(Not) Going to school in times of climate change: Natural disasters and student achievement

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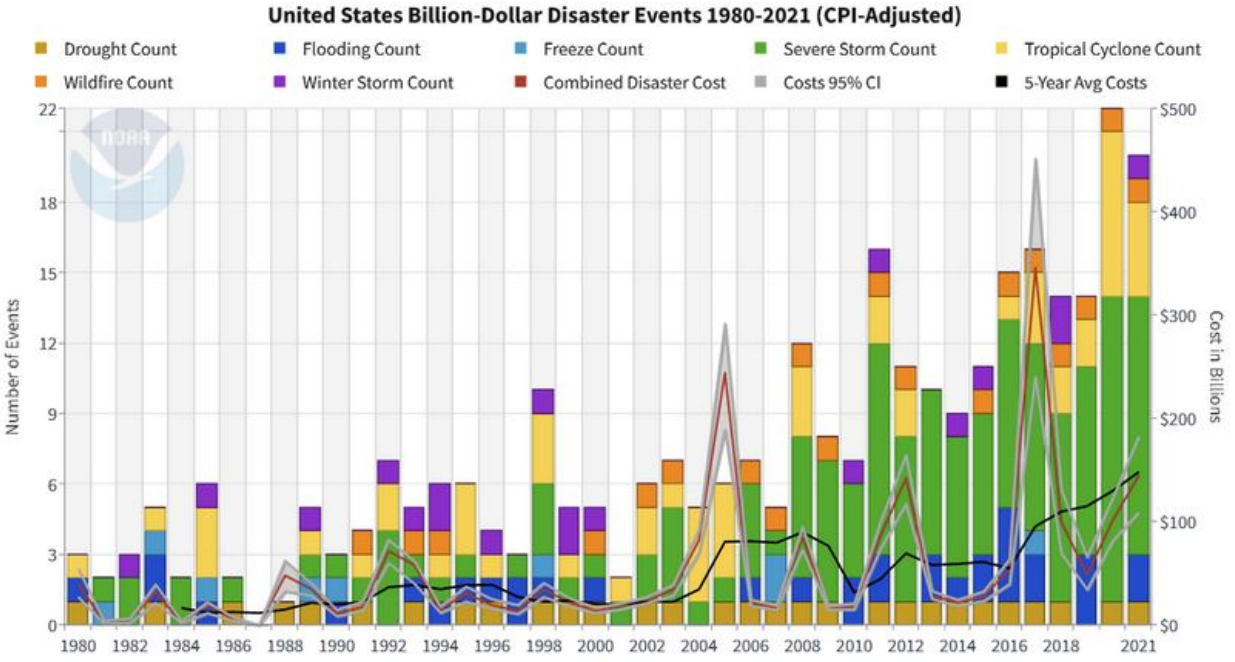
VfS 2023/09/26

Motivation



The history of billion-dollar disasters in the United States each year from 1980 to 2021, showing event type (colors), frequency (left-hand vertical axis), and cost (right-hand vertical axis.) The number and cost of weather and climate disasters is rising due to a combination of population growth and development along with the influence of human-caused climate change on some type of extreme events that lead to billion-dollar disasters. NOAA NCEI.

Fig. 1: Billion dollar disasters

Motivation

- 22,112 prolonged unplanned school closures in 2011-2019, affecting over 13 million students that resulted in 91.5 million student-days lost (Jahan et al. 2022).
- 18.7% of all schools had at least one prolonged school closure ($\geq$ 5 days).
- Natural disasters (47%), adverse weather conditions (35%) are the most frequent reason.
- Hurricane Harvey led to >3000 schools closed in four states ranging from 1-19 days.

