

COMMENTARY: THE STERN REVIEW'S ECONOMICS OF CLIMATE CHANGE

Partha Dasgupta*

When economists analyse public policy, they take two sets of considerations into account. First, they identify the ways in which the world might work (the ways in which people would choose under various circumstances, the pathways Nature chooses, and so on). Once that task is done, they are able to chart the consequences (perhaps long-term consequences) of alternative policies. Secondly, they value those consequences so as to be able to judge the relative desirabilities of the alternative policies. The former set of exercises involves *description*, while the latter involves *evaluation*. Disagreements over the desirability of alternative public policies arise when people don't agree on *facts* (e.g., the economic effects of a doubling of carbon concentration in the atmosphere) or when they don't agree on *values* (e.g., the way our well-being ought to be balanced against the well-being of all those future them). Usually, of course, *both* facts and values are subject to dispute.

Reading the many reports on the Stern Review (henceforth the Review) that have been published in newspapers and magazines since its launch – interestingly, reading the Review itself – would give one the impression that the case that has been built by the authors for strong, immediate action in the form of an annual expenditure of about 1 per cent of global GDP in order to thwart the possibility of damages amounting to as much as “20 per cent of GDP” (the Review's wording) under business as usual, rests exclusively on insights drawn from the new and more

refined global circulation models of climate scientists. The Review will hopefully be scrutinised by peers in due course. My comments will be particularly inexpert, because I have had only a few days to study it. But the conclusion I have reached is that *the strong, immediate action on climate change advocated by the authors is an implication of their views on intergenerational equity; it isn't driven so much by the new climatic facts the authors have stressed*. In what follows I explain what I mean by that.

It needs saying at once that the *ethical framework* within which the authors have chosen to work is standard in modern economics. The authors conduct a Cook's tour of contemporary ethical theories, but pretty soon get down to the framework modern economists have adopted for their ethical reasoning. A particular version of that framework, amounting to Classical Utilitarianism, was proposed by Frank Ramsey in his great 1928 paper in the *Economic Journal* ('A Mathematical Theory of Saving'). The authors of the Review follow Ramsey closely. However, the numerical figures for the ethical parameters the Review proposes are not given by the framework. We need to deliberate further if we are to arrive at them. Even the meaning of the ethical parameters isn't self-evident, because there are several alternative philosophical underpinnings of Ramsey's formulation of intergenerational justice. Moreover, each interprets the parameters in its own way (see Dasgupta, 2005). The Review is curiously silent on the differences in the views

* Sir Partha Dasgupta, FBA FRS, Frank Ramsey Professor of Economics, University of Cambridge. These comments were prepared for a seminar on the Stern Review's Economics of Climate Change, organised by the Foundation for Science and Technology at the Royal Society, London, on November 8, 2006. The Review is a long and impressive document. The authors have put together much that is now known about the effects of carbon emissions on human well-being and they remind readers of those matters that are very unknown. It is possible though that readers will not notice that the authors have treated one important aspect of the Review's economic analysis cavalierly. The comments that follow are directed at that aspect.

experts hold about what the parameter values ought to be. It is silent also on the several philosophical underpinnings of Ramsey's mathematical formulation, much explored by modern welfare economists.

Assume, as the Review does, that a generation's well-being is the sum of the well-beings of the members of that generation. Assume too, as the Review does, that each person's well-being depends on his or her level of consumption. By the *ethical values* that reflect the idea of intergenerational equity I mean two things: (1) the trade-offs that ought to be made between the well-beings of future generations and our own well-being, given that future generations will be here only in the future; and (2) the trade-offs that ought to be made between the well-beings of people regardless of the date at which they appear on the scene. Technically, (1) is reflected in the *time/risk-of-extinction discount rate*, which, following the Review, I shall call *delta*; and (2) is reflected in the *elasticity of the social weight that ought to be awarded to a small increase in an individual's consumption level*, which, following the Review, I shall call *eta*. Both terms are defined in the Review (Chapters 2 and 2A). If *delta* reflects the way the future is seen through today's telescope, *eta* is a measure of the aversion to interpersonal inequality and risk in consumption.

