Descriptive Versus Prescriptive Discounting in Climate Change Policy Analysis

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Abstract

In cost-benefit analyses of climate change policy, a small change in the value of a single technical parameter—the so-called social discount rate—can make the difference between recommending a go-slow approach to mitigating greenhouse gas emissions and recommending immediate and costly actions to curb them. This paper aims to distinguish between five different approaches to social discount rates, to criticize two of these, and to explain how the other three are to some degree mutually compatible. Along the way, I hope to shed some new and useful light on a longstanding debate in climate change economics between so-called descriptivists and prescriptivists about social discounting. My ultimate goal is to offer a sketch of the conceptual landscape that makes visible some important facets of the debate that very often go unacknowledged.

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INTRODUCTION

In many countries around the world, a key analytical framework underlying the formal analysis of climate change policy is the welfare economics framework of cost-benefit analysis. This is true, for example, in the United Kingdom, which commissioned the Stern Review on the Economics of Climate Change,[1] and in the United States, where the Obama administration's Environmental Protection Agency justified its Clean Power Plan using the tools of cost-benefit analysis.[2] Within any such analysis of climate policy, a small change in the value of a single technical parameter—the so-called *social discount rate*—can make the difference between recommending a go-slow approach to mitigating greenhouse gas emissions and recommending immediate and costly actions to curb them. The social discount rate affects the way cost-benefit analysis views future damages caused by climate change. A discount rate close to zero treats a dollar's worth of damage in the future as roughly on par with a dollar's worth of damage today, whereas a discount rate of 10% treats a dollar's worth of damage in 100 years as being *much* less costly than one cent's worth of damage today. Since the lion's share of damages from climate change are expected in the much farther future, the choice of the social discount rate exerts a powerful effect on whether the benefits of preventing future damages are viewed as worth the costs we would have to pay today to prevent them.

The literature on discount rates is technical and vast, and the disagreements among scholars can at times be quite charged. This is especially true when disagreement pits economist against philosopher. For example, one leading economist, writing in response to a heavily philosophical paper criticizing mainstream economic approaches to discounting, complains that "'[s]ocial discount rates' often bring out the intellectually worst among moral and political philosophers writing on the subject."[3] It would be foolhardy to hope that one paper—especially one by a moral philosopher—could bridge the chasm. Nevertheless, my aim is to go some distance toward that goal, by examining the possibility that in at least some cases the disagreement over discounting between economists and philosophers (and indeed between economists themselves) is more apparent than real.

My aim is to distinguish between five different approaches to social discount rates, to criticize two of these, and to explain how the other three are to some degree mutually compatible. Along the way, I hope to shed some new and useful light on a longstanding debate in climate change economics between so-called "descriptivists" and "prescriptivists" about social discounting. My

1. NICHOLAS STERN, THE ECONOMICS OF CLIMATE CHANGE: THE STERN REVIEW (2007).

2. ENVTL PROT. AGENCY, REGULATORY IMPACT ANALYSIS FOR THE CLEAN POWER PLAN FINAL RULE (2015), https://www.epa.gov/cleanpowerplan/clean-power-plan-final-rule-regulatory-impact-analysis [https://perma.cc/Z7ZN-8GKE].

3. Partha Dasgupta, *The Ethics of Intergenerational Distribution: Reply and Response to John E. Roemer*, 50 ENVTL. & RES. ECON. 475, 489 (2011).

ultimate goal is to offer a sketch of the conceptual landscape that makes visible some important facets of the debate that very often go unacknowledged.

I. PRESCRIPTIVISM VS. DESCRIPTIVISM

Cost-benefit analyses of climate change typically employ the technical tools of Optimal Growth Theory. The goal within this branch of welfare economics is to identify the intertemporal stream of consumption—often expressed as a time series of global per capita averages—that maximizes a social welfare function.[4] What this means is that economists first identify which intertemporal consumption streams of the form $(C_0, C_1, \ldots, C_t, \ldots)$ are technologically feasible, and then they seek to construct a mathematical function that treats these streams as arguments and assigns a numerical value to each. The aim is to construct a social welfare function where the values it assigns to consumption streams can be used to place those streams in order from best to worst.[5] Climate policy analysts then look to see what greenhouse gas emissions trend is associated with the highest ranked, or "optimal," consumption stream, and then hold this up as the "optimal emissions trajectory." From there the task is to figure out which policy instruments—for example, carbon taxes or carbon trading schemes—would put the world on track to attain the optimal trajectory of greenhouse gas emissions.

Here is the social welfare function standardly used for this purpose[6]:

$$V = \sum_{t=0}^{\infty} U(C_t) \cdot \left(\frac{1}{(1+\rho)^t} \right)$$

This function takes the global per capita consumption at each time, t, that is relevant to the analysis (for example, each year up to 250 years from now) and runs it through the function U. U is intended to represent the well-being obtained by someone who enjoys a given consumption level. Of course, there are many debates about the proper functional form of U, but in this paper I am not concerned with them.[7] Once a U-number has been generated as a function of consumption, that U-number is then multiplied by a *pure time discount factor*, represented above by $\left(\frac{1}{(1+\rho)^t} \right)$. Pure time discount factors are used to express how valuable future well-being is compared to present well-being.

4. In this paper, I shall abstract from all issues of risk and uncertainty.

5. *See* PARTHA DASGUPTA, HUMAN WELL-BEING AND THE NATURAL ENVIRONMENT 179–91 (2001).

6. This formulation abstracts from population size—in effect by assuming that population is constant throughout time. This is merely to simplify notation and to focus on issues that are independent of population size.

7. See Nicholas Stern, *The Marginal Valuation of Income*, *in* STUDIES IN MODERN ECONOMICS: THE PROCEEDINGS OF THE ASSOCIATION OF UNIVERSITY TEACHERS OF ECONOMICS 209–58 (M. J. Artis & A. R. Nobay eds., 1977).

Accordingly, ρ is the *rate of pure time preference*.[8] A positive rate of pure time preference has the effect of *decreasing* the discount factor that is applied to well-being in the future, which in turn has the effect of treating future well-being as less valuable than an equivalent amount of well-being today.