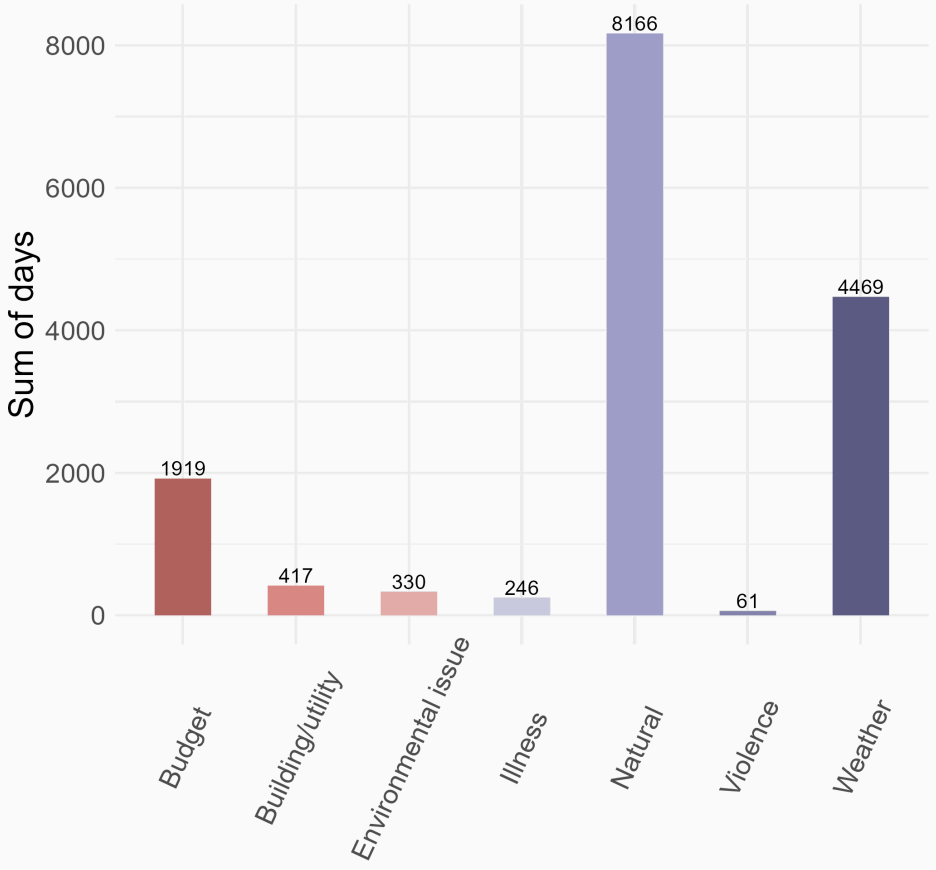


Fig. 2: School closure

Motivation

- Frequency and costs of natural disasters have increased.
- This can have lasting effects on students' achievement and future earnings.
- Natural disaster can lead to school closures, breakdown of transit system.
- Most studies look at impact of natural disasters on economic growth (eg. Dell, Jones and Olken 2012) but there is less attention on the impact on students.
- Understanding the costs of natural disasters is crucial for pre- and post-disaster investment and policies.


The New York Times

N.Y. / Region

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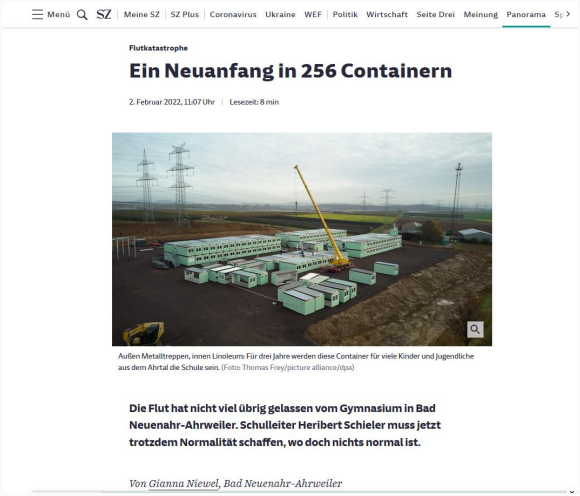
Schools Reopen to Snarls; Transit Headaches Persist

Back to School, for Some: Although most New York public schools reopened on Monday, some were still closed, and their pupils had to move elsewhere temporarily.

By VIVIAN YEE

Published: November 5, 2012


Menü | SZ | Meine SZ | SZ Plus | Coronavirus | Ukraine | WEF | Politik | Wirtschaft | Seite Drei | Meinung | Panorama

Flutkatastrophe

Ein Neuanfang in 256 Containern

2. Februar 2022, 11:07 Uhr | Lesezeit: 8 min

Außen Metalltreppen, innen Linoleum. Für drei Jahre werden diese Container für viele Kinder und Jugendliche aus dem Ahrtal die Schule sein. (Foto: Thomas Frey/picture alliance/dpa)

Die Flut hat nicht viel übrig gelassen vom Gymnasium in Bad Neuenahr-Ahrweiler. Schulleiter Heribert Schieler muss jetzt trotzdem Normalität schaffen, wo doch nichts normal ist.

Von Gianna Niewel, Bad Neuenahr-Ahrweiler

This Paper

- Main Question: What are the effects of natural disasters on student achievement?
- Data: Combining county level student achievement (SEDA) for 2009-2018 with disaster declarations in the US from the Federal Emergency Management Agency (FEMA) .
- Framework: I estimate the effect of a natural disaster on student achievements in a TWFE framework.

Contribution to existing literature

Literature on specific major disasters on schools and students

Sacerdote (2012), Di Pietro (2019), Holmes (2002), Spencer et al. (2016), Shidiqi et al. (2023) find negative short-run effects on students and schools. Evidence on long-run effects are mixed.

➞ However, most disasters are not as severe as those outliers.

Literature on school closures and absenteeism

Covid papers eg. Werner & Woessmann (2023), teacher and student absenteeism eg. Clotfelder, Ladd, and Vigdor (2006), Miller, Murnane, and Willett (2006)

➞ Natural disaster fundamentally different from Covid.

➞ Teacher and students absence suffers from endogeneity issues.

➞ Effect of both absenteeism and infrastructure damages are possible.

Data on Student Achievement

Stanford Education Data Archive (SEDA) 2009-2018

District and county level average achievement (for all students and by race/ethnicity and gender), district and county level racial/ethnic and gender achievement gaps, and district level demographic/socioeconomic data.

- **Achievement is centered around zero**, so a score of zero means the district is at the average expected level of achievement within the United States. One-unit below zero means that students in the district are one grade level behind the average; one-unit above zero means that students in the district are one grade level above the average.

