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1:15 – 2:30 TTh
March 13-April 24, 2012
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Economics 395E

Treatment Effects and Causal Inference

Syllabus:

Goals

In this course, we will examine some of the literature on *Causal Inference* in economics. Much of this work goes under the heading of *Treatment Effects* and/or *Program Evaluation*. At the heart of this literature is the “Selection Problem.” The selection problem in economics is as follows: The fact that the actions or choices of agents and their effects on the actions of others – because these agents are assumed to be optimizers, or at least purposeful decision-makers – are endogenously, rather than exogenously, determined. Selection complicates our ability to make inferences about the (causal) effects of treatments, whatever they may be. We will consider this problem, examining both experimental and non-experimental strategies for dealing with selection. We will focus primarily on the ideas behind these various methods, although, where appropriate, we will examine aspects of their formal properties. Finally, we will examine a number of empirical studies that use these methods and critically assess their appropriateness.

Course Requirements

The course will be a mix of lecture, discussion, student presentations and computer exercises. I will provide you with an introduction and overview of the various topics we will consider in my lectures. In addition, students will prepare presentations and lead discussions of some specific papers, typically ones that apply the methods or use the concepts I have been lecturing on. In these presentations, students will be expected to critically assess papers, trying to highlight their strengths and weaknesses with respect to improving our understanding of various phenomena. Finally, there will be computer exercises in which students will use and compare the various statistical methods on sample data sets. Each student taking the course for credit will make one presentation during the course. The computer exercises are optional but doing them will be extremely useful in making sure you understand and see how to use the concepts we develop in class. Whether during my lectures or the presentations of your classmates, I expect you to participate in the course by asking questions or providing insights into the topics that we consider. I cannot overemphasize the importance of asking questions and probing new ideas as an essential mode of learning. I expect students to read the papers on the reading list and will resort to “putting you on the spot” in class about the readings in class if it appears students are not doing them.

Course Website

I have established a website for the course on Blackboard. You can obtain the following materials from the website: this syllabus, and its updates, handouts, and some of the course readings and/or their location on the web. Most of the readings for the course can be obtained from JSTOR (www.jstor.org) or the websites for the various papers. If you have trouble finding papers on the reading list, please let me know and I'll put copies of the papers up on Blackboard.

Course Outline:

- 1. An Overview: The Program Evaluation Framework, Causal Inference, The Selection Problem, and Parameters of Interest**
- 2. Randomized Experimental Designs**
- 3. Non-Experimental Methods for Estimating Treatment Effects (for Conducting Causal Inference)**
 - 3.1 Overview*
 - 3.2 Matching Methods and the Propensity Score*
 - 3.3 Regression Discontinuity*
 - 3.4 Instrumental Variable Methods*
 - 3.5 Control Function Estimators*
 - 3.6 Panel Data Methods: Fixed Effect Estimators*
 - 3.7 Difference-in-Difference Methods*
 - 3.8 Bounding Treatment Effects*
- 4. Using Experimental Data to Evaluate Selection Bias and Alternative Non-Experimental Methods**
- 5. Structural & Dynamic Treatment Effect Models**

Course Outline:

Comprehensive and Background Readings

There are a number of papers and/or readings that provide comprehensive discussions and treatments of the material on treatment effects, causal inference and program evaluation. I list them below and suggest that you try to look at them throughout the course. I also provide you with a set of lecture notes that I wrote several years ago and have revised periodically. I will use these notes to structure most of my lectures. I suggest that you print a copy of these notes – they are available on Blackboard – and bring them to class.

Heckman, J. and R. Robb (1985), “Alternative Methods for Evaluating the Impact of Interventions,” in *Longitudinal Analysis of Labor Market Data*, J. Heckman and B. Singer, eds., New York: Cambridge University Press. **[On Blackboard]**

Heckman, J. J., Lalonde, R. and J. Smith (1999), “The Economics and Econometrics of Active Labor Market Programs” In *Handbook of Labor Economics*, Volume III, Eds. O. Ashenfelter and D. Card (Elsevier: Amsterdam). **[On Blackboard]**

Heckman, J. and E. Vytlacil (2007a), “Econometric Evaluation of Social Programs, Part I: Causal Models, Structural Models and Econometric Policy Evaluation,” In *Handbook of Econometrics*, Vol. 6B, J. Heckman and E. Leamer, eds. New York: Elsevier, 4779-4874. **[On Blackboard]**