When economists refer to "social discount rates," they do not usually refer to what I just termed the rate of pure time preference. For it turns out that when U takes a standard form, it is possible to derive from the social welfare function the following formula, often called the Ramsey equation[9]:

$$\delta = \eta \cdot g + \rho$$

In this formula, δ is the social discount rate, ρ is the rate of pure time preference, η is a measure of the "curvature" of the U-function (that is, the degree to which less and less well-being is obtained from each additional unit of consumption), and g is the annual rate at which consumption grows within a given consumption stream. The Ramsey equation states a condition that must be met by an optimal consumption stream: it must be true that the social welfare function will tolerate trading a small increment of consumption in period 1 for a return in period 2 only if the investment's rate of return is at least as great as the social discount rate. Social discount rates therefore convey the relative value, at the margin, of consumption today and consumption tomorrow. Since applied economic analyses frequently report costs and benefits in consumption terms, social discount rates, rather than the rate of pure time preference, are often the focus of debates about how one should value future benefits. But as the Ramsey equation shows, the latter is a key ingredient in the former.

Those who are very concerned about climate change are quite reasonably concerned that cost-benefit analyses of climate policy will use social discount rates that are unjustifiably high, for that would mislead policymakers into thinking that climate change is not a serious problem. One nice illustration of this comes from William Nordhaus, who notes that discount rates are in effect interest rates working in reverse. Nordhaus writes, "In thinking of long-run discounting, it is always useful to remember that the funds used to purchase Manhattan Island for $24 in 1626, when invested at a 4 percent real interest rate, would bring you the entire immense value of land in Manhattan today."[10] Likewise, consider a climate-related damage 382 years from now that is valued then (in year 2399) at the same (inflation-adjusted) price as Manhattan island is worth today. Now if your social discount rate is 4%, it means you should view that future climate-related damage as no worse than $24 dollars' worth of

8. J. Paul Kelleher, *Pure Time Preference in Intertemporal Welfare Economics*, ECON. & PHIL. (forthcoming).

9. OLIVIER DE LA GRANDVILLE, ECONOMIC GROWTH: A UNIFIED APPROACH 213–18 (2013).

10. WILLIAM D. NORDHAUS, A QUESTION OF BALANCE: WEIGHING THE OPTIONS ON GLOBAL WARMING POLICIES 11 (2008).

damage today. This is why Nordhaus, who uses a social discount rate of roughly 6%,[11] values a given climate-related damage a century from now as only *one-hundredth* as bad as does Nicholas Stern, who uses an effective social discount rate of 1.4%.[12]

Stern and Nordhaus are often held up, respectively, as exemplars of the so-called *prescriptivist* and *descriptivist* schools of thought on social discount rates. The terms and distinction stem from the Second Assessment Report of the Intergovernmental Panel on Climate Change (IPCC), in which the authors of a chapter on discounting[13] claimed that a major division on the issue concerned whether social discount rates should be determined using ethical arguments for one or more of the parameters in the Ramsey equation (the prescriptive approach), or by matching social discount rates to observable rates of return in real world markets (the descriptive approach). In fact, the IPCC's terms are quite imperfect, since both prescriptivists and descriptivists draw on their respective frameworks to make policy *recommendations*. In that sense, even "descriptivists" are doing much more than merely describing the world. Yet so long as we keep that fact in mind, we can use the terms as a way of signifying how different theorists *choose* the fundamental parameters that ultimately drive their policy recommendations. Thus, expressing his prescriptivism about the rate of pure time preference, Stern writes, "We take a simple approach in this Review: if a future generation will be present, we suppose that it has the same claim on our ethical attention as the current one."[14] Meanwhile, articulating his descriptive approach, Nordhaus writes: "As this approach relates to discounting, it requires that we look carefully at the returns on alternative investments—at the *real* real interest rate—as the benchmarks for climatic investments. The normatively acceptable real interest rates prescribed by philosophers, economists, or the British government are irrelevant to determining the appropriate discount rate to use . . . ."[15] According to Nordhaus, the proper way to select the Ramsey equation's normative parameters is to set the social discount rate equal to the interest rate available in actual investment markets and then to "back out" or otherwise infer the rate of pure time preference and the curvature of the utility function that would yield that social discount rate.

It is interesting to note that whereas philosophers—so far as I'm aware—unanimously favor of the prescriptive approach, economists are much more

11. *Id.* at 170.

12. Martin L. Weitzman, *A Review of the Stern Review on the Economics of Climate Change*, 45 J. ECON. LITERATURE 703, 708 (2007).

13. Kenneth J. Arrow et al., *Intertemporal Equity, Discounting, and Economic Efficiency*, *in* CLIMATE CHANGE 1995: ECONOMIC AND SOCIAL DIMENSIONS OF CLIMATE CHANGE 125, 125–44 (James P. Bruce et al. eds., 1996).

14. STERN, *supra* note 1, at 35.

15. William D. Nordhaus, *A Review of the Stern Review on the Economics of Climate Change*, 45 J. ECON. LITERATURE. 686, 692 (2007) (emphasis in original).

divided.[16] While many economists agree with Stern that it is essentially an ethical issue how one should weigh the well-being of future generations in the Optimal Growth framework, many others agree with Nordhaus that ethics should not enter into the selection of the Ramsey equation's parameters. My aim is to shed new light on this debate.

II. OPPORTUNITY COST DESCRIPTIVISM

In defending his descriptivism, Nordhaus sometimes says that it is important to match social discount rates with real rates of return on actual market investments in order to account for the opportunity costs of using productive capital in one way rather than another.[17] Consider, for example, a government climate change project that costs $100 today and delivers $1,000 worth of environmental benefits in 100 years. Is this project "worth it"? There are many ways one might wish to answer that question, but one way is to ask whether the government could have delivered more than $1,000 in benefits by investing the $100 in some alternative investment (usually, a traditional financial investment is used for this comparison). It turns out that a neat way to answer that question is to discount the value of the future environmental benefits using a discount rate that is equal to the rate of return offered by the alternative project. Suppose, for example, the interest rate available in financial markets is 6% per year. Then we can multiply the $1,000 future benefit by the discount factor $\left(\frac{1}{(1.06)^{100}}\right)$, and then subtract the $100 cost of producing that $1,000 benefit. If the result of this exercise is a positive number, then the climate change project is the better of the two. If the result is a negative number—which in this case it is—then the government would do better to make a financial investment instead. Indeed, the government could either invest the full $100 to yield roughly $40,000 worth of benefits in 100 years, or it can invest just $2.50 today in order deliver $1,000 in 100 years. Either way, some economists argue, we should want to know whether a financial investment beats a climatic investment, and the way we see this is by discounting the future benefit using a descriptive discount rate.

