416-2 Empirical Macroeconomics:

Identification, Heterogeneity, Aggregation

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Course overview: This is a course on modern empirical macroeconomics, covering recent advances on identification and how micro data can be used to better understand macro phenomena. We survey the recent surge in empirical work in macro and discuss how putting more emphasis on research design combined with more and better data has improved credibility and transparency, and how the new evidence can help to discriminate among competing theories.

The course has the aim to build up empirical tools and bring students to the research frontier. We will cover two distinct approaches to empirical macro. The first exploits time-series variation for identification, exploiting narrative, high-frequency or other external information, and is top-down: we start by identifying the macro effect and map out the heterogeneous effects after. The second approach is bottom-up: we start from micro data, such as cross-sectional or panel data on households, firms, or regions, to estimate a partial-equilibrium effect and impose additional structure to back out the aggregate effect, e.g. using a structural model or sufficient statistic approach. Throughout the course, we will cover exciting applications, ranging from the transmission of monetary and fiscal policy to the aggregate and distributional effects of energy price shocks and climate policy.

Goals, approach, and expectations: The goals for this course are the following:

1. Introduce students to important papers and research questions with high empirical content and relevance to macroeconomics, broadly defined
2. Introduce students to a variety of empirical methods and data sources – micro and macro – that can be used to test, calibrate and develop models of interest for macroeconomics and related fields
3. Inspire students to think hard about best practices in empirical work, and how to combine creativity, tools, and high standards to produce credible and successful research

4. Assist students in building up an empirical toolbox that can be used as a basis for future research
5. Provide guidance on how to identify research questions and effectively convey and present research

My approach:

- I want to give you a bird's eye view of the current state of the literature
  - Get an idea what data sources and what strategies are available to identify the parameters of interest
- And then focus in on a few papers (2-3 per class) in detail
  - You will be asked to read these carefully before class
  - Often these will be more recent papers meant to get you thinking at the frontier rather than the most seminal papers

My view on the "big questions in macro":

- What are the origins of business cycles?
- Why can seemingly small shocks can have large effects?
- And why are the responses so persistent?
- What is the role of policy, in particular monetary, fiscal and climate policy?
- And what are the distributional consequences?

What I ask of you:

- Read the required readings before class. Try to read critically and come to class with an eye towards new research questions
- Ask questions, participate, challenge me, etc.

Prerequisites: Completion of the macroeconomics and econometrics classes in the first-year PhD sequence. 3rd year students and above are welcome to audit the course. Send me an email introducing yourself and I will be happy to add you to the canvas. Auditors are not required to complete the assignments but are expected to do background readings and participate in class.

Material: The class will be largely organized around required readings. I will communicate relevant readings ahead of class. Starred (*) papers are essential reading before the lecture, while the optional readings are useful for a deeper understanding of the material. Lecture slides will be made available on the course website.

While there is no textbook for the course, there are some excellent survey articles that are a must-read:

* Valerie A. Ramey. Macroeconomic shocks and their propagation. *Handbook of Macroeconomics*, 2:71–162, 2016

* Emi Nakamura and Jón Steinsson. Identification in macroeconomics. *Journal of Economic Perspectives*, 32(3):59–86, 2018

For background reading on some of the more standard materials, I can recommend the following two textbooks:

Lutz Kilian and Helmut Lütkepohl. *Structural vector autoregressive analysis*. Cambridge University Press, 2017

Fabio Canova. *Methods for applied macroeconomic research*, volume 13. Princeton University Press, 2007

The materials presented also partly draw on the excellent teaching materials by Christian Wolf, Gabriel Chodorow-Reich, Adam Guren, Emi Nakamura and Jón Steinsson which you are also welcome to use as a reference:

- https://www.christiankwolf.com/teaching
- https://scholar.harvard.edu/chodorow-reich/classes/economics-2410hfc-advanced-topics-applied-macroeconomics
- https://people.bu.edu/guren/
- https://eml.berkeley.edu/~jsteinsson/teaching.html

Evaluation: Your performance will be evaluated based on class participation (10%), three take-home assignments (40%) and a quarter-long research project (50%).

