

EKT 816: Econometrics

Jesse Naidoo

Semester 1, 2019

E-mail: jesse.naidoo@up.ac.za

Office Hours: ???

Office: Tukkieurf 2-23

Web: TBD

Class Hours: ???

Class Room: Tukkieurf 1-37

Course Description

This is a graduate course in econometrics. Our goal is to learn some basic techniques that economists use to establish causal claims. An immediate payoff is that you will be able to read and evaluate empirical research. You may also find these methods useful in your own work.

Required Texts

There are two required texts:

- Angrist and Pischke (2008)
- Paarsch and Golyaev (2016)

Although we will not refer explicitly to Paarsch and Golyaev (2016) often, it will be useful for the computational parts of the course (and indeed for those parts of your own research that require computation).

You may also find it useful to refer to these texts:

- Stachurski (2016)
- Wooldridge (2010)
- Deaton (1997)
- Cameron and Trivedi (2005)

Of these, Deaton (1997) is available for free in PDF format from the World Bank's website, and Stachurski has posted many lecture slides and other supporting materials to his website.

Assessment

There will be 8 problem sets, a take-home exam, and a midterm (also take-home).

Class Schedule

Please read at least the prescribed readings before class, even if you find it hard to follow everything; it makes for a more productive discussion if you have figured out the easy stuff first.

You may find it helpful to pattern your notes on the readings after a referee report; Berk, Harvey, and Hirshleifer (2017) and Berk, Harvey, and Hirshleifer (2015) is a useful guide to the requirements of this important type of professional communication.

Week 01, 02/04 - 02/08: Probability and Statistics Review; Introduction to R

Distributions, expectations, quantiles. Laws of large numbers and the central limit theorem. Estimation: mean square error vs bias. Sufficient and ancillary statistics.

Week 02, 02/11 - 02/15: Probability and Statistics Review (continued)

Consistency and precision in estimation. Weighting and sample design. Identification. Hypothesis testing: size vs power.

Week 03, 02/18 - 02/22: Counterfactuals and Causal Inference

Potential outcomes notation. Randomization delivers the ATE; brief aside on SUTVA, peer effects and general equilibrium. Examples of causal claims. Internal and external validity, and the value of understanding mechanisms. The importance of a clear research design. Another aside on partial identification and “structural estimation”. Prediction vs causation.

Required Readings

- Angrist and Krueger (1999)
- Heckman and Smith (1995); Card, DellaVigna, and Malmendier (2011);
- Aron-Dine, Einav, and Finkelstein (2012); Muralidharan and Niehaus (2017)
- Angrist and Pischke (2010); Keane (2010b); Keane (2010a)
- Goldberger (1972)
- Heckman and Vytlačil (2007a)
- Imbens and Wooldridge (2009); Heckman (2010)

Optional Readings

- Acemoglu (2010)
- Heckman (2008); Sims (2010);
- Deaton (2010); Imbens (2010)
- Manski (1995)
- Mullainathan and Spiess (2017)

Week 04, 02/25 - 03/01: Linear Regression

Derivation of the OLS formula; Frisch-Waugh-Lovell theorem. Implications for interpreting regression output. Conditional expectations and best linear predictors. Typical violations of conditional independence: simultaneity, measurement error, self-selection. Applications: growth accounting and labor market discrimination.

Required Readings

- Bound, Brown, and Mathiowetz (2001)
- Meyer, Mok, and Sullivan (2015); Griliches (1986)
- Neal and Johnson (1996)
- Altonji and Blank (1999)
- Topel (1999); Barro (1999)
- Bazzi and Clemens (2013)

Week 05, 03/04 - 03/08: Matching and Inverse Probability Weighting

Basic similarities between matching and regression: matching methods aim for unweighted averages of treatment-control differences, while regression weights by the variance of $P(D = 1|X)$. Applications to the evaluation of job training programs.

Required Readings

- Kline (2011); see also the slides on Kline's website.
- Dehejia and Wahba (1999); Dehejia and Wahba (2002)
- Smith and Todd (2005); Dehejia (2005)
- Imbens (2015)
- Solon, Haider, and Wooldridge (2015)

Optional Readings

- LaLonde (1986); LaLonde (1995)
- Heckman, LaLonde, and Smith (1999)

Week 06, 03/11 - 03/15: Instrumental Variables with Homogenous Treatment Effects

Just-identified IV; 2SLS and GMM. Identification and (asymptotic) inference. Applications to the effects of Catholic schooling, the effects of childbearing on labor supply, and the returns to education.

Required Readings

- Neal (1997); Altonji, Elder, and Taber (2005); Angrist (2001)
- Oster (2017)
- Angrist (1990); Angrist and Evans (1998)

Optional Readings

- Angrist, Graddy, and Imbens (2000); Graddy (2006)
- Heckman, Lochner, and Todd (2006)
- Card (1999); Card (2001)

Week 07, 03/18 - 03/22: Weak Instruments; GMM; Selection Models (Part I)

2SLS bias; misleading inference with weak instruments. LIML. Outcome and selection equations in the "Generalized Roy Model". Varieties of treatment effects.