At this stage, many philosophers and environmentalists will wish to claim that it is improper to place a monetary value on the environmental benefits that one gives up if one makes a financial investment instead. Whatever the merits of this objection, I am not going to press it here. Instead, I wish to flag a major flaw that faces this opportunity-cost-based rationale for descriptivism even if one is willing to monetize environmental benefits. The flaw is that the approach—call it "opportunity-cost descriptivism"—requires assuming that if we invest $100 in the market today, the only relevant outcome is the monetary value of

16. For a recent survey, see Moritz Drupp, Mark Freeman, Ben Groom, and Frikk Nesje, *Discounting Disentangled: An Expert Survey on the Determinants of the Long-Term Social Discount Rate* (Ctr. Climate Change Econ. & Pol'y, Working Paper No. 195, 2015).

17. *E.g.*, WILLIAM D. NORDHAUS, CLIMATE CASINO 188–89 (2015).

the investment in 100 years. But this ignores the fact that the activities that are financed by the $100 might produce indirect, non-financial effects that are not captured by that $1,000 terminal value in 100 years. And it is a main commitment of climate change economics that such indirect effects are both relevant and potentially decisive. After all, the whole point of climate change economics is to place an economic value on mitigation projects and policies that the free market undervalues. John Broome puts the point thus:

> The producer interest rate on the market does not actually represent the opportunity cost of investment. It represents the private rate of return on investment, and this is different. The difference is the external costs imposed by private investment. Most private investment has the effect of increasing the emission of greenhouse gases into the atmosphere. If these gases are harmful, therefore, private investment imposes an external cost that does not appear in the private rate of return. If the producer-interest-rate method of project evaluation is to be used, there must at the very least be a correction for this external cost. But we cannot make the right correction without knowing in advance the cost imposed by the greenhouse gases. These gases do their damage over a long period of time. Therefore we cannot evaluate their costs without first knowing how to weigh together amounts of damage done at different times.[18]

This is a decisive reason not to use the rate of return on private investments as a social discount rate, as in fact I think most economists will acknowledge.[19] The superior alternative way to account for opportunity costs is to think of market investments in terms of the consumption they displace today (because we're investing instead), the consumption they make possible in the future (whenever the investment is "cashed-in" and spent), and the negative (as well as positive) indirect effects on consumption of the sort that Broome highlights. On this approach, sometimes called the "consumption-equivalent" approach,[20] the financial opportunity costs of a given climatic investment are accounted for not by employing a descriptive social discount rate, but by treating the foregone consumption that the financial investment would have yielded as a cost—something given up—of the climatic project. Likewise, any indirect costs of investment of the sort flagged by Broome would be treated as a decrement in consumption at a given time caused by the financial investment. When the opportunities and liabilities of financial investments are accounted for in this way, one is (as Broome says) still left with the question of how to weight consumption coming at different times. That is, one is left with the question of

18. JOHN BROOME, COUNTING THE COSTS OF GLOBAL WARMING 91 (1992).

19. Partha Dasgupta, *Discounting Climate Change*, 37 J. RISK & UNCERTAINTY 151 (2008).

20. R.C. Lind, *A primer on the major issues relating to the discount rate for evaluating national energy options*, *in* DISCOUNTING FOR TIME AND RISK IN ENERGY POLICY 39–55 (1982); WILLIAM R. CLINE, THE ECONOMICS OF GLOBAL WARMING 244 (1992).

how to choose a social discount rate. But at least one answer to that question, the answer given by "opportunity-cost descriptivism," is no longer valid: it is no longer valid to defend descriptivism by citing the need to take account of the opportunity costs of climatic investments.

III. GOULDER-WILLIAMS DESCRIPTIVISM

Despite claims by Nordhaus suggesting that he is an opportunity-cost descriptivist of the sort discussed in the previous section, I think it is possible that he is actually a second sort of descriptivist. To understand this second variety, and to see how it differs from opportunity-cost descriptivism, it helps to understand how discounting works outside of the context of climate change economics. As noted above, climate economics employs the framework of Optimal Growth Theory, which aims to construct a ranking of consumption streams by totaling and comparing each stream's discounted utility. One standard assumption within this framework is that it is possible to compare changes in utility across individuals, such that an improvement in consumption-generated utility for one person can offset or indeed outweigh a decline in utility suffered by a different person. This assumption—that changes in utility are interpersonally comparable—is customarily rejected by most kinds of economic analysis in which discount rates feature. For in contrast to Optimal Growth Theory, *applied welfare economics* begins from the assumption that interpersonal comparisons of utility are not meaningful, or at least not possible in practice.[21] The aim within applied welfare economics is not to find the policy that maximizes discounted utility, but rather to find policies that constitute *potential Pareto improvements* over the status quo. To explain, consider what it means to say that a policy is *actually* Pareto-improving: it means that the policy makes *at least one* person better off, as compared with the status quo, without making *anyone* worse off. Now since it is difficult to find policies that are *actually* Pareto-improving—usually there is at least one person who is made worse off by a policy—applied welfare economics concerns itself with *potential* Pareto improvements: these are policy changes such that the "winners" from the change *could* compensate the "losers", thereby ensuring that the losers are left no worse off than they were before the change.[22] Applied welfare economics usually does not worry about whether the winners will in fact compensate the losers; that, applied economists say, is an issue that falls outside their orbit.

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21. RICHARD E. JUST, DARRELL L. HUETH, AND ANDREW SCHMITZ, THE WELFARE ECONOMICS OF PUBLIC POLICY: A PRACTICAL APPROACH TO PROJECT AND POLICY EVALUATION (2004). I do not wish to suggest that applied work—work on real-world policy issues—cannot be done with the tools of Optimal Growth Theory. Indeed, that is what many climate economists seek to do. Rather, in accordance with fairly established terminology I am using "applied welfare economics" as a *name* to refer to the framework for policy analysis that is built around the "Pareto" concepts that I am about to introduce in the text.

22. The requirement that policies produce potential Pareto improvements is also commonly referred to as the Kaldor-Hicks compensation test.

So that is the economic task as applied welfare economics sees it. (At this point I am not defending or criticizing the aims of applied welfare economics; I mean only to explicate them.) How then do discount rates enter into its framework? The first part of the answer echoes that given by opportunity-cost descriptivism. It notes that a dollar today is worth more than a dollar next year, since today's dollar can be invested, earn interest, and end up being worth more than one dollar next year. This in turn means we should be careful when comparing (the monetized value of) benefits in different years.

