

Climate Change Adaptation: Lessons from Free to Choose

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Three Recent New York Times Headlines

OPINION

PAUL KRUGMAN

Can Inflation Reduction Save the Planet?

Aug. 1, 2022

Climate Change Is Keeping Therapists Up at Night

How anxiety about the planet's future is transforming the practice of psychotherapy.

OPINION

SPENCER BOKAT-LINDELL

Do We Need to Shrink the Economy to Stop Climate Change?

ADAPTING TO CLIMATE CHANGE

Markets and the Management
of an Uncertain Future

MATTHEW E. KAHN

MARKET RESPONSES TO
CLIMATE CHANGE

ADAPT
AND BE
ADEPT

EDITED BY
TERRY L. ANDERSON

WITH AN EPILOGUE BY BJORN LOMBERG

The Damage Function is a key Equation in the Climate Change Economics Model

- The 3 equation climate change and economic growth model (Nordhaus)
- $GHG_t = World\ Population_t * PerCapita\ GNP_t * Carbon\ Intensity_t$ (GHG Production)
- $Temperature_t = f\left(\sum_{j=0}^m GHG_{t-j}\right)$ (climate sensitivity)
- $Economic\ Damage_t = H(Temperature_t)$ (The Damage Function)
- My research agenda focuses on this last equation. This reduced form equation has not been micro founded and is subject to the Lucas Critique.
- **My Core Claim:** This $H()$ flattens over time and it would flatten even faster under Milton Friedman's "Rules of the Game"

The Microeconomic Perspective on Adaptation

- My adaptation optimism (the climate change damage function flattens over time) is based on microeconomic ideas that are all discussed in *Capitalism and Freedom* and *Free to Choose*.
 - Markets price signals
 - Competition fueling experimentation and innovation
 - Investment under uncertainty
 - Adapting to physical risks such as disasters resembles adapting to other shocks (COVID March 2020, WFH, job loss, health shock)

Poverty Reduction Fuels Private Adaptation Investment

- Economic growth causes risk adaptation
 - Costa, Dora L., and Matthew E. Kahn. "Changes in the Value of Life, 1940–1980." *Journal of risk and Uncertainty* 29 (2004): 159-180.
 - Kahn, Matthew E. "The death toll from natural disasters: the role of income, geography, and institutions." *Review of economics and statistics* 87, no. 2 (2005): 271-284.
 - Jones, Charles I., and Peter J. Klenow. "Beyond GDP? Welfare across countries and time." *American Economic Review* 106, no. 9 (2016): 2426-2457.
- Friedman on expanding the choice menu (schooling, housing, occupational access)
- Invest in people: Lessons from Hurricane Katrina
 - Glaeser, Edward L. "Should the Government Rebuild New Orleans or Just Give Residents Checks?." In *The Economists' Voice: Top Economists Take On Today's Problems*, pp. 209-216. Columbia University Press, 2011.

Adapting to Rising Heat

- The Boskin Report's logic is a central idea underpinning my adaptation optimism
 - Boskin, Michael J. "Causes and Consequences of Bias in the Consumer Price Index as a Measure of the Cost of Living." *Atlantic Economic Journal* 33 (2005): 1-13.
- Endogenous innovation depends on expected profits
- Global free trade expands market size
- Adaptation ideas diffuse across nations

The Consumer Adapts! Insights from Becker and Boskin

- Each of us seeks to be comfortable and to consume a composite good. Extreme temperatures causes discomfort if we do not move to a cooler place (extensive margin) or invest in air conditioning to offset the heat (intensive margin).
- Becker Household Production Function (HPF) of Comfort = $f(\text{outdoor temperature, electricity, air conditioner, time})$
- Boskin; endogenous technological change shifts $f()$ over time. The adaptation menu grows and real prices decline → this lowers the Social Cost of Carbon per person!!
- Stable preferences and a shifting Gary Becker HPF function!!! Adhere to Becker and Stigler (1977)

Becker and Boskin (slide 2)

- As the quality adjusted price of adaptation durables decreases, poor people can afford such goods.
- If a Phoenix is “too hot” in summer then local real estate prices decline and the population Tiebout sorts
- **Extensive margin** adaptation
- **The Adaptation strategy set’s permutations are huge** (intensive and extensive margin and time allocation) and grow over time!!



Adapting to Climate Change: The Remarkable Decline in the US Temperature-Mortality Relationship over the Twentieth Century

Alan Barreca

Tulane University, Institute for the Study of Labor (IZA), and National Bureau of Economic Research

