

Discounting while treating generations equally

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Abstract

This chapter asks whether social discounting is compatible with equal treatment of generations. It presents the rank-discounted utilitarian criterion, proposed by Stéphane Zuber and analyzed in Zuber and Asheim (2010), where priority for the worse off is not only due to their absolute well-being but also their rank in well-being. The consequences and relevance of this criterion in the context of climate change are discussed.

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1 Introduction

Anthropogenic emissions of CO₂ and other greenhouse gases – having the potential for leading to serious and long-lasting climate change – have spurred an interest in the notion of intergenerational equity. Should we incur abatement costs today in order to reduce the risk of serious and irreversible changes in future living conditions? This question is complex because present carbon emissions cause a global and enduring increase in atmospheric CO₂ concentration. Therefore, releasing carbon has a negligible effect for the emitter but a non-negligible aggregate effect for others; in economic terminology, the effect is *external*. In particular, we have to differentiate between what our generation as a collective should do – as an ethical question – to serve the interests of all generations from an impartial perspective, and what countries or individuals should do – as a strategic question – to serve their own interests when such actions influence the future strategic actions of other countries and individuals.

In 2005 Thomas C. Schelling received the Bank of Sweden Prize in Economic Sciences in Memory of Alfred Nobel for having enhanced our understanding of conflict and cooperation. In *The Strategy of Conflict* (Schelling, 1960) and other writings he has investigated conflict, commitment and coordination, with particular application to the post WW2 arms race. This analysis is also applicable to the positive-sum game that climate change constitutes: by cooperating, we can all gain. Since taking part in the first big National Academy of Science study on climate change nearly 30 years ago, Schelling has also explicitly studied the challenges of anthropogenic carbon emissions. In his writings on climate change (in particular, Schelling, 1995), he has argued against ‘time discounting’ of future generations’ well-being solely on account of their location in time, but remained open for the possibility that the well-being of people that are separated from us by geographical distance and time may be ‘depreciated’ because they are ‘far away’.

In this chapter I will argue that Schelling’s ‘depreciation’ of the well-being of people that are far from us is relevant in evaluating the different strategies that countries and individuals may adopt. However, in my view, it is not appropriate in a purely ethical analysis that abstracts from all aspects of the distributional problem but the choice between consequences in terms of well-being for the present and future generations. I will still maintain that social discounting of future generations’ well-being can be justified on other grounds, even from an ethical perspective.

In Section 2 I start by introducing the concepts of fair and equal treatment in the

context of climate change. In the following Sections 3 and 4 I consider how an axiomatically based criterion for intergenerational equity – *rank-discounted utilitarianism* recently proposed by Stéphane Zuber and analyzed in a joint paper (Zuber and Asheim, 2010) – where generations are treated equally can comprise both absolute and relative prioritarianism for the worse off. In Sections 5 and 6 I indicate how rank-discounted utilitarianism can be generalized to capture population growth and uncertainty and discuss its consequences and relevance. In Section 7 I present concluding remarks.

2 Waste and inequity of climate change

Because the effects of greenhouse gas emissions are external to the emitters, unregulated emissions of such gases lead to waste in an economic sense. By abating our emissions, and also reducing our investments in reproducible capital, it is in principle possible to make both the present and future generations better off. While present abatement costs are increased, we gain by consuming more of the goods and services that we produce. We leave a better climate to our descendants and this more than compensates for the reduced amount of knowledge and physical capital that we leave behind for them. Some writers (Foley, 2008; Broome, 2010) have emphasized that one might think of climate change as a problem of economic waste rather than as a problem of intergenerational distribution.

This is in line with the arguments of Coase (1960), who pointed out that the economic waste problem that external effects represent can be solved through negotiations by giving the parties well-defined rights (e.g., rights for the present to emit greenhouse gases, or alternatively, rights for the future to inherit an unchanged climate), provided that there are no transaction costs preventing the attainment of a bargain that eliminates the economic waste. This is the so-called the “Coase theorem”, which unfortunately has limited relevance for the problem of climate change. As the Kyoto-process illustrates, not even people living today can agree on a non-wasteful policy for greenhouse gas emissions. It is even harder to contemplate efficient negotiations with future generations that are not alive today.

Moreover, even if one accepts the separation of the problem of reducing economic waste – by making emitters responsible for the future effects of their present emissions – from the problem of distribution, one must still face the problem of assigning rights to people living at different geographical locations and at different points in time.

