

Course Overview and Syllabus

This course examines econometric research on a variety of topics related to public policy, with the goal of preparing students to undertake academic research. The course is not an econometrics or statistics course *per se*; rather, it focuses on research designs with observational data and how econometric techniques are applied in practice.

The course aims to train students to do applied economic research that involves measuring effects of theoretical or practical interest. It proceeds in three major parts. The first part examines endogeneity and inference about causal relationships. The second part studies instrumental variables methods and critiques. The third part of the course examines structural models and policy simulations. Topics covered in this part include demand, production, and dynamics. The course proceeds by analyzing, in detail, approximately twenty well-known empirical research papers in applied economics. The fields include public economics and tax policy, labor economics, law and economics, health care policy, industrial organization and competition, demand analysis, and others.

The course is participatory in nature. Attendance is mandatory. Students are expected to carefully read the assigned materials before coming to class and to contribute actively to the class discussion.

Readings

Textbook. The required course text is David A. Freedman, *Statistical Models: Theory and Practice*, 2nd edition (Cambridge University Press, 2009). Hereafter SMTP. Available as a paperback at your favorite online bookseller, Penn's bookstore, and the like.

The course assumes familiarity with basic econometrics, at the level of standard first-year graduate econometrics textbooks. Some useful references are:

- Wooldridge, Jeffrey M., *Econometric Analysis of Cross Section and Panel Data*, 2nd edition (MIT Press, 2010). Popular with students and well-written. (There is also an undergrad version).
- Greene, William H. *Econometric Analysis*, 7th edition (Prentice Hall, 2012). A cookbook. Useful for checking formulas, not so useful for learning intuition about statistical models.
- Hayashi, Fumio, *Econometrics* (Princeton, 2000). A good first-year text for good students.
- Davidson, Russell and James G. MacKinnon, *Estimation and Inference in Econ-*

ometrics (Oxford, 1993). More technical than the others. Deep and insightful.

You are not required to purchase these references. However, they provide essential background information for this course, and I would recommend acquiring at least one of them.

Readings. Most papers can be downloaded freely from the Penn Libraries. Students are responsible for downloading, printing, and reading these materials.

Throughout the year, additional materials will be posted on Canvas at [???](#)

Course Requirements

There are two course requirements: (1) Read the assigned materials and contribute to the class discussion (worth 40% of overall grade); and (2) complete the problem sets (60%). A few details:

1. *Readings.* We have relatively few readings per session. Our strategy is to cover the readings in detail, with the goal of internalizing the research techniques used. A careful reading of the papers prior to class is essential. You lose 5% every time you have to admit that you did not read the material being discussed. Students are expected to carry the bulk of the discussion in class. To ensure a high standard of discussion, I may cold call students. I may also ask students to present papers. Good presentation skills are critical to a successful career, and presenting somebody else's research is an excellent opportunity to practice.
2. *Problem Sets.* The goal of the course is to train students to do applied economic research. The problem sets are designed to further this goal. The requirement, in essence, is to carry out an empirical analysis and briefly write up the findings. Some problem sets may ask students to replicate and extend a published paper, others to conduct an empirical analysis from scratch. There will be two or three problem sets, spread out over the entire year.

Contact Information

The best way to reach me is by email. You can also stop by my office (1452 Steinberg Hall-Dietrich Hall) by appointment.

Readings and Topics for Each Week (Subject to Change)

Session 1 (8/31). Research Approaches and Empirical Strategy

The goal of today's session is to introduce the course, its objectives, and the recurrent theme of sensible research designs and models. We will discuss the following topics:

1. *Taxonomy of research approaches.* Much economic and policy research can be located along a spectrum running from purely descriptive empirical work to pure theory. Research types along the spectrum—including descriptive research, measurement of treatment effects, structural modeling, computational/calibration models, and applied theory—differ according to how statistical and behavioral assumptions are combined to draw conclusions about causes and effects.
2. *Causality and empirical inference: A famous example.* Sex bias in graduate admissions.

Please read the following papers prior to class:

Bickel, Peter J., Eugene A. Hammel, and J. William. O'Connell. Sex Bias in Graduate Admissions: Data from Berkeley. *Science*, Vol. 187, No. 4175 (1975), 398-404.

