



Allievi Program, Master in Economics, Ph.D. in Economics

# ECONOMETRIC THEORY II: The Difference-in-Differences Toolkit

Spring 2025

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## Contact Information

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## Course Description

Perhaps the most popular empirical strategy for conducting causal inference in modern micro econometrics is the so called *difference-in-differences* (DiD) method. This course will study the origin, scope, recent developments, and limitations of DiD. It will start by reviewing the Rubin Causal Model and the experimental paradigm to introduce key notation and concepts that will facilitate the exposition of DiD. The course will cover a short refreshment about the nature of panel data, as well as the classic DiD estimator and its dynamic versions. It will also review identification assumptions and their testing, as well as mixed methodologies that couple DiD with instrumental variables (IV), regression discontinuity design (RDD) and with synthetic control methods. DiD commands will be introduced for various statistical software, and empirical applications will be provided throughout the course.

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<sup>1</sup>Be prepared to make the most productive use of our time. Send an e-mail in advance explaining what you want to discuss and attach the inputs that you think will be useful for the meeting. If the meeting is a follow up to a previous meeting, send me an e-mail in advance summarizing our previous conversation and explain of any progress you have made since then.

## Requirements and Grading

Students are expected to present empirical applications (individually) and software implementations (in groups). Presentations amount to 25% of the individual final grade.<sup>2</sup> **Clarity and brevity will be rewarded.** Students will also have to work on two problems sets (in groups), which jointly represent 15% of the grade. There will also be a final exam (30%) and a research paper (individual or in groups), which should implement (some of) the methods and concepts reviewed during the course (30%).

## Textbooks and References

No single textbook covers the material presented in this course. A number of the recommended readings will consist of journal articles.

### Useful textbooks:

- Angrist, Joshua and Jorn-Steffen Pischke (2008). *Mostly Harmless Econometrics: An Empiricist's Companion*, Princeton University Press. (MHE)
- Cunningham, S. (2020) *Causal Inference. The Mixtape 1*. Yale University Press. (Early version available online on authors' page). (C)

### Other references (this list will be updated):

- 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 American Statistical Association*, 105, 493-505.
- Abadie, A. and J. Gardeazabal (2003). "The Economic Costs of Conflict: A Case Study of the Basque Country", *American Economic Review* 93 (1): 113-132.
- Acemoglu, D., L. Fergusson, J. Robinson, D. Romero, J. Vargas, (2020). "The Perils of Top-down State Building: Evidence from Colombia's False Positives", *American Economic Journal: Economic Policy*, Vol. 12(3): 1-43, 2020
- Ang, D. "The Effects of Police Violence on Inner-City Students." *Quarterly Journal of Economics* 136.1 (February 2021): 115-168

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<sup>2</sup>When presenting a paper, focus on the empirical strategy and testing of the assumptions, but also provide context: summarize its motivation, main results and contribution. Skip long lists of robustness tests as well as any theoretical model. When presenting software and commands, be sure you provide examples with real or simulated data. E-mail me when in doubt.

- Baker, A., D. F. Larcker, and C.CY Wang. (2021) "How Much Should We Trust Staggered Difference-In-Differences Estimates?."
- Bertrand, M., E. Duflo, and S. Mullainathan, (2004). "How Much Should We Trust Difference in Differences Estimates?" *Quarterly Journal of Economics* 119: 249-275
- Borusyak, K., Jaravel, X., and Spiess, J. (2021). "Revisiting event study designs: Robust and efficient estimation." *Review of Economic Studies*
- Callaway, B., and Sant'Anna, P. H. (2021). "Difference-in-differences with multiple time periods." *Journal of Econometrics*, 225(2), 200-230.
- De Chaisemartin, C. and X. d'Haultfoeuille, (2020). "Two-way fixed effects estimators with heterogeneous treatment effects," *American Economic Review*, 110, 2964–96.
- Dube, O. and J. Vargas, (2013). "Commodity Price Shocks and Civil Conflict: Evidence from Colombia," *Review of Economic Studies*, Vol. 80 (4): 1384-1421, 2013
- Duflo, E. (2001), "Schooling and Labor Market Consequences of School Construction in Indonesia: Evidence from an Unusual Policy Experiment," *American Economic Review*, 91:795–813.
- Giorgelli, M. (2019) "The long term effects of management and technology transfers," *American Economic Review*
- Goodman-Bacon, A. (2021). "Difference-in-differences with variation in treatment timing." *Journal of Econometrics*, 225(2), 254-277.
- Holland, P. (1986). "Statistics and Causal Inference", *Journal of the American Statistical Association* 81(396): 945-970 (with discussion)
- Muralidharan, K. and N. Prakash, (2017). "Cycling to school: Increasing secondary school enrollment for girls in India", *American Economic Journal: Applied Economics*, Vol. 9 (3): 321–50.
- Prem, M., M. Purroy, and J. Vargas (2023) "Landmines: The local effects of demining," *R&R Journal of Public Economics*
- Prem, M., J. Vargas and . D Mejía, (2023). "The rise and persistence of illegal crops: evidence from a naive policy announcement", *The Review of Economics and Statistics*, Vol. 105 (2): 344–358, 2023
- Prem, M., Vargas, J. F., & Namen, O. (2023). The human capital peace dividend. *Journal of Human Resources*, 58(3), 962-1002.

- Rambachan, A., and Roth, J. (2023). “A more credible approach to parallel trends.” *Review of Economic Studies*, rdad018.
- Roth, J. (2022). “Pretest with caution: Event-study estimates after testing for parallel trends.” *American Economic Review: Insights*, 4(3), 305-322.
- Roth, J., Sant’Anna, P. H., Bilinski, A., & Poe, J. (2023). What’s trending in difference-in-differences? A synthesis of the recent econometrics literature. *Journal of Econometrics*.

## **(Preliminary) Outline**

1. Review of the Rubin Causal Model
2. The experimental paradigm
3. John Snow and the history of DiD
4. Static DiD, parallel trends and event studies
5. Staggered adoption and heterogeneous treatments effects
6. Taking pre-trends seriously
7. IV DiD
8. Difference-in-discontinuity
9. Synthetic DiD