Paretian Intergenerational Discounting

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This paper argues that discounting costs and benefits of projects for the opportunity costs of capital Pareto dominates decision criteria that do not discount. It considers and rejects several objections to the Pareto dominance argument, including the problem of making compensating transfers for the costs and benefits of projects and whether taking opportunity costs into account is different than discounting. It also argues that discounting future costs and benefits of projects does not undervalue future generations.

INTRODUCTION

The problem presented by intergenerational discounting is well known. Suppose we are going to engage in a project that creates costs and benefits that are separated over a long period of time. The most common examples are global warming and disposal of nuclear waste, but the problem extends to any project that affects more than one period, future or past. How are we to compare the costs and benefits? In private projects, costs and benefits are always discounted because of the opportunity cost of capital. But if we discount public projects over long periods of time, future lives can seem to be significantly undervalued compared to present lives. With a sufficiently high discount rate or a sufficiently long time period, future lives will seem to have a value vastly lower than present lives.

Much of the discussion of discounting is driven by the intuitive implausibility of such comparisons. The power of discounting over long periods can astonish even those deeply familiar with the concept.[1] It is easy to construct examples where saving a single life today means allowing most of the world to perish at some date in the future. In one of our favorite quips, two commentators ask you to "[i]magine finding

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1   See, for example, Martin L. Weitzman, *"Just Keep Discounting, But . . ."*, in Paul R. Portney and John P. Weyant, eds, *Discounting and Intergenerational Equity* 23, 28 (Resources for the Future 1999). Suppose we have a chess board and begin by putting a single penny on the first square. In each subsequent square, we double what was in the previous square, so that the second square has two cents; the third, four cents; and so on. It would be impossible to finish this game because the last square would have to have more wealth than exists in the world today. More realistic but less dramatic examples show that with modest discount rates and time horizons, say 5 percent and two hundred years, a saving of billions in the future is worth sacrificing only thousands of lives today.

out that you, having just reached your twenty-first birthday, must soon die of cancer because one evening Cleopatra wanted an extra helping of dessert."[2] The implication is that no moral theory can support allowing your death to satisfy Cleopatra's sweet tooth. Commentators frequently compare a global catastrophe in the distant future with trivial costs today.[3] These types of comparisons create unease with discounting, even among economists.[4]

The intuitions driving these examples and, indeed, even the very mathematics of these examples are incorrect. We argue here that discounting is appropriate and, in fact, required by any moral theory that accepts the Pareto principle. In particular, under plausible conditions, discounted cost-benefit analysis Pareto dominates any other decision procedure. Although this argument is well known, it has been subject to incorrect criticisms and not fully appreciated. Substantial movements in environmental law, such as the sustainable development movement, argue for decision criteria that are Pareto dominated, and economists, lawyers, and philosophers frequently argue for a zero discount rate even while seeming to accept the Pareto principle.[5]

Although Pareto arguments do not necessarily need it, we place the argument within the context of a welfarist, consequentialist ethic and discuss how it relates to the optimal taxation arguments derived from that ethic. In particular, optimal tax theory can be used to show that under reasonable conditions, cost-benefit analysis should not be weighted to consider distributional issues, regardless of how egalitar-

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[2]   Tyler Cowen and Derek Parfit, *Against the Social Discount Rate*, in Peter Laslett and James S. Fishkin, eds, *Justice Between Age Groups and Generations* 144, 145 (Yale 1992).

[3]   See Frank Ackerman and Lisa Heinzerling, *Pricing the Priceless: Cost-Benefit Analysis of Environmental Protection*, 150 U Pa L Rev 1553, 1571 (2002) (comparing the death of a billion people in five hundred years to the death of a single person today); Geoffrey Heal, *Valuing the Future: Economic Theory and Sustainability* 13 (Columbia 1998) (comparing the world GNP in two hundred years to the price of a used car today and, based on the implausibility of this comparison, developing a book-length formalization of the theory of sustainable development). See also Graciela Chichilnisky, *An Axiomatic Approach to Sustainable Development*, 13 Soc Choice & Welfare 231, 233–34 (1996) (developing a formal theory of sustainable development from the intuition that discounting is inappropriate).

[4]   See Paul R. Portney and John P. Weyant, *Introduction*, in Portney and Weyant, eds, *Discounting and Intergenerational Equity* 1, 5 (cited in note 1) ("[I]t is impossible to read these papers without getting a sense of the unease even the best minds in the profession feel about discounting.").

[5]   See, for example, Richard L. Revesz, *Environmental Regulation, Cost-Benefit Analysis, and the Discounting of Human Lives*, 99 Colum L Rev 941, 1005–06 (1999) (arguing that utilitarian principles are inconsistent with discounting); Tyler Cowen, *Consequentialism Implies a Zero Rate of Intergenerational Discount*, in Laslett and Fishkin, eds, *Justice Between Age Groups and Generations* 162, 162 (cited in note 2) (arguing that the adoption of four axioms, one of which is Pareto indifference, inevitably leads to the conclusion that a consequentialist viewpoint requires a zero intergenerational rate of discount); Derek Parfit, *Reasons and Persons* 357 (Oxford 1984) (arguing that the social discount rate is "indefensible" because remoteness in time has no moral significance).

ian the decisionmaker. We discuss the conditions for this theorem and whether they are met in the intergenerational context.

The Paretian arguments made here relate only to opportunity costs or the productivity of capital. Therefore, we do not consider pure time-preference arguments for discounting, such as impatience, uncertainty, and the like. Many arguments against discounting focus on whether it is ethical to consider pure time preference.[6] We express no opinion on these arguments here. Moreover, because the arguments are based on the Pareto criteria, we need not consider explicitly whether future generations are likely to be better off or worse off than is the current generation, although the optimal taxation framework can incorporate these considerations.[7]

Part I lays out the basic problem and framework for addressing it. Because the arguments about discounting are about justice between generations, we take generations as the basic unit for measuring Pareto improvements rather than arguing about the welfare of each and every individual within each generation across all of time. Part I discusses this approach. Part II considers the argument that discounted cost-benefit analysis Pareto dominates any other decision criteria and discusses how this argument relates to the optimal taxation arguments. Part III considers the major objections to the Pareto argument. In particular, Part III considers the problem of making intergenerational transfers, such as when there are intervening generations, and assesses whether considerations of opportunity costs are distinct from discounting. Section IV briefly addresses additional issues, including the use of rhetoric in discounting arguments.

I. THE PROBLEM AND THE ETHICAL FRAMEWORK

Suppose there is a potential project that has costs and benefits dispersed over a long period of time. One of the most important examples is the abatement of global warming. Reducing global warming requires the current generation to incur substantial costs while producing benefits hundreds of years into the future. Other prominent examples include nuclear waste disposal and extinction of species. The problem, however, is general and runs in both directions (that is, costs today, benefits in the future or benefits today, costs in the future). For example, rather than saving resources today to help the future, we

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[6]   See, for example, Revesz, 99 Colum L Rev at 998 (cited in note 5) ("The possible justifications for discounting for time preference at a positive rate are not compelling.").

[7]   The opportunity cost argument implicitly includes considerations of relative wealth because if capital is productive, giving rise to opportunity costs, future generations are likely to be wealthier than we are.

could consider the inverse: a project that uses resources today to help current lives when those resources might otherwise have been used in the future. Using up the world's petroleum supplies is such a case, as is not engaging in global warming abatement. By merely switching the assumed status quo, we can imagine any project running in either direction. By "project" we mean any decision that imposes costs and benefits, including actual projects such as building things, regulatory projects that impose costs and benefits over time, research into new technologies, taxing, saving, running deficits or surpluses, or any other decision that has real world effects.

It is important to note that projects (and decisions about discounting) can involve the past as well as the future. A good example is the measurement of reparations for harms that occurred long ago. We might, in the case of reparations for slavery, compensate harms that occurred as long as three or four hundred years ago. Discounting can have an enormous impact on the size of reparations claims.

