

# Extreme weather events and firms' innovation propensity, considering specific institutional contexts

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*"Giovanni Anania"*

## Number of recorded natural disaster events, 1970 to 2023



The number of global reported natural disaster events in any given year. Note that this largely reflects increases in data reporting, and should not be used to assess the total number of events.



Data source: EM-DAT, CRED / UCLouvain (2024)

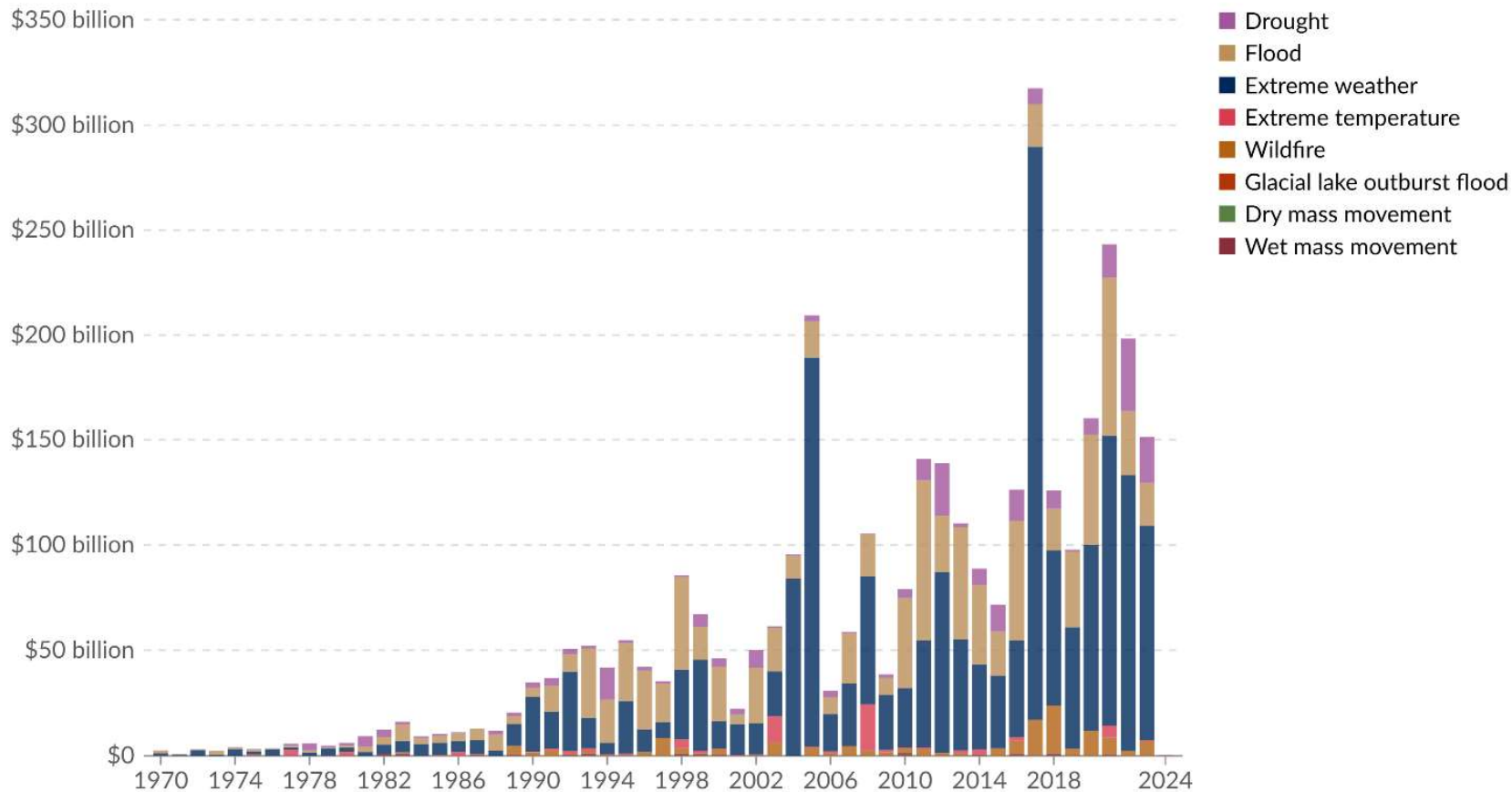
[OurWorldinData.org/natural-disasters](https://OurWorldinData.org/natural-disasters) | CC BY

Note: Data includes disasters recorded up to April 2024.

