Do climate dynamics matter for economics?

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Climate economics: Do climate dynamics matter for economics?

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Economic models of climate change are the basis for climate policy design. However, incorrect representation of physical dynamics in these models could lead to biased advice.

How stringent should climate policy be? What is the cheapest way to achieve a long-term temperature target? These are two key questions in the economics of climate change[1]. The answers depend on the dynamics of the carbon cycle and the climate. If carbon dioxide degrades faster from the atmosphere, then we would need to worry less about current emissions and more about future emissions. If the world warms faster, then damages are larger and we would need to cut emissions harder. In a recent paper, Simon Dietz and colleagues show that commonly used integrated assessment models, the workhorses of climate policy analysis, are out of step with the latest climate science[2]. Specifically, short-term warming is too low, long-term warming is too high, CO_2 stays too long in the atmosphere, and climate change does not affect the carbon cycle. These effects pull in different directions, with potential implications for policy recommendations on the optimal carbon price.

Integrated assessment models are often used to assess how society would need to change to avoid warming in excess of 1.5 or 2°C or to estimate what price to put on carbon. To achieve this, these models should accurately represent the actual climate dynamics and the climate sensitivity—how temperature will respond to higher CO_2 concentrations. However, current models may fail to capture the state-of-art of climate science. This could lead to biased policy recommendations.

The core of Dietz' argument is that integrated assessment models should reflect the current understanding of the dynamics of carbon cycle and climate. Details of the physics that are not quite right undermine the credibility of the policy recommendations. Too often, the results from integrated assessment models are dismissed because some model detail is wrong or out of date—even if that detail does not affect the thrust of the argument. Technocratic policy advice is bound to offend some political party. Faulty details can be used as an excuse to ignore findings. Steps should be taken to minimize such grounds for rejecting the research. Dietz et al. make a small step in the right direction.

A small step, as the resultant changes due to Dietz' updates are not that large (Figure 1). Placing the original and updated estimates of the social cost of carbon, a yardstick for the desirable intensity of climate policy, in the histogram of all previously published estimates[3] shows that making the changes suggested by Dietz and colleagues shifts the social cost of carbon from the 35th to the 31st percentile of previous estimates—from \$37/tCO_2 to \$30/tCO_2. In a companion paper[4], the social cost of carbon increases by \$12/tCO_2. The carbon tax needed to meet Paris' 2°C target falls more, by two-thirds. This is still small relative to the range of numbers found in the literature, where the near-term tax for the same target can differ by a factor 20 between models[5].

The update by Dietz et al. is not perfect. They omit a comparison of the updated model to records of past concentrations and temperatures. They calibrate to the median of model responses, rather than to the response of the median model. The updated model is therefore not necessarily consistent with observations and physics. They calibrate the updated integrated assessment model to one large injection of carbon dioxide into the modelled atmosphere, rather than to a more realistic series of small injections. It is not clear how this affects the calibration. They assume that warming will reduce the CO_2 uptake of the biosphere, but do not include that this effect also increases with steep emission reduction[6], which would make it rather more expensive to meet stringent temperature targets.

The paper by Dietz and colleagues is the latest in a long list where researchers tinker with the natural science components of an integrated assessment model. The social science parts need attention too, arguably more urgently so. Two aspects may be improved, in this paper and much of the literature. First, Dietz et al. assume that vulnerability to climate change is constant. Yet, poorer people are generally found to be more vulnerable, so you would expect impacts to fall with economic growth. This makes climate change seem more dangerous than it is[7, 8] and ignores that development may be more powerful than emission reduction in alleviating the impacts of climate change. Second, Dietz et al. assume that greenhouse gas emissions are reduced by a global carbon tax, imposed on an economy without distortions. This makes emission reduction seem easier and cheaper than it is [9, 10]. It distracts from the need to carefully design climate policy. Badly conceived emission reduction is ineffective, expensive, and unpopular—but rarely studied in integrated assessment models so that policy makers do not know just how much damage a bad design can do.

These limitations notwithstanding, Dietz et al. show that climate dynamics matters for economic models of climate change and their policy recommendations. Model developers should be more cautious when dealing with the physical parts of their model. However, climate dynamic are not only or even most pressing part that need updating in integrated assessment models. Larger strides are needed in other directions, especially the social science components.

Fig. 1 The histogram of published estimates of the social cost of carbon, for emissions in 2010, in 2010 U.S. dollars per tonne of carbon. The bins with the original and update estimates by Dietz et al. are marked in orange.

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Competing interests

The author declares no competing interests.