

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 two major parts. The first part examines endogeneity and inference about causal relationships, instrumental variables methods and critiques, and panel data methods. The second part of the course examines structural models and policy simulations. Topics covered in this part include sorting and selection, entry models, and counterfactual analyses of policy changes. The course proceeds by analyzing, in detail, approximately twenty well-known empirical research papers in applied economics or related fields. 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. Students are required to complete an empirical research paper that—with any success—can develop into part of a dissertation. First-year students busy preparing for exams can fulfill the course requirement with a substantive paper proposal, as opposed to an empirical research paper.

Readings

Text. The (required) course text is David A. Freedman, *Statistical Models: Theory and Practice* (Cambridge University Press, 2005). Hereafter SMTP. Available at your favorite online bookseller, Penn's bookstore, and the like.

Readings in the Bulkpack. The course reader (aka, “the bulkpack”) at Wharton Reprographics has all of the original papers we will read listed in this syllabus. Some are also on the Web at

<http://bpp.wharton.upenn.edu/mawhite/ReadingsFor911/>

Other References. The course assumes familiarity with basic econometrics, at the level of standard first-year graduate econometrics textbooks. Useful references here are:

- Wooldridge, Jeffrey M. *Econometric Analysis of Cross Section and Panel Data* (MIT Press, 2002). Popular with students and well-written. (There's also an undergrad version).
- Greene, *Econometric Analysis*, 6th Ed (Prentice Hall, 2008). A cookbook. Useful for checking formulas, not so useful for learning intuition about statistical models.

- Hayashi, *Econometrics* (Princeton, 2000). A good first-year text for good students.
- Davidson and MacKinnon, *Estimation and Inference in Econometrics* (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.

Course Requirements

There are two course requirements: (1) Read the papers and attend each class; and (2) complete the empirical research paper requirement. A few details on this:

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.
2. *Research Paper.* The goal of the course is to get students started doing good research, and the course paper requirement is designed to serve this purpose. The requirement, in essence, is to carry out an empirical analysis and write up a brief paper summarizing the results. First-year students may propose a research plan, rather than carrying out (potentially time-consuming) data and computer work this year. For second-year-and-up students, this requirement is intended to goad you into making visible progress toward research and a dissertation. Here is what is actually due:
 1. **A research critique and a paper plan.** These two items are due March 6:
 - a. **Prepare a written critique of a recent paper (or papers) in a research area of interest.** Be sure to address how the nature of data and techniques used in the(se) paper(s) affects what is known to date. Include in your write-up a clear demarcation between what we know based on existing work, and the questions remaining to be answered by (your) future work. Length: 4 pages or less. Write concisely.
 - b. **Data and paper plan.** This note should describe the data set you have identified (possibly hypothetical for 1st-years) and will use to complete the actual research paper for the course, as well as outlining your proposed plan of attack. Length: 4 pages or less. Write concisely.
 2. **Final paper.** Using feedback from the earlier rounds, run the analysis and write-up the results. You are aiming here for a document that, with further work after the term ends, could be turned into one paper for your dissertation. Length: 10 pages or less. Due: May 1 (tentative).

Readings and Topics for Each Week

Session 1. 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'll discuss the following topics:

1. *A 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. W. O'Connell. Sex Bias in Graduate Admissions. *Science*, Vol. 187:4175 (Feb. 7, 1975), 398-404.

Wainer, Howard. Simpson's Paradox. *Chance*, Vol. 12:2 (1999), 41-42.

Session 2. 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'll illustrate this first by discussing the "Rectangles Problem," a brief but vivid example in the background reading (*note: this is in the course pack, not in the text*). This transparent example, in conjunction with the sex-bias example from last class, encapsulates the quintessential points to remember in evaluat-

ing 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 Pische, 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, et al. Does the Regression Make Sense? (The Rectangles Problem). Pages 211-213 in *Statistics*, 3rd Ed. W.W. Norton, 1998 (*in bulk pack.*) Note: The 'Hooke's Law' experiment Freedman refers to is summarized in SMTP, §2.3 (p. 22).

Review: Freedman, SMTP, Chapter 4. **Be sure to read** the short discussions in §4.3 on R^2 , §4.8 (p. 63) on F -tests in applied work, and §4.9 on data mining. *I'll assume you know everything else in this chapter already, so review (or skim it) 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. (Feb., 1993), pp. 33-60.

DiNardo, John, and Jorn-Steffen Pische. The Returns to Computer Use Revisited: Have Pencils Changed the Wage Structure Too? *Quarterly Journal of Economics*, Vol. 112 (February 1997): 291-303.

Session 3. Comparison-Group Designs I

We've 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" 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: Observational Studies. Then read discussion question #30 on p. 72 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 Ed. W.W. Norton, 1998 (*in bulk pack, not SMTP*).

Main Paper:

Eissa, Nada, and Jeffrey B. Liebman. Labor Supply Response to the Earned Income Tax Credit. *Quarterly Journal of Economics*, Vol. 111:2 (May, 1996), 605-37.

Session 4. 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?

Consider two aspects of today's main paper when reading it. First, why does the author use three different sets of people to estimate the effects of job-lock in this study? What problem(s) does using each successive group address, from a confounding standpoint? Second, pay attention to the empirical implementation described on pages 33-35. In particular, how should a difference-in-difference estimate of the effect of job-lock be constructed from a probit model like the one being estimated?

On the basis of all the evidence, decide how convinced you are about the measurement of job-lock in this paper. I'll ask you to explain your thinking in class.

Background Reading:

Read: Freedman, SMTP Chapter 5: Path Models. Read §5.1 to 5.5. Gibson (1998) in §5.3 is an award-winning paper in political science, and is reprinted at the end of the book.

