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From efficiency to justice: utility as the informational basis of climate change strategies, and some alternatives

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1. Introduction

The aim of this chapter is to consider, from an ethical point of view, the role that economics should play in evaluating climate change strategies. Economics has been a prominent player in the intellectual and political debate about how to respond to climate change, and frequently a controversial one. Much of the controversy apparently surrounds how the consumption of individuals living in different places, at different times and in different states is weighted. On the temporal dimension, this issue is represented by the infamous discount rate. However, I argue that an equally, if not more, important ethical judgement made by economics comes earlier, when the informational basis of evaluation is accepted to be nothing more and nothing less than the 'utility' of individuals.

This is by no means an original insight, but on the basis of it I try to make constructive suggestions as to how evaluation of climate change can move forward, drawing on the strengths of economics, but compensating for its weaknesses. I draw on the work of John Broome (1999) and Amartya Sen (1987), among others, to argue that the strength of the economic approach lies in its emphasis on interdependence and comparability of changes to human wellbeing. That is, any climate strategy, be it adaptation, mitigation or 'business-as-usual', consists in changes to human wellbeing that are linked across time, space and states. Any convincing evaluation of such strategies must be equipped to think about the comparisons entailed.

The weakness, however, lies in seeing human wellbeing solely through a 'utility' lens. Thus what would constitute real progress would be a systematic evaluation of the positive and negative changes in human wellbeing as a result of climate change strategies, on multiple dimensions of that wellbeing. It might be argued that existing assessments, such as those of the Intergovernment Panel on Climate Change (IPCC), fit the bill, but I argue that, because they are informal, we miss an opportunity to bring to bear formal methods of comparison that might prove decisive in the climate debate.

2. Efficient climate policy

Economists have been investigating the properties of efficient responses to climate change for over thirty years[2], and have been a prominent voice in the climate debate since the early 1990s (Nordhaus 1991; Cline 1992). While differences in approach have from time to time become all too evident – William Nordhaus and William Cline in particular clashed over the opposing conclusions of their aforementioned studies, and Nordhaus (and others) have recently been involved in a very similar-looking disagreement with the findings of Nicholas Stern's (2007) study – there is a common ethical core to the great majority of analyses, which is derived from a particular mathematical model of social welfare.

In this model, the sole objective is to maximize the weighted sum of individual utilities over the time horizon, geographical space and range of states of nature (with associated probabilities) thought relevant. The weights are given by the particular social welfare function chosen, which is almost always of the 'classical utilitarian' form. In a classical utilitarian social welfare function, individual utilities are unweighted, although a positive utility discount rate is usually applied. Each individual's utility is estimated on the basis of their aggregate consumption of goods and services, using a utility function that is common to all of them. The impact of climate change, and of responses to it (i.e. adaptation and mitigation), is measured as a change in this consumption. In this way the whole approach is essentially cost-benefit analysis (CBA), although CBA, as routinely practised in appraisal of public policies and projects, shortcuts many of the steps outlined here. That is, CBA has been developed so as not to require direct estimation of changes in social welfare, as measured by discounted utility (see Dasgupta, Marglin et al. 1972).

If the foregoing description appears a little dry, that is because care needs to be taken in ascribing ethical meaning to this model – building a 'straw man' would serve little purpose in any meaningful discussion of the pros and cons of the economic approach. 'Utility' in contemporary economics is perhaps most accurately understood as "that which represents a person's preferences" (Broome 1991, p3) (see also Harsanyi 1977). This is 'axiomatic utility theory', in which the concept of utility means nothing more and nothing less than the value taken by a function describing a person's preferences over a set of alternative goods and services. These preferences must conform to a set of axioms; hence axiomatic utility theory. In this way, the particular meaning of utility has subtly changed since the time it was coined by Jeremy Bentham to denote

[2] In the early 1970s, the United States Department of Transportation carried out a study into, *inter alia*, the economic effects of climatic changes resulting from stratospheric flight by supersonic aircraft (d'Arge 1975).