Required Readings

- Bound, Jaeger, and Baker (1995)
- Stock (2010)
- Andrews, Stock, and Sun (2018)
- Eisenhauer, Heckman, and Vytlačil (2015)

Week 08, 03/25 - 03/29: Autumn Break

No class; I will post a take-home midterm before the break.

Week 09, 04/01 - 04/05: Selection Models (Part II); Marginal Treatment Effects and LATE

What does IV estimate under essential heterogeneity? Deriving the IV weights. Violations of “monotonicity”.

Required Readings

- Heckman, Urzua, and Vytlačil (2006)
- Heckman and Vytlačil (2007b)
- Kline and Walters (2019)
- Das, Newey, and Vella (2003)

Optional Readings

- Chyn (2018)
- Mueller-Smith (2015)
- Arnold, Dobbie, and Yang (2018)

Week 10, 04/08 - 04/12: Applications; MTEs and LATE in Practice

Semiparametric approaches to control function estimation. Partial equivalence to IV. Richer treatment spaces: ordered and unordered selection. Applications.

Required Readings

- Cornelissen et al. (2016)
- Wooldridge (2015)

Optional Readings

- Bazzi (2017)
- Lull (2018)
- Cornelissen et al. (2018)
- Amemiya and Davis (2012)
- Carneiro, Heckman, and Vytlačil (2011)

Week 11, 04/15 - 04/19: Synthetic Panels and Diff-in-Diff

An additively separable model for Y_0 and the parallel trends assumption. Pitfalls: heterogeneous trends and serially correlated shocks. Placebo tests and placebo outcomes (DDD); clustering and bootstrapping standard errors.

Required Readings

- Garthwaite, Gross, and Notowidigdo (2014)
- Kearney and Levine (2015); Jaeger and Joyce (2018); Kahn-Lang and Lang (2018)
- Goodman-Bacon (2018)
- Cameron and Miller (2015)
- Abadie et al. (2017)

Optional Readings

- Hornbeck (2010); Hornbeck and Naidu (2014)
- Malkova (2018)
- Duflo (2001)
- Cunningham and Shah (2018)
- Muralidharan and Prakash (2017)

Week 12, 04/22 - 04/26: Individual-Level Panel Data (Part I)

The incidental parameters problem (again). Complications: lagged dependent variables and serial correlation. Applications to the effects of job loss on workers and life-cycle labor supply.

Required Readings

- Ashenfelter and Card (1985)
- MaCurdy (1981)
- Jacobson, LaLonde, and Sullivan (1993)
- Griliches and Hausman (1986)

Optional Readings

- Diamond, McQuade, and Qian (2018)
- MaCurdy (2007)
- Topel (1991); Acemoglu and Pischke (1999)

Week 13, 04/29 - 05/03: Individual-Level Panel Data, Part II - Mover Designs

Wide-panel vs long-panel asymptotics. Multiple unordered treatments in the selection equation. Applications to medical spending and worker-firm matching.

Required Readings

- Finkelstein, Gentzkow, and Williams (2016)
- Finkelstein, Gentzkow, and Williams (2018)
- Hull (2018)

Optional Readings

- Abowd, Kramarz, and Margolis (1999); Borovičková and Shimer (2017); Song et al. (2018)
- Heckman and Pinto (2018)

Week 14, 05/06 - 05/10: Individual-Level Panel Data, Part III - Event Studies

“Dynamic treatment effects” and long-panel asymptotics. Applications to local differences in retail prices and human capital accumulation over the life-cycle.

Required Readings

- Kleven, Landais, and Sogaard (2018)
- Abraham and Sun (2018)
- Borusyak and Jaravel (2016)
- Schulhofer-Wohl (2018)

Optional Readings

- Allcott et al. (2018)
- Lagakos et al. (2018b); Lagakos et al. (2018a)
- Hendricks (2002); Hendricks and Schoellman (2018)
- Atkin (2016)
- Atkin, Faber, and Gonzalez-Navarro (2018)

Week 15, 05/13 - 05/17: Discussion of Applied Papers

Student discussion of applied papers.

Week 16, 05/20 - 05/24: Discussion of Applied Papers

Student discussion of applied papers.

References

Abadie, Alberto, Susan Athey, Guido Imbens, and Jeffrey Wooldridge. 2017. "When Should You Adjust Standard Errors for Clustering?" NBER Working Paper Series. Cambridge, MA: National Bureau of Economic Research. doi:[10.3386/w24003](https://doi.org/10.3386/w24003).

