

Unseen and Unprepared: The Fiscal Toll of Climate Change

25th Swiss Global Change Day

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What happens to economies that are hit by an adverse climatic event?

What happens to economies that are hit by an adverse climatic event?

Mozambique

- Population: 34 million
- GDP per capita: \$685 (current \$2023)
- Gov't spending per capita: \$226 (90% of which go to public sector wages and debt service)
- Sovereign debt credit rating: „CCC“ (Fitch, 2025)



Image source: Club of Mozambique

Australia

- Population: 28 million
- GDP per capita: \$67,980 (current \$2023)
- Gov't spending per capita: \$25,289
- Sovereign debt credit rating: „AAA“ (Fitch, 2024)



Image source: Britannica

What happens to economies that are hit by tropical cyclones?



Mozambique



Source: WMO

Australia



Source: Canberra City News

What happens to economies that are hit by tropical cyclones?



Mozambique



- Capital stock destroyed: **0.08%** (avg. cyclone 1970-2015, BB22)
- Deaths: **57** (avg. cyclone 2000-Apr. 2025, EM-DAT)
- GDP growth: **-9.7% to -1%** (Noy 2009 non-OECD avg.; Bakkensen Barrage 2022)

Australia



- Capital stock destroyed: **0.02%** (avg. cyclone 1970-2015, BB22)
- Deaths: **1.4** (avg. cyclone 2000-Apr. 2025, EM-DAT)
- GDP growth: **-0.1% to +1.33%** (Bakkensen Barrage 2022, Noy 2009 OECD)

What happens to economies that are hit by tropical cyclones?



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Avg. Developing country disaster response (Noy and Nualsri 2011):

- Government spending (payments): -0.3%



Image source: allafrica.com

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Avg. Developed country disaster response (Noy and Nualsri 2011):

- Government spending (payments): +2.4%



Image source: Queensland Government

What happens to economies that are hit by tropical cyclones?



- Often see similarly distinct government responses to disasters *within* countries
- For example, average annual impact in 10 years after a disaster (Miao et al. 2022; Jerch et al. 2023)

Low-Income US Areas:

- Local government spending: ↓↑
- Tax revenues: ↓
- Intergov'tal transfers: Ⓝ



Sign in North Carolina after Hurricane Helen; Image source: CBC

High-Income US Areas:

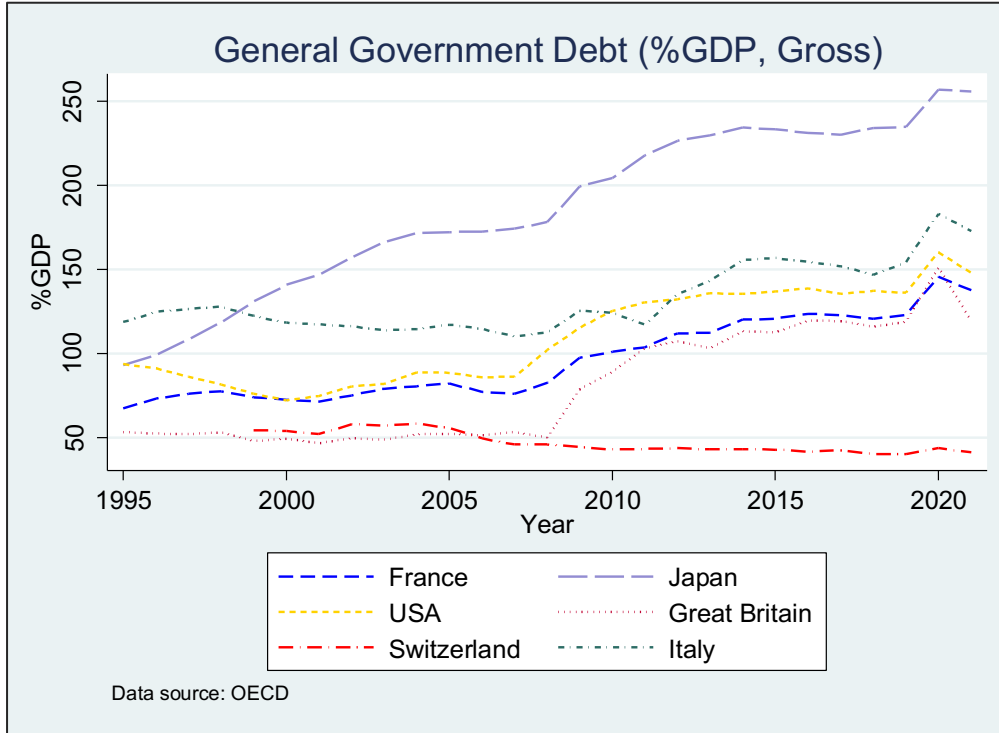
- Local government spending: ↑
- Tax revenues: ↑
- Intergov'tal transfers: ↑