"that property in any object, whereby it tends to produce benefit, advantage, pleasure, good, or happiness, (all this in the present case comes to the same thing) or (what comes again to the same thing) to prevent the happening of mischief, pain, evil, or unhappiness to the party whose interest is considered" (Bentham 1823, p2). That is, in Bentham's time utility meant the tendency to produce happiness, whereas in contemporary economics utility simply means "that which represents a person's preferences", whether or not this has anything in particular to do with an individual's happiness or good, or society's happiness or good (and happiness and good do not, of course, necessarily come to the same thing).

What is the practical importance of insisting on this kind of precision? There are two implications, one for critics of economics and one for economists themselves. With respect to the critics, this kind of precision reins in some popular misconceptions. Most of all perhaps, it is incorrect to assert that economics assumes the individual is always self-interested, in the specific sense of only preferring what is better for him/herself. Rather, the preference relation described by the utility function can accommodate altruistic behavior. For economists themselves, the main implication is that axiomatic utility theory may not have anything in particular to say about what is good for an individual, even less so what is good for society (Broome 1999).

What then the standard model implies ethically is most accurately termed 'preference-satisfaction utilitarianism', where public policies are judged on their consequences for the utility of individuals, and where utility represents their preferences. Sen (1977) has also used the term 'welfarism' to describe a model in which social welfare depends only on the utilities of individuals. However, an irony that bears brief mentioning is that axiomatic utility theory was constructed as a response to the attack, led by Lionel Robbins (1935), on the notion of making interpersonal comparisons of utility. Yet, readers will already have noted, the welfare-economic model described above is based on a social welfare function, which enables the utilities of different individuals to be aggregated. Furthermore, for the sake of simplicity, each individual is assumed to have the same utility function. Generally, this utility function embodies diminishing marginal utility of consumption. The most obvious interpretation of this model is that it does indeed make interpersonal comparisons of (cardinal) utility,[3] where utility is the satisfaction of preferences.

[3] Traditionally, CBA has tried its best to avoid making interpersonal comparisons of utility by, first, working with observable measures of willingness to pay/accept compensation, rather than measures of changes in utility, and, second, by relying on the notion of Pareto efficiency, or at least, via the potential compensation

In order to apply the economic approach to climate change empirically, it is necessary to construct a coupled model of the economy and climate system, now widely known as an Integrated Assessment Model (hereafter IAM: see Hope 2005 for a review).[4] The sorts of IAM used for economic evaluation must be 'full-scale' (Weyant, Davidson et al. 1996), in the sense that they must have some representation of every link in the chain from anthropogenic emissions of greenhouse gases to economic impacts of climate change, which, to fully optimize social welfare, must eventually work their way through economic activity back to emissions again. To achieve full scale in this way, the models must sacrifice detail, so that they are typically of a very reduced form. For example, Nordhaus' well-known DICE model (Dynamic Integrated model of Climate and the Economy; see Nordhaus 2008) comprises around 20 equations, which solve the social welfare of a single, representative global individual who lives for hundreds of years.[5] Continuing to use DICE as an example, these equations include the estimation of social welfare, as above, using a social welfare function to convert utility into social welfare and a utility function to convert consumption into utility. A single, aggregate good that can be taken to represent the vector of all goods and services in the economy is produced by combining labour and capital, and this good is either consumed or invested for future consumption. However, production of this good generates an externality in the form of greenhouse gas emissions. Greenhouse gas emissions perturb a simple model of the climate system, which generates global warming. The warming itself is linked to losses in consumption by a very simple damage function. Adaptation in DICE is implicitly incorporated in the damage function (ameliorating the negative effects of warming on consumption, and amplifying the benefits), although some studies have separated it out in order to investigate adaptation more directly (de Bruin, Dellink et al. 2009 do so for DICE itself). Greenhouse gas emissions can be abated by investing some of the output produced by the economy into mitigation measures.

