The Long-Run Impacts of Hurricanes on Educational Attainment in Puerto Rico

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Data

Population Data

Hurricane David (1979): Sample from the 5 percent Public Use Microdata Sample (PUMS) 2000 Census of Population for the United States.

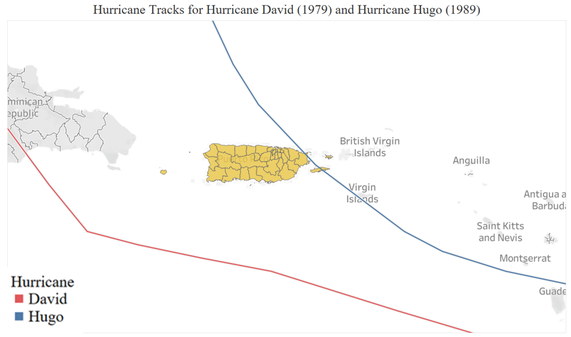
Hurricane Hugo (1989): Sample from the 5 percent 2007–2011 5-year Puerto Rican Community Survey (PRCS) Public Use Microdata Sample (PUMS)

Hurricane Data

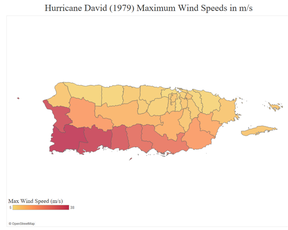
1. Data on six-hourly positions (the track of the hurricane) with intensity estimates in terms of maximum wind from the HURDAT2 database
2. Municipality-group-specific maximum wind speeds leveraging the methodology espoused in Cascio, et al(2005) Appendix A.

Hurricane Data

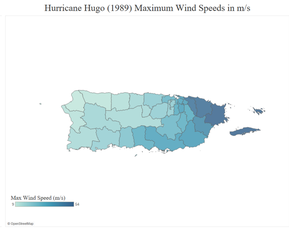
Hurricane Tracks for Hurricane David (1979) and Hurricane Hugo (1989)



Hurricane David (1979) Maximum Wind Speeds in m/s



Hurricane Hugo (1989) Maximum Wind Speeds in m/s



To count as impacted, a municipality must have:

(1) Evidence of storm-related property damage in the top five Puerto Rican newspapers **or** (2) Wind speeds (in m/s) with an intensity that could impact housing or schooling structures (F2 in Fujita Scale)

Population Data

Table 1 - Descriptive Statistics for Census Samples

N = 64,782	Hurricane David (1979) N = 37,628				Hurricane Hugo (1989) N = 27,154			
	Men		Women		Men		Women	
	Mean	SD	Mean	SD	Mean	SD	Mean	SD
A. Impacted Municipalities								
Age at Hurricane	7.19	4.13	7.38	4.05	7.26	4.11	7.59	4.15
Age at Census	28.19	4.13	28.38	4.05	27.27	4.35	27.62	4.41
Highest Grade Completed	6.20	2.41	6.94	2.42	6.47	2.30	7.27	2.27
Can Speak English	0.64	0.48	0.67	0.47	0.61	0.49	0.65	0.48
Observations	4,045		4,262		2,178		2,496	
B. Not Impacted Municipalities								
Age at Hurricane	7.42	4.08	7.47	4.08	7.12	4.06	7.38	4.08
Age at Census	28.42	4.08	28.47	4.08	27.15	4.35	27.39	4.37
Highest Grade Completed	6.36	2.49	7.05	2.45	6.50	2.40	7.32	2.36
Can Speak English	0.67	0.47	0.69	0.46	0.61	0.49	0.63	0.48
Observations	13,941		15,380		11,021		11,459	

Notes: Samples include native-born Puerto Ricans between the ages of 1 and 14 in 1979 for David and 1989 for Hugo

Introduction/Motivation

Research Questions:

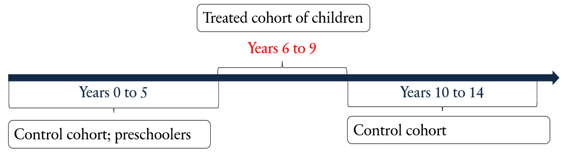
1. Are there long-term negative educational effects that stem from hurricanes?
2. Do hurricanes impact a specific gender more than the others?
3. Does living through hurricanes at key educational years (6 to 9 yrs.) entail worse long-term educational outcomes?

Why should we care?

1. Lack of conclusive evidence on the impact of hurricanes on education
2. Climate change will augment the intensity and impacts of future hurricanes.
3. Puerto Rico is an understudied territory and subject to extreme climate risk (Maria)

Empirical Strategy (DiD Motivation)

Life Cycle of a Young Childs' Education



I measure their outcomes around 20 years after each hurricane to examine the long-term effects of both Hugo and David.