The project will either pass or fail discounted cost-benefit analysis. By this we mean that the marginal costs are either less or more than the marginal benefits when all costs and all benefits are discounted (by an appropriate discount rate, which is discussed in Part IV) to the same time period. Note that because projects can involve either preserving or destroying resources, if one is a committed environmentalist, one cannot say whether passing or failing discounted cost-benefit analysis helps or hurts the environment. If the project is reparations, discounting increases the transfers to the harmed group and failing to discount reduces the transfers.[8] Moreover, there is no difference, so far, between discounting to the present period and future valuing to some future period if the same discount rate is used. All that is required is that the marginal costs and benefits be compared at the same point in time. (A discussion of the possible differences between discounting and taking opportunity costs into account can be found in Part III.C below.)

We also assume that all of the project's costs and benefits are properly counted. There are many discussions in the literature about the inadequacies of various discounting or cost-benefit procedures used in practice.[9] While these issues are important, they are not central

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8   For example, suppose that the harm to each slave was $1000 at the time and the harms occurred 250 years ago. With no discounting, reparations would be $1000 per harm (in constant dollars). With discounting, at a 5 percent rate, reparations would be almost $200 million per harm.

9   See, for example, Ackerman and Heinzerling, 150 U Pa L Rev at 1563–70 (cited in note 3) (arguing that cost-benefit analysis is inherently unreliable because not all benefits of potential government regulations can be monetized); Matthew D. Adler and Eric A. Posner, *Implementing Cost-Benefit Analysis When Preferences Are Distorted*, 29 J Legal Stud 1105, 1112–16 (2000) (arguing that traditional cost-benefit analysis includes certain factors, such as moral preferences,

to the underlying ethical issue of whether discounting is appropriate. We also assume that the value of life (and nonlife harms) is properly measured, and that life, risks to life, and enjoyment of life can be measured in money.[10] This means, among other things, that if the value of life in the future is higher than it is today (say because of increased wealth), this higher value is used. Whether life or enjoyment can be measured with money is an interesting problem, but it is orthogonal to the issues presented by discounting because it arises as well for projects that have immediate effects.[11]

More generally, we will not discuss here whether cost-benefit analysis is appropriate for projects that have only current costs and benefits.[12] In trying to understand objections to discounting, we think that many of the objections are to cost-benefit analysis generally and not about discounting as a distinct issue.[13] Although we personally would use cost-benefit analysis to evaluate projects, readers skeptical of this analysis should view our arguments as distinct from the debate on that issue. That is, we think that discounting is a related but distinct consideration from cost-benefit analysis.[14]

in the calculation of individual welfare even though such factors may be irrelevant to the individual's well-being); Lisa Heinzerling, *Discounting Life*, 108 Yale L J 1911, 1911–15 (1999) (criticizing methods of discounting that equate human lives with pure dollar values).

[10]   See Eric A. Posner and Cass R. Sunstein, *Dollars and Death*, 72 U Chi L Rev 537, 542 (2005) (recommending changes to current administrative and judicial value-of-life assessment methods).

[11]   Many counterarguments to discounting rely on an intuition that the value of life cannot be measured. They implicitly compare spending money to the certain loss of life. See, for example, Cowen and Parfit, *Against the Social Discount Rate* at 144–45 (cited in note 2). These examples trigger intuitions not only by the exponential effect of discounting but also by the difference between willingness to pay and willingness to accept. This confounding of intuitions regarding separate issues (that is, discounting on the one hand, and whether life can be measured with money on the other) can create erroneous conclusions regarding either one of the issues.

[12]   There is an extensive literature on this topic. See, for example, the various conference papers in *Cost-Benefit Analysis: Legal, Economic, and Philosophical Perspectives*, 29 J Legal Stud 837, 837–1177 (2000).

[13]   See, for example, Ackerman and Heinzerling, 150 U Pa L Rev at 1553, 1559 (cited in note 3) (objecting to cost-benefit analysis as applied to environmental regulations and explaining discounting as an essential feature of cost-benefit analysis); Heinzerling, 108 Yale L J at 1913–15 (cited in note 9) (objecting to the use of discounting on the grounds that *any* quantitative comparisons involving human beings obscure important decisional issues); Thomas O. McGarity and Sidney A. Shapiro, *OSHA's Critics and Regulatory Reform*, 31 Wake Forest L Rev 587, 629 (1996) ("For very highly valued things that are not traded in the actual marketplace, cost-benefit analysis is, at its core, 'incoherent' or 'schizophrenic' because it cannot yield a single numerical value.").

[14]   In particular, it is possible to accept cost-benefit analysis while rejecting discounting. Although few authors are explicit about this, it seems to reflect the views of Professors Revesz and Lind. See Revesz, 99 Colum L Rev at 947–48 (cited in note 5) (rejecting discounting as applied to the valuation of harms to future generations while proposing new parameters to measure costs and benefits in regards to intergenerational obligations); Robert C. Lind, *Analysis for Intergenerational Decisionmaking*, in Portney and Weyant, eds, *Discounting and Intergenerational Equity* 173, 174 (cited in note 1) (contending that the use of discounting to decide whether or not to transfer resources from present generations to future ones is irrelevant because the

How are we to evaluate this project? Our arguments below rely on the Pareto criteria—we argue that discounted cost-benefit analysis produces results that are Pareto superior to any other decision criteria, at least in most contexts. Pareto superiority is traditionally defined in terms of individuals; Pareto superiority would require that each and every individual throughout time is equal or better off with discounting. We apply the term to generations rather than individuals. We show below that each generation, however defined, is equal or better off. Particular individuals within a generation, however, may be better or worse off.

We take this approach for several reasons. First, the relevant actors in discounting debates are usually, if not always, generations. The debates are about justice between generations, not about redistribution within a generation. Moreover, each generation is, to a large extent, in charge of redistribution within that generation, perhaps favoring extensive redistribution, perhaps not. Giving each generation more total resources makes whatever distributive decisions it wants to make easier. Some might argue that we should not engage in a project that, relative to the status quo, changes the distribution of wealth within a generation, but this privileges the status quo. Moreover, it is not even clear in the abstract whether the alteration would be for the better or the worse or how it would interact with that generation's plans and ideals. Thus, we think the best approach is to think of Pareto superiority as applied to generations.

We can also frame the problem in the context of broader ethical principles. Schelling noted that the costs and benefits of long-term projects are imposed on different individuals whose lives may be largely unconnected.[15] For example, global warming abatement may very well impose costs on the United States and create benefits for future generations of foreigners living in low-lying countries such as Bangladesh. Similarly, using up resources today may transfer resources in the opposite direction, taking resources from those future

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decision is ultimately an ethical one). See also Heal, *Valuing the Future* at 13 (cited in note 3) (observing that societies devote resources to projects that are not justified by the use of traditional discount rates and, as a result, new economic models are necessary to explain these decisions); Cowen, *Consequentialism Implies a Zero Rate of Intergenerational Discount* at 162 (cited in note 5) (arguing that the consequentialist perspective dictates a zero intergenerational rate of discount when conducting a comparison of costs and benefits). Many discussions rejecting discounting, particularly in the legal literature, are found in broader examinations of cost-benefit analysis, and it is not clear whether the authors view the subjects as distinct. See, for example, Ackerman and Heinzerling, 150 U Pa L Rev at 1570–73 (cited in note 3); McGarity and Shapiro, 31 Wake Forest L Rev at 629–30 (cited in note 13).