Wainer, Howard. Simpson's Paradox. *Chance*, Vol. 12, No. 2 (1999), 41-42.

Session 2 (9/7). Causal Inference in Observational Data

Consider the following examples:

- Suppose one runs a regression of, say, hourly wages on education, experience, and gender. If the coefficient on the "female" indicator is negative, what assumptions are required to allow the researcher to infer evidence of discrimination? Is it discrimination, or is it simply "unobserved heterogeneity" correlated with gender?
- Suppose one runs a regression of firm performance on CEO tenure (and other stuff) and finds a positive relationship. Is this evidence that CEOs "ripen" in the job, or is it evidence of something else, or is it impossible to say?

The point of today's class is that regression coefficients often do not reflect the causal effects of explanatory variables on the "dependent" variable. We illustrate this first by discussing the "Rectangles Problem," a brief but vivid example in the background read-

ing. This transparent example, in conjunction with the sex-bias example from last class, encapsulates the quintessential points to remember in evaluating regression studies. The bulk of this session is devoted to examining a pair of well-known papers, one by Alan Krueger and the other by John DiNardo and Jorn-Steffen Pischke, on inference about wage changes over time using observational data. In reading the first of these papers, think about whether and how Krueger's analysis deals with Freedman's lessons.

Background Reading:

Freedman, David, Robert Pisani, and Roger Purves. Does the Regression Make Sense? (The Rectangles Problem). Pages 211-213 in *Statistics*, 3rd edition. (W.W. Norton, 1998). The "Hooke's Law" experiment Freedman refers to is summarized in SMTP, §2.3.

Freedman, SMTP, Chapters 4 and 5. Be sure to read the short discussions in §4.3 on R^2 , §5.7 on F-tests in applied work, and §5.8 on data mining. I assume you know everything else in these chapters already, so review (or skim) them at whatever level you require.

Main Papers:

Krueger, Alan B. How Computers Have Changed the Wage Structure: Evidence from Microdata, 1984-1989. *Quarterly Journal of Economics*, Vol. 108, No. 1 (1993), 33-60.

DiNardo, John and Jorn-Steffen Pischke. The Returns to Computer Use Revisited: Have Pencils Changed the Wage Structure Too? *Quarterly Journal of Economics*, Vol. 112, No. 1 (1997), 291-303.

Session 3 (9/14). Comparison-Group Designs I

We have seen problems when regression models are applied inappropriately. What are some ways around the problem? One popular and conceptually simple approach is the use of comparison groups (akin to control groups in experimental settings), and examining the contrast in responses between the affected ("treated") and comparison ("untreated") groups. Such methods are called "difference-in-differences" or "diff-in-diffs" techniques in economic work.

Today's paper is an example of this type of study, and seeks to measure the effect of one important provision in the 1986 Tax Reform Act. In reading it, think about the merits of the study design vis-à-vis what could be done with only cross-sectional regressions on wages and labor hours information.

Background Reading:

Freedman, SMTP, Chapter 1. Then read discussion question #21 on p. 58 in SMTP and decide what you think of Labrie et al. (2004)'s finding.

Freedman, David, Robert Pisani, and Roger Purves. A Closer Look at Tests of Significance. Chapter 29 in *Statistics*, 3rd edition. (W.W. Norton, 1998).

Main Paper:

Eissa, Nada, and Jeffrey B. Liebman. Labor Supply Response to the Earned Income Tax Credit. *Quarterly Journal of Economics*, Vol. 111, No. 1 (1996), 605-637.

Session 4 (9/21). Comparison-Group Designs II

This session continues our discussion of comparison-group research designs in a more complex setting. How do researchers proceed with a comparison-based design when there are many potential factors confounding the causal effect we wish to isolate?

Background Reading:

Freedman, SMTP Chapter 6. Read §6.1 to §6.5. Gibson (1998) in §6.3 is an award-winning paper in political science, and is reprinted at the end of the book.

Freedman, SMTP Chapter 7. Read §7.1 to §7.3. I assume you know all this background on probit models, so review (or skim it) at whatever level you require before today's session.

