadblock that initially appears fatal.
  - *Every* idea is related to something else and you will hear someone say ”that sounds like [insert citation here].”
  - *Every* researcher has days (weeks/months) where they work extremely hard and have nothing to show for it.
- The key is being able to wake up and work just as hard and be just as dogged on the 50th day (or 100th or 300th) as you were on the first.
  - Work on something you love that motivates you.
  - Every paper has boring parts or frustrating parts. Learn to love the challenge.
  - Use habit formation to your advantage. (watch Jiro’s dreams of sushi). Create rituals to celebrate small steps.

Working Together

- I personally love to work with others.
  - More fun.
  - Fewer dead ends, less of an echo chamber.
  - Motivate each other, give each other deadlines.
- Talk to each other. Co-author if you come up with an interesting idea.
- You will learn as much from your peers as from the faculty.
  - Get to know each other!
  - Help each other with research. Workshop ideas. Talk economics. Have fun together.
  - My PhD classmates (at Columbia and outside Columbia) are some of my best friends.
  - I continue to learn from them today.

How To Come Up With Ideas

- Most difficult part of research. Only input in short supply.
- DON'T just sit there waiting for an idea.
  - Work on something. You will bump into things.
- Talk to others! Often papers come out of conversations.
- Read a lot, and read critically.
  - Look for connections between topics.
  - Look for holes in literature, reasons to doubt papers.
  - For each paper you read, force yourself to **write** an idea out of it.
- Play with data, look for facts.
- Go through *lots* of ideas. Discard aggressively.
  - Market rewards the max of all your ideas.
  - For every idea ask yourself: "What is the best case scenario for this paper if everything works out?"
  - If not good enough, move on.
  - Try to get a sense within 1-2 weeks if it is worth continuing.
  - Can always return later if you see a way to get a more promising outcome.
- Work on what you love.

Juan's personal advice

- I don't intend to tell you how to work, not my role.
- But you have to find something that works. If you get distracted at home, then don't work at home.
- My personal opinion is that campus offers positive effects (conversations with classmates, ask faculty for a 15 min coffee and pitch an idea,...).
- Some things that have worked for me ($N = 1$, be skeptical).
  - Be methodical with my schedule. I take my work hours seriously
  - I also take my leisure seriously
  - Feeling lazy and want to go home? Push to make it to 3:00 pm. Traffic will force me to stay until 7. Problem solved.
  - Feeling unmotivated? 6:30 am surf/run and then to work. Imitate Carlos Fuentes (but less intense)
  - Meditate. Work out. Sleep. Go to therapy.
- Look for a junior faculty with a portfolio of papers you would like to have when going on the market
- How many ideas/coauthorships/research partnerships/time devoted writing/ you need to invest to have that? Do backward induction

Personal advice: what are you here for?

- You are not here only to get a diploma,...
- ...or to write a JMP
- But to build a research pipeline and create knowledge over years
- Personal experience ($N = 1$, be skeptical)
  - If you go to my website, you will see 8 clickable drafts
  - 100% I started in grad school. They were in different stages when I graduated.
  - Very soon I will have the first draft of a project I started after I moved to California
  - I went to my Dropbox this morning. I have 17 projects for which I have done significant work
  - There are dozens of ideas I have discarded throughout the years.

Things you can control and things you cannot control

Some people are more in love with being an academic than doing an academic's job. Resist that urge.

- You do not control:
  - if you graduate in a tight or slack job market
  - l if you graduate in a cohort full of great competition or without macroeconomists
  - if your department loses a faculty member/hires a new one
- Do not spend too much time thinking about things beyond your scope of control
- My examples
  - I graduated in a good year. Many universities where hiring. Good luck.
  - But competition in macro was brutal. Some names: Fabian Trottner, Steve Wu, Chen Lian, Chris Wolf, Adrien Bilal, Joe Hazell, Elisa Rubbo, Paolo Martellini, Job Boerma, Carter Braxton, Anders Humlum, John Grigsby, Nathan Zorzi,...
  - My two main advisors changed universities when I was in graduate school. It was more work, but we made it work.
- You control your actions, and you need to be smart and consistent with your effort
- You control producing new ideas, learning tools, writing drafts, being proactive, professional, take faculty time seriously, punctual, and dedicated to your craft.
- You control asking for advice!

Juan's personal rules

- If you are interested in working with me/having me in your committee, I have some personal rules
  - You take my classes (good start for those in the room)
  - You come to meetings prepared
  - You attend 286 always, and present when given a chance
  - You attend the macro seminar always
  - You CPhil by the end of your third year
  - I will invest in you if I feel you are investing in your own academic development...
  - ...and if its a good match and I actually have something to say
  - Some constraints: I would like to get tenure, and getting tenure at UCSD is not easy. Happy to talk offline about how that works. I need to publish papers, so my time is limited.

Of course, apply common sense to these requirements.