[15]   Thomas C. Schelling, *Intergenerational Discounting*, 23 Energy Policy 395, 395–96 (1995).

foreigners and transferring them to today's Americans.[16] The same is true if one analyzes projects with purely domestic consequences. One must still weigh the relevant costs and benefits to different, usually unrelated, individuals. Any analysis of the problem must take into consideration whether such a transfer is desirable. As Schelling argued, global warming abatement is as much a foreign aid problem as an environmental problem.[17]

A welfarist-consequentialist determines whether such a transfer is desirable by reference to the social welfare function. The transfer is desirable if social welfare increases because of the transfer. The difficulty with using such an analysis here is that we must decide whom to include in the social welfare function and at what weight. Utilitarianism and other forms of consequentialist reasoning do not answer this question directly. A broader ethical framework is needed.

The issues of transferring resources among nations and among generations are in fact distinct. We tend to be much more altruistic to our heirs than to strangers. For example, a recent study shows that current U.S. foreign policies have an implicit weight on the life of a foreigner as low as 1/2000 of the life of an American.[18] At the same time, most generations have left the world richer than they found it, implying that we value our heirs' lives highly. These behaviors, however, even if robust, may not comply with ethical precepts.[19]

In this paper, we will weight future lives the same as current lives. We assume the equal moral worth of all individuals, today and in the future. In particular, we assume that future lives enter into the social welfare function in exactly the same way current lives do. This means that we weight increases (and decreases) in well-being of a future individual exactly the same as an equivalent increase (or decrease) in the well-being of a currently living individual. We do not discount

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[16]   The whole notion of taking from one and giving to another requires a set of baseline entitlements that, in turn, may assume an ethical theory. We use this language and its implicit acceptance of the status quo for convenience and do not base our analysis on any assumption of baseline entitlements.

[17]   See Schelling, 23 Energy Policy at 396 (cited in note 15) ("What we are talking about is very much like a foreign aid program, with some of the foreigners being our own descendants who live not on another continent but in another century.").

[18]   See Wojciech Kopczuk, Joel Slemrod, and Shlomo Yitzhaki, *The Limitations of Decentralized World Redistribution: An Optimal Taxation Approach*, 40 Eur Econ Rev 1051, 1054 (2005).

[19]   The same is true with respect to studies showing hyperbolic or other forms of irrational discounting of the future. See Maureen Cropper and David Laibson, *The Implications of Hyperbolic Discounting for Project Evaluation*, in Portney and Weyant, eds, *Discounting and Intergenerational Equity* 163, 164 (cited in note 1). Such studies do not show anything about ethical behavior toward the future.

well-being.[20] We choose to weight future lives equally because many of the discussions of discounting implicitly use this premise.[21] Pure equality may merely be a focal point, and it is not consistent with behavior with respect to cross-nation programs, but it is, nevertheless, likely to be the least objectionable choice.

Note that weighting individuals equally in a social welfare function does not mean equality of treatment. For example, if marginal utility declines with wealth or the social welfare function is concave, we will want to transfer resources from the rich to the poor.[22] The reason is not unequal weighting. Instead, it is that overall social welfare may increase with such a transfer.

This may be true with respect to projects. If the project transfers from the poorer to the richer, the decline in utility of the poorer may be more than the gain in the utility of the richer. Thus, even if the project passes discounted cost-benefit analysis in absolute dollar terms, it may not increase social welfare. Similarly, if the project fails cost-benefit analysis but redistributes from richer to poorer, it might increase social welfare. Every progressive tax system looks like this. Because of the deadweight loss of taxation, less money is transferred to the poor than is taken from the rich, but the tax may still be desirable.

A central point in our approach to the problem is the difference between discounting lives and discounting costs and benefits. As noted, increments to well-being are counted the same for current and

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20   There is a significant body of literature on whether future generations should count less when we compute social welfare. In particular, commentators distinguish between a pure rate of time preference that determines how units of utility should be compared across periods, and an interest-like factor that depends on the rate of growth in the economy (and on the marginal utility of consuming the growing GDP in each period). See Geoffrey Heal, *Discounting: A Review of the Basic Economics*, 74 U Chi L Rev at 59, 63 (2007) ("A very important distinction . . . is between the rate [ ] at which *utility* is discounted, also known as the . . . pure rate of time preference, and the rate at which *consumption* is discounted. The latter rate is sometimes called the social discount rate."); Revesz, 99 Colum L Rev at 997 (cited in note 5) (unpacking the discount rate into a time preference term and a return on capital term). We assume that the pure rate of time preference is zero, so that all individuals, present or future, count equally.

Many of the arguments against discounting use the rhetoric of "discounting lives" in apparent reference to the pure rate of time preference. See, for example, Heinzerling, 108 Yale L J at 1912 (cited in note 9) ("Discounting lives is all about the relative worth of lives today versus lives tomorrow."). Assuming that lives count equally in the social calculus, however, says little about whether costs and benefits should be discounted for opportunity costs.

21   See Victor R. Fuchs and Richard Zeckhauser, *Valuing Health—A "Priceless" Commodity*, 77 Am Econ Rev 263, 265 (1987) ("Most policy planning discussions assume full altruism—future citizens are given equal weight with present citizens.").

22   The situation is even more complex than the text implies. It is possible to show that horizontal equity—equal treatment of equals—is *inconsistent* with welfarist-consequentialism. See Anthony B. Atkinson and Joseph E. Stiglitz, *Lectures on Public Economics* 354 (McGraw-Hill 1980) (discussing conditions under which welfare may be increased though identical individuals are treated differently).

future generations. Nevertheless, this does not mean that costs and benefits should not be discounted. Consider the principle example used by Richard Revesz.[23] He posits a two-generation world where one generation lives from years 1 through 50 and the other from years 51 through 100. There are 100 units to divide between the generations. Revesz assumes no productivity, which at least potentially translates into a zero discount rate, but supposes that there is otherwise an opportunity cost of funds, and that the discount rate is 3 percent.

Revesz posits that equal treatment of the two generations means that each should get 50 units of resources. He argues:

> In the absence of discounting for time preference, each individual would be allocated 50 units of resources. In the face of a positive rate of time preference, however, even a relatively modest one, the first individual would get the bulk of the resources. It would be difficult to construct an attractive ethical theory that privileged the first individual in this manner merely because she lived fifty years earlier than the second individual.[24]

An alternative version of equality would give the first generation approximately 80 units and the rest to the second generation (giving each one an endowment of that amount in the first year of its life). When the second generation's endowment of 20 is invested at 3 percent for the first 50 years, it will grow to about 80 units in year 51, generating an equal division of the resources.

A social welfare function that weighs each generation equally would require the 80/20 split rather than the 50/50 split. The reason why is that, with a 50/50 split, the second generation would have more total consumption. If its 50 unit endowment is invested until the time that generation is born, it will be able to consume about 220 units, compared to the 50 units consumed by the first generation. If equality is valued, there are welfare gains from transferring resources from the second generation to the first until the marginal utility of consumption of each generation is the same, which means that the endowment would be split 80/20. We adopt this latter concept of equality—intergenerational equity requires each generation to have the same marginal utility of con-

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23   See Revesz, 99 Colum L Rev at 998 (cited in note 5).

24   Id. We should note that there is an important ambiguity in his argument. The example assumes zero productivity and, therefore, no opportunity costs of capital. He is explicitly discussing only pure time preference, which involves items other than pure opportunity costs, such as impatience, that might affect the discount rate. In such a case, our analysis is consistent with his. Revesz, however, believes that taking opportunity costs into account is different from discounting, and that opportunity costs should be taken into account. Id at 1007–09. If so, he should agree with the conclusions in the text, although it is not clear that he would. The example, therefore, by assuming a zero rate of productivity, while technically correct, has the potential to confuse.

sumption (or absolute utility, depending on our social welfare function). That is, we care about equality of well-being while those arguing against discounting are arguing for an equal division of current resources, which will inevitably lead to an inequality in well-being.[25]

Much of the literature confounds these two topics: discounting individuals' lives on the one hand and discounting costs and benefits on the other, if not technically, at least rhetorically. For example, Cowen argues, using an axiomatic approach, that consequentialism implies a zero rate of intergenerational discount.[26] Nothing in his argument, however, is inconsistent with discounting costs and benefits by their opportunity costs, and his claim that there should be a zero rate of intergenerational discount should not be taken to mean that costs and benefits of projects should not be discounted! All he is arguing for is that each generation has equal weight in the social welfare function, a result entirely consistent with the approach taken here. Similarly, concerns that discounting for time is equivalent to discounting the future lives are misplaced. The two concepts are distinct.

