DISCOUNTING, EQUITY, AND COST-BENEFIT ANALYSIS

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Summary

Cost-benefit analysis is usually understood as a method for evaluating investments on the basis of related social requirements (costs) and improvements (benefits). Given that the most profitable investments should be carried out first, cost-benefit analysis provides a method for comparing the return of a new investment with the return on the most profitable alternative. The comparison is based on a discounting of future costs and benefits by a rate equal to the social rate of return on the best available alternative. If the discounted benefits exceed the discounted costs, the new project is said to yield a positive net present value. It thereby adds to the social surplus, and should be carried out. If not, the alternative should be chosen.

The discount rate, which represents the return on the most profitable alternative, is, in principle, clearly defined but it is very difficult to put a value on it in practice. Although cost-benefit analysis is often based on a large number of strong assumptions, particularly when it comes to the evaluation of public investments, the choice of a discount rate is usually pointed out as being the most influential assumption to the conclusions. The choice is particularly delicate when evaluating investments aimed at mitigating environmental problems with a long time horizon, such as climate change, because the major positive effects of climate measures tend to diminish if using the traditional approach to the choice of a discount rate.

Increasing focus on policies to mitigate long-term environmental problems has spurred new interest in the consequences of discounting. Experts seem to concur about the basic principles, but disagree when it comes to the choice of a particular rate. Some claim that a mere comparison with the return on, for example, commercial investments is inappropriate for environmental investments, especially if the environmental problem has a long time horizon. In that case, it is argued, the question of discounting also

relates to who makes the decision, and who has to bear the burden of a deteriorating environment. Therefore, the issue of equity across generations has to more explicitly considered, they argue. Others emphasize the importance of optimizing the use of all the resources available to the national economy, and demand the same requirements for all investments regardless of the aim. They think that one should not spend large sums on mitigating climate change now because of intergenerational equity, because future generations are most likely to become richer than the present generation.

This article explains how the discount rate is determined, how it can be estimated numerically, and why widely different choices of a discount rate may all be based on fairly reasonable assumptions. Then, the main determinants of the discount factor are presented, and the assumptions underlying the traditional choice of a discount rate are discussed. Finally, possible consequences of relaxing the assumptions are outlined.

1. The Impact of Alternative Choices of a Discount Rate

In its simplest form, a cost-benefit analysis implies that present and future costs and benefits are transformed into present values and compared. The present value expresses what a given amount received at some future point in time is worth today if available now and invested in the most profitable alternative. If r is the discount rate, an investment of \$100 today ought to yield an income of $100 \times (1 + r)$ dollars next year or $[100 \times (1 + r)] \times (1 + r) = 100 \times (1 + r)^2$ two years from now to be undertaken. Hence, the present value of \$100 received in the future year t is $100 / (1 + r)^t$.

The consequences of slight changes in the discount rate may be dramatic, and the results of the evaluation are therefore sensitive to the choice of discount rate, especially for investments that yield benefits in the long term. For example, the average return on investments in the private sector in most developed economies is between 4% and 7% when adjusted for inflation. The present value of \$100 received in 50 years is then \$14.00 and \$3.40, respectively. Consider an abatement measure aiming at mitigation of climate change that yields the same amount of benefits 10 years from today and 90 years from then. If the cost of this measure today is \$100, the benefits required to make the measure socially beneficial is \$5.9 each year in 90 years if the discount rate is 4%. This adds to a total benefit of \$527 over the 90 years. If the discount rate is 7%, the annual required (constant) benefit is \$13, which adds up to \$1170 for the 90 years.

With both a 4% and a 7% rate of discount, the benefits accruing 50 or more years ahead are negligible when discounted. This has been the main objection against using traditional cost-benefit analysis in the evaluation of long-term environmental policy. Some have suggested a lower discount rate in environmental policy questions, while others have gone so far as to discard discounting. This is, of course, problematic if the only reason for using a different rate is to make the environmental measures look beneficial. Cost-benefit analysis thereby loses its main force, namely to compare the social benefits of environmental investments with those of other investments. For instance, if a 2% discount rate is accepted for investments with positive environmental effects, why not use the same rate of discount for other investments that we consider positive in a social context, such as health care for poor people? However, this leaves the outcome of the analysis in the hands of the analysts. If a different discount rate is to

be used for certain projects, there has to be a reason why the traditional rate of comparing values at different points of time does not apply.

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Biographical Sketch

H. Asbjørn Aaheim (born 1951) is a senior research fellow at CICERO (Center for International Climate and Environmental Research), Oslo, in Norway. He was educated at and graduated from the University of Oslo in 1978. From 1978 to 1993 he worked at Statistics Norway with resource accounting and analysis of oil production and energy markets. Since 1993 has been at CICERO, where he has been working primarily with cost-benefit studies of environmental policy. He was lead author of the second assessment report of the Intergovernmental Panel on Climate Change (IPCC) on the applicability of cost-benefit analysis of climate policy. He has written several papers on multi-gas abatement of greenhouse gas emissions, and on ancillary benefits of climate policy. In recent years his orientation has been against the intertemporal aspect of climate policy, and decision making under uncertainty. He is also working with macroeconomic models, and development of integrated assessment models.