Climate Change Impacts on Real Estate and its Economic Context

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Lint Barrage, ETH Zurich

Climate Change and Real Estate

1. Climate risks are already having a large and increasing direct impact on property markets

- E.g.: In U.S., home price penalty for sea level rise exposure has grown from 0% in 2007 to 14% by 2016 (Bernstein et al., 2019)

2. Climate risk capitalization remains incomplete to date

- Climate risk discounts demanded vary with buyer sophistication, information, and beliefs
- Information gaps area create «climate bubble» risks & inhibiting adaptation

3. Climate change is having wide-ranging effects on markets and systems supporting real estate

- Established impacts on insurance pricing and availability, mortgage pricing and default rates, building costs, energy consumption, local public finances, infrastructure, public services, etc.
- Estabished macro-level impacts on economically relevant outcomes including GDP/income levels, migration, tourism, etc.

Physical Climate Risks and Housing Markets

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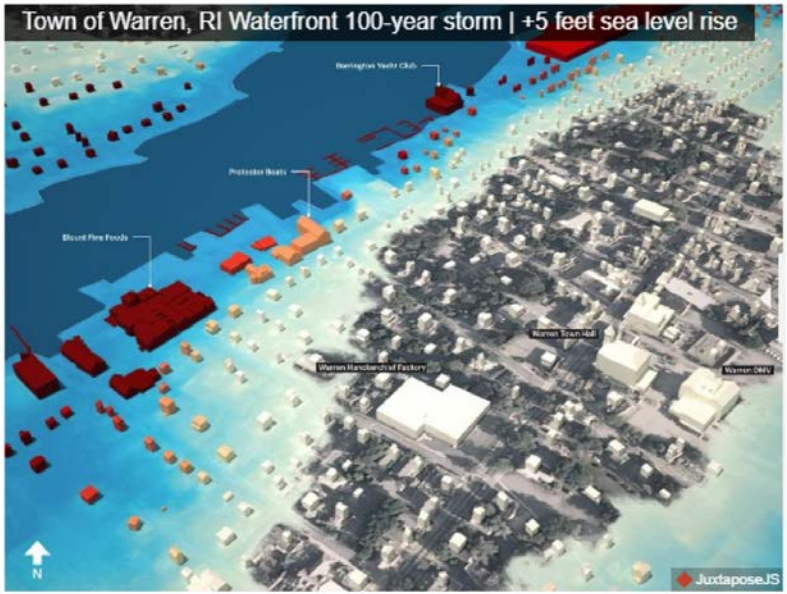

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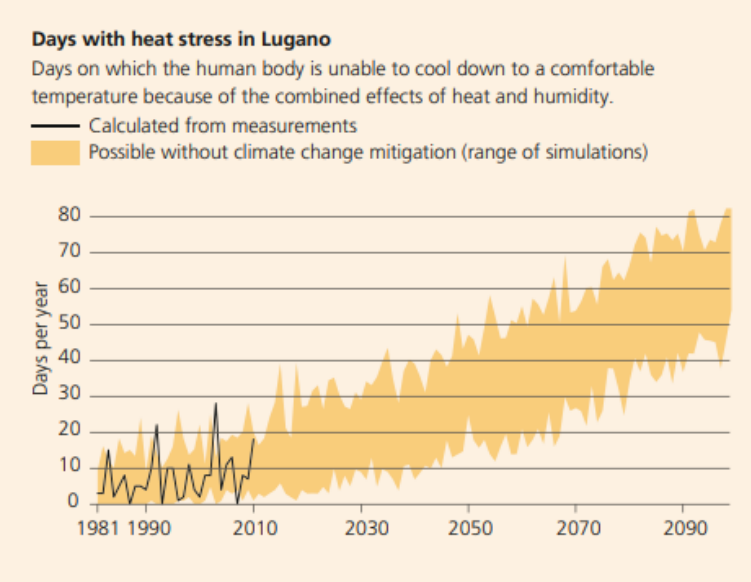


National Center for Climate Services (2018)

- *In theory*, home prices should already reflected expected present value of future damages / insurance costs / location desirability / re-sale value impacts of climatic risks

Physical Climate Risks and Housing Markets

- How are housing markets responding to climatic risks in reality?
  - Caveat: Evidence mostly from the United States due to data availability, market liquidity