➡ Use county level and focus on grade 3.

Data: Math scores

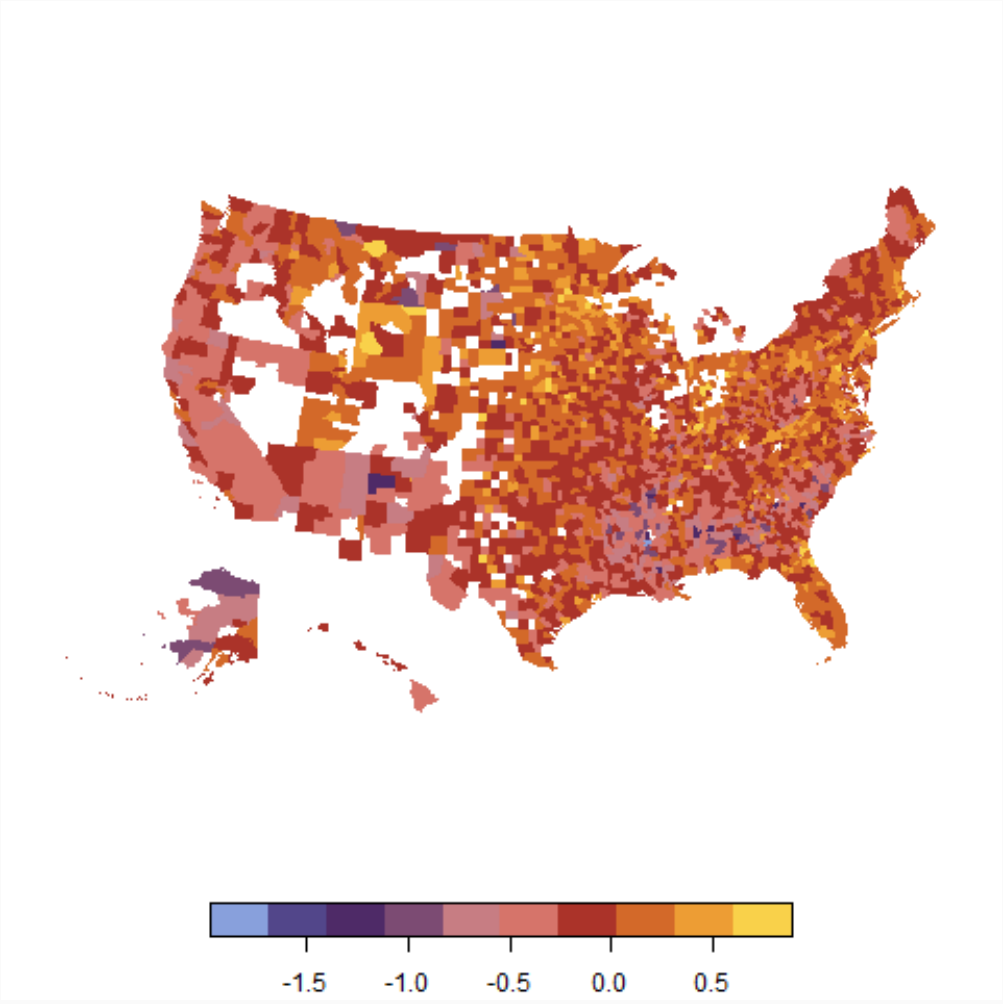


Fig. 3: Average Math Achievement Grade 3 to 5

Data on Disasters (I): FEMA

- FEMA major disaster declarations 2009-2018 (begins in 1964)
- The disaster declaration includes the date the disaster was declared, the area, the type of incident, denotes which assistance program was declared.
- Storms (73%), Floods (20%), Fire (7%), Drought (2%), Freezing, Earthquake, Landslide, Volcanic activity
- One disaster can cause multiple disaster events across different counties.
- For large disasters: Information of fatalities from EM-DAT via county and start date.
- Define severe natural disasters as disasters that caused $\geq$ 25 deaths (following Bounsat et al. 2020).

