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Climate change mitigation, sustainability and non-substitutability[1]

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Introduction

Climate change policy decisions are inescapably intertwined with future generations. Even if all carbon dioxide emissions were to be stopped today, most aspects of climate change would persist for hundreds of years. Because of cumulative emissions, seas will continue to warm for centuries, and 15 to 40 per cent of emitted CO_2 continue to contribute to warming for more than a millennium (IPCC 2013, 25–6). Anthropogenic climate change thus inevitably raises questions of intergenerational justice and sustainability. The most famous definition of sustainability comes from the Brundtland Report, which defines it as "development that meets the needs of the present without compromising the ability of future generations to meet their own needs".[2] It is clear that climate change poses a serious risk to sustainability. Climate change puts ecosystems under severe stress through increased climate-extremes such as floods, droughts, heat waves and cyclones, and affects crop yields, usually negatively. Melting snow and ice and changing precipitation alter hydrological systems, affecting the quantity and quality of water resources. All of this affects the poor disproportionately, both now and in the future, as they are more vulnerable to climate shocks (IPCC 2014a). Sustainability thus has a strong intra-generational justice aspect to it also, but this chapter will concentrate on the intergenerational side.[3]

While debates around sustainability have been going on for decades, and are perhaps already considered old news in some fields, the concept is very relevant to climate ethics and economics. This chapter argues that since not all natural capital is substitutable, we should invest in mitigation efforts. Climate policies focused mainly on adaptation are not acceptable, although adaptation measures have their role to play, especially as compensatory measures. The role of economics is very prominent in political discussions around climate change mitigation and adaptation. Therefore, to tackle justice issues effectively, one must also look into the ethical assumptions included in economic analyses. The latest Intergovernmental Panel on Climate Change (IPCC) report includes

for the first time discussion on how justice questions could be brought into economic calculations that feed into policy recommendations (IPCC 2014b). It is not an easy task, but an essential one.

The chapter proceeds as follows. The second section begins with a short overview of discount rate debate in climate economics, followed by the observation that discounting implicitly makes the assumption that natural capital is always substitutable with man-made capital (Holland 1995; Neumayer 1999, 2007, 2013; Spash 1993). The following section explores the role of substitutability in discussions around sustainability, and explains why non-substitutability matters if we are to take intergenerational justice seriously and invest aptly in mitigation. Non-substitutability simply implies that there are some forms of capital that cannot be substituted by another, and so consumption of one cannot be compensated with additional stocks of the other. The non-substitutability of critical natural capital can be defended without empirical data about preferences or the need to view the environment as a superior good, and the argument is presented through the language of keeping options open. The fourth section anticipates likely objections and tries to clarify the essence of the debate on sustainability. Those alive today make decisions about what natural capital to use and what to save for future. These choices are often represented as different points in a continuum of sustainability: weak sustainability is associated with a high degree of substitutability and therefore a lot of flexibility over what capital to consume, whereas strong sustainability is more stringent on substitutability. While it may be that in economical understanding weak and strong sustainability collapse into one another, philosophically the emphasis is slightly different. Section five discusses how *normative sustainability* can be supported without ignoring opportunity costs and trade-offs. Section six concludes.

Discounting and its implicit acceptance of substitutability

Discounting is a tool in economics that allows effects occurring at different future times to be compared. Due to the cumulative and long-term nature of the problem of climate change, future generations inevitably have to be incorporated into climate economists' models. There is an inherent intergenerational tension, as future populations will bear the environmental cost of today's emissions, while a large part of the current population benefits from the industrial activities contributing to greenhouse gas emissions. Conversely, people in the future will reap the benefits of mitigation efforts, while the current generation bear the costs, as mitigation efforts mean allocating resources away from other things. When economists make cost–benefit analyses to weight these

options, they utilise discount rates to compare the costs and benefits of climate change mitigation policies that arise at different times. In discounting, all aggregate costs and benefits are expressed in terms of their present value first. Then discounted values are compared to each other, so that a policy is considered desirable if its net present value is positive.