Foodbank relief after Hurricane Sandy; Image source: NJ.com

→ Even within wealthy countries, fiscal capacity shapes cyclone recovery

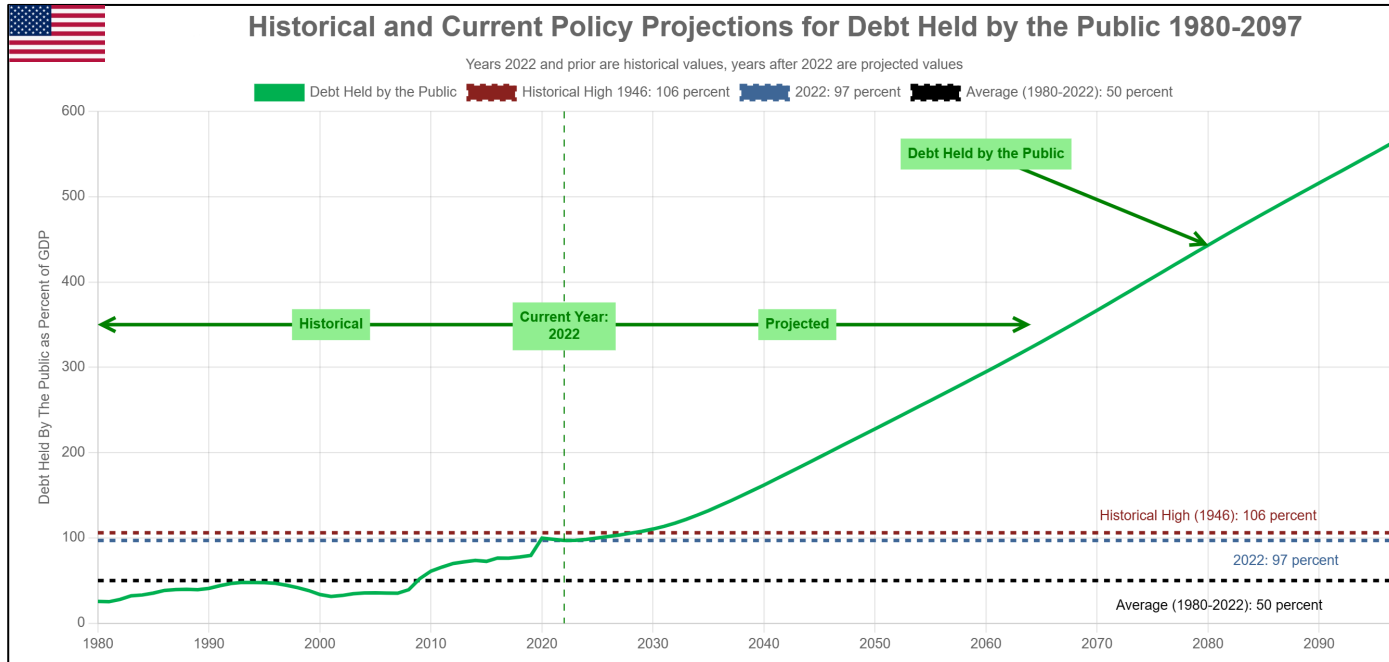
„Fiscal Space“ May Be Increasingly Threatened



