The Stakes in Limiting Climate Change

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Introduction

In 1992 the Institute for International Economics published my book, *The Economics of Global Warming* (Cline 1992). In that book I concluded that cutting global carbon dioxide emissions by half passed a costs-benefits test because the abatement costs would be less than the benefits of avoiding the damages from warming. In 2007 the much more comprehensive analysis of the Stern Review reached the same conclusion (Stern 2007). It is a great pleasure and honor for me to share the podium with Lord Stern, and with Senator Warner, who has provided strong legislative leadership on this issue.

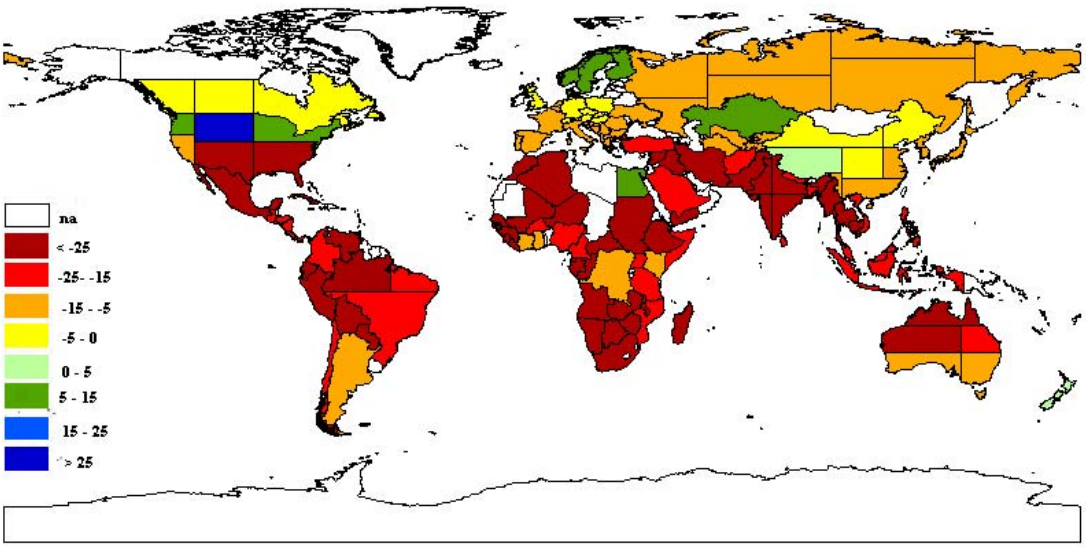
Damages from Unrestrained Warming

Agriculture

To get a concrete feel for the scope of future damages, let me first review the results of my 2007 book (Cline 2007) on global warming and agriculture (figure 1). I have combined climate and agronomic models to project the impact of global warming on world agriculture by the 2080s when, under business as usual, average temperatures will have risen 3º C globally and 4.5º C for the world's agricultural land areas. Agricultural damages tend to be greater toward the equator, and hence concentrated in developing countries. Yields and agricultural production potential would fall about 15 to 30 percent in Africa and Latin America.[1] Losses in India could be 30 to 40 percent. For the United States, the effects would be severe for the south but milder and conceivably even positive for a while for the north. Productivity losses would range between 20 and 30 percent in the southeast, and from 25 to 35 percent in the southwest plains and Mexico. These effects would grow worse with still greater warming by 2100 and after. The impacts would also be much worse already by the 2080s if the upper-end rather than the center of the projected warming range were to occur.

Figure 1 Impact on agricultural productivity without carbon fertilization, percent

[1]The lower-end estimates are for the case in which higher atmospheric concentrations of carbon dioxide act as "carbon fertilization."



Source: Cline 2007.

Other

The 2007 report of the Intergovernmental Panel on Climate Change, in its most plausible "business as usual" scenario, projected that by 2100 global mean temperature would rise by 2 to 5.4 degrees Celsius above 1990 levels, with a best estimate of 3.4 degrees. The world would be committing to even larger temperature increases after 2100, because of the long time lags from higher atmospheric concentrations to the eventual new equilibrium temperature. In addition to agricultural damages, the report stressed decreased water availability in most regions, species loss, coastal flooding and wetlands loss, and health damages from heat waves and wider spheres of infectious diseases. For the United States, recent estimates suggest relatively large losses from increased costs for water supply in the western states, increased hurricane damage, real estate losses from sea level rise, and increased electricity needs as higher cooling requirements exceed heating cost reductions, with total damages by 2100 at nearly 2 percent of GDP annually for just these four categories (Ackerman and Stanton 2008). These damages cannot be dismissed simply because they occur in the distant future. Indeed, the so-called time discount rate that both the Stern Review and I use explicitly recognizes that future generations should not be discounted simply because they are born later (Cline 1992, Chapter 6; Stern 2007, Appendix 2A).

