

2005

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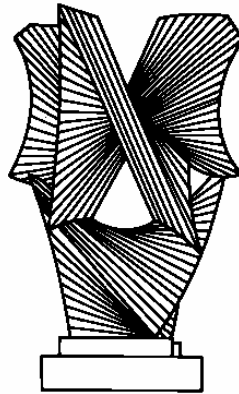
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David A. Weisbach & Dexter Samida, "Paretian Intergenerational Discounting" (John M. Olin Program in Law and Economics Working Paper No. 255, 2005).

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CHICAGO

JOHN M. OLIN LAW & ECONOMICS WORKING PAPER NO. 255
(2D SERIES)



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**THE LAW SCHOOL
THE UNIVERSITY OF CHICAGO**

August 2005

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Paretian Intergenerational Discounting

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August 15, 2005

Abstract

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 under-value future generations.

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Paretian Intergenerational Discounting

Dexter Samida and David Weisbach***

August 15, 2005

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 wastes, 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 out

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¹Consider the following example, [cite]. 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% and 200 years, saving a billions of in the future is worth sacrificing only thousands of lives today.

that you, having just reached your twenty-first birthday, must soon die of cancer because one evening Cleopatra wanted an extra helping of dessert.” Cowen and Parfit [1992; 145] 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. Ackerman and Heinzerling [2002; 1571] compare the death of a billion people in 500 years to the death of a single person today. Heal [1998; 13] compares the world GNP in two hundred years to the price of a used car today and, based on the implausibility of this comparison, develops book-length formalization of the theory of sustainable development.² These types of comparisons create unease with discounting even among economists. [Portney and Weyant 1999; 5]

The intuitions driven by 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 does not seem to have been fully appreciated or has been subject to incorrect criticisms. 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.³

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

²For a similar formal theory based on the intuition that discounting is inappropriate, see Chichilnisky [1996].

³See., e.g., Parfit [1984]; Cowen [1992]; Revesz [1999].

consider distributional issues, regardless of how egalitarian the decision maker. 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. For example, see Revesz [1999; ___] 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.⁴

Section 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. Section I discusses this approach. Section 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. Section III considers the major objections to the Pareto argument. In particular, Section III considers the problem of the difficulty of making intergenerational transfers, such as when there are intervening generations and considers whether considerations of opportunity costs are distinct from discounting. Section IV briefly considers additional issues, including the use of rhetoric in discounting arguments.

⁴The 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.

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 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 (i.e., 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 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 the 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 as long as three or four hundred years ago. Discounting can have an enormous impact on the size of reparations claim.

The project will either pass or fail discounted cost benefit analysis. By this we mean that the marginal costs are either less than or exceed the marginal benefits when all costs and all benefits are discounted (by an appropriate discount rate, discussed later) 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.⁵ 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 Section III 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. Adler and Posner [2000]; Heinzerling, [1999; 69-71]; Ackerman and Heinzerling [2002; 1563-1570.] While these issues are important, they are not central to the underlying ethical issue of whether discounting is appropriate. We also assume that the value of life (and non-life harms) is properly measured, and that life, risks to life, and enjoyment of life can be measured in money. Posner and Sunstein [2005] 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 for projects that have immediate effects.⁶

⁵For example, suppose that the harm to each slave was \$1,000 at the time and the harms occurred 250 years ago. With no discounting, reparations would be \$1,000 per harm. With discounting, at a 5% rate, reparations would be almost \$200 million per harm.

⁶Many counter-arguments to discounting rely on an intuition that the value of life cannot be measured. They compare spending money to the certain loss of life. See., e.g., Cowen and Parfit [1992] 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 can create erroneous conclusions regarding either one of the issues.

More generally, we will not discuss here whether cost benefit analysis is appropriate for projects that have only current costs and benefits.⁷ 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.⁸ 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.⁹

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

⁷There is an extensive literature on this topic. For an overview, see, *The Journal of Legal Studies* Volume 29 (2000).

⁸See e.g., Heinzerling [1998]; Ackerman and Heinzerling [2002]; McGarity and Shapiro [1996].

