Boston University Questrom School of Business

Course Outline DS925 (formerly SI915)

Causal Inference for Management Research (*Fall 2016*)
Course Meets: Tuesdays 2:00-5:00 PM, Questrom School of Business, Room 615 / 658

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Objectives

How should you respond when a referee says your paper has an endogeneity problem, or a seminar participant asks about your identification strategy? This course will teach you to apply methods for estimating causal relationships using observational (i.e. non-experimental) data, and in the process, how to address issues of endogeneity and identification that commonly arise in applied empirical research. We will discuss how to establish what relationships exist in the data, when you can interpret these relationships as causal, and how you can convince your audience of your results (without overselling). We will also discuss the importance of careful theoretical thinking, and a detailed knowledge of relevant institutions for this type of empirical research, particularly as applied to management topics.

The course has two main goals. The first is to develop a clear understanding of the conceptual difficulties associated with establishing causality in empirical research. In particular, I hope to de-mystify several concepts that are frequently invoked as "problems" or "issues" in empirical research, but seldom clearly explained. A good grasp of these concepts will lead to improved research design and a sharper understanding of the relative strengths and weaknesses of various statistical methods. The second goal is to describe some of the practical problems that arise in the application of these methods. I will place a special emphasis on testing the key underlying assumptions. The ultimate goal is for you to leave prepared to undertake your own empirical research.

Preparation and Prerequisites

This course is designed to complement a graduate sequence in econometrics, but it should be accessible to students with basic knowledge of probability and statistics. We will emphasize intuition and application over proof. However, the readings and class discussion will cover technical material. Most problem sets and in-class examples will be taught using the Stata statistical software package, and students will find that a working knowledge of Stata is quite valuable for following the class discussion. However, I have started to translate some course materials into R, and will accept assignments that are completed using that open source alternative.

Auditing

You are welcome to audit this class as long as you show up prepared to contribute to class discussion. I will only grade your assignments (including comments on the final paper) if you enrol for credit.

Assignments & Grading

Grades will be based on class participation (15%), two problem sets (15% each), a post-publication review (10%), a short simulation (5%), a replication exercise (20%), and a final paper (20%).

Class participation (15%): Read the materials, come to class (on time), and participate in the discussion. I will strive to create opportunities for everyone to contribute. Asking a good question is often more valuable than having the best answer.

Problem Sets (15 each%): I will provide two empirical exercises that allow you to practice the methods we learn in class within a fairly controlled environment. The data will be relatively clean, and the tasks should be clearly described (so feel free to ask questions if they are not). Students may work on these assignments in teams, but should write up their final submissions individually.

Post-publication review (10%): Choose a highly-cited empirical paper that was published within your field during the last ten years. Write a 2-3 page review of the paper that discusses and/or critiques its empirical methods using concepts from class. The review can be positive, negative or neutral about the overall merits of the paper. You are permitted, but not required, to obtain the underlying data and check the paper's key results. Examples can be found at the SRI "On Further Review" web site (http://onfurtherreview.blogspot.com/), and I hope – with your permission – to submit several of your assignments to that outlet.

Simulation assignment (5%): A short assignment distributed in the first class to get you thinking about identification and test your Stata/R programming skills.

Replication/Reproduction Exercise (20%): Choose an existing empirical paper to replicate, and discuss/critique the robustness of the results using concepts from class. Several journals (e.g. Management Science, American Economic Review, American Economic Journals, Journal of Applied Econometrics, Journal of Business Economics and Statistics) and various researchers post data from published papers. While there is no page limit, my guess is that the reports will contain 1-4 pages of text, 2-5 tables and/or figures, and a Stata ".log" output file. One to three tables would likely replicate results from the existing paper and one or two more would present results that are not shown in the paper. If you can communicate the core ideas in less space, no problem. If you need more space, that's fine too. The key is to show that you could reproduce the main results and that you tried some additional specifications (informed by what we do in class) to check robustness. *Please confirm with me that your chosen paper is appropriate before starting to gather data*, and don't hesitate to ask questions at any point in the process!