To see how this is related to a second brand of descriptivism, consider again the idea of a potential Pareto improvement. Suppose we want to know whether a greenhouse gas abatement policy will constitute a potential Pareto improvement. That just means we want to know whether the "winners" could compensate the "losers" after the policy change is enacted. Suppose future generations stand to "win" from the policy (because they will face fewer climate-related impacts) and that present generations will "lose" (because they will have to make burdensome changes in order to emit fewer greenhouse gases). In order to tell whether the winners could compensate the losers, applied welfare economists tell us to ask: First, what would future generations be willing to pay to bring about fewer emissions today? Second, what are present generations willing to accept by way of compensation for emitting less? A great deal of applied welfare economics is concerned with answering these questions, but suppose we already have answers to them. Should we then just compare them, to see if future willingness to pay (WTP) is greater than present willingness to accept (WTA)? We should not. We should not do this because, as we have seen, a future dollar is worth less than a present dollar. The present generation is going to want to know whether future generations' WTP *really can* match the present generation's WTA, which is of course denominated in today's dollars. So we need to adjust for this difference in value in order to see if the value-adjusted future WTP really is greater than present WTA. And that is precisely the adjustment that is made when applied welfare economists "discount the future": discounting the future at market interest rates is how applied welfare economists determine whether a policy change really would yield potential Pareto improvements.[23]

Now you might think: "Boy, that's unfair. It assumes that future generations should have to pay for an improved environment, and that the present generation should be able to demand compensation for emitting fewer greenhouse gases." Perhaps you are right about this being unfair. But it is important to note that this is no objection to *discounting* as applied welfare economists do it. To see this, suppose we agree with you and now turn our focus to what future generations would be willing to accept to tolerate an atmosphere that is damaged by present emissions. We would then compare *present* WTP with *future*

23. Richard B. Howarth, *Discounting and Sustainability: Towards Reconciliation*, 6 INT'L J. SUSTAINABLE DEV. 87, 87–97 (2003).

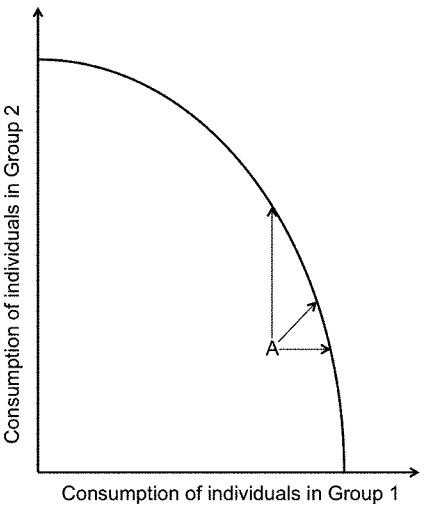

Figure 1

WTA. But even here, the dollar value of future WTA must be adjusted for the productivity of investment, since what we want to know—if we are interested in potential Pareto improvements—is whether our WTP today is enough to pay what future generations demand. There are two equivalent ways to find this out: we can either imagine putting the present WTP in a bank account and letting it grow at the prevailing rate of interest, and we can then see if it would end up being (more than) enough to match future WTA; *or*, we can use the rate of interest to construct the same discount factor we constructed above. If present WTP is greater than the discount-factor-adjusted future WTA, then it means the policy is a potential Pareto improvement: the present generation would be made better off and future generations could be left no worse off by having the present generation invest the proper sum in a bank account that is then given as compensation to those who will exist in the future.

According to applied welfare economics, then, discounting future WTP or WTA values at market interest rates is the way to tell whether a policy yields a potential Pareto improvement. To see this point visually, consider Figure 1.

In this figure, the curved line that connects the vertical and horizontal axes is a *consumption possibility frontier*. It represents all the feasible options allowed by the economy. The figure shows that in order to give Group 1 any consumption at all, Group 2 must have less than its maximal possible amount, and vice versa. Suppose that Group 1 represents the present generation and Group 2 represents future generations. The consumption possibility frontier will then depict the possible combinations of consumption across two time periods. Indeed, we should think of each point on the frontier as representing a two-period consumption stream of the sort that Optimal Growth Theory seeks to rank using a social welfare function. Suppose now that our economy is at point A. Being "inside the frontier," as A is, means that Pareto improvements are

possible: it's possible to improve present generations without harming future generations (by moving along the ray to the right of point A) and it's possible to improve future generations without harming present generations (by moving along the ray above point A). And indeed it is also possible to make *both* groups better off, for example by moving from point A in a northeasterly direction along the diagonal ray. Here's the upshot: applied welfare economists claim that by discounting WTP and WTA at market interest rates, we can find potentially Pareto-improving policies that move the economy from point A onto the consumption possibility frontier. Most of the time these policies would leave at least one group worse off than they were before the change. But recall that applied welfare economists are concerned only with whether a policy makes a Pareto improvement *possible*.

We now come to the second kind of descriptivism, which I shall call *Goulder-Williams descriptivism*. The name derives from two economists, Lawrence H. Goulder and Robertson C. Williams III, who have written an underappreciated paper that makes a surprising suggestion, viz. that Nordhaus prefers descriptivist discount rates because he shares the aims of applied welfare economists. In other words, the suggestion is that, despite using the machinery of Optimal Growth Theory, which usually signals that the user seeks to pick a best-of-the-best point on the entire consumption possibility frontier, Nordhaus uses that machinery instead to identify policies that that are potential Pareto improvements over the status quo.[24]

Unfortunately, Goulder and Williams do not offer much textual evidence in support of their interpretation of Nordhaus, and part of my aim now is to bolster their analysis. Let us start by asking how a social welfare function, whose main job is to rank *all* points on a possibility frontier within an Optimal Growth exercise, could be used by a Goulder-Williams descriptivist to carry out the specific brand of analysis characteristic of applied welfare economics. I believe the answer is as follows. First, suppose one uses a market social discount rate within an Optimal Growth exercise. Then, the exercise will yield a specific ranking of all feasible consumption streams. Each stream in this ranking will be associated with a trajectory or "path" of greenhouse gas emissions. That is, since greenhouse gas emissions affect future consumption, the model will associate each consumption stream with a compatible time path of emissions. Next, we note that it is a necessary condition of maximizing any Optimal Growth model's social welfare function that, along the optimal consumption path, the marginal costs of emissions-reductions are equal to the discounted marginal benefits of emissions reductions in all time periods.[25] This makes intuitive sense: if reducing emissions by one unit created future discounted

24. Lawrence H. Goulder & Roberton C. Williams III, *The Choice of Discount Rate for Climate Change Policy Evaluation*, 3 CLIMATE CHANGE ECON. 1250024-1, 1250024-9 (2012).