Abowd, John M., Francis Kramarz, and David N. Margolis. 1999. "High Wage Workers and High Wage Firms." *Econometrica* 67 (2): 251–333. doi:[10.1111/1468-0262.00020](https://doi.org/10.1111/1468-0262.00020).

Abraham, Sarah, and Liyang Sun. 2018. "Estimating Dynamic Treatment Effects in Event Studies With Heterogeneous Treatment Effects." Department of Economics, MIT. doi:[10.2139/ssrn.3158747](https://doi.org/10.2139/ssrn.3158747).

Acemoglu, D, and Jörn-Steffen Pischke. 1999. "Beyond Becker: Training in Imperfect Labour Markets." *Economic Journal* 109 (453): F112 —F142. <http://onlinelibrary.wiley.com/doi/10.1111/1468-0297.00405/abstract>.

Acemoglu, Daron. 2010. "Theory, General Equilibrium, and Political Economy in Development Economics." *Journal of Economic Perspectives* 24 (3): 17–32. doi:[10.1257/jep.24.3.17](https://doi.org/10.1257/jep.24.3.17).

Allcott, Hunt, Rebecca Diamond, Jean-Pierre Dubé, Jessie Handbury, Ilya Rahkovsky, and Molly Schnell. 2018. "Food Deserts and the Causes of Nutritional Inequality." Palo Alto, CA: Department of Economics, Stanford University.

Altonji, Joseph G, and Rebecca M Blank. 1999. "Race and Gender in the Labor Market." In *Handbook of Labor Economics*, 3:3143–3259. Elsevier.

Altonji, Joseph G, Todd E Elder, and Christopher R Taber. 2005. "Selection on Observed and Unobserved Variables: Assessing the Effectiveness of Catholic Schools." *Journal of Political Economy*

- 113 (1). The University of Chicago Press: 151–84. <http://www.jstor.org/stable/10.1086/426036>.
- Amiti, Mary, and Donald R. Davis. 2012. "Trade, Firms, and Wages: Theory and Evidence." *Review of Economic Studies* 79 (1): 1–36. doi:[10.1093/restud/rdr016](https://doi.org/10.1093/restud/rdr016).
- Andrews, Isaiah, James Stock, and Liyang Sun. 2018. "Weak Instruments in IV Regression: Theory and Practice." Department of Economics, MIT.
- Angrist, Joshua D. 1990. "Lifetime Earnings and the Vietnam Era Draft Lottery: Evidence from Social Security Administrative Records." *American Economic Review* 80 (3): 313–36.
- . 2001. "Estimation of Limited Dependent Variable Models With Dummy Endogenous Regressors." *Journal of Business & Economic Statistics* 19 (1): 2–28. doi:[10.1198/07350010152472571](https://doi.org/10.1198/07350010152472571).
- Angrist, Joshua D, and William N Evans. 1998. "Children and Their Parents' Labor Supply: Evidence from Exogenous Variation in Family Size." *American Economic Review* 88 (3). American Economic Association: 450–77. <http://www.jstor.org/stable/116844>.
- Angrist, Joshua D, and Alan B Krueger. 1999. "Empirical Strategies in Labor Economics." In *Handbook of Labor Economics*, 1277–1366. <http://linkinghub.elsevier.com/retrieve/pii/S1573446399030047>.
- Angrist, Joshua D, and Jörn-Steffen Pischke. 2008. *Mostly Harmless Econometrics: An Empiricist's Companion*. Princeton University Press.
- . 2010. "The Credibility Revolution in Empirical Economics: How Better Research Design is Taking the Con out of Econometrics." *Journal of Economic Perspectives* 24 (2): 3–30. doi:[10.1257/jep.24.2.3](https://doi.org/10.1257/jep.24.2.3).
- Angrist, Joshua D, Kathryn Graddy, and Guido W Imbens. 2000. "The Interpretation of Instrumental Variables Estimators Equations in Simultaneous Models to with the Application Demand for." *Review of Economic Studies* 67 (3): 499–527. <https://www.jstor.org/stable/2566964>.
- Arnold, David, Will Dobbie, and Crystal S Yang. 2018. "Racial Bias in Bail Decisions." *Quarterly Journal of Economics* 133 (4): 1885–1932. doi:[10.1093/qje/qjy012](https://doi.org/10.1093/qje/qjy012).
- Aron-Dine, Aviva, Liran Einav, and Amy Finkelstein. 2012. "The RAND Health Insurance Experiment, Three Decades Later." *Journal of Economic Perspectives* 27 (1). National Bureau of Economic Research: 197–222. doi:[10.1257/jep.27.1.197](https://doi.org/10.1257/jep.27.1.197).
- Ashenfelter, Orley, and David Card. 1985. "Using the Longitudinal Structure of Earnings to Estimate the Effect of Training Programs." *Review of Economics and Statistics* 67 (4). The MIT Press: 648–60. <http://www.jstor.org/stable/1924810>.
- Atkin, David. 2016. "The Caloric Costs of Culture: Evidence from Indian Migrants." *American Economic Review* 106 (4): 1144–81. doi:[10.1257/aer.20140297](https://doi.org/10.1257/aer.20140297).
- Atkin, David, Benjamin Faber, and Marco Gonzalez-Navarro. 2018. "Retail Globalization and Household Welfare: Evidence from Mexico." *Journal of Political Economy* 126 (1): 1–73. doi:[10.1086/695476](https://doi.org/10.1086/695476).
- Barro, Robert J. 1999. "Notes on Growth Accounting." *Journal of Economic Growth* 4 (2): 119–37. <https://www.jstor.org/stable/40216002>.
- Bazzi, Samuel. 2017. "Wealth Heterogeneity and the Income Elasticity of Migration." *American Economic Journal: Applied Economics* 9 (2): 219–55. doi:[10.1257/app.20150548](https://doi.org/10.1257/app.20150548).
- Bazzi, Samuel, and Michael A. Clemens. 2013. "Blunt Instruments: Avoiding Common Pitfalls in Identifying the Causes of Economic Growth." *American Economic Journal: Macroeconomics* 5 (2):

