RESPONSE

Comment on *Of Montreal and Kyoto: A Tale of Two Protocols*

by Peter R. Orszag and Terry M. Dinan

In *Of Montreal and Kyoto: A Tale of Two Protocols*,[1] Prof. Cass Sunstein compares the political economy dynamics leading up to the signing and ratification of the Montreal Protocol (governing substances that deplete the ozone layer) and the Kyoto Protocol (governing substances that contribute to global warming). He observes that the United States was a strong and early supporter of the control of ozone-depleting substances but has generally opposed binding controls on greenhouse gases (GHGs). In contrast, Britain was significantly more reluctant to agree to limits on ozone-depleting substances but has actively supported restrictions on GHGs. Professor Sunstein attributes that contrast to differences in the two nations' perceptions of domestic benefits and costs from environmental action, and he concludes that the key to obtaining a global agreement on GHGs will involve raising perceived benefits within the United States from such an agreement while reducing its perceived domestic costs. He suggests that motivating developing countries to agree to emission limits and achieving such reductions through an incentive-based global approach—such as a global tax on carbon dioxide (CO_2) emissions or a global cap-and-trade program—are the most promising approaches to altering U.S. perceptions of domestic benefits and costs.

It is undoubtedly correct that perceptions of domestic benefits and costs are important determinants of countries' willingness to enter into international agreements (including those about limits on global pollutants).[2] As we discuss in Section I below, however, if one accepts Professor Sunstein's perspective and measures of the domestic benefits of GHG emissions reductions, his proposed approaches would be unlikely to motivate the United States to enter into such agreements. Specifically, those approaches would actually serve to increase costs to the United States while doing little to increase its perception of domestic benefits (based on the benefits measures that Professor Sunstein uses). While incentive-based approaches are likely to be important components of a cost-effective approach to reducing GHG emissions, we point out in Section II that Professor Sunstein does not give sufficient attention to the serious implementation challenges that would be associated with a global cap-and-trade program. Finally, we suggest in Section III that the measures of domestic benefits that Professor Sunstein presents do not adequately incorporate a primary motivation for agreeing to GHG restrictions: reducing the possibility that the buildup of those gases could lead to extremely large, potentially even catastrophic, damage that could not easily be allocated among countries.[3]

I. Distribution of Costs and Benefits in a Global Emissions-Reductions Scheme

Any effort to make meaningful reductions in global emissions of GHGs would have to involve the world's five major emitters: (1) the United States; (2) China; (3) the European Union (EU); (4) Russia; and (5) India (see Table 1). As Professor Sunstein points out, available estimates of the damage that China and the United States would incur (inadequately accounting for the uncertain possibility of catastrophic outcomes, as discussed below) as a result of a 2.5 degrees Celsius (°C) increase in average global temperature may provide an insufficient incentive for either the United States or China to agree to incur significant costs to reduce emissions.[4] Further, China may be less willing to shoulder even more modest costs given its low per capita income. Among those five top emitters, India is predicted to benefit the most from reduced warming, but like China, it has far fewer economic resources to devote to the problem than either the United States or the EU. Among the key players, the countries in the EU stand out as likely to benefit significantly from reduced warming (again, in expected value terms and without accounting for very uncertain but potentially very large damage), having sufficient per capita income so that reasonable levels of emission reductions would not pose undue hardship, and having contributed significantly to the stock of emissions in the past.

Professor Sunstein observes that changing the dynamics of international negotiation would require a method of increasing perceived benefits and reducing perceived costs for some of the major emitters. He suggests that a global tax or cap-and-trade program might help achieve such an outcome. We agree that a global incentive-based approach would lower the aggregate cost of reducing emissions and could lead to greater total reductions. It would be much less likely, however, to alter the *distribution* of potential benefits (as indicated by the distribution of expected damage pre-

Peter R. Orszag is the Director of the Congressional Budget Office (CBO). Terry Dinan is the CBO's Senior Advisor for Climate Policy.