Final Paper (20%): At the end of the semester, you should submit a written "research design." This 4 to 6 page document will describe how you plan to implement an empirical study. Your research design should read like the "Data and Methods" section of a high-quality empirical paper. I expect to see a description of your data, a specification for the regressions you will perform, and (most importantly) discussion and justification of the assumptions that your reader must maintain in order to believe that your analysis constitutes an answer to the proposed research question.

For this assignment, I strongly recommend that you choose a question you are actually working on. Preferably, you have the data in hand. However, an acceptable alternative is to choose a research question that leads to a regression specification (or set of hypotheses) developed as part of a previous

class assignment. In either case, you should submit a 1 or 2 page summary of the theory / hypotheses along with your research design, for a total of 5 to 8 pages.

Assigned Reading

Each class will have several assigned readings. There are three types of reading:

1) Conceptual readings deal with tools and methods for causal inference. Some conceptual readings are academic papers, and otehrs are chapters from <u>Mostly Harmless Econometrics: An Empiricist's Companion</u>, by Joshua Angrist and Steve Pischke. This is an excellent handbook for applied empirical research, and I highly recommend that you purchase a copy. Since MHE is not a complete reference, you may also wish to get a copy of William Greene's <u>Econometric Analysis</u>, Jeffrey Wooldridge's <u>Econometric Analysis of Cross Section and Panel Data</u>, or Cameron and Trivedi's <u>Microeconometrics</u>.

2) Applied Readings are research papers that use the tools and methods we learn in class. For each Applied Reading, you should arrive in class ready to answer to the following questions: What is the research question? What is the unit of observation? What are the sources of variation? What are the key estimating equation(s)? What are the results and interpretation? In some cases, you will have access to the underlying data used in an Applied Reading, and I strongly encourage you to play around with it.

3) Optional readings provide additional detail on topics related to those covered in class.

Calendar

	Room	Date	Topic	Assignments Due
1	615	Sep 6	What is "identification"?	
2	615	Sep 13	Classic problems & field expt's	Simulation
3	615	Sep 20	Selection on observables	
4	615	Sep 27	Matching methods	
5	615	Oct 4	Instrumental Variables	Post-pub review
		No Class on October 11		
6	**658**	Oct 18	Instruments continued	Problem Set 1
7	615	Oct 25	Regression Discontinuity	
8	615	Nov 1	Panels and fixed effects	
9	615	Nov 8	Diff-in-diffs	Problem Set 2
10	615	Nov 15	Unification & extension	
11	615	Nov 22	Non-linear models	Replication
12	615	Nov 29	"Structural" methods	
13	**658**	Dec 6	Conclusions	
		Dec 13	FINAL PAPER DUE	

Detailed Reading List

KEY: C = Required conceptual reading; A = Required application reading; O=optional reading.

Session 1: What is Identification?

C: Cochran, W. (1972) "Observational Studies" reprinted with comments at http://obsstudies.org/files/cochran_and_comments.pdf

C: Gelman, A. (2015) "The State of the Art in causal Inference: Some Changes Since 1972" http://andrewgelman.com/2015/03/16/state-art-causal-inference-changes-since-1972/

C: Freedman, D. (1991), "Statistical Models and Shoe Leather," *Sociological Methodology*, 21, 291-313*.*

C: Manski, C. (1995), Identification Problems in the Social Sciences, Introduction and Chapter 1.

C: Gelman and Imbens (2013), "Why ask Why? Forward causal inference and reverse causal questions" http://www.stat.columbia.edu/~gelman/research/unpublished/reversecausal_13oct05.pdf

C: Mostly Harmless Econometrics, Chapters 1 & 2.

C: Imbens, G. and Wooldridge, J (2008) "Recent Developments in the Econometrics of Program Evaluation" NBER Working Paper 14251. PAGES 1 to 15 ONLY.

