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RESPONSE

Critiquing the Critique of the Climate Change Winner Argument

by Richard D. Morgenstern

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Developing a rational, globally efficient time path for pricing or controlling greenhouse gas (GHG) emissions presents daunting challenges to policy makers, with large scientific uncertainties, and the absence of consensus over the long term goals of climate policies. In their article *Climate Change and U.S. Interests*, Jody Freeman and Andrew Guzman (FG) attempt to debunk what they label the "climate change winner" argument, i.e., the notion that the United States is likely to fare relatively well in a warmer world, at least compared to most other nations, and is thus not rationally compelled to invest in expensive mitigation efforts that may largely accrue to the benefit of others. Focusing on the integrated assessment models (IAMs), FG argue that the models are "methodologically limited in ways that systematically skew toward an understatement of . . . [damages]."[1] Their conclusion: damage estimates derived from the IAMs are too low by an order or magnitude, not including a number of impact categories they are unable to quantify.

As is widely understood by natural scientists, lawyers, economists, and others concerned with climate policy, there are significant tensions between the estimation of economic damages from climate change and the limits of efforts to model the effects. Notwithstanding these tensions, I believe FG have unfairly attacked the IAMs and over interpreted the model results, with a focus on point estimates and neglect of the uncertainty inherent in any such calculations. FG identify six critical deficiencies in the IAMs' estimates:

- optimism about modest projected temperature rise;
- failure to account for the possibility of catastrophic loss under different future scenarios;
- omission of negative cross-sectoral impacts;
- exclusion of non-market costs;
- optimism about projected continued economic growth (which assumes productivity will be unaffected by climate change); and a
- failure to account for international spillovers.

For each claimed deficiency, FG offer their judgments on a preferred estimate of climate-induced damages. Yet, contrary to their claims, most of these issues have already been addressed in prior reviews and meta-analyses of the IAMs, with somewhat different results. Most of the other assessments find lower central estimates than FG, and they recognize greater uncertainty in the results.[2]

My comments focus on two issues: 1) the relative unimportance of damage estimates in the climate policy debate; and 2) the inherent difficulty of dealing with the uncertainties in both physical and monetary damages in a scientifically credible manner. Overall, I commend the authors for undertaking the effort to critique the centrist view on climate damages. Like FG, I do not see the climate change winner argument as particularly compelling. At the same time, I do not see their critique as a significant advance in the debate.

There are, in fact, two distinct analytic approaches to developing a rational response to global warming: cost-effectiveness or benefit cost analysis. The former assumes that policymakers have in mind a long run target for limiting the amount of projected climate change or atmospheric GHG accumulations, and focuses on what policy trajectory might achieve alternative goals at minimum economic cost, accounting for practical constraints, including incomplete international coordination. The latter approach, weighing the benefits and costs of slowing climate change, introduces the more contentious issues of damage assessment and valuation, including extreme or catastrophic climate risks. IAMs cross the traditional boundaries of individual academic disciplines and integrate knowledge from different fields into a single framework, including algorithms representing emissions/concentrations relationships, climate adjustment and sensitivity, damages from climate change inferred from a point estimate of total damages using functional form assumptions, and discount rates. While admirers see IAMs as powerful analytical tools,

1. Jody Freeman & Andrew Guzman, *Climate Change and U.S. Interests*, 41 ELR 10695 (Aug. 2011).

2. An exception is a recent paper by Frank Ackerman and Elizabeth A. Stanton that considers what they term the "morally offensive assumption to value human lives less in poor countries than in rich ones." *See* Frank Ackerman & Elizabeth A. Stanton, E3 Network The Social Cost of Carbon: A report for the Economics for Equity and Environment Network (2010), *available at* www.e3network.org.

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detractors see them as black boxes, virtually incomprehensible to the outsider.

The good news is that the policy community has consistently supported cost-effectiveness as the relevant approach for addressing climate change. Every single legislative proposal advanced over the past several years, including the sole bill achieving a majority vote in Congress (H.R. 2454), has stated the goals in terms of a target greenhouse gas concentration or emissions levels. While policies are neither conceived nor framed in terms of the monetized benefits, I would not reject the benefit cost framework as applied to this issue. Rather, I see it as an evolving area of research not yet ready for prime time in the policy world.

