

## The Hidden Local Costs of Hurricanes

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### Introduction

Since 1980, over 2,000 local government jurisdictions in US Atlantic and Gulf states have been hit by a hurricane. Such natural disasters can exert severe budgetary pressure on local governments' ability to provide critical infrastructure, goods, and services. We study local government revenue, expenditure, and borrowing dynamics in the aftermath of hurricanes. These shocks reduce tax revenues and expenditures and increase the cost of debt in the decade following exposure. Our results reveal how hurricanes create collateral fiscal damage for local governments by increasing the cost of debt at critical moments after a hurricane strike. Municipalities with larger racial minority populations suffer expenditure losses more than two times larger and debt default risk 8 times larger than municipalities with average racial composition in the decade following a hurricane strike. As hurricanes increase in frequency and severity, these results suggest that climate change can exacerbate environmental justice challenges.

### Why Local Governments Matter

Local governments are essential providers of public goods and services used by Americans every day. Sanitation, policing, parks and recreation, public transit, and street maintenance are a subset of the wide array of services primarily provided at the local level. In 2017, local government expenditures comprised 35% of the combined \$15,541 per person spent by all levels of government on public goods and services. To fund their operations, local governments rely on local tax revenues and

### Highlights

- Hurricanes deplete local tax revenues and expenditures on infrastructure, utilities, transit, and public works in the 6 to 10 years after exposure.
- Transfers from state and federal sources offset the initial shock of hurricanes, but revenues erode 6 to 10 years after exposure once the disaster aid dries up.
- Less affluent municipalities suffer revenue and expenditure losses over twice as large as average municipalities.
- Ratings agencies downgrade bond ratings in response to the economic shock caused by hurricanes. This makes borrowing for capital expenditures more expensive.
- Hurricanes can create a “vicious cycle” for local governments by increasing their cost of debt and depleting their tax base, making adaptation to future shocks more difficult.

debt, both of which depend heavily on the existence of a stable tax base. We examine how extreme weather events threaten the stability of local revenue sources and the ability of municipalities to provide essential goods and services. Understanding the fiscal dynamics from hurricane shocks has important distributional consequences because local public services, such as transportation and public hospitals, are essential for lower income households<sup>1</sup> and because local governments in municipalities with large racial minority populations are more likely to be exposed to extreme weather events. Taken together, these facts highlight the important environmental justice implications associated with understanding who bears the cost of climatic natural disasters.

## Identifying the Causal Effect of Hurricanes on Cities

Using the universe of Atlantic Basin hurricanes that made landfall in the United States between 1972 and 2017, we estimate how a municipality's budget, tax base, and debt financing evolve in the decade following exposure to hurricanes. Our empirical approach relies on comparing municipalities in the same state that possess similar demographic and geographic characteristics but differ in whether fate put them in the path of a hurricane. We measure hurricane exposure for each municipality based on the maximum wind speed observed at the level of the census tract in each year from 1972 to 2017. We then combine our exposure measure with annual municipal finance outcomes (e.g., tax revenues, expenditures, and debt outstanding) to understand how finances develop in the aftermath of hurricane exposure. Because municipalities cannot accurately predict within a year's time when and where future hurricanes will strike, we are able to interpret post-hurricane changes in finances as a causal result of hurricane exposure.

## Hurricanes, Battered Budgets, and Costly Debt

Our analysis provides two key findings. First, local governments experience significant declines in revenues, expenditures, and debt in the 10 years after a hurricane strike. These declines are initially muted

by intergovernmental transfers in the immediate aftermath of a hurricane but manifest significantly after 6 to 10 years post hurricane. Local revenue sources, including taxes and fees, fall up to 2% in the 6 to 10 years after exposure. Major hurricanes, those with a maximum wind speed exceeding 96 knots, have much larger effects than minor hurricanes. The effects from major hurricanes are over twice as large as that of the average storm: we find major hurricanes reduce local revenues by 7.2% in the decade following a hurricane. The magnitude of this effect is economically large, matching the average amount taxpayers spend annually on state and local government employee payroll.<sup>2</sup> Depleted revenues subsequently deplete local public goods provision: expenditures on public works including water, sewer, trash, and public transit, decline by 3.4% in the 6 to 10 years after exposure. Major hurricanes cause significantly more service disruption: local public works expenditures decline 13%.

