COMMENTARY:

Pricing climate risk mitigation

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Adaptation and geoengineering responses to climate change should be taken into account when estimating the social cost of carbon.

At the September 2014 United Nations Climate Summit, 73 countries and more than 1,000 companies advocated pricing carbon[1]. Economists have long called for pricing carbon to reflect the social damages associated with the impacts of carbon dioxide emissions on the global climate[2,3]. Such an approach generally reflects the polluter pays principle — as elaborated in the 1992 Rio declaration on environment and development, with its emphasis on the use of economic instruments to internalize environmental costs[4]. Scholars have also called for the organization of international negotiations around agreement on a carbon price to provide the basis for emission commitments[5,6].

The meaning of carbon pricing

For some policymakers, setting a price on carbon that reflects the cost of carbon pollution can inform the 'objective' of climate policy. For example, the US government uses an estimate of the social cost of carbon (SCC) — the present value of monetized damages associated with an incremental ton of carbon dioxide emissions — to evaluate standards for fuel economy, appliance efficiency and carbon emissions[7]. As some laws require regulations to reflect a weighting of benefits and costs, the application of the SCC could determine the ambition of energy and climate policies.

For other policymakers, pricing carbon is an 'instrument' of climate policy — such as carbon dioxide cap-and-trade programmes or a carbon tax. For example, the European Union emissions trading scheme and the British Columbia carbon tax impose a price that carbon dioxide-emitters must bear. Of course, these two interpretations can be mutually reinforcing. In a benefit–cost framework, a policy that maximizes net social benefits would equate the SCC with the price borne by emitters under a tax or cap-and-trade instrument[8].

Whether the SCC determines the objective of policy, informs the design of a pricing instrument, or serves as a focal point in international negotiations, it will play an important role in the future of climate change policy. The social damages of carbon emissions will depend on the impacts of a warming world, such as sea-level rise, extreme weather events and changes in agricultural productivity, as well as potential catastrophic harms, migration, conflict and so on[9]. The SCC will also vary with alternative efforts to mitigate climate change risks, such as adaptation and geoengineering. Thus, it is important to conceptualize the SCC in the context of the full suite of risk management policies for climate change.

Managing risks posed by climate change

Policymakers, individuals and businesses can use three general approaches to mitigate the risks posed by climate change. First, they can halt the atmospheric accumulation of greenhouse gases, thereby preventing the problem through emission abatement. Second, they can avoid some climate change impacts by making investments in adaptation and resilience. Third, they can attempt to 'fix' the problem through geoengineering, such as solar radiation management strategies.

This multipronged approach to mitigating climate risk has emerged only recently in the debate over climate change policy. In the 1990s, international and domestic climate change policy focused almost exclusively on emission abatement. In the early 2000s, adaptation joined emission abatement in multilateral negotiations as well as development policy. In recent years, scholars have raised the prospect of geoengineering paired with emission abatement to avoid potentially catastrophic climate change[10–12]. Putting a price on carbon for emission abatement that fails to account for adaptation and geoengineering risks could leave too few resources for these options, which have potentially high returns in reducing climate change damages.

Role of adaptation and geoengineering

Pricing carbon within a comprehensive risk management framework requires continued work and advances in our understanding of climate change damages. Scholars from an array of disciplines have raised questions about the damage functions in the integrated assessment models that generate SCC estimates[9,13,14]. Improving the knowledge base on climate change impacts is a necessary foundation for evaluating the risk mitigation impacts of emission abatement, adaptation and geoengineering.

The status quo integrated assessment model approach produces an estimate of SCC without consideration of geoengineering and typically with incomplete or ad hoc attempts to represent adaptation[15]. Of the more than 400,000 SCC estimates produced by the US government in its 2013 report[15], 160 scenarios had a SCC in excess of US$1,000 per ton — or nearly US$10,000 in annual climate damages per US household — for its residential energy consumption. It is difficult to imagine that if the world were in such a dire state there would be no increase in adaptation investment or geoengineering deployment to offset at least some of these impacts.