1. Cass R. Sunstein, *Of Montreal and Kyoto: A Tale of Two Protocols*, 38 ELR (Envtl. L. & Pol'y Ann. Rev.) 10566 (Aug. 2008) (a longer version of this article was originally published at 31 Harv. Envtl. L. Rev. 1 (2007)).

2. This observation holds regardless of which level of government adopts the policy intervention. For a discussion of how the distribution of costs and benefits among states affects the likelihood of reaching an agreement on the control of tropospheric ozone, see Terry Dinan & Natalie Tawil, *Solving Environmental Problems With Regional Decision-Making: A Case Study of Ground-Level Ozone*, 56 Nat'l Tax J. 123 (2003). We also note that many analyses that consider emissions restrictions from a global perspective suggest that well-designed policy actions to slow climate change would produce larger benefits than costs.

3. While Professor Sunstein has written extensively about the role that concern about catastrophic outcomes plays in shaping climate policy, the expected value measures of damage that he presents here do not adequately represent those outcomes. *See* Cass R. Sunstein, Worst-Case Scenarios (2007) [hereinafter Sunstein, Worst-Case Scenarios].

4. In reality, the increase in the average global temperature resulting from unchecked emissions may be much larger than 2.5 °C. Further, preventing an increase of 2.5 °C may not be feasible given the emissions that have already occurred. However, the pattern of relative damage across countries is likely to provide insight into the pattern of relative benefits for policies that restrict emissions.

sented in Table 1), which is independent of where and how emission reductions occur.[5]

Professor Sunstein also suggests that major emitters with sufficient means could increase the benefits that China would receive from restricting emissions by paying it to undertake reductions, and that such payments could be built into a global cap-and-trade program through the allocation of allowances (that is, rights to emit).[6] If China were given enough allowances to cover its anticipated growth in emissions, any reductions in its emissions relative to that baseline would free up allowances that it could sell at a profit. However, giving China enough allowances to provide it with unrestricted growth potential would mean that other major emitters, such as the United States, would need to receive far fewer allowances than their business-as-usual baseline. The result would, therefore, essentially transfer income from the United States to China—improving the benefit-to-cost ratio for China but worsening it for the United States.

II. Implementation Challenges of a Global Cap-and-Trade Program

Linking the cap-and-trade programs of various countries could help minimize the overall cost of reducing emissions but could also create significant concerns. Competitive forces would equalize the price of allowances among countries, a desirable outcome in that it is a necessary condition for global cost-minimization. However, countries would have to give up sovereignty over the price of allowances traded in their programs as well as control over the standards governing emissions reductions. Lax monitoring or enforcement by any one country would lessen the incentive to cut emissions in other participating countries and could undermine the integrity of the whole system. Including developing countries in a cap-and-trade program could increase the likelihood of that outcome since such nations may lack the institutional structures necessary for successful monitoring and enforcement.[7]

A harmonized tax—implemented in different countries at an agreed-upon rate—could avoid one of the potential problems of a linked cap-and-trade program: lax monitoring and enforcement in one country would not undermine the integrity of the tax system in other countries.[8] If such a tax were agreed to by developed countries, some of the revenue proceeds could be used to fund emission reductions in developing countries in ways that would depend less on the ability of the country to monitor and enforce an incentive-based policy.[9] For example, China could agree to require new electricity-generating facilities to meet certain efficiency standards, which would be funded by proceeds from the tax on CO_2 emissions in developed countries.

A similar outcome could be achieved through a system of harmonized domestic cap-and-trade programs. In that case, countries could agree to adopt equivalent domestic cap-and-trade programs (with similar expected allowance prices), sell a share of the allowances, and use some of the auction proceeds to fund emission reductions in developing countries.[10]

Either the harmonized tax and transfer—or the harmonized cap-and-trade and transfer—policy described above could reduce the problem of system integrity associated with a global cap-and-trade program, but neither would create a more favorable benefit-to-cost ratio for the United States, based on the distribution of expected damage (and, thus, potential benefits) presented in Table 1. Those measures do not, however, reflect the fundamental uncertainties associated with climate change and, as a result, may not adequately capture a primary motivation for limiting GHG emissions.