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tests of Hicks (1940) and Kaldor (1939), on the notion of *potential* Pareto efficiency. However, the economic evaluation of climate change explicitly posits a utility function that applies to all individuals. In any case, the appeal to the Hicks-Kaldor compensation tests as a means to circumnavigate interpersonal comparisons of utility has never been particularly convincing, since it can be argued that they merely render the comparison implicit, or else ignore it, whereby someone else (i.e. a non-economist) still has to make the comparison.

[4] Note, however, that while all economic evaluations of climate change require an IAM to be employed, not all IAMs are economic – some restrict their analysis to linking a model of the climate system with environmental changes in their natural units.

[5] The idea of a very long-lived representative individual who embodies distributional decisions across generations was devised by Ramsey (1928).

What are the typical results of running models like this? Insofar as one can draw a caricature, economic evaluations of climate change have tended to conclude, on the one hand, that both adaptation and mitigation are efficient strategies (thus in respect of mitigation they contradict the climate 'deniers' or 'skeptics'), but, on the other hand, that the optimal rate of greenhouse gas emissions reductions is rather modest (e.g. Nordhaus 1991; Maddison 1995; Manne and Richels 1995; Tol 1997; Nordhaus and Boyer 2000; Nordhaus 2008). Perhaps this should not surprise us, given President Truman's famous rhetorical call for 'one-handed' economists.[6] By modest is meant both gradual in the first instance and lower in the long run than many environmentalists and climate scientists would recommend. Thus, taking a representative sweep across the economic literature, one finds little support for a strategy that limits global warming to below 2°C relative to pre-industrial levels, despite the recent political and scientific focus on just such a long-run target.

However, readers will no doubt already be complaining that such a caricature masks some well-known exceptions. These include the studies of Cline (1992) and Stern (2007), both of whom recommended more aggressive action to mitigate climate change in the short and long run (although even Stern's study does not firmly advocate a commitment to avoiding 2°C warming). There are several other studies that could be cited here.

The reasons for disagreement from within the economic tradition are essentially twofold, and both are rather instructive for the present purposes. First, studies have varied in the predictions they have made about the (undiscounted) costs and benefits of adaptation and mitigation. Some studies are essentially optimistic that the economic impacts of climate change will be relatively low, due to a moderate climatic response to emissions, and easy adaptation to environmental changes. Others are more pessimistic. Similarly, some studies are pessimistic about the economic cost of mitigation. Others are optimistic. Different researchers thus make different predictions in the face of uncertainty, illustrating in one way why uncertainty is relevant to ethical discussions of climate change (Gardiner 2004).[7] Interestingly, while there is no obvious reason why optimistic (pessimistic) assumptions about economic impacts of climate change should correlate with pessimistic (optimistic) assumptions about mitigation costs, in practice a reading of recent debates within the literature has tended to show just that (see e.g. Tol and Yohe 2006, which explains their

[6] Truman complained that his economic advisers always said "on the one hand _ and on the other _".
[7] More generally, the reason for this is that, given the large uncertainties affecting responses to climate change, any viable ethical approach will need to yield sensible answers in a range of future states of nature.

position relative to Stern). There are doubtless issues here connected to the philosophy of science, which I cannot elaborate upon.

Second, studies have varied in the way in which the standard welfare-economic model, described above, has been parameterized. In particular, studies have used different utility discount rates, which, to recall, changes the weight placed on the utility of future generations in the social welfare function. They have also posited different values for the elasticity of the marginal utility of consumption, or in other words the rate at which the marginal utility of consumption falls as one becomes richer (I will return to this specific issue in section four). While the technical details need not detain us (Dietz, Hepburn et al. 2008 elaborate on these issues), both of these factors come together to describe the infamous social discount rate. Some studies, notably Cline (1992) and Stern (2007), set a zero or near-zero rate of discount on utility, and allied to their assumptions about the marginal utility of consumption, set a low social discount rate. Since the nature of the climate problem is in large part the need to make an up-front investment in mitigation for the benefit of distant generations, this tends to make mitigation a more favorable strategy, *ceteris paribus*. Other studies have done just the opposite, and Nordhaus (2007; 2008) has been particularly firm in defending a higher social discount rate.

