Climate Change and the Future of Economic Growth

Diego R. Känzig
Northwestern University, CEPR & NBER

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Growth changes the climate—and the climate changes growth

Fossil energy powers growth

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Climate damages feed back into growth

The resulting warming affects **productivity**, **mortality**, and **future growth**

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How large is the feedback and when does policy protect growth?

Three questions on climate change and growth

1. How big are the **macroeconomic damages** from warming?

2. What are the impacts on welfare, including **mortality**?

3. How should policy respond given **size** of climate damages?

Estimating climate damages

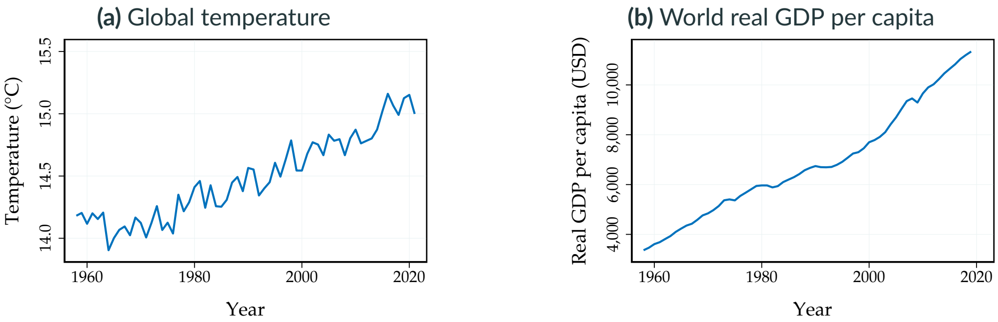
The macroeconomic impact of climate change

- Influential empirical work compares **hotter and cooler places over time**
  - Credible identification of exposure to local temperature
  - Points to moderate damages: **1–3% GDP loss** per 1°C warming
- But local variation can miss common shocks, spillovers, and ocean dynamics
- In macroeconomics, the key object is the effect of a **global climate shift**
- In recent work, we exploit **global temperature variation** to revisit climate damages
  Bilal & Känzig (QJE 2026)

Global temperature as a sufficient statistic

- It is the central summary statistic used by the IPCC
- It combines **land and ocean surface temperatures**
- It captures the common climate state behind correlated local extremes
- Natural variability provides changes **unrelated** to current economic activity
  - El Niño, volcanic eruptions, solar cycles, and other climate fluctuations

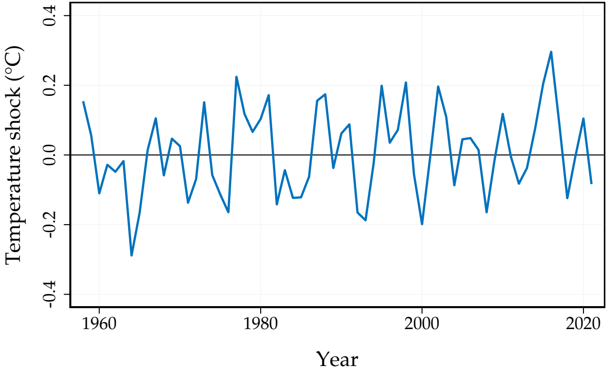
Global temperature and economic growth



Notes: Global average temperature including sea surface from Berkeley Earth; world real GDP from PWT.

- The shared trend obscures the causal effect of warming
- We therefore focus on **temperature shocks**

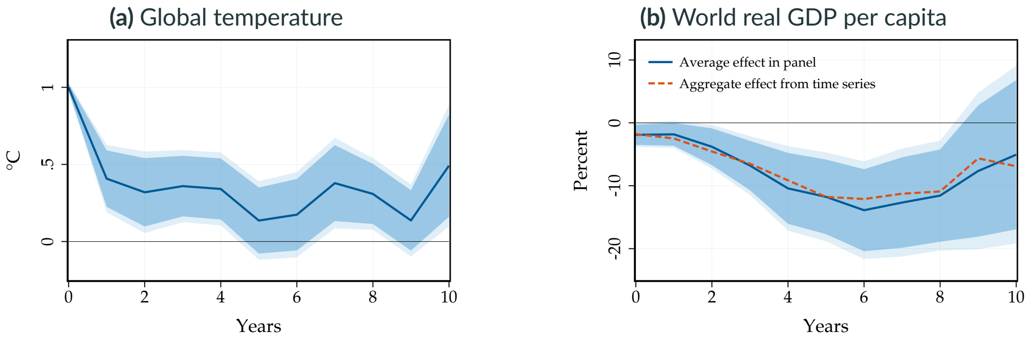
Measuring temperature shocks and tracing their effects



- Isolate innovations around the temperature trend
- Trace effect on GDP for the following decade
- Compare with similarly constructed local shocks

Notes: Temperature innovations use a Hamilton filter; results are similar with alternative filters.