Catastrophic Risks

Ultimately, however, it is probably the risk of catastrophic effects that is more troublesome than these central-case damages. Three major risks include a shut-down in the ocean conveyor belt that produces the Gulf Stream and keeps northern Europe relatively warm; the break-up of the West Antarctic ice shelf that, when it arrives, could

raise global sea levels by 7 meters in the space of a few weeks (but probably at least a century or two from now); and a runaway greenhouse effect as massive amounts of frozen methane are released from permafrost and continental shelves.

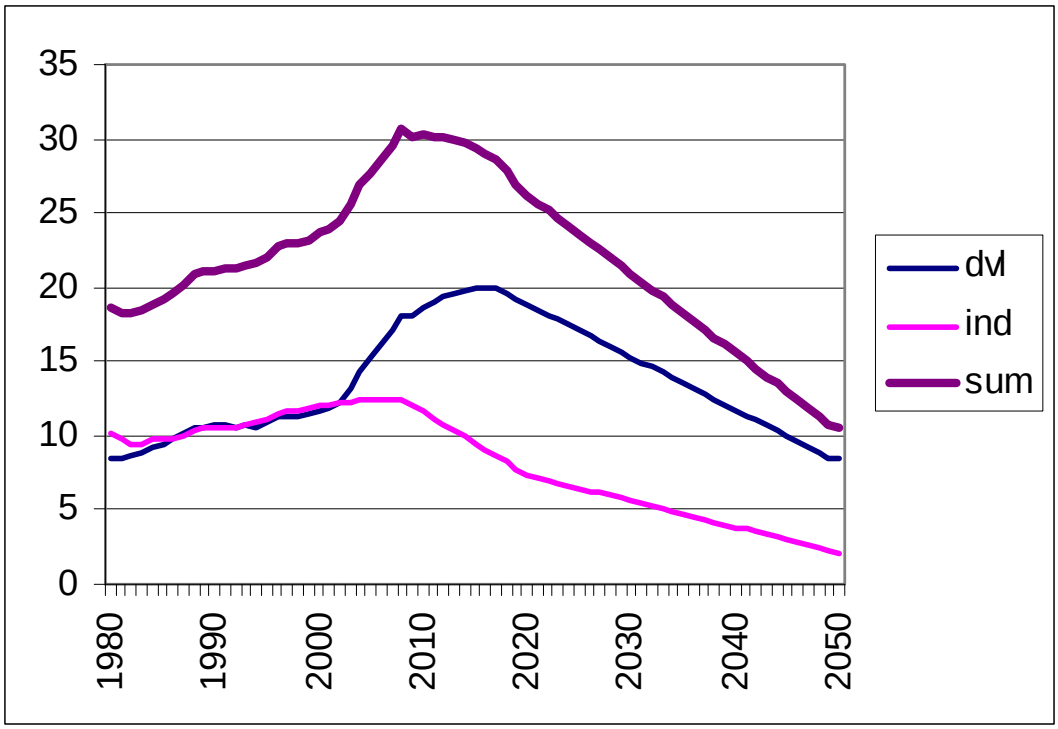
Perhaps the most widely used economic model of global warming, the DICE model of William Nordhaus at Yale University, attempts to incorporate both the central damage estimates and some probability of catastrophic effects (Nordhaus 2008). For the world as a whole, he estimates that warming of 4 degrees Celsius would impose damage of 5 percent of world product; warming of 6 degrees would cause damage amounting to 10 percent of world product. Economist Martin Weitzman of Harvard University has argued instead that it is the small probability of much more catastrophic impacts that truly matters in deciding how much to pay for insurance against climate damage. He argues that there is a 1 percent chance that by 2100 warming could amount to 10 degrees Celsius, which would impose enormous damage (Weitzman 2009).

