Hannah Druckenmiller

Resources for the Future
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Appointment

Resources for the Future, Fellow — August 2021

Research Interests

Environmental and natural resource economics, applied econometrics, ecosystem valuation, land use policy, machine learning/remote sensing

Education

University of California, Berkeley
Ph.D. Agricultural and Resource Economics — May 2021

- Dissertation title: "The social cost of ecosystem loss and degradation"
- Committee members: Sol Hsiang, Joe Shapiro, Max Auffhammer, David Anthoff

University of California, Berkeley
M.S. Agricultural and Resource Economics — May 2018

Stanford University
B.S. Earth Systems, *with honors and distinction* — June 2014

Grants, Fellowships, and Awards

2020 "A new approach to measuring the wealth of nations: understanding long-run economic growth using historical aerial photographs", Riksbankens Jubileumsfond, $6,218,140
(with A. Madestam, A. Tompsett, S. Hsiang, L.Y. Huang, N. Nordfors, and T.Chong)

2019 AI for Earth Innovation Grant, National Geographic Society & Microsoft, $183,581
(with S. Hsiang, A. Tompsett, A. Madestam, B. Recht, & S. Jain)

Outstanding Graduate Student Instructor Award, UC Berkeley

2017 Doctoral Fellow, Global Policy Laboratory, UC Berkeley

2016 National Science Foundation Graduate Research Fellowship Program (NSF GRFP)

The Berkeley Fellowship, UC Berkeley

2014 Firestone Medal for Excellence in Undergraduate Research, Stanford University

Dean's Award for Academic Achievement, School of Earth Sciences, Stanford University

Research papers

"Estimating an Economic and Social Value of Forests: Evidence from Tree Mortality in the American West" (JOB MARKET PAPER) *Available here.*
Linkages between healthy forests and human well-being are often theorized, yet the magnitude of benefits remains unknown. This paper uses a natural experiment to assess the welfare consequences of changes in forest health across the American West. My empirical analysis relies on plausibly random variation in tree mortality generated by the thermal threshold at which cold-induced mortality occurs in pests. I find that forest die-off has significant and economically meaningful impacts on both the market value of forests and the non-market benefits these ecosystems provide. I estimate that over the last two decades, tree mortality decreased the value of timber tracts by $1.1 billion, decreased home values by $16.5 billion, and increased damages from air

pollution, wildfire, and floods by a combined $921 million. In a back-of-the-envelope calculation, I find that the death of a tree in my sample costs society $43 in foregone benefits.

"Accounting for Unobservable Heterogeneity in Cross Section using Spatial First Differences" (with Solomon Hsiang) *Available here.*
We develop a cross-sectional research design to identify causal effects in the presence of unobservable heterogeneity. When units are dense in physical space, we propose regressing the "spatial first differences" (SFD) of the outcome on the treatment and omitting all covariates. The identifying assumptions of SFD are similar in mathematical structure and plausibility to other quasi-experimental designs. We demonstrate the SFD approach by recovering new cross-sectional estimates for the effects of time-invariant geographic factors, soil and climate, on long-run agricultural outcomes across US counties — relationships that are notoriously confounded by unobservables but crucial for guiding policy decisions.

"Wetlands and Flood Mitigation" (with Charles A. Taylor) *Available here.*
Wetlands are thought to mitigate damages from flooding, the most common and costly type of natural disaster. Yet efficient regulation that corrects market failures in the provision of wetland-related public goods is impeded by uncertainty around the magnitude of wetland benefits. This study estimates the flood mitigation value of wetlands in the US using detailed data on flood insurance claims and land use change. We employ three identification strategies that exploit temporal, spatial, and plausibly exogenous variation to establish a causal effect. We consistently find that a hectare of wetlands provides $9,000 in annual flood mitigation value, and that wetland loss since 2001 has increased flood claims by $2.7 billion annually.

"**Using Historical Aerial Photography and Machine Learning to Map 20th Century Global Change"** (with L.Y. Huang, S. Hsiang, T. Chong, N. Nordfors, A. Madestam, and A. Tompsett)
Satellite imagery has transformed our understanding of both the natural world and human well-being, but the instrumental record only begins in 1972. We develop an approach to extend these data backwards in time an additional 30 years. We digitize the only complete archive of 1.6 million aerial photographs collected during the processes of mapping what was then the British Empire. This archive surveys 64 former colonies, where granular data from other sources is notoriously sparse, repeatedly from the 1940s to the 1990s. We develop a novel machine learning approach to assemble these photographs into historical mosaics comparable to modern satellite observations. We then generate large-scale, gridded datasets that provide measures of population density, land use, and infrastructure at 1km resolution.

Published papers

"The effect of large-scale anti-contagion policies on the COVID-19 pandemic" (with S. Hsiang, D. Allen, S. Annan-Phan, K. Bell, I. Bolliger, T. Chong, L. Huang, A. Hultgren, E. Krasovich, P. Lau, J. Lee, E. Rolf, J. Tseng, and T. Wu). Nature 548, 262-267 (2020). *Available here.*
Governments around the world are responding to the coronavirus disease 2019 (COVID-19) pandemic with unprecedented policies designed to slow the growth rate of infections. Many policies, such as closing schools and restricting populations to their homes, impose large and visible costs on society but their benefits cannot be directly observed. We compile data on 1,700 non-pharmaceutical interventions across six countries at the sub-national level and apply reduced-form econometric methods to empirically evaluate the effect that these anti-contagion policies have had on the growth rate of infections.

Research in progress

"A new approach to measuring the wealth of nations: understanding long-run economic growth using historical aerial photographs" (with A. Madestam, A. Tompsett, S. Hsiang, L.Y. Huang, N. Nordfors, and T.Chong)

"The Effect of Human settlement on Local Surface Temperature throughout the United States" (with James A. Rising and Solomon Hsiang)

"Generalizing Earth Observation: We use One Task-independent Algorithm to Produce 100 Gridded Datasets for the Globe" (with T. Carleton, J. Proctor, J. Tseng, T. Chong & S. Hsiang)

Talks

2021 Association of Environmental and Resource Economists (AERE) Summer Conference
World Bank, Mostly Harmless Econometricians Seminar Series
Online Summer Workshop in Environment, Energy, and Transportation (OSWEET)
Resources for the Future Seminar Series

NYU Institute for Policy Integrity Seminar Series

2020 Columbia University, Interdisciplinary PhD Workshop in Sustainable Development
UC Berkeley, Environmental and Resource Economics Seminar

2019 National Bureau of Economic Research Summer Institute,
Stanford University, SEEPAC Research Lunch
Columbia University, Interdisciplinary PhD Workshop in Sustainable Development
UC Berkeley, Environmental and Resource Economics Seminar

2018 UC Santa Barbara, Occasional Workshop in Environmental and Resource Economics
UC Berkeley, Climate Economics Workshop

2017 UC Berkeley, Climate Change Economics Lunch

Teaching

University of California, Berkeley	Agricultural and Environmental Policy	2018
Stanford University	World Food Economy	2014
Stanford University	Feeding Nine Billion	2013

Service

Research mentor and supervisor for the Undergraduate Research Apprentice Program at UC Berkeley, External Grant Reviewer for AI for Earth, National Geographic Society & Microsoft

References

Professor Solomon Hsiang
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