The Stern Review and the discount rate

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Author: Dominic Webb
Economic Policy and Statistics Section

This note examines the arguments about the discount rate used in the Stern Review on the Economics of Climate Change.

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A. Introduction

The Stern Review on the Economics of Climate Change was published by the Treasury in October 2006. It argued for immediate strong action on climate change. The review estimated the costs of climate change as between 5% and 20% of GDP. This compares with a cost of reducing greenhouse gas emissions to avoid climate change of 1% of GDP.

One feature of the Stern Review which has attracted considerable attention and debate is the choice of the discount rate. The discount rate reflects the weight that policymakers put on the benefits and costs incurred in the future compared with those incurred today.

This note explains why discount rates are relevant to climate change policy, the approach taken by the Stern review and criticisms of Stern's approach. This is a complicated and technical subject. This note aims to provide a brief introduction to the issues.

B. What are discount rates and why are they relevant to climate change policy?

One of the most keenly debated areas of the Stern review is the extent to which the welfare of future generations should be taken into account when evaluating environmental policies to be adopted now. Decisions taken today about the level of greenhouse gas emissions will have long-term effects for future generations. Certain policy options will involve short-term costs but will yield benefits in the longer term which will be of benefit to future generations. A key issue is the weight to be given to these future benefits and how these should be balanced against costs borne now or in the near future.

Economists attempt to analyse this issue by means of a "discount rate." A high discount rate means costs and benefits in the future are given a low weight relative to costs and benefits incurred now. By contrast, a lower discount rate gives future costs and benefits more weight compared with using a higher discount rate.

C. Stern's discount rate

Stern explained his approach to discounting in an article in the *Financial Times*:

> The review examines the application of discounting to the particular characteristics of climate change. How much we discount the future depends on how much richer we expect to be. But climate change implies that strongly divergent paths for future growth are possible, so that the use of a single discount rate is inappropriate. Moreover, an examination of discounting cannot avoid the ethical issues involved in allocations between generations, some of which are very distant in time.
>
> The bottom line is that the less weight you attach to the future simply because it is the future, the less you will value investments in a stable climate. If you consider that the

> needs of future generations should be represented in decision-making, the case for strong mitigation is overwhelming.[1]

Stern's approach was summarised in an article in the *Financial Times*:

> The Stern report suggests, persuasively, that there is no compelling reason to value the welfare of future generations much below our own. The only reason to do so, it argues, is the possibility of extinction. It suggests, accordingly, that the pure rate of time preference should be 0.1 per cent a year.
>
> The report assumes, in addition, that a doubling of consumption halves marginal value (so-called "unit elasticity"). If we assume a rate of growth of consumption of 1.5 per cent a year, the discount rate would then be just 1.6 per cent a year. With 2 per cent consumption growth, it would be 2.1 per cent.
>
> Because the rate of growth of consumption is itself affected by the mitigation scenario, this is not exactly the approach taken in the report. Instead, welfare is compared directly across all scenarios. The conclusion is that the so-called "balanced growth equivalent" of the losses caused by "business as usual" are between 5 and 20 per cent of consumption.
>
> Now suppose that one objects, as critics do, that these assumed discount rates are far too low. The implication is that we should care less about the impact of climate change on the standard of living of future generations because they are expected to be vastly richer than we are today. This, of course, is a distributional judgment. Its implication is that we should care far more about the distribution of income across the globe today than we do. I wonder how many sceptics accept that implication? Few, if any, I imagine.[2]

Stern responded to some of the comments on the review's approach to discounting (see below) in a Postscript.[3] This contained a sensitivity analysis, using different discount rates. This concluded:

> The sensitivity analysis allows us to explore the effect of different assumptions, but it does not change our overall conclusion, that climate change is likely to cause damages which are very severe and of much greater consequence than the costs of greatly reducing risks by strong reduction in emissions. In the report we calculated damages from business-as-usual which were equivalent to at least a 5% loss in consumption, based on a narrow definition of risks and impacts, and up to 20% if a broader range of risks and impacts are considered. The sensitivity analysis marginally reduces the lower end and increases the upper end. The only exception is where we use high pure time discounting rates, which are in our view implausible relative to most positions on ethical values and take a very narrow view of impacts (i.e. excluding environment and health). In other words, unless the interests of future generations are heavily disregarded there is a very powerful case for strong mitigation.