- **Sea level rise exposure:**
  - Average price discount (over statistically identical homes in same area): -7% (2007-16)

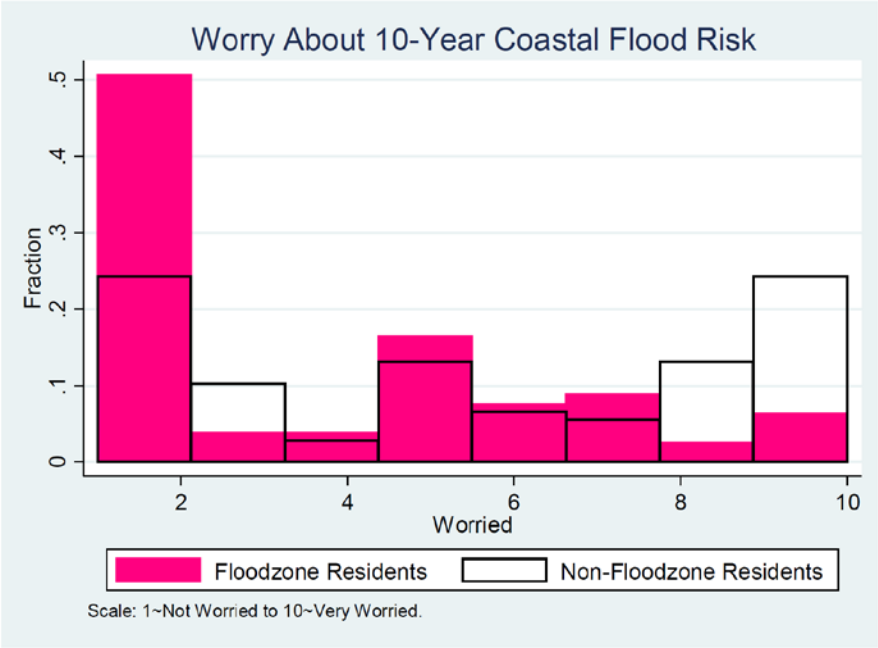
  - However, price impacts vary strongly across market segments:
  - Non-owner occupied buyers demand -13% discount on average
  - Owner-occupied buyers do not command statistically discernible discount for sea level rise risk...
  - ...except in areas with high levels of general climate change concern (-8.5% discount at 90th percentile)

  - Price discounts also increasing in the *salience* of climatic risks (after, e.g., storms, floods, media coverage, etc.)
    - E.g., after Hurricane Sandy, NYC price penalty for (undamaged) high flood risk homes rose from 0% (2003-12) to -8% (2013-17)

  - Risk discounts / safety premiums also depend on climatic risk information/disclosure rules

Climate Risks, Housing, and Beliefs

- At-risk homes appear increasingly occupied by those disproportionately unconcerned about climatic risks
- 70% of coastal residents surveyed understimate their home's flood risk relative to inundation model



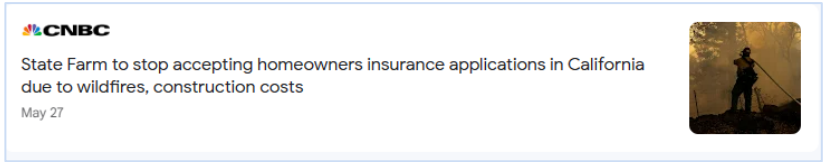
Rhode Island, USA Case Study, Bakkensen and Barrage (2021)

Climate Risks, Housing, and Beliefs

- Excessive optimism about climatic risk may lead to overvaluation, risk of «climate risk bubble» (Bakkensen and Barrage, 2021)
  - Future coastal home price change due to sea level rise -3% with fully informed public vs. -17% with 35% of pop. underestimating risk
- Recent US-wide estimates imply overvaluation of properties at flood risk of US$121-237 bil. (Gourevitch et al., 2023)
- New housing construction response to climatic risks also depends on local population beliefs (Barrage and Furst, 2019)

Climate Change and Real Estate: Broader Market Impacts

- **Insurance:** Prices increasing or availability decreasing depending on regulatory context