⁹In 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 lawyers such as Revesz [1999] and of the many economists who reject pure discounting such as Lind [1999], Cowen [1992], and Heal [1998]. Many discussions rejecting discounting, particularly in the legal literature, are found in broader analyses of cost benefit analysis and it is not clear whether the authors view the subjects as distinct. See, e.g., Ackerman and Heinzerling [2002; 1570-73]; McGarity and Shapiro [1996; 630].

generation. Moreover, each generation is, to a large extent, in charge of redistribution within that generation, perhaps favoring extensive redistribution, perhaps not. Given each generation more total resources makes whatever distributive decisions that want 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 with 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 [1995] noted that the costs and benefits of long term projects are imposed on different individuals whose lives may be largely unconnected. For example, global warming abatement is likely to impose costs on the United States and create benefits for future generations of Indians, Chinese, and Bangladeshis. Similarly, using up resources today may transfer resources in the opposite direction, taking resources from those future foreigners and transferring it to today's Americans.¹⁰ 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 [1995] argued, global warming abatement is as much a foreign aid problem as an environmental problem.

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 who is in the social

¹⁰The whole notion of taking from one and giving to another requires a set of baseline entitlements which, 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.

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 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. Kopczuk, Slemrod and Yitzhaki [2005] 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.¹¹

In this paper, we will weigh 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 well-being.¹² We choose to weigh future lives equally because many of the discussions of discounting implicitly use this premise. Thus, as Fuchs and Zeckhauser [1987; 265] note, “[m]ost policy planning discussions assume full altruism

¹¹The same is true with respect to studies showing hyperbolic or other forms of irrational discounting of the future. Cropper and Laibson [1999]. Such studies do not show anything about ethical behavior toward the future.

¹²Many of the arguments against discounting use the rhetoric of “discounting lives.” Heinzerling, [1999]. It seems, on its face, unethical to discount the life of some individual. Although this is a nice rhetorical trick, akin to relabeling the estate tax the death tax, it is not clear what it means. Advocates using this rhetoric would likely accuse us of discounting lives but our social welfare function weights future lives equally to current lives and future increases in welfare count exactly the same way current increases in welfare count. No life is being discounted.

– future citizens are given equal weight with present citizens.” 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 weighing individuals in a social welfare function equally 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.¹³ The reason is not unequal weighting. Instead, it is that overall social welfare may increase with such a transfer.¹⁴

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,

¹³The 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. [Atkinson and Stiglitz 1980; 354]

¹⁴While we do not address the appropriate degree of convexity of the social welfare function, note that there are arguments that convexity should be increase (possibly to infinity) if outcomes are uncertain (as opposed to merely risky in the Knightian sense). [Arrow 196_, others] Although we are not sure we believe that there Knightian uncertainty is a meaningful category, to the extent it is, very long-term projects of the type considered here are the most likely candidate. Because our arguments below are based on the Pareto criteria, we need not address this issue and, therefore, ignore problems created by Knightian uncertainty.

increments to well being are counted the same for current and future generations. Nevertheless, this does not mean that costs and benefits should not be discounted. Consider the principle example used by Revesz. Revesz [1999; 998]. 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. He assumes no productivity, which at least potentially translates into a zero discount rate, but suppose either that there is productive activity or there is otherwise an opportunity cost of funds, and that the discount rate is 3%.

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.¹⁵

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% for the first 50

¹⁵We 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. Revesz [1999; 1007-1009]. 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, had the potential to confuse.

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 consumption (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.¹⁶

Much of the literature confounds these two topics, discounting individuals' lives and discounting costs and benefits, if not technically, at least rhetorically. For example, Cowen [1992] argues, using an axiomatic approach, that consequentialism implies a zero rate of intergenerational discount. 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 have 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.

¹⁶There are a variety of ways we can view equality and the question "equality of what?" is important. See Sen [1992; 12-30]. We do not think, however, that Revesz's version of equality, equality of initial allocations, is a plausible version of equality.