The gross similarities in aggregate impacts predicted by the models mask huge inconsistencies across the studies, particularly regarding the relative importance of different damage categories. In fact, the FG paper is but one of several recent efforts to evaluate the damage literature, with a focus on the IAMs. A paper by Aldy et al. characterizes the representative estimates of damages from warming presumed to occur by around 2100 in the range of 1-2 percent of GDP for warming of 2.5 degrees C above pre-industrial levels, and on the order of 2-4 percent of GDP for warming of 4 degrees C.[3] The figure accompanying this article, from Aldy et al., displays the range of estimates from a set of widely discussed models. As shown, there are huge differences about the size of market and nonmarket damages, and the expected catastrophic risks. As the authors note, few studies tend to value damages from extreme warming scenarios "… given that so little is known about physical impacts of large temperature changes."[4] As exceptions to that observation, they point to two papers that put total damages at 10.2 -11.3 percent of GDP, for warming of 6–7.4 degrees C. However, they also point to the large inconsistencies in the relative importance of nonmarket impacts: in one study they account for about half of the overall damages, but are largely offset by the gains from leisure activities in another study.

A further analysis, which highlights some of the complexities of assessing the IAMs, is an exercise recently conducted by a federal Interagency Working Group (IWG), drawing on experts from the President's Council of Economic Advisors, the Environmental Protection Agency, the Department of Treasury, and more than half a dozen other executive branch agencies. The IWG analysis seeks to estimate the monetized damages associated with an incremental increase in carbon dioxide (CO_2) emissions in a given year, labeled the social cost of carbon. The stated purpose of the exercise is to provide a basis for agencies "to incorporate the social benefits of reducing . . . CO_2 emissions into cost-benefit analyses of regulatory actions that have small or 'marginal' impacts on cumulative emissions."[5]

In thinking about the different approaches adopted for assessing the uncertainty inherent in IAMs, choices must be made about the appropriate evaluative standard to be used. Arguably, different academic disciplines might embrace different approaches. In the fields of public policy and economics, an oft-cited standard is the one developed by the U.S. Office of Management and Budget (OMB) for regulatory analysis of very large federal regulations. In its Circular A-4, the OMB recommends that agencies:

> [assess] . . . the sources of uncertainty and the ways in which benefit and cost estimates may be affected under plausible assumptions . . . [apply] principles of full disclosure and transparency . . . [and] be credible, objective, realistic, and scientifically balanced.[6]

> [OMB also recommends] that data and models . . . [used] to analyze uncertainty should be fully identified . . . [and] the quality of the available data used . . . [should be discussed]. Inferences and assumptions used . . . should be identified, and . . . analytical choices should be explicitly evaluated and adequately justified. . . . [T]he strengths of your analysis . . . [should be delineated] . . . along with any uncertainties about its conclusions. Your presentation should also explain how your analytical choices have affected your results.[7]

With such an approach in mind, let me briefly consider the methods, imperfect as they are, used to develop the IWG's social cost of carbon.

The starting point for the IWG is a set of simulations conducted on three well-known IAMs: FUND, PAGE, and DICE. At the outset, the IWG acknowledges that "these representations are incomplete and highly uncertain. But given the paucity of data linking the physical impacts to economic damages, we were not able to identify a better way to translate changes in climate into net economic damages, short of launching our own research program."[8] The next step for the IWG is to conduct sensitivity analyses across a series of input parameters, including a number of those considered by FG: the discount rate, the growth in GDP, population, and emissions. For the climate sensitivity parameter, a key input into the IAMs, the IWG selects

3. Joseph E. Aldy et al., Resources for the Future, Designing Climate Mitigation Policy, Discussion Paper 08-16 (2009), *available at* http://rff.org/RFF/Documents/RFF-DP-08-16-REV.pdf.
4. *Id.* at 8.
5. Interagency Working Group on Social Cost of Carbon, Appendix 15A. Social Cost of Carbon for Regulatory Impact Analysis Under Executive Order 12866, *in* U.S. Department of Energy, Final Rule Technical Support Document (TSD): Energy Efficiency Program for Commercial and Industrial Equipment: Small Electric Motors (2010), *available at* http://www1.eere.energy.gov/buildings/appliance_standards/commercial/pdfs/smallmotors_tsd/sem_finalrule_appendix15a.pdf.
6. Office of Management and Budget, Circular A-4 (2003), *available at* http://www.whitehouse.gov/omb/ circulars_a004_a-4/#a.
7. *Id.*
8. Interagency Working Group on Social Cost of Carbon, *supra* note 5, at 8.