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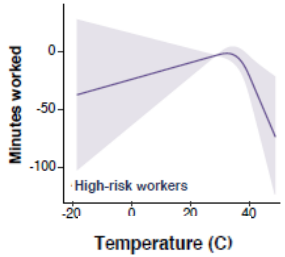
- **Mortgages:** More defaults after disasters (Issler et al. 2020), higher interest rates on risky properties (Nguyen et al. 2022)
- **Building costs:** Construction workers vulnerable to labor supply, productivity effects of warming
  - Very hot days decrease outdoor labor supply by 30 mins on average (Rode et al., 20022)



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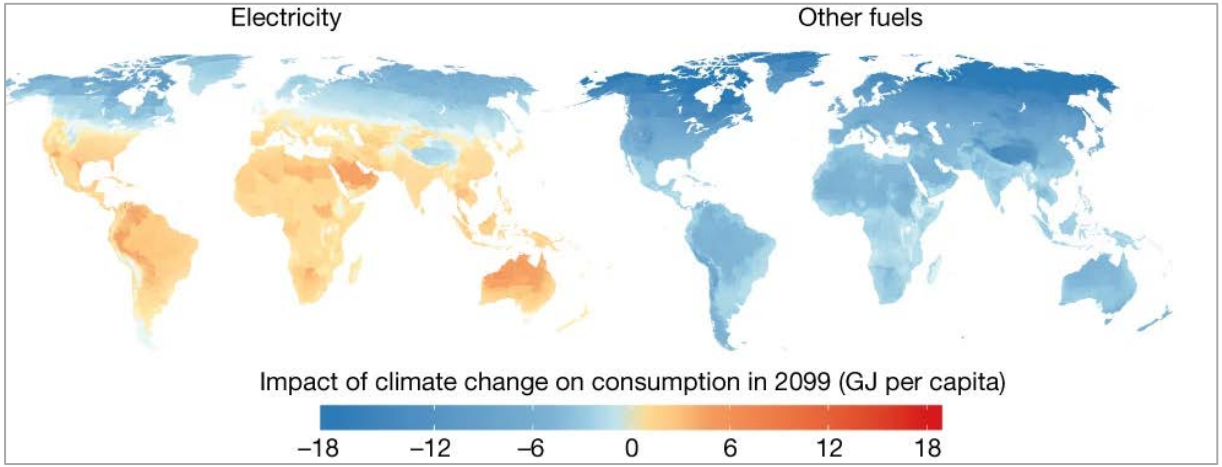

Rode et al. (2021)

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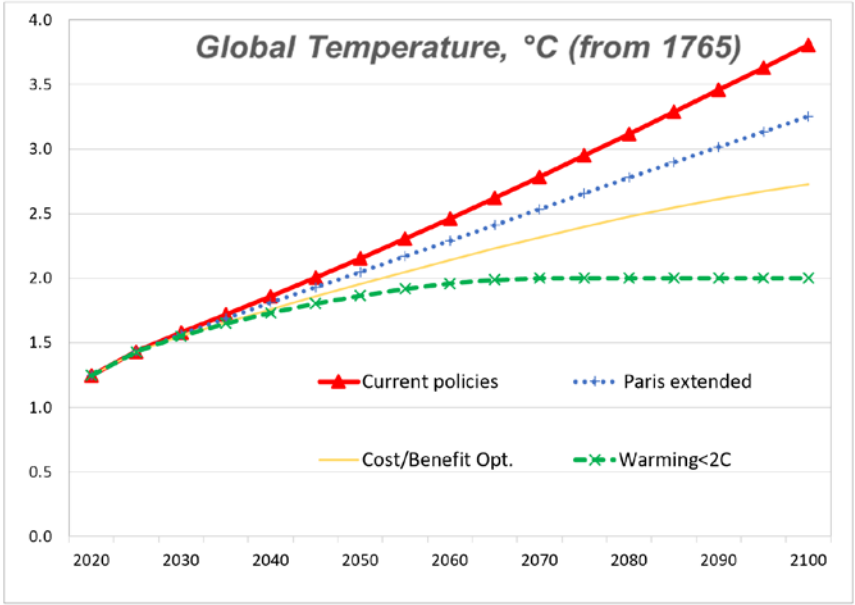
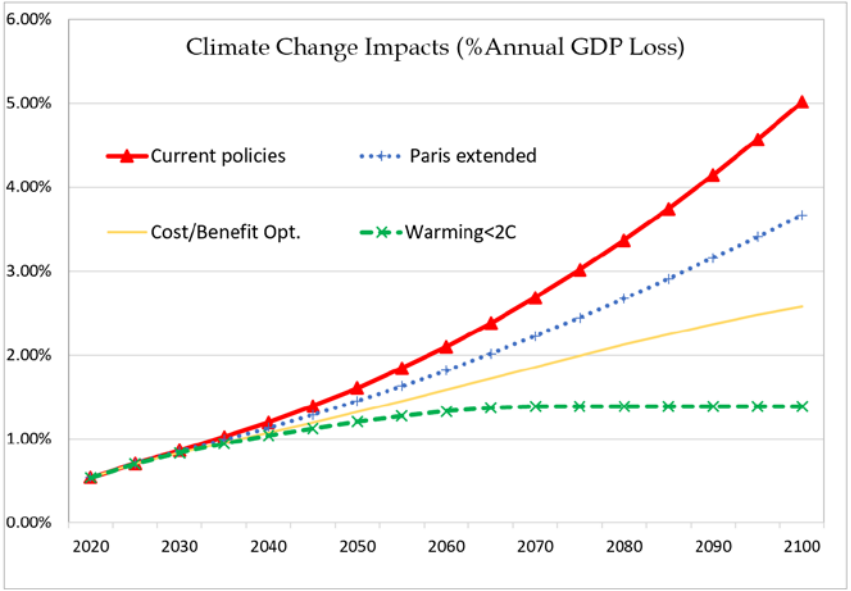
- **Local public finances:** Higher expenditure requirements (firefighting, infrastructure, healthcare, etc.), lower tax revenues, higher deficit probability, higher borrowing costs → Tax increases, lower public services provision possible as a result of increasing climatic risks (Barrage 2021; Liao and Kousky 2022; Jerch et al. 2022; Painter 2022; etc.)

