Evaluating intergenerational risks☆

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ABSTRACT

Climate policies have stochastic consequences that involve a great number of generations. This calls for evaluating social risk (what kind of societies will future people be born into) rather than individual risk (what will happen to people during their own lifetimes). We respond to this call by proposing and axiomatizing probability adjusted rank-discounted critical-level generalized utilitarianism (PARDCLU) through a key axiom ensuring that the social welfare order both is ethical and satisfies first-order stochastic dominance. PARDCLU yields a new useful perspective on intergenerational risks, is ethical in contrast to discounted utilitarianism, and avoids objections that have been raised against other ethical criteria. We show that PARDCLU handles situations with positive probability of human extinction and is linked to decision theory by yielding rank-dependent expected utilitarianism—but with additional structure—in a special case.

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1. Introduction

This paper proposes a new normative criterion that can potentially be used for ranking climate policies. Climate policies seeking to abate anthropogenic greenhouse gas emissions have extremely long-term stochastic consequences, as greenhouse gas emissions cause environmental risks that extend into the far future. Therefore, to evaluate such policies one must assess risks that involve a great number of generations.

In this time frame, where people's lives are short compared to the time period for which the policies will have an effect, the objective social risk concerning

what kind of societies will future people be born into

might be more important than the subjective individual risk concerning

what will happen to people during their own lifetimes.

That is, it might be reasonable to be more concerned about reducing the probability that future people will live miserable lives, rather than avoiding volatility in the living conditions that people experience within their own lifetimes.

This motivates an approach that abstracts from lifetime fluctuations by assuming that people live for one period only. Moreover, the lives of the 'same' individual in two different future realizations might be considered as the lives of two different people, each living with the probability assigned to the realizations in question. Hence, if a future individual has equal probability of living a good or bad life, then this might be modeled as two different people, one living a good life and one living a bad life, where each has probability 0.5 of coming into existence.

Different normative considerations arise in a setting where people do not experience fluctuations and risk within their own lifetime. In particular, we are not concerned about individual risk attitudes and the risk generations may face from an abstract *ex ante* point of view. We are only concerned with the final distribution of well-being. The important question for the evaluation of policies with long-term intergenerational effects is how to handle inequality. Clearly, if, for each chosen policy, all people – now and in all future realizations – have the same level of lifetime

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well-being, then this uniform well-being level can be used to rank policies. Thus, in our context, only social aversion to inequality matters, while subjective aversions to individual fluctuations and risk play no role.

By focusing on social risks, our approach differs from the vast literature on the aggregation of preferences under risk and uncertainty stemming from Harsanyi's (1955) seminal contribution. This literature has focused on respecting people preferences, in a context where the society and the individuals face the 'same' uncertainty, in the sense that uncertainty does not concern the mere existence of people. The contributions have wavered between an ex ante approach that relaxes rationality (Diamond, 1967; Epstein and Segal, 1992) to allow for *ex ante* fairness, and an ex post approach that fails the ex ante Pareto principle (Broome, 1991; Fleurbaey, 2010) to allow for *ex post* fairness. In the present paper, these issues do not arise because we interpret individuals in different events as different individuals: individuals are born only after the realization of events relevant for their lives. This interpretation is consistent with other papers focusing on social risk rather than individual risks (for instance Asheim and Brekke, 2002; Piacquadio, 2015).

In the framework of Harsanyi's (1953) impartial observer theorem, Grant et al. (2010) have highlighted the distinction in social evaluation between lotteries over identities and lotteries over outcomes. We focus on lotteries over identities but add the complication that people may exist with different probabilities. We also depart from expected utility to address population ethics and equity concerns.

Our analysis will be confined to the case where there are objective assessments of the probabilities of different realizations. Hence, formally we will be concerned with risk rather than uncertainty. Moreover, we will assume that there is an indicator of lifetime well-being which is at least ordinally measurable and level comparable across people. Following the usual convention in population ethics, we will normalize the well-being scale so that lifetime well-being equal to 0 represents *neutrality*. Hence, a life with lifetime well-being above 0 is worth living; below 0, it is not.

We are concerned with normative evaluation where people are treated equally. This differs from the common use of discounted utilitarianism in integrated assessment models of climate change, where transformed well-being (*utility*) is discounted by a constant and positive per-period time-discount rate. As a matter of principle, utilitarianism with time-discounting means that people across time are not treated equally. As a matter of practical policy evaluation, this criterion is virtually insensitive to the long-term effects of climate change, beyond year 2100 when the most serious consequences will occur, in particular for poor groups who are expected to bear the highest costs (see for instance World Bank, 2013).