# Economic damage by natural disaster type, 1970 to 2024



Global economic damage from natural disasters, differentiated by disaster category and measured in US\$ per year.



Data source: EM-DAT, CRED / UCLouvain (2024)

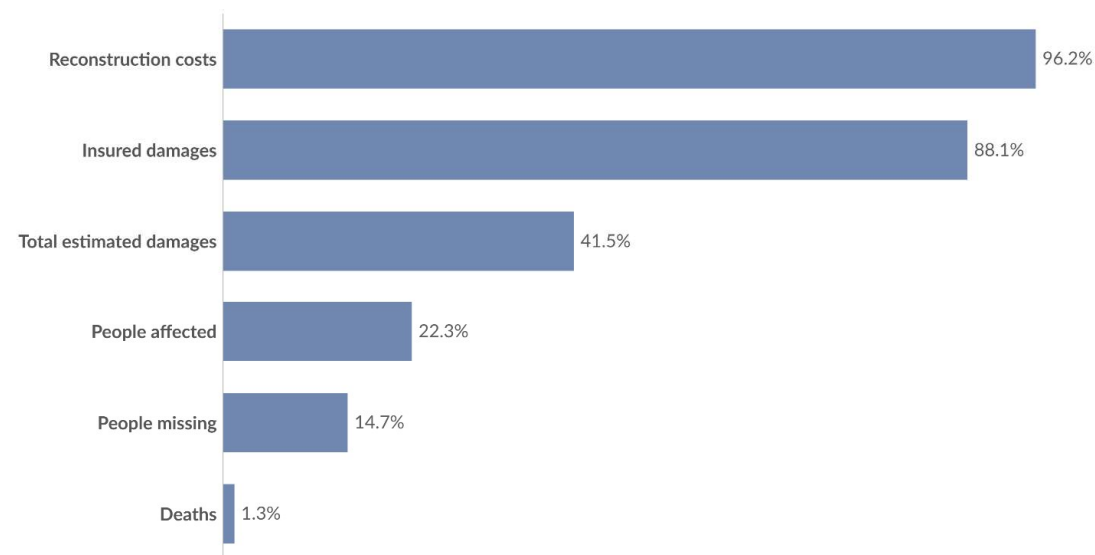
OurWorldinData.org/natural-disasters | CC BY

Note: Data includes disasters recorded up to April 2024.

## Share of disaster events with missing data



The share of disaster events recorded in the widely-cited EM-DAT database with missing data for a given metric. This was measured over the period from 1990 to 2020.



**Data source:** Jones, R.L et al. (2022). Human and economic impacts of natural disasters: can we trust the global data?. Scientific Data.

**Note:** EM-DAT is the International Disaster Database of the Centre for Research on the Epidemiology of Disasters (CRED).

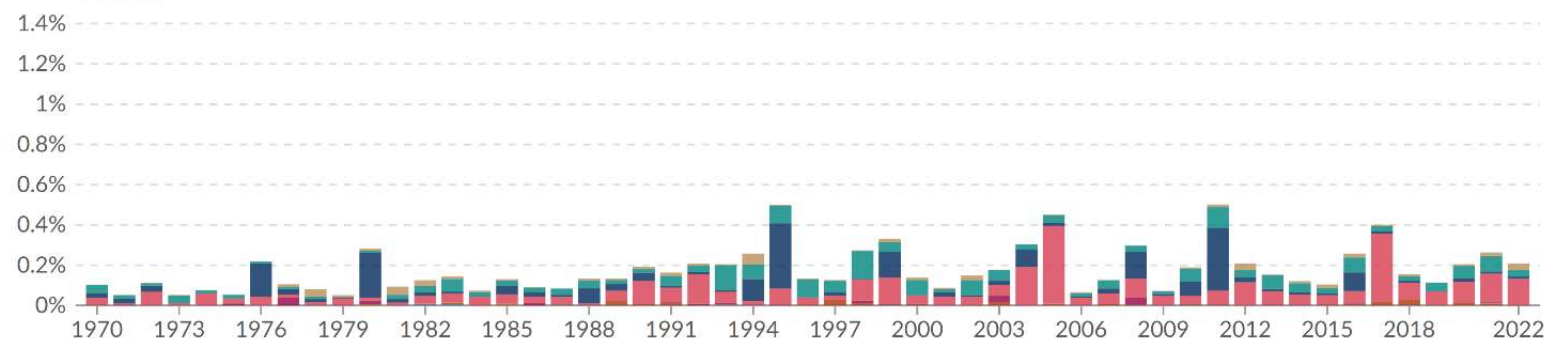
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# Economic damages from disasters as a share of GDP, 1970 to 2022

