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## *Discounting, Uncertainty, and Climate Change*

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- Climate change policy is often evaluated by discounting the future benefits of emissions abatement at a high (6%) discount rate. This suggests that greenhouse gas emissions should continue to grow and that the welfare of future generations is unimportant.
- Economic theory supports the use of low ( $\leq 1\%$ ) discount rate based on decision-makers' aversion to risk and uncertainty.
- The use of a low discount rate supports aggressive steps to stabilize global climate and also upholds the principles of intergenerational fairness.

### *Some Fundamentals*

In the theory of cost-benefit analysis, the *discount rate* represents the return on investment required to justify the expenditure of scarce social resources. This in turn reflects decision-makers' impatience or *time preference* – the degree to which they prefer to receive benefits in the present rather than the future.

In the economics of climate change, one key argument is that the future benefits provided by greenhouse gas emissions abatement should be discounted at a rate equal to the average return on a typical private-sector investment (Manne, 1999). The rationale is that resources should be allocated to uses that provide the greatest benefits to society. Historical data suggest that typical private-sector investments yield real (inflation-corrected) returns of 6% per year (Nordhaus 1994). Yet the use of a 6% discount rate has strong consequences in the evaluation of climate change policy regimes. It implies that:

1. No more than  $\$0.003X$  should be spent today to avoid environmental impacts that would impose  $\$X$  of damages one century in the future.
2. Greenhouse gas emission should be allowed to grow at a robust rate.

In one example of this approach, Nordhaus and Boyer (2000) find that carbon dioxide emissions would rise by 64% between 2005 and 2105 given optimal climate change

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<sup>1</sup> Economics for Equity and the Environment Network (E3) is a nationwide network of economists developing arguments for environmental protection with a social equity focus. For more information, please contact Kristen Sheeran, Director, at [ksheeran@e3network.org](mailto:ksheeran@e3network.org). E3 is a program of Ecotrust.



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policies. Under business-as-usual, emissions would rise by 85%. The inference is that it is better for society to bear the long-term costs of climate change than the short-run costs of climate stabilization. This conclusion contradicts the primary goal of the U.N. Framework Convention on Climate Change, which calls for major and sustained emissions reductions to “prevent dangerous anthropogenic interference with the climate system.”

### *Intergenerational Fairness*

Critics charge that the use of high (c. 6%) discount rates can support policy outcomes that are unfair to future generations. One line of argument holds that climate change would impose major, uncompensated costs on posterity. This violates the moral principle that our children and grandchildren have a right to: (a) inherit an undiminished natural environment; or (b) protection from uncompensated environmental harms (Brown, 1998). The claim here is not that high discount rates fail to capture individuals’ time preference, but rather that individuals’ time preference is irrelevant in considering questions of intergenerational fairness.

A second argument is grounded in utilitarian moral reasoning, which holds that equal weight should be attached to the welfare of each present and future person. Stern (2007) argues that this moral premise is consistent with the use of a 1.4% discount rate in monetary cost-benefit analysis. This holds true because, in a world of economic growth, the welfare provided by an extra dollar of income should decline over time. Economists have long recognized that the use of low (c. 1%) discount rates supports aggressive steps to stabilize global climate (Cline, 1992). The utilitarian defense of low discount rates, however, is controversial because it rests on contested moral judgments and scientifically untestable assumptions about the relationship between affluence and welfare (Manne, 1995).

### *Discounting and Uncertainty*

The use of low discount rate can be justified without appeals to principles of intergenerational fairness. Suppose that one accepts the view that public policies should be evaluated using the same discount rates employed in private-sector decisions. While it may be true that a typical private-sector investment generates an average return of 6% per year, it is also true that financial markets provide a wide array of investment options with widely varying rates of return. In particular, investors demand:

- 1% returns on safe (or “risk-free”) investments such as money market funds.
- 2% returns on low-risk investments such as long-term, high-quality bonds.
- 7% returns on risky investments such as corporate stocks.



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In theory, the discount rate that should be employed in cost-benefit analysis should reflect the risks presented by the policy under investigation. The appropriate discount rate is equal to the sum of two terms: (a) the risk-free rate of return; and (b) a risk premium.

In the case of the stock market, the risk-premium assumes a large, positive value. This is because investing in stocks increases the overall risk or volatility associated with an investor's portfolio. The risk premium represents the compensation that investors demand to accept the prospect of potential losses.

Greenhouse gas emissions abatement, in contrast, would serve to reduce potentially catastrophic risks. The impacts of climate change are only partially understood and are subject to key uncertainties. But by reducing climatic risks, emissions abatement is akin to an insurance policy. Economic theory implies that the risk premium should be *negative* for policies that reduce major risks to future economic welfare (Howarth, 2005). From this it follows that the discount rate employed in evaluating the net benefits of climate change policies should be no higher than the risk-free rate of return.

This line of reasoning supports the use of low ( $\leq 1\%$ ) discount rates in the economics of climate change based purely on an analysis of decision-makers' behavior in capital markets. Data from financial markets suggest that people have: (a) low rates of time preference; and (b) high rates of risk aversion. Accounting for these facts favors aggressive steps to stabilize global climate.



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*References*

- Arrow, K.J., W.R. Cline, K.G. Mäler, M. Munasinghe, R. Squitieri, and J.E. Stiglitz. 1996. "Intertemporal Equity, Discounting, and Economic Efficiency." In *Climate Change 1995: Economic and Social Dimensions of Climate Change* (J.P. Bruce, H. Lee, and E.F. Haites, eds.). Cambridge: Cambridge University Press.
- Brown, P.G. 1998. "Toward an Economics of Stewardship: The Case of Climate." *Ecological Economics* 26: 11-21.
- Cline, W.R. 1992. *The Economics of Global Warming*. Washington: Institute for International Economics.
- Howarth, R.B. 2005. "Against High Discount Rates." In *Perspectives on Climate Change: Science, Economics, Politics, Ethics* (W. Sinnott-Armstrong and R.B. Howarth, eds.). Amsterdam: Elsevier.
- Manne, A. S. 1995. "The Rate of Time Preference: Implications for the Greenhouse Debate." *Energy Policy* 23: 391-394.
- Nordhaus, W.D. 1992. *Managing the Global Commons*. Cambridge, Massachusetts: MIT Press.
- Nordhaus, W.D. and J. Boyer. 2000. *Warming the World*. Cambridge, Massachusetts: MIT Press.
- Stern, N. 2007. *The Economics of Climate Change: The Stern Review*. Cambridge: Cambridge University Press.