

The Impact of Natural Disasters on Education: Evidence from Standardized Testing

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Introduction

I exploit quasi-random variation in natural disaster exposure in the United States to answer two questions:

- ▶ **What is the causal effect of natural disasters on academic achievement as measured by standardized test scores?**
- ▶ What is the role of federal disaster assistance? Which counties apply for assistance?

Why is this important?

Negative effects in education affect earnings potential \implies
Inequality in disaster risk exposure could exacerbate economic inequality

Data

- ▶ **Natural disasters:**
 - ▶ Federal Emergency Management Agency (FEMA) declarations
 - ▶ Storms from the National Weather Service (NWS)
 - ▶ Work in progress: Data on extreme heat
- ▶ **Standardized testing outcomes** from the Stanford Education Data Archive ([Reardon et al., 2021](#)):
 - ▶ Cohort standardized average scores by county in Mathematics & Reading Language Arts (RLA)
 - ▶ Grades 3 through 8 for schoolyears 2008/2009 to 2017/2018
- ▶ **Public Assistance applications and payments** from FEMA

Distribution of mean test scores by subgroup

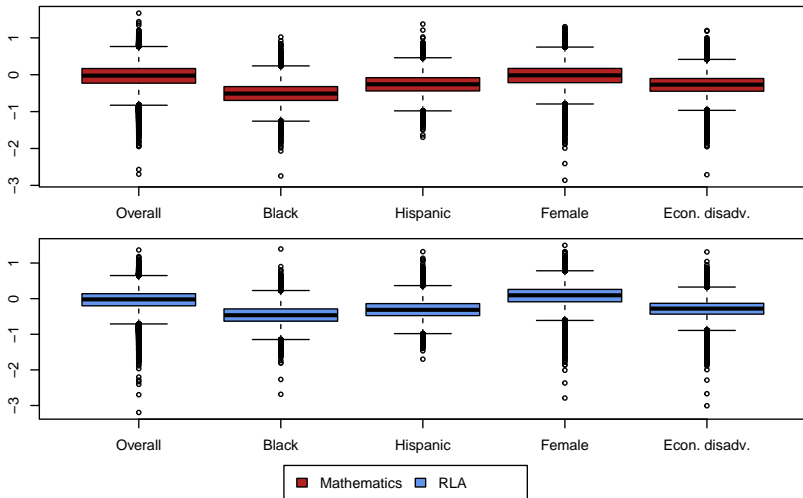


Figure: Boxplots of mean test scores by subgroup

When do counties apply for assistance?

Table: Share of counties that applied for federal assistance following a disaster by disaster type (schoolyears 2016/2017 and 2017/2018)

	Number of Cases	Applied for Assistance (in %)
Dam/Levee Break	3	0.00
Fire	106	10.38
Flood	85	9.41
Hurricane	1263	23.91
Mud/Landslide	1	0.00
Severe Ice Storm	20	0.00
Severe Storm(s)	154	30.52
Tornado	29	79.31
Total	1661	23.54

Which counties apply for assistance?

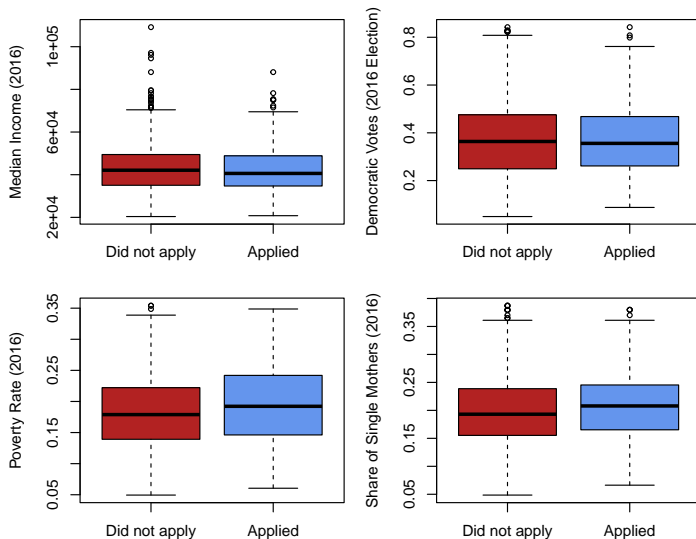


Figure: Boxplots by application status

Empirical Strategy

- ▶ Event-study design:

$$y_{i,t,g} = \beta_{-5} \mathbb{1}\{t - E_i \leq 5\} + \sum_{l=-4, l \neq -1}^8 \beta_l \mathbb{1}\{t - E_i = l\} \\ + \alpha_i + \lambda_t + \zeta_g + \varepsilon_{i,t,g}$$