- Public debt burdens are large and increasing

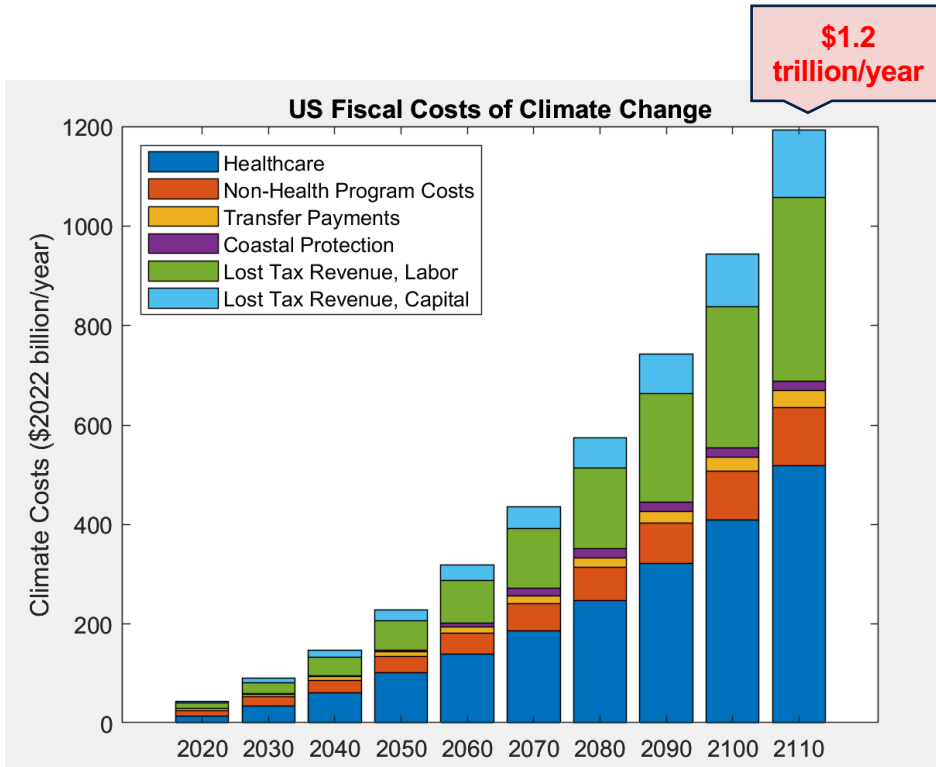
„Fiscal Space“ May Be Increasingly Threatened

- Public debt burdens are large and increasing
- Future projections can be even more dire



Source: U.S. Treasury (2022)

„Fiscal Space“ May Be Increasingly Threatened



Source: Barrage (2024), assuming ~RCP 6.0

- Public debt burdens are large and increasing
- Future projections can be even more dire
- **Climate change itself can threaten public finances by :**
 - **Decreasing tax revenues**
 - **Increasing borrowing costs**
 - **Increasing expenditure requirements**

This Talk

- Interactions between climate change and public finances are **currently ignored** by both standard fiscal projections and most estimates of the economic impacts of climate change
- Rest of this talk:
 1. **Context: The Economic Costs of Climate Change**
 2. **Fiscal Impacts of Climate Change**
 3. **Conclusion**



Image source: ChatGPT

Context: The Economic Costs of Climate Change

- Over the past 30 years the world has learned a lot about the economic impacts of climate change