Karen Clay

Carnegie Mellon University and National Bureau of Economic Research

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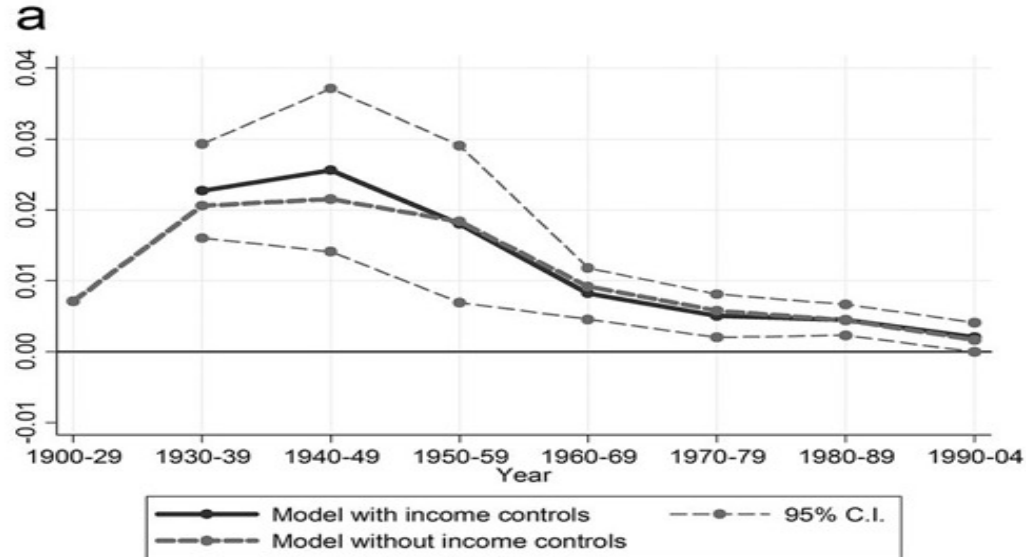
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JPE 2016; The Flattening Climate Damage Function



An Asymmetry in the Endogenous Innovation Literature!!

Mitigation Optimism versus Adaptation Pessimism

- Newell, Richard G., Adam B. Jaffe, and Robert N. Stavins. "The induced innovation hypothesis and energy-saving technological change." *The Quarterly Journal of Economics* 114, no. 3 (1999): 941-975.
- Carleton, Tamma, Amir Jina, Michael Delgado, Michael Greenstone, Trevor Houser, Solomon Hsiang, Andrew Hultgren et al. "Valuing the global mortality consequences of climate change accounting for adaptation costs and benefits." *The Quarterly Journal of Economics* 137, no. 4 (2022): 2037-2105.
- Acemoglu, Daron, and Joshua Linn. "Market size in innovation: theory and evidence from the pharmaceutical industry." *The Quarterly journal of economics* 119, no. 3 (2004): 1049-1090.

- Kahn, Matthew E., and Daxuan Zhao. "The impact of climate change skepticism on adaptation in a market economy." *Research in Economics* 72, no. 2 (2018): 251-262.

Competition Facilitates Adapting to Local Flood Risk and Wildfire Risk

- Sherwin Rosen's emphasis of homes as tied bundles to places (differentiated products) and market hedonic price dynamics representing Adam Smith's equalizing differences
- Rosen, Sherwin. "Markets and diversity." *American Economic Review* 92, no. 1 (2002): 1-15.
- Self selection given self awareness of one's own diverse type
- Bunten, Devin Michelle, and Matthew E. Kahn. "Optimal real estate capital durability and localized climate change disaster risk." *Journal of Housing Economics* 36 (2017): 1-7.

Wildfire Smoke Is Erasing Progress on Clean Air

By Mira Rojanasakul Sept. 22, 2022

- How do free markets help us to adapt to the nasty combination of heat and drought in the American West?



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The Central Role of Expectations Formation

- Friedman's work on the Permanent Income Hypothesis hinges on expectations formation
- Becker, Gary S., and Casey B. Mulligan. "The endogenous determination of time preference." *The Quarterly Journal of Economics* 112, no. 3 (1997): 729-758.
- We cannot adapt to “unknown unknowns” . Robust decision making and low probability events
- Climate risk perceptions (Manski on subjective probabilities!)
- Wallace-Wells, David. *The uninhabitable earth: A story of the future*. Penguin UK, 2019.

The Emerging Climate Risk Rating Industry: My Work with First Street Foundation

The screenshot shows the 'Wildfire Risk Overview' tool interface. At the top, the address '615 WARNER AVE, LOS ANGELES, CA 90024' is entered. The navigation bar includes 'Partnerships & Pricing', 'Methodology', and 'Help'. Below this, there are tabs for 'Risk Overview', 'Flood Factor 9/10', 'Fire Factor 2/10' (which is selected and highlighted in orange), and 'Heat Factor 6/10'. A secondary navigation bar contains 'Fire Risk Report', 'Fire Maps', and 'Fire Damages'. On the left side, a vertical menu lists: 'Wildfire Risk Overview' (with a house icon), 'Current & Future Risk' (with a refresh icon), 'Wildfire Intensity' (with a flame icon), 'Home Vulnerability' (with a dollar sign icon), 'Historic Wildfires' (with a circular arrows icon), and 'Community Risk' (with a house and grid icon). The main content area is titled 'WILDFIRE RISK OVERVIEW' and features the question 'Does this property have risk?'. Below this, a large orange box displays a '2 /10' rating and the text 'Minor FIRE FACTOR™'. To the right of this box, a paragraph explains: 'Yes, based on this property's distance to wildfire risk areas and burnable vegetation, it has a **Minor Fire Factor®**. This risk is due to the property being located in the ember zone of potential wildfires nearby or due to a low, but non-zero probability of wildfire reaching this property.' At the bottom of the main content area, there is a dark blue button with a lock icon and the text 'Unlock Pro Features'.