Discussing the arguments for and against a low social discount rate would require a paper in itself, and is indeed picked up elsewhere in this book. Therefore I will not focus on it here, turning instead in section four to the ethical implications of utility as the informational basis for a climate strategy. First, however, I want to examine what is compelling about the economic approach.

3. Interdependence as the strength of the economic approach

In thinking about what there might be to commend the economic approach from an ethical point of view, particularly in the context of climate change, it is worth reflecting on some of the more important general contributions to the subject. Amartya Sen's *On Ethics and Economics* (Sen 1987) and John Broome's *Ethics out of Economics* (1999) draw similar conclusions. For them, the strength of the economic approach is its emphasis, via an elaborate set of analytical tools, on interdependence.

Sen uses as his main example the study of the causes of famine:

> "The fact that famines can be caused even in situations of high and increasing availability of food can be better understood by bringing in patterns of interdependence which general equilibrium theory has emphasized and focused on." (p9)

This argument stresses the contribution of so-called 'positive' economics. Indeed, Sen describes his example as one where the contribution comes from what he calls the 'engineering approach' to economics. In this vein, economics has enhanced our understanding of effective climate strategies in many ways. Prominent examples of how the study of interdependent supply and demand relations has generated insights for climate strategies include the way in which decentralized incentives such as tradable carbon permits might bring about cost-effective emissions reductions across space and time, the so-called 'rebound effect', whereby increases in the efficiency with which we use energy lead to increases in energy use itself as prices fall (i.e. a cautionary tale), and the potential for changing relative prices to bring about adaptation to climate change.

But Sen's argument does not have anything to do with ethics *per se*. Rather, it highlights the contribution of positive economics to the design and implementation of effective climate strategies, which is of indirect ethical significance only (effective responses to climate change are presumably ethically desirable in the vast majority of cases). Broome (1999) takes on the contribution of economics to ethics more directly.

In the previous section I noted that economists' recommendations on optimal greenhouse gas emissions have tended to be of the "on the one hand _ on the other hand _" variety that (in a quite different context) so frustrated Harry Truman. This is even true of those economic studies that most look like a call to arms, such as the Stern Review (Stern 2007), for even Stern was careful to present his reasoning on optimal emissions as a broad comparison of benefits and costs (see in particular his chapter 13). One of the main reasons why economists tend to draw these conclusions is that responses to climate change are generally thought to involve weighing the interests of individuals in different places and times (and, less intuitively, in different states). It is this aspect of interdependence that interested Broome (Broome 1999):

> "we have to balance the interests of future people against the interests of presently living people, fun in retirement against fun in youth, the wellbeing of the deprived against the

> wellbeing of the successful or lucky…These are places where the scarcity of resources forces a society to weigh up alternative possible uses for these resources, and economics claims to be the science of scarcity." (p1-2)

How can economics help us to think about these problems? For Broome, the answer generally lies in the way in which economics forces us to think comparatively (where he thinks philosophers face some room for improvement), and specifically in the axioms of utility theory, which provide useful theorems that can, by analogy, be used to analyze the structure of good. However, we must remember not to equate utility with good – Broome was careful to argue that economics has useful things to say about the structure of good only, not the substance.

Again there are numerous examples of the power of economics in this regard. Indeed, it can be argued that the discounting debate has done as much as any other intellectual exchange to highlight the intergenerational balancing act we are required to resolve in the face of anthropogenic climate change, even though some economists involved would not like to admit the ethical issues involved (Dietz, Hepburn et al. 2008). Similarly, while controversial in many quarters, Bjorn Lomborg has undoubtedly pursued a powerful line of questioning in the so-called Copenhagen Consensus (see Lomborg 2004), namely that scarce resources should be targeted at whichever public policy problem has the highest social rate of return. In this way he pits investment in climate change mitigation against, for instance, direct spending on public health in low-income countries, and he tends to find that climate change mitigation fares rather poorly. Many have objected to the concept of the Copenhagen Consensus (e.g. Sachs 2004) – and it is undoubtedly flawed even from an economic perspective[8] – but the general premise of comparing the return to investment in climate change with returns to other public investments such as health and education has rather a lot of appeal.

