New DD Estimators

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Workshop on Causal Inference with Panel Data

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Revisiting the Issue

Problem with TWFE

Recall the biggest issues with "standard" TWFE estimates:

- Best case: Variance-weighted ATT
- Biased with heterogeneous effects over time and differential timing
- Differential timing **alone** can introduce bias because already treated act as controls for later treated groups

"Heterogeneous" treatment effects should be the baseline

Solution

Only consider "clean" comparisons:

- Separate event study for each treatment group vs never-treated
- Callaway and Sant'Anna (2020)
- Sun and Abraham (2020)
- de Chaisemartin and D'Haultfoeuille (2020)
- Cengiz et al. (2019), Gardner (2021), and Borusyak et al. (2021)

Callaway and Sant'Anna

CS Estimator

- "Manually" estimate group-specific treatment effects for each period
- Each estimate is propensity-score weighted
- Aggregate the treatment effect estimates (by time, group, or both)

CS in Practice

Stata

```
ssc install csdid
ssc install event_plot
ssc install drdid

insheet using "https://raw.githubusercontent.com/imccart
gen perc_unins=uninsured/adult_pop
egen stategroup=group(state)
drop if expand_ever=="NA"
replace expand_year="0" if expand_year=="NA"
destring expand_year, replace

csdid perc_unins, ivar(stategroup) time(year) gvar(expan
estat event, estore(cs)
event_plot cs, default_look graph_opt(xtitle("Periods si
```

R

```
library(tidyverse)
library(did)
library(DRDID)
mcaid.data <- read_tsv("https://raw.githubusercontent.co
reg.dat <- mcaid.data %>%
  filter(!is.na(expand_ever)) %>%
  mutate(perc_unins=uninsured/adult_pop,
         post = (year>=2014),
         treat=post*expand_ever,
         expand_year=ifelse(is.na(expand_year),0,expand_
  filter(!is.na(perc_unins)) %>%
  group_by(State) %>%
  mutate(stategroup=cur_group_id()) %>% ungroup()

mod.cs <- att_gt(yname="perc_unins", tname="year", idnam
```

Sun and Abraham

Sun and Abraham

$$y_{it} = \gamma_i + \gamma_t + \sum_g \sum_{\tau \neq -1} \delta_{g\tau} \times 1(i \in C_g) \times D_{it}^{\tau} + x_{it} + \epsilon_{it}$$

- Intuition: Standard regression with different event study specifications for each treatment group
- Aggregate $\delta_{g\tau}$ for standard event study coefficients and overall ATT

Sun and Abraham in Practice

Stata

```
ssc install eventstudyinteract
ssc install avar
ssc install event_plot

insheet using "https://raw.githubusercontent.com/imccart
gen perc_unins=uninsured/adult_pop
drop if expand_ever=="NA"
egen stategroup=group(state)
replace expand_year="." if expand_year=="NA"
destring expand_year, replace
gen event_time=year-expand_year
gen nevertreated=(event_time==.)

forvalues l = 0/4 {
    gen L`l'event = (event_time==`l')
}
```

R

```
library(tidyverse)
library(modelsummary)
library(fixest)
mcaid.data <- read_tsv("https://raw.githubusercontent.co
reg.dat <- mcaid.data %>%
  filter(!is.na(expand_ever)) %>%
  mutate(perc_unins=uninsured/adult_pop,
         post = (year>=2014),
         treat=post*expand_ever,
         expand_year = ifelse(expand_ever==FALSE, 10000,
         time_to_treat = ifelse(expand_ever==FALSE, -1,
         time_to_treat = ifelse(time_to_treat < -3, -3,

mod.sa <- feols(perc_unins~sunab(expand_year, time_to_tr
                  cluster=~State,
                  data=reg.dat)
```

de Chaisemartin and D'Haultfoeuille (CH)

CH

- More general than other approaches
- Considers "fuzzy" treatment (i.e., non-discrete treatment)
- Considers fixed effects and first-differencing

New paper from Callaway, Goodman-Bacon, and Sant'Anna also looks at DD with continuous treatment

CH Approach

- Essentially a series of 2x2 comparisons
- Aggregates up to overall effects

CH in Practice

Stata

```
ssc install did_multiplegt
ssc install event_plot

insheet using "https://raw.githubusercontent.com/imccart
gen perc_unins=uninsured/adult_pop
drop if expand_ever=="NA"
egen stategroup=group(state)
replace expand_year="." if expand_year=="NA"
destring expand_year, replace
gen event_time=year-expand_year
gen nevertreated=(event_time==.)
gen treat=(event_time>=0 & event_time~=.)

did_multiplegt perc_unins stategroup year treat, robust_
event_plot e(estimates)#e(variances), default_look graph
title("de Chaisemartin and D'Haultfoeuille (2020)") xlab
```

R(not the same as in Stata)

```
library(DIDmultiplegt)
mcaid.data <- read_tsv("https://raw.githubusercontent.co
reg.dat <- as.data.table(mcaid.data) %>%
  filter(!is.na(expand_ever)) %>%
  mutate(perc_unins=uninsured/adult_pop,
         treat=case_when(
           expand_ever==FALSE ~ 0,
           expand_ever==TRUE & expand_year<year ~ 0,
           expand_ever==TRUE & expand_year>=year ~ 1))

mod.ch <- did_multiplegt(df=reg.dat, Y="perc_unins", G="
                         placebo=3, dynamic=4, brep=50,
```

And even more!

Cengiz et al. (2019)

- "Stacked" event studies
- Estimate event study for every treatment group, using never-treated as controls
- Aggregate to overall average effects

Stata

```
stackdev
```

R

```
#nothing yet
```

Gardner (2021)

- "Remove" fixed effects via first stage regression only among non-treated units
- Predict FE from first stage and residualize the outcome
- Run standard event study specification on residualized outcome variable

Stata

`did2s`

R

`did2s`

Borusyak et al. (2021)

- Imputation approach
- Estimate regression only for untreated observations
- Predicted untreated outcome among the treated observations and take the difference
- Aggregate differences to form overall weighted average effect

Stata

`did_imputation`

R

`did2s`

Putting things together

Seems like lots of "solutions"

- Callaway and Sant'Anna (2020)
- Sun and Abraham (2020)
- de Chaisemartin and D'Haultfoeuille (2020)
- Cengiz et al (2019), Gardner (2021), and Borusyak et al. (2021)

Goodman-Bacon (2021) explores the problems but doesn't really propose a solution (still very important work though!)

Comparison

Similarities

- Focus on clean treatment/control
- Focus on event study framework (not a single overall effect)
- Impose some form of parallel trends assumption

Differences

- What are the control units?
- How to include covariates?

State of current work

- Careful consideration of treatment timing and control group(s)
- `panelView` package is great here!
- Implement 2 or more approaches