Eric Neumayer

A missed opportunity: the Stern review on climate change fails to tackle the issue of non-substitutable loss of natural capital

Article (Accepted version) (Refereed)

Original citation:
Neumayer, Eric (2007) A missed opportunity: the Stern review on climate change fails to tackle the issue of non-substitutable loss of natural capital. Global Environmental Change, 17 (3/4). DOI: 10.1016/j.gloenvcha.2007.04.001

A Missed Opportunity: The Stern Review On Climate Change Fails to Tackle the Issue of Non-Substitutable Loss of Natural Capital

Revised version April 2007

Eric Neumayer*

Abstract

The *Stern Review on The Economics of Climate Change* is one of the few cost-benefit analyses of climate change to come out in favour of immediate and decisive action to reduce greenhouse gas emissions. The choice of a low discount rate is the main reason for the Review's divergence in conclusions compared to other economic studies. I argue that the Review's ethical reasons for a low discount rate are defendable, but unlikely to find wider public support. In order to justify spending a large amount of scarce resources for the purpose of limiting climate change it is necessary to move beyond the discounting debate. Unfortunately, the Review did not develop a persuasive argument for why climate change threatens to inflict upon future generations irreversible and non-substitutable damage to and loss of natural capital. This represents a missed opportunity as it would have provided a much more compelling case for drastic action than the Review's arguments for a low discount rate.

* Professor of Environment and Development, London School of Economics and Political Science (LSE), Department of Geography and Environment and Centre for Environmental Policy and Governance, Houghton Street, London WC2A 2AE, UK. Ph: +44-207-9557598. Fax: +44-207-9557412. Email: e.neumayer@lse.ac.uk. Web: http://personal.lse.ac.uk/neumayer. Thanks to Simon Dietz, Tom Wright and three anonymous referees for helpful comments.

Introduction

The *Stern Review on The Economics of Climate Change* (Stern 2007) has stirred great media attention worldwide. Being endorsed by both Gordon Brown and Tony Blair has provided its central message – that it is *economically* desirable to stabilize greenhouse gas emissions somewhere in the range of 450 to 550 ppm CO_2 equivalent – with high-level political backing. This aim is not as ambitious as some would have hoped for (e.g., Baer 2006), but it calls for far more drastic action than many prior studies that have conducted a cost-benefit analysis (CBA) of climate change.

It is impossible to do justice to the detail, breadth and depth of a report of almost 700 pages here. I will concentrate on what I regard as its major weakness. I thereby inevitably neglect its many strengths. My major criticism of the Review is that it correctly identifies the pivotal role that value judgements play in decision-making on climate change, but misses the opportunity to tackle what should be the real issue in dispute. To make this point, I will first explain why the Review comes to different conclusions than many other previous studies. This leads us to the crucial role of the discount rate. The Stern Review and its recommendations are persuasive if one agrees with its normative assumptions that lead to the low discount rate. I then argue, however, that these normative assumptions are unlikely to find wider public support. Therefore, in order to justify immediate and decisive action for mitigating climate change, it is better to go beyond arguments for a low discount rate and to build a case for why climate change is likely to inflict upon future generations irreversible and non-substitutable damage to and loss of natural capital. I assess the Review in the light of these arguments and find that it ultimately fails to provide a convincing case for spending a large amount of scarce financial resources on reducing greenhouse gas emissions.

Why are the Review's Conclusions so Different from Those of Other Studies? The Crucial Role of the Discount Rate

There are of course many aspects that distinguish the Review from previous studies. Some of them are based on laudable innovations in the Review, such as the more comprehensive treatment of future uncertainty and its acknowledgement that the expected growth rate of consumption, and therefore one part of the discount rate, are endogenous to future paths of emissions and damage from climate change. The Review also claims that, contrary to earlier studies, it takes account of more recent scientific literature suggesting significant risks of temperature increases above 5 degrees Centigrade. Other aspects of the Review have raised more eyebrows. For example, Nordhaus (2006), Mendelsohn (2006) and other critics complain that the damage estimates used in the Review are systematically taken from the top of the range of available estimates. Be that as it may (I am in no position to judge), there is one factor that has an overwhelming impact on any CBA of climate change. This crucial factor is, not surprisingly to those with some knowledge of the subject, the discount rate employed.