Main Paper:

Madrian, Brigitte. Employment-Based Health Insurance and Job Mobility: Is There Evidence of Job-Lock? *Quarterly Journal of Economics*, Vol. 109, No. 1 (1994), 27-53.

Session 5 (9/28). Instrumental Variables Methods: Theory and Concepts

This is the first of three sessions on instrumental variable (IV) techniques. Today's session reviews the theory and purpose of IV-based inference. The motivation for this class is that students emerging from standard first-year graduate statistics or econometrics courses often have mastered the mechanics of IV techniques, but not the more fundamental research-related aspects of what problems these techniques can solve and how one goes about justifying the assumptions the technique requires. In addition to clarifying the statistical framework underlying IV methods, this session examines in detail (1) what practical problems these techniques can solve (at least in principle), (2) what "identification" means in this setting (and for what sub-populations), and (3) some common problems and limitations (e.g., weak instruments, bias).

Background (well, sort of):

Whitehouse, Mark. Is an Economist Qualified to Solve Puzzle of Autism? *Wall Street Journal*, Feb. 27 (2007), 1. An evocative primer on on-going debates.

Main Readings:

Freedman, SMTP, Chapter 9. Read §9.1 to §9.8.

Angrist, Joshua D. and Alan B. Krueger. Instrumental Variables and the Search for Identification. *Journal of Economic Perspectives*, Vol. 15, No. 4 (2001), 69-85.

Further Readings:

(Optional) Deaton, Angus. Instruments, Randomization, and Learning about Development. *Journal of Economic Literature*, Vol. 48, No. 2 (2010), 425-455. The first salvo in the recent debate about the role of instrumental variables techniques and natural experiments.

(Optional) Heckman, James and Sergio Urzua. Comparing IV with Structural Models: What simple IV Can and Cannot Identify. *Journal of Econometrics*, Vol. 156, No. 1 (2010), 27-37. Piling it on.

(Optional) Heckman, James. Building Bridges Between Structural and Program Evaluation Approaches to Evaluating Policy. *Journal of Economic Literature*, Vol. 48, No. 2 (2010), 356-398. Piling it on.

(Optional) Imbens, Guido. Better LATE than Nothing: Some Comments on Deaton (2009) and Heckman and Urzua (2009). *Journal of Economic Literature*, Vol. 48, No. 2 (2010), 399-423. The response.

Session 6 (10/12). Unpacking Instrumental Variables Methods

When explanatory variables are shifted experimentally, it is often straightforward to ascertain their causal effects on outcomes of interest. Yet social scientists typically cannot run experiments—at least, not large enough to generalize to a larger population of interest. Today’s papers are well-known examples of the use of IV methods to draw causal inferences from observational data.

Our class session will focus on Angrist’s draft lottery paper, which you should read carefully. In doing so, think about (1) what assumptions are required to justify his interpretation of the results as casual effects of military service, and especially (2) for what population of individuals do these results apply? Then think about how you interpret Angrist’s findings after reading Keane’s discussion of it.

Main Papers:

Angrist, Joshua D. Lifetime Earnings and the Vietnam Era Draft Lottery: Evidence from Social Security Administrative Records. *American Economic Review*, Vol. 80, No. 3 (1990), 313-336. Figures 1 and 3 are reversed, captions are in right order.

Keane, Michael P. Structural vs. Atheoretic Approaches to Econometrics. *Journal of Econometrics*, Vol. 156, No. 1 (2010), 3-20.

Further Reading:

(Optional) Frankel, Jeffrey A. and David Romer. Does Trade Cause Growth? *American Economic Review*, Vol. 89, No. 3 (1999), 379-399. A nice (viz., educational) example of IV methods, here applied to make progress on an age-old “chicken-and-the-egg” question: how much trade determines economic growth? *We are unlikely (alas) have time to do this paper in class.*

Session 7 (10/19). Instrumental Variables Methods and Critiques

Instrumental variable methods and “natural experiment” analogs have become popular research designs, and can be very useful. But they are not without problems. Today we continue our discussion of instrumental variable methods, their limits, and recent critiques. The application we examine today is a more traditional (and more common) application of IV methods to market-based data, as opposed to a “natural experiment” with true randomization. The excerpt from Reiss-Wolak in the background reading sets the Hausman-Bresnahan’s papers in the research context that economists have in mind beforehand.