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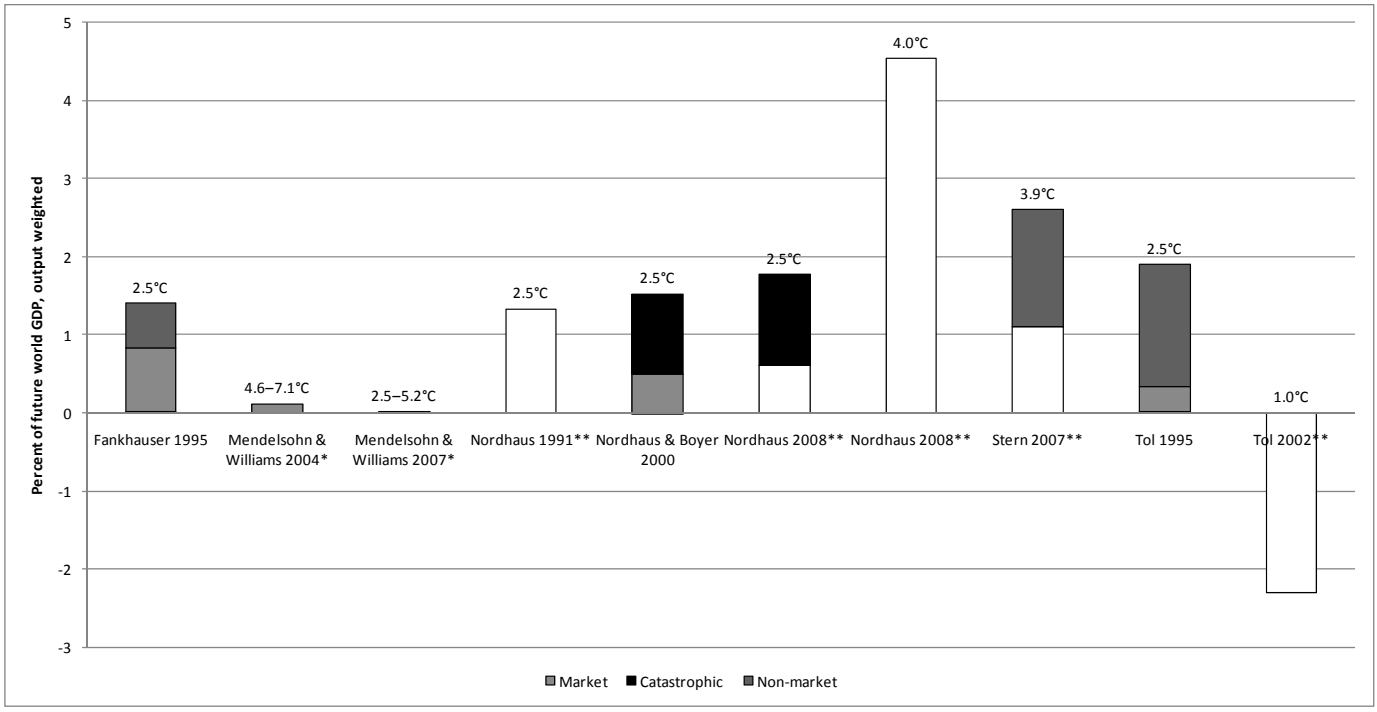
Selected Estimates of Contemporaneous World GDP Damages From Global Warming Occurring Around 2100



Notes:

* Only market damages were estimated in these studies. And the above figure is the midpoint of a range of damage estimates.

