PSCI 587: Structural Modeling and Estimation

Fall 2023
TR 11:05am–12:20pm
Harkness 329

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By blending formal theory and statistical inference, structural models enable social scientists to conduct rich analyses of how institutions and public policy shape individual or collective decision-making. The structural approach to empirical research is particularly useful in settings where more traditional methods cannot be applied, such as when agents behave strategically or when we wish to predict the consequences of never-before-observed policy interventions. This course covers the fundamentals of structural modeling and estimation, running the gamut from individual choice to strategic interaction, both static and dynamic. Depending on student interest, applications from political science, economics, finance, and marketing may be considered, but emphasis will be placed on the methodology with the aim of helping students expand their research toolkit.

Prerequisites: Students are expected to have taken PSCI 404, 405, 407, and 408, or equivalent graduate courses in another department. While PSCI 584 is not required, students unfamiliar with games of incomplete information should be prepared to learn the material on their own as needed for the course.

Computing: Structural models rarely admit estimation using canned routines in popular statistical software (e.g., SPSS, Stata). Familiarity with a programming language (e.g., Matlab, Python, R) is therefore indispensable for structural estimation. Students should be prepared to acquire the necessary programming skills.

Grading:

- Class participation.

- Assignments during the course of the semester.

- Presentation of a paper from the reading list.

- Presentation of a research proposal (20 minutes), accompanied by a written paper outline (due on 12/15).

Reading: Most of the course material will be presented in self-contained lecture notes. Two textbooks, *Numerical Methods in Economics* by K. Judd and *Applied Computational Economics and Finance* by M. Miranda and P. Fackler, may prove useful (but are not required). The content of the course is divided into four main topics, showcasing the key ideas and techniques underpinning the applications. Topic 0 introduces background methodological debates.

0. THE CAUSAL VERSUS STRUCTURAL DEBATE

- Heckman, J. J. (2000). Causal Parameters and Policy Analysis in Economics: A Twentieth Century Retrospective. *Quarterly Journal of Economics*, 115(1):45–97.

- Deaton, A. (2010). Instruments, Randomization, and Learning about Development. *Journal of Economic Literature*, 48:424–455.

- Heckman, J. J. and Urzúa, S. (2010). Comparing IV with structural models: What simple IV can and cannot identify. *Journal of Econometrics*, 156:27–37.

- Imbens, G. W. (2010). Better LATE Than Nothing: Some Comments on Deaton (2009) and Heckman and Urzua (2009). *Journal of Economic Literature*, 48:399–423.

- Angrist, J. D. and Pischke, J.-S. (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.

- Nevo, A. and Whinston, M. D. (2010). Taking the Dogma out of Econometrics: Structural Modeling and Credible Inference. *Journal of Economic Perspectives*, 24(2):69–82.

- Rust, J. (2010). Comments on: "Structural vs. atheoretic approaches to econometrics" by Michael Keane. *Journal of Econometrics*, 156:21–24.

1. AGGREGATE DISCRETE CHOICE

- Berry, S. T. (1994). Estimating Discrete-Choice Models of Product Differentiation. *RAND Journal of Economics*, 25(2):242–262.

- Berry, S., Levinsohn, J., and Pakes, A. (1995). Automobile Prices in Market Equilibrium. *Econometrica*, 63(4):841–890.

- Nevo, A. (2000). A Practitioner's Guide to Estimation of Random-Coefficients Logit Models of Demand. *Journal of Economics & Management Strategy*, 9(4):513–548.

- Dubé, J.-P., Fox, J. T., and Su, C.-L. (2012). Improving the Numerical Performance of Static and Dynamic Aggregate Discrete Choice Random Coefficients Demand Estimation. *Econometrica*, 80(5):2231–2267.

- Judd, K. L. and Skrainka, B. S. (2011). High Performance Quadrature Rules: How Numerical Integration Affects a Popular Model of Product Differentiation. CEMMAP Working Paper CWP03/11.

- Reynaert, M. and Verboven, F. (2014). Improving the performance of random coefficients demand models: The role of optimal instruments. *Journal of Econometrics*, 179:83–98.

- Gandhi, A. and Houde, J.-F. (2020). Measuring Substitution Patterns in Differentiated-Products Industries. Working Paper.

- Berry, S. and Haile, P. (2016). Identification in Differentiated Products Markets. *Annual Review of Economics*, 8:27–52.