Data on Disasters (II): FEMA

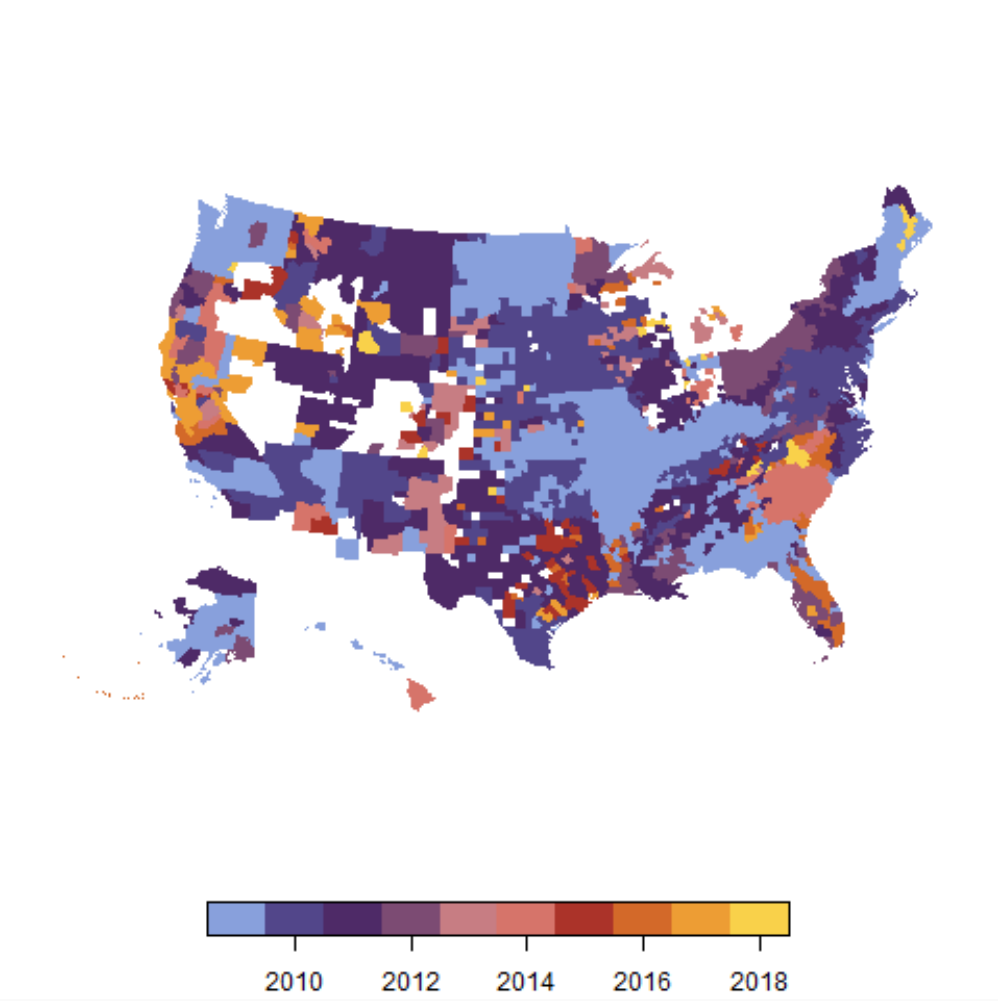


Fig. 4: First year of a natural disaster

Target Parameter

- Problem: Staggered adoption, coefficients on lead and lag indicators in a dynamic specification can be biased with TWFE.
- Solution: reweighting following Sun and Abraham (2021)

Cohort average treatment effect on the treated for a treatment cohort e and relative time period l

$$CATT_{e,l} = E[Y_{i,e+l} - Y^{\infty}_{i,e+l} | E_i = e]$$

$Y^{\infty}_{i,e+l}$ is the potential outcome of county i in a world where it is untreated.

Here, a treatment cohort e are counties that are treated at the same time. l are periods to i's initial natural disaster.

Dynamic Treatment effect following Sun & Abraham

Estimate the event study regression using "last treated" as control (C):

$$Y_{i,t} = \alpha_i + \lambda_t + \sum_{e \notin C} \sum_{l \neq -1} CATT_{e,l}(1\{E_i = e\} \cdot D_{i,t}^l) + \epsilon_{i,t}$$

The interaction weighted estimator

Take the weighted average over all estimates for $CATT$ multiplied by the sample share of each cohort in the period $Pr(E = e)$:

$$\hat{v}_g = \frac{1}{|g|} \sum_{l \in g} \sum_{e} \widehat{CATT}_{e,l} \hat{Pr}(E_i = e | E_i \in [-l, T-l])$$

