

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

The views expressed are those of the speaker and not necessarily those of the Federal Reserve Bank of Philadelphia, the Federal Reserve System, or Banco de México.

Improvements to Event-Study Plots

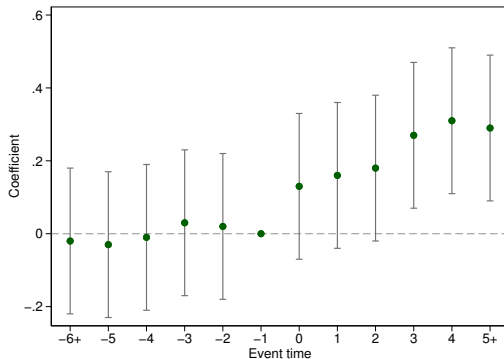
Estimating equation

$$y_{it} = \sum_{k=-G-L_G}^{M+L_M-1} \delta_k \Delta z_{i,t-k} + \delta_{M+L_M} z_{i,t-M-L_M} + \delta_{-G-L_G-1} (-z_{i,t+G+L_G}) \\ + \alpha_i + \gamma_t + \mathbf{q}_{it}' \psi + \mathbf{C}_{it} + \varepsilon_{it}$$

(estimating equation)

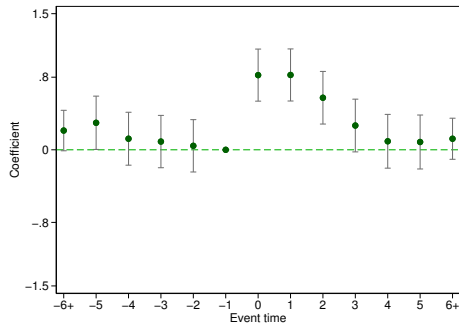
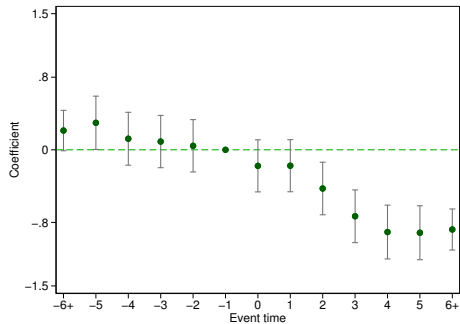
- ▶ Will refer to index k as *event time*
- ▶ Will refer to vector δ as *event time path* of outcome

Standard event-study plot



Points on plot correspond to $\{(k, \hat{\delta}_k)\}_{k=-G-L_G-1}^{k=M+L_M}$ in the estimating equation.

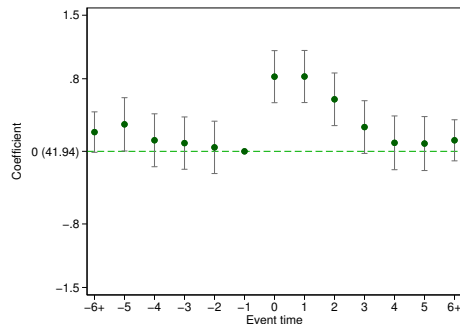
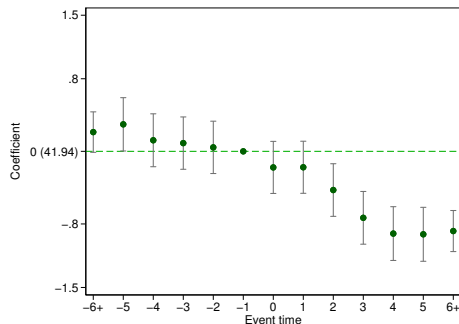
Normalization



Suggestion

Normalize $\delta_{-G-1} = 0$ in the estimating equation. (True here for $G = 0$.)