Economists typically either justify discounting future values with the opportunity costs of investment (the descriptive approach) or with recourse to an explicitly normative framework (the prescriptive approach). Within the normative framework, discounting can be justified either because future generations' utility is regarded as worth less than the current generations' utility (the pure rate of time preference) or because future generations are expected to be richer than the present (the consumption discount rate).

The Review endorses the prescriptive approach and sets the pure rate of time preference essentially to zero.[1] It does so in accordance with a long tradition of scholars

[1] It is actually set to 0.1% to allow for the remote possibility that the human race or at least modern civilization as we know it will become extinct by a meteorite or nuclear warfare. If a low pure rate of time preference is

arguing that it is ethically indefensible to discount the future for the pure reason of it being later in time. The other part of the discount rate, the consumption discount rate, is the product of two factors. One derives from forecasts of future consumption growth including the feedback that climate change damage has on such growth, which as mentioned already represents a major strength of the Review. The other factor is an essentially assumed value for the elasticity of marginal utility of consumption, which accounts for the fact that the same amount of consumption is typically thought to generate more utility to poorer individuals than to richer ones. Here, the Review assumes a value of one, which implies logarithmic utility in the social welfare function and, thus, some mild averseness against income inequality. Concretely, it is assumed that equal proportional (i.e. percentage) increases in consumption are of equal social value independently of the consumption level of the individual or generation. In plain words, if the current generation has consumption level 10 and some future generation has consumption level 20, then one extra unit of consumption to the poorer current generation (equivalent to 10% extra consumption) is counted equal to two extra units of consumption to the future generation that is twice as rich (also equivalent to 10% extra consumption).

A pure rate of time preference of essentially zero added to the forecasts of future consumption growth multiplied by an elasticity of marginal utility of consumption of one, together generate an overall discount rate of something like 1.4% in the Review, but variable depending on emission and climate change paths. This is quite low when compared to

---

deemed the "right" one, then this should be employed in all public sector decision-making. The Review argues for differentiated pure rates of time preference (and thereby discount rates) on the basis that more short-term public sector projects face project uncertainty and may collapse for some reason in the future (Stern 2007: 53). Such reasoning is erroneous. If there is project uncertainty, then it is the values themselves, which need correction, not the pure rate of time preference.

discount rates used in most existing CBAs of climate change. Whatever the other differences to previous studies, the low discount rate used in the Review favours decisive and urgent action. This is, of course, no new insight: Cline (1992) has demonstrated this already 15 years ago. In contrast, higher discount rates of the order of 4-6% typically lead to the conclusion that only rather small emission reductions are economically optimal.

Critics of the Review have been quick to pick up the crucial role of the discount rate (Dasgupta 2006; Nordhaus 2006; Tol and Yohe 2006; Maddison 2006). Some argue that low discount rates like the ones employed in the Review are simply inconsistent with the allocation of income toward consumption and savings by the current generation. Specifically, if the current generation were serious about employing such a low discount rate, it would have to consume far less now and invest the enhanced savings for the benefit of the future. That it does not do so is taken as evidence by critics that the current generation does not embrace such low discount rates and that therefore higher discount rates should be employed.

To assess the validity of this inconsistency counter-argument to the Stern Review would require a lengthy and technical discussion that is far beyond the scope of this article (see, for example, Lind 1995; Schelling 1995; Dasgupta 2006; DeLong 2006; Quiggin 2006). The more important and easily understandable point is that there is no such thing as the "right" discount rate, particularly not for such long time spans as those relevant to climate change (i.e, several centuries). The choice of the pure rate of time preference as well as the

elasticity of marginal utility of consumption[2] necessarily derive from ethical value judgements that, because they are normative judgements, can and will always be contested.[3]

The Real Issue: Non-Substitutable Loss of Natural Capital

In my view, the discounting debate, important as it is, misses what really should be the major issue in dispute on climate change: whether and, if so, to what extent climate change inflicts irreversible and non-substitutable damage to and loss of natural capital (see also Neumayer 1999, 2003). Natural capital is a term used by economists to summarize the multiple and various services of nature from which humans benefit – from natural resources (incl. food and water), to pollution absorption and environmental amenities (recreation, wildlife tourism etc). That climate change leads to many irreversible negative effects on natural capital is largely undisputed. But what does 'non-substitutable' mean? Put simply, damage to and loss of natural capital is non-substitutable if it cannot be compensated for by growth in consumption. This can be motivated in at least two ways. One approach sticks to a utility-based framework and argues that climate change, at least above a certain threshold, is likely to lower the utility of future generations. This would call for action if one is willing to make the ethical judgement that a decrease in future utility must be prevented. The other approach

[2] This elasticity need not be constant, but could be a function of future expected consumption growth. I, for one, do not think that giving up 1% of consumption today for the purpose of giving 1% extra consumption to much better off future generations is ethically desirable.

