

Research Notes

Discount Rates for Environmental Benefits Occurring in the Far-Distant Future

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February 3, 2009

As is often the case in economics, an obscure and often dull-sounding issue, can quickly get into some deep moral questions. Standard cost-benefit analysis methods involve estimating the dollar values of costs and benefits over some time horizon that is considered to be appropriate for the full costs and benefits to be realized. In some cases, such as economic or health impacts, benefits may not be realized until many years into the future. With reductions in greenhouse gas emissions, it may even be hundreds of years in the future when actions taken today have an impact. In the more usual case of say, an investment in a bridge or infrastructure project, the most likely time frame is decades rather than centuries. In business, decisions involving cost-benefit analysis may be even shorter. Here though, we focus on long term policy decisions, so the appropriate time frame is decades or centuries.

To make a comparison of costs and benefits the estimated values for each year are discounted back to the reference year (usually the current year). To value these potentially far-off future benefits or costs in today's dollars we need an appropriate discount rate.

The social discount rate is the discount (or interest rate) we apply to dollar values that arise in different time periods in order to make consistent comparisons with today's dollar values. What discount rate is appropriate is particularly tricky for inter-generational policies, i.e. the things our governments do today that will impact future generations. If we use a high discount rate, or even a relatively standard rate such as 5%, values far into the future get very small in today's dollars. If we use a low or zero discount rate, those far off benefits not

experienced for 100 or more years from now, are given values similar to what they would have if we got the benefit today.

Why the Discount Rate Matters

Suppose the policy we are considering will save lives but those lives will not even be started for a hundred year from now. If we value a human life at say \$5 million in today's dollars (another post will get into the whole thorny issue of valuing human life), and we can save one life 100 years from now, a sensible seeming discount rate of 5% per year will mean that that future person's life is worth a bit less than \$40,000 in today's dollars. With 5% discounting, if that life saved occurs 200 years from now instead of 100, it would be worth a only \$304 to us today; and lives saved 300 years from now would only be worth \$2.30! You see where the controversy comes in. Is saving one of your far off descendants worth so much less to society than saving you today??

How do we arrive at such a dramatic mark-down in the value of a life saved a century from now versus a life-saved today? It is simply the exponential nature of discount and interest rates. This is the "miracle of compound interest" in reverse. Any positive interest rate means that current dollars will increase in nominal value for any future period, so over long periods of time current values become much higher at far-distant time periods. Similarly, any nonzero discount rate will produce a large decrease in value over long periods of time. Just lowering the social discount rate to 3% per year, would make \$5 million life saved 100 years would be worth a bit less than \$268,000. This is still a lot less than the \$5 million future value, but it's a lot more than the \$40,000 that the 5% rate produces. So using a lower discount rate makes future values much larger in today's



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dollars. A zero discount rate, would of course make them equal to today's value — \$5 million in 100 years would be valued at \$5 million today. Clearly, it would be pretty easy to justify all kinds of “way out” futuristic policies with a zero social discount rate.

But those dollars values and the discount rates mean something — they embed assumptions about how much value that we place on future human lives. If the discount rate is zero, we value future lives equally to current human lives.

Why Not Just Use the Market Rate?

Policy decisions require a social discount rate rather than a simple market discount (or interest rate). The social discount rate provides an estimate of the rate at which society not just the market trades off the future and the present. Lind et al(1982), among others, suggest that the discount rate consists of two components: the productivity of capital, and the social rate of time preference.

The productivity of capital component is related to, but not the same as, market interest rates. Social rate of return on capital is likely higher than the private returns because of various factors such as the taxing of capital returns, imperfections in capital markets and crowding out due to government borrowing and taxation. These factors tend to lower market returns relative to social returns to capital investments. The second component, the social rate of time preference, is just a measure of how impatient we are, i.e. our preference for receiving benefits or consuming today rather than tomorrow. Even if the return on capital due to productivity gains are zero, the preference for benefits now rather than in the future means that current resources are likely to be of greater value than future resources (or benefits).