The implemented distribution is a consequence of uneven prior development in

different parts of the world and the asymmetry of generations along the time axis. This leads to large geographical differences in well-being, which might however be mitigated by the concern that people in rich countries feel for the less fortunate. Along the time axis people living today are in complete control of the present management of manmade and natural assets. Our provision for future generations is to a large extent the byproduct of assets accumulated for the purpose of contributing to a good life for ourselves and our immediate descendants.

Many will argue that the implicit rights determined by the distribution that will actually be implemented do not correspond to a fair distribution from an impartial point of view. Rather, the real-world distribution is a consequence of the political and economic realities that determine economic and social conditions in different parts of the world and for future generations.

A fair treatment of people living at different geographical locations and at different points in time depends among other things on their entitlements and the chosen procedures for redistribution. It may be reasonable to argue that prior accumulation of assets provides the owners entitlements to the future yields of such assets. Likewise, prior injustice with long-lasting effects (like the slave trade and its effect on social capital in the affected parts of Africa, see Nunn and Wantchekon, 2009) or prior unequal depletion of a scarce resource (like the atmosphere's capacity to absorb CO₂ without leading to climate change) may be used as arguments for special entitlements for certain parts of the world. Procedural issues may include infringements of civil liberties.

What if we abstract from entitlements and procedures and are purely concerned with consequences? In this consequentialist setting, fair treatment is reduced to equal treatment of people independently of their geographical location and to which generation they belong.

In my own research on intertemporal social choice I have been concerned with an even more abstract setting, where non-overlapping generations follow each other in sequence and differ only by their location in time. In particular, I have assumed that population size is given and constant over time, and that there is an infinite but countable number of future generations that will exist with certainty. The assumption of an infinite number of generations is meant to capture that there are many people that may potentially live in the future.

What does it mean to treat generations equally in such a setting? Does equal treatment rule out social discounting? I turn to these questions next. The relevance of considering intergenerational equity in this setting will be discussed later.

3 Absolute prioritarianism only

Consider a setting where there is an infinite but countable number of generations which follow each other in sequence. To each generation is assigned a level of generational well-being which indicates the situation under which people within this generation live. (In Asheim, 2010, Section 2.2, I provide a short discussion of in what sense I use the terms ‘generational well-being’ and, below, ‘utility’.) Hence, future development is given by an infinite stream of well-being. The literature on axiomatic social choice raises the following normative question: how should different streams of well-being be ranked from a social point of view, taking into account the interests of all generations?

Much of the literature on intertemporal social choice has been concerned with the conflict between sensitivity and equal treatment. A ranking of infinite well-being streams satisfies the axiom of Strong Pareto if it deems one well-being stream superior to another if at least one generation is better off and no generation is worse off. This axiom captures efficiency concerns and ensures that social evaluation is sensitive to an increase in well-being for any one generation.

A ranking of infinite well-being streams satisfies the axiom of Strong Anonymity if it leaves the social valuation of a well-being stream unchanged when the locations of well-being are reordered. This axiom applies to a consequentialist setting where there is no uncertainty about the existence of future generations. In this setting it is a basic procedural equity norm ensuring equal treatment of all generations. Invoking impartiality in this way is the cornerstone of ethical social choice theory reaching far beyond comparisons of infinite streams (see, e.g., Sen, 1970, Ch. 5; Hammond, 1976; d’Aspremont and Gevers, 1977; Roemer, 1996, p. 32; Mongin and d’Aspremont, 1998).

Unfortunately, as pointed out by Van Liedekerke and Lauwers (1997), there exists no ranking of infinite well-being streams satisfying sensitivity and equal treatment as captured by the axioms of Strong Pareto and Strong Anonymity. To see this, consider the following two streams:

$$\begin{array}{cccccccccc} 1 & 0 & 1 & 0 & 1 & 0 & \dots & 1 & 0 & \dots \\ 0 & 0 & 1 & 0 & 1 & 0 & \dots & 1 & 0 & \dots \end{array}$$

It is easily seen that one can go from the first to second by reordering the locations (by moving location 2 to location 1, all other even locations two periods backwards, and all odd locations two periods forwards); hence, by Strong Anonymity they are equally good. However, the first dominates the second, so by Strong Pareto, it is strictly

better. The resulting contradiction shows that Strong Anonymity and Strong Pareto are incompatible.