152–86. doi:[10.1257/mac.5.2.152](https://doi.org/10.1257/mac.5.2.152).

Berk, Jonathan B, Campbell R Harvey, and David Hirshleifer. 2017. “How to Write an Effective Referee Report and Improve the Scientific Review Process.” *Journal of Economic Perspectives* 31 (1): 231–44. doi:[10.1257/jep.31.1.231](https://doi.org/10.1257/jep.31.1.231).

Berk, Jonathan, Campbell R Harvey, and David A Hirshleifer. 2015. “Preparing a Referee Report: Guidelines and Perspectives.” *SSRN Electronic Journal*. doi:[10.2139/ssrn.2547191](https://doi.org/10.2139/ssrn.2547191).

Borovičková, Katarína, and Robert Shimer. 2017. “High Wage Workers Work for High Wage Firms.” NBER Working Paper Series. National Bureau of Economic Research. doi:[10.3386/w24074](https://doi.org/10.3386/w24074).

Borusyak, Kirill, and Xavier Jaravel. 2016. “Revisiting Event Study Designs.” Department of Economics, Harvard University. doi:[10.2139/ssrn.2826228](https://doi.org/10.2139/ssrn.2826228).

Bound, John, Charles Brown, and Nancy Mathiowetz. 2001. “Measurement Error in Survey Data.” In *Handbook of Econometrics*, 5:3705–3843. 59. Elsevier Science Publishers. <http://www.sciencedirect.com/science/article/B7GX7-4DXJCWR-1M/2/90c6de4bee614acfb9b03e96ed021274>.

Bound, John, David A Jaeger, and Regina M Baker. 1995. “Problems with Instrumental Variables Estimation When the Correlation between the Instruments and the Endogenous Explanatory Variable Is Weak.” *Journal of the American Statistical Association* 90 (430). American Statistical Association: 443–50.

Cameron, A Colin, and Douglas L Miller. 2015. “A Practitioner’s Guide to Cluster-Robust Inference.” *Journal of Human Resources* 50 (2): 317–72.

Cameron, A Colin, and Pravin K Trivedi. 2005. *Microeconometrics: Methods and Applications*. New York: Cambridge University Press.

Card, David. 1999. “The Causal Effect of Education on Earnings.” In *Handbook of Labor Economics*, 3:1801–64.

———. 2001. “Estimating the Return to Schooling: Progress on Some Persistent Econometric Problems.” *Econometrica* 69 (5). The Econometric Society: 1127–60. <http://www.jstor.org/stable/2692217>.

Card, David, Stefano DellaVigna, and Ulrike Malmendier. 2011. “The Role of Theory in Field Experiments.” *Journal of Economic Perspectives* 25 (3): 39–62. doi:[10.1257/jep.25.3.39](https://doi.org/10.1257/jep.25.3.39).

Carneiro, Pedro, James J Heckman, and Edward J Vytlacil. 2011. “Estimating Marginal Returns to Education.” *American Economic Review* 101 (6): 2754–81. doi:[10.1257/aer.101.6.2754](https://doi.org/10.1257/aer.101.6.2754).

Chyn, Eric. 2018. “Moved to Opportunity: The Long-Run Effect of Public Housing Demolition on Labor Market Outcomes of Children.” *American Economic Review* 108 (10): 3028–56. doi:[10.1257/aer.20161352](https://doi.org/10.1257/aer.20161352).