Review: Freedman, SMTP Chapter 6, §6.1 to 6.3. *I'll 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 C. Employment-Based Health Insurance and Job Mobility: Is There Evidence of Job-Lock? *Quarterly Journal of Economics*, Vol. 109 (Feb., 1994), 27-54.

Session 5. Instrumental Variable 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 1st-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 (2007). “Is an Economist Qualified to Solve Puzzle of Autism?” *The Wall Street Journal*, Feb. 27, p. 1(!). An evocative primer on on-going debates.

Main Readings:

Freedman, SMTP, Chapter 8: Simultaneous Equations (read thru §8.8).

Angrist, Joshua D., and Alan B. Krueger. Instrumental Variables and the Search for Identification. *Journal of Economic Perspectives*, Vol. 15:4 (Fall 2001), 69-85.

Session 6. Unpacking Instrumental Variable 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. 80:3 (June, 1990), 313-36.

Keane, Michael P. Structural versus Atheoretic Approaches to Econometrics. *Journal of Econometrics* (forthcoming). Revised May 2006.

Further Reading:

(Optional) Frankel, Jeffrey A., and David Romer. Does Trade Cause Growth? *American Economic Review*, Vol. 89:3 (June, 1999), 379-99. 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. Instrumental Variable 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 Hausman/Bresnahan’s papers in the economic research context that economists have in mind beforehand.

Our session will focus on both Hausman’s paper and Bresnahan’s critique. (*N.B.*: They are both listed in the same paper in the reader—Bresnahan’s comment immediately follows Hausman’s article). 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*, Volume 6 (forthcoming), manuscript of Feb. 2005. Read: §7.1 (pp. 57-63).

Main Paper:

Hausman, Jerry A. Valuation of New Goods Under Perfect and Imperfect Information. In *The Economics of New Goods*, Timothy F. Bresnahan and Robert J. Gordon, eds., NBER Studies in Income and Wealth No. 58 (University of Chicago Press, 1997), pp. 209-237.

Comment, Reply, and Rejoinder:

Bresnahan, Timothy F. Comment. *Ibid*, pp. 237-247.

Hausman, Jerry A. *Reply to Prof. Bresnahan*. Unpublished Note, July 21, 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. 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 ob-

served 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. 94:1 (Feb., 1980), 113-134.

Reiss, Peter C., and Matthew W. White. What Changes Energy Consumption Habits? Prices and Public Pressure. NBER Working Paper No. 9986, Rev. September 2007.

Session 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, focusing 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. 64:4 (Jul., 1996), 957-979.

Session 10. 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’ll discuss the fifth example at the start of

class, which is due to Abraham Wald—one of the 20th 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. 11:2 (1998), 3-42.

Main Paper:

Heckman, James. Shadow Prices, Market Wages, and Labor Supply. *Econometrica*, Vol. 42:4 (July, 1974), 679-694.

Further Reading:

I (strongly) recommend you read Freedman, SMTP Chapter 6, §6.4-6.5 on the effect of Catholic schools. It provides an insightful and educational critique of Evans and Schwab’s (1995 *QJE*) article, and selection methods using Heckman’s (1974, 1979) models 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 Freedman’s book.

Session 11. Modeling Endogeneity and Sorting for Prospective Analyses

This paper is part of a newer generation of work addressing sorting and selection problems in empirical research. The main contribution of the paper is its method for dealing with endogeneity based on an explicit model of sorting along a (in this case, nonlinear) budget constraint. Since it is a complicated paper, focus at first read on the concepts and logic rather than the formulas—we’ll do the math in class in a more intuitive way. In particular, in reading it try to answer the following interrelated questions:

- (1) What is the practical motivation for this paper?
- (2) Why is there an endogeneity problem here?
- (3) Why does the paper’s practical motivation lead the authors to their estimation technique, rather than IV methods, to address the endogeneity problem?
- (4) Why does the paper include a validation exercise (in §7) and the prediction exercise (in §8)?

Main Paper:

Reiss, Peter C. and Matthew W. White. Household Electricity Demand, Revisited. *Review of Economic Studies*, Vol. 72 (Jul., 2005), 853-883.

Session 12. 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 the 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 background Reiss-Wolak *Handbook* manuscript 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 §1-3.3 (pp. 1-24). The material in §10.2-10.6 summarizes the model and logic of Bresnahan-Reiss (1991), and you may find it helpful for understanding their paper.

Background Reading:

Reiss, Peter C. and Frank A. Wolak. Structural Econometric Modeling: Rationales and Examples from Industrial Organization. *Handbook of Econometrics*, Volume 6 (forthcoming), manuscript of Feb. 2005. Read: §1-3 and §10.2-10.6 (pp. 128-37).

Main Paper:

Bresnahan, Timothy F; Reiss, Peter C. Entry and Competition in Concentrated Markets. *Journal of Political Economy*, Vol. 99:5 (Oct. 1991), p. 977-1009.

Session 13. 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. We have already seen some papers of this sort (in Sessions 11 and 12). 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 an earlier article by Berry, Levinsohn, and Pakes (*Econometrica* 1995), 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 the BLP pa-

per, 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. *NB:* This is an ambitious paper; please set aside adequate time to read it.

Background Reading:

Reiss, Peter C. and Frank A. Wolak. Structural Econometric Modeling: Rationales and Examples from Industrial Organization. *Handbook of Econometrics*, Volume 6 (forthcoming), manuscript of Feb. 2005. Read: §7.3-7.5 (pp. 72-85).

Main Paper:

Berry, Steve, James Levinsohn, and Ariel Pakes. Voluntary Export Restraints on Automobiles: Evaluating a Trade Policy. *American Economic Review*, Vol. 89:3 (June, 1999), 400-430.