On the Timing of Greenhouse Gas Emissions Reductions: A Final Rejoinder to the Symposium on "The Economics of Climate Change: The *Stern Review* and its Critics"

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In this final rejoinder to the symposium on "The Economics of Climate Change: The *Stern Review* and Its Critics", we respond to comments published in the last issue of this journal by Robert Mendelsohn, Thomas Sterner and U. Martin Persson, and John P. Weyant (Mendelsohn et al. 2008). In particular, we examine the point of debate with arguably the greatest practical importance for ongoing negotiations over an international agreement to succeed the Kyoto Protocol: namely the appropriate timing of global reductions in greenhouse gas emissions.

Too often in the past, this debate has been presented as one between the poles of 'act now' and 'wait-and-see'. Weyant (see Weyant's comments in Mendelsohn et al. 2008) is right to dismiss this false dichotomy. All sensible proposals concerning the appropriate trajectory for global greenhouse gas emissions entail at least some reductions in the near term, as well as efforts to promote the development of new technologies. But make no mistake, there is still room for widely divergent recommendations with potentially great ramifications.

One recommendation, which has been clearly elucidated by William Nordhaus (2007) and appears to be endorsed by both Mendelsohn (see Mendelsohn's comments in Mendelsohn et al. 2008) and Weyant (see Weyant's comments in Mendelsohn et al. 2008), is the 'climate-policy ramp.' Under the slow policy ramp, the economically efficient climate policy entails "modest rates of emissions reductions in the near term, followed by sharp reductions in the medium and long term" (Nordhaus, 2007). This is presented as a stark alternative to the recommendations of, for example, the Stern Review (Stern, 2007), where the case was made to begin sharp reductions in the near term.

It is very important to be as clear as possible about the consequences of the slow policy ramp. In Nordhaus' latest analysis, the so-called optimal control rate of carbon dioxide (CO_2) emissions (i.e. the fraction of global business-as-usual emissions abated) is approximately 0.25 in 2050, which leads to an atmospheric concentration of CO_2 of around 480 parts per million (ppm) in 2050 (Nordhaus 2008). More importantly, under this scenario the optimal stock of CO_2 in the atmosphere is still rising rapidly in 2050, reaching around 586 ppm in 2100 and peaking at nearly 700 ppm in about 2175. To these stocks one must add the carbon dioxide equivalent (CO_2e) concentration of other greenhouse gases. While the additional contribution of other greenhouse gases will depend on assumptions about business-as-usual emissions and control rates of these gases, the radiative forcing they cause, as well as atmospheric chemistry and carbon cycling, there is a strong likelihood that 480 ppm of CO_2 will correspond to over 550 ppm of CO_2e, 586 ppm of CO_2 will correspond to over 700 ppm of CO_2e, and 700 ppm of CO_2 will correspond to over 900 ppm of CO_2e (Fisher *et al*., 2007).

Such high concentrations pose risks of unprecedented increases in temperature and therefore changes in climate. Even if the concentration of all greenhouse gases were to be stabilised at 550 ppm, an analysis carried out for the Stern Review (see Stern, 2008) indicates that there would still be a 7% probability of an eventual increase in global temperature of 5°C (i.e. at equilibrium). Stabilising at 650 ppm, that probability increases to 24% and at 750 ppm it is almost 50:50. Furthermore, these probabilities are likely conservative, since they do not account for the possibility that the carbon cycle will weaken as temperatures rise.

There is near unanimous agreement that a world that is on average 5°C warmer than pre-industrial times is a most dangerous prospect (see Weitzman, 2007), something well beyond the realms of human experience and attained within a geologically instantaneous time period. The changes we have to contemplate are transformational: one need only compare the conditions during the last ice age, when global average temperatures were 5°C cooler than today, to see that. The confidence shown by for instance Mendelsohn (in Mendelsohn et al. 2008) and Nordhaus (2008), that the risks of a world with temperatures that are on average 5°C warmer than pre-industrial times can be offset by general investments elsewhere in the economy, seems misplaced to say the least. This is why the notion of increasing the relative scarcity of the environment, clearly set out by Sterner and Persson (2008), is so important to the economics of climate change. As they ask in their comments (see Sterner and Persson's comments in Mendelsohn et al. 2008), "if a third of biodiversity is gone but we are otherwise ten times richer—is it not plausible that the value of ecosystem services may have increased beyond current imagination?"