Results (DiD)

Table 2 - DiD on Educational Outcomes for David

	(1) Years of Edu.		(2) Speak English		(3) Finish HS		(4) Go to coll.	
	Men	Women	Men	Women	Men	Women	Men	Women
*Age 6-9 in 1979 * Hit*	-0.0851	-0.0694	-0.0308*	-0.0060	-0.0383*	-0.0109	-0.0049	0.0014
	(0.0976)	(0.0921)	(0.0187)	(0.0175)	(0.0196)	(0.0188)	(0.0174)	(0.0184)
All Controls	Yes		Yes		Yes		Yes	
Observations	17,986	19,642	17,986	19,642	17,986	19,642	17,986	19,642
R-squared	0.0541	0.0484	0.0324	0.0277	0.0296	0.0221	0.0366	0.0245

Table 3 - DiD on Educational Outcomes for Hugo

	(1) Years of Edu.		(2) Speak English		(3) Finish HS		(4) Go to coll.	
	Men	Women	Men	Women	Men	Women	Men	Women
*Age 6-9 in 1979 * Hit*	0.1430	-0.0666	0.0249	-0.0351	0.0164	-0.0102	-0.0120	-0.0338
	(0.1233)	(0.1149)	(0.0251)	(0.0235)	(0.0259)	(0.0240)	(0.0225)	(0.0237)
All Controls	Yes		Yes		Yes		Yes	
Observations	13,199	13,955	13,199	13,955	13,199	13,955	13,199	13,955
R-squared	0.0361	0.0378	0.0514	0.0477	0.0323	0.0214	0.0584	0.0646

Notes: Standard errors in parentheses. Samples include native-born Puerto Ricans between the ages of 1 and 14 in 1979 for David and between the ages of 1 and 14 in 1989 for Hugo. All regressions include municipality fixed effects, cohort fixed effects, and a linear inter-cohort trend. *** p<0.01, ** p<0.05, * p<0.1

Key Findings

1. Are there long-term negative educational effects that stem from hurricanes? Is this impact gender-specific? Do hurricanes impact a specific gender more than the other?
   - On average, hurricanes have little impact on highest grade completed in Puerto Rico (Figure 2 and 3)
   - The more impactful hurricane (Hugo) has less of an effect suggesting a story of resilience (Figure 3)
   - Most estimates for the effects of the storms are negative for men and positive for women yet not statistically significant (Figure 2)
2. Do cohorts of kids that live through hurricanes at key development years (6 to 9 yrs. old) suffer worse long-term educational outcomes?
   - I find no statistically significant results that those individuals ages 6 to 9 are more at risk than other cohorts (Table 2 and 3).
   - Impacts are idiosyncratic with the most at risk being women aged 14 at the time of the hurricane (Figures Avg. Education)

Empirical Strategy (Restricted DiD)

$$Y_{mtv} = \theta + \beta A_t HIT_v + \alpha_t + \boldsymbol{\varphi}_v + \delta_v t + \varepsilon_{mtv}$$

m = individual; **t** = year; **v** = municipality group v in 2011 (Hugo) and 2000 (David)

$\boldsymbol{Y_{mtv}}$ = educational outcome of individual m, born in year t, and residing in municipality v

$\boldsymbol{HIT_v}$ = 1 if municipality is impacted

$\boldsymbol{A_t} = \sum_{a=6}^{9} A_t^a = \{1(6 \leq year - t \leq 9)\}$ which will be an indicator equal to one if a person was between the ages of 6 and 9 in 1979 for David and 1989 for Hugo

$\boldsymbol{\alpha_t}$ = Cohort fixed effects

$\boldsymbol{\varphi_v}$ = Municipality group fixed effects

$\boldsymbol{\delta_v t}$ = Linear inter-cohort trend at the municipality group level

Conclusions and Avenues for Further Inquiry

- Analyze if results are similar for Hurricane Maria integrating the remedial measures unavailable for the hurricanes I studied
- Study the mechanisms that produce the negative welfare impacts of natural disasters and what policies alleviate at risk populations
- Scrutinize other countries that have enacted policy interventions to minimize the long-term effects of shocks in early childhood education

References

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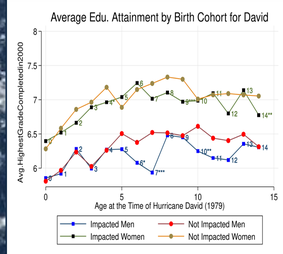
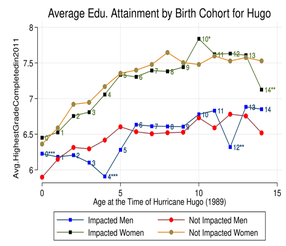
Average Education by Age Group

Hurricane David (1979)



Hurricane Hugo (1989)



Empirical Strategy (Treatment across ages)

$$Y_{mtv} = \theta + \sum_{a=1}^{14} (\beta^a A_t^a HIT_v) + \alpha_t + \boldsymbol{\varphi}_v + \delta_v t + \varepsilon_{mtv}$$

m = individual; **t** = year; **v** = municipality group v in 2011 and 2000

$\boldsymbol{Y_{mtv}}$ = years of completed schooling of individual m, born in year t, and residing in municipality v

$\boldsymbol{HIT_v}$ = 1 if municipality is impacted

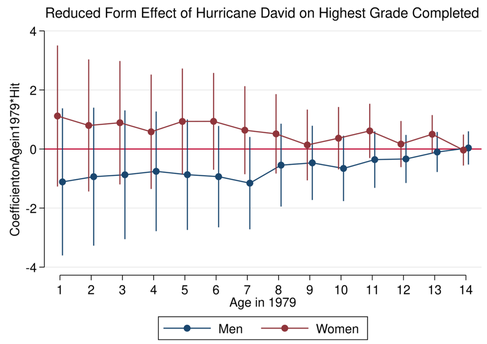
$\boldsymbol{A_t^a} = \{1(year - t = a)\}$ which will be an indicator for the age of individuals in cohort t at the year of the storm (from 1 to 14) and equals 0 for ages 15 to 18 (the control group)

$\boldsymbol{\alpha_t}$ = Cohort fixed effects

$\boldsymbol{\varphi_v}$ = Municipality group fixed effects

$\boldsymbol{\delta_v t}$ = Linear inter-cohort trend at the municipality group level

Results (David, 1979)



Results (Hugo, 1989)