II. DISCOUNTED COST-BENEFIT ANALYSIS PARETO DOMINATES ANY OTHER DECISION CRITERIA

In this Part, we show that discounted cost-benefit analysis (unweighted for distributional issues) Pareto dominates any other decision criteria, at least under likely scenarios. Although these arguments are, to some extent, known, we lay them out in more detail than usual in order to explore underlying assumptions. As noted, the arguments made here are purely arguments about opportunity costs. In Part III we discuss whether and to what extent these arguments are distinct from other types of discounting. We consider here two cases: first, a project that fails discounted cost-benefit analysis but that seems attractive for distributional reasons, and second, a project that passes cost-benefit analysis but that seems unattractive for distributional reasons.

Consider the case where a project fails discounted cost-benefit analysis. That is, the discounted marginal costs exceed the discounted marginal benefits. The project may still improve social welfare because of the distribution of the costs and benefits. For example, it might impose costs on the rich and endow the poor with benefits. Nevertheless,

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[25]   There are a variety of ways we can view equality, and the question "equality of what?" is important. See, for example, Amartya Sen, *Inequality Reexamined* 12–30 (Harvard 1992). We do not think, however, that Revesz's version of equality—that is, equality of initial allocations—is a plausible one.

[26]   See Cowen, *Consequentialism Implies a Zero Rate of Intergenerational Discount* at 162 (cited in note 5).

we should not engage in the project because there will always be another project that is a Pareto improvement.

Suppose, for example, that a project will impose costs today and help a future generation. Given a valuation of life for today and in the future (which may differ because willingness to pay for life may increase as wealth increases), suppose that the discounted future increase in welfare is less than the current decrease. For example, suppose we were to spend $1 million today to save $100 million in 100 years. If the discount rate is more than (roughly) 5 percent, this project fails discounted cost-benefit analysis because the present value of the $100 million benefit in 100 years is less than the $1 million cost today.

If we were considering this project, we would be better off engaging in other projects that meet discounted cost-benefit analysis. For example, we could take the present value of $100 million and invest it in a project that receives the market rate of return. Future generations would still get $100 million but the current cost to us would be lower. Alternatively, we could invest the full $1 million, imposing the same cost on the current generation, and give future generations more. Either way, at least one generation is better off and nobody is worse off. Therefore, regardless of whether the project increases welfare, we should not engage in the project because there are other projects that increase welfare more. If it were the case that other projects were limited, the analysis might be different, but we can always invest funds at the market rate.

This argument gives an additional reason why the claim that discounting does not respect future generations as equals is incorrect. Suppose that we decide to engage in this project on the basis that future generations are equals and, because $100 million is more than $1 million, the project is worthwhile. If we could ask future generations whether they would want us to engage in this project, they would prefer that we just invest the money at the market rate of return because they would be better off with such an investment. If respecting future generations means anything, it should mean respecting our best guess as to their wishes and helping them as much as feasible. A project that fails discounted cost-benefit analysis fails this minimal test.[27]

The other case is a project that passes discounted cost-benefit analysis but which has bad distributional consequences. For example, it might create benefits for the rich that exceed on a dollar basis the costs it imposes on the poor but, because the poor feel the pain of the

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[27] A similar argument is made in Ari Rabl, *Discounting of Long-Term Costs: What Would Future Generations Prefer Us to Do?*, 17 Ecol Econ 137, 139 (1996) ("A cost-benefit analysis from the perspective of future generations implies that the preferred rate . . . is the growth rate . . . of the economy.").

loss of a dollar more than the rich feel the benefit of the gain, the project on its own reduces social welfare. Rejecting this project, however, would be a Pareto dominated decision.

Suppose the project produces benefits of $100 and only costs $90, both in present value terms. In addition, suppose that the benefits go to wealthy individuals who, because of declining marginal utility of wealth, do not value them very much, and the costs are imposed on poor individuals who view the costs as a large imposition. Although the project taken alone would seem to reduce welfare, there exists an offsetting transfer that makes the project a Pareto improvement. In particular, the wealthy individuals would be willing to give up $95 to get the project (gaining $5) and the poor would be willing to accept $95 to agree to the project (gaining $5). Thus, although the project taken alone reduces welfare, the combination of the project plus the transfer is a Pareto improvement over rejecting the project.

Future generations, of course, are not yet alive to strike such a bargain with us, and even if they were alive, no such bargain would be enforceable. And it is difficult to even imagine a bargain because the ethical discussion is about the rights and responsibilities of each generation; without a background set of rights and responsibilities, there cannot easily be a bargain.[28] Without an actual transfer, the project is merely Kaldor-Hicks efficient and may not be consistent with improving social welfare.

By hypothesis, there is a project on the table that has costs and benefits to the present and the future. The current generation is entirely in control of the project—it can decide whether to engage in it entirely without regard to the future.[29] Given whatever level of altruism (or selfishness) the current generation has, however, it makes sense to exercise that altruism in the most efficient fashion. That is, it never makes sense to throw resources away. Therefore, there need not be a bargain between generations or an enforcement mechanism for the Pareto dominance argument to hold.

To illustrate, go back to our example and suppose that the current generation is rich and the future is expected to be poor, and that, rela-

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[28]   See Cass Sunstein and Arden Rowell, *On Discounting Regulatory Benefits: Risk, Money, and Intergenerational Equity* 74 U Chi L Rev 171, 194–95 (2007) (noting that absent a theory of entitlements and a mechanism for enforcing intergenerational bargains, Pareto allocation cannot be affected). This is not necessarily the case. Individuals frequently bargain successfully in the presence of great uncertainty about their underlying rights and responsibilities.

[29]   Although moral theories can reject, as an ethical matter, the dictatorship of the present, they cannot reject it as a factual matter. The current generation can make the decision whether to engage in the project or not. See id at 195 ("[The current generation] can decide to consume all existing resources, to ruin the environment, to impoverish posterity, even to remain childless and not create later generations at all.").

tive to the status quo, the project transfers $100 to the current generation at the expense of $90 to the future generation. Suppose also that the current generation otherwise plans to transfer $1,000 to the future because of its altruism. The current generation should engage in the project and increase its transfer to the future by somewhere between $90 and $100. The current generation is better off—it meets its altruistic or selfish goals (depending on what one thinks about the transfer of $1,000) and gets the project. The future generation is also better off. There is no need for an actual bargain for the transfer to occur. The current generation could always do the project without the transfer of $90 to the future, but it could also just reduce the legacy it would otherwise leave from $1,000 to $990.

We can produce similar examples where the current generation is poor and the future rich, or where the costs and benefits of the project go in different directions, or where the level of altruism changes. As long as there are sufficient transfers among generations, these existing transfers can be altered to make the project a Pareto improvement if it passes discounted cost-benefit analysis.

The argument is closely related to a theorem from the public finance literature first put forth by Anthony Atkinson and Joseph Stiglitz.[30] They considered the case of optimal redistributive tax and transfer systems, but their argument has been extended to cost-benefit analysis and to public goods.[31] These extensions show that cost-benefit

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[30] See generally Anthony B. Atkinson and Joseph E. Stiglitz, *The Design of Tax Structure: Direct Versus Indirect Taxation*, 6 J Pub Econ 55 (1976).

