NIPE Summer School
University of Minho

DIFFERENCE-IN-DIFFERENCES AND EVENT STUDIES FOR PANEL DATA
AND REPEATED CROSS SECTIONS

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We will cover difference-in-differences and event study methods for policy analysis, with an emphasis on panel data. However, I will also discuss how flexible regression methods apply to repeated cross sections. We will begin with flexible regression-based methods, including two-way fixed effects estimation of a flexible equation allowing for staggered interventions and heterogeneous treatment effects. Imputation methods and doubly robust methods based on rolling estimation (including long differencing) also will be covered.

I will make connections between standard difference-in-differences estimators and event-study estimators, including how to make event-study methods more flexibly by controlling for covariates in order to relax the parallel trends assumption. We will discuss how to test for pre-trends and how to adjust for heterogeneous trends.

Other topics include modifications required if there is no never treated group, how to allow for exit from treatment, how to handle unbalanced panels, and issues that arise with time-varying control variables. We will also learn how one can obtain inference in situations with a small number of cross-sectional units, as well as provide an overview of synthetic control methods.

We will briefly cover extension of regression-based methods to non-binary treatments. I will show how linear regression methods extend to nonlinear difference-in-differences methods for binary, fractional, and nonnegative (including count and corner solution) outcomes. The final topic shows how methods for panel data can be modified for repeated cross sections.

Background Reading

Abadie, A., A. Diamond, and J. 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, 493-505

Arkhangelsky, D., S. Athey, D.A. Hirshberg, G.W. Imbens, and S. Wager (2021), "Synthetic Difference-in-Differences," *American Economic Review* 111, 4088-4118.

Borusyak, K., X. Jaravel, and J. Spiess (2023), "Revisiting Event Study Designs: Robust and Efficient Estimation," forthcoming, *Review of Economic Studies*.
https://arxiv.org/abs/2108.12419

Callaway, B. and P.H.C. Sant'Anna (2021), "Difference-in-Differences with Multiple Time Periods," *Journal of Econometrics* 225, 200-230.

Callaway, B., A. Goodman-Bacon, and P.H.C. Sant'Anna (2024), "Difference-in-Differences with a Continuous Treatment," working paper.
https://arxiv.org/pdf/2107.02637.pdf

de Chaisemartin, C., and X. D'Haultfœuille (2020), "Two-Way Fixed Effects Estimators with Heterogeneous Treatment Effects," *American Economic Review* 110, 2964-2996.

de Chaisemartin, C., and X. D'Haultfœuille (2023), "Two-Way Fixed Effects and Differences-in-Differences with Heterogeneous Treatment Effects: A Survey," *Econometrics Journal* 26, C1-C30.

Lee, S.J., and J.M. Wooldridge (2023), "A Simple Transformation Approach to Difference-in-Differences Estimation for Panel Data," working paper.
https://papers.ssrn.com/sol3/papers.cfm?abstract_id=4516518

Roth, J. and P.H.C. Sant'Anna (2023), "When is Parallel Trends Sensitive to Functional Form?" *Econometrica* 91, 737–747.

Sun, L., and S. Abraham (2021), "Estimating Dynamic Treatment Effects in Event Studies with Heterogeneous Treatment Effects," *Journal of Econometrics* 225, 175-199.

Wooldridge, J.M. (2021), "Two-Way Fixed Effects, the Two-Way Mundlak Regression, and Difference-in-Differences Estimators," working paper.
https://www.researchgate.net/publication/353938385_Two-Way_Fixed_Effects_the_Two-Way_Mundlak_Regression_and_Difference-in-Differences_Estimators

Wooldridge, J.M. (2023), "Simple Approaches to Nonlinear Difference-in-Differences with Panel Data," *Econometrics Journal* 26, C31-C66.

Wooldridge, J.M. (2024), "Simple Approaches to Inference with Difference-in-Differences Estimators with Small Cross-Sectional Sample Sizes," working paper.

Program

DAY 1

Session 1: 9:15-10:30
Introduction and Overview; Two-Period Panel Data Case; No Anticipation and Parallel Trends; Regression Adjustment and Propensity Score Methods

Coffee Break: 10:30-10:45

Session 2: 10:45-12:00
General Common Intervention Timing; Pooled OLS and Extended Controlling for Covariates via Regression Adjustment; Event Study Estimation

Lunch Break: 12:00-13:30

Session 3: 13:30-14:45
Staggered Interventions, I; Heterogeneous Effects; Imputation; Pooled OLS and Extended TWFE; All Units Eventually Treated

Coffee Break: 14:45-15:00

Practical Session: 15:00-16:30

DAY 2

Session 4: 9:15-10:30
Staggered Interventions, II. Strategies with Exit. Event Study Methods. Testing and Correcting for Violation of Parallel Trends.

Coffee Break: 10:30-10:45

Session 5: 10:45-12:00
Staggered Interventions, III; Alternative Imputation Estimators; Rolling Methods and Long Differencing; Propensity Score Methods.

Lunch Break: 12:00-13:30

Session 6: 13:30-14:45
Small Number of Cross-Sectional Units; Synthetic Control Methods

Coffee Break: 14:45-15:00

Practical Session: 15:00-16:30

DAY 3

Session 7: 9:15-10:30
Non-Binary Treatments; Time-Varying Covariates; Unbalanced Panels; Standard Errors

Coffee Break: 10:30-10:45

Session 8: 10:45-12:00
Nonlinear DiD. Binary, Fractional, and Nonnegative Reponses; Quasi-MLE Estimation

Lunch Break: 12:00-13:30

Session 9: 13:30-14:45
Difference-in-Differences with Repeated Cross Sections

DAY 4

Research Seminar: "Estimating Distributional Treatment Effects with Staggered Interventions for Panel Data"