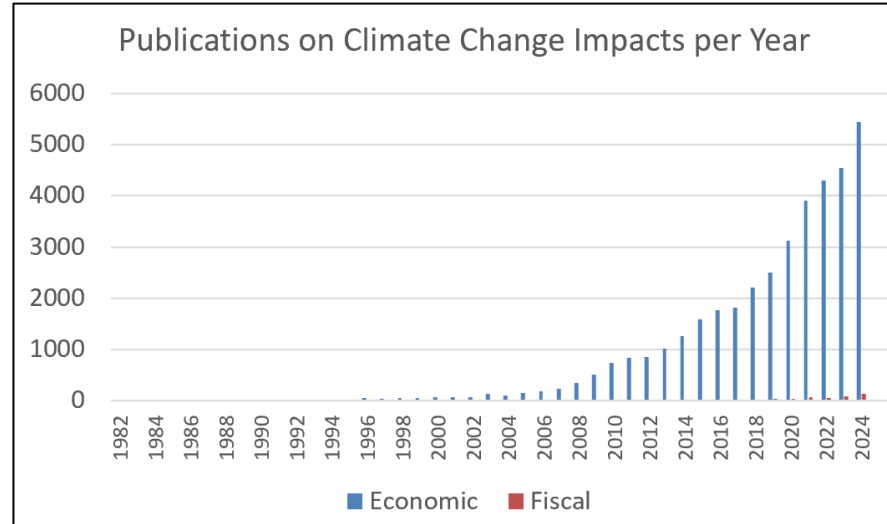
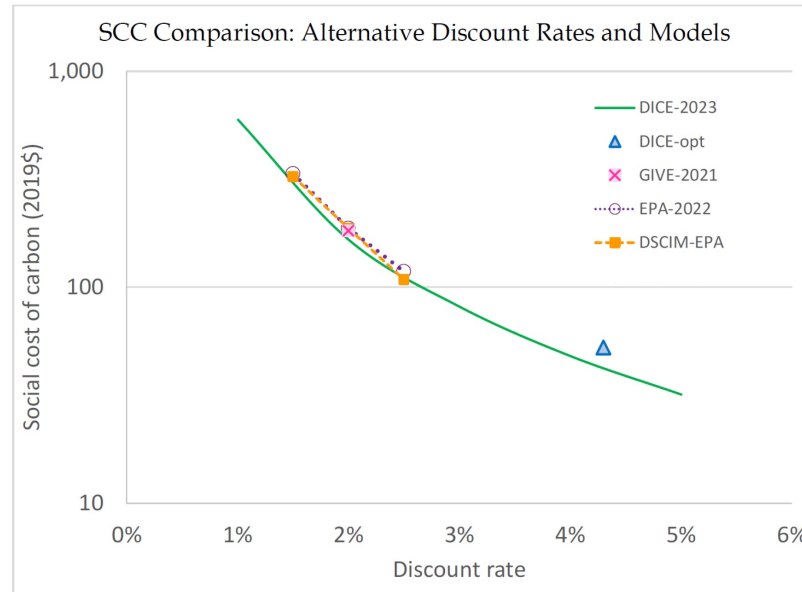


Image source: Web of Science search for "economic impacts climate change" or "fiscal impacts climate change"

Context: The Economic Costs of Climate Change

- Over the past 30 years the world has learned a lot about the economic impacts of climate change
- **Social Cost of Carbon (SCC):** Present value of future (global) economic impacts of +1 ton CO₂
- Despite differences across individual estimates, several recent methodologically distinct multi-study based estimates of the SCC find remarkably similar results (conditional on discounting)

~\$200/tCO₂ with
~2%/yr discount rate



~\$80/tCO₂ with DICE-
2023 market-based
discount rate (2025)

Context: The Economic Costs of Climate Change

- Over the past 30 years the world has learned a lot about the economic impacts of climate change
- **Social Cost of Carbon (SCC):** Present value of future (global) economic impacts of +1 ton CO2
- Despite differences across individual impact estimates, several recent methodologically distinct multi-study based estimates of the SCC find remarkably similar results (conditional on discounting)
- Yet there are many important impact channels **missing** from standard global estimates

Impacts and Associated Damages	
Human Health and Well-being	
Heat and cold related mortality	●
Mortality and morbidity from extreme weather events (e.g., storms, wildfire, flooding), and sea level rise	◐
Mortality and morbidity from climate mediated changes in the formation of criteria air pollutants (e.g., ozone, PM2.5)	○
Infectious diseases	○
Other morbidity (e.g., malnutrition, allergies)	○
Displacement and migration	○
Labor	
Labor supply (i.e., hours worked)	●
Labor productivity (i.e., output per hour worked)	○
Energy	
Energy consumption (e.g., heating, cooling)	●
Energy production and provision (e.g., hydroelectric, thermal power generation)	◐
Water	
Water consumption (residential, industrial, commercial)	○
Provision of safe drinking water	○
Water storage and distribution	○
Ecosystem services	
Availability and quality of natural capital used in the production of marketable goods	○
Biodiversity and wildlife habitat (e.g., aquatic environments, breeding grounds)	○
Other provisioning and regulating services (e.g., water filtration, wildfire/flood/pest mitigation, medicinal resources, pollination)	○
Culturally and historically significant landmarks and resources	
	○
Crime (property, violent)	
	○
National Security	
Military base impacts	○
Military mission impacts from international civil conflict	○
International development, humanitarian assistance	○
Trade and logistics	
Supply chain disruption (e.g., from extreme weather)	○
Supply chain transitions (e.g., altering trade routes)	○

