Press release: 16th May 2017

Taking uncertainty into account to better fight climate change

Based on an interview with Loïc Berger on his paper* "Managing Catastrophic Climate Risks Under Model Uncertainty Aversion" coauthored with Johannes Emmerling and Massimo Tavoni (*Management Science, 2017*).

New research by Loïc Berger shows that taking deeply uncertain and catastrophic climate events into account has important implications for climate policy. When such events are included in economic-climate models, the need to adjust policies to reduce the impact of catastrophes resulting from global warming emerges. The key takeaway from Berger's work is that current emissions targets need to be revised.

Biography

Loïc Berger is Assistant Professor at the Department of Economics and Quantitative Methods at IÉSEG School of Management. He received his Ph.D. in economics from the Toulouse School of Economics, France, and the Université libre de Bruxelles in Belgium. His research focuses on the economics of risk and uncertainty, with emphasis on environmental economics, the economics of climate change and health economics. Berger is also currently an associate researcher at Fondazione Eni Enrico Mattei (FEEM) and Euro-Mediterranean Center on Climate Change (CMCC) collaborating on the Climate Change and Sustainable Development program.

Methodology

Berger et al. combined three approaches to understand the effect of deep uncertainty on the way we cope with global climate change phenomena. Firstly, they developed a theoretical decision model to show the effect of deep uncertainty, which can be applied to any event. The team gathered data from climate experts related to the probability of the collapse of the Atlantic thermohaline circulation and constructed an index to determine its degree of deep uncertainty. They then used this to calibrate a well-known integrated assessment model (DICE), which combines economic and climate change models. Results show that more should be done today to reduce the probability of such catastrophes, which are associated with potentially great socio-economic impact.

The socio-economic consequences of climate change are concerning and unpredictable. Policy makers rely on models to demonstrate the potential impact of climate change and from these develop policies that could mitigate effects. "These models have been criticised as they don't account for the possibility of climate catastrophe and the deep uncertainty related to these phenomena," says Loïc Berger. "For instance, there are some predicted catastrophic events that are thought to have a 'tipping point', after which we would see an abrupt and disproportionate change

in the climate system." These include alteration of: the Atlantic thermohaline circulation, the Greenland ice sheet, the West Antarctic ice sheet, the Amazon rainforest and the El Niño/Southern Oscillation. Berger adds, "We know very little about the probability of these events occurring or what impact they would have on our lives and the economy."

Atlantic circulation collapse

To determine the economic effects of deeply uncertain climate change events, Berger and co-workers focused on the changes related to the collapse of the Atlantic thermohaline circulation. This important circulation in the Atlantic is based on salinity and temperature differences in the ocean and has been widely studied in the context of how it might be affected by climate change. And yet, Berger explains that this catastrophic event is deeply uncertain: "When you ask climate change scientists how likely it is that the Atlantic ocean's circulation will collapse, the answers received will be extremely varied."

Deep uncertainty included in integrated assessment model of economics and climate

The team used data on the different likelihoods of collapse with their newly developed decision model that mathematically determines the effect of deep uncertainties. These were implemented into an integrated assessment model that combines key elements of both biophysical and economic systems by integrating climate science with the economic consequences of greenhouse gas emissions, which is commonly used by policy makers. Berger and co-workers could use this to directly compare the effect of including deep uncertainty and the potential influence on policy. "An important metric that comes from the integrated model is the social cost of carbon, a measure of the cost of emitting CO_2 to society that should be taken into account through a tax or permit price," explains Berger. "Using the standard model, with no catastrophe or deep uncertainty considered, the social cost of carbon is estimated to be 18$/tonne."

Uncertainty increases the social cost of carbon

When deep uncertainty and the aversion towards this uncertainty is included in the model, the social cost of carbon increases to 23-27$/tonne. Berger concludes, "If we take such deeply uncertain catastrophes into account, more should be done to mitigate the effects of climate change. Emissions should be reduced by 26-42%".

Practical applications

"Policy makers need to realise that it is important to take the possibility of catastrophe into account," Berger stresses. "Although these events are deeply uncertain, we can now include this uncertainty in the models used to develop policy." Berger adds, "The consequences of disregarding the occurrence of deeply uncertain climate change events could have huge socio-economic impact. We may be able to mitigate this by taking precautions and dramatically reducing emissions now." The inclusion of uncertainty into integrated assessment models will also influence climate change and economic researchers and have implications for the International Panel for Climate Change (IPPC).

About IÉSEG School of Management: Established in 1964, IÉSEG School of Management is one of the top business schools in France, and ranked 17th in 2016 in the Financial Times ranking of Master in Management Programs. As a French Grande École and member of the *Conférence des Grandes Écoles*, IÉSEG is one of the most prestigious higher education institutions in the country. It has also been awarded the triple crown of international accreditations: AACSB, AMBA, and EQUIS.
The School currently has 4 800 students at its two campuses; the historic campus in Lille and at Paris at La Défense, Europe's biggest business hub. Bachelor, Master of Science and Post-graduate Programs at IÉSEG are taught in English. IÉSEG collaborates closely with the largest institute of research in Europe, the French National Centre for Scientific Research (CNRS). 84% of IÉSEG's permanent faculty is international, and the school has a network of more than 260 partner universities in 66 countries.
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**"Managing Catastrophic Climate Risks Under Model Uncertainty Aversion" Management Science (2017), Loïc Berger, (IÉSEG, FEEM, CMCC), Johannes Emmerling, (FEEM, CMCC), and Massimo Tavoni (Politecnico di Milano, FEEM, CMCC).*

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