Cornelissen, Thomas, Christian Dustmann, Anna Raute, and Uta Schönberg. 2016. “From LATE to MTE: Alternative methods for the evaluation of policy interventions.” *Labour Economics* 41. Elsevier B.V.: 47–60. doi:[10.1016/j.labeco.2016.06.004](https://doi.org/10.1016/j.labeco.2016.06.004).

———. 2018. “Who Benefits from Universal Child Care? Estimating Marginal Returns to Early Child Care Attendance.” *Journal of Political Economy* 126 (6): 2356–2409. doi:[10.1086/699979](https://doi.org/10.1086/699979).

Cunningham, Scott, and Manisha Shah. 2018. “Decriminalizing Indoor Prostitution: Implications

- for Sexual Violence and Public Health.” *Review of Economic Studies* 85 (3): 1683–1715. doi:[10.1093/restud/rdx065](https://doi.org/10.1093/restud/rdx065).
- Das, Mitali, Whitney K Newey, and Francis Vella. 2003. “Nonparametric Estimation of Sample Selection Models.” *Review of Economic Studies* 70 (1): 33–58. <https://www.jstor.org/stable/3648610>.
- Deaton, Angus. 2010. “Instruments, Randomization, and Learning about Development.” *Journal of Economic Literature* 48 (2): 424–55. doi:[10.1257/jel.48.2.424](https://doi.org/10.1257/jel.48.2.424).
- Deaton, Angus S. 1997. *The Analysis of Household Surveys: A Microeconomic Approach to Development Policy*. Johns Hopkins University Press.
- Dehejia, Rajeev. 2005. “Practical propensity score matching: a reply to Smith and Todd.” *Journal of Econometrics* 125. Elsevier B.V.: 355–64. <http://linkinghub.elsevier.com/retrieve/pii/S0304407604000831>.
- Dehejia, Rajeev, and Sadek Wahba. 1999. “Causal Effects in Nonexperimental Studies: Reevaluating the Evaluation of Training Programs.” *Journal of the American Statistical Association* 94 (448): 1053–62. <https://www.jstor.org/stable/2669919>.
- . 2002. “Propensity Score Matching Methods for Non-Experimental Causal Studies.” <https://www.jstor.org/stable/3211745>.
- Diamond, Rebecca, Timothy McQuade, and Franklin Qian. 2018. “The Effects of Rent Control Expansion on Tenants, Landlords, and Inequality: Evidence from San Francisco.” NBER Working Paper Series. Cambridge, MA: National Bureau of Economic Research. doi:[10.3386/w24181](https://doi.org/10.3386/w24181).
- Duflo, Esther. 2001. “Schooling and Labor Market Consequences of School Construction in Indonesia: Evidence from an Unusual Policy Experiment.” *American Economic Review* 91 (4): 795–813. doi:[10.1257/aer.91.4.795](https://doi.org/10.1257/aer.91.4.795).
- Eisenhauer, Philipp, James J Heckman, and Edward Vytlačil. 2015. “The Generalized Roy Model and the Cost-Benefit Analysis of Social Programs.” *Journal of Political Economy* 123 (2). University of Chicago Press: 413–43. doi:[10.1086/679498](https://doi.org/10.1086/679498).
- Finkelstein, Amy, Matthew Gentzkow, and Heidi Williams. 2016. “Sources of Geographic Variation in Health Care: Evidence from Patient Migration.” *Quarterly Journal of Economics* 131 (4): 1681–1726. doi:[10.1093/qje/qjw023.Advance](https://doi.org/10.1093/qje/qjw023.Advance).
- . 2018. “Place-Based Drivers of Mortality: Evidence from Migration.” Cambridge, MA: Department of Economics, MIT.
- Garthwaite, Craig, Tal Gross, and Matthew Notowidigdo. 2014. “Public Health Insurance, Labor Supply, and Employment Lock.” *Quarterly Journal of Economics* 129 (2): 653–96. doi:[10.1093/qje/qju005](https://doi.org/10.1093/qje/qju005).
- Goldberger, Arthur S. 1972. “Structural Equation Methods in the Social Sciences.” *Econometrica* 40 (6): 979–1001. doi:[10.2193/2007-307](https://doi.org/10.2193/2007-307).
- Goodman-Bacon, Andrew. 2018. “Difference-in-Differences With Variation in Treatment Timing.” NBER Working Paper Series. Cambridge, MA: National Bureau of Economic Research. <http://www.nber.org/papers/w25018>.
- Graddy, Kathryn. 2006. “The Fulton Fish Market.” *Journal of Economic Perspectives* 20 (2): 207–20. doi:[10.1257/jep.20.2.207](https://doi.org/10.1257/jep.20.2.207).
- Griliches, Zvi. 1986. “Economic Data Issues.” In *Handbook of Econometrics*, edited by Zvi Griliches

and M D Intriligator, 3:1465–1514. Elsevier Science Publishers. doi:[10.1016/S1573-4412\(86\)03005-2](https://doi.org/10.1016/S1573-4412(86)03005-2).