Legend

- Explicit Representation
- ◐ Partial or Implicit Representation
- Not Yet Incorporated

Context: The Economic Costs of Climate Change

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- Despite differences across individual impact estimates, several recent methodologically distinct multi-study based estimates of the SCC find remarkably similar results (conditional on discounting)
- Yet there are many important impact channels missing from standard global estimates
- One missing impact channel not even *mentioned* by the US EPA are **effects on public finances**

Fiscal Impacts of Climate Change

- Climate change expected to affect public finances through at least 4 channels:



1. **Public Spending Pressures**

Rising costs for healthcare, disaster relief, infrastructure, income support, etc.



2. **New Investment Needs**

Adaptation (e.g., sea walls) may require new outlays



3. **Revenue Shortfalls**

GDP losses shrink tax bases (income, sales, property)

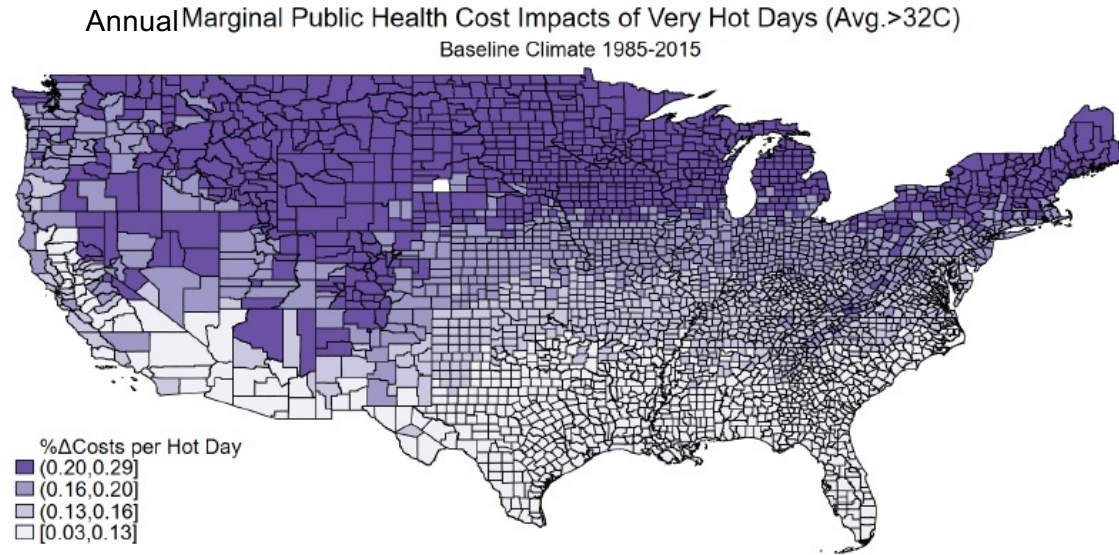


4. **Higher Public Borrowing Costs**

Climate risks and uncertainties raise public bond yields

Fiscal Impacts of Climate Change: Public Healthcare

- Healthcare costs are a large and growing budgetary item for many governments around the world
- In the US, a single additional hot day ($>32^{\circ}\text{C}$) raises *annual* public medical spending by +0.3%



Barrage (2024)

- Also see effects from hurricanes (Deryugina 2017), West Nile Virus (EPA 2017), air quality (Garcia-Menendez et al. 2015), wildfires, etc.