25. RICHARD S.J. TOL, CLIMATE ECONOMICS: ECONOMIC ANALYSIS OF CLIMATE, CLIMATE CHANGE AND CLIMATE POLICY 114–15 (2014).

benefits that are greater than the abatement costs, the social welfare function would recommend abating one more unit; and if the costs of the marginal unit of abatement were greater than the discounted benefits produced, the social welfare function would recommend emitting one more unit. Therefore, on the optimal path, the marginal costs of abatement will equal the marginal benefits of abatement. Now we note—and this is the third point—that since the marginal benefits of emissions reductions are expressed in terms of the monetized value of the goods and services that the reductions make possible, discounting these benefits at market rates would seem to serve the same purpose that is served by discounting future WTP in applied welfare economics. That is, discounting the benefits tells us how much, in "present value" terms, future generations would be willing to give up to achieve a marginal reduction in greenhouse gas emissions today. For example, if one extra unit of abatement today increased consumption in 100 years by $X, then the generation in 100 years should be willing to pay up to $X to us to abate. If we then require a payment of $5 to abate, then in order to know whether abatement constitutes a potential Pareto improvement, the applied welfare economist tells us to discount the future WTP using a descriptivist rate and to compare it with present WTA. From this it seems to follow that along the time path of emissions reductions deemed optimal by a social welfare function that uses a descriptivist social discount rate, the future consumption benefits generated by those reductions will be enough to fully compensate those who take on the costs of abatement. Indeed, all emissions reductions except for the final marginal unit reduced will increase future consumption by more than enough to fully compensate those who do the abating.

Thus, according to applied welfare economics, if one maximizes a social welfare function whose corresponding social discount rates are yoked to market rates, one thereby identifies a time path of emissions reductions that is, by construction, potentially Pareto-improving. And while it is true that the Optimal Growth exercise yields a ranking of all points on the frontier (or all possible consumption streams in a model with more than two time periods), a Goulder-Williams descriptivist is not primarily interested in *that* headline ranking. Indeed, she is not really interested in that ranking *at all*, because her commitment to the aims of applied welfare economics leads her to abstain from the task of weighing gains for one generation against losses for another. The Goulder-Williams descriptivist is instead concerned exclusively with the *ancillary* analytical result that is embodied in the time path of emissions (reductions) that is associated with the optimal consumption point (or stream). And this, again, is because the optimal path of emissions (reductions) constitutes a potentially Pareto-improving policy for placing the intertemporal economy on the consumption possibility frontier from a point beneath it. So that is why a Goulder-Williams descriptivist wishes to use a market discount rate within an Optimal Growth Theory exercise.

Yet what is the evidence for thinking Nordhaus is a descriptivist of this stripe? Consider that in his review of Stern's report on the economics of climate change, Nordhaus asks us to consider the following "fiscal policy experiment."[26] He first asks us to imagine adopting "a set of abatement strategies that correspond to the optimum in the Ramsey growth model [i.e. the Optimal Growth framework]." Next, Nordhaus asks us to imagine that the current generation implements the initial abatement strategies while simultaneously borrowing from financial markets just enough to compensate themselves for the trouble of doing so. The resulting debt would then be carried through time until future generations arrive onto the scene and pay it off. Nordhaus dubs this the "optimal-plus-deficit" strategy: it implements the abatement strategies that correspond to the optimal consumption stream, and then uses deficit financing to ensure that earlier generations suffer no loss in consumption. Nordhaus then writes:

> Assuming that the investments and fiscal policies are efficiently designed, so that capital continues to earn its marginal product as measured by the market real return, the optimal-plus-deficit strategy will increase the consumption possibilities of all future generations (those coming after fifty years). In other words, the optimal abatement policies (compared with no abatement) *by construction* must be Pareto-improving. *Under the optimal policies, the optimal investments in climate capital must raise future output by more than enough to repay the debt.*[27]

Nordhaus then observes that this is not true of Stern's approach, and he suggests that this is directly related to Stern's low prescriptive discount rate. Since Nordhaus says his optimal abatement strategy makes Pareto improvements available "by construction," it is tempting to conclude that his descriptivism is tied to an approach to policy analysis typical of applied welfare economics.[28]

Whether or not Nordhaus himself is a Goulder-Williams descriptivist is not, for me, the central point. The central point is that there is a framework of economic analysis, represented by applied welfare economics, that would seem to license a descriptivist approach to social discount rates on the grounds that they are the discount rates to use if one wishes to identify potential Pareto improvements from the status quo. Consider, as a further example, the defense of descriptivism by the U.S. government's Interagency Working Group on Social Cost of Carbon. The social cost of carbon (SCC) is a monetary measure, expressed in discounted net present value terms, of all future damage that would be caused by emitting one extra ton of greenhouse gas along a given baseline

26. Nordhaus, *supra* note 15, at 695.

27. *Id.* (emphasis added).

28. *See* William Nordhaus, Comments on John Broome's Tanner Lectures (Mar. 16, 2012), https://deepblue.lib.umich.edu/handle/2027.42/90883 [https://perma.cc/38KD-8XSV], at timestamp 2:09:50.

trajectory of emissions. Because discounting is involved in estimating the SCC, and because the Interagency Working Group used Optimal Growth models to do the calculation, it had to weigh in on the descriptivism/prescriptivism debate. Here is what it argued, using a technical name (the "Kaldor-Hicks test") for what I have been calling the potential Pareto criterion:

> One theoretical foundation for the cost-benefit analyses in which the social cost of carbon will be used—the Kaldor-Hicks potential-compensation test—also suggests that market rates should be used to discount future benefits and costs, because it is the market interest rate that would govern the returns potentially set aside today to compensate future individuals for climate damages that they bear . . . We draw on both approaches but rely primarily on the descriptive approach to inform the choice of discount rate. With recognition of its limitations, we find this approach to be the most defensible and transparent given its consistency with the standard contemporary theoretical foundations of benefit-cost analysis . . . .[29]

Thus, even if I am mistaken in my interpretation of Nordhaus, the Interagency Working Group's rationale provides indisputable proof that at least some real world descriptivists are motivated by what I have called Goulder-Williams descriptivism.

