

Nature as a Defense from Disasters: Natural Capital and Municipal Bond Yields

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Abstract

I examine the value of climate change mitigation strategies such as nature conservation in municipal bond markets. I find that the market starts to price the value of natural capital after an extreme weather event. Natural capital protection could decrease the county's cost of debt by as much as \$1 million for an average bond. Bonds tied to specific infrastructure projects experience a larger yield increase than general-purpose bonds. The effects of mitigation strategies impact the county with the natural capital and its neighbors. More broadly, I find that natural capital loss is related to population migration and a decrease in personal income, with counties dependent on farming suffering the most. Overall, this paper shows that financial markets price the value of mitigation and highlights the critical role of nature as a shield from natural disasters.

Introduction

Estimating the value of natural mitigation strategies is essential for assessing the financial impact of local climate change risk as well as evaluating the trade-offs between nature conservation and economic development.

- The environmental literature has shown that nature can reduce risks from natural disasters, as well as stimulate biodiversity and collect greenhouse gasses from the atmosphere.
- Municipal bonds provide an ideal setting for studying this question since investors need to account for local climate-related risks when pricing these assets.

I show that a **mitigation premium** arises after an extreme weather event hits the counties that experience natural capital loss.

Data

Natural Capital Loss: Protected Areas Downgrading, Downsizing, and Degazettement (PADDD)