II. Discounted cost benefit analysis Pareto dominants any other decision criteria

In this section, 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 the underlying assumptions. As noted, the arguments made here are purely arguments about opportunity costs. In the next section we discuss whether and the extent to which 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, 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 to save \$100 million in one hundred years. If the discount rate is more than (roughly) five percent, this project fails discounted cost benefit analysis because the present value of the \$100 million benefit is less than the \$1 million cost.

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 case 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. Rabl [1996] makes a similar argument about the desires of future generations.

The other case is projects that pass discounted cost benefit analysis but the proposed decision criteria would recommend rejecting them. This might be the case because the project 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 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 that 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 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 and without a background set of rights and responsibilities, there cannot easily be a bargain.¹⁷ 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.¹⁸ 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

¹⁷See Sunstein and Rowell [2005; 16]. This is not necessarily the case. Individuals frequently bargain successfully in the presence of great uncertainty about their underlying rights and responsibilities.

¹⁸Although 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.

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 expected to be poor, and that, relative to the status quo, the project transfers \$100 to the current generation at the expense of \$90 to the future. 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 Atkinson and Stiglitz [1976]. 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.¹⁹

¹⁹Legal readers are likely to know this theorem from the arguments about the desired efficiency of legal rules. Shavell [1981]; Kaplow and Shavell [1994]. The tax version of this argument has been extensively discussed in the literature. See Deaton [1981]; Stiglitz [1987]; Saez [2002]; Kaplow [2004]. The application to cost benefit analysis was first suggested by Hylland and Zeckhauser [1979]. Kaplow [1996] considers the application to public goods.

These extensions show that cost benefit analysis should not, under the conditions of the theorem, be adjusted for distributional considerations, regardless of how egalitarian we are. Hylland and Zeckhauser [1979]. Similarly, the government should purchase public goods without regard to the tax cost of financing them. Kaplow [1996].

We can use the same example used above to illustrate the argument.²⁰ 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.²¹ The

²⁰The version of the argument here is due to an interpretation of the Atkinson Stiglitz 1976 result originally by Hylland and Zeckhauser [1979] and treated extensively in Kaplow and Shavell [1994]; Kaplow [1996], and Kaplow [2004].

²¹Sophisticated 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 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. For a discussion, see Weisbach and Bankman, [2005].

conclusion is that *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, 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.²²

II. Counter-arguments

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 counter-arguments to the Pareto dominance argument is that intervening generations may abscond with any

²²There is a subtlety. In Hylland and Zeckhauser [1979] or particularly Kaplow [2004], the tax adjustment offsets the public good, excise tax, project or the like. The tax will have an affect on the margin but this is offset by the benefit (or cost) of the project on the margin. 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 the like and the same goes for the benefit of the project.

savings that we intended to leave for distant future generations.²³ Lind [1999; 174-175] is a particularly emphatically stated version. He argues:

[I]ntergenerational transfers, either forward or backward, generally must be made through series of intervening generations. Designing and implementing such 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.

Lind goes on to dramatize the point by hypothesizing a proposal to transfer resources to the future through an investment with a zero percent rate of return (at a time when money or other projects earn a 10% return). Lind [1999; 176] argues

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 investment and reinvesting those funds for eventual delivery as consumer goods to the generation 200 years from now.

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 pick the project with the highest rate of return.

²³See, e.g., Sunstein and Rowell; draft at 14 for a version of this argument.

For example, suppose we are considering conserving petroleum for use in 200 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 to interfere with some transfers 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 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 present any general theory.²⁴

Moreover, it is not clear that tying the hands of intervening generations would be wise. We can imagine that intervening generations are more, equal to, or less altruistic to the future than we are. If they more than or equal to the current generation, Lind’s argument presents no issue. If they are less altruistic, we would have to ask why. It could be the case

²⁴Arrow [1999; 18] makes a similar point.