- **Application**: Iaryczower, M., Kim, G., and Montero, S. (2020). Representation Failure. Working Paper.

2. DISCRETE GAMES, PARTIAL IDENTIFICATION

- Ciliberto, F. and Tamer, E. (2009). Market Structure and Multiple Equilibria in Airline Markets. *Econometrica*, 77(6):1791–1828.

- Bajari, P., Hong, H., and Ryan, S. P. (2010b). Identification and Estimation of a Discrete Game of Complete Information. *Econometrica*, 78(5):1529–1568.

- Romano, J. P. and Shaikh, A. M. (2010). Inference for the Identified Set in Partially Identified Econometric Models. *Econometrica*, 78(1):169–211.

- Andrews, D. W. K. and Soares, G. (2010). Inference for Parameters Defined by Moment Inequalities Using Generalized Moment Selection. *Econometrica*, 78(1):119–157.

- Romano, J. P., Shaikh, A., and Wolf, M. (2014). A Practical Two-Step Method for Testing Moment Inequalities. *Econometrica*, 82(5):1979–2002.

- Shi, X. and Shum, M. (2015). Simple Two-Stage Inference for a Class of Partially Identified Models. *Econometric Theory*, 31(3):493–520.

- Canay, I. A. and Shaikh, A. (2017). Practical and Theoretical Advances for Inference in Partially Identified Models. In Honoré, B., Pakes, A., Piazzesi, M., and Samuelson, L., editors, *Advances in Economics and Econometrics*, volume 2, pages 271–306. Cambridge University Press.

- Jia, P. (2008). What Happens When Wal-Mart Comes to Town: An Empirical Analysis of the Discount Retailing Industry. *Econometrica*, 76(6):1263–1316.

- McKelvey, R. and Palfrey, T. (1995). Quantal Response Equilibria for Normal Form Games. *Games and Economic Behavior*, 10(1):6–38.

- Bajari, P., Hong, H., Krainer, J., and Nekipelov, D. (2010a). Estimating Static Models of Strategic Interactions. *Journal of Business & Economic Statistics*, 28(4):469–482.

- Magnolfi, L. and Roncoroni, C. (2019). Estimation of Discrete Games with Weak Assumptions on Information. Working Paper.

- **Application**: Gibilisco, M. and Montero, S. (2020). Do Major-Power Interventions Encourage the Onset of Civil Conflict? A Structural Analysis. *Journal of Politics*, forthcoming.

- **Application**: Kalandrakis, T. (2019). One-dimensional scaling without apologies. Working Paper.

3. DYNAMIC PROGRAMMING

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

- Rust, J. (1988). Maximum Likelihood Estimation of Discrete Control Processes. *SIAM Journal on Control and Optimization*, 26(5):1006–1024.

- Hotz, V. and Miller, R. (1993). Conditional Choice Probabilities and the Estimation of Dynamic Models. *Review of Economic Studies*, 60(3):497–529.

- Hotz, V., Miller, R., Sanders, S., and Smith, J. (1994). A Simulation Estimator for Dynamic Models of Discrete Choice. *Review of Economic Studies*, 61(2):265–289.

- Magnac, T. and Thesmar, D. (2002). Identifying Dynamic Discrete Decision Processes. *Econometrica*, 70(2):801–816.

- Aguirregabiria, V. and Mira, P. (2002). Swapping the Nested Fixed Point Algorithm: A Class of Estimators for Discrete Markov Decision Models. *Econometrica*, 70(4):1519–1543.

- Aguirregabiria, V. and Mira, P. (2010). Dynamic discrete choice structural models: A survey. *Journal of Econometrics*, 156(1):38–67.

- Norets, A. (2009). Inference in Dynamic Discrete Choice Models with Serially Correlated Unobserved State Variables. *Econometrica*, 77(5):1665–1682.

- Arcidiacono, P. and Miller, R. (2011). Conditional Choice Probability Estimation of Dynamic Discrete Choice Models With Unobserved Heterogeneity. *Econometrica*, 79(6):1823–1867.

- Hu, Y. and Shum, M. (2012). Nonparametric Identification of Dynamic Models with Unobserved State Variables. *Journal of Econometrics*, 171:32–44.