Municipal Bonds: MSRB and Bloomberg

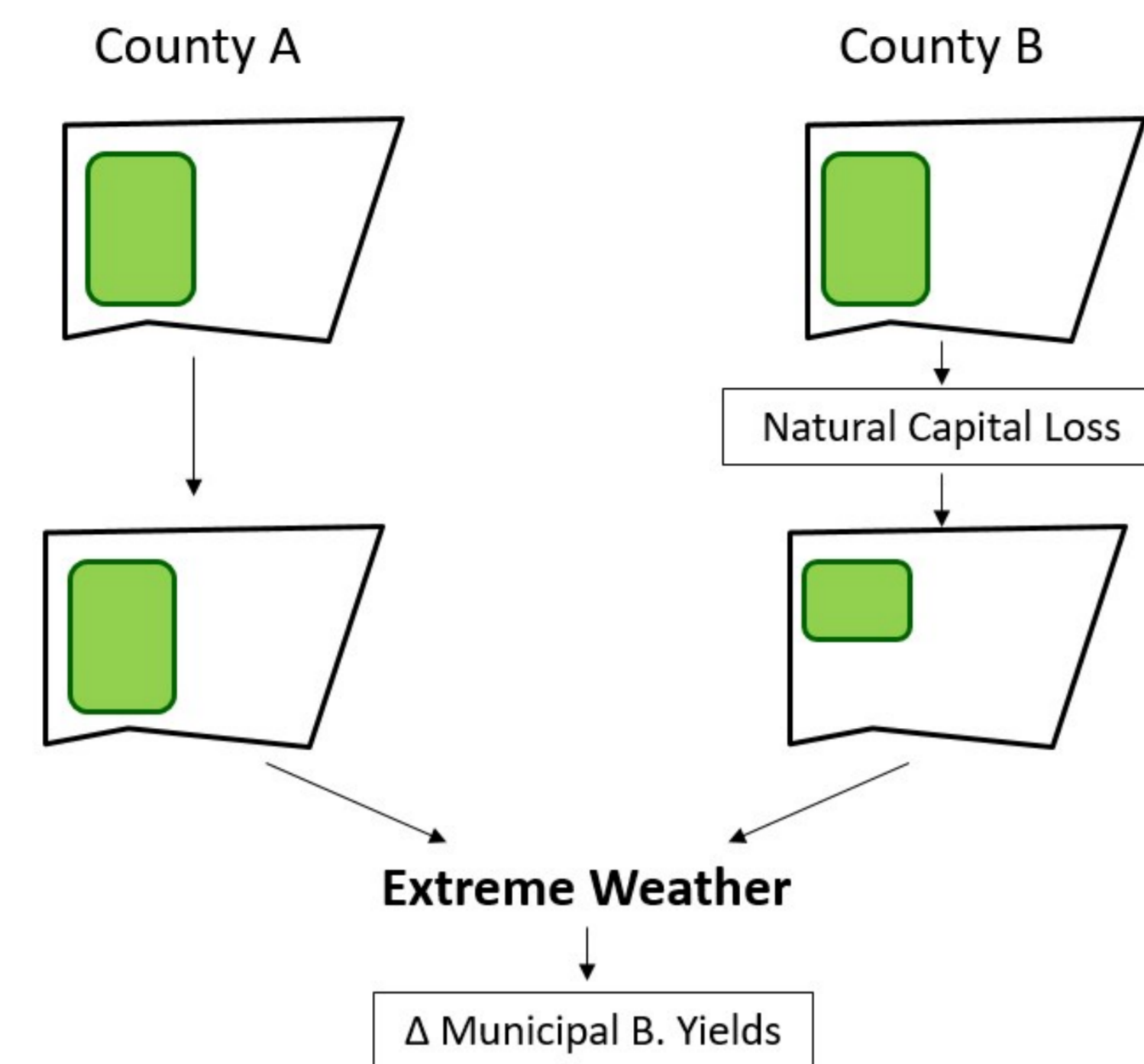
Weather Damages: NOAA

Precipitation: PRISM

Empirical Approach

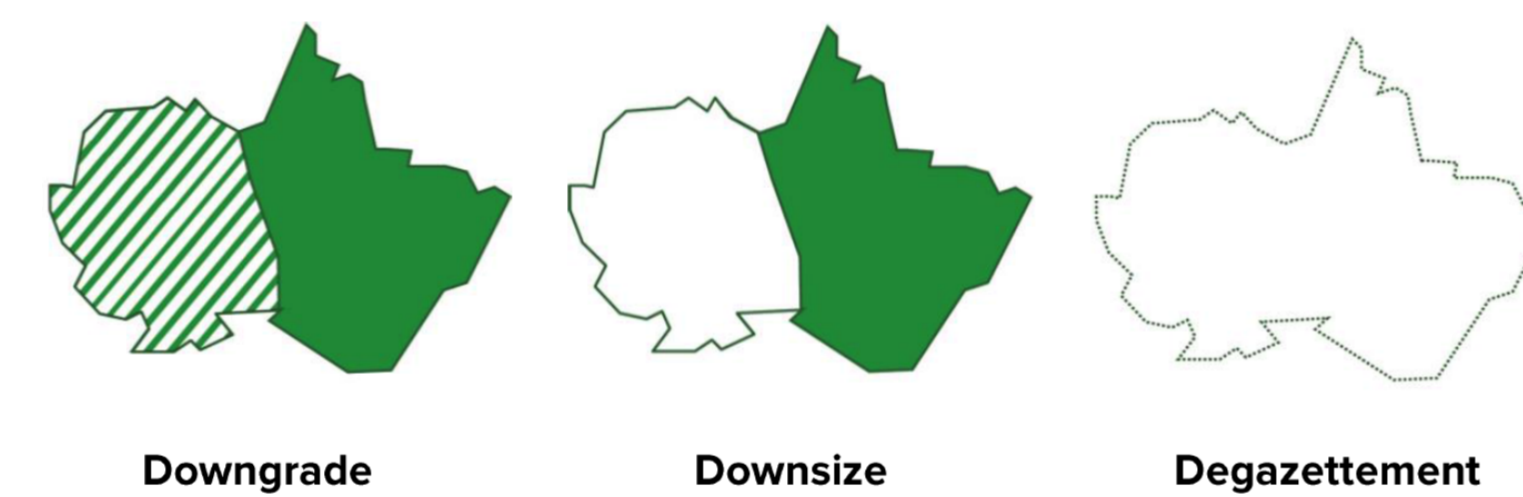
- Difference-in-difference estimator
 - Extreme weather and natural capital loss events as exogenous shocks
 - Adjusted using De Chaisemartin and d'Haultfoeuille (2020)
- Matching
 - Propensity score
 - Nearest neighbor
 - Same county

Identification



The green areas represent the **natural capital** of the county.