[3] Note that this is not equivalent to uncertainty about the discount rate. In an important contribution, Weitzman (1998) pointed out that if there is uncertainty about the right discount rate, then it can be shown that the discount rate one should use converges to the lowest of the uncertain discount rates in the long run. However, this argument applies to uncertainty about the growth rate of future consumption, but not to the choice of the pure rate of time preference or the elasticity of marginal utility of consumption. Economists and other social scientists are not uncertain about these, but simply differ in their choice because of differing value judgements.

abandons utilitarianism and requires us to base our decision-making regarding future generations on a de-ontological or rights-based fundament. This would call for action if climate change violates fundamental and inalienable rights of future generations. Let us discuss each approach briefly in turn.

In the first approach natural capital *directly* enters the utility function in addition to consumption, so that climate change damage, which affects utility but cannot be adequately translated into consumption loss equivalents, is taken into account. This first approach would then argue that climate change, at least above a certain threshold, damages the utility of future generations to an extent that they are worse off than the present generation, whatever the baseline consumption growth. This may sound implausible to many economists, but only because they often overestimate the extent to which consumption growth leads to actual utility gains (see Easterlin 2003). Once it is acknowledged that further consumption growth may only lead to a small rise in utility, then the proposition that climate change may actually decrease utility despite consumption growth is not too far fetched. Admittedly, such an argument must ultimately rest on a normative judgement. This is for two reasons. First, there is no way of knowing future generations' preferences. Second, there is similarly no way of adequately valuing the utility loss from, say, the loss of glaciers, wetlands, forests and coral reefs, the damages to coastal, marine, arctic, mountain and other ecosystems and the likely massive rise in the rate of species extinction, which are all likely to be associated with already moderate temperature increases.

In principle, this utility-based approach could be accommodated for within a CBA framework by assuming a damage function from climate change that translates temperature increases into sufficiently severe utility losses. The non-utilitarian approach toward non-substitutable loss of natural capital, however, cannot be accommodated. This approach posits that the current generation is not un-constrained and must not base its inter-generational

decision-making on the utilitarian principle of social welfare maximization (alone). Rather, prior to anything else it needs to respect the fundamental and inalienable rights of future generations. This second approach would then argue that climate change, at least above a certain temperature rise, violates fundamental principles of sustainable development, inter-generational stewardship and fairness and therefore violates the inalienable rights of future generations.

The two approaches toward non-substitutable loss of natural capital are clearly different from each other, but both lead to the same conclusion: no expected consumption growth can compensate future generations for the damage to and loss of natural capital that climate change risks to inflict on the future. There is an emerging literature that argues the case for non-substitutability (see, for example, Spash 2002; Gardiner 2004; Page 2006). Unfortunately, the Stern Review failed to push this argument forward, as we will see now.

The Stern Review: A Missed Opportunity

Without doubt, the Review has great merit. In fact, judged from the perspective of those calling for drastic and immediate action, the Review is probably as good as it currently gets with a CBA approach to climate change. There is no reason why the Review should not have applied its monetary valuation of benefits and costs in order to demonstrate that social welfare maximization alone calls for decisive and urgent action given certain assumptions about the discount rate, despite the fact that future generations will be much better off in consumption terms than us. It had to do some kind of CBA in any case as otherwise it would have lost all credibility among mainstream economists critical toward the Review's recommendations.

At the same time, however, the Review should have gone beyond what it did. The Review does many things, but it does not really tackle the issue of non-substitutability. To be

fair, there are some hints of it in the Review. For example, contrary to some earlier studies it is careful to include some so-called non-market impacts, which include damage to natural capital. However, by expressing these impacts as a percentage of GDP it implicitly assumes that this damage is substitutable. As another example, in the appendix to chapter 2 it briefly discusses the concept of sustainable development and the notion of 'stewardship'. It mentions, under the heading "Further Complications" (!), that utility might depend on both current consumption and the natural environment. There is also much in the detail and between the lines of the Review that points in the right direction. Yet, the Review missed the opportunity to try and build a persuasive case for non-substitutability. At the end of the day, it was therefore easy for critics to point out that the central message of the Review is crucially dependent on the discount rate used, which is really no news.