III. The Uncertain Possibility of Catastrophic Consequences

Estimating the damage that might result from unrestrained growth in emissions of GHGs is complicated by several factors. Once emitted, GHGs can linger for a very long time in the atmosphere (for example, each ton of CO_2 generates a rise in the average global temperature that peaks about 40 years after the CO_2 is emitted and then dissipates slowly, with a half-life of about 60 years), and the damage that they create could be irreversible.[11] Further, analysts face profound uncertainties about baseline emissions, the physical processes leading to changes in the average global temperature, the resulting changes in regional climates, and ecological and human responses to changes in regional climates.[12] Potential outcomes from unrestricted emissions include a much larger temperature increase than the 2.5 °C value on which the Table 1 damage estimates are based; a weakening of the Gulf Stream, resulting in a much colder climate in Europe; rapidly rising sea levels, with resulting land losses; and far more rapid warming than anticipated (making adaptation much more difficult) as a result of strong positive feedback effects, such as the release of large quantities of

5. A global incentive-based approach could affect the distribution of benefits only if it led to much larger emission reductions than would have occurred under non-linked programs. In that case, adopting a global approach could alter the types of damages that would be avoided and, as a result, the distribution of benefits.

6. Others have suggested a similar approach. *See*, *e.g.*, Robert Stavins, Brookings Institution, *A U.S. Cap-and-Trade System to Address Global Climate Change* (Hamilton Project Discussion Paper No. 2007-13, 2007), *available at* http://www.brookings.edu/~/media/Files/rc/papers/2007/10climate_stavins/10_climate_stavins.pdf.

7. See Table 1, for a cross-country comparison of governance indicators.

8. In addition, countries would have a greater incentive to enforce a harmonized tax than a global cap-and-trade program. For a discussion of this point, see William D. Nordhaus, *To Tax or Not to Tax: Alternative Approaches to Slowing Global Warming*, 1 Rev. Envtl. Econ. & Pol'y 26, 33 (2007).

9. *See* Joseph E. Aldy et al., *Climate Change: An Agenda for Global Collective Action* (paper prepared for the Pew Center on Global Climate Change Workshop on the Timing of Climate Change Policies, Oct. 11–12, 2001), *available at* http://www.sbgo.com/Papers/Aldy-Orszag-Stiglitz_5.pdf; Joseph E. Aldy et al., *Thirteen Plus One: A Comparison of Global Climate Change Policy Architectures* (Kennedy Sch. Gov't Working Paper Series, Paper No. RWP03-012; FEEM Working Paper No. 64.2003, 2003), *available at* http://ssrn.com/abstract=385000.

10. Assuring that emitters face similar incentives to reduce their emissions would be more difficult under a system of harmonized cap-and-trade programs than under a harmonized tax, however, because allowance prices would fluctuate with changes in underlying market conditions in individual countries.

11. *See* William A. Pizer, *Combining Price and Quantity Controls to Mitigate Global Climate Change*, 85 J. Pub. Econ. 416 (2002).

12. For an excellent discussion of how these factors, as well as uncertainty and irreversibility on the cost side, affect policymaking, see Robert S. Pindyck, *Uncertainty in Environmental Economics*, 1 Rev. Envtl. Econ. & Pol'y 45 (2007).

methane (a potent GHG) due to melting permafrost. Yet, scientists have been unable to determine what level of GHG buildup would trigger such outcomes, and the risk of them occurring is captured very imprecisely in the damage estimates presented in Table 1. Specifically, those highly uncertain but potentially extremely large losses are essentially translated into much smaller but certain losses.[13]

Critics of the damage estimates presented in Table 1 suggest that alternative ways of incorporating the profound uncertainties associated with climate change (methods that better reflect the variation in possible outcomes around expected outcomes) would result in far higher potential damage estimates.[14] In fact, some analysts suggest that reducing the risk of catastrophic outcomes is the primary motivation for restricting emissions.[15] Further, if damage in individual regions grew to very large levels, the spillover effects to other regions could be large, making the allocation of catastrophic damage across different countries more difficult.[16] If the uncertain possibility of extremely large losses was better accounted for and the potential for spillover effects was taken into account, the motivation for countries, such as the United States, to agree to emissions restrictions could be much greater than the damage estimates presented in Table 1.