Natural Capital Loss



- PADDD events are enacted at the federal level
- Natural capital loss events mostly affect rural areas
- 47 of the 50 U.S. states experienced at least one natural capital loss event from 1976 to 2020
- The majority of PADDD are caused by infrastructure projects and subsistence
 - Subsistence: non-commercial or small-scale commercial, artisanal, or non-mechanized extraction or production activities for local or personal consumption

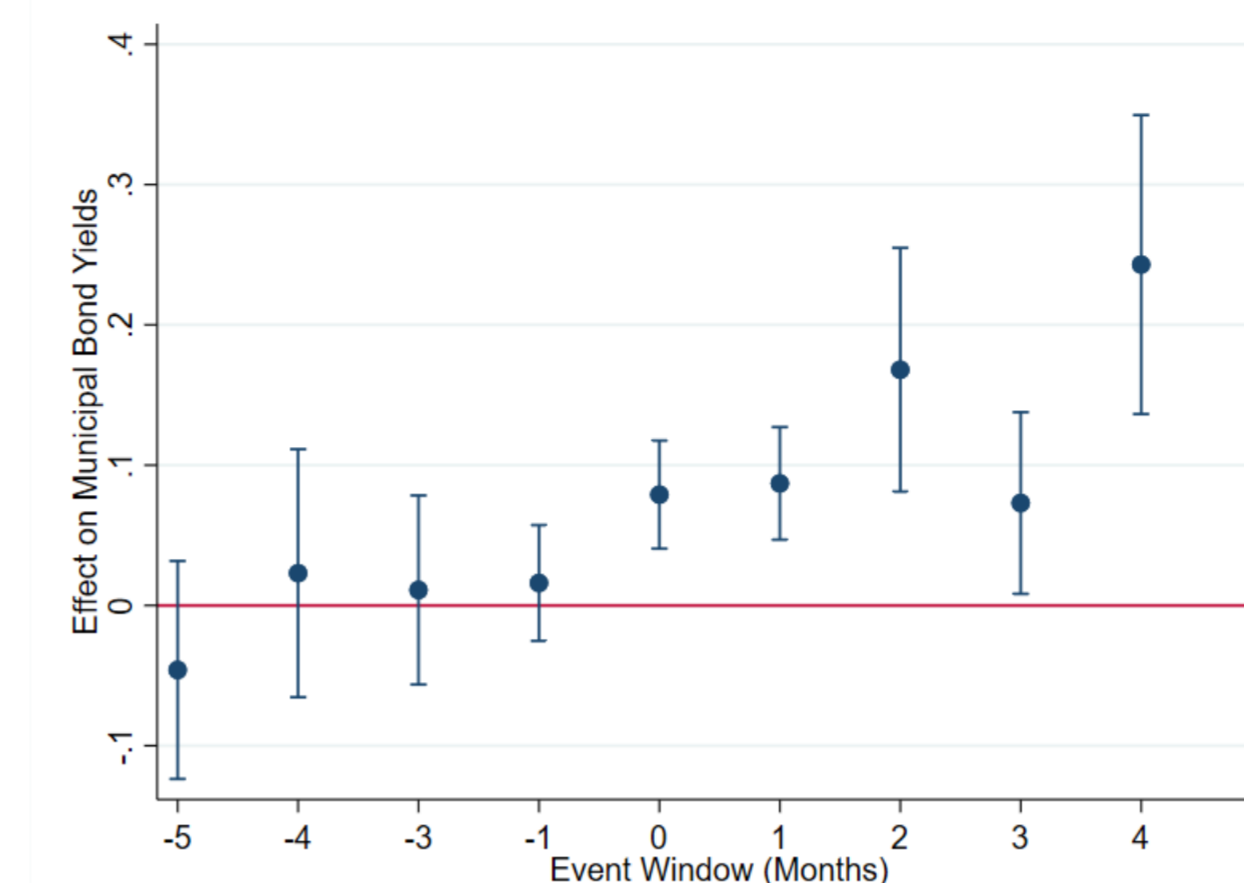
Extreme Weather Measure

$$Weather\ Exp_{c,t} = \max\left(\frac{Prec_{c,t} - Avg.\ Prec_{c,0-10}}{St.\ Dev.\ Prec_{c,0-10}}, 0\right), \quad (1)$$

