Climate Economist

*Bob Simison profiles Berkeley's **Solomon Hsiang**, who uses big data to inform climate change policies*

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Solomon Hsiang is a smart man. He listens to his wife.

Over breakfast a day or two after the California pandemic lockdown in March 2020, Google researcher Brenda Chen asked a question. Couldn't her husband's Global Policy Laboratory at the University of California, Berkeley, shed some light on the world's fight against COVID-19?

"A lab called 'the Global Policy Lab' should be able to tackle this question," she recalls saying.

He raised it with his team on a conference call that morning. The lab uses sophisticated statistical analysis of economic data—econometrics—and advanced computing power to address questions related to climate change, development, violence, migration, and disasters. When the group reconvened after a day of research, "we realized that nobody knew if all these lockdown policies would really work," says Hsiang, a 37-year-old economist and climate physicist.

Over the next 10 days, Hsiang and 14 researchers worked around the clock gathering vast amounts of data on dozens of pandemic policies such as business and school closings, travel bans, social distancing mandates, and quarantines from China, France, Iran, Italy, South Korea, and the United States. Applying econometric tools, they found that the anti-contagion policies significantly slowed the spread of disease, averting 495 million infections. The paper they cranked out appeared June 8, 2020, in the journal *Nature*. It has been accessed 309,000 times and cited by 361 news outlets, according to *Nature*.

Transforming economics

The episode shows how Hsiang (pronounced "Shung") is helping to transform the way economists conduct research. He's leading a new generation in leveraging newly available giant databases, massive modern computing power, and large, interdisciplinary teams to address thorny global issues such as climate change and the pandemic. Previous work on the economics of climate change relied largely on sweeping assumptions rather than hard data and was carried out mostly by solo researchers or a few collaborators.

Within just a decade of earning his doctorate from Columbia, Hsiang has published a raft of startling and sometimes controversial findings. He and various research partners showed that rising temperatures increase civil conflict and slow economic growth; that as tropical storms grow more intense, the economic effects are more severe and last longer; and that trying to fight climate change by mimicking volcanic eruptions to dim the sun would reduce global crop yields. Now he's leading researchers in a years-long effort to calculate the true cost worldwide of greenhouse gas carbon emissions.

"Sol is one of the preeminent figures in interdisciplinary research on the impacts of climate change," says the University of Maryland's Maureen Cropper, a leading climate change economist who was a co-chair of the 2017 National Academies report on the social cost of carbon. "His work is having a huge impact—directly and indirectly—on climate policy."

Organizations citing Hsiang's work include the Federal Reserve, the Congressional Budget Office, the Environmental Protection Agency, the United Nations, the Bank of England, and the IMF. After the COVID-19 study appeared in June 2020, the US Centers for Disease Control and Prevention tapped Hsiang's group to analyze a massive database on every disease-control policy worldwide.

"Economics is at the dawn of a new era of taking advantage of computers and data to fully understand the impact of climate change," says the University of Chicago's Michael Greenstone, a frequent collaborator of Hsiang's. "And Sol is at the forefront of it."

Hsiang came to economics through his love for biology and physics. His father is a math professor and his mother a computer science professor at Syracuse University in New York. At home growing up, it was all science all the time, he says.

As an undergrad at the Massachusetts Institute of Technology, he studied earth, atmospheric, and planetary science. "I started to understand that the problems in the atmosphere are results of policies and economics," he says. His senior year he loaded up on economics courses and "fell in love with it," he says. For graduate school, he landed at Columbia, known for its premier interdisciplinary program in sustainable development.

High school prom date Chen joined him there for her doctorate in biomedical engineering. Before their first date 19 years ago, the couple would hang out in the art room after high school. "Sol is a great oil painter," Chen says. They've since taken up snowboarding, surfing, rock climbing, birding, and pottery. Last spring, they welcomed a daughter. Hsiang has a strong romantic streak, Chen says.

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"For date night once, he sent an email that had some computer code attached," Chen says. "When I ran the code, it drew nautical flags on the screen. Decoding the flags revealed an ISBN number. I found the book with that number deep in the stacks of the Columbia library. Behind it was a book for me, a card with paw prints from our cats, and tickets to a Broadway show."

During Hsiang's first year at Columbia, the British Treasury published a 712-page report, *The Economics of Climate Change: The Stern Review*. The authors argued that the world could lower greenhouse gas emissions at a significant but manageable cost and recommended regulations, carbon taxes, and carbon trading.

"Everyone was talking about it," Hsiang says. "The problem is that the review had almost no data. There were lots of grand assumptions. My question was, Why not go out and look at the real data?"

That's what Hsiang did. For his master's thesis, he crunched weather and economic data for 28 countries in Central America and the Caribbean from 1970 through 2006. He showed that each 1°C increase in surface temperature was associated with a 2.5 percent reduction in economic output. The paper appeared in the *Proceedings of the National Academy of Sciences* in August 2010.

"When I showed the data to the chairman of my graduate committee, he said it couldn't be right," Hsiang says. "I had similar reactions to other findings, such as the effect of higher temperatures on increasing violence."

Following postdoctoral work at Princeton and the National Bureau of Economic Research, Hsiang took an assistant professorship at Berkeley. He won tenure within two years and promotion to full professor in five, at the age of 34.

21st century challenge

Hsiang sees climate change as the fundamental 21st century challenge for economics, much as slavery was the dominant issue of the 19th century and whether humans should organize collectively to share things—socialism—was for the 20th century.