Identifying the 50-50 and 80-20 Targets

Especially because of uncertainty about catastrophic effects, arriving at a time path for economically optimal emissions is inherently problematic. Instead, it is attractive to consider whether the benefits broadly exceed abatement costs for meeting a physical target ceiling for atmospheric concentrations. Internationally the target that has gained the most support is to cut global carbon dioxide emissions by 50 percent below 1990 levels by the year 2050. I call this the 50-50 target. This amount of abatement would limit atmospheric concentrations to about 500 parts per million, or 80 percent above preindustrial levels and one-third above today's level. This ceiling would give a 50 percent chance of limiting warming to about 2.5 degrees Celsius above 1990 levels.

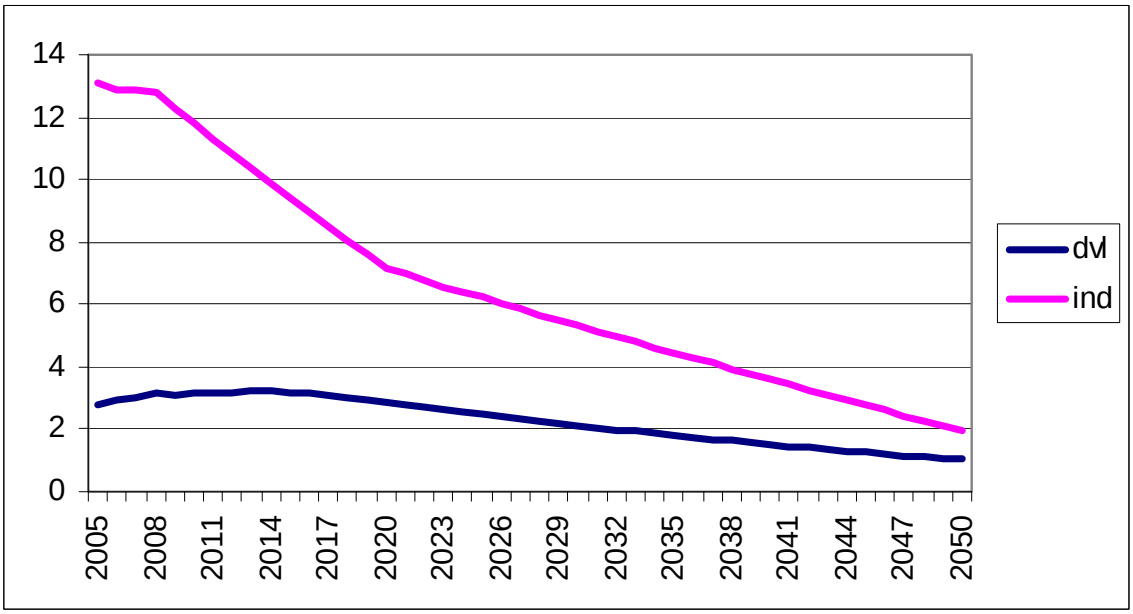
There is a corresponding distributional target that has gained considerable support: Industrial countries would cut emissions 80 percent below 1990 levels, and developing countries 20 percent below 1990 levels (figure 2). An 80 percent cut from 1990 levels by 2050 is what the Obama administration has proposed. In 1990, industrial-country emissions somewhat exceeded those of developing countries. By now, after China has passed the European Union in emissions and other developing-country emissions have also risen sharply, developing countries account for almost 60 percent of global emissions. It will be imperative that developing countries not follow the earlier high-carbon development path of the industrial countries, but instead participate in abatement. Otherwise, as my colleague David Wheeler at the Center for Global Development has calculated, increased emissions from the developing countries alone will be sufficient to cause global warming that will impose severe damages on them (Wheeler and Ummel 2007).