These budgetary shocks make borrowing for capital expenditures, including infrastructure projects that could reduce the cost of future storms, more difficult. We find that total debt falls by 19.2 to 25.9% in the 10 years following a major hurricane. Part of this decline in municipal debt is caused by responses of ratings agencies. Using novel bond ratings data from Moody's Analytics—one of the three largest ratings agencies in the world—we find ratings of municipal bonds fall in the aftermath of a hurricane. These downgrades translate into a 13% increase in the risk of default relative to the sample standard deviation in each of 10 years after a hurricane strike. Figure 1 shows the ratings dynamics: the ten-year default rate increases approximately 4 years after hurricane exposure (Panel A), leading to a change in the composition of debt risk. The share of municipal bonds rated low risk declines (Panel B) whereas the share of bonds rated medium or high risk increase by an average of 5.2 and 1.5 percentage points, respectively (Panels C and D). Importantly, a future hurricane does not predict any changes in a municipality's current bond ratings, corroborating our assumption that a hurricane strike is as good as random. Collectively, these results imply that municipalities face interest rates on debt that are approximately 1% larger after exposure to a

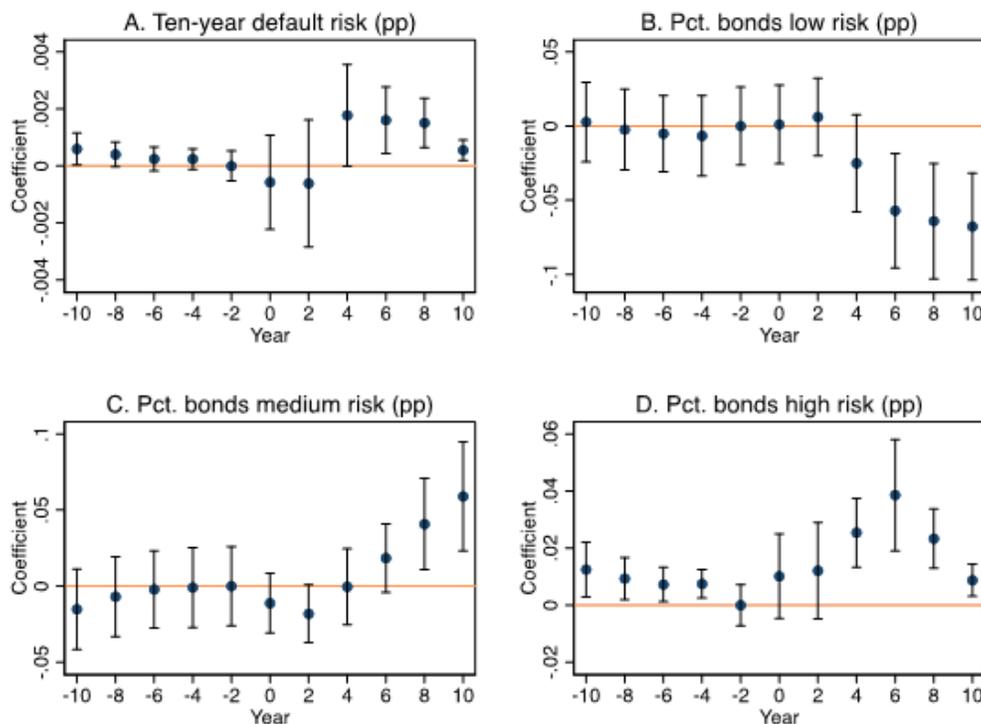


Figure 1. Hurricanes and Municipal Bond Rating Dynamics, 1982-2009

Source: Authors

Note: Figure 1 plots the estimates and 95% confidence intervals of the effect of hurricane exposure in year  $t$  on each of four outcomes: the ten-year default risk (panel A), and the percent of a municipality's bonds rated low risk (panel B), medium risk (panel C) and high risk (panel D). All results measured in percentage points ("pp"). See Jerch et al. (2021) for details on the estimation equation and data sources.<sup>4</sup>

hurricane. For a city like Philadelphia, which had 84 ongoing road and bridge projects as of 2020, a 1% higher interest rate means that the city would face \$13 million in added infrastructure costs for that year's projects after exposure to a hurricane.

## Climate Justice Implications

Our second key finding is that less-affluent municipalities—those with poorer, less-educated residents and a higher proportion of racial minorities—are hardest hit by the post-storm budgetary losses. Figure 2 shows that cities with a higher share of residents with incomes below the poverty line, non-white residents, and residents with no high school degree are significantly more harmed by hurricanes. For instance, a municipality with a percentage point larger share of non-white

residents experiences tax revenue declines that are 7.1% larger than a municipality with an average racial composition in the decade after a hurricane. Compared to our main effects, the magnitudes of our estimates imply 1.5 to 2.6 times larger declines for those low socio-economic status municipalities.

Overall, our results demonstrate how hurricanes can cause a divergence in fiscal outcomes across municipalities that differ demographically, even within the same state. To the extent that hurricane-induced fiscal shocks impact individual economic mobility, our findings suggest that the spatial distribution of climate risk can contribute to structural inequality in the US.