C: Heckman, J. (2000), "Causal Parameters and Policy Analysis in Economics: A Twentieth Century Retrospective" *Quarterly Journal of Economics*, 115, 45-97. SECTIONS I, II.2. II.3 and III.3 ONLY

C: Bellmare, M. (2016) "There is more than one source of endogeneity" Blog post, http://marcfbellemare.com/wordpress/11579

Session 2: Classic problems & field-experiments

Go to this web site, and find examples that correspond to Omitted variables self-selection, simultaneity and reverse causality. Be prepared to discuss:

http://jfmueller.faculty.noctrl.edu/100/correlation_or_causation.htm

Part 1: Classic Identification Problems

(Self) Selection

Heckman (1979) "Sample Selection Bias as a Specification Error," Econometrica, 47, 153-161.

Manski, C. (1999), Identification Problems in the Social Sciences, Chapter 2.

Bound and Solon (1999), "Double trouble: on the value of twins-based estimation of the return to schooling," *Economics of Education Review*, 18: 169–182.

Simultaneity & Reverse Causality

Manski, C. (1999), Identification Problems in the Social Sciences: Chapter 6.

Angrist, J., K. Graddy and G. Imbens (2000) "The Interpretation of Instrumental Variables Estimators in Simultaneous Equations Models with an Application to the Demand for Fish" Review of Economic Studies, 67, 499-527.

Simcoe and Waguespack (2011), Status, Quality and Attention: what's in a (missing) name? Management Science, 57(2): 274-290.

State-dependence vs. Heterogeneity

Heckman, J. (1991), "Identifying the Hand of Past: Distinguishing State Dependence from Heterogeneity" American Economic Review, 81(2), 75-99.

Keane, M. P. (1997), Modeling Heterogeneity and State Dependence in Consumer Choice Behavior, Journal of Business & Economic Statistics, 15(3):310-327.

Co-linearity

O: Goldberger, A. (1991) "Multicollinearity," Ch. 23 in A Course in Econometrics, Harvard University Press.

Mehta, A., M. Rysman and T. Simcoe (2007) "Identifying the Age Profile of Patent Citations: New Estimates of Knowledge Diffusion" manuscript.

Bronwyn H. Hall & Jacques Mairesse & Laure Turner, 2005. "Identifying Age, Cohort and Period Effects in Scientific Research Productivity: Discussion and Illustration Using Simulated and Actual Data on French Physicists," NBER Working Papers 11739

The Reflection Problem

Manski, C. (1999), Identification Problems in the Social Sciences: Chapter 7. OR Manski, C. (1993) "Identification of Endogenous Social Effects: The Reflection Problem," Review of Economic Studies, 60(3), 531-542.

De Giorgi, G., A. Frederiksen and L. Pistaferi (2015) "Consumption Network Effects." Working Paper at https://www.economics.utoronto.ca/index.php/index/research/downloadSeminarPaper/60199

Sacerdote, Bruce. 2001. Peer Effects with Random Assignment: Results for Dartmouth Roommates. Quarterly Journal of Economics 116(2), 681-704.

Part 2: Field Experiments

C: Mostly Harmless Econometrics, Chapter 3.

C: Abhijit Banerjee, Sylvain Chassang and Erik Snowberg, "Decision Theoretic Approaches to Experiment Design and External Validity" Working Paper, April 2016. SECTIONS 1 1, 3.1.1 and 3.2,1 ONLY

C: Gelman, A (2010) "Experimental Reasoning in Social Science," Chapter 7 in Field Experiments and Their Critics, ed. D. Teele, Yale University Press.