Griliches, Zvi, and Jerry A Hausman. 1986. “Errors in Variables in Panel Data.” *Journal of Econometrics* 31 (1): 93–118. doi:[10.1016/0304-4076\(86\)90058-8](https://doi.org/10.1016/0304-4076(86)90058-8).

Heckman, James J. 2008. “Econometric Causality.” *International Statistical Review* 76 (1): 1–27. doi:[10.1017/CBO9781107415324.004](https://doi.org/10.1017/CBO9781107415324.004).

———. 2010. “Building Bridges Between Structural and Program Evaluation Approaches to Evaluating Policy.” *Journal of Economic Literature* 48 (June): 356–98. doi:[10.3386/w16110](https://doi.org/10.3386/w16110).

Heckman, James J, and Rodrigo Pinto. 2018. “Unordered Monotonicity.” *Econometrica* 86 (1): 1–35. doi:[10.3982/ECTA13777](https://doi.org/10.3982/ECTA13777).

Heckman, James J, and Jeffrey A Smith. 1995. “Assessing the Case for Social Experiments.” *Journal of Economic Perspectives* 9 (2): 85–110.

Heckman, James J, and Edward Vytlacil. 2007a. “Econometric Evaluation of Social Programs, Part I: Causal Models, Structural Models and Econometric Policy Evaluation.” In *Handbook of Econometrics*, 4779–4874. <http://linkinghub.elsevier.com/retrieve/pii/S1573441207060709>.

———. 2007b. “Econometric Evaluation of Social Programs, Part II: Using the Marginal Treatment Effect to Organize Alternative Econometric Estimators to Evaluation Social Programs, and to Forecast Their Effects in New Environments.” In *Handbook of Econometrics*, 4875–5143. <http://linkinghub.elsevier.com/retrieve/pii/S1573441207060710>.

Heckman, James J, Robert J LaLonde, and Jeffrey A Smith. 1999. “The Economics and Econometrics of Active Labor Market Programs.” In *Handbook of Labor Economics*, 1865–2097. <http://linkinghub.elsevier.com/retrieve/pii/S1573446399030126>.

Heckman, James J, Lance J Lochner, and Petra Todd. 2006. “Earnings Functions, Rates of Return and Treatment Effects: The Mincer Equation and Beyond.” In *Handbook of the Economics of Education*, edited by Eric A Hanushek and Finis Welch, 1st ed., 307–458. Elsevier B.V. <http://linkinghub.elsevier.com/retrieve/pii/S1574069206010075>.

Heckman, James J, Sergio Urzua, and Edward J Vytlacil. 2006. “Understanding Instrumental Variables in Models with Essential Heterogeneity.” *Review of Economics and Statistics* 88 (3). MIT Press: 389–432. doi:[10.1162/rest.88.3.389](https://doi.org/10.1162/rest.88.3.389).

Hendricks, Lutz. 2002. “How Important Is Human Capital for Development? Evidence from Immigrant Earnings.” *American Economic Review* 92 (1): 198–219. <https://www.jstor.org/stable/3083328>.

Hendricks, Lutz, and Todd Schoellman. 2018. “Human Capital and Development Accounting: New Evidence from Wage Gains at Migration.” *Quarterly Journal of Economics* 133 (2): 665–700. doi:[10.1093/qje/qjx047](https://doi.org/10.1093/qje/qjx047).

Hornbeck, Richard. 2010. “Barbed Wire: Property Rights and Agricultural Development.” *Quarterly Journal of Economics* 125 (2): 767–810. doi:[10.1162/qjec.2010.125.2.767](https://doi.org/10.1162/qjec.2010.125.2.767).

Hornbeck, Richard, and Suresh Naidu. 2014. “When the Levee Breaks: Black Migration and Economic Development in the American South.” *American Economic Review* 104 (3): 963–90. doi:[10.1257/aer.104.3.963](https://doi.org/10.1257/aer.104.3.963).

Hull, Peter. 2018. “Estimating Treatment Effects in Mover Designs.” Department of Economics,

University of Chicago.

Imbens, Guido W. 2010. "Better LATE Than Nothing: Some Comments on Deaton (2009) and Heckman and Urzua (2009)." *Journal of Economic Literature* 48 (2): 399–423. doi:[10.1257/jel.48.2.399](https://doi.org/10.1257/jel.48.2.399).

———. 2015. "Matching Methods in Practice: Three Examples." *Journal of Human Resources* 50 (2): 373–419. doi:[10.3368/jhr.50.2.373](https://doi.org/10.3368/jhr.50.2.373).

Imbens, Guido W, and Jeffrey M Wooldridge. 2009. "Recent Developments in the Econometrics of Program Evaluation." *Journal of Economic Literature*, Working paper series, 47 (1). National Bureau of Economic Research: 5–86. doi:[10.1257/jel.47.1.5](https://doi.org/10.1257/jel.47.1.5).