In the final analysis, however, Goulder-Williams descriptivism is tremendously problematic. This is because the applied welfare economics framework it is embedded in faces what the latest IPCC report calls "severe objections."[30] Like the latest report, the 1995 IPCC report only briefly mentioned the potential Pareto principle because, it wrote, the principle "is no longer accepted."[31] There are at least three reasons for this. First, the potential Pareto principle for ranking policies requires only that winners *could* compensate losers, but there is no reason to think that the world has in fact been improved as the result of a *potential* Pareto improvement. Second, decades of theoretical work in welfare economics has shown that it is simply not true that whenever economists' measure of WTP outruns their measure of WTA, this means the winners can compensate the losers. Expressing this finding in somewhat technical jargon, Boadway and Bruce write, "The use of the unweighted sum of household compensating or equivalent variations as a necessary and sufficient indicator of

29. INTERAGENCY WORKING GRP. ON SOC. COST OF CARBON, TECHNICAL SUPPORT DOCUMENT: SOCIAL COST OF CARBON FOR REGULATORY IMPACT ANALYSIS UNDER EXECUTIVE ORDER 12866, at 18–19 (2010), https://www.epa.gov/sites/production/files/2016-12/documents/scc_tsd_2010.pdf [https://perma.cc/T33K-CUPM].

30. Charles Kolstad et al., *Social, Economic and Ethical Concepts and Methods*, *in* CLIMATE CHANGE 2014: MITIGATION OF CLIMATE CHANGE 225 (O. Edenhofer et al. eds., 2014).

31. Kenneth J. Arrow et al., *Intertemporal Equity, Discounting, and Economic Efficiency*, *in* CLIMATE CHANGE 1995: ECONOMIC AND SOCIAL DIMENSIONS OF CLIMATE CHANGE 142 (James P. Bruce et al. eds., 1996).

potential Pareto improvements is rife with difficulties."[32] Finally, it turns out that even when a change from state of affairs X to state of affairs Y represents a potential Pareto improvement, it is sometimes also true that a change *back* from Y to X is also a potential Pareto improvement.[33] These are well-known, stubborn, and intractable problems that really should have spelled the demise of applied welfare economics years ago. Instead, many economists make certain technical but implausible assumptions that would prevent some (but not all) of the problems from arising in the first place.[34] So the techniques continue to be employed in many quarters. And, as I've suggested, I think it's possible they are being employed in climate change economics by Nordhaus and the Interagency Working Group on Social Cost of Carbon.

It is important to flag and explain Goulder-Williams descriptivism not because of the position's cogency, but rather because it is a rationale for a descriptivist approach to discount rates that can easily fly under the radar. As I've noted, Nordhaus suggests at times that his descriptivism is of the opportunity-cost type, and not of the Goulder-Williams type. This can mask the fact that when Nordhaus employs the machinery of Optimal Growth Theory, he may not be interested in identifying the emissions path that corresponds to the best-of-the-best point on the consumption frontier; rather he may be interested in finding an emissions path that constitutes a potential Pareto improvement from the status quo.

One indication that Nordhaus's Goulder-Williams descriptivism flies under the radar is found in the "Social, Economic and Ethical Concepts and Methods" chapter in the most recent report by the Intergovernmental Panel on Climate Change (IPCC). As I have noted, the report does mention the "potential Pareto criterion," but it does so mainly to report that it is "subject to severe objections" as a basis for climate policy analysis.[35] There is no hint that the criterion might actually play a significant role in real-world debates concerning the economics of climate policy. Instead, the IPCC takes pains to illustrate what it sees as the contrast between analyses that are focused on (potential) Pareto improvements, on the one hand, and on the other analyses that employ social welfare functions to rank all points on the consumption possibility frontier.[36] As illustrated in the IPCC diagram included here as Figure 2,[37] the IPCC asserts that both Stern and Nordhaus employ social welfare functions intended to select, as a "social

32. ROBIN BOADWAY & NEIL BRUCE, WELFARE ECONOMICS 271 (1984).

33. *Id.* at 99.

34. *See, e.g.*, ANTHONY E. BOARDMAN, ET AL., COST-BENEFIT ANALYSIS: CONCEPTS AND PRACTICES 36 (4th ed. 2011).

35. *See* Kolstad, *supra* note 30, at 225.

36. *Id.* at 227.

37. Kolstad et al., *supra* note 30, at 227. This figure is used with permission. IPCC, https://www.ipcc.ch/publications_and_data/publications_and_data_figures_and_tables.shtml [https://perma.cc/6B26-U4F4].

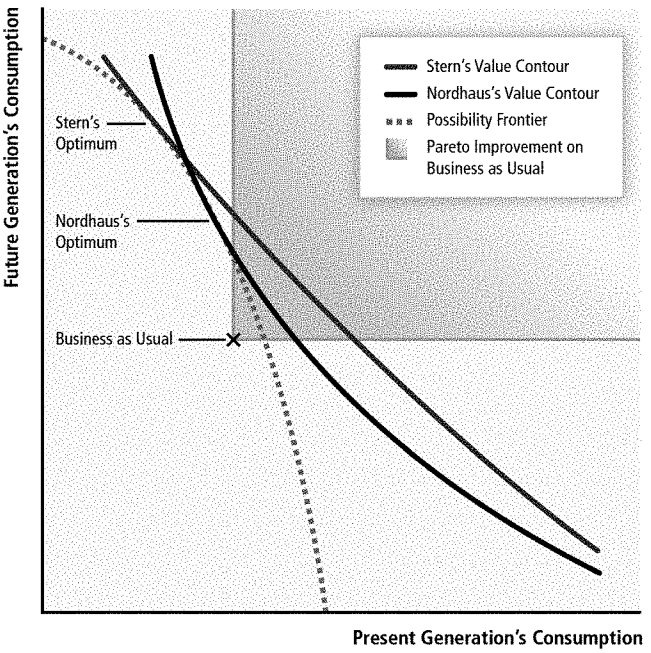

Figure 2

optimum," points on the consumption possibility frontier whose achievement would require a sacrifice by at least one generation (as compared to Business as Usual). The clear message from the IPCC discussion is that mainstream approaches to the social discount rate in climate policy analysis—represented by the range running from Stern's relatively low rate to Nordhaus's relatively high rate—reject the applied welfare economics obsession with (potential) Pareto improvements.