This poses a dilemma. One possibility is to weaken equal treatment to a finite version of anonymity, whereby only a finite number of locations are reordered, as suggested by Diamond (1965). However, it can be shown that even this weaker kind of equal treatment rules out an explicitly described social ranking when combined with Strong Pareto (Basu and Mitra, 2003; Lauwers, 2010; Zame, 2007). If one insists on keeping the axiom of Strong Pareto as a requirement of sensitivity, one possibility is to drop equal treatment altogether. This can be used as an argument for discounting future generations due to their location in time, as in discounted utilitarianism (Koopmans, 1960). However, another possibility is to stick with Strong Anonymity as a demanding requirement of equal treatment, and instead weaken sensitivity. This is the route I will investigate below.

In a purely consequentialist setting where the well-being of different generations are comparable, equal treatment of generations is compatible with letting the weights assigned to different generations' marginal well-being depend on their absolute level of well-being and vary according to their relative rank in well-being.

The undiscounted utilitarian approach allows the weights assigned to different generations' marginal well-being to depend on their absolute well-being only. In this approach, the weight on the marginal well-being of generation t is proportional to $U'(x_t)$, where x_t denotes generation t 's well-being and where U' is the derivative of an increasing utility function U that maps x_t into generation t 's utility $U(x_t)$. If we associate well-being x with a comprehensive measure of consumption, and assume that unequal distribution of consumption is deemed undesirable in social evaluation, then such inequality aversion can be captured within the undiscounted utilitarian approach by letting U be a strictly concave function of x . This implies that U' is a decreasing function of x , thereby giving more weight to the marginal well-being of worse off generations.

In applications, U is often taken to be of the form $U(x) = x^{1-\eta}/(1-\eta)$ (if $\eta > 0$ satisfies $\eta \neq 1$ and $U(x) = \ln x$ otherwise) so that the weight is a decreasing function of absolute well-being: $U'(x) = x^{-\eta}$. Here, the parameter η captures inequality aversion.

In the undiscounted utilitarian approach, the weights assigned to marginal well-being do not depend on how the generations rank, implying equal weight to different generations's marginal *utility*. In a situation with n different generations, with n being a positive and finite integer, one can simply give the weight $1/n$ to marginal utility independently of rank, leading to a weight of $U'(x_t)/n$ to generation t 's marginal well-

being. If U is strictly concave (corresponding to a positive η when $U'(x) = x^{-\eta}$), then greater weight is assigned to the marginal well-being of less fortunate generations. This can be called *absolute prioritarianism* (see, e.g., Fleurbaey, 2001, p. 4, who distinguishes an “absolute” Priority View from a “relative” one). In my context, Parfit’s (1997) support for prioritarianism as an alternative to utilitarianism should be interpreted as being opposed to simply adding well-being (or equivalently, letting $U(x) = x$).

However, with an infinite but countable number of generations, this approach fails. If weights do not depend on rank, then the weight assigned to any one generation’s marginal utility, relative to the sum of the weights given to all other generations’ marginal utility, is zero. This implies that undiscounted utilitarian criterion leads to questionable distributional consequences, even under the special circumstances where it can be applied to the infinite case. Mirrlees (1967) computed optimal intertemporal well-being patterns in plausible economic models under undiscounted utilitarianism. He observed that present generations should save up to 50 % of their net income for the sake of future generations (see also Dasgupta, 2008, Section 3.2). On the basis of such findings, Rawls (1999, p. 262) reluctantly pointed out that “[t]his consequence can be to some degree corrected by discounting the welfare of those living in the future”, and Arrow (1999, p. 16) concluded that “the strong ethical requirement that all generations be treated alike, itself reasonable, contradicts a very strong intuition that it is not morally acceptable to demand excessively high savings rates of any one generation, or even of every generation”.

To discount future generations’ marginal utility due to the location in time would contradict equal treatment. A distributional justification for discounted utilitarianism, like the one indicated in the previous paragraph (and I should add, not endorsed by Rawls, 1999, p. 262, as its failure to comply with procedural equity “has no intrinsic ethical appeal”), critically relies on the assumption that future generations are better off in the implemented intergenerational allocation. However, as demonstrated by Dasgupta and Heal (1979, Chapter 10), in certain technological contexts like the Dasgupta-Heal-Solow model of capital accumulation and resource depletion, discounted utilitarianism implies that generations in the distant future will be *worse* off than the present (see also Asheim and Buchholz, 2003, Section V). This illustrates the possibility that generations’ sequencing in time under discounted utilitarianism may not correspond to their rank in well-being, thereby undermining the argument that time discounting of utility can be used to prevent high sacrifices for the sake of others that are better off.

