

Visualization, Identification, and Estimation in the Linear Panel Event-Study Design

Simon Freyaldenhoven¹ Christian Hansen²
Jorge Pérez Pérez³ Jesse M. Shapiro⁴

¹Federal Reserve Bank of Philadelphia

²University of Chicago

³Banco de México

⁴Brown University and NBER

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Approaches to Identification without Proxies or Instruments

Confound

$$y_{it} = \alpha_i + \gamma_t + \mathbf{q}_{it}'\psi + \sum_{m=-G}^M \beta_m \mathbf{z}_{i,t-m} + C_{it} + \varepsilon_{it} \quad (\text{linear panel model})$$

- ▶ Parameters of interest not identified unless we can say something more about the confound C_{it}
- ▶ Appropriate identifying assumptions should be justified on economic grounds
- ▶ This video: Identification Strategies without Proxies or Instruments
- ▶ Next video: Identification Strategies with Proxies or Instruments

Confound is low-dimensional

Assumption

$$C_{it} = \lambda_i' F_t$$

with

- a. $F_t = 0$ for all t
 - ▶ Aggregate shocks affect all units in the same way via time FE
 - ▶ Estimate via two-way fixed effects (TWFE)
- b. $F_t = f(t)$ for $f(\cdot)$ a known low-dimensional set of basis functions
 - ▶ Approximating possible sources of confounding with a trend (e.g. Jacobson et al. 1993)
 - ▶ Estimate via TWFE controlling for unit-specific trends
- c. F_t low-dimensional
 - ▶ Units respond differently to common shocks (e.g. Powell 2021)
 - ▶ Estimate via interactive fixed effects, common correlated effects, or synthetic controls

Confound can be extrapolated from pre-event period

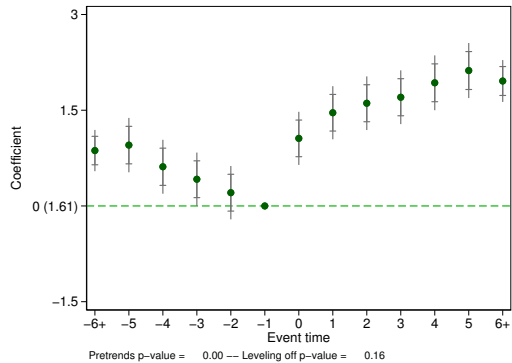
Assumption

$$\mathbb{E}[C_{it}|z_i, \alpha_i, \gamma, q_i] = \tilde{\alpha}_i + \tilde{\gamma}_t + q'_{it}\tilde{\psi} + \sum_m \phi' f(m) z_{i,t-m}$$

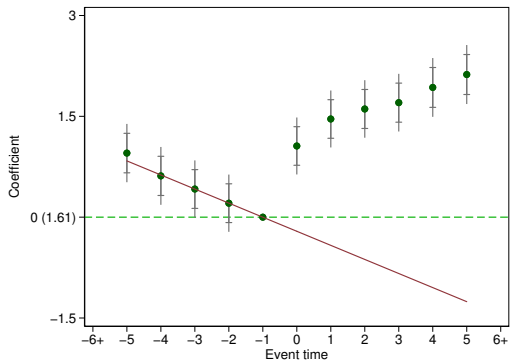
for $f(\cdot)$ a known low-dimensional set of basis functions, and $\tilde{\alpha}_i$, $\tilde{\gamma}_t$, $\tilde{\psi}$, and ϕ unknown parameters.

Example: Dobkin et al. (2018)

Event-time path of the outcome



Overlay trend



Subtract extrapolated trend