where $Prec_{c,t}$ represents the precipitation in county c in year t . The time period for the average and standard deviation start from period t to $t-10$.

Extreme weather month: a county experienced average precipitation greater than the 95th percentile of the distribution of past precipitation.

Bond Yields around Extreme Weather Event



Bonds issued by counties that lose natural capital display a **"mitigation premium"**, i.e., **higher** municipal bond yields, compared to similar bonds issued by counties that do not experience natural capital loss. The mitigation effect is only priced **after** the extreme weather event hits.

The effect of mitigation (or lack thereof) could increase the municipality's cost of debt by as much as **\$1 million** over the life of a single bond.

Discussion of the Channel

	Annual Damages (CPI Adjusted)		
	DiD (1)	Matching (2)	(3)
Treated × Post	9.71** (1.85)	9.41** (1.83)	23.75** (2.01)
$Weather\ Exp_{1-5}$	0.41 (0.20)	0.71 (0.37)	-
$Weather\ Exp_{6-10}$	-	2.20 (1.41)	-
Controls	Y	Y	-
County FE	Y	Y	-
State-Year FE	Y	Y	-
Observations	124,820	124,820	9,563

Counties affected by a loss in natural capital experience **greater weather damages** between \$9.71 and \$23.75 million.

Physical vs Non-Physical Bonds

	(1)	(2)	(3)
Treated × Post	0.145** (2.32)	0.217*** (3.18)	0.220*** (3.51)
Treated × Post × Physical	0.140*** (3.15)	0.182*** (3.67)	0.241*** (2.98)
Treated Bonds	-	143	94
Control Bonds	-	286	188
Physical Bonds	-	202	133
Non-Physical Bonds	-	227	149
County Controls	Y	Y	N
Bond Controls	Y	Y	Y
Same County, same Year	N	N	Y
Observations	205,105	20,322	9,835

Bonds issued for "physical" projects are more affected than "non-physical" bonds.

Spillover Effects

	(1)	(2)	(3)
Treated × Post	0.185* (2.01)	0.148*** (3.41)	0.166*** (3.55)
Treated × Post × Physical	-	0.425*** (5.16)	0.473*** (5.71)
Treated Bonds	-	110	38
Control Bonds	-	220	76
Physical Bonds	-	155	63
Non-Physical Bonds	-	175	51
County Controls	Y	Y	N
Bond Controls	Y	Y	Y
Same County, Same year	N	N	Y
Fixed Effects	Y	-	-
Observations	17,207	45,436	10,384

The effects of natural capital loss are not limited to the county that possesses the natural capital. In fact, when excluding counties directly hit by natural capital loss and including only **neighboring counties**, the effects are still economically and statistically significant.

County Economic Dependence and Other Economic Outcomes

	(1)	(2)	(3)
Treated × Post	0.152*** (3.53)	-0.058 (-0.82)	-0.13* (-1.91)
Treated × Post × Farming	0.171*** (4.13)	-0.338** (-2.82)	-0.15 (-1.56)
County Controls	Y	Y	Y
Bond Controls	Y	-	-
Fixed Effects	Y	Y	Y
Observations	17,221	170,293	170,293

The results show that natural capital loss affects bonds issued by **farm-ing counties** more than other counties and impacts other important economic outcomes, such as population migration and personal income.

Conclusion

- The study highlights the impact of nature conservation on financial markets.
- I shed light on the connection between natural capital loss and climate change risk mitigation.
- I contribute by proposing an alternative way to price the value of natural capital.