4. Utility as an informational basis for climate change strategies

[8] In terms of economic theory, the problem with the question posed by the Consensus is that it posits an arbitrary set of policy problems and an arbitrary budget constraint for spending on them. From an economic point of view, climate change is a market failure, such that it should be adapted to and mitigated up to the point where the costs and benefits of doing so are all equal at the margin. This should be the case for any and all public expenditures, but the Consensus constrains the problem such that social welfare cannot be maximized in this way.

Climate change has the potential to bring about wide-ranging effects on human wellbeing. For example, in its Fourth Assessment Report, the IPCC provides a summary classification of five types of effect: on water supply, natural ecosystems, food supply, land in coastal zones, and health (2007). In turn, this broad range of changes has the potential to affect human lives in a variety of ways, including directly, and indirectly by changing people's economic, social and political circumstances. Mitigation of climate change will also affect human wellbeing. In this case, many of the relevant changes are likely to work their way through economic circumstances, as the cost of purchasing goods and services with embodied carbon rises. However, broader changes will also occur. For instance, any unemployment caused by mitigation has social as well as economic consequences. On a brighter note, efforts to reduce fossil-fuel burning improve air quality. With respect to both impacts/adaptation and mitigation, some of the changes are expected to be positive, and some negative.

Any such diversity of impact presents challenges for evaluation. The economic approach, however, responds in a singular way, attempting to measure all relevant changes as changes in utility. From an ethical point of view, this is likely to be the single most important precommitment, at least as important as particular choices about how utilities are weighted, which is essentially what much of the discounting controversy is about. As Sen put it:

> "Each evaluative approach can, to a great extent, be characterised by its informational basis: the information that is needed for making judgments using that approach and – no less important – the information that is "excluded" from a direct evaluative role in that approach" (1999, p56).

It is again worth taking some care to explain precisely how this transformation into the metric of utility is achieved in practice. As discussed, the basis of utility is an aggregate measure of the consumption of goods and services by individuals. Aggregate consumption per capita in empirical studies is simply derived from a future prediction of economic output (i.e. gross domestic product or GDP) per capita, by netting out investment. The impacts of climate change, and responses to it, are then estimated as equivalent changes in consumption, and added to this baseline flow of consumption per capita. Thus every effect of climate change, of adaptation and of mitigation must be priced.

Consumption is transformed into utility by means of a utility function, which is almost always of the analytically convenient constant-elasticity-of-substitution (equivalently constant-relative-risk-aversion) type, meaning the elasticity of substitution between consumption in any two places (i.e. in space, time, or states) is constant. The curvature of this function is given by the elasticity of the marginal utility of consumption. The higher is this elasticity, the more concave the function, and the faster the marginal utility of an extra unit of consumption falls as one becomes richer. In other words, the more averse the social planner is assumed to be to inequality in consumption. Figure one helps visualize this property, presenting the utility function for three different values of the elasticity of the marginal utility of consumption.

INSERT FIGURE ONE HERE

There are undoubtedly things to commend about such an approach. Certainly any approach that takes seriously (i) the consequences of policy choices for (ii) human wellbeing can be insightful (Sen 1999). However, the narrowness of the approach also gives rise to some serious concerns, which have been expressed more generally about welfare economics in numerous other settings.

Perhaps the most obvious one is that the approach apparently ignores several factors that contribute to human wellbeing. In particular, what role do changes in environmental, political and social circumstances play? The answer is that if they can be estimated as equivalent changes in consumption – monetized – then they can be included in the estimation of utility. However, there are two problems. First, the baseline for utility is, as mentioned, taken from aggregate consumption per capita, or in other words essentially individual income. Thus the baseline is a certainly a narrow measure of human wellbeing, and does ignore other non-monetary constituents. So we do not have a broad view of where people are starting from in terms of wellbeing. Second, it is in practice very difficult to place money values on many of the effects of climate change, and it is well known that the IAMs used to conduct economic evaluation omit some potentially important changes in environmental, political and social conditions (Watkiss and Downing 2008).