Our session will focus on both Hausman’s paper and Bresnahan’s critique. They each wrote unpublished but widely-disseminated replies. Hausman’s reply and Bresnahan’s rejoinder are pointed and informative, in both substantive and procedural ways (e.g., how scholars defend their work—for good and for bad). Aim to understand the substantive issues behind the Hausman-Bresnahan debate; that is, what issues they agree upon, what points are matters of contention, and how well Hausman responds to Bresnahan’s concerns. Think also about what are the right lessons to draw from their post-article responses to one another.

Background Reading:

Reiss, Peter C. and Frank A. Wolak. Structural Econometric Modeling: Rationales and Examples from Industrial Organization. *Handbook of Econometrics*, Vol. 6, Chapter 64 (2007), 4277-4415. Read §7.1.

Main Paper:

Hausman, Jerry A. Valuation of New Goods Under Perfect and Imperfect Competition. In Timothy F. Bresnahan and Robert J. Gordon (eds.), *The Economics of New Goods*, (University of Chicago Press, 1997), 209-237.

Comment, Reply, and Rejoinder:

Bresnahan, Timothy F. Comment. *Ibid*, 237-247. Bresnahan's comment is printed immediately following Hausman's article.

Hausman, Jerry A. *Reply to Prof. Bresnahan*. Unpublished Note, 1997.

Bresnahan, Timothy F. *The Apple-Cinnamon Cheerios War: Valuing New Goods, Identifying Market Power, and Economic Measurement* (Rejoinder to Prof. Hausman). Unpublished Note, 1997.

Session 8 (11/2). Using Panel Data

The differences between cross-sectional units (individuals, firms, etc.) often elude statistical explanation. Importantly, these unobserved differences are often correlated with the observed variables, making inference difficult. To cite an earlier example, education is presumably correlated with unobserved "ability," making it difficult to infer the causal effect of education on, say, income. When one has repeated observations on the cross-sectional units (in the form of panel, or longitudinal, data), it is sometimes possible to address such problems.

Today we talk about data structures and associated techniques that allow researchers to avoid some of the problems endemic to cross-sectional data. As you read about these techniques, think about whether they eliminate the major limitations of cross-section data. What concerns remain?

Main Papers:

Brown, Charles. Equalizing Differences in the Labor Market. *Quarterly Journal of Economics*, Vol. 94, No. 1 (1980), 113-134.

Reiss, Peter C., and Matthew W. White. What Changes Energy Consumption? Prices and Public Pressure. *Rand Journal of Economics*, Vol. 39, No. 3 (2008), 636-663.

Session 9 (11/9). Panel Data: More Sophisticated Uses

Although panel data allow one to draw inferences that are not possible with only cross-sectional data, as we have seen last class, they also permit far more sophisticated analysis of research problems. This session is a bridge between two segments of the course, focus-

ing on the use of formal probability models to deal with data-related problems that cannot be easily addressed using the frameworks covered in the course so far. Such explicit modeling is the hallmark of structural methods to be covered in the balance of the course. In reading Card's paper, think about what problems the literature has unsatisfactorily resolved (in Card's view) prior to his paper; what aspects of the data allow him to make progress on this issue; and why the explicit (if complicated) econometric model is useful given Card's agenda. Note: There is only one paper for today, and it is a sophisticated one. Give yourself adequate time to read it, so you can follow the logic of his modeling approach.

Main Paper:

Card, David. The Effect of Unions on the Structure of Wages: A Longitudinal Analysis. *Econometrica*, Vol. 64, No. 4 (1996), 957-979.

Session 10 (11/16). Selection Models: Concepts and Classical Techniques

Selection problems are one of the fundamental sources of confounding in observational research in any field. Understanding how selection effects arise, and their consequences if unaddressed, is one of the central lessons for researchers in the social sciences to know. The short background reading for today introduces the main concepts through five well-known examples of selection problems. We will discuss the fifth example at the start of class, which is due to Abraham Wald—one of the twentieth century's great statisticians. As simple as it seems in hindsight, think about what the engineers would have done to improve the aircraft without Wald's observation!