Figure 2 CO_2 emissions: developing and industrial countries, billion tons CO_2



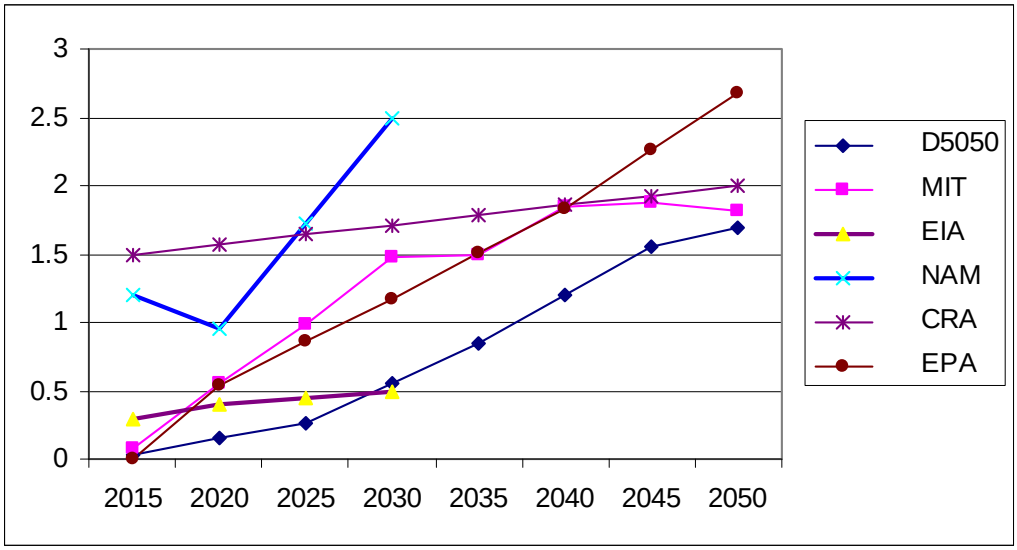
Fairness does compel an earlier and deeper cutback by the industrial countries. Per capita emissions of carbon dioxide today amount to 13 tons per person in the industrial countries (and 20 tons per person in the United States) but only about 3 tons per person in developing countries. Figure 3 shows what would happen to per capita emissions under the 50-50 target with 80-20 cuts, after allowing for population growth.

Figure 3 Per capita CO_2 emissions, tons per person



Returning to the target path for global emissions, how much would it cost to achieve this path? Representative abatement models would place the cost at the global level at about 0.25 percent of world product by 2020, 0.5 percent by 2030, and 1.5 percent by 2040–50.[2] For the United States, several models of the Lieberman-Warner bill cutting US emissions by 75 percent by 2050 place abatement cost at about 1 percent of GDP annually by 2025, and about 1.5 to 2 percent by 2050 (figure 4). Some models would show a considerably lower price by 2050 because they have a "backstop technology" providing unlimited supplies of carbon-free energy.

Figure 4 Abatement cost as percent GDP, global and United States (Lieberman-Warner)



Source: DICE model (Nordhaus 2008), Paltsev 2008, EIA 2008, ACCF and NAM 2008, CRA 2008, and EPA 2008).

Technological change will be crucial in keeping down the abatement costs. Most of the models make some allowance for declining unit abatement costs over time as the technological alternatives expand. The most dramatic example would be carbon capture and sequestration (CCS) technology that would make it possible to use coal and store the carbon dioxide underground.

The bottom line is that for something on the order of one-half of one percent of world product or less globally over the next quarter century, and 1 percent or less for the United States, it should be possible to purchase climate insurance that should easily pay for itself even in the central estimates but more importantly would greatly reduce the risk of truly catastrophic results. With a strong boost to technological change, it seems likely that the abatement costs could be held close to this modest range even in later decades. Moreover, there is a wide range of agreement among economists studying this issue that inaction would be a mistake. Indeed, by 2015 even the "optimal" abatement path in the Nordhaus DICE model, using his preferred, higher time discount rate, calls for the same 14 percent

[2] Based on the DICE model (Nordhaus 2008).

cutback from the business-as-usual emissions as in the 50-50 path, and by 2025 his optimal cutback is still relatively close (25 percent versus 33 percent).

Ensuring Global Action

The principal task will be enlisting cooperation of all of the major emitting nations. It turns out that only 15 countries (counting the European Union as one) account for 85 percent of global emissions, and this concentration should facilitate meaningful negotiation. The super emitters are the United States and China (each about 20 percent of the world total) and the European Union (15 percent). In the next tier, Russia, Japan, and India each contribute about 5 to 6 percent. Then Canada and Korea each account for about 2 percent. Finally, South Africa, Mexico, Iran, Indonesia, Australia, Brazil, and Saudi Arabia each contribute 1.3 to 1.5 percent of the world total of industrial emissions. It will be essential for agreement to be reached among these large emitters. For this purpose, it seems likely that a meaningful program of technological assistance to these (and other) developing countries will need to be part of the international strategy.

Since I wrote my book in 1992, I have acquired several grandchildren. I hope that the world we leave to them and their grandchildren will be one that avoids unrestrained global warming. I believe it is possible to do so at a relatively reasonable price. However, to succeed will require nearly unprecedented political cooperation among the nations.

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