Outline

Key Concepts[2]

- Data Generating Process
- Identification
- Causal Effect / Treatment Effect
- Moment

Data Generating Process

- A data generating process (DGP) is a complete specification of the stochastic process generating the observed data.
- Equivalently, a specification of the probability $P_\theta(\boldsymbol{y})$ of observing any possible vector valued realization of the data $\boldsymbol{Y}$.
- Example: A DGP for (Y_i, X_i) is

$$Y_i = X_i + \epsilon_i$$
$$(X_i, \epsilon_i) \sim N(0, I_2)$$

- In general a DGP is something you should be able to program in your computer and draw a sample from.

Data Generating Process

- The DGP is assumed to belong to some family $\mathcal{F}$.
- A set of restrictions indexing a particular DGP in $\mathcal{F}$ is called a *structure* $\mathcal{S}$.
- A *model* $\mathcal{M}$ is a family of possible structures.
- Example of a *model*:

$$
\begin{aligned}
Y_i &= \beta_0 + \beta_1 X_i + \epsilon_i \\
(X_i, \epsilon_i) &\sim N\begin{pmatrix} \mu_1 & \sigma_1^2 & \sigma_{12}^2 \\ mu_2, & \sigma_{12}^2 & \sigma_2^2 \end{pmatrix} \\
\theta &= (\beta_0, \beta_1, \mu_1, \mu_2, \sigma_1^2, , \sigma_2^2, , \sigma_{12})
\end{aligned}
$$

- Example of a *structure*: $\theta = (0, 0, 0, 0, 1, 1, 0)$

Identification

- What is it?

Identification

- The problem of determining the structure from the joint distribution of the data in the population.
- Population $\Rightarrow$ What is knowable in infinite datasets.
- Tells us whether it is worth constructing estimators for use in real datasets.
- Two structures θ' and θ'' are *observationally equivalent* if $P_{\theta'}(\boldsymbol{y}) = P_{\theta''}(\boldsymbol{y})$.
- The structure θ' is *globally point identified* if there is no other θ in the model space with which it is observationally equivalent.

Examples

$$Y_i \sim N(\mu, \sigma^2)$$
$$\theta = (\mu, \sigma^2)$$

- Is θ identified? How?
- Neoclassical growth model. Identified? How?

Language

- In econometrics you can either identify the structure θ (think parameters) in the model $\mathcal{M}$ or you cannot.
- "Identifying assumptions" are restrictions on the model $\mathcal{M}$ (family of DGPs) such that θ is identified.
- Don't run a regression if you can't describe the model $\mathcal{M}$ under which the parameter(s) of interest are identified.

Causality

- Identification by itself has nothing to do with causality.
- Structural models postulate functional relationships for how endogenous variables are generated from exogenous variables. E.g.:

$$Y_i = f(S_i, X_i, U_i)$$
$$(s, x, u) \in \Omega_S \times \Omega_X \times \Omega_U$$

  with (Y, S, X) observed and U unobserved.
- If S can be varied independently of X and U, then the model implies a set of *counterfactual* values that the outcome $y = f(s, x, u)$ would take under various values of the treatment s.
- The *causal effect* or *treatment effect* of changing s from s' to s'' is

$$\Delta_i = f(s'', x_i, u_i) - f(s', x_i, u_i)$$

Potential Outcomes

- Microeconomists will often use potential outcome notation for specifying causal questions.
- An advantage of this framework is that it forces the researcher to be very explicit about the counterfactual.
- $D_i \in [0, 1]$ is the treatment indicator.
- Y_i is the observed data, Y_i^0 the outcome under treatment $D_i = 0$, and Y_i^1 the outcome under treatment $D_i = 1$,

$$Y_i = D_i Y_i^1 + (1 - D_i) Y_i^0$$

- The causal / treatment effect is

$$\Delta_i = Y_i^1 - Y_i^0$$

Average Treatment Effect

- We are often interested in the *average treatment effect* (ATE), $E(\Delta_i)$.
- If treatment is independent of potential outcomes,

$$D_i \perp (Y_i^1, Y_i^0)$$

then a simple difference in means uncovers the ATE:

$$\begin{aligned} E(Y_i^1|D_i = 1) - E(Y_i^0|D_i = 0) &= E(Y_i^1) - E(Y_i^0) \\ &= E(Y_i^1 - Y_i^0) \\ &= E(\Delta_i) \end{aligned}$$

- Independence is an identifying assumption. This condition is sometimes called "unconfoundedness."

Conditional Independence

- It is rare in (macro-)economics that the independence assumption is reasonable.
- Most of empirical we will see in this class will assume

$$D_i \perp (Y_i^1, Y_i^0 | X_i)$$

- X could be a set of controls, in which case this will be termed “conditional independence assumption” or “selection on observables”.
- X could also be an instrument that is correlated with the treatment.

SUTVA

- Potential outcomes are not commonly used in macroeconomics.
- This is because the *stable unit treatment value assumption* (SUTVA) is less plausible.
- SUTVA:
  - The potential outcome is unaffected by the mechanism by which treatment is assigned.
  - The potential outcome is unaffected by the treatment exposure of all other individuals.
- In macro we often worry about “spillovers” through general equilibrium price changes, migration, etc, which would violate (2).
- If SUTVA is invalid then the (conditional) difference in means no longer identifies the ATE.
- This is closely related to the aggregation problem from micro to macro.