There is, however, some reason to believe that the IPCC's depiction is mistaken. First, in depicting Nordhaus's social optimum—his top-ranked point on the consumption possibility frontier—the IPCC locates it to the northwest of the Business as Usual point. Yet, a recent analysis by von Below, Denning, and Jaakkola shows that Nordhaus's social optimum, which is achieved by maximizing a social welfare function that discounts at market rates, actually lies to the *southeast* of the Business as Usual point.[38] That is, relative to Business as Usual, Nordhaus's optimal consumption path involves increases in consumption for early generations and then decreases for future generations at least into the twenty-third century. By contrast with its interpretation of Nordhaus, the IPCC correctly depicts Stern's social optimum as involving decreased consumption by

38. David Von Below, Francis Denning, and Nikko Jaakkola, The Climate Pension Deal: An Intergenerational Bargain 28 (Apr. 2016) (unpublished manuscript), https://www.nottingham.ac.uk/climateethicseconomics/documents/papers-workshop-2/jaakkola-et-al.pdf) [https://perma.cc/BL3E-LUUX].

the early generations followed by increases for future generations beginning around the year 2040. But if von Below, Denning, and Jaakkola are correct about Nordhaus's results, how did the IPCC come to make such a mistake?

I believe the answer lies in the fact that Nordhaus confusingly uses the phrase "the optimum" to refer to *both* the top-ranked consumption stream *and* the top-ranked time path of greenhouse gas emissions. For example, in presenting the fiscal policy experiment that we have discussed above, Nordhaus says that when compared to a policy in which the consumption of earlier generations is held steady by debt-financed compensation, "The optimum might have slightly lower consumption in the early years." I suspect the IPCC infers from this that Nordhaus's optimal point on the consumption possibility frontier lies just to the northwest of the Business as Usual point; after all, only points to the northwest involve "slightly lower consumption in the early years" as compared to a policy that maintains the present generation's Business as Usual consumption level. What the IPCC misses, however, is that the northwest point that Nordhaus refers to as "the optimum" is almost certainly the point that the world would arrive at if we adopted what he refers to as the "*optimal policy*", that is, the policy that places the world on "the best possible policy path of emissions reductions."[39] In the context of his fiscal policy experiment, it is this "optimal abatement strategy"—the "set of abatement strategies that *correspond* to the optimum in the Ramsey [optimal] growth model"—that Nordhaus seems to refer to as "the optimum."[40] If this optimal abatement strategy were imposed by governmental regulation—e.g. by imposing an uncompensated carbon tax on the current generation—that would indeed leave the world at a point on the frontier that is northwest of Business as Usual. For such a policy would make the current generation somewhat worse off (due to the taxes) and future generations better off (due to an improved environment). And that is exactly the sort of policy one would expect to be recommended by a Goulder-Williams descriptivist who seeks to identify and recommend potentially Pareto-improving emissions-reduction policy using an Optimal Growth model that discounts at market rates.

In my view, then, the best explanation of the IPCC's mistake concerning Nordhaus's optimal *consumption* point is that the IPCC fails to see that Nordhaus is primarily focused on the optimal *emissions path* (and, thus, the optimal *abatement policy* that would put us on that path). Further, by focusing on the sacrifices that would be necessary to achieve the optimal *consumption* path indicated by Nordhaus's and Stern's models, the IPCC neglects the fact that, by discounting at market rates, Nordhaus may hope to ensure that his optimal emissions path constitutes—by construction—a potential Pareto improvement over the status quo. I of course have suggested that this aspiration is misguided, owing to the major problems with the applied welfare economics framework.

39. NORDHAUS, *supra* note 10, at 68.
40. Nordhaus, *supra* note 15, at 695 (emphasis added).

But at this point I am focusing on what Nordhaus's view might be, not on whether it is defensible.

Setting the limitations of applied welfare economics aside, note that it is perfectly coherent for the very same person to be interested in *both* the task of identifying (emissions-related) potential Pareto improvements *and* the task of identifying the overall optimal point on the consumption possibility frontier. There is nothing inconsistent about being interested in both tasks at the same time, nor is there yet any obvious reason why one should use the very same discount rate for each task. It is therefore quite possible for a Goulder-Williams descriptivist to select a social discount rate that differs from that which another theorist might choose, and yet for there to be no genuine disagreement between them. We shall see in the next section that this "compatibilism" holds for three other approaches to social discounting as well.

IV. TWO TYPES OF PRESCRIPTIVISM, AND ONE MORE TYPE OF DESCRIPTIVISM

So far I have distinguished between opportunity-cost descriptivism and what I have called Goulder-Williams descriptivism, and I have noted problems for each. In this section I want to further distinguish between two types of prescriptivism and then identify one additional type of descriptivism. Consider, then, Goulder and Williams's claim that a prescriptivist "social welfare function will embrace all relative normative dimensions (including both efficiency and distributional considerations)."[41] Put in terms of Figures 1 and 2, the idea is that prescriptivists are interested in finding discount rates that ensure that the ranking produced by an Optimal Growth exercise is an *all-things-considered* ethical ranking of points on the consumption possibility frontier. However, this picture contrasts sharply with the picture painted by the IPCC in its chapter on ethics and economics. According to the IPCC, the aim of a social welfare function is to rank points on the possibility frontier in terms of their overall *value*, where value is to be understood as follows:

> Ethics may be broadly divided into two branches: justice and value. Justice is concerned with ensuring that people get what is due to them. If justice requires that a person should not be treated in a particular way—uprooted from her home by climate change, for example—then the person has a right not to be treated that way. Justice and rights are correlative concepts. On the other hand, criteria of value are concerned with improving the world: making it a better place . . . To see the difference between justice and value, think of a transfer of wealth made by a rich country to a poor one. This may be an act of restitution. For example, it may be intended to compensate the poor country for harm that has been done to it by the rich country's emissions of GHG. In this case, the transfer is made on grounds of justice. The payment is taken to be due to the poor country, and to satisfy a right that the poor country has to

41. Goulder & Williams, *supra* note 24, at 1250024-16.

> compensation. Alternatively, the rich country may make the transfer to support the poor country's mitigation effort, because this is beneficial to people in the poor country, the rich country, and elsewhere. The rich country may not believe the poor country has a right to the support, but makes the payment simply because it does 'good'. This transfer is made on grounds of value. What would be good to do is not necessarily required as a matter of justice. Justice is concerned with what people are entitled to as a matter of their rights.[42]

