

# Advanced Time Series Cross-Section Analyses

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**General:** Data collected over both units (e.g., municipalities, states, countries) and time (e.g., days, months, years)—known as pooled time series—are common in social science. By gaining leverage both across units and over time, this data structure helps us answer important questions that would be difficult if we only looked at a single year (e.g., cross section) or single country (e.g., time series): the relationship between growth and democracy, whether or not the resource curse exists, and how institutions shape political and economic outcomes. However, pooled time series often show types of heterogeneity that make standard regression approaches inappropriate. In this week, building off Module I’s Essentials of Time Series for Time Series Cross-Section Analyses (TSCS) and Module II’s Fundamentals of Time Series Cross-Section Analyses, we cover several advanced topics regarding these data. This includes a focus on establishing identification, model selection testing procedures, as well as more advanced estimation methods.

During the first four days, the course will involve about three hours of lecture time with breaks, then lunch, and then three to four hours of hands-on instruction in analysis that takes place in smaller groups using Stata. On the fifth day, students will work on a specific project assignment that applies the concepts introduced in the course.

**Prerequisite:** A full-semester graduate-level course in multiple regression analysis, Essentials of TS for TSCS (Module 1) and Fundamentals of TSCS analysis (Module 2) or the equivalent thereof.

## Course Outline

- Modelling Unit Heterogeneity: Intercepts and Slopes
- Modelling Unit Heterogeneity & Common Correlated Effects
- Generalized Method of Moments (GMM) estimators
- Models for Dichotomous Dependent Variables in TSCS

## Topic 1: Modelling Unit Heterogeneity: Intercepts and Slopes

For the first topic, we start with a review of standard regression assumptions. We then move into the basics of time series data. We will cover how to write time series notation, how to analyze time series data, and begin to discuss threats to inference common in time series data, including autoregression and non-stationarity.

- Readings:
  - Bell, A., and Jones, K. "Explaining Fixed Effects: Random Effects Modeling of Time-Series Cross-sectional and Panel data." *Political Science Research and Methods*, 3.1 (2015): 133-153.
  - Kittel, Bernhard and Hannes Winner. "How Reliable is Pooled Analysis in Political Economy? The Globalization- Welfare State nexus Revisited." *European Journal of Political Research* 44.2 (2005): 269-293.
  - Wilson, S.E. and D.M. Butler. "A Lot More to Do: The Sensitivity of Time-Series Cross-Section-Analyses to Simple Alternative Specifications." *Political Analysis* 15 (2007): 101-123.
  - Zhu, L. "Panel Data Analysis in Public Administration: Substantive and Statistical Considerations." *Journal of Public Administration Research and Theory* 23 (2012): 395-428.

## Topic 2: Modelling Unit Heterogeneity & Common Correlated Effects

For the second topic, we will explore recent efforts developed to explore heterogeneity in effects between units with models such as the mean group (MG) estimator and pooled mean group estimator. We will show why common correlated effects models represent an alternative approach to address the problem of endogeneity between regressors and unit fixed effects. We will also discuss how these models account for unobserved common shocks by including cross-sectional averages of the dependent and independent variables.

- Readings:
  - Chapter 22 Dynamic Heterogeneous Panel Data Models of Asteriou, Dimitriou and Stephen G. Hall, *Applied Econometrics*, 3rd edition. Palgrave, 2016.
  - Chapter 27, Cross-Section Dependence and Nonstationary Data of Måns Söderbom and Francis Teal with Markus Eberhardt, Simon Quinn and Andrew Zeitlin, *Empirical Development Economics*, 1st edition. Routledge, 2015.
  - Blackburne, Edward F. III and Mark W. Frank. "Estimation of nonstationary heterogeneous panels." *The Stata Journal* 7.2 (2007): 197-208.
  - Ditzen, Jan. "Estimating Dynamic Common Correlated Effects in Stata." *The Stata Journal*, 18:3 (2018): 585-617.

- Pesaran, M.H. and Smith, R. "Estimating long-run relationships from dynamic heterogeneous panels." *Journal of Econometrics* 68.1 (1995) :79-113.

### Topic 3: Generalized Method of Moments (GMM) estimators

For the third topic, we will introduce the one- and two-step generalized method of moments (GMM) estimators for dynamic panels. We will show how these models handle the endogeneity of regressors and unit fixed effects, as well as discuss some of the potential pitfalls that should be avoided in estimation.

- Readings:

- Chapter 24, Estimation of Dynamic Effects with Panel Data of Måns Söderbom and Francis Teal with Markus Eberhardt, Simon Quinn and Andrew Zeitlin, *Empirical Development Economics*, 1st edition. Routledge, 2015.
- Roodman, David. "How to do xtabond2: An Introduction to Difference and System GMM in Stata ." *The Stata Journal* 9.1 (2009), 86-136.
- Roodman, David. "A Note on the Theme of Too Many Instruments." *Oxford Bulletin of Economics and Statistics* 71.1 (2009), 135-158.
- Kripfganz, S. "xtdpqml: Quasi-maximum likelihood estimation of linear dynamic short-T panel data models." *The Stata Journal* 16.4 (2016), 1013-1038.
- Pickup, M., P. Gustafson, D. Cubranic, and G. Evans. "OrthoPanels: An R Package for Estimating a Dynamic Panel Model with Fixed Effects Using the Orthogonal Reparameterization Approach." *The R Journal* 9.1 (2017):60-76.
- Wawro, G. "Estimating Dynamic Panel Data Models in Political Science." *Political Analysis* 10.1 (2002): 25-48.

### Topic 4: Models for Dichotomous Dependent Variables in TSCS

For the fourth topic, we will explore how to model dichotomous dependent variables. These models require us to think differently about event dependence than models with a continuous dependent variable.

- Readings:

- Carter, David B. and Curtis S. Signorino. "Back to the Future: Modeling Time Dependence in Binary Data." *Political Analysis* 18.3 (2010): 271-292.
- Beck, Nathaniel, Jonathan N. Katz, and Richard Tucker. "Taking Time Seriously: Time-Series-Cross-Section Analysis with a Binary Dependent Variable." *American Journal of Political Science* 42 (1998): 1260-1288.

### Topic 5: Final Presentations

We will have student presentations of a research project developed over the week. Everyone will provide feedback. If needed, we will also finish up any lectures.