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Estimating dynamic treatment effects in event studies with heterogeneous treatment effects

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ABSTRACT

To estimate the dynamic effects of an absorbing treatment, researchers often use two-way fixed effects regressions that include leads and lags of the treatment. We show that in settings with variation in treatment timing across units, the coefficient on a given lead or lag can be contaminated by effects from other periods, and apparent pretrends can arise solely from treatment effects heterogeneity. We propose an alternative estimator that is free of contamination, and illustrate the relative shortcomings of two-way fixed effects regressions with leads and lags through an empirical application.

1. Introduction

Rich panel data has fueled a growing literature estimating treatment effects with two-way fixed effects regressions. This body of applied work has prompted a corresponding econometrics literature investigating the assumptions required for these regressions to yield causally interpretable estimates. For example, Athey and Imbens (2018), Borusyak and Jaravel (2017), Callaway and Sant'Anna (2020a), de Chaisemartin and D'Haultfœuille (2020) and Goodman-Bacon (2018) interpret the coefficient on the treatment status when there are treatment effects heterogeneity and variation in treatment timing. Researchers are often also interested in dynamic treatment effects, which they estimate by the coefficients μ_ℓ associated with indicators for being ℓ periods relative to the treatment, in a specification that resembles the following:

$$Y_{i,t} = \alpha_i + \lambda_t + \sum_{\ell} \mu_\ell \mathbf{1}\{t - E_i = \ell\} + \upsilon_{i,t}. \tag{1}$$

Here $Y_{i,t}$ is the outcome of interest for unit i at time t, E_i is the time when unit i initially receives the binary absorbing treatment, and α_i and λ_t are the unit and time fixed effects. Units are categorized into different cohorts based on their initial treatment timing. The relative times $\ell = t - E_i$ included in (1) cover most of the possible relative periods, but may still exclude some periods.

The first goal of this paper is to uncover potential pitfalls associated with using the estimates of the relative period coefficients μ_ℓ as "reasonable" measures of dynamic treatment effects. We decompose μ_ℓ to show it can be expressed as a linear combination of cohort-specific effects from both its own relative period ℓ and other relative periods; unless strong assumptions regarding treatment effects homogeneity hold, the terms that include treatment effects from other relative

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