C: Duflo, E., Glennerster and Kremer (2006) "Using Randomization in Development Economics Research: A Toolkit" NBER Technical Working Paper No. 333

A: Bertrand, M. and S. Mullainathan (2004), "Are Emily and Greg More Employable than Lakisha and Jamal?: A Field Experiment on Labor Market Discrimination" American Economic Review 94(4): 991-1013

O: Gelman (2013), Blog Post, http://andrewgelman.com/2013/12/06/comments-on-improving-the-dependability-of-research-in-personality-and-social-psychology-recommendations-for-research-and-educational-practice-the-report-of-the-spsp-task-force-on-publication-and/

O: Gelman and Carlin (2014) "Beyond Power Calculations: Assessing Type S (Sign) and Type M (Magnitude) Error Rates"
http://www.stat.columbia.edu/~gelman/research/published/retropower20.pdf

O: Bem (2011), "Feeling the Future: Experimental Evidence for Anomalous Retroactive Influences on Cognition and Affect" Journal of Personality and Social Psychology, Vol 100(3), 407-425.

O: Bloom, N., B. Eifert, A. Mahajan, D. McKenzie and J. Roberts (2013), "Does Management Matter?: Evidence From India" Quarterly Journal of Economics 128(1): 1-51.

Session 3: Selection on Observables

C: Imbens, G. and Wooldridge, J (2008) "Recent Developments in the Econometrics of Program Evaluation" NBER Working Paper 14251. Section 5 to 6.2, PAGES 19 to 54 ONLY.

C: Rosenbaum, P. and D. Rubin (1983): "The Central Role of the Propensity Score in Observational Studies for Causal Effects," *Biometrika*, 70, 41-55.

C: Iacus, S., G. King, and G. Porro (2011). "Causal Inference Without Balance Checking: Coarsened Exact Matching." Political Analysis.

C/A: LaLonde, R. (1986), "Evaluating the econometric evaluations of training programs with experimental data" *American Economic Review*, 76, 604-620.

A: Jaffe, A., M. Trajtenberg and R. Henderson (1993), "Geographic Knowledge Spillovers as Evidenced by Patent Citations" *Quarterly Journal of Economics*, 108(3):577-98.

A: Kruger, A. (1993), "How Computers Have Changed the Wage Structure: Evidence from Micro Data" *Quarterly Journal of Economics*, 108, 33-60.

A: DiNardo, J, and Pischke J. (1997), "The Returns to Computer Use Revisited: Have Pencils changed the Wage Structure Too?" *Quarterly Journal of Economics*, 112, 291-303.

O: Dehejia, Rajeev and Sadek Wahba. 1999. "Causal Effects in Nonexperimental Studies: Reevaluating the Evaluation of Training Programs," *Journal of the American Statistical Association.*

O: Smith, J and P. Todd (2001). "Reconciling Conflicting Evidence on the Performance of Propensity-Score Matching Methods," *American Economic Review*, 91 (2): 112-118.

O: Sacerdote, B. (2005) "Fixing Broken Experiments Using the Propensity Score" in <u>Applied Bayesian Modeling and Causal Inference from Incomplete-Data Perspectives</u>, Gelman and Line, eds., John Wiley & Sons.

Session 4: Matching Methods

C: Todd, P. (2006), "Matching Estimators" (athena.sas.upenn.edu/~petra/papers/mpalgrave2.pdf)

C/A: Alberto Abadie, Alexis Diamond and Jens Hainmueller (2010) "Synthetic Control Methods for Comparative Case Studies: Estimating the Effect of California's Tobacco Control Program" Journal of the American Statistical Association, 105, 490-505.

A: Marx, M., D. Strumsky and L. Fleming (2009), "Mobility, Skills and the Michigan Non-Compete Experiment" Management Science 55(6):875-889.

A: Thompson, P., and M. Fox-Kean (2005): "Patent citations and the geography of knowledge spillovers: a reassessment" *American Economic Review*, 95(1): 450-460.

A: Simcoe and Toffel (2014), "Government Green Procurement Spillovers: Evidence from Municipal Building Policies in California", Journal of Environmental Economics and Management, 68(3):411-34.

C: Imbens, G. (2004), "Nonparametric Estimation of Average Treatment Effects Under Exogeneity: A Review" *Review of Economics and Statistics*, 86, 4-29.