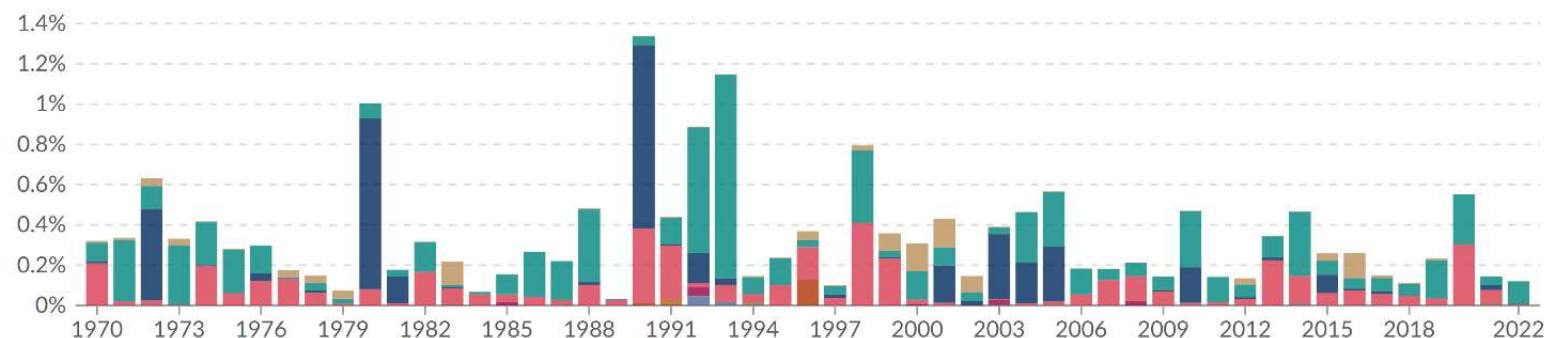
Our World  
in Data

■ Droughts 
 ■ Earthquakes 
 ■ Extreme temperatures 
 ■ Floods 
 ■ Glacial lake outbursts 
 ■ Mass movement (dry) 
 ■ Mass movement (wet) 
 ■ Storms 
 ■ Volcanoes 
 ■ Wildfires

## World



## Lower-middle-income countries



Data source: EM-DAT, CRED / UCLouvain (2024); Multiple sources compiled by World Bank (2024)

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- I will summarize the results of some studies that investigate the impacts of extreme weather events on firms' behavior, focusing on **innovation and energy practices**.
- These **micro-level studies** offer valuable insights to the theme of this seminar.
- **Firstly**, extreme weather events, core aspect of climate change, can disrupt economic activities and exacerbate existing ***societal vulnerabilities, potentially triggering or intensifying social unrest and displacement***. Research on firms' responses to climate shocks provides crucial insights into how businesses, as key actors in the economy, are adapting to these challenges.
- **Secondly**, the transition to a low-carbon economy will have profound social and economic consequences. Understanding whether and how firms are innovating and adapting is essential to ensure this transition is equitable and **minimizes potential disruptions that could contribute to social instability and migration**

# Extreme weather events and firms' energy practices. The role of country governance (Energy Policy, 2024)

## **Research Question:**

- Do extreme weather events impact firms' adoption of green energy practices?

## **Motivation:**

- Growing concern over climate change impacts on economic activity.
- Literature focuses on macro-level impacts, with limited research on firm-level responses.
- Investigate the role of country governance in shaping these responses.

# Hypotheses:

**Ambiguous relationship:** Extreme events can both stimulate (learning, innovation, policy windows) and hinder (economic losses, disruption) green energy adoption

**Role of Governance:** Good governance (e.g., low corruption, political stability) facilitates firms' adaptation to climate shocks

- **Data:**

Enterprise Surveys (2018-2020) - large sample of firms across countries.