The Review, rightly in my view, takes it that the trade-off among the well-being between the present US and the future THEMs should be, roughly speaking, one-to-one, or in other words, that we should not discount future generations' well-beings simply because those generations will appear only in the future. The Review assumes that *delta* ought to be set equal to 0.1 per cent a year, which is a very low figure if we are to compare it with the values advocated by other climate economists (see below). This is to adopt a very egalitarian attitude across the *time* dimension. But curiously, the Review adopts a very *inegalitarian* attitude with regard to the distribution of well-being across people when futurity is not the issue – for example, when comparing the well-beings of the poor and rich in the contemporary world. The Review's central case is based on the assumption that *eta* ought to be unity, which, as I show below, reflects a fairly indifferent attitude towards equity over the distribution of well-being among people, *qua* people. The distinction between the two parameters is crucial. As the numerical figures that are assumed for them influence estimates of the economic costs and benefits of controlling carbon emissions, enlarging sequestration possibilities, and investing in alternative energy technologies, *delta* and *eta* are hugely significant parameters.

In fact, pretty much the same ethical values adopted in the Review were the basis of a pioneering 1992 study on the economics of climate change (aptly titled *The Economics of Global Warming*) by William Cline of the Institute for International Economics, Washington DC. In a symposium on Cline's book in *Finance and Development*, a quarterly publication of the World Bank and the International Monetary Fund, Cline (1993) summarised his finding thus: "My central scenario shows that . . . if risk aversion is incorporated by adding high-damage and low-damage cases and attributing greater weight to the former, benefits comfortably cover costs (with a benefit–cost ratio of about 1.3 to 1). Aggressive abatement is worthwhile even though the future is much richer, because the potential massive damages warrant the costs." Despite the striking similarities between the numerical figures adopted for the pair of ethical parameters in the two studies (Cline assumed *delta* to be zero and *eta* to be 1.5), there is no mention of Cline's work in the Review.

Because it isn't possible to find much difference between Cline's book and the Stern Review if we look at the figures taken to be appropriate for *delta* and *eta*, I turned to the work of William Nordhaus, who has been studying the economics of climate change for over three decades. The most remarkable conclusion of his studies – conducted on his Dynamic Integrated Model of Climate and the Economy (DICE) – has been that, despite the serious threats to the global economy posed by climate change, little should be done to reduce carbon emissions in the near future; that controls on carbon should be put into effect in an increasing, but gradual manner, starting several decades from now. This conclusion has withstood the many modifications Nordhaus and others have made to the climate science embodied in DICE. Their idea is not that climate change shouldn't be taken seriously, but that it would be more equitable (and efficient) to invest in physical and human capital now, so as to build up the productive base of economies (including, especially, poor countries), and divert funds to meet the problems of climate change at a later date. These conclusions are reached on the basis of an explicit assumption that global GDP per capita will continue to grow over the next 100 years and more even under business as usual, an assumption that the Review would appear to make as well.

The general message of DICE will be familiar to you. It has influenced Mr Bjorn Lomborg, which, although it is understandably tempting to think otherwise, is not by itself a reason for not taking DICE seriously. It is a reasonable guess that DICE's message was the basis on which the so-

called Copenhagen Consensus, much publicised by the *Economist*, was reached in 2004.

Where then is the real difference between the economics in DICE and the economics in the Review? No doubt DICE differs from PAGE (the acronym for the Review's climate model) in their climatic specifications; but I looked for the underlying ethics in the two bodies of work. Nordhaus and others have used a considerably higher figure for *delta* (point (1) above). In contrast to the Review's figure of 0.1 per cent a year, Nordhaus in recent years has used a starting value of 3 per cent a year for *delta*, declining to about 1 per cent a year in 300 years' time. Interestingly, Nordhaus also takes *eta* (point (2) above) to be unity. He reports that the first-period social price of carbon (which is a measure of the social damage a marginal unit of carbon emitted today inflicts on humanity) is about \$13 per ton, whereas the figure reached in the Review's central case is about \$310 per ton. But if the Review's figure for *delta* is put to work on DICE, the first-period social price of carbon becomes about \$150 per ton. This is about half the figure offered by the Review, but it is enough to suggest that the drivers behind the Review's findings are the very low values of the two ethical parameters, *delta* and *eta*. Indeed, modifying DICE slightly, so as to take a more alarming view for the worst case scenario under business as usual, raises the figure for the social price of carbon to \$400 per ton, in excess of the figure recommended in the Review. (I am grateful to William Nordhaus for these figures. A recent working paper by Ackerman and Finlayson (2006) reports a similar set of calculations.)