O: Sloczynski, T. (2015) "New Evidence on Linear Regression and Treatment Effect Heterogeneity" IZA Working Paper.

O: Alberto Abadie, Alexis Diamond and Jens Hainmueller (2012) "Comparative Politics and the Synthetic Control Method" *MIT Political Science Department Research Paper No. 2011-25*. Available at http://papers.ssrn.com/sol3/papers.cfm?abstract_id=1950298

Session 5: Instrumental Variables

C: Mostly Harmless Econometrics, Chapter 4.

C: Imbens, G. and Wooldridge, J (2008) "Recent Developments in the Econometrics of Program Evaluation" NBER Working Paper 14251. Section 6.3, PAGES 53 to 58 ONLY.

C: Angrist and Kruger (2001) "Instrumental Variables and the Search for Identification: From Supply and Demand to Natural Experiments," Journal of Economic Perspectives, 15, 69-85.

A: Acemoglu, D., S. Johnson and J. Robinson (2001) "The Colonial Origins of Comparative Development: An Empirical Investigation" American Economic Review, 5, 1369-1401.

A: Albouy, D. (2004) "The Colonial Origins of Comparative Development: An Empirical Investigation:

Comment" American Economic Review, forthcoming. (http://www-personal.umich.edu/~albouy/)

O: James H. Stock & Francesco Trebbi (2003), "Who Invented Instrumental Variable Regression?" *Journal of Economic Perspectives*, 17(3), pages 177-194.

O: Imbens, G. and J. Angrist (1994). "Identification and Estimation of Local Average Treatment Effects" Econometrica, 62:2, pp. 467-475.

Session 6: IV Continued

C: Murray, Michael (2006). "Avoiding Invalid Instruments and Coping with Weak Instruments," Journal of Economic Perspectives.

C: Bellemare (2015) Blog Post: "You Keep Using That Instrumental Variable; I Do Not Think It Does What You Think It Does," http://marcfbellemare.com/wordpress/10900.

C/A: Sarsons (2015) "Rainfall and Conflict: A Cautionary Tale," *Journal of Development Economics, 115: 62-72.*

A: Galasso, A., M. Schankerman and C. Serrano (2013). "Trading and Enforcing Patent Rights", RAND Journal of Economics 44(2): 275-312.

A: Hoxby, C. (2000) "Does Competition Among Public Schools Benefit Students and Taxpayers?" *American Economic Review*, 90, 1209-1238.

O: Rothstein, J. (2007) "Does Competition Among Public Schools Benefit Students and Taxpayers? A Comment on Hoxby (2000)" *American Economic Review*, 97, 2026-2038.

O: Hoxby, C. (2005) "Competition Among Public Schools: A Reply to Rothstein (2004)" NBER Working Paper No. 11216.

Session 7: Regression Discontinuity

C: Mostly Harmless Econometrics, Chapter 6.

C: Imbens, G. and Wooldridge, J (2008) "Recent Developments in the Econometrics of Program Evaluation" NBER Working Paper 14251. Section 6.4, PAGES 58 to 64 ONLY.

C: Imbens, G. and T. Lemieux (2007) "Regression Discontinuity Designs: A Guide to Practice" NBER Technical Working Paper No. 337.

C: Gelman and Imbens (2014) "Why High Order Polynomials Should Not Be Used in Regression Discontinuity Designs," NBER Working Paper 20405

C: Card, D., D. Lee, Z. Pei and A Weber (2015) "Inference on Causal Effects in a Generalized regression Kink Design" IZA Working Paper.

C: Calonico, S., M. Cattaneo, R. Titiunik (2014). "Robust data-driven inference in the regression-discontinuity design " The Stata Journal 14(4), 909-946. SKIM.

A: Lee, D.S., E. Moretti and M. Butler (2004) "Do Voters Affect Or Elect Policies? Evidence from the U. S. House" *Quarterly Journal of Economics*, 119, 807-859.