- ▶ Treatment begins in the period of first disaster (E_i) and is absorbing (staggered adoption)
- ▶ But: Always-treated (i.e. disaster in the first year) counties are dropped
- ▶ Never-treated counties act as the baseline
- ▶ Standard-errors clustered at the cohort level ([Abadie et al., 2017](#))

Empirical Strategy: Identification

- ▶ Natural disasters are plausibly independent of unobserved determinants of test scores conditional on location and year
- ▶ Heterogenous treatment effects \implies simple TWFE is inadequate (de Chaisemartin and D'Haultfœuille, 2020; Sun and Abraham, 2021)
- ▶ Solution: Interaction-Weighted Estimator (IW) by Sun and Abraham (2021)
- ▶ Identifying Assumptions: Parallel Trends & No Anticipatory Behavior
- ▶ IW consistently estimates a weighted average of cohort average treatment effects on the treated (CATT)

Main Results: FEMA

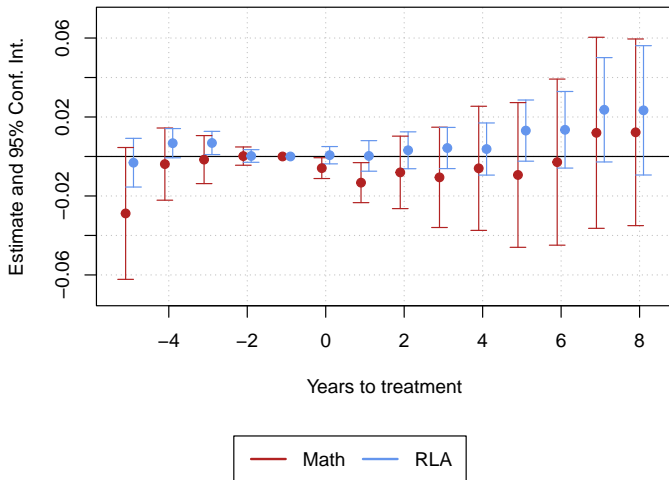


Figure: Dynamic Treatment effects in relative time: FEMA disaster data

Main Results: Subgroups, FEMA

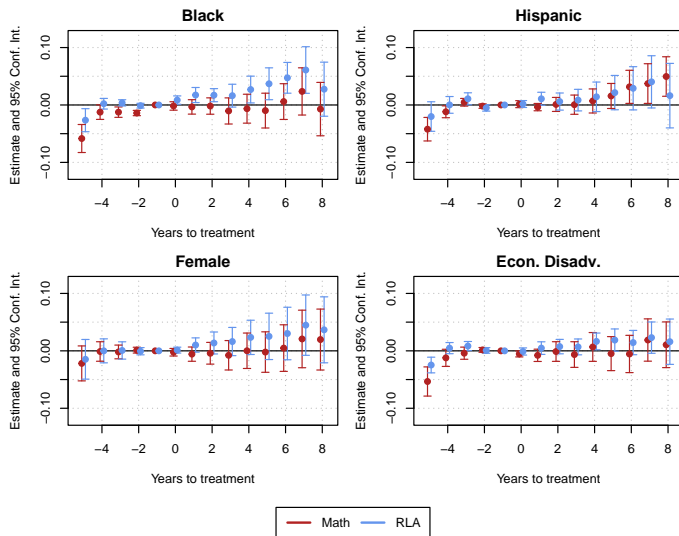


Figure: Dynamic Treatment effects in relative time: FEMA disaster data

Main Results: Storms

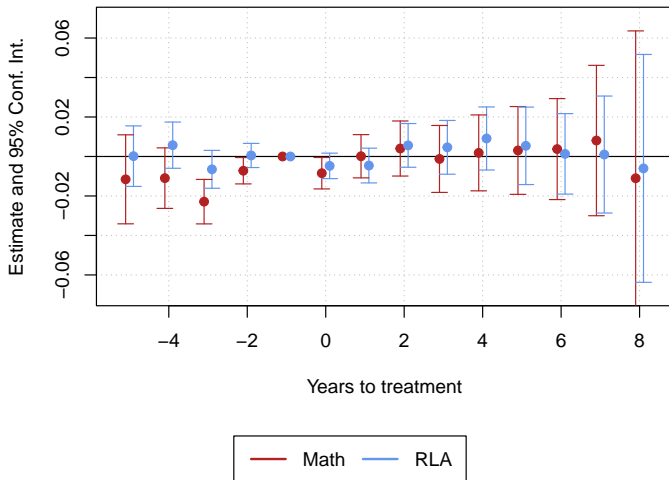


Figure: Dynamic Treatment effects in relative time: NWS storm data