Another concern is that the approach does not pay nearly enough attention to the distinction that is suggested to exist between the things that human beings vitally need, and the things that they

merely desire (e.g. O'Neill, Holland et al. 2008).[9] David Wiggins (2005) makes this point in a quite different, but relevant, context, reflecting on plans to demolish significant tracts of urban London in the 1960s and 1970s to make way for a system of motorways (a plan that, incidentally, failed to materialize). One argument for doing so was the result of a CBA, which compared the cost of land, resettlement and construction with the benefit of travel-time savings. According to the CBA, the net present value of the project was positive, but for Wiggins this ran contrary to an intuitive sense in which the capacity of local communities to meet their vital needs was being diminished:

> "These were places in which ordinary human lives of passable urban contentment were already being lived, and in which it was possible to satisfy after some fashion a huge variety of human needs [at least some of which were 'vital']. The disvalue of the destruction was swamped, however, by the simple numerosity of a vast sum of time savings" (p27).

It does seem on the basis of Wiggins' account that the CBA of the London urban motorway system was very narrowly construed, such that the only costs of the project that were actually measured were of acquiring land, resettling residents, and construction. The broader social costs of dislocation were thus ignored, not to mention the environmental costs. But the theory and practice of CBA has moved on a long way since then, and in particular due to its increasing application to environmental problems, a great deal of work has been done on monetizing impacts that are not valued in markets (Pearce, Atkinson et al. 2006). As a result, and indeed as a consequence of changing other assumptions, it is quite conceivable that a broader CBA would have suggested the project costs exceeded the benefits. It is also important to point out that the assumption of diminishing marginal utility of consumption does capture the fact that those on low incomes obtain (lose) far more utility from an increase (decrease) in that income than those on high incomes, which might be interpreted as capturing some notion of need.

However, these qualifications are rather beside the point, which is that there is no *guarantee* that the failure of some individuals to meet their basic needs is not overridden by an increase to other individuals of things that they merely desire (or in other words that they merely instrumentally

[9] See also the Royal Institute of Philosophy Supplement 57 on *The Philosophy of Need*, edited by Soran Reader (volume 80, 2005). The concept of vital need – those things essential for a flourishing life (or, as per Aristotle, without which it is impossible to live) – must be distinguished from merely instrumental needs, since in everyday language the concept of need is used very broadly to cover both contexts.

need, as opposed to vitally needing).[10] Similar points have been raised in connection with the economic evaluation of climate change, where it has for instance been pointed out that it is possible for recreational benefits of warming in high-latitude, high-income regions to outweigh loss of life in low-income countries (Spash 1998).

In any case, the focus on diminishing marginal utility is also beside the point, since an approach founded on vital needs tends to point towards a variety of such needs, none of which are substitutable, either by instrumental needs, or by other vital needs (O'Neill, Holland et al. 2008). The 'monistic' method of collapsing all relevant changes in human wellbeing to changes in utility does not reflect that. I shall return to notions of multiple criteria and pluralism below.

Closely related to the emphasis on vital needs are notions of liberty and in particular of rights. A vast amount has been written about liberties and rights, ranging from extensive systems such as Robert Nozick's (1974) to less extensive ones such as John Rawls' (1971), and I cannot hope to cover them here. What generally unites such approaches, however, is the idea that there is some set of rights (i.e. to some things) that must not be violated under any circumstances, or at least only under the most extreme of circumstances.[11] They are, in effect, side constraints, and like vital needs they would constitute the sort of absolute 'bottom line' for evaluation that utility analysis cannot represent.

