

Interpreting the Stern Review on the Economics of Climate Change

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Introduction

The Stern Review conveys a number of useful points about the nature of the climate threat on which there is broad agreement among analysts of this issue.

- Human-induced climate change is a problem of risk management. It cannot be proved that the outcome will be dire or shown with certainty that it will not. As with other problems we face in private life and public policy, from controlling your cholesterol level to defense against epidemic disease, uncertain dangers can warrant reasonable measures to reduce risk.
- Capping the level of greenhouse gas concentrations in the atmosphere at different levels is a useful way to think about long-term objectives in dealing with this risk.
- Because of the long lives of these gases in the atmosphere, waiting to take action on emission mitigation has the effect of gradually ruling out options for controlling the ultimate human influence on the climate system.
- Economically efficient and effective control will require efforts to develop low-emissions technology *and* the imposition of direct price and regulatory pressure on the emissions themselves. Neither is sufficient to make much difference alone.
- With intelligent policies and global cooperation, climate change risks could be limited without taking a substantial bite out of GDP growth.

My conclusion from these points is that the major nations, importantly including the United States, should be taking more action to reduce climate change risks.

The widespread visibility of the Review comes in large part from its two striking conclusions about risk and cost and its ultimate recommendation. First, the Review holds that if we don't control greenhouse gas emissions the risks of future climate damage will be the equivalent of 5% of GDP each year, beginning now and continuing forever, and maybe as high as 20%.¹ And the second main conclusion is that greatly reducing these risks need cost only around 1% of global GDP each year. These two numbers, 20% and 1%, have dominated public discussion of the Review and are used to bolster its main recommendation: we must mount an urgent global response to hold an extremely tight cap on the atmospheric concentration of greenhouse gases.

These results and the methods used to reach them have stirred both enthusiastic support and controversy. Let's look at each of these three points in turn – climate damage, cost of action and urgent global response – and how they might be interpreted.

¹ This way of expressing damages can be thought of as an annuity, indexed to GDP, that has the same welfare implications over time as the as the projected damages. By this translation damage that occurs in particular years gets evened out across all time.

Climate Damage

First the climate damage estimate. The 5% and 20% loss figures result from a policy scenario in which no action is ever taken to limit emissions. Estimates were made of the resulting economic loss based on a cascade of projections: human emissions impact the Earth's climate, which leads to negative and positive effects on market and non-market systems, which creates losses and gains that are converted to a common monetary measure. These projections, extending to 2200 and beyond, take account of uncertain ranges in the temperature response and in the damage estimates, in order to construct a picture of global risk in economic terms. Then to recognize potential events in the extreme upper tail of potential climate outcomes the authors added consideration of major changes in the climate system that are not normally incorporated in formal analysis of the range of climate response because their likelihood and timing are poorly understood (e.g., see IPCC, 2007), and they applied what were necessarily very rough assumptions about catastrophic social effects beyond those quantified in the current literature.

All these phenomena – both the well-understood and the more speculative, and effects near-term and in the distant future – deserve attention in a discussion of climate change risk. They all figure in my subjective judgment. But when I come to interpret the Review's specific monetary damage numbers three issues need to be sorted out. The first is the handling of events of high consequence but unknown probability. The risk calculation requires estimates of the probabilities of climate outcomes and associated social costs, and the Review breaks this into two parts: (1) estimates based on the current literature, and (2) extreme events for which likelihood estimates are not available. To account for the latter Review authors simply imposed an upward shift in the range of outcomes, and this subjective judgment is a key element of the expansion from 5% to 20% loss. I would have preferred to keep these extreme risks in the discussion but out of the formal calculation. Also, I will note that the analysis was not able to consider uncertainty in the baseline emissions forecast. Our MIT analysis of temperature change to 2100 indicates that about half the uncertainty originates in the Earth science and half comes from uncertainty in projections economic growth, technical change and greenhouse gas emissions (Webster et al., 2003).

A second task is to interpret the way the Review weighs-up economic losses over time – their discount rate. Its selection has a huge effect on the results. The authors apply a standard discounting formula but they choose a set of its parameters that, taken together, produces a rate that is substantially below the range judged in the literature to be consistent with the way the economy operates.² The result is a low discount rate that, if applied to other realms of economic life, would justify increases in the savings rate and thus large reductions in current consumption to increase that of (much richer) people in the distant future. Because climate change is such a long-term problem the authors justifiably may have wanted to insure that distant risks were taken into account. Moreover they may feel that climate change should be treated differently from other economic choices. But pushing parameters of the standard discounting formula outside conventional bounds was arguably not the best or a transparent way to accomplish that result. At the very least the text should have made clear what fraction of the 5% and 20% losses are attributable to modeled damages that come 200 or more years in the future.