Moments

- Identification and causality are population-level concepts.
- A *moment* is a statistic of the data, either in population or in a finite sample.
- Examples:
  - $E(Y_i^1|D_i = 1) - E(Y_i^0|D_i = 0)$.
  - Every estimator is a moment.
  - Causal effects are moments.
- But not all moments are causal effects, estimators, etc.

Outline

Classic Macro Questions

- What are the sources of business cycle fluctuations?
- How does monetary policy affect the economy?
- How does fiscal policy affect the economy?
- Why do some countries grow faster than others?

- Why are we still asking the same questions?
- Nakamura-Steinsson: Identification in macro is hard.

Endogeneity Problem

- Example: Monetary Policy
- Federal Reserve changes interest rates for a reason.
- Quickly lowered interest rates in early 2020.
- Regress

$$\text{Output Growth}_t = \beta_0 + \beta_1 \text{FFR}_t + \epsilon_t$$

  will yield $\beta_1 > 0$...
- Does this mean increasing interest rates raises GDP growth?

External Validity Problem

- Even if we can identify a causal effect, the information content is limited.
- E.g., does not answer “raise the FFR by 25bp today vs next month.”

- High dimensionality of policy: Raise rates now? Later? Announcements or actions.
- Causal effect depends on reaction of other policy variables: e.g., fiscal, monetary.
- Impact may be state-dependent: e.g., recession vs boom.
- Is policy anticipated or a surprise?

$\Rightarrow$ Paucity of evidence relative to dimensionality of policy means macroeconomics tends to rely more on structural modeling.

Combining Model and Data: Calibration

- The calibration approach uses select micro and macro moments to discipline model parameters.
- Examples:
  - Exponent on production function from factor shares.
  - Labor supply elasticity from labor literature.
  - Equity premium.
- Essentially GMM without standard errors (exactly identified).
- Which moments to select? How informative are they?

Combining Model and Data: Structural Estimation

- Bayesian estimation of structural model:
  - Match time series: Smets and Wouters (2007)
  - Match IRF to monetary policy shock: Christiano, Eichenbaum and Evans (2005)
- Mapping from data to model not always transparent.
- How important are priors?
- How important is model misspecification?

Combining Model and Data: Causal Effects

- Nakamura and Steinsson advocate for the use of causal effects (“identified moments”) in distinguishing between competing models of the macroeconomy.

  $\Rightarrow$ Use causal effects in moment matching / structural estimation.

- Why causal effects?
  - Portable: Statistics that can be used over and over again to discipline and test different models. (What statistic is not portable?)
  - Informative: Help discipline particular causal mechanism of model. Invariant to changes in other model “blocks.”

Examples of Causal Effects

- Real effect of monetary policy.
- Gali (1999) Basu-Fernald-Kimball (2006) responses of output and hours to identified productivity shock reject RBC.
- MPC out of tax rebates useful to discipline “consumption block” of models.
- Mian-Sufi-Rao: Causal effect of house prices on consumption reject complete market models in favor of incomplete markets/life-cycle models.
- Labor supply elasticity.

Aggregate versus Cross-Sectional Identification

- Estimating convincing casual effects in the aggregate (time-series) is extremely difficult.
- Identification arguments are generally more plausible in the cross-section:
  - Control for confounding observables.
  - Difference out unknown confounding variation that is common across units with time fixed effects.
  - Deep dive next lecture.
- Fiscal multipliers:
  - Wide range of aggregate multipliers (e.g., Blanchard and Perotti 2002, Rameym 2011)
  - Cross-sectional multipliers cluster around 1.5-2 (Chodorow-Reich, 2019).

Aggregation

- Key challenge:
  - Cross-sectional responses don't directly answer key aggregate questions.
  - How to go from cross-sectional responses to aggregate responses?
- Need to build model for the aggregation step.
  - Focus next lecture
- Success is that the cross-sectional causal effect tells us something important about the aggregate economy.
  - E.g., aggregate effect, set identification of model...
- The modern macroeconomists needs to do both a labor economists and a micro theorists.
  - Is life unfair?

Does Monetary Policy Have Real Effects?

- NS close by discussing evidence on the real effects of monetary policy:
  - Large shocks: Friedman and Schwartz (1963), Volcker Recession
  - Discontinuity-Based Identification: Mussa (1986).
  - Narrative approach: Romer and Romer (1989).
  - Controlling for observables: structural VARs, Romer and Romer (2004).
- Which approaches are more convincing?
- What do they have in common?

Reis (2018)

"Is Something Really Wrong With Macroeconomic?"

Asking an active researcher in macroeconomics to consider what is wrong with macroeconomics today is sure to produce a biased answer. The answer is simple: everything is wrong with macroeconomics. Every hour of my workday is spent identifying where our knowledge falls short and how can I improve it. Researchers are experts at identifying the flaws in our current knowledge and in proposing ways to fix them. That is what research is. So, whenever you ask me what is wrong with any part of economics, I am trained by years on the job to tell you many ways in which it is wrong. With some luck, I may even point you to a paper that I wrote proposing a way to fix one of the problems.