4 Adding relative prioritarianism

Interpreting utility discounting as a means of preventing high sacrifices from the poor is closely related to the social weights used in rank-dependent measures of social welfare. An example of a rank-dependent criterion is the Gini social welfare function. Generalizations thereof have been proposed by Weymark (1981) and Ebert (1988). The main feature of rank-dependent social welfare functions is that they put more weight on the marginal utility of the worse off. Employing such rank-dependent weights may be referred to as *relative prioritarianism*, although it seems like most writers on prioritarianism (including Parfit, 1997, p. 214) “are keen on insisting on a non-relative definition of ‘worse off’” (Fleurbaey, 2001, p. 4); see also Tungodden (2003).

Recently, Stéphane Zuber has proposed to apply rank-dependent methods to inter-generational equity. The suggestion (which is analyzed in greater detail in Zuber and Asheim, 2010) is to evaluate infinite well-being streams according to a rank-discounted utilitarian social welfare function:

$$\delta \cdot \sum_{r=1}^{\infty} \frac{1}{(1 + \delta)^r} U(x_{[r]}).$$

Here, $\delta > 0$ is a utility discount rate and the well-being stream $(x_{[1]}, x_{[2]}, \dots, x_{[r]}, \dots)$ is a reordering of the well-being stream $(x_1, x_2, \dots, x_t, \dots)$ such that $x_{[1]} \leq x_{[2]} \leq \dots \leq x_{[r]} \leq \dots$. Note that r refers to the rank of generation $[r]$. The reason for multiplying the expression by δ is to ensure that the rank-dependent weights assigned to the generations’ marginal utility sum up to 1.

However, an obstacle to applying rank-discounted utilitarianism in the context of infinite well-being streams is that well-being streams where some generations have infinite ranks cannot be reordered into a non-decreasing stream. The stream

$$1 \quad 0 \quad 0 \quad 0 \quad \dots \quad 0 \quad 0 \quad \dots$$

is one example, where the first location with well-being 1 will end up at some finite location in any reordered stream. We resolve this problem by showing how the rank-discounted utilitarian approach can be extended in a natural manner to the full domain by including also well-being streams that cannot be reordered into non-decreasing streams. In fact, this resolution follows by first restricting to the set of non-decreasing streams the axioms used by Koopmans (1960) in his derivation of discounted utilitarianism and then adding Strong Anonymity as a axiom of equal treatment. This kind of extended rank-discounted utilitarianism entails sensitivity to the marginal utility of a

generation only if the generation has finite rank. Strong Pareto is not satisfied as there is no sensitivity to the marginal utility of generations with infinite rank; this weakening of sensitivity allows even the strongest form of equal treatment to be imposed.

In our paper we explore the implications of rank-discounted utilitarianism. Even though rank-discounted utilitarianism satisfies equal treatment as captured by Strong Anonymity and is responsive to the interests of future generations, it is still behaviorally indistinguishable from discounted utilitarianism in important circumstances (like the Ramsey model with high productivity) and can be used to support the ethical judgement on utility discounting made by economists in such settings. However, rank-discounted utilitarianism leads to different implications than discounted utilitarianism if climate change breaks the correlation between time and well-being.

The highly publicized debates on discounting in the context of climate change have highlighted its importance for policy evaluation. An ‘ethical’ view has suggested low values for the utility discount rate, on the ground that pure time-discounting violates equal treatment. Rank-discounted utilitarianism suggests an alternative ‘ethical’ view where utility discounting is an added expression of aversion to inequality from an impartial perspective. Indeed, in Zuber and Asheim (2010, Section 4.2) we define comparative inequality aversion and prove that a more inequality averse social evaluation always discount the future more, *provided that future generations are better off*.

If future generations will be better off in spite of climate change, then a more inequality averse extended rank-discounted utilitarian social observer will agree with the recommendation of Nordhaus (2008) to have gradual emission control policies rather than that of Stern (2007) who calls for immediate action. However, since rank-discounting depends on a generation’s rank in the intergenerational distribution rather than its rank in time, if future generations will be less well-off because of climate change, then more weight should be assigned to their marginal utility than our own, and strong action should be undertaken to mitigate climate change.

5 Population and uncertainty

Zuber and Asheim (2010) introduce rank-discounted utilitarianism in a deterministic setting where population growth is not explicitly discussed. Application of rank-discounted utilitarianism to climate change, and indeed to a number of other policy issues, requires explicit treatment of population growth and uncertainty, however, and I offer some brief and tentative comments on these issues now.