Several have suggested that future generations have certain rights that might be compromised by climate change (Spash 1998; Shue 1999; Adger 2004; Caney 2008). Let us look at Simon Caney's formulation. According to it, climate change threatens several fundamental interests of future people, including their food supply, their access to land, and their health. These interests are weighty enough to impose obligations on others, which by definition allows corresponding rights to be established. These rights must not be violated, which leads to a presumption in favour of mitigation of climate change, until we can be sufficiently confident that they will be protected.

[10] From a technical point of view, the utility function is smooth and continuous, so there is no sharp distinction between a certain income that might be vitally needed (to live some minimally acceptable life) and income in addition to that. If the elasticity of the marginal utility of consumption were high, there would be a range of consumption over which the function would begin to *resemble* that sharp distinction (see how the utility function in figure one becomes increasingly concave, and imagine increasing the elasticity still further; soon enough the function will resemble a right angle). However, in practice empirical studies have tended to use lower values in the region of 1.

[11] See Nozick's (1971) 'catastrophic moral horrors'.

The difficulty with this argument, which is non-consequentialist, is the following. If it turned out that mitigation of climate change would also violate human rights of one form or another, it would no longer be clear what course of action to take. One would in effect have conflicting side constraints. In fact, Caney (2008) does address this matter, but his assumption is that the cost of mitigation (in a general sense) is sufficiently low to negate the potential conflict:

> "Were the costs excessive [which they are judged not to be] then one might conclude that the interests in avoiding dangerous climate change are not fundamental enough to impose obligations on others" (p539).

However this is not entirely reassuring, since Caney did not have at his disposal empirical evidence of the sort required to carefully evaluate the claim. What Caney was able to rely on were well-known studies of the overall economic cost of reducing greenhouse gas emissions to a low level, expressed as a change in global GDP (e.g. IPCC 2007). While informative, these studies, or at least their summary results, do not give us the evidence we need to carefully evaluate whether some human rights, somewhere, are violated due to mitigation.

This reveals a general problem with a rights-based approach, where rights might be in conflict. In particular, it strongly recalls the need for a framework for evaluation that places emphasis on comparison and interdependence. I praised economics for this in section three, but opened the discussion to criticism of the utility metric in this section. Broome (1999), then, appears to be right – what we should take into the evaluation of climate change from economics is structure, but not substance, or at least not unreservedly so. This does beg the question, however, of what to do instead, and it is to this that I turn in the next section.

5. Just keep maximizing, but...?

It seems possible to identify two ways forward. The first, which has been suggested by Alan Randall (2007), is to forge ahead with CBA, but to add side constraints to the maximization of utility. In Randall's formulation, which is expressly intended for use in environmental management, the side constraint takes the form of a Safe Minimum Standard of conservation (Ciriacy-Wantrup 1968), which is invoked when the moral consequences of human modification of

the environment are deemed unacceptable. Unacceptability, according to Randall's pluralist ethical approach, can be defined with respect to various ethical theories, such as those that identify non-consequentialist duties and obligations as above. The key point here is that the Safe Minimum Standard is a common-sense decision heuristic, which represents, and can put into operation, these concerns. One might understand a limit of 2°C warming above pre-industrial levels as such a Safe Minimum Standard for climate change. There is certainly no overwhelming evidence that unacceptable moral consequences begin at 2°C above pre-industrial levels, as opposed to say 2.2°C, so it seems to serve a heuristic purpose. CBA still has a role, Randall argues, because "a society of thoughtful moral agents would agree to take seriously an account of benefits and costs, within some more complete set of principles" (p111).

This certainly seems like an improvement on unalloyed utility maximization, and indeed it can be argued to be consistent with the disclaimer, which most economists would add to any of their evaluations, that CBA is but one input into the decision-making process. In fact, Randall goes further than the standard disclaimer, which, as he correctly points out, leaves entirely unanswered the questions (i) how much attention should be paid to economic evaluation and under what circumstances, and (ii) if CBA is systematically deficient, then why not try to fix it? Responding to (i), Randall seeks to establish the principle that CBA should be carried out "where no overriding moral concerns are threatened" (p112), and where those moral concerns are given by basic rights or similar – i.e. "don't do anything disgusting" (p112).