Equal treatment of people in axiomatic analysis is captured by the *Anonymity* axiom, whereby social evaluation is invariant to permuting two individuals' well-being. Combined with sensitivity for the interests of all people, as captured by the *Strong Pareto* principle, this leads to the *Suppes–Sen* principle (Suppes, 1966; Sen, 1970). This principle requires that one allocation be better than another if the former dominates the latter when being rank-ordered according to the levels of well-being. Conversely, the Suppes–Sen principle combined with the *Continuity* axiom implies both Anonymity and the Strong Pareto principle. A criterion that satisfies the Suppes–Sen principle is called *ethical* by Svensson (1980). In this paper, we characterize an ethical criterion that avoids objections raised against other ethical criteria, e.g. utilitarian and egalitarian criteria.

Undiscounted utilitarianism, where utility is summed without discounting, is one criterion which satisfies the Suppes–Sen principle. However, when modeling the many potential future people by

assuming that there are infinitely many generations, this criterion assigns zero relative weight to the present generation's interests. It leads to the unappealing prescription that the present generation should endure heavy sacrifices even if it contributes to only a tiny gain for all future generations. Moreover, in a variable population setting with an unbounded number of potential people, it is subject to the *Repugnant conclusion*[1] or the *Very sadistic conclusion*.[2]

The egalitarian criterion of maximizing the well-being of the worst-off generation (*maximin*) also satisfies the Suppes–Sen principle, but assigns zero relative weight to all generations but the worst-off. It leads to the unappealing prescription that the present generation should not do an even negligible sacrifice for the benefit of better off future generations. Maximin has also problematic implications when applied in a variable population setting (Arrhenius, forthcoming; Asheim and Zuber, 2014).

This dilemma – that ethical criteria may to lead to extreme prescriptions in terms of sacrifice for future generations – motivates *rank-discounted generalized utilitarianism* (RDU), proposed and analyzed by Zuber and Asheim (2012). RDU discounts future utility as long as the future is better off than the present, thereby trading-off current sacrifice and future gain. However, if the present generation is better off than all future generations, then priority shifts to the future. In this case, zero relative weight is assigned to present utility. RDU is compatible with equal treatment of generations as discounting is made according to rank, not according to time. Asheim and Zuber (2014) extend RDU to a variable population setting by proposing and axiomatizing *rank-discounted critical-level generalized utilitarianism* (RDCLU). RDCLU avoids both the Repugnant and Very sadistic conclusions, thereby evading serious objections raised against other variable population criteria.

In the present paper we extend RDCLU to risky situations, including the case with positive probability of human extinction, by proposing the *probability adjusted rank-discounted critical-level generalized utilitarian* (PARDCLU) social welfare order (Definition 1). We start out in Section 2 by developing a framework where each (potential) individual is characterized by a level of lifetime well-being and a probability of existence. We show in Appendix A how this set-up is equivalent to a formulation where the individuals are distributed through time and over risky states. In this alternative dynamic framework individuals live for one period only and are not subjected to risk during their lifetime, reflecting our intergenerational perspective.

We then, in Section 3, present an axiomatic foundation for PARDCLU through Theorem 1. A key axiom, called *Probability adjusted Suppes–Sen*, generalizes the Suppes–Sen principle to a setting where people need not exist with probability one. In conjunction with the Continuity axiom, it implies invariance to permutations of individuals with the same well-being and the same probability of existence. It also entails invariance to the replacement of one individual with given well-being and probability with two individuals having the same well-being and whose probabilities of existence sum up the probability of the original individual. In the special case where the individual probabilities of existence sum up to one, Probability adjusted Suppes–Sen corresponds to first-order stochastic dominance. Hence, this axiom can be also considered as a generalization of first-order stochastic dominance to a normative multi-person setting.

[1] The *Repugnant conclusion* (Parfit, 1976, 1982, 1984) states that, for any population in which people have high levels of well-being, there is a larger population in which people have lives barely worth living that is deemed socially better.

[2] The *Very sadistic conclusion* (Arrhenius, 2000, forthcoming) states that, for any population in which people have terrible lives not worth living, there is a larger population in which everyone has a life worth living that is deemed socially worse.