[31] Legal readers are likely to know this theorem from the arguments about the desired efficiency of legal rules. See Louis Kaplow and Steven Shavell, *Why the Legal System Is Less Efficient Than the Income Tax in Redistributing Income*, 23 J Legal Stud 667, 667 (1994) (arguing that "redistribution through legal rules offers no advantage over redistribution through the income tax system and typically is less efficient"); Steven Shavell, *A Note on Efficiency vs. Distributional Equity in Legal Rulemaking: Should Distributional Equity Matter Given Optimal Income Taxation?*, 71 Am Econ Rev 414, 414 (1981) (arguing that even in the face of an imperfect ability to redistribute income through taxation, legal rules chosen only on the basis of their efficiency should still be strictly preferred). The tax version of this argument has been extensively discussed in the literature. See Louis Kaplow, *On the Undesirability of Commodity Taxation Even When Income Taxation Is Not Optimal*, 90 J Pub Econ 1235, 1237–39 (2006) (designing a method for constructing a Pareto superior tax regime using solely an income tax from an initial regime that uses a positive commodity tax rate); Emmanuel Saez, *The Desirability of Commodity Taxation Under Non-Linear Income Taxation and Heterogeneous Tastes*, 83 J Pub Econ 217, 218 (2002) (investigating how the Atkinson-Stiglitz theorem applies in cases of heterogeneous consumption preferences); Joseph E. Stiglitz, *Pareto Efficient and Optimal Taxation and the New New Welfare Economics*, in Alan J. Auerbach and Martin Feldstein, eds, 2 *Handbook of Public Economics* 991, 1002–06 (Elsevier Science 1987) (building a model of optimal taxation following allocative maximization of public spending); Angus Deaton, *Optimal Taxes and the Structure of Preferences*, 49 Econometrica 1245, 1245–46 (1981) (analyzing how individuals' preference structures affect optimal tax rates). The application to cost-benefit analysis was first suggested by Aanund Hylland and Richard Zeckhauser. See Aanund Hylland and Richard Zeckhauser, *Dis-*

analysis should not, under the conditions of the theorem, be adjusted for distributional considerations, regardless of how egalitarian we are.[32] Similarly, the government should purchase public goods without regard to the tax cost of financing them.[33]

We can use the same example discussed above to illustrate the argument.[34] In the example, rich individuals were made better off by $100 and the poor worse off by $90. Rather than a voluntary transfer from the rich to the poor to pay for the project, we would use an identical adjustment to the tax schedule. Suppose we increase the progressivity of the tax system by increasing taxes on the rich by $100 and reducing taxes on the poor by $90, leaving both classes of individuals in the same place as without the project and tax adjustment. There are no distributive effects of the combined project and tax adjustment. Unlike with the voluntary exchange case considered above, however, taxes might create deadweight losses, such as those caused by a reduction in labor effort. Note, however, that by leaving each individual in the same place, the combination of the project and tax adjustment introduces no distortions into the economy, such as the usual deadweight loss caused by a tax. Finally, because taxes went up on the rich by $100 and down on the poor by only $90, there is an additional $10 of tax receipts that can be used to make everyone (or some people) better off, resulting in a Pareto improvement.[35] The conclusion is that

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tributional Objectives Should Affect Taxes But Not Program Choice or Design, 81 Scandinavian J Econ 264, 265 (1979). See also Louis Kaplow, *The Optimal Supply of Public Goods and the Distortionary Cost of Taxation*, 49 Natl Tax J 513, 513 (1996) (examining the relationship between the optimal supply of public goods and the distortionary cost of income taxation).

   [32]   Hylland and Zeckhauser, 81 Scandinavian J Econ at 274–76 (cited in note 31) (proving that in instances where optimal taxation is available, the choice between competing government programs should be made solely on the basis of the programs' respective net benefits and not based on distributional considerations).

   [33]   See Kaplow, 49 Natl Tax J at 524 (cited in note 31) (explaining that "under standard simplifying assumptions, there exists a way to modify the income tax to finance a public good such that there is no additional distortion").

   [34]   See Atkinson and Stiglitz, 6 J Pub Econ at 56 (cited in note 30) (proposing that under a relatively wide class of conditions, "the optimal tax system can rely solely on income taxation"); Kaplow, 90 J Pub Econ at 1236 (cited in note 31) (extending the Atkinson-Stiglitz conclusion that the social welfare optimum can rely solely on income taxation to cases in which the income tax is not set at an optimal level); Kaplow, 49 Natl Tax J at 514 (cited in note 31) ("[T]he simple cost-benefit formula indicates whether the public good should be supplied. There should be no adjustment to account for the distortionary cost of labor income taxation."); Kaplow and Shavell, 23 J Legal Stud at 677 (cited in note 31) ("[I]t is appropriate for economic analysis of legal rules to focus on efficiency and ignore the distribution of income in offering normative judgments."); Hylland and Zeckhauser, 81 Scandinavian J Econ at 266 (cited in note 31) (developing a model proving that distributional objectives can be achieved through the tax system alone rather than through the pursuit of redistributional goals, and therefore, government programs should be chosen solely on the basis of efficiency criteria).

   [35]   Sophisticated readers are probably thinking at this point of "the theorem of the second best," which states that distortion counting of the sort in the text cannot be used for welfare

as long as the tax system is sufficiently flexible to make offsetting distributional adjustments, projects should be undertaken if and only if they pass unweighted cost-benefit analysis.

This conclusion, usually stated for projects with present costs and benefits, also applies to projects with costs and benefits spread over time and between generations. As long as the discounted costs are less than the discounted benefits, there exists an offsetting tax and transfer adjustment that makes everyone better off, even if the project taken alone seems to have bad distributional effects. Therefore, the appropriate decision criteria for projects is discounted cost-benefit analysis.[36]

III. Counterarguments

The Pareto dominance arguments have long been recognized in the literature, but, we believe, have not been uniformly accepted because of a variety of objections. We consider some of these objections here.

A. Intervening Generations

One of the most common counterarguments to the Pareto dominance argument is that intervening generations may abscond with any savings that we intended to leave for distant future generations.[37] Lind offers a particularly emphatic version, arguing: "[I]ntergenerational transfers, either forward or backward, generally must be made through series of intervening generations. Designing and implementing such

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analysis. One of their assumptions, namely weak separability between labor and leisure, eliminates this problem. Relaxing this assumption means that it is possible that the tax on the commodity reduces the distortion in labor supply caused by the labor income tax. The commodity, for example, might be a relative complement to leisure. In practice, the possibility of taxing relative complements to leisure is obscure and has few if any implications for intergenerational projects. See Joseph Bankman and David A. Weisbach, *The Superiority of an Ideal Consumption Tax over an Ideal Income Tax*, 58 Stanford L Rev 1413, 1451–52 (2006) (arguing that saving, and by implication future consumption, is not a complement to leisure).

[36] There is a subtlety. In prior literature advocating tax offsets, the tax affected the margin but was offset by the benefit (or cost) of the project on the margin. See Kaplow, 90 J Pub Econ at 1236–37 (cited in note 31) (proposing a method for constructing a Pareto optimal tax regime that relies solely on income taxation); Hylland and Zeckhauser, 81 Scandinavian J Econ at 266 (cited in note 31) (proposing a method for financing allocatively optimal public spending without additional labor supply distortion). For example, suppose that the benefit of the project goes up linearly with income. Increasing the income tax to the same extent will not distort labor effort because if an individual works harder he gets both the benefit of increased enjoyment from the project and increased taxes. In the intergenerational context, both the tax and the project costs and benefits are more lump sum. For example, suppose that the current generation must transfer $100 to a future generation because a project benefits us by $100. Assuming that the transfer will be made, the tax cannot be avoided by working less or by anything of the like, and the same goes for the benefit of the project.