Climate Change and Relevant Macro-Level Impacts

- Globally, current policies projected to lead to significant warming and global income losses





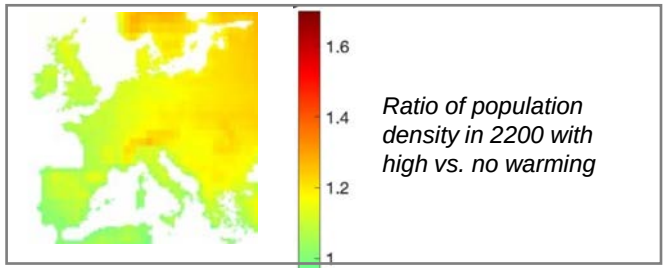
Barrage and Nordhaus (2023)

Climate Change Macro Impacts

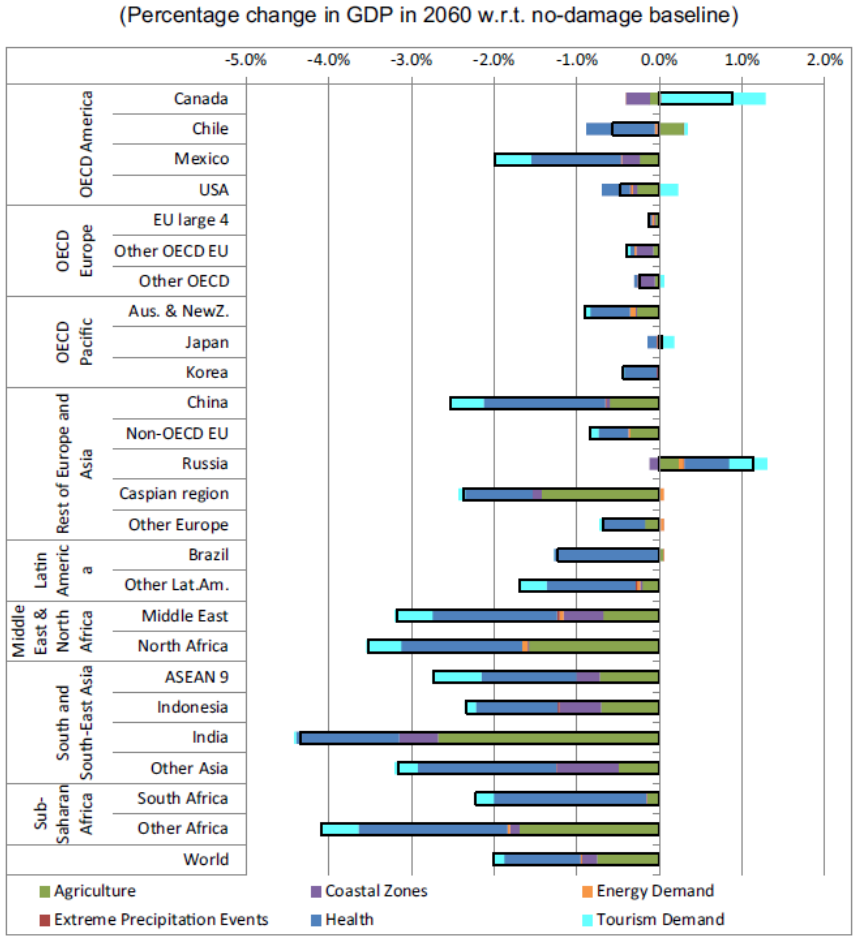
- Agriculture and health among key vulnerabilities