Fiscal Impacts of Climate Change: Two Lessons

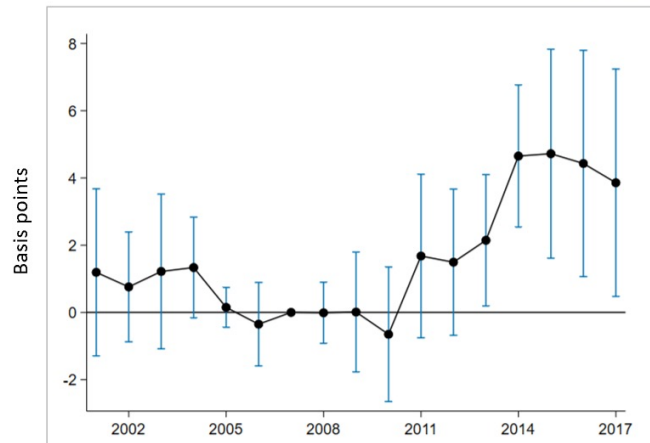
2) Fiscal costs can have first-order climate policy implications: Increase U.S. SCC by +23-33%

Scenario	U.S. SCC		%Δ
	Yes	No	
Benchmark	60	47	+28%
Higher non-fiscal damages	95	77	+23%
Fewer int. climate policy spillovers	22	17	+29%
Higher int. climate policy spillovers	156	117	+33%
Lower discount rate	89	70	+27%
Higher labor supply response to taxes	59	45	+31%

Fiscal Impacts of Climate Change: Borrowing Costs

- When governments want to make investments or pay for expenses that they cannot finance with annual revenues, they typically borrow by issuing bonds (e.g., US Treasuries, Bundesanleihen, etc.)
- Since around 2014, governments with higher climate risk exposure are having to pay higher yields, e.g.:

Effect of Sea-Level Rise Exposure on U.S. Muni
Bond Credit Spreads over Time
(in basis points per +1 std. dev. sea level rise exposure)

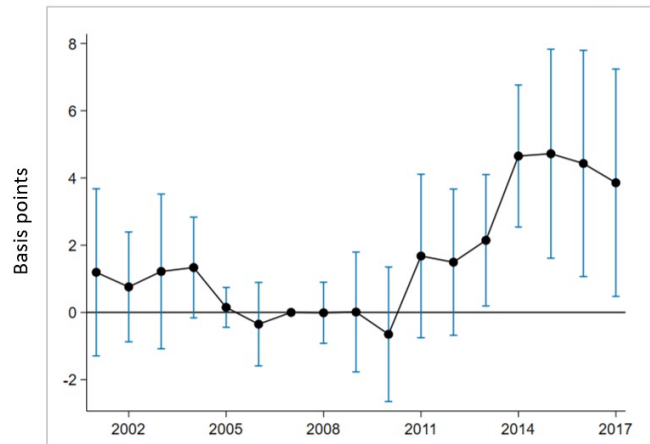


Goldsmith-Pinkham et al. (2021)

Fiscal Impacts of Climate Change: Borrowing Costs

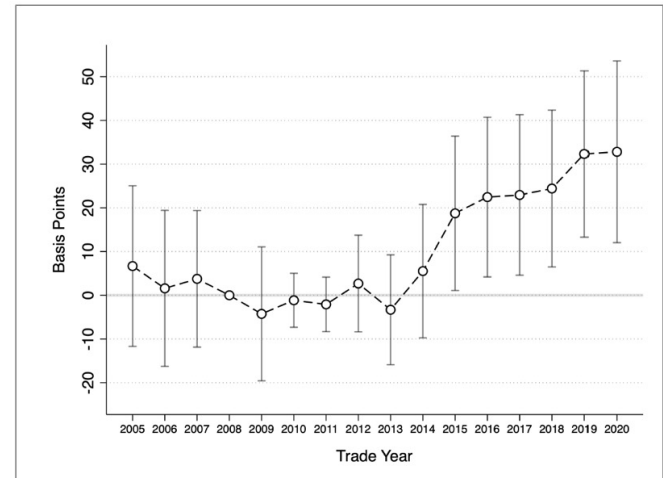
- When governments want to make investments or pay for expenses that they cannot finance with annual revenues, they typically borrow by issuing bonds (e.g., US Treasuries, Bundesanleihen, etc.)
- Since around 2014, governments with higher climate risk exposure are having to pay higher yields
- Data show this effect even across bonds with different climate risk issued by the *same municipality*, e.g.:

Effect of Sea-Level Rise Exposure on U.S. Muni Bond Credit Spreads over Time
(in basis points per +1 std. dev. sea level rise exposure)