A: Oreopoulos, P. (2006) "Estimating Average and Local Average Treatment Effects of Education when Compulsory Schooling Laws Really Matter." American Economic Review.

O: Lee, D., and T. Lemieux (2010). "Regression Discontinuity Designs in Economics." Journal of Economic Literature, 48(2): 281–355.

Session 8: Panel Data and Fixed Effects

C: Mostly Harmless Econometrics, Chapters 5 and 8.

C: Imbens, G. and Wooldridge, J (2008) "Recent Developments in the Econometrics of Program Evaluation" NBER Working Paper 14251. Section 6.5, PAGES 64 to 71 ONLY.

C/A: Griliches, Z. and J. Mairesse (1995) "Production Functions: The Search for Identification" NBER Working Paper 5067.

C: Fixed Effects Infatuation: http://greedgreengrains.blogspot.com/2013/11/fixed-effects-infatuation.html

C: Heckman, J. And J. Smith (1999) "The pre-programme earnings dip and the determinants of participation in a social programme: Implications for simple programme evaluation strategies" Economic Journal, 109(457), 313-348.

C: Bellemare, M. "What to do with repeated cross-sections?" Blog post, March 21, 2016. http://marcfbellemare.com/wordpress/11800

C: Deaton, A. (1985), "Panel Data from Times Series of Cross-Sections,"*Journal of Econometrics* (30): 109-126.

O: Hausman, Jerry A., and William E. Taylor. 1981. Panel Data and Unobservable Individual Effects. Econometrica 49(6), 1377-1398.

Session 9: Difference-in-Differences

C: Bertrand, M., E. Duflo and S. Mullainathan (2004), "How Much Should We Trust Differences-in Differences Estimates?" *Quarterly Journal of Economics*, 119, 249-76.

C: Donald, S. and K. Lang (2007), "Inference with Difference in Differences and Other Panel Data" *Review of Economics and Statistics*, 2, 221-233.

C: Abadie, A. (2005) "Semiparametric Difference-in-Differences Estimators" *Review of Economic Studies*, 72, 1-19.

C: Sylvain Chabé-Ferret (2015). "Bias of Causal Effect Estimators Using Pre-Policy Outcomes " Working Paper.

A: Mas, Alex "Labour Unrest and the Quality of Production: Evidence from the Construction Equipment Resale Market" Review of Economic Studies (2008) vol. 1 pp. 1-30.

A: Agrawal, A., and A. Goldfarb (2008). "Restructuring Research: Communication Costs and the Democratization of University Innovation." *American Economic Review*, 98(4): 1578–90.

A: Azoulay, P., J. Graff-Zivin and J. Wang (2010). "Superstar Extinction." *The Quarterly Journal of Economics, 125 (2): 549-589.*

Session 10: Unification and Extension

Read the following post to prepare for the replication assignment: *http://www.env-econ.net/2016/03/replication-vs-duplication-whats-the-difference.html*

O: Athey, S. and G. Imbens (2006). "Identification and Inference in Nonlinear Difference-In-Differences Models," Econometrica, 74(2): 431-497.

C: Wooldridge, J. (2015). "Control Function Methods in Applied Econometrics." Journal of Human Resources, 50(2): 420-445.

C: Cornelissen, T., C. Dustmann, A. Raute and U. Schonberg (2016) "from LATE to MTE: Alternative Methods for the Evaluation of Policy Interventions." IZA Discussion Paper No. 10056.

C: Heckman, J., S. Urzua and E. Vytlacil (2006) "Understanding Instrumental Variables in Models with Essential Heterogeneity," Review of Economics and Statistics.

Session 11: Non-linear models

C: Angrist, J. (1999) "Estimation of Limited Dependent Variable Models with Dummy Endogenous Regressors: Simple Strategies for Empirical Practice" Journal of Business and Economic Statistics, 19(1), 2-16.