Jacobson, Louis S, Robert J LaLonde, and Daniel G Sullivan. 1993. "Earnings Losses of Displaced Workers." *American Economic Review* 83 (4): 685–709. <http://www.jstor.org/stable/2117574>.

Jaeger, David A, and Theodore J Joyce. 2018. "A Cautionary Tale of Evaluating Identifying Assumptions: Did Reality TV Really Cause a Decline in Teenage Childbearing?" NBER Working Paper Series. Cambridge, MA: National Bureau of Economic Research. doi:[10.3386/w24856](https://doi.org/10.3386/w24856).

Kahn-Lang, Ariella, and Kevin Lang. 2018. "The Promise and Pitfalls of Differences-in-Differences: Reflections on '16 and Pregnant' and Other Applications." NBER Working Paper Series. National Bureau of Economic Research. doi:[10.3386/w24857](https://doi.org/10.3386/w24857).

Keane, Michael. 2010a. "A Structural Perspective on the Experimentalist School." *Journal of Economic Perspectives* 24 (2): 47–58. doi:[10.1257/jep.24.2.47](https://doi.org/10.1257/jep.24.2.47).

———. 2010b. "Structural vs. atheoretic approaches to econometrics." *Journal of Econometrics* 156 (1): 3–20. doi:[10.1016/j.jeconom.2009.09.003](https://doi.org/10.1016/j.jeconom.2009.09.003).

Kearney, Melissa S, and Phillip B Levine. 2015. "Media Influences on Teen Sexual Behavior and Childbearing: The Impact of MTV's 16 and Pregnant." *American Economic Review* 105 (12): 3597–3632. doi:[10.1257/aer.20140012](https://doi.org/10.1257/aer.20140012).

Kleven, Hendrik, Camille Landais, and Jakob Egholt Sogaard. 2018. "Children and Gender Inequality: Evidence From Denmark." NBER Working Paper Series. Cambridge, MA: National Bureau of Economic Research.

Kline, Patrick. 2011. "Oaxaca-Blinder as a Reweighting Estimator." *American Economic Review: Papers & Proceedings* 101 (3): 532–37. doi:[10.1257/aer.101.3.532](https://doi.org/10.1257/aer.101.3.532).

Kline, Patrick, and Christopher R. Walters. 2019. "On Heckits, LATE, and Numerical Equivalence." *Econometrica (Forthcoming)*, 1–27. doi:[10.3386/w24477](https://doi.org/10.3386/w24477).

Lagakos, David, Benjamin Moll, Tommaso Porzio, Nancy Qian, and Todd Schoellman. 2018a. "Life Cycle Wage Growth Across Countries." *Journal of Political Economy* 126 (2): 797–849. doi:[10.1086/696225](https://doi.org/10.1086/696225).

———. 2018b. "Life-Cycle Human Capital Accumulation Across Countries: Lessons from U.S. Immigrants." *Journal of Human Capital* 12 (2): 305–42. doi:[10.1086/697245](https://doi.org/10.1086/697245).

LaLonde, Robert J. 1986. "Evaluating the Econometric Evaluations of Training Programs with Experimental Data." *American Economic Review* 76 (4). JSTOR: 604–20.

———. 1995. "The Promise of Public Sector-Sponsored Training Programs." *Journal of Economic Perspectives* 9 (2): 149–68. doi:[10.1257/jep.9.2.149](https://doi.org/10.1257/jep.9.2.149).

Llull, Joan. 2018. "Immigration, Wages, and Education: A Labour Market Equilibrium Structural