Heckman, J. and E. Vytlacil (2007b), “Econometric Evaluation of Social Programs, Part II: Using the Marginal Treatment Effect to Organize Alternative Econometric Estimators to Evaluate Social Programs, and to Forecast their Effects in New Environments,” In *Handbook of Econometrics*, Vol. 6B, J. Heckman and E. Leamer, eds. New York: Elsevier, 4875-5143. **[On Blackboard]**

Abbring, J. and J. Heckman (2007), “Econometric Evaluation of Social Programs, Part III: Distributional Treatment Effects, Dynamic Treatment Effects, Dynamic Discrete Choice, and General Equilibrium Policy Evaluation, In *Handbook of Econometrics*, Vol. 6B, J. Heckman and E. Leamer, eds. New York: Elsevier, 5145-5303. **[On Blackboard]**

Hotz, V. J. (2007), *Lectures on Evaluation of Social Programs*, Lectures given at the World Bank, Rev. April 2007, Lectures 1 and 2. **[On Blackboard]**

Blundell, R. and M. Costa Dias (2009), “Alternative Approaches to Evaluation in Empirical Microeconomics,” *Journal of Human Resources*, 44(3): 565-640.

Imbens, G. and J. Wooldridge (2009), “Recent Developments in the Econometrics of Program Evaluation,” *Journal of Economic Literature* 47(1): 5-86.

1. An Overview: The Program Evaluation Framework, Causal Inference, The Selection Problem, and Parameters of Interest

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Heckman, J. (1990), “Alternative Approaches to the Evaluation of Social Programs: Econometric and Experimental Methods,” Barcelona Lecture, World Congress of the Econometric Society, 1990. **[On Blackboard]**

Heckman, J.J. (2005), “The scientific model of causality,” *Sociological Methodology*, 35, 1–97.

Heckman, J. (2008), “Econometric Causality,” *International Statistical Review*, 76(1): 1-27.

Heckman, J. J., Lalonde, R. and J. Smith (1999), “The Economics and Econometrics of Active Labor Market Programs” In *Handbook of Labor Economics*, Volume III, Eds. O. Ashenfelter and D. Card (Elsevier: Amsterdam). **[On Blackboard]**

Heckman, J., J. Tobias, and E. Vytlacil (2001), “Four Parameters of Interest in the Evaluation of Social Programs,” *Southern Economic Journal*, Vol. 68, No. 2. (Oct., 2001), pp. 210-223.

Hotz, V. J. (2007), *Lectures on Evaluation of Social Programs*, Lectures given at the World Bank, Rev. April 2007, Lectures 1 and 2. **[On Blackboard]**

Imbens, G. and J. Wooldridge (2009), “Recent Developments in the Econometrics of Program Evaluation,” *Journal of Economic Literature* 47(1): 5-86.

Manski, C. (1989), “Anatomy of the Selection Problem,” *Journal of Human Resources*, 24, pp.343—360.

Manski, C. (1995), *Identification Problems in the Social Sciences*, Cambridge, MA: Harvard University Press. **[On Blackboard]**

Haavelmo, T. (1944), “The Probability Approach in Econometrics”, *Econometrica* 12, July 1944.

2. Randomized Experimental Designs

Angrist, J. and G. Imbens (1991), “Sources of Identifying Information in Evaluation Models,” NBER Working Paper Series, 1991. **[On Blackboard]**

Burtless, G. (1995), “The Case for Randomized Field Trials in Economic and Policy Research,” *Journal of Economic Perspectives*, Vol. 9, No. 2, pp. 63-84

Heckman, J. and J. Smith (1998), “Assessing the Case for Social Experiments,” *Journal of Economic Perspectives*, Vol. 9, No. 2, pp. 85-110.

Heckman, J. J., H. Ichimura, J. Smith and P. Todd (1998), “Characterizing Selection Bias Using Experimental Data,” *Econometrica*, Vol. 66, 1017-1098.

Hotz, V. J. (2007), *Lectures on Evaluation of Social Programs*, Lectures given at the World Bank, Rev. April 2007, Lectures 1 and 2. **[On Blackboard]**

Hotz, V. J. and S. Sanders (1994) “Bounding Treatment Effects in Experimental Evaluations Subject to Post-Randomization Treatment Choice,” *Bulletin of the International Statistical Institute*, Geneva, Switzerland, 1994. **[On Blackboard]**

Kling, J., J. Liebman and L. Katz (2007), “Experimental Analysis of Neighborhood Effects,” *Econometrica*, vol. 75, January 2007, 83-119.

Krueger, A. (1999), “Experimental Estimates of Education Production Functions”, *Quarterly Journal of Economics*, vol. 114, May 1999, pp. 497-532.