[37] See Sunstein and Rowell, *On Discounting Regulatory Benefits* 74 U Chi L Rev at 193–94 (cited in note 28) (offering a hypothetical in which a present generation confiscates resources from a future generation).

transfers is virtually impossible, and the potential for an intervening generation to break the chain of transfer makes such transfer schemes virtually impossible to implement."[38]

Lind goes on to dramatize the point by hypothesizing a proposal to transfer resources to the future through an investment with a 0 percent rate of return, at a time when money or other projects earn a 10 percent return:

> The preferred decision may well be to make that investment and transfer the resources to the future generation even though it earns a zero rate of return. At this point an eager graduate student jumps up, sensing an economic slam dunk, and says, "that was a really dumb decision. You could have invested that money at 10% and made those people a lot better off." Wrong! We don't know how to set aside investment funds and to commit intervening generations to investing and reinvesting those funds for eventual delivery as consumer goods to the generation 200 years from now.[39]

It is Lind, however, and not the eager graduate student who is wrong. The reason why is that any project, including the project being analyzed such as Lind's zero rate of return project, can be destroyed by an intervening generation. Absent a reason to believe that transfers from one project are less easily misdirected than transfers from others, we should still pick the project with the highest rate of return.

For example, suppose we are considering conserving petroleum for use in two hundred years, and the rate of return on this project is less than the market rate of return. We should not engage in the project because other projects would confer more value on future generations for less money. If we are worried about intervening generations with respect to the alternative projects, we have to worry that intervening generations will interfere with the project at issue, say by using up the petroleum themselves. Similarly, if we are considering transferring resources to a future generation by abating global warming, an intervening generation could always take the transfer for itself by releasing excess carbon into the air, destroying our attempt to preserve the resource for the future.

Lind and others who make this claim, however, do not make the necessary institutional arguments about the ability of future generations to interfere with some forms of transfer but not others. They give no more reason to believe that intervening generations will respect an environmental choice than they would leave money in the bank or in

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[38]   Lind, *Analysis for Intergenerational Decisionmaking* at 174–75 (cited in note 14).
[39]   Id at 176.

another type of project. They assume, nonetheless, that this would be the case—environmental projects (or whatever unstated projects are uppermost in the analyst's mind) are assumed to be feasible methods of transferring resources while other projects with a market rate of return are assumed to be infeasible methods of transferring resources. While it is possible (indeed likely) that some transfers are more easily reversed than others, such a claim is not sufficiently general to reject discounting. Arguments about which transfers cannot be undone are likely to be very project-specific and do not systematically disfavor discounting.[40]

Moreover, it is not clear that tying the hands of intervening generations would be wise. We can imagine that intervening generations are more, equally, or less altruistic to the future than we are. If they are more altruistic than the current generation or equally so, Lind's argument presents no issue. If they are less altruistic, we would have to ask why. It could be the case that they have discovered new and better ethical theories and are behaving consistently with those theories. We should probably want to respect that choice. Alternatively, they might merely be selfish or have adopted worse ethical theories, in which case we might want to tie their hands. If we can successfully tie the hands of future generations (by engaging in one particular project but not in others), however, we would prevent both the unwise generation from reneging and the wise generation from improving. Thus, even if we could establish, on a project-by-project basis, which projects are less subject to reneging, it is not clear that engaging in those projects would be wise.

The discounted cost-benefit analysis assumes that transfers to or from the future can be made at the market rate of return. This is a good first-best baseline from which to think about the issue. To incorporate Lind's arguments, future work would have to make institutional or second-best arguments, trying to distinguish which types of projects are better or worse from a commitment standpoint. We see no particular reason why such an analysis would favor the types of long-term projects currently discussed, such as global warming abatement or prevention of species extinction, although it might. (To be sure, these projects may very well pass discounted cost-benefit analysis in any event. We take no position on that issue.)

B.   Difficulty of Transfers

A common reaction to the Atkinson and Stiglitz tax argument when applied to projects is that the scope of most projects is too nar-

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[40]   See K.J. Arrow, et al, *Intertemporal Equity, Discounting, and Economic Efficiency*, in James P. Bruce, Hoesung Lee, and Erik F. Haites, eds, *Climate Change 1995: Economic and Social Dimensions of Climate Change* 125, 132 (Cambridge 1996).

row (and the scope of taxation too broad) for such adjustments to be made. For example, we might be deciding whether to build a highway that produces noise and pollution next to a poor neighborhood and benefiting those rich persons who happen to use it as their commuting route. Broad-based tax adjustments will not be able to tax those particular commuters and benefit those particular residents affected by the project. But if we are talking about large scale intergenerational issues—the only kind worth our attention—this objection goes away. The relative redistribution is between current and future generations rather than particular individuals. (To be sure, even large scale projects will have narrow effects. The costs of reducing global warming will not fall on all Americans equally. But *inter*generational equity is not usually concerned with these *intra*generational issues.)

Another objection frequently made is that the offsetting tax adjustments might not be made, for purely political reasons such as the separation of powers in the U.S. system. For example, Adler and Posner observe that an agency deciding whether to pursue a project does not have the choice of making offsetting tax adjustments.[41] It is hard to see why the adjustments would not be made, however, at least on an economy-wide, systematic basis. Positing that projects will have good distributional effects but taxes cannot be adjusted to have the same effects requires very strong assumptions about the political process, assumptions that are unlikely to hold systematically. Instead, it is better to assume that the political process produces some equilibrium amount of redistribution, which may or may not be optimal. More importantly, these sorts of objections have no bearing on large scale intergenerational projects. Any project that has sufficient redistributive impact to be worth our attention is going to have legislative involvement, and the legislature clearly has power over both the project and taxes.

The main assumption made by the theorem that might affect its application to intergenerational projects is that the tax and transfer system can be adjusted to offset the effect of the project. If a project is going to impose costs today and produce benefits in two hundred years, we must be able to adjust taxes and transfers between these two generations to offset any distributional implications. Leaving aside the "intervening generation" problem discussed above, there should clearly be sufficient intergenerational transfers that can be adjusted. Suppose, for example, we are going to incur costs today to help those in two hundred years, and we believe that individuals in two hundred years

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41   See Adler and Posner, 29 J Legal Stud at 1138 (cited in note 9) ("We know of no agency in the U.S. government that has the authority to order wealth transfers, and there are many good reasons for denying them this authority.").

will be systematically better off. The project would redistribute in the wrong direction, helping those who are better off. To offset this redistribution, the project could be deficit financed or other taxes could be reduced. The legacy each generation leaves to the next is enormous, and there is no reason to believe that adjustments to offset bad distributional consequences of projects would not be available.

The most serious objection to the above analysis is that the tax and transfer system is not sufficiently flexible to transfer resources to or take resources from future generations of individuals in other nations. For example, abating global warming may impose costs on the current U.S. generation and help future foreigners. This seems a valid objection. There are ways to redistribute to and from future foreigners by adjusting foreign aid, military spending, and the like, but there is nothing very direct and efficient.

If we were to weight future foreigners in our social welfare function at the same weight as current locals, and if a given project is the best way of transferring resources to poor future foreigners, it would be welfare-improving to adopt the project. For example, the argument would be that the United States should incur costs today to abate global warming because doing so is the best way to help future foreigners. That is, those arguing against discounting must directly confront Schelling's argument that most long-term projects are really foreign aid projects.[42]

As noted, foreigners are barely weighted in a U.S. social welfare function derived from actual behavior.[43] If we weight foreigners equally, current projects would have to be changed so dramatically that most long-term projects, such as global warming abatement, would no longer be near the top of our priority list. Alternatively, if we take our current valuation of foreigners, we would vastly discount their lives in our social welfare function, and most projects of a global scale such as global warming abatement would not remotely pass cost-benefit analysis.

For example, suppose we are considering a project that will cost the current generation living in the United States $100 and help a future generation of poor foreigners by a present value amount of $90, and that because of distributional considerations, the benefits to the future foreigners are more than costs to current U.S. lives. Our argument above was that the project should be rejected because it is better to transfer $90 directly. Suppose, however, that no direct transfer will

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[42]   See generally Schelling, 23 Energy Policy 395 (cited in note 15).