Giles, D. (2011) "Dummies for Dummies" Blog post http://davegiles.blogspot.com/2011/03/dummies-for-dummies.html

Logit, Probit and LPM

http://davegiles.blogspot.co.uk/2012/06/another-gripe-about-linear-probability.html
http://davegiles.blogspot.co.uk/2012/06/yet-another-reason-for-avoiding-linear.html
http://www.mostlyharmlesseconometrics.com/2012/07/probit-better-than-lpm/

Beck, N. (2015) "Estimating grouped data models with a binary dependent variable and fixed effects: What are the issues?" Working Paper.

Non-linear interactions

Ai, Chunrong, and Edward C. Norton. 2003. "Interaction Terms in Logit and Probit." Economics Letters 80, 123-129.

Puhani, Patrick A. 2008. "The Treatment Effect, the Cross Difference, and the Interaction Term in Nonlinear "Difference-in-Differences" Models." IZA Discussion Paper # 3478.

Count Data

Wooldridge, J. (1999) "Distribution free estimation of some non-linear panel data models" Journal of Econometrics, 77-97.

Mullahy, J. (1997), "Instrumental-Variable Estimation of Count Data Models: Applications to Models of Cigarette Smoking Behaviour," Review of Economics and Statistics, 11, 586-593.

Santos Silva, J. M. C. and Silvana Tenreyro. 2006. "The Log of Gravity." Review of Economics and Statistics 88(4): 641-658.

Duration Data

Jenkins, S. (1995). Easy estimation methods for discrete-time duration models. Oxford Bul letin of Economics and Statistics 57 (1), 129–137.

Van den Berg, G. J. (2005). Competing Risks Models. Working Paper.

Session 12: "Structural" Models

C: Reiss, Peter C., and Frank A. Wolak. 2007. "Structural Econometric Modeling: Rationales and Examples from Industrial Organization." in Handbook of Econometrics, Vol. 6A. Eds. James Heckman and Edward Leamer. Chapter 64, pp. 4277-4415.

C: Journal of Economic Perspectives (Spring 2010). Symposium: Con Out of Economics (Skim)

C/A: Bajari, P., H. Hong, J. Krainer and D Nekipelov (2010) "Estimating Static Models of Strategic Interactions" Journal of Business and Economic Statistics, 28(4): 469-482.

C/A: Olley, Steve and Pakes, A (1996) "The dynamics of productivity in the telecommunications equipment industry." Econometrica".

C/A: Rust, J. (1987) "Optimal Replacement of GMC Bus Engines: An Empirical Model of Harold Zurcher" Econometrica, 55(5): 999-1033.

O: Ackerberg, Daniel A., Kevin Caves, and Garth Frazer. 2006. "Structural Identification of Production Functions." Working paper, University of Toronto.

O: Bresnahan, Timothy F., and Peter C. Reiss. 1991. "Entry and Competition in Concentrated Markets." Journal of Political Economy 99(5), 977-1009.

O: Pakes, A. (1986) "Patents as Options: Some Estimates of the Value of Holding European Patent Stocks" Econometrica 54(4): 755-784.

O: Rust, J. (2013) "The Limits of Inference With Theory: A Review of Wolpin (2013)" Working Paper.

Session 13: Conclusions

C/A: Bisbee, J., R. Dehejia, C. Pop-Eleches and C. Samii (2015) "Local Instruments, Global Extrapolation: External Validity of the Labor Supply-Fertility Local Average Treatment Effect." Working Paper.

C: Leamer, E. (2010) "Tantalus on the Road to Asymptopia," Journal of Economic Perspectives, 24(2):31-46.

C: Section I of the Strategy Research Initiative "Strategy Reader" available at (http://strategyresearch.net/strategy_reader)

O: Imbens, G. and Wooldridge, J (2008) "Recent Developments in the Econometrics of Program Evaluation" NBER Working Paper 14251.

O: Journal of Economic Literature (June 2010). Forum on the Estimation of Treatment Effects