- Projected impacts vary significant across countries
- Warming projected to produce some benefits but losses on net
- In some countries, losses may be existential (e.g., agricultural productivity declines of >70%) (Nath, 2022)

- Switzerland projected to see more **migration**, higher population as a result of warming (Cruz and Rossi-Hansberg, 2023)



Ratio of population density in 2200 with high vs. no warming



Dellink et al. (2019)

Climate Change and Real Estate: Concluding Thoughts

- U.S. evidence suggests that vulnerability from (some) climatic risks is already affecting property prices
- More sophisticated, informed buyers command increasing risk discounts / safety premiums
- Availability of granular climate risk information increases safety premiums, helps avoid bubbles
  - U.S.: First Street Foundation collaboration of researchers, industry, government

RISK FACTOR

2818 VALENCIA DR, SANTA BARBARA, CA 93105

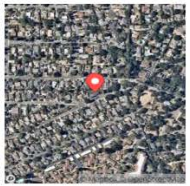
Partnerships & Pricing | Methodology | Help | Sign in | Sign up

Risk Overview | Flood Factor 6/10 | Fire Factor 3/10 | Heat Factor 6/10 | Wind Factor 1/10

Share report access

2818 VALENCIA DR, SANTA BARBARA, CALIFORNIA 93105

This property has risk from 3 of 4 environmental factors



View flood report

Water to building

1 ft This year | 1 ft In 30 years

Explore flood maps

Estimated cost of 1 ft of water

1 ft
First floor elevation

$0
Estimated repair cost

0
Estimated days to repair

Calculate flood damages

View fire report

Likelihood of being in a wildfire

0.02 % This year | 0.07 % In 30 years

Explore fire maps

Estimated cost to rebuild after wildfire

High Risk
Nearby combustible vegetation

$656,039
Estimated cost to rebuild

Yes
In the ember zone of potential nearby wildfires

Calculate fire damages

View heat report

Total days above 84°F

10 This year | 26 In 30 years

Explore heat maps

Estimated A/C usage this year

70°F
Desired cooling temperature

1,324
Annual A/C energy consumption (kWh)

230
Annual emissions from A/C (lbs CO2)

Calculate heat damages

View wind report

Prior nearby severe wind events

13 Total Events | Unknown Strongest Event

Explore wind maps

Estimated damage from 80 mph gusts

Unknown
Direction of building

More information needed
Estimated cost ($) to repair

More information needed
Estimated days to repairs

Calculate wind damages

FIRST STREET FOUNDATION

Mission | Methodology

Press / Redfin Publishes Flood Risk Data from Flood Factor for Over 94 Million Homes

PRESS RELEASE

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Climate Change and Real Estate: Summary

- U.S. evidence suggests that vulnerability from (some) climatic risks is already affecting property prices
- More sophisticated, informed buyers command increasing risk discounts / safety premiums
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  - U.S.: First Street Foundation collaboration of researchers, industry, government

- Climate risk impacts also increasingly evident foir insurance prices and availability, mortgage pricing, construction costs, heating/cooling demand, local public finances, and other relevant markets
- At macro level, climate change poses global income risk (on net), may increase CH migration

- Wildcard: Climate *policy*. So far, have focused on projected impacts of physical climate change.
  - Climate policy likely to impact property prices, valuation of home energy efficiency, building costs, etc.
  - Details depend entirely on how climate policy is implemented (e.g., who pays for oil heater replacements?)