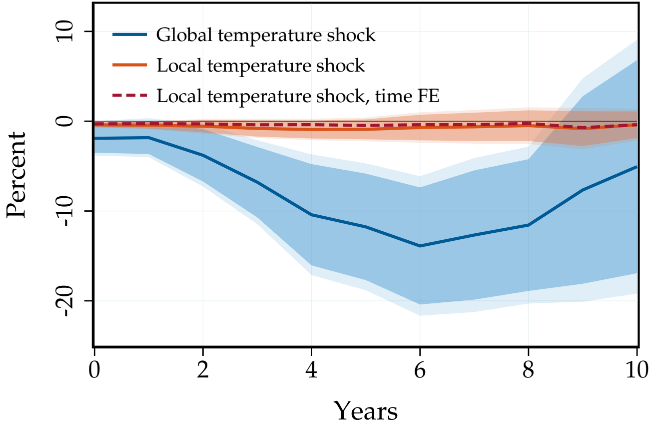
The impact of a 1°C global temperature shock



Notes: 90 and 95% confidence bands. GDP per capita data: Penn World Tables, 173 countries, 1960–2019.

- A permanent 1°C rise leads to a **roughly 20% reduction** in world GDP per capita
- Result survives a myriad of robustness checks

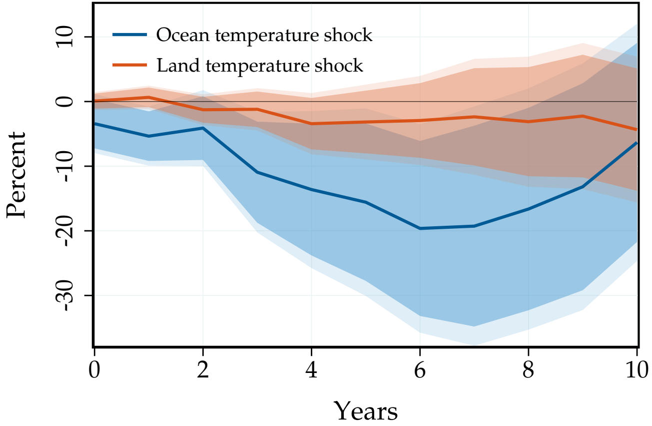
Impact of global vs. local temperature shocks



- **Local shocks** have only modest effects on average
- Robust finding, in line with previous literature
- **Global shocks** have much larger and persistent impact

Notes: Point estimates with 90 and 95% confidence bands based on Driscoll–Kraay standard errors.

Oceans drive global temperature effects

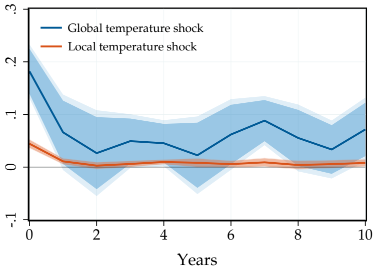


- Ocean temperature reflects the planet's energy balance
- It predicts damaging extreme events across countries
- Local temperature alone misses common and spillover effects

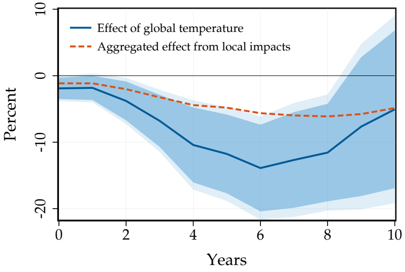
Notes: Joint response to innovations in ocean and land temperatures; 90 and 95% confidence bands.