The main paper for today, by (Nobel Laureate) Jim Heckman, motivated an important and extensive literature concerned with sample selection biases and population inference. When reading it, think about how estimation of individuals' wage/price sensitivity would proceed using a pure instrumental-variables technique, and why researchers might prefer an explicit selection-based model instead.

Background Reading:

Wainer, Howard, Samuel Palmer, and Eric T. Bradlow. A Selection of Selection Anomalies. *Chance*, Vol. 11, No. 2 (1998), 3-7.

Main Paper:

Heckman, James. Shadow Prices, Market Wages, and Labor Supply. *Econometrica*, Vol. 42, No. 4 (1974), 679-694.

Further Reading:

(Optional) SMTP Chapter 7. Read §7.4. I (strongly) recommend you read the material on the effect of Catholic schools. It provides an insightful and educational critique of Evans and Schwab's (1995) article, and selection methods following Heckman's (1974) paper generally. We would cover this paper in class if we had an additional session; Freedman is an excellent substitute. Evans and Schwab (1995) is reprinted at the end of the book.

Session 11 (11/30). Market Equilibrium Models I: Entry and Competition

Today we examine structural approaches to discrete outcomes determined by equilibrium conditions (e.g., entry and exit). Here economic theory provides both guidance on estimation, and a framework for giving parameters precise economic interpretations. The Bresnahan and Reiss paper uses the relationship between market size and the number of firms in a market to infer the effect of entry on prices. In reading it, think carefully about how and why they are able to do this (e.g., what assumptions are maintained?).

This session also illustrates the development of structural econometric models in industrial organization, one of the leading areas for this type of work. The Reiss and Wolak background reading explains why this style of research has become important for studying firms' interactions in markets. For today's class, first skim the introductory material in §1 to §3. The material in §10.2 to §10.6 summarizes the model and logic of the Bresnahan and Reiss paper, and you may find it helpful for understanding the paper.

Background Reading:

Reiss, Peter C. and Frank A. Wolak. Structural Econometric Modeling: Rationales and Examples from Industrial Organization. *Handbook of Econometrics*, Vol. 6, Chapter 64 (2007), 4277-4415. Read §1 to §3 and §10.2 to §10.6.

Main Paper:

Bresnahan, Timothy F. and Peter C. Reiss. Entry and Competition in Concentrated Markets. *Journal of Political Economy*, Vol. 99, No. 5 (1991), 977-1009.

Session 12 (12/7). Market Equilibrium Models II: Policy Simulations

An important motivation for structural econometric work is to evaluate the effects of complex policies or developments that cannot be estimated directly using other empirical methods. This session considers the problem of evaluating a complex economic policy, relative to alternatives not taken, when the policy affects *both* the supply decisions of firms *and* the demand decisions of individuals.

This paper applies a demand model developed in a path-breaking earlier article by Steve Berry, Jim Levinsohn, and Ariel Pakes in order to assess the impact of this controversial trade policy using counterfactual simulations of the US automobile market. The background reading (which is a little easier to read) summarizes the demand model. In reading today's main paper, note (1) the structure involved in modeling demand behavior; (2) the assumptions about firms' strategic responses to one another and to the trade policy; and (3) how the ultimate economic variables of interest—changes to consumption, revenue, welfare, profits, and the like—are deduced from the model(s) after estimation.

Background Reading:

Reiss, Peter C. and Frank A. Wolak. Structural Econometric Modeling: Rationales and Examples from Industrial Organization. *Handbook of Econometrics*, Vol. 6, Chapter 64 (2007), 4277-4415. Read §7.3 to §7.5.

Main Paper:

Berry, Steve, James Levinsohn, and Ariel Pakes. Voluntary Export Restraints on Automobiles: Evaluating a Trade Policy. *American Economic Review*, Vol. 89, No. 3 (1999), 400-430. This is an ambitious paper; please set aside adequate time to read it.

Further Reading:

(Optional) Berry, Steve, James Levinsohn, and Ariel Pakes. Automobile Prices in Market Equilibrium. *Econometrica*, Vol. 63, No. 4 (1995), 841-890.