[43]   See Kopczuk, Slemrod, and Yitzhaki, 40 Eur Econ Rev at 1054 (cited in note 18) (finding that the level of U.S. foreign aid is consistent with foreigners "being valued by the U.S. at just 16 percent of an average American, with the citizens of the poorest countries weighted by as little as 1/20th of 1 percent").

be made, so that the optimal tax argument does not apply. It still makes no sense to spend $100 to transfer the $90. If we are unwilling to transfer $90 directly (spending $90 to transfer $90), we should not transfer $90 by spending $100. To suggest that we really do want to transfer the $90 and that the only way to do so is to engage in a project costing $100, while possible, seems implausible.

Another way to look at this issue is to compare the Pareto analysis with a welfarist analysis. The example presented immediately above was a Pareto analysis. For any given level of transfers to foreigners, it should be done efficiently. A welfarist would not be happy with this because a welfarist would insist on the right level of transfers to foreigners, a level likely to be significantly higher than current transfers. Such a welfarist might then have a valid argument that the distributive effects of the project must be considered rather than merely using discounted cost-benefit analysis. At the same time, however, the welfarist might be more concerned about our current level of foreign aid or the current distribution of resources in the world.

C.   Difference between Opportunity Costs and Discounting

Many commentators have argued that taking opportunity costs into account is not the same as discounting.[44] Others have argued that it is not appropriate to take opportunity costs into account.[45] We consider these arguments in this Part.

Taking opportunity costs into account presumably means taking into account the alternative uses of resources that we are considering using for a project. This is equivalent to taking the future value of these resources at the highest rate of return available. There is, however, a perfect mathematical equivalence between discounting and taking future values. Algebraically, the two are the same, and any project that passes (fails) discounted cost-benefit analysis passes (fails) future valued cost-benefit analysis.

Everyone knows this, so commentators arguing that opportunity costs should be taken into account but projects not discounted must

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[44]   See, for example, Cowen and Parfit, *Against the Social Discount Rate* at 152 (cited in note 2) ("Although certain opportunity costs do increase over time, it misrepresents our moral reasoning to treat these opportunity costs in terms of a social discount rate. These costs should be considered directly. If instead we express these costs in terms of a discount rate, we can be led astray.").

[45]   See, for example, William R. Cline, *Discounting for the Very Long Term*, in Portney and Weyant, eds, *Discounting and Intergenerational Equity* 131, 134 (cited in note 1):

> The fundamental problem with discounting the very long term at today's rate of return on capital is that to do so . . . promises something that cannot be delivered: that today's generation and all intervening generations will keep intact an investment fund that is capable of continued real returns at today's level.

have something else in mind. A significant possibility is that they are focusing on reasons for discounting other than the opportunity cost of capital. For example, some have suggested that interest rates are positive because of impatience (pure time preference) or because of the possibility of a catastrophe (better to consume the resources than have them destroyed in the catastrophe). In this paper we do not consider these rationales for discounting and, therefore, need not consider whether they are appropriate. Note that this means the discounting argued for here would be at a lower rate than the market rate of interest because the market rate of interest will reflect factors other than opportunity costs.[46]

Derek Parfit gives four reasons why the existence of opportunity costs does not support discounting.[47] First, he argues that some benefits are consumed rather than reinvested. He posits the enjoyment each year of a stretch of countryside, arguing that enjoyment in later years should not count less than enjoyment in earlier years. Consumption, however, can be thought of as a stream of money—the willingness to pay or accept. If the value to an individual of the countryside in ten years is $100, the individual would accept less than $100 today to give up the enjoyment of the countryside in ten years. There is no difference between consumption items that are consumed and those that are reinvested.

John Broome draws a conclusion similar to Parfit's from the same example, although for different reasons.[48] Broome generally favors discounting on a theory closely analogous to the opportunity cost arguments made here. Broome argues that because of the productivity of capital, most commodities will be cheaper in the future—this is why there is a positive rate of interest and why commodities should be discounted. For example, producing televisions gets cheaper, so the market prices of televisions today and in the future are different. He uses the idea of a commodity's "own interest rate" as the rate of change of the price of the commodity. One should agree to pay less for future televisions than today's televisions because of this "fertility" of capital. Open countryside, however, is not fertile: "Scarce resources cannot be converted into a greater quantity of future resources, and they therefore have own interest rates of zero or thereabouts."[49] If the value of a commodity will remain the same through time, it should not be discounted.

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46   See, for example, Rabl, 17 Ecol Econ at 138–39 (cited in note 27) (arguing on similar grounds for a long-term discount rate that reflects the expected growth in the economy rather than recently observed interest rates).

47   See Parfit, *Reasons and Persons* at 483 (cited in note 5).

48   See John Broome, *Discounting the Future*, 23 Phil & Pub Aff 128, 148 (1994).

49   Id.

This argument is consistent with the opportunity-costs arguments made here. If the absolute value of the scarce resource remains the same but other resources get cheaper, the relative price of the scarce resource will go up. Indeed, this is why we can think of there being a single interest rate in the economy notwithstanding each commodity having its own "fertility." Therefore, one can reframe Broome's argument as an argument that a consistent opportunity-cost discount factor should be used, but that it should be based on relative future prices. If the price of the scarce resource goes up at the same rate as the discount factor, the net effect of determining the future price and discounting it back is zero. If the price of the resource goes up faster than the discount rate, the net effect is like having a negative discount factor.

Does it matter which procedure is used—not discounting (or more precisely, determining a commodity's own rate of interest) or determining future prices and discounting—if the net effect is the same? In a technical sense, the answer is "no." All we care about is making the welfare-maximizing decisions. Rhetorically, however, commentators such as Parfit use these sorts of arguments as a wedge to argue against discounting more generally. It is important to realize that these arguments are not inconsistent with discounting.[50]

Parfit's second argument is that many harms will not be compensated. He considers the case of a pollutant that will cause congenital deformities among some unlucky future individuals and assumes that they will not be compensated. There are two distinct elements in the example. The first is similar to the countryside example above. A deformity tomorrow reduces welfare just as much as a deformity in the future, so deformities may not be like commodities that get cheaper over time. The same answer given above applies and, in fact, the case might be easier, because the cost of care or cost of a cure for deformi-

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50   Moreover, Broome's underlying assumption, that some goods are scarce and, therefore, their price will go up over time at least as fast as the overall discount rate, is also controversial. Julian Simon and his critics have been debating this for more than thirty years without apparent resolution. Compare Julian L. Simon, *The Ultimate Resource* 27 (Princeton 1981), with Paul R. Ehrlich, *An Economist in Wonderland*, 62 Soc Sci Q 44, 46 (1981). Even if one disagrees with Simon, and many do, at a minimum he is correct that it is difficult to make a prediction like Broome's, that the price of a given scarce commodity will go up over time. For example, Parfit and Broome use open countryside as their illustration. It is difficult to determine the price of open countryside because the term has no precise meaning. One possibility is that open countryside is any land that is neither urban nor farm. Data show that the amount of nonurban, nonfarm land in the continental U.S. has increased in the last half century. Since 1945, urban areas have grown by roughly 69,000 square miles. Since 1950, farmland has decreased by almost 360,000 square miles. See Demographia, *Urbanization and Urban Densities in the United States from 1945* (2005), online at http://www.demographia.com/db-1945uza.htm (visited Jan 23, 2007); USDA National Agricultural Statistics Service, *Trends in US Agriculture*, online at http://www.usda.gov/nass/pubs/trends/farmnumbers.htm (visited Jan 23, 2007).

ties is likely to go down over time, implying that there is an "own in-terest rate."[51] Second, there is the issue of noncompensation. This argument does not distinguish opportunity costs from discounting more generally. The arguments about the need for compensation and the likelihood of providing compensation were discussed above. It is our view that for large-scale projects, compensation can be provided, at least for within-country effects.