"Climate change is the question of who owns the rights to this multitrillion-dollar asset, the atmosphere," he says. "If we assign those rights, there are huge implications. And if we don't, there are huge implications."

Many people have long been skeptical of climate change "for reasonable reasons," Hsiang acknowledges. It's hard to grasp, he says, that the world economy could be so energy-intensive as to raise the temperature of the very air and oceans around us. But now the data prove it.

It's important to consider the matter in economic terms and not just scientific or philosophical terms, Hsiang argues. That's because climate change grows out of economic activity, and managing it will involve economic trade-offs. In 2019, he testified before Congress that the direct thermal effects of warming over the next 80 years could reduce American incomes by $4.7 trillion to $10.4 trillion. The combined effects of climate change on agriculture, energy, labor, health, crime, and coastal communities could cost the United States 1.2 percent of gross domestic product for each 1°C increase in temperature, he said, while overall death rates, suicides, sexual assaults, murders, and birth-related harm would all rise significantly.

At the same time, the economist rejects the urge of some environmental advocates to throw everything possible at the problem. Some critics fault his research for generating cost and benefit estimates that don't seem catastrophic enough, he says.

"We can't pretend that climate change is our only economic problem," Hsiang says. The stakes in mitigating and adapting to climate change are so high that "if we make a mistake, the amount of misallocation of resources could be astronomical," he says. "We shouldn't overspend on climate change."

Consequently, Hsiang and collaborators have focused on calculating the social cost of carbon, or the comprehensive future impact on the world of each additional ton of carbon dioxide emitted into the atmosphere. Carbon dioxide is the main greenhouse gas responsible for climate change, and much of it comes from the burning of fossil fuels. The world spews more than 30 billion tons of it into the atmosphere every year, according to the International Energy Agency. And the CO_2 will stay there for 1,000 years.

"The social cost of carbon is one of the most important economic numbers we don't know,"

Hsiang says. "It will play a huge role in making decisions. If we knew what it was, we could put a value on our atmosphere as an asset" and decide on policies for addressing climate change. The Biden administration has made it a priority to update the US government's estimate. In 2010, the Obama administration put it at $51 a ton. The Trump administration cut that to $7. The case can be made that the figure should be at least $125, according to the University of California Santa Barbara's Tamma Carleton, one of Hsiang's former students, and the University of Chicago's Greenstone.

In the 2015 book *Economic Risks of Climate Change: An American Prospectus*, Hsiang and 11 co-authors made the first comprehensive assessment of the economic risks of climate change for the United States. Out of that effort grew the Climate Impact Lab, a six-year-old research consortium led by Hsiang, Greenstone, Rutgers climate scientist Robert Kopp, and Trevor Houser, a partner in the research organization Rhodium Group.

The lab deploys more than 30 researchers at Berkeley, the University of Chicago, and Rutgers, many of them graduate students, and relies on Rhodium Group's computing power. The team includes economists, climate change scientists, data engineers, and risk analysts.

"It's a recognition of the scale of the problem that you need a lot of human resources," Hsiang says. The Climate Impact Lab uses climate and economic data on a local level to document how climate change affects society, from droughts in California to mortality in India to labor productivity in China. Even though the Trump administration downplayed the issue at the federal level, the lab's granular data helped American states and cities decide where factories could be safely built and how to plan for hurricanes, according to Carleton, who was the lab's first graduate student employee.

Hsiang projects that the Climate Impact Lab will publish the initial version of its calculation of the global cost of carbon within a year. But that won't be the end of the work, he says.

"We need more economists working on this problem," Hsiang says. At the request of the editors of several academic journals, Hsiang and collaborators produced a four-part tutorial on climate change for economists. "We're trying to document our new methods for others," he says.

"We're all supposed to produce science," says Maximilian Auffhammer, an environmental economist at Berkeley. "The great ones also produce other scientists, and Sol has already trained a bunch of really impressive students."

Of course, Hsiang has detractors. The University of Sussex's Richard Tol, the creator of the widely used FUND model for estimating climate change's economic effects, has been a frequent critic.

"My main issue is that he uses weather shocks to study climate change," Tol says. "Weather shocks are unexpected. Climate change is slow and predictable. As a result, he overstates the impacts."

Data and policymaking

Hsiang rejects that, saying, "we have been doing a lot of innovation to study how populations adapt," and argues that his use of data and econometrics produces quite different findings from the FUND model.

Others say it's a waste of time to calculate the cost of carbon because there will always be too much missing data to get it right. "We don't need a full optimization model to make certain decisions," write Nobel laureate economist Joseph Stiglitz and Britain's Nicholas Stern in a February 2021 paper. Policies should be built around the goals set in the 2015 Paris Agreement, they say.

Hsiang maintains that policymakers need to rely on data-based findings. "Almost everyone's intuition for the role of the climate in the economy is not right," he says.

"The advent of large-scale data collection, high-powered computing, and the application of science to policy means that we can now build transparent and evidence-based systems to guide our thinking," he says. "The future of managing all planetary resources fairly and sustainably, even beyond climate change, will rely on these tools."

As for the alarming effects of climate change and the world's tardy, confused, and incoherent response, Hsiang takes a long view, harking back to the days when leaders consulted oracles to divine the future.

"We are at the state of scientific sophistication where we can understand future pathways and make thoughtful decisions in advance," he says. "This is the first time in human history where we saw something this big coming and have the opportunity to do something about it." FD

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