In Zuber and Asheim (2010, p. 4), we interpret x_t as “a one-dimensional indicator of the well-being of generation t ”. However, how can we compare the well-being of the present generation with the well-being of future generations if population size changes with time?

Rank-discounted utilitarianism can in a straightforward manner be generalized to a situation where population size changes exogenously over time, by letting individuals rather than generations be the object of analysis. This generalization has several implications, one of which is particularly interesting to point out: If there is no intragenerational inequality and per capita well-being increases over time, then the aggregate marginal utility of a generation increases with the number of individuals belonging to this generation. On the other hand, the average rank-dependent discount rate with which this aggregate marginal utility is discounted between this generation and its immediate predecessor increases with its size.

A much more challenging situation is where population changes endogenously, e.g., as a consequence of climate change. Climate change may prevent the existence of a great many people who would otherwise have existed (Broome, 2010). How can we take into account in our evaluation the loss of such potential lives? Broome’s (2004) argument for the position that one cannot simply ignore this effect when evaluating climate change is convincing. Rather, it seems natural to assume that there exists a critical level of well-being which, if experienced by an added individual without changing the well-being levels of the existing population, leads to an alternative which is as good as the original (Blackorby et al., 2005). The question of how to merge critical-level population ethics with rank-discounted utilitarianism is a topic for future research.

To handle uncertainty, one has to make a choice between first doing the ranking within each realization and then assign probability weights to the different realizations, or first determining a certainty equivalent for each individual/generation and then do the ranking. This choice matters for policy evaluation: in the context of climate change, the possibility for catastrophic consequences is assigned more weight if the ranking is done within each realization. To determine what axiomatic basis exists for each of these positions and thereby shed light on which one fits more naturally with the rank-discounted utilitarian approach is also a topic for future research.

Finally, the issues of population and uncertainty might be interrelated. In particular, there might be a positive probability that the human race will be extinguished. Indeed, by appealing to Harsanyi’s (1953) original position and using Harsanyi’s (1955) theorem, Dasgupta and Heal (1979, pp. 269–275) justified the use of discounted utilitar-

ianism where the utility discount rate is the probability of human extinction. Also the Stern Review (2007, Ch. 2) argued that this probability is the primary justification for utility discounting (other contributions include Bommier and Zuber, 2008, and Roemer, 2010). Blackorby et al. (2007) supported this justification within a variable population framework. It is premature to speculate on how rank-discounted utilitarianism, when applied to questions of intergenerational equity, can take these issues into account. Note, however, that the justification for utility discounting within the rank-discounted utilitarian approach is unrelated to the probability of human extinction.

6 Consequences and relevance

Axiomatic analysis investigates on what fundamental ethical conditions various criteria for intergenerational equity are based, which in turn allows for the evaluation of their normative appeal. The normative question of how to resolve intergenerational distributional conflicts can, however, be approached and answered in an alternative manner: by considering different kinds of technological environments (e.g., growth models without or with the restrictions imposed by natural resource constraints), one can explore the consequences of different criteria, and compare the properties of the intergenerational well-being streams that are generated.

It is consistent with Rawls' (1999) *reflective equilibrium* to do both: criteria for intergenerational equity should not only be judged by the ethical axioms on which they build, but also by their consequences in specific environments. One may question the appropriateness of a deduced criterion for intergenerational equity if there is substantive discrepancy between the consequence of a criterion and our ethical intuition in relevant technological environments. This view has been supported by many scholars, including Koopmans (1965, pp. 228–229), Dasgupta and Heal (1979, p. 311) and Atkinson (2001, p. 206). An application of the notion of reflective equilibrium was already included in Section 3, where the appropriateness of undiscounted utilitarianism was questioned on account of its demand for heavy sacrifices from the present generation for the benefit of later generations that are far better off.

When applying the rank-discounted utilitarian criterion, the parameters δ and η , both of which express aversion to inequality, can be adjusted so that its implications are in line with our ethical intuitions. Rank-discounted utilitarianism has the same implications for intergenerational distribution as discounted utilitarianism for a given discount rate, provided that well-being increases with time. However, its implications

are very different if climate change breaks the perfect correlation between time and well-being. Because of geographical variation in the effects of climate change, the great uncertainty relating to climate sensitivity and the damaging effects of climate change, and the reliance of continued growth on access to cheap energy which might not be forthcoming, such a perfect correlation is far from assured.