Main assumptions: Parallel trends for all units, Limited anticipation

Results

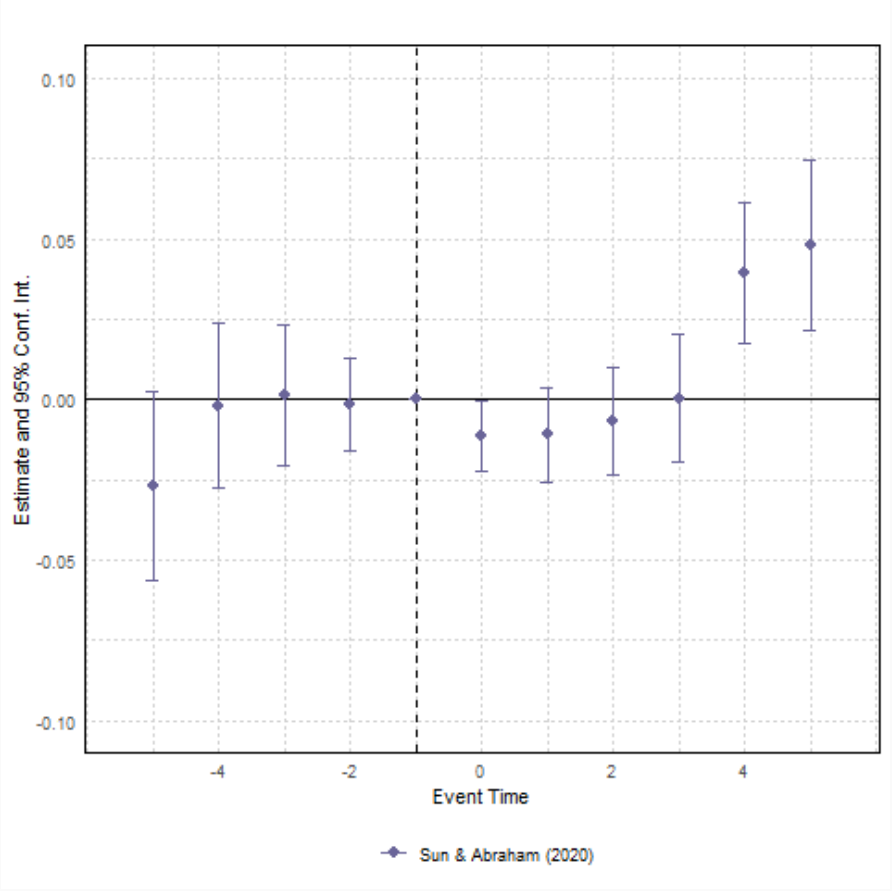


Fig. 5: Math achievement in grade 3

Alternative specification

Do more disasters cause more harm?

$$Y_{i,t} = \alpha_i + \lambda_t + \beta \boldsymbol{Disaster}_{i,t} + \delta'(\mathbf{X}_i \lambda_t) + \epsilon_{i,t},$$

where $\boldsymbol{Disaster}_{i,t}$ is the number and severity of a natural disasters in the past 5 years in a county and year, $\boldsymbol{\alpha}_i$ and $\boldsymbol{\lambda}_t$ are county and year fixed effects, $\mathbf{X}_i \boldsymbol{\lambda}_t$ includes an interaction between initial county population and a linear time trend.

The preferred measure of a "severe" disaster is one that caused 25 or more deaths, following Boustan et al. (2020).

Results: Larger natural disasters cause more harm

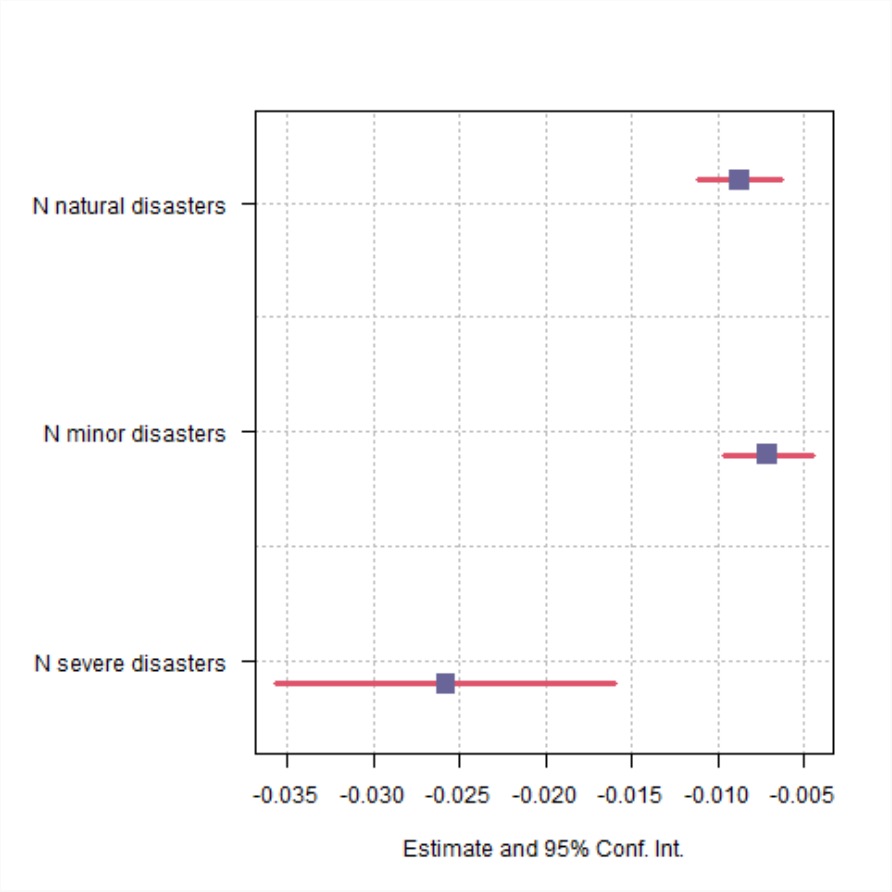


Fig. 6: Number of natural disasters in the past 5 years.

Robustness and Sensitivity

- Using never treated as control.
- Results look similar with Borusyak, Jaravel, and Spiess (2023).
- What about movers? enrollment.
- Does age matter? Similar effects for kids in grade 4 and 5.

Conclusion (for now)

- What is the effect of natural disasters on students?
- Setting: US where already now 80% of the prolonged unplanned school closures are due to natural disasters and adverse weather conditions.
- Evidence points to s negative effect of natural disaster on student achievement in the year of the natural disaster.
- More natural disasters cause more harm. This effect is larger for large natural disasters.

Get in contact!