RISK FACTOR

615 WARNER AVE, LOS ANGELES, CA 90024

Partnerships & Pricing Methodology Help

Risk Overview Flood Factor 9/10 **Fire Factor 2/10** Heat Factor 6/10

Fire Risk Report Fire Maps Fire Damages

Wildfire Risk Overview

WILDFIRE RISK OVERVIEW

Does this property have risk?

2 /10 **Minor** FIRE FACTOR™

Yes, based on this property's distance to wildfire risk areas and burnable vegetation, it has a **Minor Fire Factor®**. This risk is due to the property being located in the ember zone of potential wildfires nearby or due to a low, but non-zero probability of wildfire reaching this property.

Unlock Pro Features

Housing Search and Property Specific Exposure to Place Based Climate Risk

- Housing search and the hedonic equilibrium in the presence of shrouded attributes
- My new Redfin research
- Sandoval-Olascoaga, S., Metcalfe, R., Kahn, M., Fairweather, D., (2023). The Impact of Flooding Information on the Property Market: Evidence from a Nationwide Field Experiment. *NBER Summer 2023*
- Treatment group is exposed to the property specific Flood scores . Treatment group search behavior changes (search, bidding and offers!). Result similar in Republican and Democrat areas.

The “Peltzman Effect” Revisited: Moral Hazard Effects Induced by Federal Spatial Subsidies

- Does Government investment crowd out Self Protection? (Friedman’s Other People’s \$)
- Peltzman, Sam. "The effects of automobile safety regulation." *Journal of political Economy* 83, no. 4 (1975): 677-725.
- Ouazad and Kahn on subsidized levee construction and levee depreciation’s unintended consequences
- Ehrlich, Isaac, and Gary S. Becker. "Market insurance, self-insurance, and self-protection." *Journal of political Economy* 80, no. 4 (1972): 623-648.
- Kousky, Carolyn, Erzo FP Luttmer, and Richard J. Zeckhauser. "Private investment and government protection." *Journal of Risk and uncertainty* 33, no. 1 (2006): 73-100.

Government Decentralization Fuels Spatial Competition and Experimentation

- Home prices adjust to reflect quality of life dynamics ; property owners as an adaptation interest group
- Will climate change create the next “Detroit”? -- Urban Doom Loop?
 - Glaeser, Edward L., and Joseph Gyourko. "Urban decline and durable housing." *Journal of political economy* 113, no. 2 (2005): 345-375.
- A Twist on Paul Romer’s Charter Cities Ideas
 - Road pricing
 - Up zoning on higher ground
 - Insurance risk pricing and water and electricity surge pricing

Regulatory Barriers Limit Adaptation Progress

Gary Libecap's work on Water Markets in the American West --- Alfalfa growing in Arizona?

Opinion

OP-ED CONTRIBUTOR

- **Fires Aren't the Only Threat to the**
- **California Dream**
-
-

By **Enrico Moretti**

Nov. 3, 2017

4 MIN READ

Political Economy of Policy Reform; When Does Reform Occur?

- Coase versus Mancur Olson (concentrated winners from the Status quo policies)
- Becker, Gary S. "Public policies, pressure groups, and dead weight costs." *Journal of public economics* 28, no. 3 (1985): 329-347.
- Baylis, Patrick, and Judson Boomhower. "The economic incidence of wildfire suppression in the united states." *American Economic Journal: Applied Economics* 15, no. 1 (2023): 442-473.

The Empirical Adaptation Research Agenda Going Forward

$$Damage_{ijt} = B_t * Shock_{jt} + U_{ijt}$$

- Is B_t shrinking over time? At what cost to individuals and to society as a whole?
- Gandhi, Sahil, Matthew E. Kahn, Rajat Kochhar, Somik Lall, and Vaidehi Tandel. *Adapting to flood risk: Evidence from a panel of global cities*. No. w30137. National Bureau of Economic Research, 2022.

The Lucas Critique's Implications for the Social Cost of Carbon

- Lucas as a climate economist!
- As Mother Nature changes the “rules of the game”, forward looking households and firms change their optimal decision rules → extrapolation using reduced form historical relations over-predicts future damage.
- The cost of adaptation (while difficult to measure) continuously declines
- Empirical benchmarking is required to test this “Baby Boskin” hypothesis!!

Caveats

- I am not brave enough to solve a Pareto Problem on how much we should be investing now in carbon mitigation and geo-engineering
- During a time when the US share of global GHG emissions is falling, the logic for the
- Inflation Reduction Act's huge subsidies hinges large learning by doing effects and ignores that land and rare earths are key complements of the green economy
- **An aside;** The IRA is good politics as it fires up the Democrat's base and creates a new "green crony capitalism"
- Martin Weitzman and I would debate his "Rare Disasters" Hypothesis. Endogenize the probability and the loss from a rare disaster!
- Weitzman, Martin L. "Fat tails and the social cost of carbon." *American Economic Review* 104, no. 5 (2014): 544-546.

Bonus Slides; Gary Becker at the Plate!