- Kasahara, H. and Shimotsu, K. (2008). Pseudo-likelihood estimation and bootstrap inference for structural discrete Markov decision models. *Journal of Econometrics*, 146(1):92–106.

- Kasahara, H. and Shimotsu, K. (2009). Nonparametric Identification of Finite Mixture Models of Dynamic Discrete Choices. *Econometrica*, 77(1):135–175.

- Imai, S., Jain, N., and Ching, A. (2009). Bayesian Estimation of Dynamic Discrete Choice Models. *Econometrica*, 77(6):1865–1899.

- **Application**: Frey, A., López-Moctezuma, G., and Montero, S. (2020). Sleeping with the Enemy: Effective Representation under Dynamic Electoral Competition. Working Paper.

4. DYNAMIC GAMES

- Bajari, P., Benkard, C. L., and Levin, J. (2007). Estimating Dynamic Models of Imperfect Competition. *Econometrica*, 75(5):1331–1370.

- Aguirregabiria, V. and Mira, P. (2007). Sequential Estimation of Dynamic Discrete Games. *Econometrica*, 75(1):1–53.

- Pakes, A., Ostrovsky, M., and Berry, S. (2007). Simple estimators for the parameters of discrete dynamic games (with entry/exit examples). *RAND Journal of Economics*, 38(2):373–399.

- Pesendorfer, M. and Schmidt-Dengler, P. (2008). Asymptotic Least Squares Estimators for Dynamic Games. *Review of Economic Studies*, 75(3):901–928.

- Pesendorfer, M. and Schmidt-Dengler, P. (2010). Sequential Estimation of Dynamic Discrete Games: A Comment. *Econometrica*, 78(2):833–842.

- Hu, Y. and Shum, M. (2013). Identifying Dynamic Games with Serially-Correlated Unobservables. In *Advances in Econometrics (Volume 31): Structural Econometric Models*. Emerald Publishing.

- Jia Barwick, P. and Pathak, P. (2015). The costs of free entry: an empirical study of real estate agents in Greater Boston. *RAND Journal of Economics*, 46(1):103–145.

- **Application**: Crisman-Cox, C. and Gibilisco, M. (2018). Audience Costs and the Dynamics of War and Peace. *American Journal of Political Science*, 62(3):566–580.

5. APPLICATIONS

- Diermeier, D., Eraslan, H., and Merlo, A. (2003). A Structural Model of Government Formation. *Econometrica*, 71(1):27–70.

- Diermeier, D., Keane, M., and Merlo, A. (2005). A Political Economy Model of Congressional Careers. *American Economic Review*, 95(1):347–373.

- Knight, B. (2005). Estimating the Value of Proposal Power. *American Economic Review*, 95(5):1639–1652.

- Diermeier, D., Eraslan, H., and Merlo, A. (2007). Bicameralism and Government Formation. *Quarterly Journal of Political Science*, 2:227–252.

- Strömberg, D. (2008). How the Electoral College Influences Campaigns and Policy: The Probability of Being Florida. *American Economic Review*, 98(3):769–807.

- Buera, F. J., Monge-Naranjo, A., and Primiceri, G. E. (2011). Learning the Wealth of Nations. *Econometrica*, 79(1):1–45.

- Merlo, A. and Tang, X. (2012). Identification and Estimation of Stochastic Bargaining Models. *Econometrica*, 80(4):1563–1604.

- Kalandrakis, T. and Spirling, A. (2012). Radical Moderation: Recapturing Power in Two-Party Parliamentary Systems. *American Journal of Political Science*, 56(2):413–432.

- Iaryczower, M. and Shum, M. (2012). The Value of Information in the Court: Get it Right, Keep it Tight. *American Economic Review*, 102(1):202–237.

- Lim, C. (2013). Preferences and Incentives of Appointed and Elected Public Officials: Evidence from State Trial Court Judges. *American Economic Review*, 103(4):1360–1397.

- Kawai, K. and Watanabe, Y. (2013). Inferring Strategic Voting. *American Economic Review*, 103(2):624–662.

- Acemoglu, D., García-Jimeno, C., and Robinson, J. A. (2015). State Capacity and Economic Development: A Network Approach. *American Economic Review*, 105(8):2364–2409.

- Weese, E. (2015). Political mergers as coalition formation: An analysis of the *Heisei* municipal amalgamations. *Quantitative Economics*, 6:257–307.