If, as indicated in the previous section, rank-discounted utilitarianism is generalized by letting individuals rather than generations be the object of analysis, its prescription for intrageneration redistribution is even stronger than those provided by discounted utilitarianism, for a given utility function U that maps well-being x into utility $U(x)$. The reason is that the worse off are prioritized not only because of their lower absolute level of well-being, through the concavity of U , but also because of their lower rank in well-being. The amount of redistribution in a rank-discounted utilitarian optimum would of course be limited by the cost of redistribution from the rich to the poor part of the world, but would still lead to the ethical prescription that a much more equal distribution is desirable from an impartial point of view. It also gives a high value to climate policies that improve the living conditions of poor people gravely affected by future climate change.

When discounted utilitarianism is used in regional integrated assessment models like RICE-2004 (Yang and Nordhaus, 2006) and MERGE (Manne and Richels, 2004), Negishi weights are applied (Negishi, 1972; Stanton, 2010). Without such weights, increased consumption in a poor region would contribute more to welfare than increased consumption in a rich region, as marginal utility is assumed to be a decreasing function of consumption. Negishi weights ensure that the optimal solution does not involve redistribution between regions by assigning less weight to the marginal utility of people living in poor countries than those living in rich countries. Thereby, they introduce relative prioritarianism, but in a perverse manner, by favoring the better off.

As the real-world distribution is a consequence of the political and economic realities that determine economic and social conditions in different parts of the world, weights on marginal utility determined so that the status quo optimally remains has no ethical significance. The fact that redistribution to poor countries is small, in spite of the large disparity of well-being, may reflect a small degree of concern and a high cost of redistribution, and cannot be interpreted to be an impartial optimum in an abstract setting where redistribution is assumed to be costless.

The combined effect of time-discounting and Negishi weights used in important regional integrated assessment models is that such models discount the marginal utility

of people that are ‘far away’ from those presently living in the rich part of the world. Rank-discounted utilitarianism replaces this kind of distant-dependent relative prioritarianism with the principle that more weight be given to the marginal utility of the worse off.

What is the relevance of axiomatic analysis of intergenerational equity when the present generation, even if governed by democratic administrations, has dictatorial powers in the management of current manmade and natural assets? Why ask what our generation as a collective should do, as an ethical question, if we are not motivated to follow the ethical prescriptions?

Judging from the distributional consequences that have been observed at a world scale during the last few generations, later generations have been more fortunate in comparison with the earlier ones, but with large intragenerational inequities. In particular, it seems like members of each generations are motivated to bequeath assets to their children, facilitating intergenerational transfers. As climate change concerns to a large extent intergenerational distribution, can we conclude that the altruism of parents towards their children will lead to a good outcome for the long-term development of societies even when faced with climate change? Is the “nirvana ethics” (Sinn, 2008, p. 369) of axiomatic intertemporal social choice superfluous for this reason?

I will argue that this is not be the case. Given the external effects of greenhouse gas emissions, taking care of our descendants does not solve the the distributional problems that climate change poses, but may add gravity to the problem. If each of us seeks to protect our immediate descendants against the effect of climate change, then reducing our own greenhouse gas emissions is not a productive line of action. Rather, it is likely that we will choose to accumulate private assets, thereby ensuring the next generation in our own dynasty a good start in life at the cost of all other dynasties. The same logic applies to countries.

In behavioral economics it is often assumed that people have social preferences, whereby they trade off their own material interest against the wider interests of society (see, e.g., Bolton and Ockenfels, 2000; Brekke et al., 2003). This requires that these wider interests are captured by some fairness ideal (Cappelen et al., 2007). Adopting this perspective to climate policies, individuals or countries may forecast the responses to their actions, and base their decisions partly on the effect in terms of self-interested well-being and partly on the effect measured by some impartial welfare indicator. In the context of climate change and intergenerational equity, the latter measure might be derived from axiomatic analysis of the kind presented for rank-discounted utilitarianism

in Zuber and Asheim (2010).

The resulting preferences, on which individuals and countries make their decisions, may then resemble those suggested by Schelling (1995) where the well-being of people that are separated from us by geographical distance and time may be ‘depreciated’ because they are ‘far away’. Still, axiomatic analysis of intergenerational equity, with equal treatment as a key ingredient, can play a role in the formation of these preferences.