- **Dependent Variable:**

Index of green energy practices (PCA-based) – measures adoption of energy-efficient practices and renewable energy sources.

- **Key Independent Variable:** Firm-level indicator of monetary losses due to extreme weather events.

- **Control Variables:** Firm characteristics (size, age, industry, etc.), country-level controls (GDP per capita).

- **Regression analysis** to assess the impact of extreme weather events on green energy practices.

$$SEPI_i = \alpha + \beta_1 EEL_i + \phi X_i + \sum_t \gamma_t T_t + \sum_s \delta_s S_s + \sum_c \alpha_c C_c + \epsilon_i$$

- Control for endogeneity concerns.

## *Key Findings*

- **Positive relationship:** Extreme weather events are positively associated with firms' adoption of green energy practices.
- **Role of Governance:** Good governance (low corruption, political stability) strengthens the positive impact of extreme events on green energy adoption.
- Corruption can hinder adaptation by diverting resources and slowing down recovery. Political instability can be particularly harmful in periods of crisis, which tend to aggravate uncertainty

## Mechanisms:

- Extreme events stimulate **innovation** and encourage firms to adopt more environmentally-conscious strategies.
- Human capital plays a crucial role in facilitating adaptation.

## Key takeaways:

- Extreme weather events can act as a catalyst for firms to innovate and adopt greener energy practices.
- Country governance plays a crucial role in shaping firms' responses to climate shocks.
- Limitations: cross-sectional data, potential for unobserved heterogeneity, lack of information on the amount invested in green energy practices

# Policy Implications

- **Strengthening Governance:** Reduce corruption, improve political stability, and enhance law enforcement to create a conducive environment for green investment. Promote transparency and accountability in public resource allocation.
- **Supporting Innovation:** Invest in green R&D to accelerate the development and diffusion of clean technologies.
- **Support vocational training programs** to enhance employee skills and knowledge related to sustainable energy.
- **Raising Awareness:** Implement public campaigns to inform firms about climate risks and the benefits of green energy practices. Provide guidance and support to firms on accessing public funding and navigating regulatory processes.

The innovation channel and the role of IQ is corroborated by Agostino et al. (2025):

*“Extreme Weather Events and Efficiency in Italy’s Food Sector: Does Institutional Quality Matter?”* Economic Modelling, 2025

Using a large sample of Italian food manufacturers, and applying Data Envelopment Analysis (DEA) and Stochastic Frontier Analysis (SFA), results reveal that

- while extreme weather initially reduces technical efficiency, it can stimulate longer-term improvements, through mechanisms such as investment and performance-driven adjustments.
- Notably, institutional quality significantly mitigates short-term disruptions and amplifies long-term gains. Therefore, ***highly contextual nature of both extreme events impact and the subsequent response efforts.***

## However

- **Agostino and Rondinella (2025)**

*Do climate extreme events stimulate or hinder green innovation? Evidence from the Italian manufacturing sector.* Structural Change and Economic Dynamics, 73, 101-111

demonstrate a negative association between extreme events and **green patenting** among Italian manufacturing firms.

## Differing Measures of Innovation

- The first study focuses on **technical efficiency**, which can be improved through various means, including the replacement of damaged capital with newer, more advanced equipment. This type of innovation often involves incremental improvements and the adoption of existing technologies.
- The second study examines **green patenting**, which represents a more complex and strategic form of innovation. Green patents require significant R&D investments, long-term vision, and a commitment to developing environmentally friendly technologies.

# Industry-Specific Dynamics

- The studies focus on different sectors. The first study examines food manufacturers, while the second study considers a broader sample of manufacturing firms.
- The food sector may be more directly impacted by extreme weather events, as these events can disrupt supply chains, damage crops, and disrupt production processes. In response, food manufacturers may prioritize investments in resilient infrastructure and technologies that enhance efficiency.

## Future Research:

- Investigate **long-term** impacts of extreme events on firm behavior;
- Explore the role of different types of extreme events on specific types of innovation;
- Analyze the impact of specific policy interventions to encourage green energy adoption.

## Future Research:

- The Impact of Innovation and Green Transition on Migration Patterns: **How does the transition to a green economy, driven by climate change (EEL) and policies, influence migration patterns** within and between countries?

Analyze data on extreme events, green investments, job creation, and migration flows to understand if and how the green transition leads to new opportunities or displacement.