The problem, however, is that maximization with side constraints does not really address the concern, expressed at the end of previous section, that the side constraints themselves could be in conflict. Indeed, this was recognized early on to be a problem with the notion of a Safe Minimum Standard of conservation, so that the *ad hoc* concept of 'intolerable cost' was later added (Bishop 1978). In effect, the method only works if there is an envelope of possible strategies that do not violate constraints either on the side of environmental change, or on the side of mitigating actions. Another problem, in practice, is that this approach seemingly does little to bring the wider set of non-utilitarian constituents of human wellbeing directly into the evaluation of climate change. Rather, they are cast outside the framework, giving rise to side constraints that may or may not be carefully justified with evidence. For an example of how careful evaluation may not underpin side constraints, see Tol's (2007) coruscating review of the adoption by the European Union of the 2°C

target. In any case, we still have not done anything to 'fix' economic evaluation, even though it does indeed seem to be systematically deficient from a moral point of view (point (ii) above).

What is being argued for, then, is an evaluation framework that makes best use of the structure of CBA, with all of its emphasis on interdependence, but with the 'benefits' and 'costs' under examination consisting in a broader set of determinants of human wellbeing. These determinants would need to be carefully specified, but there is much supporting work in ethics and in policy to inform them. Examples of the former include Rawls' (1971) notion of primary goods, and Sen's (1999) capabilities framework. Examples of the latter include the United Nations Development Programme's *Human Development Reports*, the *World Development Indicators* of the World Bank, and the Millennium Development Goals. What all share is a conception of human wellbeing, whereby it consists in several factors, such as education, environmental quality, health, political and social opportunities, and of course income.

It might be said that such a pluralistic evaluation of climate change already exists. Take the IPCC's *Assessment Reports* for example. As indicated above, it is an established practice in the IPCC's Reports to evaluate the impacts of climate change and of adaptation to climate change on multiple dimensions (IPCC 2007). Elsewhere in the Reports, the impacts of mitigation are considered (IPCC 2007). However, the evaluation lacks formality and the sort of unifying framework that might shed more light on the choices we face. Impacts/adaptation are presented in a separate report to mitigation, and the treatment of the two issues, while similar, lacks some consistency.

Doing so, however, raises very challenging questions of aggregation. These are apparently much less at issue in approaches such as economic evaluation, which are interested in maximizing (or at least increasing) the value of a single, homogeneous quantity such as utility. Following such approaches, it is more straightforward to construct a complete ordering over social states (provided one rides over concerns about interpersonal comparisons). Working with multiple dimensions, complete orderings are less easily obtained.

However, the process of doing so is likely to be very insightful. For example, could it be that a particular climate strategy dominates all of the alternatives, because it is better on one dimension, and at least as good on all others? If the dimensions of wellbeing consist mainly in meeting vital needs, it might be the case that a strategy to aggressively reduce carbon emissions, with the vast

majority of that burden borne by the developed world, would dominate any other strategy. This might be true if the impacts of climate change threaten the vital needs of future generations of people in either the developed or currently developing world, *and* that mitigation in the developed world does not threaten to diminish the capacity of people to meet their vital needs. This is often argued, but to my knowledge the proposition has rarely if ever been put to careful empirical test. Even if it is not possible to identify a dominant strategy, it might be possible to identify a range of weights on the dimensions of human wellbeing, over which a particular strategy is best (Sen 1970). That it may not be necessary to come to agreement on unique weights for each dimension is significant. The weights would, of course, be most legitimately derived from some deliberative process.

This pluralistic, but formal, evaluation can be considered a *direct* response to the weaknesses identified with the economic approach. CBA with side constraints can be considered a *supplementary* response (Sen 1999). Both are likely to be informative, but the former may be more so in terms of the choices we face to respond to climate change.

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Figure 1. Utility as a function of consumption for different elasticities of the marginal utility of consumption (shown on the right).