If the IPCC is correct to say that justice and value are two genuine and distinct branches of ethics, and if it is correct in its further claim that the job of a social welfare function is to "determine an overall value for society" by "aggregat[ing] different people's lifetime wellbeing . . . to arrive at an overall value,"[43] then Goulder and Williams would seem to be wrong to say that prescriptivist social welfare functions are to rank consumption streams in terms of *all* relevant normative dimensions. Who, then, is right? Here again, the answer can be: *Both*. For what we have identified are two distinct tasks that a prescriptivist might be concerned with: There is the task of choosing prescriptive discount rates for use in a ranking of consumption streams in terms of all relevant normative dimensions, and then there is the task of choosing prescriptive discount rates for use in a ranking of consumption streams solely in terms of the "value" they contain. Thus, if one wishes to advance a prescriptivist approach to discounting, one should be upfront and clear from the beginning which task one is taking up. I have, for example, argued elsewhere that whereas Stern is a prescriptivist of the sort associated with IPCC's view of social welfare functions, Partha Dasgupta is a prescriptivist of the sort associated with Goulder and Williams's view of prescriptivist social welfare functions.[44] And yet Stern and Dasgupta *appear* to disagree on discounting because each purports to give arguments for what "the" social discount rate should be. There is no acknowledgement that they might be concerned with quite different and compatible tasks. True, perhaps each would argue that their respective task is the proper one for economists to focus on. But no such defense is ever offered, because each assumes that the other is concerned with the same task.

Finally, it also turns out that there is still a third version of descriptivism at play in climate change economics. For it is quite possible to be interested in the task of ranking all the points on the possibility frontier while also holding that real-world interest rates reveal information that is relevant to that task. For example, the rates of return that are offered on certain investments in financial markets reveal (however imperfectly) the degree to which current consumers must be rewarded by accrued interest before they will agree to forego consumption today in favor of consumption tomorrow. Conversely, interest rates also

42. *See* Kolstad, *supra* note 30, at 211.
43. *Id.* at 222.
44. Kelleher, *supra* note 8.

reveal the penalty, e.g. in the form of interest paid on credit card debt, that current consumers are willing to pay today in order to consume more now and less later. In light of these observations, one might argue that certain market rates reveal the degree of time bias that current consumers display in favor of present consumption. And one might think that this form of time bias is relevant to a certain Optimal Growth exercise that seeks to rank consumption streams in terms of their ability to satisfy the present-oriented preferences of the existing generation. Indeed, that appears to be just the task that Martin Weitzman has in mind when he criticizes Stern's prescriptivist approach to discounting:

> An enormously important part of the "discipline" of economics is supposed to be that economists understand the difference between their own personal preferences for apples over oranges and the preferences of others for apples over oranges. Inferring society's revealed preference value of [the discount rate] is not an easy task in any event . . . but at least a good-faith effort at such an inference might have gone some way towards convincing the public that the economists doing the studies are not drawing conclusions primarily from imposing their own value judgments on the rest of the world.[45]

We might call this version of descriptivism *revealed-ranking descriptivism*, in order to highlight the fact that it uses the present generation's revealed time preferences in order to produce a "democratic" ranking of consumption streams. In contrast with Goulder-Williams descriptivism, the aims of revealed-ranking descriptivism are not conceptually tied to the task of identifying potential Pareto improvements from business as usual. Still, since each is a form of descriptivism in which observable market rates are to serve as the social discount rate, it should not be surprising if there are similarities in the emissions-related policy recommendations emanating from each. The important point, however, is that from the standpoint of the foundations of public policy analysis, the underlying theoretical bases of each brand of descriptivism are importantly different.

Most philosophers and at least some economists reject what I am calling revealed-ranking descriptivism.[46] They insist that the question of how to weight future consumption against present consumption is a straightforwardly moral question about intergenerational equity that cannot be answered by looking at the largely self-interested borrowing and spending decisions of the current generation. Here I shall register only that I have tremendous sympathy with that criticism, and that in my view the best response for a revealed-ranking descriptivist to make is not "Yes, the moral question really can be answered by focusing exclusively on the current generation's preference," but rather "No, that is actually not the question welfare economics seeks to answer." That is to say, the

45. Weitzman, *supra* note 12, at 712.

46. For critical discussion of the "democratic" arguments for what I am here calling revealed-ranking descriptivism, see H. Greaves, *Discounting for climate change: A critical survey*, ECON. & PHIL. §10 (forthcoming), and BROOME, CLIMATE MATTERS 140 (2012).

only viable reply for the revealed-ranking descriptivist is to insist that welfare economics is actually not concerned to "throw light on what is right,"[47] but instead to present in a systematic way the implications of the current generation's preferences.[48] Generally speaking, philosophers would like welfare economics to play the first role if it is going to play any role at all, whereas my reading of economists is that there is no consensus one way or the other. In such circumstances, it is extremely important for those who want to use a specific discount rate in economic analyses of climate change to be very clear about what sort of analysis they seek to provide. If it is a "current-generation-oriented" analysis that is deliberately silent on many other morally relevant considerations, the analyst should say so.

CONCLUSION

In this paper, I have distinguished between three kinds of descriptivism and two kinds of prescriptivism. Further, I have flagged serious problems for two of these—opportunity-cost descriptivism and Goulder-Williams descriptivism—while claiming that the other three are to some degree compatible with one another. This is because the other three positions argue for a given approach to choosing social discount rates in part on the basis of the *specific economic task* the rate is to figure in. There is, I have said, the task of ranking all points on the consumption possibility frontier in terms of every ethically relevant consideration, the task of ranking all points on the consumption possibility frontier in terms "value" considerations only, and the task of ranking all points on the consumption possibility frontier solely in terms of the preferences of the current generation. Depending on how wide-ranging one's interests are, the very same person could be interested in all three tasks and thus may choose three different social discount rates—two prescriptively, one descriptively—for use in each of those three distinct tasks. Because these nuances are usually ignored, I suspect that some (and perhaps many) debates over "the" social discount rate in climate policy analysis probably amount to talking at cross-purposes. I am hopeful that at least some of the disagreement about social discount rates can be avoided if analysts state very clearly the specific task for which social discount rates are to be employed.

47. RICHARD LAYARD & STEPHEN GLAISTER, COST-BENEFIT ANALYSIS 31, 33 (2d ed. 1994).

48. DAVID PEARCE, EDWARD BARBIER & ANIL MARKANDYA, SUSTAINABLE DEVELOPMENT: ECONOMICS AND ENVIRONMENT IN THE THIRD WORLD 46 (1990).