Local extremes account for over half of the aggregate damage

(a) Extreme heat

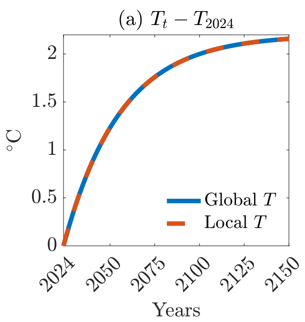


(b) Bottom-up aggregation



- **Global temperature shocks** increase the frequency of local extremes
- Increases **heat** but also **droughts, extreme wind, and precipitation**
- Aggregating these local impacts accounts for **over 50%** of our estimate

The impact of climate change



- Use standard growth model disciplined with our estimates to study warming scenarios
- The **global-temperature** estimate is far larger than the **local-temperature** estimate

Updating damage estimates

- 2°C warming lowers **output** by over **50%** in long run, implies a **35% welfare loss** today
  - Compared to a **9%** output loss using local temperature variation
- The implied social cost of carbon is **over \$1,200 per ton of CO_2**
- But GDP is only one part of welfare: warming also changes **who survives**

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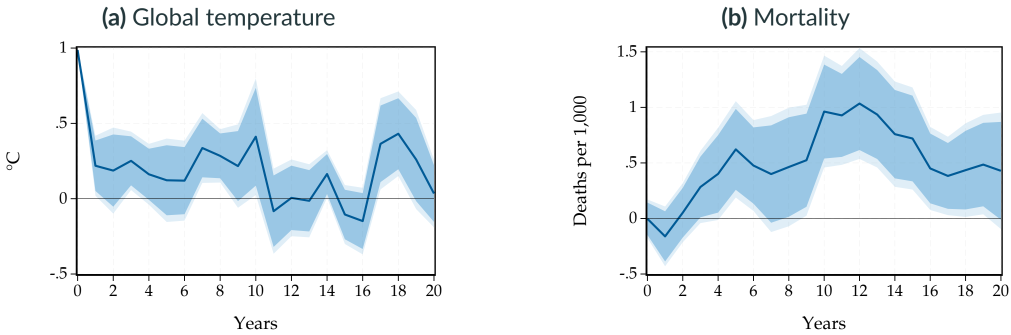
The next step is to put mortality into the same macroeconomic framework

Mortality impacts

Climate change and mortality

- Mortality is one of the most salient consequences of climate change
- Most evidence studies direct exposure to **local heat and cold**
- Economic disruptions may lead to additional, **indirect mortality**
  - Lower income may increase mortality due reduced access to care
- In recent work, we provide a more comprehensive estimate of mortality impacts
  Bilal, Känzig & Lisiecki (2026)

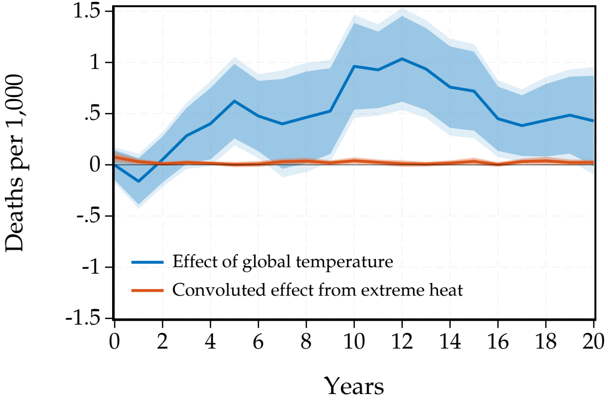
The impact of a 1°C global temperature shock



Notes: 90 and 95% confidence bands based on Driscoll–Kraay standard errors.

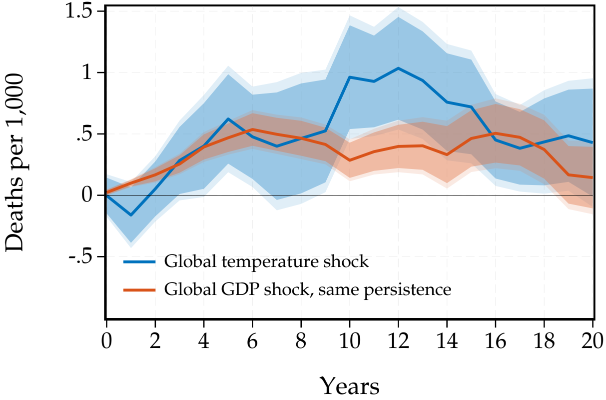
- A permanent 1°C increase causes **2.5 additional annual deaths per 1,000 people**