Miguel, E. and M. Kremer (2004), “Worms: Identifying Impacts on Education and Health in the Presence of Treatment Externalities”, *Econometrica*, vol. 72, January 2004, pp. 159-217.

3. Non-Experimental Methods for Estimating Treatment Effects (for Conducting Causal Inference)

3.1 Overview

Angrist, J. and A. Krueger (1999), “Empirical Strategies in Labor Economics” in *Handbook of Labor Economics*, Vol. 3A, Ashenfelter and Card (eds.), 1999. **[On Blackboard]**

Heckman, J. and R. Robb (1985), “Alternative Methods for Evaluating the Impact of Interventions,” in *Longitudinal Analysis of Labor Market Data*, J. Heckman and B. Singer, eds., New York: Cambridge University Press. **[On Blackboard]**

Heckman, J., R. Lalonde, and J. Smith (1999), “The Economics and Econometrics of Active Labor Market Programs,” *Handbook of Labor Economics*, Volume 3, Ashenfelter, A. and D. Card, eds., Amsterdam: Elsevier Science. **[On Blackboard]**

Heckman, J. and E. Vytlacil (2007a), “Econometric Evaluation of Social Programs, Part I: Causal Models, Structural Models and Econometric Policy Evaluation,” In *Handbook of Econometrics*, Vol. 6B, J. Heckman and E. Leamer, eds. New York: Elsevier, 4779-4874. **[On Blackboard]**

Heckman, J. and E. Vytlacil (2007b), “Econometric Evaluation of Social Programs, Part II: Using the Marginal Treatment Effect to Organize Alternative Econometric Estimators to Evaluate Social Programs, and to Forecast their Effects in New Environments,” In *Handbook of Econometrics*, Vol. 6B, J. Heckman and E. Leamer, eds. New York: Elsevier, 4875-5143. **[On Blackboard]**

Hotz, V. J. (2007), *Lectures on Evaluation of Social Programs*, Lectures given at the World Bank, Rev. April 2007, Lectures 1 and 2. **[On Blackboard]**

LaLonde, R. (1986), “Evaluating the Econometric Evaluations of Training Programs with Experimental Data,” *American Economic Review* 76:4, 604-620. [S]

- Manski, C. (1995), *Identification Problems in the Social Sciences*, Cambridge, MA: Harvard University Press. **[On Blackboard]**
- Meyer, B. (1995), "Natural and Quasi-Experiments in Economics." *Journal of Business and Economic Statistics*. 13: 151-161.
- Mitnik, O. (2004), Differential effects of welfare to work programs: identification with unknown treatment status. Unpublished manuscript, Department of Economics, University of Miami, May.
- Moffitt, R. (1999), "New Developments in Econometric Methods for Labor Market Analysis," in *Handbook of Labor Economics*, Vol. 3A, Ashenfelter and Card (eds.), 1999. **[On Blackboard]**
- Moffitt, R. (2005), "Remarks on the Analysis of Causal Relationships in Population Research." *Demography* 42(1), 91-108.
- Smith, J. (2000), "A Critical Survey of Empirical Methods for Evaluating Employment and Training Programs." *Schweizerische Zeitschrift für Volkswirtschaft und Statistik* 136(3), 247-268.
- Wooldridge, J. (2002), *Econometric Analysis of Cross Section and Panel Data*. Cambridge, MA: MIT Press. **[On Blackboard]**

3.2 *Matching Methods and the Propensity Score*

- Abadie, A., D. Drukker, J. Herr and G. Imbens, (2001), "Implementing Matching Estimators for Average Treatment Effects in Stata," *The Stata Journal*, 1:1, 1-18.
- Abadie, A. and G. Imbens (2006), "Large Sample Properties of Matching Estimators for Average Treatment Effects," *Econometrica* 74(1), 2006, 235-267.
- Abadie, A. and G. Imbens (2009) "Matching on the Estimated Propensity Score," NBER Working Paper #15301, August 2009.
- Angrist, J. (1998), "Estimating the Labor Market Impact of Voluntary Military Service Using Social Security Data on Military Applicants." *Econometrica* 66(2), 249-288.
- Angrist and J. Hahn (2004), "When to Control for Covariates? Panel-Asymptotic Results for Estimates of Treatment Effects," *Review of Economics and Statistics*, February 2004.
- Ashenfelter, O. (1978), "Estimating the Effect of Training programs on Earnings," *The Review of Economics and Statistics* 60 (1978), 47-57.
- Ashenfelter, O. and D. Card (1985), "Using the Longitudinal Structure of Earnings to Estimate the Effect of Training Programs on Earnings," *The Review of Economics and Statistics* 67 (1985), 648- 66.