Main Results: Subgroups, Storms

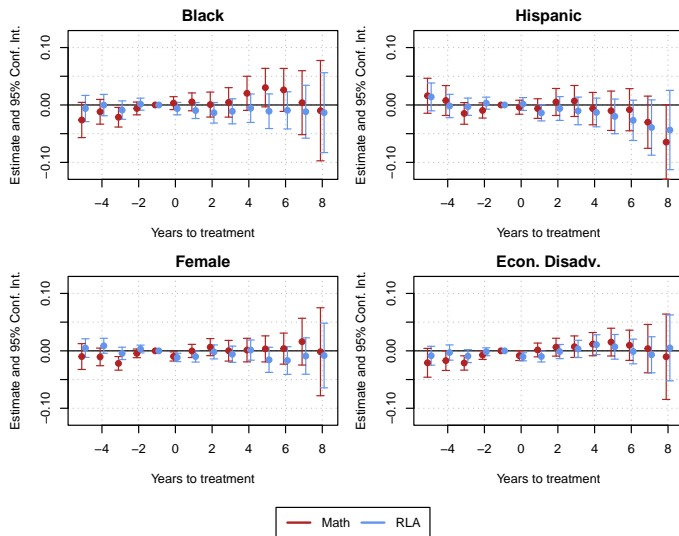


Figure: Dynamic Treatment effects in relative time: NWS storm data

Are these results driven by changes in county composition?

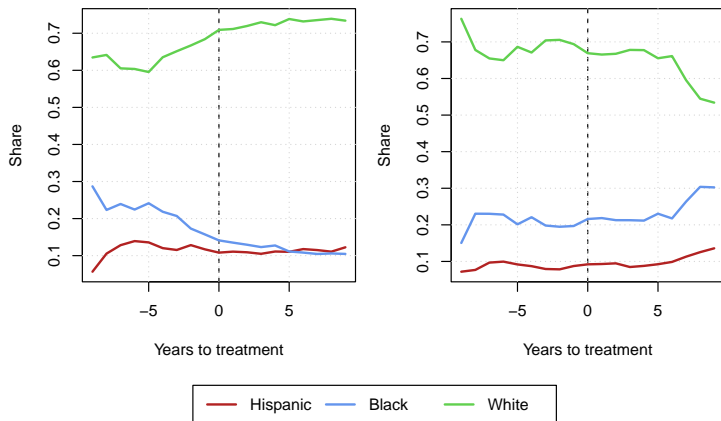


Figure: Aggregated ethnic shares by treatment timing based on FEMA disasters (left) and on NWS storms (right)

Conclusion

- ▶ Negative short-term effect of disasters on achievement in mathematics
- ▶ Some positive long-term effects among subgroups (but not very robust)
- ▶ Socially vulnerable counties are more likely to need federal assistance following a disaster

References

- Abadie, A., Athey, S., Imbens, G. W., and Wooldridge, J. (2017). When should you adjust standard errors for clustering? Technical report, National Bureau of Economic Research.
- de Chaisemartin, C. and D'Haultfœuille, X. (2020). Two-way fixed effects estimators with heterogeneous treatment effects. *American Economic Review*, 110(9):2964–96.
- Reardon, S., Kalogrides, D., Ho, A., Shear, B., Fahle, E., Jang, H., and Chavez, B. (2021). Stanford education data archive (version 4.1).
- Sun, L. and Abraham, S. (2021). Estimating dynamic treatment effects in event studies with heterogeneous treatment effects. *Journal of Econometrics*, 225(2):175–199.