Third, Parfit argues that, in some time periods, there will be no opportunity costs because investment will bring no return. While this is possible, it is a technical economics question to estimate the likely opportunity costs, not an ethical question about whether discounting is appropriate in the presence of those costs.[52]

Finally, Parfit argues that the rhetoric of discounting is inappropriate and that a project's costs and benefits should be expressed in a "more temporally neutral way."[53] This same idea is echoed by Lisa Heinzerling and Richard Revesz.[54] For example, Heinzerling objects to the language of opportunity costs and future values because it "elides . . . moral issues."[55] Revesz claims that discounting the utilities of future generations is the objective function of a specific ethical theory while "paying attention to opportunity costs does not imply the choice of any particular theory."[56] We fail to see how one mathematical procedure can present different moral issues than another identical mathematical procedure. If the issue is about presenting information to decisionmakers or the public in a way that helps inform them, we are in favor of such a presentation, but nothing in these discussions makes a serious case that one form of presentation is better in this regard than another. Our intuition is that discounting is likely to be more informa-

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[51]   Broome, 23 Phil & Pub Aff at 149–50 (cited in note 48) (observing that the medical costs of saving a life are decreasing).

[52]   See Cowen and Parfit, *Against the Social Discount Rate* at 151 (cited in note 2) (arguing that opportunity costs cannot be used to justify the use of a discount rate because the marginal productivity of capital depends on other social decisions, most notably, the savings rate). Within this analysis, however, the distribution of wealth across generations is held constant when making project choices. Project choice, therefore, will not affect the discount rate, at least in any direct way. See Louis Kaplow, *Discounting Dollars, Discounting Lives: Intergenerational Distributive Justice and Efficiency*, 74 U Chi L Rev 79, 111–12 (2007) (explaining that when intergenerational wealth distribution is held constant the market interest rate, and hence the discount rate, would also be constant and the choice of projects should be made solely on the grounds of efficiency).

[53]   Parfit, *Reasons and Persons* at 484 (cited in note 5).

[54]   Heinzerling, 108 Yale L J at 1911 (cited in note 9) (arguing that resolutions to questions of environmental law "do not turn on financial rates of return, and resort to such figures will obscure rather than illuminate the relevant concerns"); Revesz, 99 Colum L Rev at 1008 (cited in note 5).

[55]   Heinzerling, 108 Yale L J at 1911 (cited in note 9).

[56]   Revesz, 99 Colum L Rev at 1008 (cited in note 5).

tive because it presents all information using current dollars, which policymakers can easily understand.

In sum, the only merit to the position that discounting and taking opportunity costs into account are not the same is with respect to reasons for discounting unrelated to the productivity of capital, such as impatience. Claims that taking opportunity costs into account is different from discounting are erroneous.

IV. ADDITIONAL ISSUES

There is a large technical literature on determining the correct discount rate. Issues arise such as wedges between the return to consumption and the return to investment, adjusting for risk, and estimating future productivity.[57] Martin Weitzman, for example, presents arguments for a low discount rate based on how one aggregates the probabilities of various discount rates in the future.[58] These arguments are very important—changing the discount rate even a small amount can change whether many projects pass cost-benefit analysis. Nevertheless, they are technical in nature—they do not have to do with the propriety of discounting.

Another issue is whether it is appropriate to discount life. Many commentators object to discounting life but not money.[59] As should be apparent from the discussion so far, we do not believe that discounting for opportunity costs involves discounting future lives. Future lives are weighed equally to current lives and a loss of a future life reduces social welfare just like loss of a current life. What we propose to discount is expenditures and receipts, or in the case of projects that directly affect utility without market intermediation, their monetary equivalents.[60]

Another common argument is that discounting is inappropriate when there are significant irreversibilities, such as in the case of global warming or extinction of a species. The right approach to irreversibilities, however, is not to refuse to discount. Instead, it is to use real op-

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[57]   See Richard W. Tresch, *Public Finance: A Normative Theory* 733–56 (Academic 2d ed 2002) (summarizing challenges to finding the right discount rate).

[58]   Martin L. Weitzman, *Gamma Discounting*, 91 Am Econ Rev 260, 261 (2001) (utilizing the survey responses of over two thousand economists to construct a sliding-scale discount rate that decreases drastically the farther into the future costs and benefits are projected).

[59]   See Revesz, 99 Colum L Rev at 1008–09 (cited in note 5) (distinguishing between discounting future generations' utility and accepting the growth of capital). See also Heinzerling, 108 Yale L J at 1913 (cited in note 9) (arguing that because life is nonfungible it does not "compound the way money does" and hence is not subject to discounting).

[60]   See Sunstein and Rowell, *On Discounting Regulatory Benefits*, 74 U Chi L Rev at 182–83 (cited in note 28) (emphasizing that administrative agencies deciding whether and how to deploy welfare enhancing resources are informed by willingness to pay measures, which are inherently in dollar units).

tion theory.[61] This theory takes into account the problem of lost opportunities, or sunk investments. It also fully incorporates discounting (necessarily so because it is attempting to model when to incur an irreversible cost). Although we must be cautious about irreversible actions, refusing to discount is unlikely to get the right result.

Finally, we should say a word about rhetoric. Because of the power of discounting it is easy to come up with rhetorical quips that make discounting seem unattractive. Frank Ackerman and Lisa Heinzerling object that with "a discount rate of five percent, for example, the death of a billion people 500 years from now becomes less serious than the death of one person today."[62] As noted, our favorite is Cowen and Parfit's statement: "Imagine finding out that you, having just reached your twenty-first birthday, must soon die of cancer because one evening Cleopatra wanted an extra helping of dessert."[63]

Many of the claims comparing stubbing one's toe to blowing up the world implicitly depend on discount rates over long periods of time that are far higher than possible. If the discount rate used is greater than the long-run growth rate of the economy, a project of any size will, with sufficient time, be worth more than all the wealth in the world, an obvious contradiction (the project would be part of the world so it could not be worth more than the world). Under the argument we make here, long-run discount rates should instead be limited to expected long-run economic growth because this is the true opportunity cost.[64] With more appropriate discount rates, current costs will not grow to implausible sizes in the long-run future. If a cost is, say, 1 percent of the current economy, discounting will keep it at 1 percent of the future economy. Stubbing one's toe remains stubbing one's toe.

Moreover, what these quips miss is that discounting provides for Pareto superior outcomes. Failure to make decisions following discounted cost-benefit analysis means throwing resources away to nobody's benefit. For example, the reverse of Cowen and Parfit's problem arises if one looks forward rather than backwards. Suppose that you are going to spend a dollar today. That dollar will grow to a billion, a trillion, or more dollars with enough time. Spending that dollar today means taking that money from the future. To paraphrase Cowen

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61   For an accessible explanation of real option theory, see generally Avinash K. Dixit and Robert S. Pindyck, *Investment Under Uncertainty* (Princeton 1994).

62   Ackerman and Heinzerling, 150 U Pa L Rev at 1571 (cited in note 3).

63   Cowen and Parfit, *Against the Social Discount Rate* at 145 (cited in note 2).

64   This is the approach adopted in Rabl, 17 Ecol Econ at 139 (cited in note 27) (explaining that the conventional social discount rate treats the time-preference component of the discount rate as if it represented creation of wealth rather than only redistribution, and therefore, that only the growth component of the discount rate is relevant to a cost-benefit analysis).

and Parfit, every time you eat a banana, you condemn a million people in the future to death.

CONCLUSION

We conclude that discounting by the opportunity cost of capital is generally appropriate and Pareto dominates any other decision procedure. The most difficult case is where a project transfers significant amounts to or from future foreigners and where it is difficult to make those transfers or offsetting transfers in any other way.