Scientists will continue to work at improving their understanding of the conditions under which catastrophic outcomes might occur while analysts strive to develop better methods of incorporating uncertainty into analyses of the costs and benefits of restricting emissions. Meanwhile, policymakers must grapple with these uncertainties and understand the limitations of available damage estimates. Applying an insurance framework to policy decisions might be helpful—while imposing costs on the economy, restricting emissions could be viewed as a method of buying a reduction in the risk of triggering much larger losses than those presented in Table 1 (or of being in a position to reduce emissions more quickly should scientists judge that the concentration of emissions in the atmosphere was approaching a critical threshold that would trigger large losses). Adopting that insurance perspective could cause major emitters to revise their perceptions of domestic costs and benefits and provide a foundation for a global agreement.

Table 1. Factors Affecting Countries' Potential Willingness and Ability to Implement a Carbon Dioxide Tax or Cap-and-Trade Program

	Contributions to GHG Emissions[1] (Measured as a percentage of global emissions)			Governance Indicators[3] (Country's percentile rank)					
Country	Current (in 2000)	Future (projected for 2030)	Historic (1850 to 2002)	Damages From 2.5º C Warming (as a % of GDP)[1]	Per Capita GNI[2]	Government Effectiveness	Regulatory Quality	Rule of Law	Control of Corruption
United States	20.6	18.6	29.3	0.45	44,970	90th-100th	90th-100th	90th-100th	75th-90th
China	14.7	24.5	7.6	0.22	2,010	50th-75th	25th-50th	25th-50th	25th-50th
EU	14.0[4]	16.3[5]	26.5[4]	2.83[6]	34,149[7]	75th-80th[8]	75th-80th[8]	75th-80th[8]	75th-80th[8]
Russia	5.7	n.a.[9]	8.1	-0.65	5,780	25th-50th	0-25th	0-25th	0-25th
India	5.6	5.0	2.2	4.93	820	50th-75th	25th-50th	50th-75th	50th-75th

1. Measures used as reported in Sunstein, *supra* note 1. Additional data available in the original version, published at 31 Harv. Envtl. L. Rev. 1 (2007).
2. Gross national income (GNI) converted to U.S. dollars using the World Bank Atlas method. *See* World Bank, World Development Indicators 2007 (2007).
3. Daniel Kaufmann et al., *Governance Matters VI: Governance Indicators for 1996-2006* (World Bank Pol'y Research Working Paper No. 4280, 2007), *available at* http://ssrn.com/abstract=999979.
4. Includes countries in the EU with the exception of Bulgaria and Romania.
5. Includes all countries in Europe.
6. Includes all European countries in the Organization for Economic Co-operation and Development (OECD).
7. Includes all countries in the European Monetary Union.
8. Reflects average of European countries in the OECD.
9. Included in future emissions for all countries in Europe.

13. The potential for catastrophic losses of the type described above are represented as a single probability (derived from a survey of subjective probability estimates provided by experts) of a 25% loss in global income under a 2.5 °C increase in temperature. That aggregate loss was then distributed across countries on the basis of other damage estimates. *See* William D. Nordhaus & Joseph Boyer, Warming the World: Economic Models of Global Warming 87-88 (2000).

14. *See*, *e.g.*, Martin L. Weitzman, On Modeling and Interpreting the Economics of Catastrophic Climate Change (Feb. 8, 2008) (unpublished manuscript), *available at* http://www.economics.harvard.edu/faculty/weitzman/files/modeling.pdf.

15. Robert S. Pindyck, Uncertainty in Climate Change Economics, Presentation at the International Monetary Fund (Jan. 24, 2008) (slides on file with the *Environmental Law and Policy Annual Review*).

16. Professor Sunstein raises a related point, referred to as "social amplification of risk," in Sunstein, Worst-Case Scenarios, *supra* note 3, at 138.