7 Concluding remarks

In the economic debate related to climate change, it is often claimed that utility discounting undermines sustainability and constitutes an unacceptably unfavorable treatment of future generations. Such opponents of utility discounting often suggest that a utilitarian criterion with zero discounting should be applied instead. Indeed, this is basically the intergenerational social welfare function adopted by the Stern Review.

On the other hand, there are relevant models and choice situations where discounted utilitarianism appears to outperform utilitarianism with zero discounting. One can argue that utility discounting of future generations is a means of protecting the present generation from heavy sacrifices for the sake of gains for the later generations that will be far better off.

In this chapter I have examined the claim that utility discounting contradicts equal treatment of generations, reporting on joint work with Stéphane Zuber (Zuber and Asheim, 2010). I have presented how the rank-discounted utilitarian criterion, which in important circumstances is behaviorally indistinguishable from discounted utilitarianism, can be combined with even the strongest form for equal treatment of generations (the axiom of Strong Anonymity) and can be responsive to the interests of generations in the distant future. Rank-discounted utilitarianism accomplishes this by discounting utility not according to time but according to rank.

I have also indicated how such a purely ethical analysis can be of relevance for individuals and countries faced with challenges of choosing policies that might reduce the potential long-lasting and serious effects of climate change.

The debate following the publication of the Stern Review has to a large extent been confined to a discussion of what parameters to use in a discounted (or undiscounted) utilitarian criterion. The criterion of rank-discounted utilitarianism and other axiomatically based criteria for intergenerational equity proposed during the last years (see Asheim, 2010, for a survey) illustrate that there is a wider set of ethical criteria

that should perhaps be considered for evaluating climate policies and, more generally, policies for sustainable development.

References

- Arrow, K.J. (1999). Discounting, morality, and gaming. In *Discounting and Intergenerational Equity*, ed. P.R. Portney, J.P. Weyant (eds.). Washington, DC: Resources for the Future.
- d'Aspremont C, Gevers L. (1977). Equity and the informational basis for social choice. *Review of Economic Studies* **44**, 199–208.
- Asheim, G.B. (2010). Intergenerational equity. *Annual Review of Economics* **2**, 197–222.
- Asheim, G.B., Buchholz, W. (2003). The malleability of undiscounted utilitarianism as a criterion of intergenerational justice. *Economica* **70**, 405–422.
- Atkinson, A.B. (2001). The strange disappearance of welfare economics. *Kyklos* **54**, 193–206
- Basu K, Mitra T. 2003. Aggregating infinite utility streams with intergenerational equity: the impossibility of being Paretian. *Econometrica* **32**, 1557–1563
- Blackorby, C., Bossert, W., Donaldson, D. (2005). *Population issues in social choice theory, welfare economics, and ethics*. Cambridge University Press, Cambridge.
- Blackorby, C., Bossert, W., Donaldson, D. (2007). Variable-population extensions of social aggregation theorems. *Social Choice and Welfare* **28**, 567–589.
- Bolton, G.E., Ockenfels, A. (2000). ERC: A theory of equity, reciprocity, and competition. *American Economic Review* **90**, 166–193.
- Bommier, A., Zuber, S. (2008). Can preferences for catastrophe avoidance reconcile social discounting with intergenerational equity? *Social Choice and Welfare* **31** 415–434.
- Brekke, K.A., Kverndokk, S., Nyborg, K. (2003). An economic model of moral motivation. *Journal of Public Economics* **87**, 1967–1983.
- Broome, J. (2004). *Weighing Lives*. Oxford: Oxford University Press.
- Broome, J. (2010). The most important thing about climate change. In *Public Policy: Why ethics matters*, ed. J. Boston, A. Bradstock, D. Eng, pp. 101–116. Canberra: ANU E Press.
- Cappelen, A., Hole, A.D. Sørensen, E.Ø. and Tungodden, B. (2007). The Pluralism of Fairness Ideals: An Experimental Approach. *American Economic Review* **97**, 818–827.
- Coase, R. (1960). The problem of social cost. *Journal of Law and Economics* **3**, 1–44.