- Model." *Review of Economic Studies* 85 (3): 1852–96. doi:[10.1093/restud/rdx053](https://doi.org/10.1093/restud/rdx053).
- MaCurdy, Thomas. 1981. "An Empirical Model of Labor Supply in a Life-Cycle Setting." *Journal of Political Economy* 89 (6): 1059–85. <http://www.jstor.org/stable/1837184>.
- . 2007. "A Practitioner's Approach to Estimating Intertemporal Relationships from Longitudinal Data: Lessons from Applications in Wage Dynamics." In *Handbook of Econometrics*, 6A ed., 4057–4167. <http://linkinghub.elsevier.com/retrieve/pii/S157344120706062X>.
- Malkova, Olga. 2018. "Can Maternity Benefits Have Long-Term Effects on Childbearing? Evidence from Soviet Russia." *Review of Economics and Statistics* 100 (4): 691–703. doi:[10.1162/rest_a_00713](https://doi.org/10.1162/rest_a_00713).
- Manski, Charles F. 1995. *Identification Problems in the Social Sciences*. Harvard University Press.
- Meyer, Bruce D, Wallace K C Mok, and James X Sullivan. 2015. "Household Surveys in Crisis." *Journal of Economic Perspectives* 29 (4): 199–226. doi:[10.1257/jep.29.4.199](https://doi.org/10.1257/jep.29.4.199).
- Mueller-Smith, Michael. 2015. "The Criminal and Labor Market Impacts of Incarceration." Ann Arbor, MI: Department of Economics, University of Michigan. <https://sites.lsa.umich.edu/mgms/wp-content/uploads/sites/283/2015/09/incar.pdf>.
- Mullainathan, Sendhil, and Jann Spiess. 2017. "Machine Learning: An Applied Econometric Approach." *Journal of Economic Perspectives* 31 (2): 87–106. doi:[10.1257/jep.31.2.87](https://doi.org/10.1257/jep.31.2.87).
- Muralidharan, Karthik, and Paul Niehaus. 2017. "Experimentation at Scale." *Journal of Economic Perspectives* 31 (4): 103–24. doi:[10.1257/jep.31.4.103](https://doi.org/10.1257/jep.31.4.103).
- Muralidharan, Karthik, and Nishith Prakash. 2017. "Cycling to School: Increasing Secondary School Enrollment for Girls in India." *American Economic Journal: Applied Economics* 9 (3): 321–50. doi:[10.1257/app.20160004](https://doi.org/10.1257/app.20160004).
- Neal, Derek. 1997. "The Effects of Catholic Secondary Schooling on Educational Achievement." *Journal of Labor Economics* 15 (1): 98. doi:[10.1086/209848](https://doi.org/10.1086/209848).
- Neal, Derek, and William Johnson. 1996. "The Role of Premarket Factors in Black-White Wage Differences." *Journal of Political Economy* 104 (5). The University of Chicago Press: 869–95. <http://www.jstor.org/stable/2138945>.
- Oster, Emily. 2017. "Unobservable Selection and Coefficient Stability: Theory and Evidence." *Journal of Business and Economic Statistics* 0 (0). Taylor & Francis: 1–18. doi:[10.1080/07350015.2016.1227711](https://doi.org/10.1080/07350015.2016.1227711).
- Paarsch, Harry J, and Konstantin Golyaev. 2016. *A Gentle Introduction to Effective Computing in Quantitative Research: What Every Research Assistant Should Know*. The MIT Press.
- Schulhofer-Wohl, Sam. 2018. "The Age-Time-Cohort Problem and the Identification of Structural Parameters." *Quantitative Economics* 9 (2): 643–58. doi:[10.3982/QE738](https://doi.org/10.3982/QE738).
- Sims, Christopher A. 2010. "But Economics Is Not an Experimental Science." *Journal of Economic Perspectives* 24 (2): 59–68. doi:[10.1257/jep.24.2.59](https://doi.org/10.1257/jep.24.2.59).
- Smith, Jeffrey A., and Petra E. Todd. 2005. "Does matching overcome LaLonde's critique of nonexperimental estimators?" *Journal of Econometrics* 125 (1): 305–53. doi:[10.1016/j.jeconom.2004.04.011](https://doi.org/10.1016/j.jeconom.2004.04.011).
- Solon, Gary, Steven J Haider, and Jeffrey M Wooldridge. 2015. "What Are We Weighting for?" *Journal of Human Resources* 50 (2): 301–16. <http://jhr.uwpress.org/content/50/2/301.short>.
- Song, Jae, David Price, Fatih Guvenen, Nicholas Bloom, and Till von Wachter. 2018. "Firming up

- Inequality." *Quarterly Journal of Economics* (Forthcoming). doi:[10.3386/w21199](https://doi.org/10.3386/w21199).
- Stachurski, John. 2016. *A Primer in Econometric Theory*. Cambridge, MA: MIT Press.
- Stock, James. 2010. "The Other Transformation in Econometric Practice: Robust Tools for Inference." *Journal of Economic Perspectives* 24 (2): 83–94. doi:[10.1257/jep.24.2.83](https://doi.org/10.1257/jep.24.2.83).
- Topel, Robert H. 1991. "Specific Capital, Mobility, and Wages: Wages Rise with Job Seniority." *Journal of Political Economy* 99 (1): 145. doi:[10.1086/261744](https://doi.org/10.1086/261744).
- . 1999. "Labor Markets and Economic Growth." In *Handbook of Labor Economics*, 2943–84. <http://linkinghub.elsevier.com/retrieve/pii/S1573446399300353>.
- Wooldridge, Jeffrey M. 2010. *Econometric Analysis of Cross Section and Panel Data*. 2nd ed. MIT Press Books. The MIT Press.
- . 2015. "Control Function Methods in Applied Econometrics." *Journal of Human Resources* 50 (2): 420–45. doi:[10.3368/jhr.50.2.420](https://doi.org/10.3368/jhr.50.2.420).