Magnitude

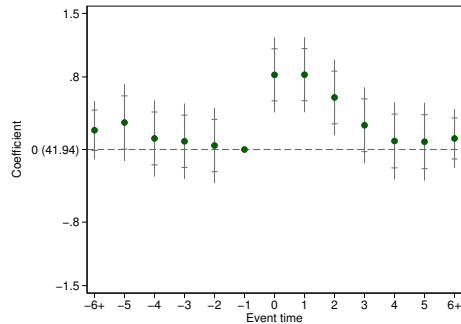
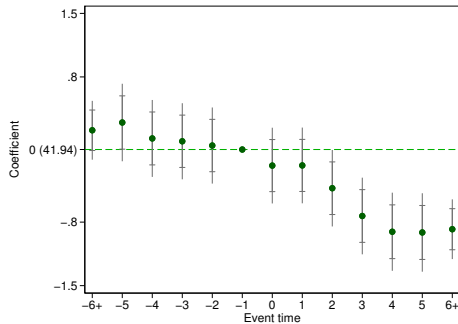


Suggestion

Include a parenthetical label showing the mean value of the dependent variable in periods corresponding to the normalized coefficient, e.g.,

$$\frac{\sum_{(i,t): \Delta z_{i,t+G+1} \neq 0} y_{it}}{|(i,t) : \Delta z_{i,t+G+1} \neq 0|}.$$

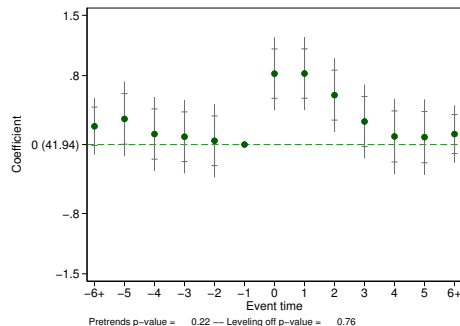
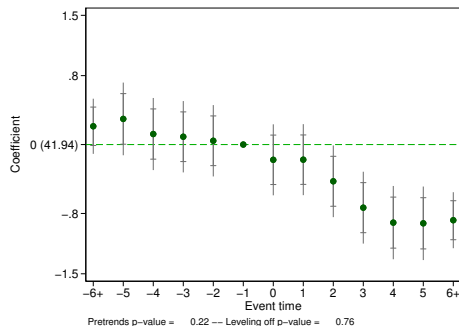
Inference



Suggestion

Add a uniform confidence band in addition to the pointwise confidence intervals.

Overidentification tests



Suggestion

Include p-values for Wald tests of the following hypotheses:

$$H_0 : \delta_k = 0,$$

$$-(G + L_G) \leq k < -G$$

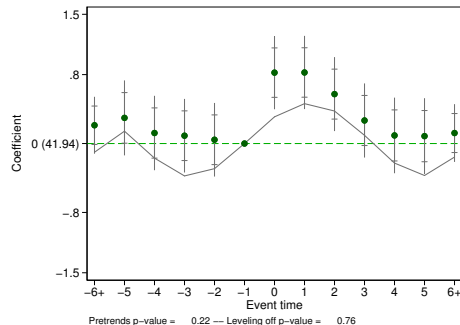
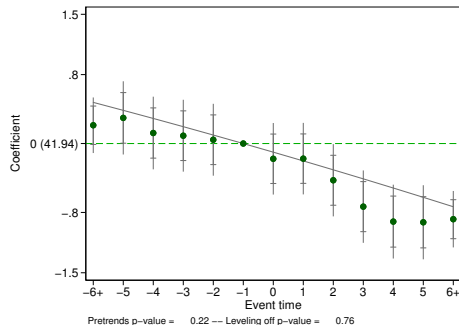
(no pre-trends)

$$H_0 : \delta_M = \delta_{M+k},$$

$$0 < k \leq L_M$$

(dynamics level off)

Confound paths



Suggestion

Plot the least “wiggly” confound whose event-time path is consistent with the data. Specifically, plot the polynomial with lowest-magnitude high-order coefficient among polynomials of lowest order that pass through the Wald region for δ .

Implementing suggestions with `xtevent` in Stata

- ▶ Estimation

```
xtevent y, panelvar(i) timevar(t) policyvar(z) window(5)
```

- ▶ Event-study plot

```
xteventplot
```

- ▶ Confound dynamics

```
xteventplot, smpath(line)
```