- Francois, P., Rainer, I., and Trebbi, F. (2015a). How Is Power Shared in Africa? *Econometrica*, 83(2):465–503.

- Francois, P., Rainer, I., and Trebbi, F. (2015b). The Dictator's Inner Circle. Working Paper.

- Kawai, K. and Sunada, T. (2015). Campaign Finance in U.S. House Elections. Working Paper.

- Kang, K. (2016). Policy Influence and Private Returns from Lobbying in the Energy Sector. *Review of Economic Studies*, 83(1):269–305.

- García-Jimeno, C. (2016). The Political Economy of Moral Conflict: An Empirical Study of Learning and Law Enforcement Under Prohibition. *Econometrica*, 84(2):511–570.

- Montero, S. (2016). Going It Alone? An Empirical Study of Coalition Formation in Elections. Working Paper.

- Martin, G. J. and Yurukoglu, A. (2017). Bias in Cable News: Persuasion and Polarization. *American Economic Review*, 107(9):2565–2599.

- Silveira, B. S. (2017). Bargaining with Asymmetric Information: An Empirical Study of Plea Negotiations. *Econometrica*, 85(2):419–452.

- García-Jimeno, C. and Yildirim, P. (2017). Matching Pennies on the Campaign Trail: An Empirical Study of Senate Elections and Media Coverage. Working Paper.

- Canen, N., Jackson, M. O., and Trebbi, F. (2017). Endogenous Networks and Legislative Activity. Working Paper.

- Lim, C. and Yurukoglu, A. (2018). Dynamic Natural Monopoly Regulation: Time Inconsistency, Moral Hazard, and Political Environments. *Journal of Political Economy*, 126(1):263–312.

- Iaryczower, M., Shi, X., and Shum, M. (2018). Can Words Get in the Way? The Effect of Deliberation in Collective Decision-Making. *Journal of Political Economy*, 126(2):688–734.

- Spenkuch, J. L., Montagnes, B. P., and Magleby, D. B. (2018). Backward Induction in the Wild? Evidence from Sequential Voting in the US Senate. *American Economic Review*, 108(7):1971–2013.

- Ascencio, S. J. and Rueda, M. R. (2019). Partisan Poll Watchers and Electoral Manipulation. *American Political Science Review*, 113(3):727–742.

- Kawai, K., Toyama, Y., and Watanabe, Y. (2019). Voter Turnout and Preference Aggregation. *American Economic Journal: Microeconomics*, forthcoming.

- López-Moctezuma, G. (2019). Sequential Deliberation in Collective Decision-Making: The Case of the FOMC. Working Paper.

- Iaryczower, M., López-Moctezuma, G., and Meirowitz, A. (2019). Career Concerns and the Dynamics of Electoral Accountability. Working Paper.

- Canen, N., Kendall, C., and Trebbi, F. (2020). Unbundling Polarization. *Econometrica*, 88(3):1197–1233.

- Abramson, S. F. and Montero, S. (2020). Learning about Growth and Democracy. *American Political Science Review*, 114(4):1195–1212.

- Francois, P., Trebbi, F., and Xiao, K. (2020). Factions in Nondemocracies: Theory and Evidence from the Chinese Communist Party. Working Paper.

- Cruz, C., Keefer, P., Labonne, J., and Trebbi, F. (2020). Making policies matter: Voter responses to campaign promises. Working Paper.

- Ciancio, A. and García-Jimeno, C. (2020). The Political Economy of Immigration Enforcement: Conflict and Cooperation under Federalism. Working Paper.

- Kang, K. and Silveira, B. S. (2020). Understanding Disparities in Punishment: Regulator Preferences and Expertise. Working Paper.

- Cooley, B. (2020). Trade Policy in the Shadow of Power: Theory and Evidence on Economic Openness and Coercive Diplomacy. Working Paper.

- Abramson, S. F., Cooley, B., and Lacina, B. (2020). How Wide is the Ethnic Border? Working Paper.

- Kenkel, B. and Ramsay, K. W. (2020). The Effective Power of Military Coalitions: A Unified Theoretical and Empirical Model. Working Paper.

- Gibilisco, M., Kenkel, B., and Rueda, M. R. (2020). Competition and Civilian Victimization. Working Paper.

- Christensen, D. and Gibilisco, M. (2020). How Budgets Shape Power Sharing in Autocracies. Working Paper.