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 renegeing and the wise generation from improving. Thus, even if we could establish, on a project by project basis which ones are less subject to renegeing, 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/Stiglitz tax argument when applied to projects is that the scope of most projects is too narrow (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 benefitting those rich who happen to use it as their commuting route. Broad based tax adjustments will not be able to tax those particular rich and benefit those particular poor 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 intergenerational equity is not usually concerned with these intragenerational 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 [2000] argue that an agency deciding whether to pursue a project does not have the choice of making offsetting tax adjustments. 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 sort 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 it assumes 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 200 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 200 years and we believe that individuals in 200 years 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 Chinese. 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 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 [1995] that most long-term projects are really foreign aid projects.

As noted, foreigners are barely weighted in a derived U.S. social welfare function. Kopczuk, Slemrod, and Yitzhaki [2005]. 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 State \$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 we would never transfer the \$90, for either good or bad reasons. It makes no sense, in such a case, to spend \$100 to transfer the \$90. 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 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 would 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. Others have argued that it is not appropriate to take opportunity costs into account. We consider these arguments in this section.

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 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. Rabl [1996] for example, argues on these grounds for a long-term discount rate that reflects the expected growth in the economy than recently observed interest rates. Weitzman [2001] makes a similar argument.

Parfit [1984; 483] gives four reasons why the existence of opportunity costs does not support discounting. 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 10 years of \$100, the individual would accept less than \$100 today to give up the enjoyment of the countryside in 10 years. There is no difference between consumption items that are consumed and those that are reinvested.

Broome [1994; 148] draws a conclusion similar to Parfit's from the same example, although for different reasons. 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 today 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." Broome [1994; 148] If the value of a commodity will remain the same through time, it should not be discounted.

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 determine a commodity's own rate of interest) or determining future prices and discounting, if the net effect is the same? In a technical sense 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 and it is important to realize that they are not inconsistent with discounting.²⁵

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 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 of or cure for deformities is likely to go down over time, implying that there is an "own interest rate." Broome [1994; 149-150] Second, there is the issue of non-compensation. 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

²⁵Moreover, 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 30 years without apparent resolution. Even if one disagrees with Simon, and many do, at a minimum Simon 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 example. 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 farms. Data show that the amount of non-urban, non-farm land in the continental U.S. has increased in the last half century. Since 1945, urban areas have grown by roughly 69 thousand square miles. Since 1950, farmland has decreased by almost 360,000 square miles. See <http://www.demographia.com/db-1945uza.htm> and <http://www.usda.gov/nass/pubs/trends/farmnumberslandsizes.csv>

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.²⁶

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." Parfit [1984; 484]. This same idea is echoed in Heinzerling [1999; ___] and Revesz [1999; 1008] For example, Heinzerling prefers the language of opportunity costs and future values because it "elides normative issues." 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." 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 decision makers 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 informative 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.

²⁶Cowen and Parfit (1992) argue that the discount rate is a choice variable in the decision because it depends on the extent of savings. Suppose that we decide to pass more on to future generations by saving more. If the marginal product of capital is declining, this will reduce the discount rate. They conclude that this means that we should not discount future prices to the present when making decisions. We agree with Broome's [1994; 140] explanation of why this is not the case.

III. 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. For example, Weitzman [2001] presents arguments for a low discount rate based on how one aggregates the probabilities of various discount rates in the future. For a summary, see Tresch [2002; 733-756]. 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. Revesz [[1999, __]; Heinzerling [date]. 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, the monetary equivalents. As Sunstein and Rowell [2005] emphasize, harms to lives, whether present or future, can be and should be thought of in monetary terms.

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 option theory. This theory takes into account the problem with 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. Ackerman and 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.” Ackerman and Heinzerling [2002; 1571]. As noted, our favorite is Cowen and Parfit’s [1992; 145] 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.”

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 the expected long-run economic growth because this is the true opportunity cost. For a similar argument, see Rabl [1996]. With this more appropriate discount rates, current costs will not grow to implausible sizes in the long-run future. If a cost is, say, 1% of the current economy, discounting will keep it at 1% 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 Cowen and Parfit [1992] 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 and Parfit, every time you eat a banana, you condemn a million people in the future to death.

IV. 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 make those transfers or offsetting transfers in any other way.

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