² The triplet of inputs at issue are the social discount rate or pure rate of time preference, set effectively to zero in the calculations, the elasticity of the marginal utility of consumption (the social weight attributed to a small increase in an individual's consumption) set to 1.0, and the rate of economic growth.

A third concern is the Review's application of monetary measures to non-market effects (e.g., human mortality, species loss, forced migration) – a task for which economists lack adequate methods. How these effects were handled is not clearly documented, so the reader has a hard time judging whether to accept the estimates as reasonable. My own view is that the non-market effects are the heart of the issue. Many are described in early chapters of the review, but more effort was needed to develop a few summary indicators in natural units (people, hectares, species), to be presented alongside a clearer statement of the monetary values attached (see Jacoby, 2004).

So how to pull all this together? I believe the first concern implies an under-estimate of uncertainty and the second an overweighting of distant events in the GDP calculation. Opening up the valuation of market damage to closer scrutiny could lead to either higher or lower estimates depending on what is inevitably a subjective valuation. However one comes out on the Stern economic analysis there is ample evidence in the Review to indicate that we face a serious global economic and environmental risk. It would be a shame if useful insights about the risk were clouded by controversy over benefit-cost methods or charges that the authors went too far in an effort to convey their level of alarm.

The Cost of Action

With regarding to mitigation cost, underlying the estimate of a 1% GDP cost of mitigation in 2050 is a policy scenario whereby all nations, rich and poor, take universal collective action – reducing fossil and other industrial greenhouse gases and stopping forest destruction – by applying same emissions penalty everywhere, beginning now and continuing into the future.³ This cost result estimate assumes a control regime that imposes measures with an average price of \$100 per ton CO₂ in 2015, this cost falling over time as assumed technological change kicks in.

I will make just a couple of points in interpreting this result. First, the modeling approach adopted by the Review was capable of analysis only to 2050. What cost levels would be if the analysis were extended over a longer time period is not discussed. Whether the cost would rise or fall with time depends on the outcome of a race between economic growth and technological change. My expectation is that costs would rise.

A second concern is the implied stringency of emissions mitigation in the early years. The Review does not report what marginal cost (and therefore emission price) is implied in 2015. Because there are some relatively cheap reductions in the mix it is somewhere above \$100 per ton CO₂ and probably substantially above. This result may be compared with what the futures markets say is the likely price in the European Trading System (ETS) in the first Kyoto period, which is \$15 per ton. My own view, and that of most previous economic studies of climate policy, is that an emissions penalty closer to the neighborhood of this ETS level is appropriate at the outset, to allow for adjustment of existing capital stock, then a price rising steadily over time.

³ In a study just completed for the U.S. Climate Change Science Program a similar calculation was carried out by three U.S. modeling groups (CCSP, 2006). For the case closest to the one analyzed in the Review the GDP loss in 2050 ranged from 1.5% to 5% (among modeling groups that is; this was not an uncertainty analysis). The CCSP authors are careful to point out that these likely are minimum estimates because computer models are very good at identifying mitigation actions of an economic efficiency that political processes rarely match.

An Urgent Global Response

Whether or not one accepts the Review's stabilization target, a judgment that nations should do *something* more to reduce the risk raises the question "what now?" We don't live in the world of universal participation, and a necessary step in achieving it is acceptance by 20 or so of the largest emitters of an international structure for the difficult negotiations over equitable levels of national effort. The trade regime established at the end of World War II was one such arrangement, and the architecture for negotiating reductions in ozone destroying chemicals was another. The Kyoto Protocol was the first try at such a regime for the climate issue, but it has now fragmented. These most important nations will not seriously pursue the search for a workable architecture until the U.S. takes additional action on emissions, independent of any international agreement.

If my judgment about the international prospects is correct, then near-term U.S. decisions about new emissions measures have the character of a strategic move in a complicated multi-party game. If the U.S. doesn't take additional mitigation measures the international process will stall. But decisions about how stringent a policy to adopt need to consider not only the urgency of the problem and likely domestic economic effects but also issues of international competitiveness when trading partners lag behind and the tangle of this issue with our other foreign relations. The Review has very useful things to say about policy instruments, with a heavy emphasis on the use of market-based measures to the degree possible, and the fostering of more R&D and international technology cooperation. Among the market-based approaches a universal national carbon tax is the favorite of many economists. A cap-and-trade system, like the ETS or the one we apply to sulfur emissions, can serve the same purpose. Moreover either approach can provide flexibility to adapt to an evolving level of commitment by other nations. If we can take a sense of urgency from the Stern effort, then, I would suggest it is to move ahead with a careful exploration of these options and the adoption of one or the other on a national basis.

References

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