Carbon Prices, Preferences, and the Timing of Uncertainty

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In a talk which began with the big picture question, "What is the social cost of carbon?" Gernot Wagner, currently a Research Associate with Harvard's School of Engineering and Applied Sciences, presented an overview of research in progress which he is pursuing with Bill Hogan, Raymond Plank Professor of Global Energy Policy at HKS. Hogan and Wagner are undertaking a new analysis of how uncertainty and consumption preferences over time may factor in to setting an appropriate carbon price.

Efforts to estimate the social cost of carbon must grapple with many uncertainties, Wagner began. One important source of uncertainty is not knowing how sensitive climate is to changes in atmospheric carbon—just how much will average global temperatures increase, given a doubling of carbon dioxide concentrations above pre-industrial levels?

Wagner showed how a range of analyses develop probability distributions to answer this question, with the "likely" range as 1.5-4.5 degrees Celsius, but possible values extending out to 6 degrees and beyond.

How should policymakers think about this uncertainty in setting carbon prices? Wagner explained that he and Hogan are thinking about this question in the context of previous work by researchers Roe and Bauman, who in a 2013 article drew attention to a seemingly simple point: the higher are possible equilibrium climate sensitivity values, the longer it takes for global average temperatures to rise to those levels. Time matters.

This insight might be well-known to climate scientists, but it has largely been ignored in the climate-economics literature so far. Hogan pointed out that the Roe and Bauman paper had been cited a mere 15 times; Wagner quipped that 3 of those are his. Wagner explained how incorporating this timing element into a model of the economic impacts of carbon emissions reduces the uncertainty of likely temperature impacts of carbon emissions over the next few decades. We may not know where we are heading over the long term, but we know more about likely temperature change over a shorter time horizon. Furthermore, the impact of persistent uncertainty about climate impacts can be minimized by being flexible about future policies—we have the ability to keep observing and learning about the trajectory we are on as time passes and we get more information about temperature, and to change our actions accordingly. The result of this analysis, taken by itself, is a decrease in both uncertainty and in the related optimal social cost of carbon by about 30% relative to scenarios that ignore this time element.

Hogan and Wagner's work-in-progress presentation then went a step further. Recent key advances in the climate-economic literature focus on the introduction of so-called "Epstein-Zin preferences." Unlike most standard preference assumptions, this allows for a separation of risk across time and risk across states. Hogan and Wagner modify Bill Nordhaus's well-known DICE model to allow for this richer set of preferences. Early results indicate that, under reasonable assumptions, the social cost of carbon does not vary much with changing assumptions around risk aversion. It does, however, vary significantly with changing assumptions around people's preferences across time. That is particularly troubling, as there is currently no academic consensus about how much consumption today an impartial third party interested only in maximizing utility over time ought to be willing to give up for the sake of more

consumption in the future. In fact, Wagner noted, using different assumptions about the willingness to substitute consumption in the future for consumption today leads to far greater differences in the optimal price of carbon today than do current uncertainties about the temperature impacts of carbon emissions.

This continuing uncertainty about how to value current costs vs. future costs "dwarfs" almost all other uncertainties, Wagner concluded. While using "Epstein-Zin preferences" is a significant step forward from earlier, simpler preference specifications, uncertainty around the correct discount rate has now simply moved one step closer to another time-dependent parameter that is difficult to pin down. Optimal climate policy—setting the right price of one ton of carbon dioxide emitted into the atmosphere—crucially depends on assumptions of people's willingness to trade off consumption today versus tomorrow. Risk matters. Timing might matter even more.

Wagner and Hogan presented their draft paper as part of the Kennedy School's Energy Policy Seminar Series, which is sponsored by the Consortium for Energy Policy Research of the Mossavar-Rahmani Center on Business and Government.