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1 "Gains from greenhouse action outweigh the costs", *Financial Times*, 8 November 2006

2 "After the arguments, the figures still justify swift climate action", *Financial Times*, 15 November 2006

3 http://www.hm-treasury.gov.uk/media/A/6/Postscript.pdf (see also Technical Annex to the Postscript: http://www.hm-treasury.gov.uk/media/1/8/Technical_annex_to_the_postscript_P1-6.pdf

D. Comments and criticisms of Stern's approach

The discount rate used in the Stern review has been criticised for being too low. The implication of this criticism is that the future benefit of actions to reduce global warming are given too high a weight in the Stern review. For example, in evidence to the Treasury Committee, Lord Lawson said:

> [The discounting] part of Stern is not only highly contestable but highly contested. Professor Dasgupta says it is ridiculous and he has pointed out that if you accept Stern's [assumption about intergenerational equity] it means that the people of this generation should be saving 75% of their income for future generations. As he says, that is absurd. That part of Stern is, I believe, widely believed to be absurd.
>
> […]
>
> The proposition is that we should ask the people of this generation all round the world … to make considerable sacrifices now in order that their great-grandchildren or great-great-grandchildren, or whatever, who will be seven times as well off as they are today rather than six times as well off. It is as if at the time of the industrial revolution just under 200 hundred years ago people were told that they should not embark on that process and burn coal but use wind and water, which were well known technologies at that time, so that we in this generation would not be as well off than we are today. I do not think they would support that.[4]

William Nordhaus of Yale University has argued that Stern's approach to discounting is "questionable" and "leads to economic results that are inconsistent with market data".[5] Sir Partha Dasgupta of Cambridge University describes the Stern Review as an "impressive document" but criticises its approach to the discount rate:

> Sir Partha Dasgupta … noted that the review's "deeply unsatisfactory" assumption that "the distribution of well being among people doesn't matter much" implies "we should spend huge amounts for later generations even if, adjusting for risk, they were expected to be much better off than us". The cause was not served "when parameter values are so chosen that they yield desired answers". He advised the review team to present a "sensitivity analysis" of its results using different ethical parameters.[6]

The IMF World Economic Outlook:

> Quantifying the aggregate losses across generations involves use of a single welfare measure and bears on the present value estimates of global losses. The rate at which the welfare of future generations should be discounted to the present (which relates to the marginal product of capital) is the subject of considerable debate. The Stern Review's estimate that climate change would produce a large welfare cost— equivalent to a permanent reduction in consumption of about 14 percent of world output over the next two centuries— is much higher than the average annual estimated output loss. This reflects a low elasticity of marginal utility to consumption

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4 Treasury Committee, Climate change and the Stern Review: the implications for Treasury policy, HC 231, 5 February 2008, para 23

5 William Nordhaus, *Critical Assumptions in the Stern Review on Climate Change"*, Science, 13 July 2007

6 "Consensus fails to materialise among experts", *Financial Times*, 13 January 2007

and an assumed pure rate of time preference of approximately zero, both of which give a large weight to consumption losses from distant generations. Many consider these assumptions unpersuasive because they imply a much higher-than-observed savings rate and a lower-than-observed rate of return on capital (Nordhaus, 2007a; and Dasgupta, 2007). Stern (2008) points out that discount rates are conditional on the path of future growth in consumption, implying that a lower discount rate should apply in a world with climate change than in a world without it, all other things equal. He also underscores that basing discount rates on market rates is fundamentally inappropriate in cases involving welfare trade-offs across far-apart generations and across countries with different levels of income.[7]

