CLIMA-U

Ökonomie des Klimawandels: Klimapolitik unter Unsicherheit (Climate change mitigation and adaptation under uncertainty)

Verantwortliche/ Ansprechpartner: Daiju Narita| Kiel Institute for the World Economy (and the JICA Research Institute, Japan) // Thomas Lontzek | University of Zurich, Switzerland//

a) Themes and objectives of the project

Uncertainties are thought to be a central feature of the climate change problem, but economic research on the uncertainties of climate change is still limited. The project aims to shed light on economic impacts of climate-change-related uncertainties, especially on those concerning random changes (stochasticity), on which research is still scarce.

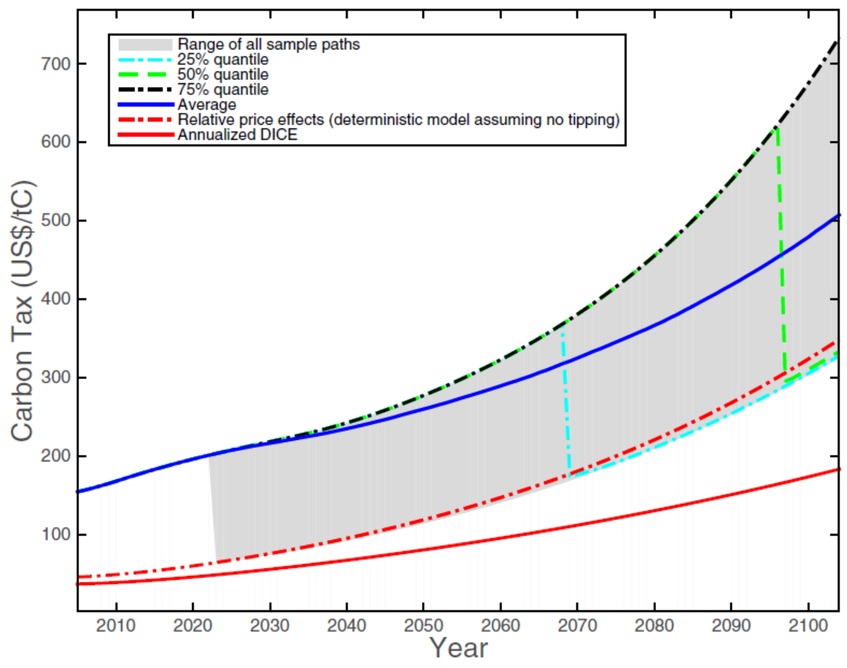

Figure: The optimal carbon taxes for the case in which the tipping point impacts market and nonmarket goods for our benchmark parameter levels. The state of the environmental good crosses a tipping point probabilistically, and so the paths of 25%, 50%, and 75% quantiles and of the average are shown as well as the range of all sample paths and two reference paths (the path of the annualized DICE model and the path with relative price effects from the deterministic model assuming no tipping).

CORE THEMES AND FINDINGS

- The project aims to shed light on economic impacts of climate-change-related uncertainties
- We performed numerical simulations for conceptual, simplified models of climate change mitigation and adaptation by using methods to reflect random changes (stochasticity) of the natural system induced by climate change
- We found that consideration of uncertainties, especially those on climate-induced ecosystem tipping points, could substantially change the cost-benefit assessment of climate change.

b) Implications for climate policy

Consideration of uncertainties, especially those not yet given much attention in the policy debates, could *substantially* change the cost-benefit assessment of climate change. In particular, our results imply that the needs for climate change mitigation (the Social Cost of Carbon, SCC) could turn out much higher than currently understood if the risks of climate-induced ecosystem tipping points are taken into account.

c) Research designs and methods

We performed numerical simulations for conceptual, simplified models of climate change mitigation (or the SCC) and adaptation. We employed modeling methods that could reflect random changes (stochasticity) of the natural system induced by climate change (stochastic dynamic optimization and real options analysis). For analysis of the SCC, we used a modified version of the DICE model (DSICE model) in collaboration with researchers from Stanford University.

d) Results*

Impacts of uncertainties (stochasticity) are substantial on optimal decisions of climate change mitigation and adaptation. In particular, our simulation analysis showed the possibility that even a modest risk of ecosystem tipping points linked to climate change can drastically change the SCC (See Figure on the left column).

*For further information, please see:

Cai, Y., K.L. Judd, T.M. Lenton, T.S. Lontzek, and D. Narita, *PNAS* 112(15): 4606-4611, 2015.

Narita, D., and M. Quaas, *Climate Change Economics* 5(4) 1450013, 2014

Contact:

Dr. Daiju Narita, Kiel Institute for the World Economy and the JICA Research Institute, Japan (e-mail: daiju.narita@ifw-kiel.de, Narita.Daiju@jica.go.jp)

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