Why it Matters: A Comparison of Worst-Case Scenarios

The question is: does it matter? After all, the Review came out in favour of immediate and decisive action. I think it does matter because the non-substitutability argument can provide much stronger justification for the Review's recommended measures. This becomes clear by looking at worst-case scenarios. Assume that the world fails to follow the Review's recommendations and that it will achieve only very modest emission reductions over the next decades (not an unrealistic scenario in my view of world politics). In this case, the Review predicts a substantial loss of output (consumption) for far-off future generations, possibly up to 20% or even up to 35.2%. However, because of baseline consumption growth the future will also be very much richer than the present and, despite climate change damage, will still be very much better off than the present. For example, based on the assumptions in the Review, even in the worst-case scenario the future generation of 2200 will still be 8 times better off than the present one (rather than 12.3 times better off without climate change).

Within the CBA framework of the Review allowing such damage to occur is clearly sub-optimal and inefficient. But the worst that can happen if the world fails to heed the Review's advice is that the distant future is only much, much better off than the present instead of being much, much, much better off. That's too bad, but it is not really a tragedy.[4]

Compare and contrast this to the implications of failure to reduce emissions substantially for either of the two approaches toward non-substitutability of natural capital. In this case, climate change will cause irreversible and non-substitutable damage to and loss of natural capital via the multiple and complex channels so eloquently described in the Review itself as well as in the recently published update to the report by the Inter-Governmental Panel on Climate Change (IPCC 2007). In other words, climate change will harm future generations in a way that no consumption growth, however high, can compensate for it. Now, that would be a tragedy and really represents cause for action.

Still, failing to tackle the non-substitutability issue may not matter if preventing climate change were cheap. Unfortunately, it is not. The Stern Review likes to portray the likely cost of keeping us within the 450-550 ppm threshold as 'equivalent to a one-off increase in the average price level of 1%'.[5] This sounds so innocuous to laypeople as to totally mislead them about the true cost dimension. What kind of person would not agree to decisive and urgent action to reduce greenhouse gas emissions if all it takes to do so is that the prices of all goods

[4] That this largely increased future wealth is likely to be unevenly distributed is no valid counter-argument. Neither is the argument that climate change will hit predominantly the poor. First, even the future poor are likely to be better off than the current poor and quite possibly better off than the current rich. Second, if it is all about consumption growth, then there are many other things one could think of that would benefit the poor and raise their consumption by much more, per unit of money spent, than can be achieved via reducing greenhouse gas emissions.

[5] See answer to 'How should a cost of 1% of GDP be interpreted?' part of the FAQ part accompanying the Stern Review website (http://www.hm-treasury.gov.uk/media/7CF/61/FAQ's.pdf).

and services go up by 1%? However, once laypeople understand that investing 1% of global GDP for mitigating climate change each year means spending $350 billion currently and something like $1000 billion in 2050, they may no longer regard the cost as innocuous. If we presume further that the majority, if not all, of this additional spending will have to come from the rich countries, then, as Dasgupta (2006: 8) calculates, we ask developed countries to spend something like 1.8% of their GDP. That is more than twice the United Nations target for international aid and at least four times actual recent aid levels. No doubt then, limiting climate change asks for substantial sacrifices by the current generation. It takes a lot of guts and leadership by politicians to persuade their domestic publics to make such sacrifices.

Conclusion

Whether and how to act against climate change cannot be decided on the basis of "hard numbers" because there are no "hard numbers" when it comes to climate change. To outsiders, the CBA studies of economists may suggest otherwise. But those who understand what the studies do, also know two things. First, many effects of climate change simply cannot be adequately monetarily valued. Second, what can be valued needs to be transformed from values in the far distant future to present values and any CBA recommendation is therefore crucially dependent on the discount rate used, which is in turn inextricably linked to normative value judgements. It follows that, one way or the other, the decision-making toward climate change is heavily influenced by ethical choices. But it is important that we face the real issues when making ethical choices and orient the discussion toward what matters to people.

I contend that those who believe that the current generation should take immediate and decisive action against climate change need to go beyond arguing for a low discount rate. Otherwise, the case for action crucially depends on asking the current generation to make

substantial sacrifices for cushioning consumption losses to future generations that are much better off than us anyway. This will not be very popular once voters understand what they are being asked to do. It will be even less popular when critics point out that the very favourable benefit-cost ratios of action presented by the Stern Review diminish and even turn negative with different, and *a priori* no less valid, assumptions about the components of the discount rate.