Impact of global vs. local heat shocks



- Local heat implies only **0.1 deaths per 1,000** for a 1°C global rise
  - In line with previous estimates
- Remaining mortality response must operate through broader channels

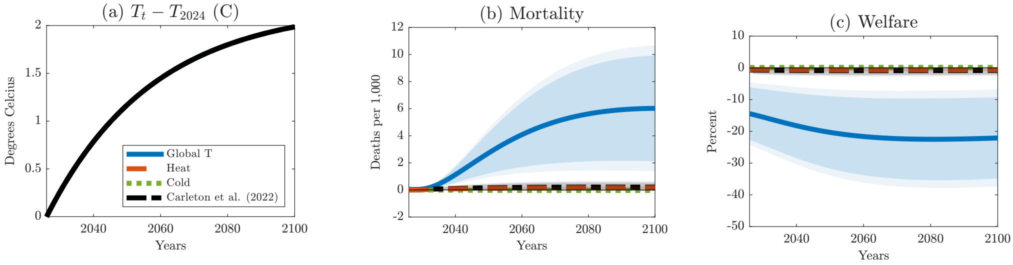
Global income losses explain the mortality impact



- Global warming lowers world income
- Lower global income raises mortality through health systems, nutrition, and public capacity
- Channel explains about **two thirds** of our direct estimate

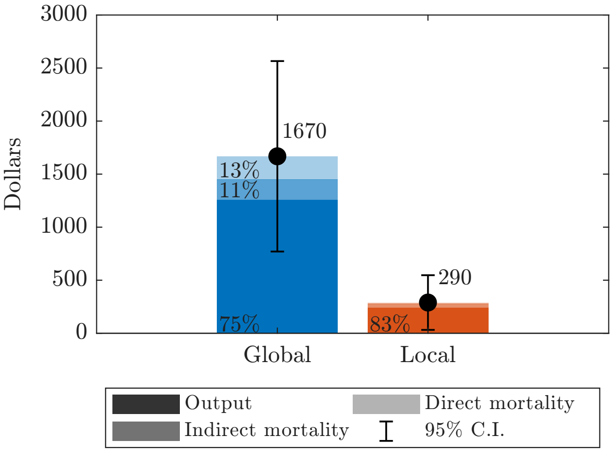
Notes: orange line combines externally estimated temperature-to-GDP and GDP-to-mortality responses.

Climate change and mortality



- **Global-temperature channels** dominate direct heat and cold exposure
- Warming-implied mortality generates a welfare loss of **15%** today

The Social Cost of Carbon: Mortality and the economy



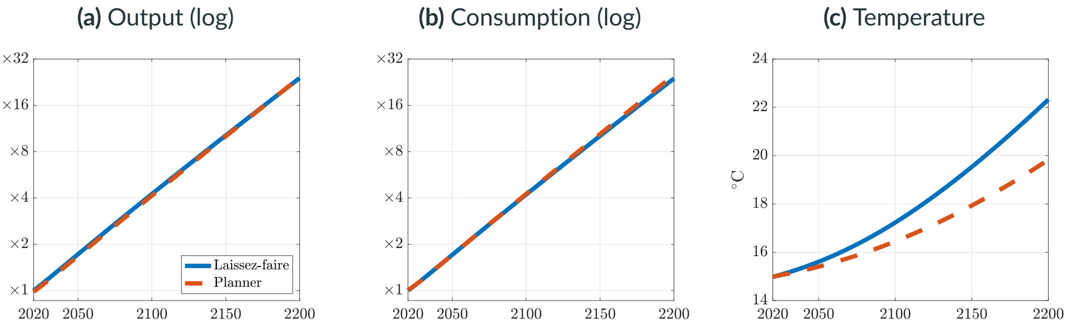
- Global estimate over **$1,600/tCO$_2$**
- Mortality contributes roughly **one quarter**
- Much higher than under **local** temperature estimates

Long-run growth and optimal policy

Balancing growth in a warming world

- Growth and climate change are fundamentally intertwined
- Yet carbon policy is built on the presumption that warming will **stabilize**
- Known reserves and incomplete decarbonization imply that **warming may persist**
- In recent work, we explore whether **growth** can coexist with **warming** and the **optimal policy response** to it
  Bilal, Ingrand & Känzig (2026)