Goldsmith-Pinkham et al. (2021)

Effect of Future Wildfire Risk Increases on U.S. Muni Bond Credit Spreads over Time
(in basis points per +1 std. dev. future wildfire risk increase)



Jeon et al. (2024)

Fiscal Impacts of Climate Change: Borrowing Costs

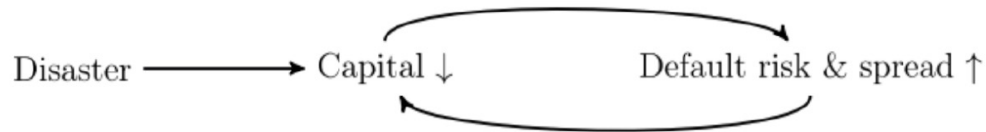
- Importance:

1) **Increased capital costs** for climate-vulnerable communities (that need to invest in resilience)

2) **Increased inequality** as climate risk capital cost impacts appear bigger in lower income communities

- Same level of wildfire risk increases low income areas' borrowing costs 2 times more (Jeon et al. 2024)

3) **“Fiscal climate poverty trap”** risk:



Fiscal Impacts of Climate Change: Borrowing Costs

- 2004: Hurricane Ivan devastated Grenada
 - 90% of homes damaged, 30% destroyed, damages > 200% GDP (UNSTATS)
- Government could not make debt payments → default, restructuring
- One *fiscal adaptation* innovation: “hurricane clauses” in government bonds
 - E.g., in case of a hurricane strike, interest payments are paused
- Activated for the first time in 2024 after Hurricane Beryl:

Grenada triggers ‘hurricane clause’ to suspend bond payments

First-ever debt pause linked to natural disaster could spur wider adoption



FINANCIAL TIMES

Joseph Cotterill and Lee Harris in London

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Fiscal Impacts of Climate Change: Borrowing Costs

- How much can “hurricane clauses” and related financial tools (like CATastrophe bonds) help?

Fiscal Impacts of Climate Change: Borrowing Costs

- How much can “hurricane clauses” and related financial tools (like CATastrophe bonds) help?
- We don’t really know – limited literature to date yields rather different results

Study	Hurricane Clause Type	Estimated Reduction in Climate Change Costs
Mallucci (2022)	Delayed payment	15%
Mallucci (2022)	Debt reduction	47%
Phan and Scharzman (2024)	Debt reduction	~0%
Borenzstein et al. (2009)	Caribbean cross-country insurance pool (CCRIF)	Reduce Belize’s “worst case” 2020 debt-GDP ratio from 170% to 150%

- Given importance and scale of the problem, should arguably be a research priority

Fiscal Impacts of Climate Change: Further Policy Implications

- More broadly, emerging literature showing **critical importance of fiscal policy for climate damages**
 - Specifically, how much a *given amount of physical climate change* affects the economy, e.g.:
- Economic (welfare) costs of 2°C warming in Austria can be >300% higher or lower depending on fiscal policy response to budgetary climate impacts (Bachner and Bednar-Friedl 2018)
- Economic (welfare) costs of un-mitigated climate change in the U.S. up to 300% higher or lower depending on fiscal constraints, baseline tax policy (Barrage 2024)
- Public income transfer programs can significantly mitigate effects of adverse climatic shocks, e.g.:
 - Reduce negative effect of birth-year rainfall shocks on schooling attainment by 20% (Adhvaryu et al. 2024)
 - Reduce effects of higher temperatures on homicide rate by 50% or more (Garg et al. 2024)

Conclusion

- **Climate–fiscal interactions are a first-order concern** for societal resilience, economic damages, and public budgets
- Yet they remain **severely understudied**—standard models miss key fiscal-climate feedbacks
- **Opportunity** to develop adaptive fiscal and financial tools that mitigate climate costs
- **Risk** of vicious cycles as climate shocks hit budgets precisely when spending flexibility is needed
- **Inter- and cross-disciplinary work is essential**
 - Emerging fiscal impacts literature reliant on natural sciences
 - Important impacts still under-counted (e.g., health costs from wildfire smoke) due to modeling gaps (Qiu et al. 2024)