Many individuals and businesses have strong incentives to mitigate their exposure to risks related to climate change. If the impacts of climate change become more severe, then they will increase their private adaptation investments. Moreover, governments are likely to increase outlays for resilience and adaptation if climate risks become more pronounced.

Adaptation will not fully offset the increase in damages, but it is likely to offset some climate change risk. As a result, the integrated assessment framework for evaluating the damages of an incremental emission of carbon dioxide should be expanded to include an 'adaptation response function'. Such a function (or system of functions) would represent how adaptation actions by governments and private agents respond to climate change, how adaptation affects the residual damages associated with another ton of carbon dioxide in the air, and how much this adaptation costs. This adaptation response function would result in lower monetized damages — because adaptation reduces the impacts of a changing climate — and an opportunity cost for these adaptation investments. If adaptation investments occur only when their returns (benefits of climate risk reduction) exceed their costs, then on net this adaptation function approach would result in a lower SCC than the status quo approach. If private agents, however, make adaptation investments that are privately welfare-improving, but impose local negative externalities (for example, damming a waterway), then the SCC could increase when accounting for adaptation response.

Similarly, a 'geoengineering response function' could be incorporated into integrated assessment models. Such a function would be likely to focus on state behaviour and, possibly, multilateral coordination. This response function could represent a future multilateral governance regime, especially if such a regime provided clear guidance on the use of geoengineering. Alternatively, the response function could model the incentives and behaviour of various countries likely to react to adverse climate impacts through unilateral geoengineering actions. Just as in the case of adaptation response, a geoengineering response would be likely to reduce some climate risks (for example, temperature-related impacts) at the cost of designing and implementing the geoengineering actions. It is important to recognize that these costs would include those associated with launching the geoengineering solution (for example, injecting reflective particles into the stratosphere) as well as possible unintended side effects. Based on the first-order effects, accounting for geoengineering response would be likely to reduce the SCC — again, through lower impacts net of the direct cost of implementing geoengineering — but the unintended side effects may increase social losses and could potentially offset the social gains.

Constructing such response functions requires, at a minimum, research on three dimensions of the problem. First, greater spatial and temporal resolution in estimating impacts can inform the consideration of adaptation and the incentives for any given state to launch geoengineering. Second, the construction of such response functions should explicitly enable uncertainty analysis. Just as there are uncertainties in how emissions translate into impacts, meaningful uncertainties characterize the form, timing and efficacy of adaptation and geoengineering responses. Third, these functions could inform a richer application of game theory, drawing from international relations and economics, to understand the likely reactions of countries to a changing climate and the prospects for building a credible international climate policy architecture. As the incentives for free-riding differ dramatically across these three general approaches[16], explicit modelling of behaviour may be important in constructing the response functions.

Policy implications

A conventional economic approach to this kind of risk management problem would call for evaluating the returns (say, in reduced damages) associated with incremental investments along each of these three approaches. A policy that maximizes the risk reduction for a given expenditure of resources would equate the marginal return on emission abatement with the marginal return on adaptation, and with the marginal return on geoengineering. This is simply an extension of the same cost-effectiveness analysis that underlies the case for putting a common price on carbon across all emission sources to maximize emission reductions for a given expenditure of resources on abatement. Even if there is no explicit policy effort to equate the marginal returns with actions along these three approaches, the avoided damages associated with emission abatement are likely to be affected by adaptation and geoengineering responses that could occur in the future.

The use of a SCC enhances the transparency of public decision-making and can facilitate the identification of opportunities to mitigate climate change risks. The failure to meaningfully slow the growth in global greenhouse-gas emissions in recent decades suggests that driving emission abatement through carbon pricing is important, but only part of the risk management portfolio. There will be hard decisions in the future. Policymakers will need rigorous tools that account for all available options for the risk management of climate change to inform these decisions. ❐

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