- Dasgupta, P.S. (2008). Discounting climate change. *Journal of Risk and Uncertainty* **37**, 141–169.
- Dasgupta, P.S., Heal, G.M. (1979). *Economic Theory and Exhaustible Resources*. Cambridge, UK: Cambridge University Press.
- Diamond, P. (1965). The evaluation of infinite utility streams. *Econometrica* **33**, 170–177.
- Ebert, U. (1988). Measurement of inequality: An attempt at unification and generalization, *Social Choice and Welfare* **5**, 147–169.
- Fleurbaey, M. (2001), Equality versus Priority. How relevant is the distinction? Forthcoming in *Fairness and goodness in health*, ed. C. Murray, D. Wikler. WHO.
- Foley, D.K. (2008). The economic fundamentals of global warming. In *Twenty-First Century Macroeconomics: Responding to Climate Challenge*, ed. J.M. Harris, N.R. Goodwin, pp. 115–126, Northampton: Edward Elgar.
- Hammond, P.J. (1976). Equity, Arrow’s conditions, and Rawls’ difference principle. *Econometrica* **44**, 793–804.
- Harsanyi, J.C. (1953). Cardinal utility in welfare economics and in the theory of risk-taking. *Journal of Political Economy* **61**, 434–435.
- Harsanyi, J.C. (1955). Cardinal welfare, individualistic ethics, and interpersonal comparisons of utility. *Journal of Political Economy* **63**, 309–321.
- Koopmans, T.C. (1960). Stationary ordinal utility and impatience. *Econometrica* **28**, 287–309.
- Koopmans, T.C. (1965). On the concept of optimal economic growth. *Academiae Scientiarum Scripta Varia* **28**, 225–287.
- Lauwers, L. (2010). Ordering infinite utility streams comes at the cost of a non-Ramsey set. *Journal of Mathematical Economics* **46**, 32–37.
- Manne, A.S., Richels, R.G. (2004). MERGE: An Integrated Assessment Model for Global Climate Change. <http://www.stanford.edu/group/MERGE/>
- Mirrlees, J.A. (1967). Optimum growth when technology is changing. *The Review of Economic Studies* **34**, 95–124.
- Mongin, P., d’Aspremont, C. (1998). Utility theory and ethics. In *Handbook of Utility Theory*, ed. S. Barbera, P.J. Hammond, C. Seidl, Volume 1, pp. 371–481. Boston: Kluwer Academic Publishers.
- Negishi, T. (1972). *General Equilibrium Theory and International Trade*. Amsterdam-London: North-Holland Publishing Company.

- Nordhaus, W.D. (2008). *A Question of Balance: Weighing the Options on Global Warming Policies*. New Haven, CT: Yale University Press.
- Nunn, N., Wantchekon, L. (2009). The slave trade and the origins of mistrust in Africa. NBER Working Paper 14783.
- Parfit, D. (1997). Equality or Priority? *Ratio* **10**, 202–221.
- Rawls, J. (1999). *A Theory of Justice*, revised edition. Cambridge, MA: The Belknap Press of the Harvard University Press.
- Roemer, J.E. (1996). *Theories of Distributive Justice*. Cambridge, MA: Harvard University Press.
- Roemer, J.E. (2010). The ethics of intertemporal distribution in a warming planet. Forthcoming in *Environmental and Resource Economics* (DOI 10.1007/s10640-010-9414-1).
- Schelling, T.C. (1960). *The Strategy of Conflict*. Cambridge, MA: Harvard University Press.
- Schelling, T.C. (1995). Intergenerational discounting. *Energy Policy* **23**, pp. 395–401.
- Sen, A. (1970). *Collective Choice and Social Welfare*. San Francisco: Holden-Day.
- Sinn, H.W. (2008). Public policies against global warming. *International Tax and Public Finance* **15**, 360–94.
- Stanton, E.A. (2010). Negishi Welfare Weights: The Mathematics of Global Inequality. Forthcoming in *Climatic Change*.
- Stern, N. (2007). *The Stern Review on the Economics of Climate Change*. HM Treasury, London.
- Tungodden, B. (2003). The value of equality. *Economics and Philosophy* **19**, 1–44.
- Van Liedekerke, L., Lauwers, L. 1997. Sacrificing the patrol: Utilitarianism, future generations and infinity. *Economics and Philosophy* **13**, 159–174.
- Weymark, J. (1981). Generalized Gini inequality indices. *Mathematical Social Sciences* **1**, 409–430.
- Yang, Z., Nordhaus, W.D. (2006). Magnitude and direction of technological transfers for mitigating GHG emissions. *Energy Economics* **28**, 730–741.
- Zame, W. 2007. Can intergenerational equity be operationalized? *Theoretical Economics* **2**, 187–202.
- Zuber, S., Asheim, G.B. (2010). Justifying social discounting: the rank-discounted utilitarian approach. CESifo Working Paper 3192.