For these reasons, we suggested in the Stern Review that 550 ppm of CO_2e was the upper limit to what could be recommended. Depending on one's view of the balance of costs and benefits of emissions reductions, the desired stabilisation level could be much lower. In fact, James Hansen and co-authors have suggested that CO_2 concentrations should not exceed 350 ppm at stabilisation, which is even lower than today's level (Hansen *et al*., 2008).

Stabilisation at even the upper limit of 550 ppm of CO_2e will require sharp reductions in emissions in the near and medium term. The atmospheric concentration of greenhouse gases is already around 435 ppm and increasing by about 2.5 ppm per annum (the annual rate of increase is itself rising and will soon be 3 ppm if unchecked). In the Stern Review we estimated that the global emissions control rate in 2050 would have to be around 0.6-0.65 for stabilisation at 550 ppm, and 0.85 for stabilisation at 450 ppm. Thus there is a very substantial mitigation 'gap' to bridge and time is in short supply. The earlier we begin, the greater are the opportunities to (i) limit the accumulation of carbon-intensive capital stock and (ii) drive innovation of low-carbon technologies. Moreover, the earlier we begin, the greater are the opportunities to reverse our decision later should we make unanticipated discoveries about the costs and benefits of emissions reductions. As for instance Yohe *et al*. (2004) have shown, only with sharp near-term emissions reductions can we keep ambitious stabilisation targets of 550 ppm of CO_2e and below 'in play'. If we drive up the policy ramp too slowly, it will soon to be too late or prohibitively costly to achieve such targets: we will fall into the gap. Thus delay now and haste later not only builds up damage, but also risks expensive mistakes in investment decisions. We are arguing for clarity and strength in policy now.

References

Fisher, B. S., N. Nakicenovic, K. Alfsen, J. Corfee Morlot, F. de la Chesnaye, J.-C. Hourcade, K. Jiang, M. Kainuma, E. La Rovere, A. Matysek, A. Rana, K. Riahi, R. Richels, S. Rose, D. van Vuuren and R. Warren (2007). Issues related to mitigation in the long term context Climate Change 2007: Mitigation. Contribution of Working Group III to the Fourth Assessment Report of the Inter-governmental Panel on Climate Change. B. Metz, O. R. Davidson, P. R. Bosch, R. Dave and L. A. Meyer Cambridge, United Kingdom and New York, NY, USA, Cambridge University Press**:** 169-250.

Hansen, J., M. Sato, P. Kharecha, D. Beerling, R. Bernerd, V. Masson-Delmotte, M. Pagani, M. Raymo, D. L. Royer and J. C. Zachosh (2008). Target Atmospheric CO2: Where Should Humanity Aim? Mimeo. New York, NASA/Goddard Institute for Space Studies.

Mendelsohn, Robert, Thomas Sterner and U. Martin Persson, and John P. Weyant . 2008. Comments on Simon Dietz and Nicholas Stern's *Why Economic Analysis Supports Strong Action on Climate Change: A Response to the Stern Review's Critics. Review of Environmental Economics and Policy* 2(2): 309-13.

Nordhaus, W. D. (2007). "A Review of The Stern Review on the Economics of Climate Change." Journal of Economic Literature **45**(3): 686-702.

Nordhaus, W. D. (2008). A Question of Balance: Weighing the Options on Global Warming Policies. New Haven and London, Yale University Press.

Stern, N. (2007). The Economics of Climate Change: The Stern Review. Cambridge, UK, Cambridge University Press.

Stern, N. (2008). "The economics of climate change." American Economic Review **98**(2): 1-37.

Sterner, T., and U. M. Persson. 2008. An Even Sterner Review: Introducing Relative Prices into the Discounting Debate. *Review of Environmental Economics and Policy* 2(1): 61-76.

Weitzman, M. L. (2007). "A Review of the Stern Review on the Economics of Climate Change." Journal of Economic Literature **45**(3): 703-724.

Yohe, G., N. Andronova and M. Schlesinger (2004). "To hedge or not against an uncertain climate." Science **306**(5695): 416-417.