In the past, cost-benefit analyses often applied one discount rate to all estimated future costs and benefits. Recently, however, there is some debate as to whether environmental benefits should be discounted at a different social discount rate than that used for other types of benefits and for overall costs. In particular it has been argued that there should be declining discount rates (DDR) applied to environmental benefits that will persist far into the future.

Climate Change Policy and the Debate over Social Discount Rate

One area where this has been hotly debated recently is in the field of climate change, especially in the

reaction to the Stern Review on the Economics of Climate Change in Britain. It famously concluded that the damages from emissions of greenhouse gases are very large and immediate strong action was economically warranted. Reviews by Nordhaus(2007) and Weitzman (2007), who were less or more sympathetic to the overall findings of the report respectively, both pointed out that the Stern Review findings depend crucially on the use of a near-zero discount rate and a particular utility function. Nordhaus argued that the Stern Review's conclusions would not hold under more general conditions such as discount rates that are closer to market discount rates.

A very low discount is appealing on ethical grounds since it implies that current and future generations are treated more equitably. On the other hand, using a very low discount rate virtually guarantees high valuation of any benefits that may occur in the far future. But do we really value the future close to the same way as we value things we can experience in the near or medium term future? We may value our children's future well being quite high and their children's too, but how much value do we really place on the well-being of those not yet born, and not to be born for more than 100 years from now? Of course in principle, we may value future generations' well-being quite highly, or say we do. But how do we really square that with the fact that most of us can't even manage to save enough for our own well-being in retirement!! That we can't put away enough in our own pensions suggests that we do indeed care more about the present than the future and therefore we discount the future heavily.

The discount rate we choose is effectively a price (any interest or discount rate tells us about the price of a dollar in two different time periods). And, in market-based systems, prices are very important drivers of how much of our available resources we spend on something. Since there are few if any markets for environmental goods or good health or future well being, it's always going to be difficult to know what proper valuations and prices should be. However, if we go ahead with policies based on an unrealistically low discount rate we may devote too much of our current resources to far-off future benefits. Nordhaus (2007) argues in his criticism of the Stern Review, that imposing a low discount rate for investments made to mitigate climate change in a world where other types of investments must generate higher returns would imply inefficient allocation of resources over time.

There is no consensus yet on the appropriate discount rate to use for climate change policies. But,



there is considerable agreement on what policy makers can do for now in the face of the uncertainty about the appropriate discount rate. They should employ sensitivity analysis. That is, they need to make sure that their analysis considers different discount rate scenarios, not just a very low or high one. Nordhaus and others recommend that the range of discount rates to consider should include a rate close to the market discount rate. It has been also been recommended that there should be declining discount rates (DDR) applied to environmental benefits that will persist far into the future. For example, Weitzman (2001) recommends declining discount rate scale as follows. Use a discount rate of 4% for the first 5 years, 3% for years 6 to year 25; 2% for years 26 through 75 years; 1% for the distant future in 76 to 300 years from now and 0% for the far-distant future of 300 years from now or more.

Declining discount rates, and Weitzman's approach in particular, seem to be very pragmatic solution to this issue. The nonzero discount rates in the years up to year 300 mean that the overall stream of future benefits is reduced in value compared to the equivalent amount experienced today. This seems a sensible way to express our tendency to be impatient and value things today higher than the same thing experienced in the future. Once we are considering events in the far off future, we slow reduce the rate of discount. This reflects the fact that today, we likely don't have strong opinions about the relative difference between effects that are going to happen 75 years from now versus 100 years from now or 350 years from now. So the rate at which we discount the future probably does slow down once you get far enough out. I think that overall society does care about the future, and future generations' wellbeing but we don't act as if we value the future as much as we value the present. Declining discount rates seem to be useful mechanism for incorporating this moral view point and practical observed behaviour. No small feat, yet a workable solution.

Rose Cunningham, Ph.D.
Independent Economic Advisers
rcunningham@iearesearch.com

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