- Campbell, D. (1969), "Reforms as Experiments," *American Psychologist* 24 (April 1969), 409-429.
- Dehejia, R. and S. Wahba (1999), "Causal Effects in Nonexperimental Studies: Re-evaluating the Evaluation of Training Programs," *Journal of the American Statistical Association* 94 (Sept. 1999). [S]
- Dehejia, R., (2005), "Final Thoughts." *Journal of Econometrics*, 125(1-2),
- Dehejia, R. (2005), "Practical Propensity Score Matching: A Reply to Smith and Todd." *Journal of Econometrics* 125(1-2), 355-364.
- Heckman, J. and V.J. Hotz (1989), "Choosing Among Alternative Nonexperimental Methods for Estimating the Impact of Social programs: The Case of Manpower Training," *Journal of the American Statistical Association* 84 (1989): 862-8. [S]
- Heckman, J. J., H. Ichimura and P. Todd (1998), "Matching As An Econometric Evaluation Estimator," *Review of Economic Studies*, Vol. 65, 261-294.
- Hahn, J. (1998), "On the Role of the Propensity Score in Efficient Estimation of Average Treatment Effects," *Econometrica* 66, March 1998.
- Heckman, J., H. Ichimura, and P. Todd (1997), "Matching as an Econometric Evaluation Estimator: Evidence from Evaluating a Job Training Program", *Review of Economic Studies*, 64, 605-654.
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- Imbens, G. (2000), "The role of the propensity score in estimation dose-response functions," *Biometrika*, 87:3, 706-710.
- Imbens, G. (2004), "Nonparametric Estimation of Average Treatment Effects Under Exogeneity: A Review", *Review of Economics and Statistics*, vol. 86, February 2004, pp. 4-29.
- King, G. (2006), "Matching as Nonparametric Preprocessing for Reducing Model Dependence in Parametric Causal Inference." Unpublished Manuscript, Harvard University.
[\[http://gking.harvard.edu/files/matchp.pdf\]](http://gking.harvard.edu/files/matchp.pdf)
- Lechner, M. (2001), Identification and estimation of causal effects of multiple treatments under the conditional independence assumption," In *Econometric evaluation of labour market policies*, ed. Michael Lechner and Friedhelm Pfeiffer. Heidelberg, Germany: Physica/Springer.
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- Rosenbaum, R., (1999), "Choice as an Alternative to Control in Observational Studies," *Statistical*

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Rosenbaum, P., and D. Rubin, (1983), "Assessing Sensitivity to an Unobserved Binary Covariate in an Observational Study with Binary Outcome," *Journal of the Royal Statistical Society, Series B*, 45, 212-218.

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Rubin, D. (1977), "Assignment to Treatment Group on the Basis of a Covariate," *Journal of Educational Statistics* [1], Spring 1977 1-26.

Rubin, D. (1979), "Using multivariate matched sampling and regression adjustment to control bias in observational studies," *Journal of the American Statistical Association* 74:318-328.

Smith, J. and P. Todd (2001), "Reconciling Conflicting Evidence on the Performance of Propensity Score Matching Methods," *American Economic Review* 91 (May 2001).

Smith, J. and P. Todd (2005), "Does Matching Overcome LaLonde's Critique of Nonexperimental Methods?" *Journal of Econometrics* 125(1-2), 305-353.

Smith, J. and P. Todd (2005), "Rejoinder." *Journal of Econometrics* 125(1-2), 365- 375.

Wooldridge (2002), Chapter 18, Sections 18.1 to 18.3. **[On Blackboard]**

3.3 Regression Discontinuity Methods

Angrist, J. and V. Lavy (1999), "Using Maimonides Rule to Estimate the Effect of Class Size on Scholastic Achievement," *Quarterly Journal of Economics*, 114: 533-575. [S]

Black, S. (1999), "Do 'Better' Schools Matter? Parental Valuation of Elementary Education," *Quarterly Journal Economics*, 114: 577-599. [S]

Chay, K. and M. Greenstone (2005), "Does air quality matter? Evidence from the housing market," *Journal of Political Economy* 113, 376-424.