E. Appendix 1: Stern's approach to the discount rate

The following is taken from "Frequently Asked Questions" section of the Stern Review website:

> The decision on discounting depends on two factors: first, how to take into account the fact that people are likely to be richer in the future; and second, whether the future should be discounted simply because it is the future.
>
> We discount in the standard way to allow the possibility that people will have higher consumption in the future. Climate change implies that strongly divergent paths for future growth are possible. The use of a single set of discount rates for all paths is inappropriate when looking at non-marginal changes.
>
> The degree of discounting depends on attitudes to income distribution, which are captured by the elasticity of the marginal utility of consumption. We use an elasticity of one, in line with some empirical estimates. For this case, the contribution to the discount rate is equal to the rate of growth of consumption of the path. This reflects an assumption that society is moderately averse to income inequality and therefore is more worried about adverse impacts that fall on poorer generations. If society were more strongly averse to income inequality, it would be appropriate to use a higher multiple of the average growth rate.
>
> In addition, we carefully examine the case for discounting the future just because it is the future – which in economic terms is known as pure time preference. This requires a consideration of the ethical issues involved in comparing the incidence of costs and benefits between generations, some of which are distant in time. We argue – in line with economists including Ramsey, Sen, Pigou and Solow – that the welfare of future generations should be treated on a par with our own. This means that the only justification for a positive rate of pure time preference in assessing the impacts of climate change is the possibility that the human race may be extinguished. As the possibility of this happening is low, we assume a low rate of pure time preference, 0.1%, which corresponds with a 90% probability of humanity surviving a 100-year period. Higher probabilities of survival would imply a still lower rate. There are other approaches to pure time discounting and references are given in the Review (Chapter 2 and the appendix) and in the "Modelling Paper" on www.sternreview.org.uk.

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[7] IMF, World Economic Outlook, April 2008, p8

The average discount rate used in the modelling exercise is then the combination of these two elements: the average growth rate over the relevant time horizon for the particular path being examined (in the case where the elasticity of the marginal utility of consumption is one), plus the 0.1% pure rate of time preference.

Many previous studies have used higher rates of pure time preference, which are similar to those used for evaluating other kinds of investments. However, we argue that this disinvestment in the environment cannot be considered in, say, the same way as an economist would consider an investment in a railway. A railway can be replaced or redesigned, it can become obsolete or redundant. In other words, the probability of survival depends on the context. In this case the context is that of the whole planet.[8]

F. Appendix 2: Links to further information

The Stern Review, October 2006:
http://www.hm-treasury.gov.uk/independent_reviews/stern_review_economics_climate_change/sternreview_index.cfm

Other papers by the Stern Review team
http://www.occ.gov.uk/activities/stern.htm

Treasury Committee, Climate change and the Stern Review: the implications for Treasury policy, HC 231, 5 February 2008
http://www.publications.parliament.uk/pa/cm200708/cmselect/cmtreasy/231/231.pdf

Government Response, HC 495, 30 April 2008
http://www.publications.parliament.uk/pa/cm200708/cmselect/cmtreasy/495/495.pdf

House of Lords Select Committee on Economic Affairs, The Economics of Climate Change, HL Paper 12-I, 6 July 2005
http://www.publications.parliament.uk/pa/ld200506/ldselect/ldeconaf/12/12i.pdf

Government Response, HL Paper 71, 28 November 2008
http://www.publications.parliament.uk/pa/ld200506/ldselect/ldeconaf/71/71.pdf

IMF World Economic Outlook, April 2008, Chapter 4: Climate Change and the Global Economy
http://www.imf.org/external/pubs/ft/weo/2008/01/pdf/c4.pdf

William Nordhaus, various papers on economics of climate change
http://nordhaus.econ.yale.edu/recent_stuff.html

Sir Partha Dasgupta, Comments on the Stern Review's Economics of Climate Change, 12 December 2006
http://www.econ.cam.ac.uk/faculty/dasgupta/stern07.pdf

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8 http://www.occ.gov.uk/activities/stern_papers/faq.pdf