Are the numbers taken in the Review to reflect the two ethical parameters compelling? I have little problem with the figure of 0.1 per cent a year the authors have chosen for the rate of pure time/risk-of-extinction discount (*delta*) – although many economists would think otherwise. But the figure they have adopted for *eta* – the ethical parameter reflecting inequality and risk in human well-being – is deeply unsatisfactory to me. To assume that *eta* equals 1 is to say that the distribution of well-being among people doesn't matter much, that we should spend huge amounts for later generations even if, adjusting for risk, they were expected to be much better off than us. To give you an example of what I mean, suppose, following the Review, we set *delta* equal to 0.1 per cent a year and *eta* equal to 1 in a constant-population, deterministic economy that experiences no technological change. Suppose the social rate of return on investment there is 4 per cent a year. *It is an easy calculation to show that the current generation in that model economy ought to save a full 97.5 per cent of its aggregate output for the future!* You should know that the

aggregate savings ratio in the UK is currently about 15 per cent of GDP. A 97.5 per cent saving rate is so patently absurd that we must reject it out of hand. To accept it would be to claim that the current generation in the model economy ought literally to starve itself so that future generations are able to enjoy ever increasing consumption levels. (In fact, to suppose that *eta* is 1 is also to suppose that starvation isn't all that painful!)

It can be argued that there is no obvious reason why *eta* should be independent of the level of consumption. And you should know that the distributive ethics of John Rawls' theory of justice would require that *eta* be infinity, which reflects an uncompromising aversion to inequality and risk in consumption. The moral is this: we should be very circumspect before accepting numerical values for parameters for which we have little *a priori* feel. One can't get an intuitive feel for them from huge computer runs because it is usually not possible to track what's influencing what in a sharp way. This is where class room exercises, involving simple stylised models, become so useful. Experience with such exercises suggests that values of 2–4 for *eta* yield more ethically satisfactory consequences. (For example, if we were to set *eta* equal to 3 in the model I have just reported, the optimum saving rate becomes a reasonable 25 per cent of net aggregate output.)

What we should have expected from the Review is a study of the extent to which its recommendations are sensitive to the choice of *eta*. (Many economists would expect a sensitivity analysis over the choice of *delta* too.) A higher figure for *eta* would imply greater sensitivity to risk and inequality in consumption, meaning that it could in principle imply greater or less urgency in the need for collective action on global warming. Whether PAGE would regard the urgency to be greater or less depends on whether or not the downside risks associated with the warming process in PAGE overwhelm growth in expected consumption under business as usual. A higher value of *eta* could imply that the world should spend more than 1 per cent of GDP on curbing emissions, or it could imply that the expenditure should be less. Only a series of sensitivity analyses would tell. Curiously, the Review doesn't report any such sensitivity analysis.

An annual expenditure of 1 per cent of world GDP (amounting to some 570 billion international dollars) is surely affordable. It is affordable even if it were to be met by rich countries only, for it would amount only to 1.8 per cent of their annual GDP. We should remember though that the figure in question is some seven times the annual global aid budget. How do you persuade the voting public in rich

countries to instruct their governments, collectively, to spend that large sum each year? The Review would have it that voters should recognise that it is a moral imperative. The rhetoric deployed by the authors does stress the uncertainties that are inherent in climate science, but it skims over the fact that we have little intuitive feel for the numerical weights that should be placed on normative parameters. Where the modern economist is rightly hesitant, the authors of the Review are supremely confident.

Climate change has been taken very seriously by all economists who have studied the science since the late 1970s. To be critical of the Review is not to understate the harm humanity is inflicting on itself by degrading the natural environment – not only in regard to the stock of carbon in the atmosphere, but also in regard to so many other environmental matters besides. But the cause is not served when parameter values are so chosen that they yield desired answers.

REFERENCES

- Ackerman, F. and Finlayson, I.J. (2006), 'The economics of inaction on climate change: a sensitivity analysis', Working paper.
- Cline, W. (1993), 'Give greenhouse abatement a fair chance', *Finance and Development*, World Bank/IMF, March, pp. 3–5.
- Dasgupta, P. (2005), 'Three conceptions of intergenerational justice', in Lillehammer, H. and Mellor, D.H. (eds), *Ramsey's Legacy*, Oxford, Clarendon Press.
- Ramsey, F. (1928), 'A mathematical theory of saving', *Economic Journal*, 38, pp. 543–59.