AAAS
ADVANCING SCIENCE, SERVING SOCIETY

http://www.aaas.org/3fA

The Financial Risks of Climate Change Remain a Riddle, Scientists and Economists Say

2 DECEMBER 2014 | GINGER PINHOLSTER

AAAS News [1]
Center for Public Engagement with Science and Technology [2]
Science Policy [3]

A day after the United States and China reached a landmark climate-change agreement, AAAS and Resources for the Future (RFF) convened scientists and economists to consider how best to calculate the financial risks associated with a changing climate, which will be critical to policy decisions.

Financial expert Bob Litterman on 12 November urged scientists to work toward better quantifying the economic costs of extreme temperature increases as well as catastrophic, yet less likely climate-change events.

Litterman, a partner and chairman of the Risk Committee at Kepos Capital, pointed to wide variations in existing estimates of climate-change costs. The 2014 Synthesis Report of the Intergovernmental Panel on Global Climate Change (IPCC) also expressed concerns that economic models do not adequately capture catastrophic risk, he noted. "That's true, but it's unacceptable to simply criticize those models without helping to improve the estimates," Litterman said. "There is no other source of information about potential catastrophic risks that we can use to tell us the social cost of carbon. We need science to help quantify that risk."

> "The biggest source of uncertainty is the human dimension. That's really what is going to determine the level of global warming."
>
> **Noah Diffenbaugh, Stanford University**

Litterman further called on scientists to embrace their responsibility to help inform policy decisions about climate change. Nobel laureate Mario Molina, who spoke during a public [4] portion of the symposium, said that he thinks scientists may sometimes be overly timid about informing policymakers of climate-change risks, for fear of sounding too alarmist. "It's very clear we have not done a very good job in the scientific community of communicating with the public," said Molina, distinguished professor of chemistry and biochemistry at the University of California, San Diego. "Perhaps we were very shy in terms of potential catastrophes." Yet, he added that there is a "very real risk of catastrophes happening," unless tougher policies are put in place to reduce greenhouse gas emissions.

Existing estimates suggest that climate change will cause losses of between 0.2 and 2.0 percent of income, if temperatures rise by about 2.5 degrees Celsius above pre-industrial levels, according to the IPCC's Synthesis Report. That report added, however, that "losses are more likely than not to be greater, rather than smaller, than this range."

Mario Molina talks with an attendee at the meeting. | AAAS/Earl Lane

Moreover, current economic assessments of climate-change risks fail to account for the possibility of freakish, large-scale events — the so-called "black swan" scenarios, such as the risk of a 14-meter storm surge in Tampa Bay — or continued global warming higher than 3 degrees Celsius above the current level.

How best to assess such "tail risks," as economists call them, was a key focus of discussion among some 60 leading climate, financial, and policy experts at the RFF event, along with concerns about the accuracy of existing estimates of the "social cost of carbon." Traditionally, economists have tried to gauge climate-change costs by using "integrated assessment models" to calculate the overall damages caused by adding one more metric ton of carbon dioxide to the atmosphere in a given year. Such calculations also reflect "the value of damages avoided for a small emission reduction," according to the U.S. Environmental Protection Agency [5]. Unfortunately, as the IPCC report noted, social cost of carbon estimates "lie between a few dollars and several hundreds of dollars per [ton] of carbon in 2000 to 2015" — a range that Litterman described as "much too wide."

The most widely accepted estimate for the social cost of carbon is between thirty-five and forty dollars, but Economics Professor Michael Greenstone of the University of Chicago, who was involved in developing the U.S. government's estimate, said that "the number might be too small." First, he said, models used for setting the figure "don't really admit the uncertainty about what the damages will be." In addition, the calculations fail to reflect different impacts from region to region, or from person to person. Finally, Greenstone said, social cost of carbon estimates can be tricky because of the difficulties in establishing "discount rates" — that is, the perceived return, or potential future benefits from efforts to reduce, or mitigate climate change. If those investments are deemed comparable to the stock market, the discount rates would be set at between 5 and 7 percent, Greenstone explained. However, he added, if climate change proves to be very damaging, then climate-change mitigation will “pay off in the bad state of the world,” and a lower discount rate, such as gold’s average annual return of 2 percent, would be more appropriate. In that case, he said, the true social cost of carbon would be larger, and possibly substantially so.