** Damage categories are not precisely de-lineated in these studies.

Source: Aldy et al, *supra* note 3, at 47.

one specific value from the peer-reviewed literature, on the basis of explicit criteria and after consultation with relevant IPCC authors. Combining the alternative assumptions, the IWG develops a range of estimates: $5-$65 per ton of CO_2 reduced, with a central estimate of $21/ton in 2010 (2007$), rising over time to $16-$136 per ton, with a central estimate of $45 in 2050.

Even with this relatively wide range of estimates, the IWG endeavors to identify the limits of their analysis. Specifically, they note the incomplete treatment of both catastrophic and non-catastrophic damages, of adaptation and technical change, and risk aversion. As regards issues of catastrophic damages, they raise concerns about the extrapolation of climate damages to high levels of warming, the failure to incorporate inter-sectoral and inter-regional interactions, and the imperfect substitutability of environmental amenities.

In contrast to the IWG, or to the Aldy et al assessment, FG do not focus on the highly uncertain nature of the existing estimates, or the inconsistencies among the IAMs. Instead, they simply characterize the IAMs as generating GDP loss estimates of 0-3 percent and, then, proceed to consider the six issues they have identified as the cause of the presumed underestimates. Thus, a key difference between the FG approach, and those adopted by either the IWG or by Aldy et al, lies in the recognition and treatment of the uncertainty inherent in the estimates. Although none of the studies performs the formal Monte Carlo analyses recommended by OMB, the IWG clearly comes closest to the OMB approach with its extensive sensitivity analyses. The Aldy et al. paper provides some sensitivity analysis, albeit more limited than the IWG. Both the IWG and Aldy et al. present their results as a range, including a central estimate. FG focus on a single estimate, comparable in some respects to the IWG's central estimate.

In all the papers, some potential damages remain unquantified. In the case of the IWG, there is explicit consideration of key variables such as the climate sensitivity parameter, emissions growth, and others factors. Aldy et al. focus considerable attention on catastrophic damages, non-market impacts and the discount rate. Interestingly, they also discuss air capture and geo-engineering as possible policy options for mitigating extreme events. In contrast, FG do not conduct a sensitivity analysis of any kind. They use limited data to analyze uncertainty and fail to evaluate the analytical choices they have made or to delineate the strengths of their analysis along with the uncertainties about its conclusions. In effect, FG have substituted their scientific judgments for those of the integrated assessment modelers, with quite limited analytical support.

Unsurprisingly, the results of these analyses are quite different. FG adopt a central estimate that is an order of

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magnitude larger than the conventional estimates of the IAMs. Aldy et al. do not explicitly identify a preferred central estimate. Implicitly, however, they seem to favor a relatively small increment above the conventional wisdom, largely to incorporate catastrophic risks. The IWG goes the furthest in its quantitative analysis and does include a range that spans an order of magnitude, although the central estimate is well below the upper bound. It also identifies a series of major limitations of current knowledge and calls for further research.[9]

So, where does all this lead? Clearly, the preference in the climate policy community is for cost-effectiveness as opposed to cost-benefit analysis. Nonetheless, there is an understandable desire to assess the existing cost-benefit literature. Given the relatively primitive state of knowledge of the physical impacts of climate change—and even more so for the monetized value of damages—there is plenty of room for debate.

Overall, FG have performed a useful service by laying out some of the issues that may give rise to underestimates by the IAMs and, particularly, in making the issues accessible to audiences not steeped in the subtleties of the climate sensitivity parameter, Monte Carlo analysis or similar complexities. At the same time, the IWG estimate of $21 of an incremental ton of CO_2 reduced in 2010, ranging up to $65 under some assumptions, and increasing steadily over time is hardly a sign that the United States is a climate change winner, as FG suggest. Especially with the rampant efforts underway to attack the underlying science of climate change, I believe it is important to embrace strong scientific methods when assessing the IAMs, even at the risk of understating somewhat the potential damages. It is better to be generally correct than precisely wrong.

9. Specifically, the IWG identifies five major limitations of current knowledge: Incomplete treatment of noncatastrophic damages; incomplete treatment of potential catastrophic damages; uncertainty in extrapolation of damages to high temperature; incomplete treatment of adaptation and technical change; and risk aversion.