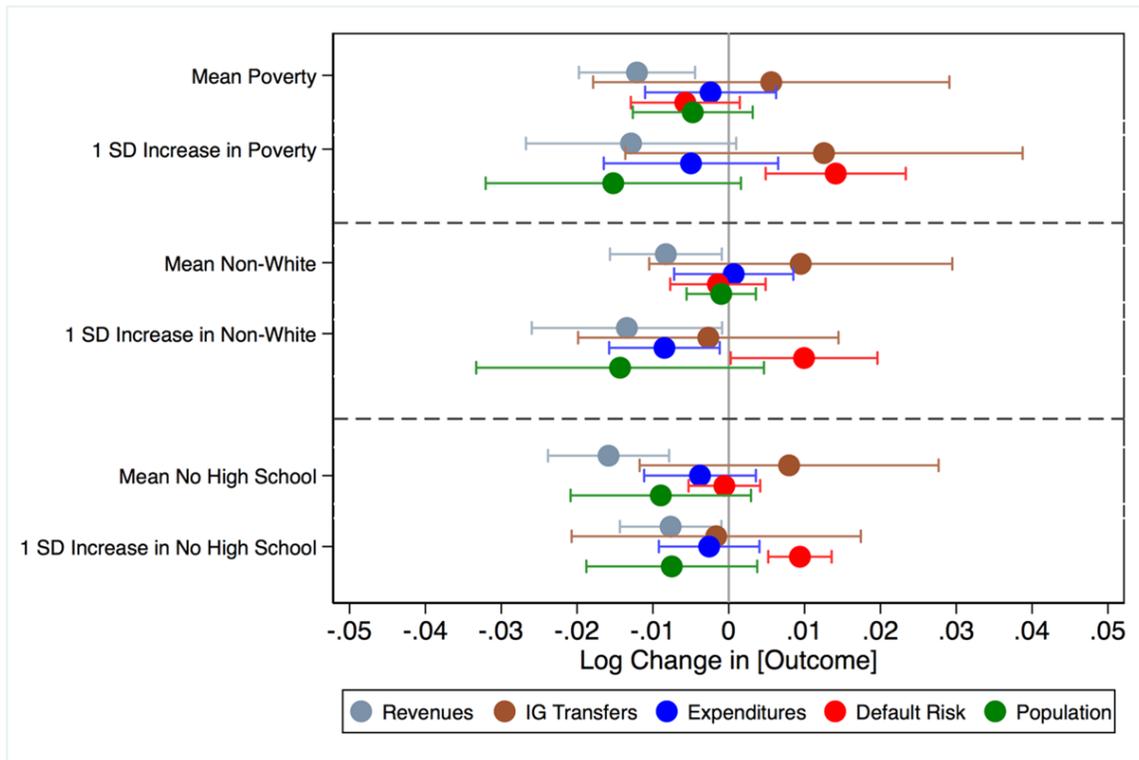


Figure 2. Fiscal Effects of Hurricanes by Municipal Demographic Attributes, 1982-2017  
Source: Authors

Note: Figure is divided into 3 segments, each with two rows. The figure plots the estimates and 95% confidence intervals of the average effect of hurricane exposure in the top row and the additional effect among municipalities with a one standard deviation increase in the attribute noted in the second row. The figure shows that cities with a higher share of residents below the poverty line, non-white residents, and residents with no high school degree are significantly more harmed by hurricanes. For instance, the coefficients on revenues indicate that municipalities with a 1 standard deviation greater share of residents in poverty, that are non-white, or have no high school degree experience, respectively, 1.3%, 1.3% and 0.8% additional declines in own-source revenues as a result of a one standard deviation increase in hurricane exposure. Compared to hurricanes' main effects, these magnitudes imply 1.5 to 2.6 times larger declines for these low socio-economic status municipalities. See Jerch et al. (2021) for details on the estimation equation and data sources.<sup>3</sup>

## Summary

We examine the impact of hurricanes on local governments through their effects on the provision of local public goods and resources. Our results show that hurricanes cause locally-generated revenues as well as goods and services provision to fall significantly. Local governments with large minority, low-income, or low-educated populations face the largest revenue and expenditure cutbacks following hurricanes. Intergovernmental transfers to local governments offset some of the initial fiscal impacts of hurricanes, but do not, on average, alleviate long-

term declines in local government funding sources.

Our study provides the first evidence that natural disasters can create a “vicious cycle” for local governments by depleting the tax base, increasing their cost of debt, and inhibiting their ability to make large, capital investments. In so doing, climate-induced natural disasters can discourage local governments from investing in precisely the hazard mitigation technologies or reconstruction projects required to deflect future damages from hurricane shocks. Our findings suggest that inter-governmental budget-stabilizing programs, like state rainy day funds

or FEMA assistance, are important for mitigating local fiscal distress.

Is it socially efficient for capital, public funds, and people to retreat from areas with greater climate risk? Possibly. If local governments are not allocating a marginal tax dollar to its best use, then fiscal shocks may serve to improve efficiency. Hurricane shocks may also serve to relocate people and their tax dollars to locations with better economic opportunity.<sup>3</sup> Notably, most global economic activity is concentrated in coastal cities despite their vulnerability to natural disasters. Our results illuminate how disruptions in local provision of goods and services are an additional, yet heretofore undocumented, economic cost for those with the least ability to cope with natural disaster risk.

## References

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