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Descriptive Table

Show 20 entries

Search:

Variable	N	Mean	Std.Dev.	Min	Max
math grade 3	27465	-0.015	0.31	-1.9	1.4
math grade 4	27417	-0.038	0.31	-2.7	1.2
math grade 5	26576	-0.058	0.31	-1.6	1.1
math grade 6	26451	-0.044	0.31	-2.6	1
male-female gap	23773	-0.0056	0.094	-0.55	0.59
non-ECD ECD gap	21308	0.53	0.17	-0.17	1.4
White-Black gap	9264	0.64	0.22	-0.4	1.7
proportion in urban school	27759	0.066	0.18	0	1
proportion in suburban school	27759	0.091	0.21	0	1
proportion in town schools	27759	0.29	0.3	0	1
proportion in rural school	27759	0.56	0.33	0	1
number of students in grade	27713	1168	3875	2	120833

Showing 1 to 20 of 21 entries

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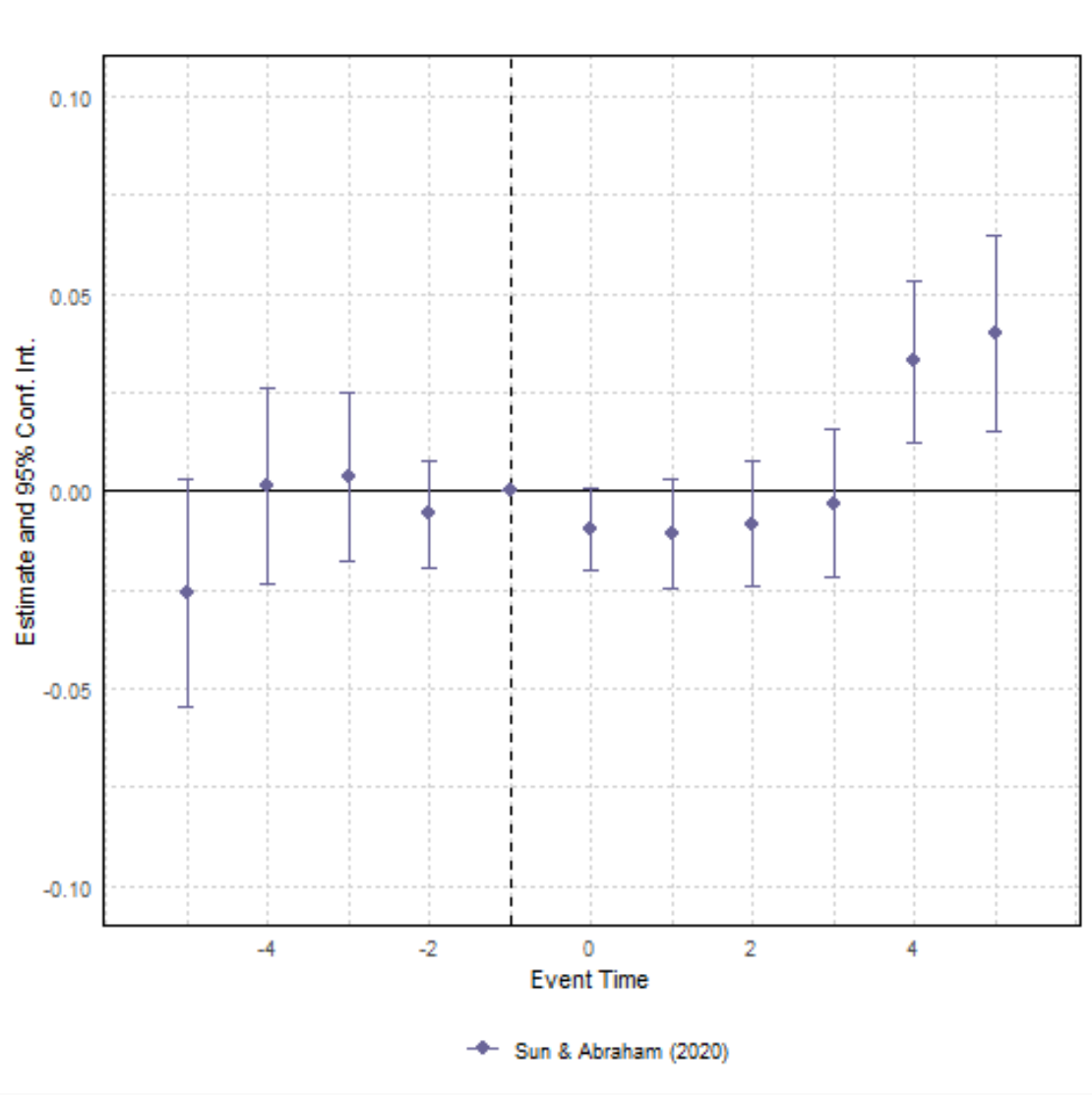
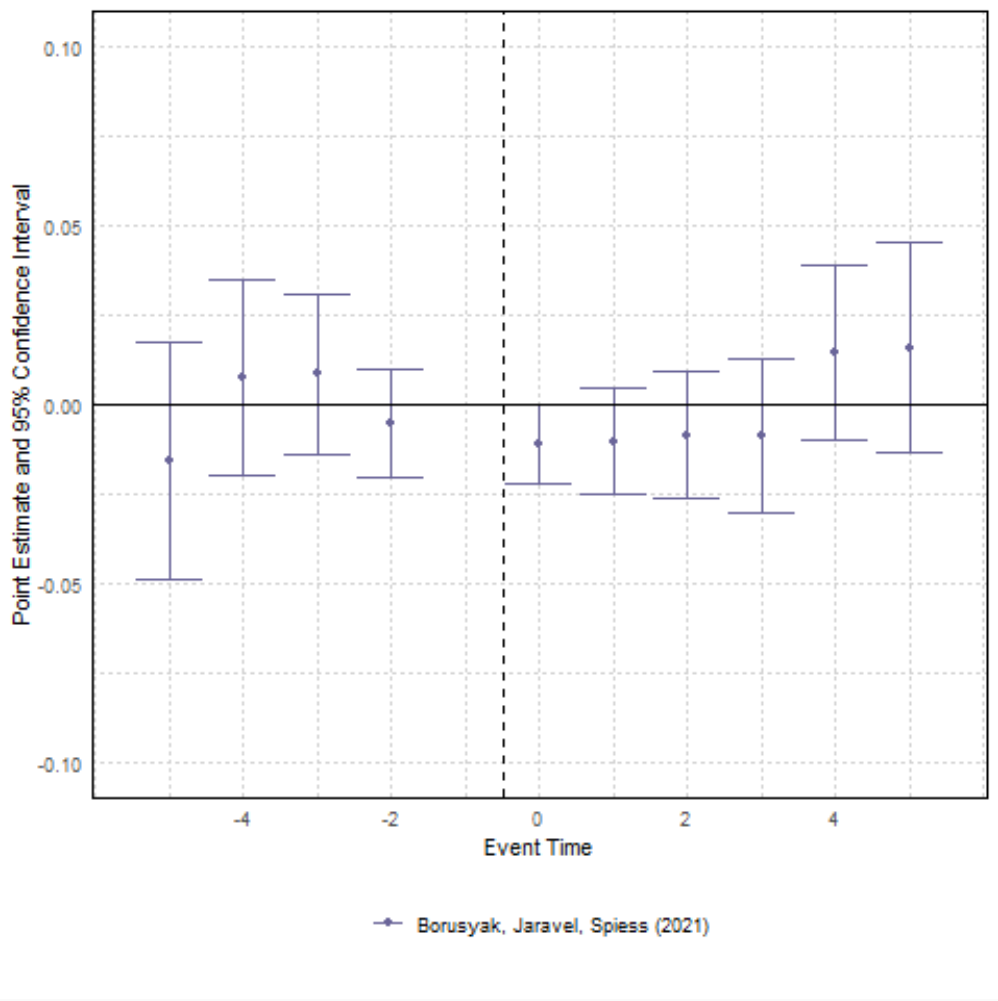
Sun and Abraham with never treated