Fortunately, few people would want the future to be worse off than us or would want to violate the inalienable rights of future generations. They are also possibly willing to sacrifice quite a bit for preventing this from happening. Hence, if one can convince voters and politicians of the case for non-substitutability, then there is a much better chance of gathering enough support for the measures described in the Stern Review to keep the world within the 450-550 ppm threshold.

I also contend that the non-substitutability issue is much closer to the real concerns of people. By contrast, CBA studies of climate change and the debate on the discount rate are strangely out of touch with reality. Voters and politicians who favour decisive and urgent action surely do not do so because they want to save much better off future generations from some consumption loss that, even if it happened, would still leave them much better off than us. Instead, they are concerned that climate change is like no other and that its sheer scale and extent of damage threatens to create a new bio-physical world that either leaves the future worse off or violates their inalienable rights, despite consumption growth. It may come as a surprise to some economists, but Article 2 of the United Nations Framework Convention on Climate Change calls for ‘stabilization of greenhouse gas concentrations in the atmosphere at a level that would prevent dangerous anthropogenic interference with the climate system’, not for maximizing the present discounted value of an inter-temporal social welfare function.

That limiting climate change is costly is no reason against action. However, if we are going to ask people to make substantial sacrifices for reducing greenhouse gas emissions, then let us do so for the right reason: the threat of irreversible and non-substitutable loss of natural capital if we fail to reduce emissions.

References

Baer, Paul. 2006. The Worth of an Ice Sheet. http://www.postnormaltimes.net/blog/archives/2006/12/the_worth_of_an_1.html

Cline, William R. 1992. *The Economics of Global Warming.* Washington DC: Institute for International Economics.

Dasgupta, Partha. 2006. Comments on the Stern Review's Economics of Climate Change. http://www.econ.cam.ac.uk/faculty/dasgupta/STERN.pdf

DeLong, Brad. 2006. Partha Dasgupta Makes a Mistake in His Critique of the Stern Review. http://delong.typepad.com/sdj/2006/11/partha_dasgaptu.html

Easterlin, R.A., 2003. Explaining happiness. *Proceeding of the National Academy of Sciences* 100: 11176-11183

Gardiner, Stephen M. 2004. Ethics and Global Climate Change. *Ethics* 114: 555-600.

IPCC. 2007. *Climate Change 2007 - Impacts, Adaptation and Vulnerability*. Cambridge: Cambridge University Press.

Lind, Robert C. 1995. Intergenerational Equity, Discounting, and the Role of Cost–Benefit Analysis in Evaluating Global Climate Policy, *Energy Policy* 23 (4/5): 379–89.

Maddison, David. 2006. Further Comments on the Stern Review. http://www.economics.bham.ac.uk/maddison/Stern%20Comments.pdf

Mendelsohn, Robert O. 2006. A Critique of the Stern Report. *Regulation* (Winter 2006-2007): 42-46.

Neumayer, Eric. 1999. Global Warming: Discounting is not the Issue, but Substitutability is. *Energy Policy* 27 (1): 33–43.

Neumayer, Eric. 2003. *Weak versus Strong Sustainability: Exploring the Limits of Two Opposing Paradigms*, Second, Revised Edition, Cheltenham and Northampton: Edward Elgar.

Nordhaus, William. 2006. The Stern Review on the Economics of Climate Change. http://nordhaus.econ.yale.edu/SternReviewD2.pdf

Quiggin, John. 2006. Stern and the Critics on Discounting. http://johnquiggin.com/wp-content/uploads/2006/12/sternreviewed06121.pdf

Page, Edward A. 2006. *Climate Change, Justice and Future Generations*. Cheltenham and Northampton: Edward Elgar.

Schelling, Thomas C. 1995. Intergenerational Discounting, *Energy Policy* 23 (4/5): 395–401.

Spash, Clive L. 2002. *Greenhouse Economics – Value and Ethics*. London: Routledge.

Stern, Nicholas. 2007. *The Economics of Climate Change – The Stern Review*. Cambridge: Cambridge University Press.

Tol, Richard S.J. and Gary W. Yohe. 2006. A Review of the Stern Review. *World Economics* 7 (4); 233-250.

Weitzman, Martin L. 1998. Why the Far-Distant Future Should be Discounted at Its Lowest Possible Rate, *Journal of Environmental Economics and Management* 36 (1): 201–8.