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- Imbens, G. and T. Lemieux (2008), "The Regression Discontinuity Designs: A Guide to Practice," *Journal of Econometrics*, vol. 142, February 2008, 615-635. [S]
- Lee, D. (2008), "Randomized Experiments from Non-Random Selection in US House Elections", *Journal of Econometrics*, vol. 142, February 2008, 675-697. [S]
- Lee, D. and D. Card (2008), "Regression Discontinuity Inference with Specification Error", *Journal of Econometrics*, vol. 142, February 2008, 655-674. [S]
- McCrary, J. and H. Royer (2005), "The Effect of Maternal Education on Fertility and Infant Health: Evidence from School Entry Policies Using Exact Date of Birth." Unpublished manuscript, University of Michigan. [http://www-personal.umich.edu/~jmccrary/mccrary_and_royer2005.pdf]
- Van der Klaauw, W. (2002), "Estimating the Effect of Financial Aid Offers on College Enrollment: A Regression-Discontinuity Approach." *International Economic Review* 43(4), 1249-87. [S]

3.4 Instrumental Variable Methods

- Angrist, J. (1990), "Lifetime Earnings and the Vietnam Era Draft Lottery: Evidence from Social Security Administrative Records," *American Economic Review*, June 1990. [S]
- Angrist, J. (2004), "Treatment Effect Heterogeneity in Theory and Practice," *The Economic Journal* 114, March 2004, C52-C83.
- Angrist, J. and A. Krueger (1992), "The Effect of Age at School Entry on Educational Attainment: An Application of Instrumental Variables with Moments from Two Samples," *Journal of the American Statistical Association* 87 (June 1992).
- Angrist, J. and A. Krueger (1995), "Split-Sample Instrumental Variables Estimates of the Returns to Schooling," *Journal of Business and Economic Statistics*, April 1995.
- Angrist, J. and A. Krueger (2001), "Instrumental Variables and the Search for Identification: From Supply and Demand to Natural Experiments." *Journal of Economic Perspectives* 15(4), 69-86.
- Angrist, J. and G. Imbens (1995), "Two-Stage Least Squares Estimation of Average Causal Effects in Models with Variable Treatment Intensity," *Journal of the American Statistical Association*, June 1995.
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- Angrist, J., G. Imbens, K. Graddy (2000), “The Interpretation of Instrumental Variables Estimators in Simultaneous Equations Models with an Application to the Demand for Fish,” *Review of Economic Studies* 67[3], July 2000, 499-528. [S]
- Angrist, J., Imbens, G. and D. B. Rubin (1996), “Identification of Causal Effects Using Instrumental Variables,” *Journal of the American Statistical Association*, 91, pp.444-455. [S]
- Bound, J., D. Jaeger, and R. Baker (1995), “Problems with Instrumental Variables Estimation When the Correlation Between the Instruments and the Endogenous Explanatory Variables is Weak”, *Journal of the American Statistical Association*, vol. 90, 1995, pp. 443-450.
- Cameron and Trivedi (2005), Sections 4.8, 4.9, 6.4, 8.3, 8.4. **[On Blackboard]**
- Card, D. (1999), “The Causal Effect of Education on Earnings,” *The Handbook of Labor Economics, Volume IIIA*, Elsevier Science Publishers, 1999. **[On Blackboard]**
- Heckman, J. (1997), “Instrumental Variables: A Study of Implicit Behavioral Assumptions Used in Making Program Evaluations.” *Journal of Human Resources*. 32(3). 441-452. [S]
- Heckman J. and E. Vytlacil (1999), “Local instrumental variables and latent variable models for identifying the bounding treatment effects,” *Proceedings of the National Academy of Sciences*, vol 96, 8, pp 4730-4734. [S]
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To The Returns To Schooling,” *Econometrica*, Vol. 68, No. 4.

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Cameron and Trivedi (2005), *Microeconometrics. Methods and Applications*, Sections 16.5-16.7. **[On Blackboard]**

Florens, J., J. Heckman, C. Meghir and E. Vytlacil (2008), “Identification of Treatment Effects Using Control Functions in Models with Continuous, Endogenous Treatment and Heterogeneous Effects,” *Econometrica*, 76(5): 1191-1206, 2008.

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3.6 Panel Data Methods: Fixed Effect Estimators

Autor, D. (2003), “Outsourcing at Will: The Contribution of Unjust Dismissal Doctrine to the Growth of Employment Outsourcing”, *Journal of Labor Economics*, vol. 21, 1-42.

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3.7 Difference-in-Difference Methods

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- Bertrand, M., E. Duflo and S. Mullainathan (2004), "How Much Should We Trust Differences-in-Differences Estimates?" *Quarterly Journal of Economics* 119(1): 249-275. [S]
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