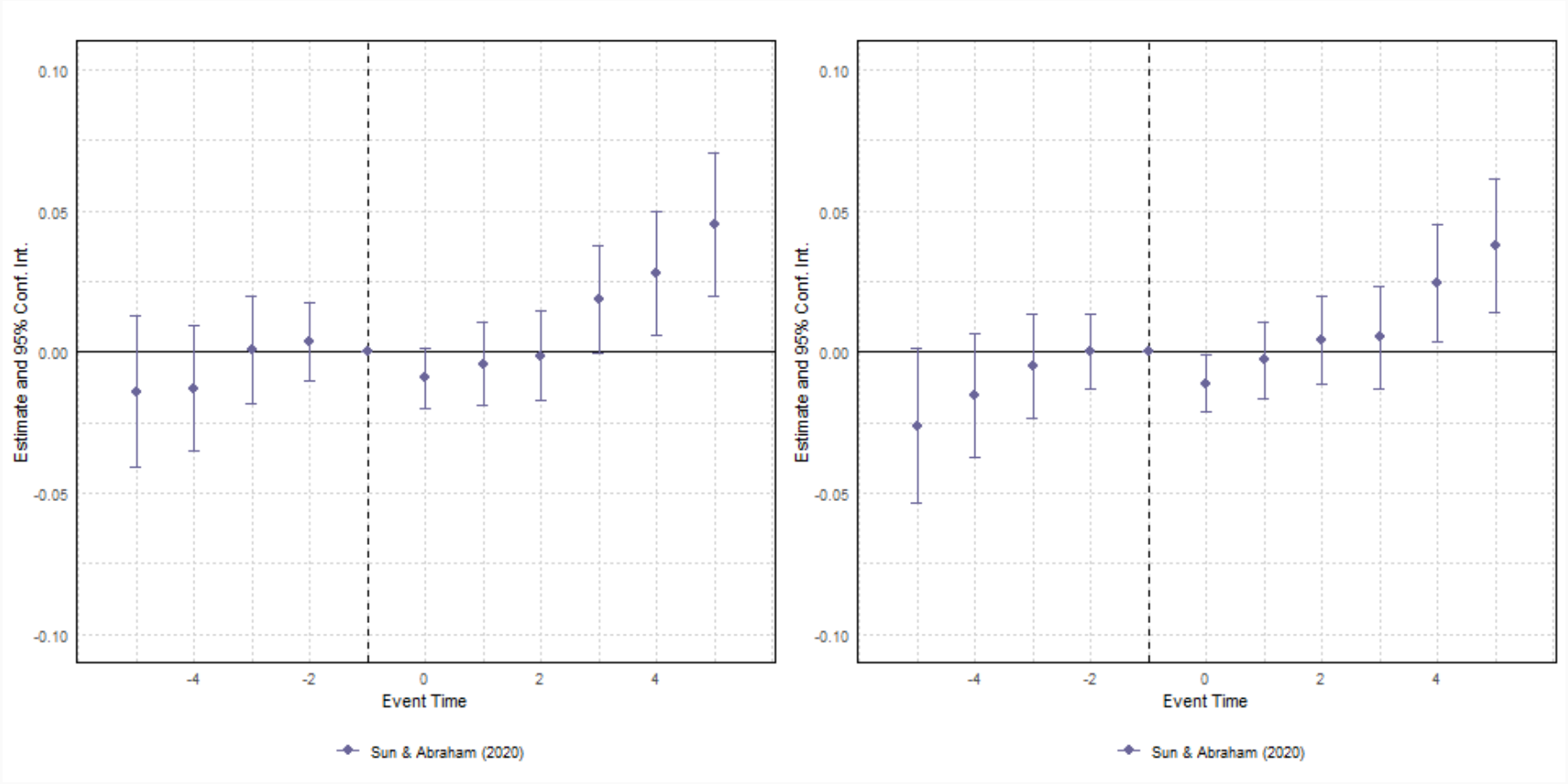


Imputation method



Intuition: Borusyak et al. 2021 imputes Y(0) with not-yet treated and never treated units.

Results for Grade 4 and 5



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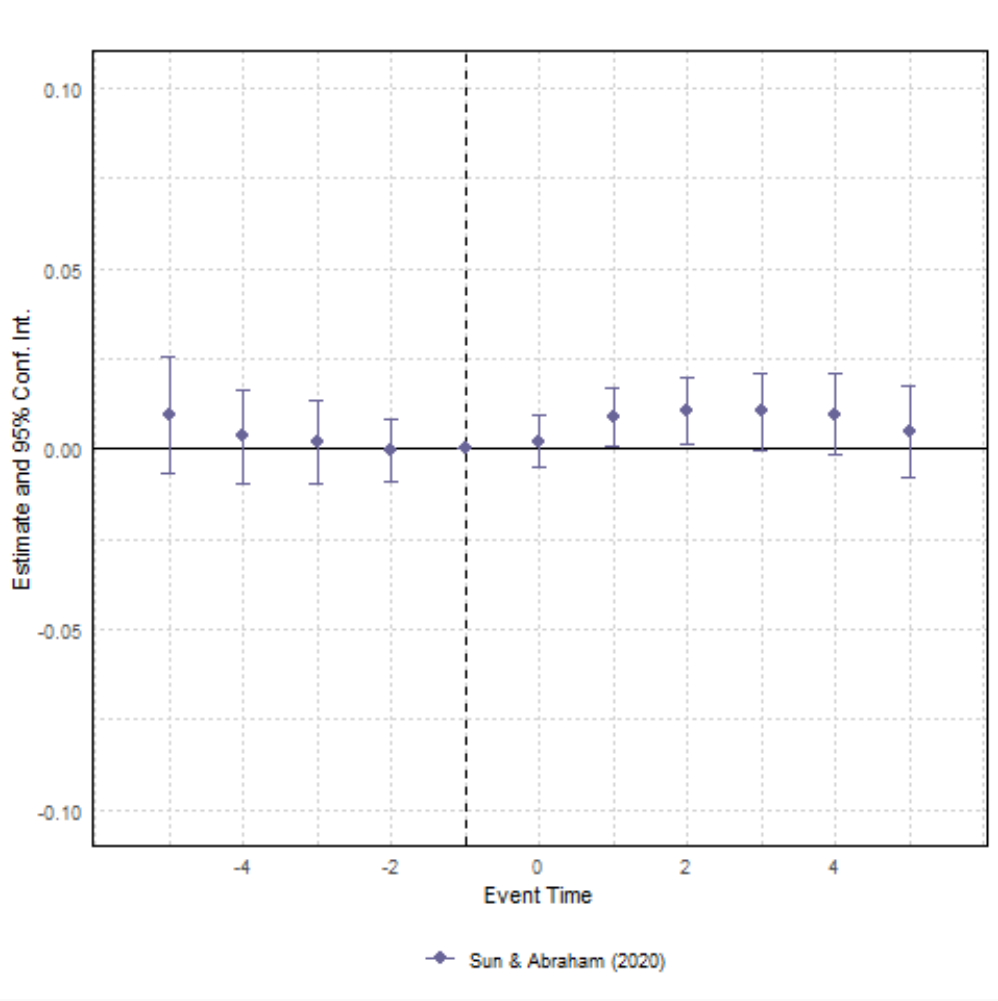
Enrollment



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