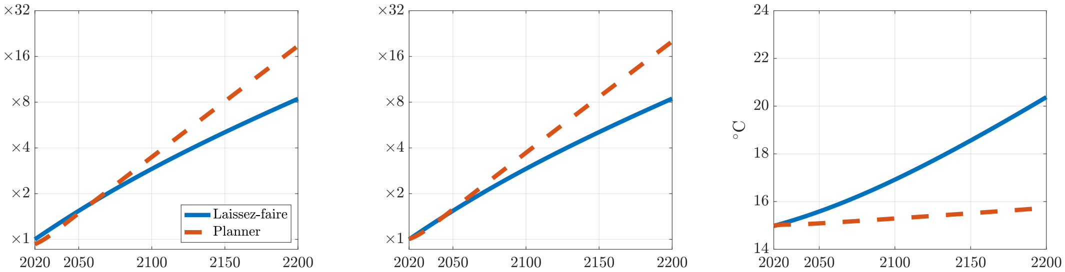
Under low damages: Little role for policy



- Social-planner output growth is the same as under laissez-faire
- Temperature reaches about 2.5°C in 2100; afterward warming continues

Under high damages: Policy is key

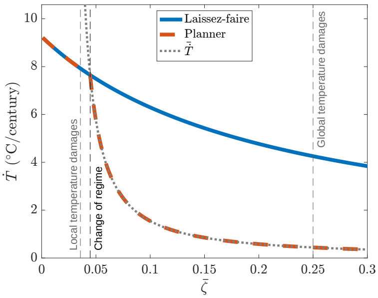
(a) Output (log) (b) Consumption (log) (c) Temperature



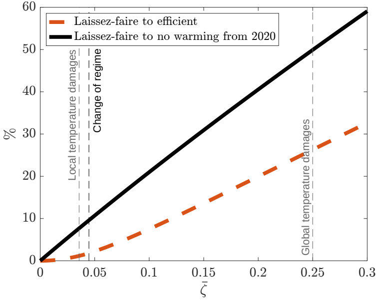
- Social-planner output growth is **0.8 percentage points** higher than under laissez-faire
- The 2100 temperature cap is about **1.5°C above pre-industrial levels** ; thereafter, 0.4°C per century

Warming and welfare gains as a function of damages

(a) Long-run warming rate

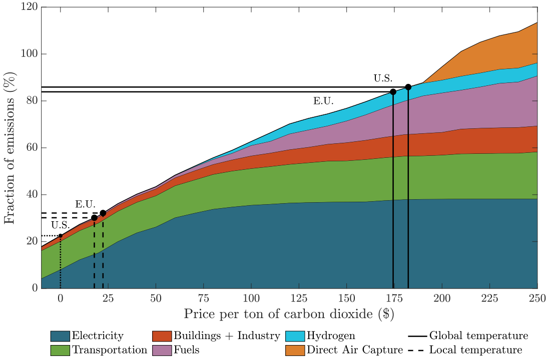


(b) Welfare gains from efficient policy



- The regime changes near **5% output damages per 1°C**
- At the high end of modern estimates, optimal policy yields a **26% welfare gain**

Simple cost-benefit analysis



- Update cost-benefit analysis
  Bilal & Känzig (AEAPP, 2025)
- Start from **engineering marginal abatement-cost curve**
- Measure marginal benefits using the **domestic cost of carbon**
- Intersection gives **cost-effective level of unilateral abatement**

Simple cost-benefit analysis

- With **low damages**, only 20–30% unilateral abatement is cost-effective
- With **high damages**, deep unilateral decarbonization becomes worthwhile
  - More than **80% abatement** for large economies such as the US and EU
- Mortality damages strengthen the case for **populous economies** as well
  - More people protected means larger domestic benefits from decarbonization

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Large damages can overcome the prisoner's dilemma

Unilateral decarbonization becomes privately optimal

Conclusion

Climate policy can be growth policy

- **Measurement matters:** global temperature reveals much larger macro damages
- **Welfare extends beyond GDP:** mortality adds one quarter to the social cost of carbon
- **The long run is nonlinear:** when damages are large, optimal policy switches to a temperature cap
- **Large damages realign incentives:** unilateral decarbonization becomes cost-effective

Thank you!