Policymakers could benefit from more accurate answers to questions about the cost of climate change in order to decide on steps to adapt as well as to mitigate damages in the future, said Terry Dinan, a senior advisor in the U.S. Congressional Budget Office. Scientific uncertainties — particularly the risk of less likely but massively catastrophic events — strongly affect financial estimates of climate change, she noted.

While the social cost of carbon can be a useful measure of climate-change impacts, Dinan said that it should not be the only measure. More descriptive information about scientific uncertainties and climate thresholds remain essential, too. In addition, for policy decisions about adapting to climate change, Dinan said: "To the extent that we can provide localized, time-sensitive information about changing probabilities of damages, say, to coastal communities in ways that individual communities can use, and private entities can use, I think that can be extremely helpful in the next couple of decades."

James McCarthy (left) and Lawrence Linden | AAAS

As noted in the recent AAAS What We Know [6] report, chaired by Molina, climate scientists clearly agree that climate change is real and related to human activities — particularly fossil-fuel burning and deforestation. Over the past two centuries, a 30-percent increase in greenhouse gases in the atmosphere has resulted in "profound changes" as carbon dioxide has "warmed the surface of the planet and oceans and has melted polar ice," contributing to extreme weather events, said James McCarthy, the Alexander Agassiz Professor of Biological Oceanography at Harvard University.

Yet, scientific uncertainties related to some of the mechanisms, rate of change, climate "tipping points," and the possibility of massively disruptive events make it difficult to put a precise price-tag on climate-change impacts. Robert Kopp, an associate professor at Rutgers University who served as lead scientist for an influential report, *American Climate Prospectus: Economic Risks in the United States* [7], spelled out five specific areas of uncertainty that can affect climate-change risk assessments. Future greenhouse gas emissions remain unclear, for one thing; moreover, due to uncertainty in feedback mechanisms, scientists don't know precisely how much warming will result from given changes in emissions. The relationship between regional and worldwide climate change represents yet another question mark for scientists, Kopp said, as does the impact of natural variability, and the economic consequences of surpassing the Earth's unknown climate thresholds. "Nonetheless," Kopp said, "we do know enough about some of these uncertainties to at least partially quantify them and incorporate them into risk analyses."

Human behavior represents a whole other category of uncertainty, when it comes to climate change, said Noah Diffenbaugh, an associate professor at Stanford University. After all, Diffenbaugh said, drawing on his experience as a parent, giving a teenaged boy a bicycle doesn't mean that he will always wear his helmet. "The biggest source of uncertainty is the human dimension," Diffenbaugh said. "That's really what is going to determine the level of global warming."

Watch Mario Molina's Special Lecture

- video [4]

Real-world human responses to disasters — known as "dynamic risks" — also must be taken into account, said Michael Oppenheimer, the Alfred G. Milbank professor of geosciences at Princeton University, whose comments reflected his experience with Hurricane Sandy in 2012 — an extreme weather event associated with climate change. "There's a shortfall between what's hypothetically possible, and what actually happens in the real world," Oppenheimer said. "If you looked at the aftermath [of Sandy], a lot of things that should have been done weren't done. In New Jersey, the transit system was disabled because [train] cars were parked almost at sea level."

The AAAS-RFF event was organized with support from the Rockefeller Family Fund to honor Lawrence H. Linden, Board Chair Emeritus for RFF, a nonprofit organization dedicated to environmental and natural resource policymaking. Our planet "is something beautiful, and we shouldn't degrade it casually," Linden said. He called for "an economy-wide solution" as well as stronger leadership by policymakers and scientists, working together.

Nobel laureate Molina spent part of the day of the symposium visiting with Congressman Lamar Smith (R-Texas), chairman of the House science committee. Molina described the meeting as a friendly one.

This story includes reporting by Earl Lane.

[Credit for associated teaser image: Flickr/MTAPhotos [8]]

Links:
[1] http://www.aaas.org/topics/aaas-news
[2] http://www.aaas.org/topics/center-public-engagement-science-and-technology
[3] http://www.aaas.org/topics/science-policy
[4] http://www.rff.org/Events/Pages/RFF-and-AAAS-Present-a-Conversation-with-Nobel-Laureate-Mario-Molina.aspx

[5] http://www.epa.gov/climatechange/EPAactivities/economics/scc.html
[6] http://whatweknow.aaas.org
[7] http://www.climateprospectus.org
[8] https://www.flickr.com/photos/mtaphotos/8141518609/