1. *Class participation:* Starred (*) papers are essential reading before the lecture. Parts of each class will revolve around discussion of those papers, so it is important that you are equipped to critically assess them.

2. *Assignments:* Your first assignment will be to write a referee report (2-4 pages) on a recent working paper in empirical macro, broadly defined.

   The second and third assignments will be empirical exercises centered around the replication of an empirical paper and extending the analysis in some directions.

3. *Research project:* The final part of your evaluation will be a quarter-long research project. The objective is to get you started on the research process, so the expectation is for you to take concrete steps towards a research paper – I would rather get you part of the way towards an exciting project than for you to finish something purely for this class.

   More specifically, I expect you to formulate an original research idea, develop a clear research plan, and at least take some initial steps towards its execution. The paper should be in empirical macroeconomics broadly defined (drawing at least partly on the methods discussed in class), and is encouraged to be motivated by the topics covered in class. It can be an idea for a significant extension of some paper we cover in class or an entirely new research idea.

   Your proposal should include a discussion of the following:

   - Why is your question of interest? How does it relate to the existing literature?
   - Present a theoretical framework for your analysis
   - What kind of data would you like to use? What's your empirical specification? How does it relate to the theoretical framework?
   - Present some preliminary modeling and empirical findings

   Towards the mid of the term, you will submit an initial proposal, receive feedback on that proposal, and then submit a final version at the end of term. Towards the end of the term, we will also schedule presentations where all students will give a short presentation of their project in class and have the opportunity to get feedback.

Course outline

Disclaimer: the following course outline is preliminary and is still subject to change.

1. Introduction and overview: macroeconomic shocks
   (a) Advice on becoming a researcher
   (b) Background: What is a macroeconomic shock? Why does modern macro take a shock-propagation perspective? What are policy shocks?

(c) Identification in macro: two complementary approaches. Outline for the rest of the class

2. Refresher: linear models and time series methods

   (a) Slutzky–Frisch paradigm

   (b) Lag operators, linear filters, VARMA, SVMA

   (c) Autocovariance function, spectrum, Wold decomposition

3. Identification using time-series variation

   (a) Identifying assumptions

   - Background: the SVMA model identification challenge
   - Identification under invertibility: zero restrictions (short-run, long-run), sign/magnitude restrictions, max-share, proxies/external instruments (high-frequency identification, narrative approach), heteroskedasticity
   - Identification without invertibility: instruments/proxies, dynamic residual rotation and Blaschke matrices, FAVARs

   (b) Estimation strategies

   - Overview: VAR, LP (and intermediate shrinkage techniques)
   - LP/VAR population equivalence
   - Finite-sample recommendations

   (c) Pitfalls

   - Anticipations
   - Trends, lags, outliers and influential observations
   - Counterfactuals
   - Nonlinearities

   Throughout we will illustrate these methods through applications to canonical macro shocks (monetary policy, fiscal policy, technology, oil, climate policy).

4. Macro shocks and micro data

   (a) Overview of data sources: households, firms, ...

   (b) Two-step approach: grouping estimators, panel local projections

   (c) Unified approach: functional VARs

5. Identification using cross-sectional variation

   (a) Research designs
      - Difference-in-difference
      - Shift-share

   (b) What does cross-sectional variation identify?
      - Cross-household/firm analysis & partial equilibrium effects
      - Cross-regional analysis & local general equilibrium effects
      - Local average versus heterogeneous effects

   (c) The "missing intercept"/aggregation
      - Semi-strucutral approach, sufficient statistics
      - Structural approach, moment matching (micro moments, identified moments)

   (d) Bridging theory and empirics
      - Using cross-sectional data to learn about transmission channels
      - Model selection

   Throughout we will illustrate these methods through well-known recent applications (mostly to fiscal spending multipliers & stimulus checks).

References

Fabio Canova. *Methods for applied macroeconomic research*, volume 13. Princeton University Press, 2007.

Lutz Kilian and Helmut Lütkepohl. *Structural vector autoregressive analysis*. Cambridge University Press, 2017.

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Valerie A. Ramey. Macroeconomic shocks and their propagation. *Handbook of Macroeconomics*, 2: 71–162, 2016.