Discounting is traditionally justified with the assertion that present utility counts more than future utility. In economics, future generations are also assumed to be better off than we are. For example, Geoffrey Brennan (2007: 277–80) argues that, on average, each generation over the past 300 years or so has systematically done better than its predecessors, mainly through gaining socially robust institutions and an ever-increasing stock of knowledge.[4] I remain sceptical of the growth optimism, especially with the possibility of runaway climate change scenarios. In any case, just because the material conditions and medical care of the average person has improved vastly in the past few hundred years, taking a bird's-eye view of history gives us no real assurance that this is a trend that will definitely continue.[5] Importantly, even if economic growth were to continue, it does not mean that it would translate to the benefit of those at the bottom of the ladder, even in the future. However, for the sake of the argument, reservations about this assumption will be left aside for the remainder of the chapter as it is not the only problematic one in discounting, as we will soon see.

The exact value of the discount rate has ethical implications, as it determines how the consequences of mitigation are distributed between generations. When payoffs are in the distant future, seemingly insignificant differences in discount rates can make an enormous difference. This has led Martin Weitzman (2012: 309–10) to argue that it may not be too much of an exaggeration to say that, in climate economics, almost any answer to a cost–benefit analysis question can be defended by the choice of a discount rate. To give a prominent example, the 2006 Stern Review on the Economics of Climate Change (Stern 2007) utilised a low discount rate (1.4 per cent per year) and concluded that we should take immediate action to reduce emission, whereas Nordhaus's (2008) analysis assumed a higher discount rate (around 5.5 per cent per year) and reached the conclusion that only a mild reduction in the short term followed by more significant reduction in the mid-term were economically desirable. The choice of discount rate thus leads to differences in policy recommendations regarding mitigation and adaptation. The majority of debates on climate ethics and economics have thus unsurprisingly centred on the discount rate chosen (in addition to Stern and Nordhaus, see also Azar and Sterner 1996[6]; Brennan 2007; Broome 1992[7], 1994; Dasgupta 2007; Weitzman 2012).

Eric Neumayer (1999: 39) argues that attacking the discount rate ignores the real problem: the premise of perfect substitutability – that natural capital is always substitutable by human capital – which "is the implicit underlying theoretical foundation for discounting". Alan Holland (1995) had observed similarly a few years earlier that one of the framework assumptions implicit in cost–benefit analysis is the homogenising of value and preferences: you cannot compare environmental goods with other goods without a common measure of value. Holland notices that if we are to bring environmental goods into the (hypothetical) market, it amounts to pronouncing them substitutable (others to have discussed substitutability include Spash 1993 and Gardiner 2004). To give an example of how the empirical assumption of natural capital being substitutable by human capital is implicit in discounting, Nordhaus's dynamic optimisation economic growth model meshes together benefits and costs as shares of total output, regardless of whether they are about consumption or connected to environmental amenities. Neumayer argues that this is the first of two closely related ways in which the model implicitly assumes substitutability. The other is that material costs and benefits can substitute for environmental costs and benefits, which is implicitly assumed in the way Nordhaus discounts the future. The model utilises Ramsey's (1928) formula for discounting where the discount rate relates to the growth rate of consumption: future counts less as future generations are presumed to be better off due to increased consumption, so increased consumption is implicitly assumed to perfectly compensate for losses in environmental amenities. (Neumayer 1999, 35–7, 2013: 31–4; Nordhaus 2008).

According to Neumayer (2007, 300–1), the Stern Review missed the opportunity to build a more persuasive case for current generations to take immediate, decisive action on climate change mitigation, as it was too easy for critics to point out that the Review's central message is decisively dependent on the discount rate used. Rather than focusing on the low discount rate and possible substantial losses of output, Neumayer argues that the non-substitutability argument could have provided a much stronger case for the measures recommended by the Review. This is because even in the Review's worst-case scenario, people living in 2200 are assumed to be eight times better off than present generations. In contrast, the non-substitutability argument draws attention to how future generations are harmed by climate change in a way that consumption growth just cannot compensate for.

While Neumayer is seemingly correct in criticising the Stern Review for failing to explicitly problematise the assumption of substitutability, he lacks the apparatus to make his argument persuasive. This is because Neumayer (1999: 41–2) concludes that favouring non-substitutability

over "perfect substitutability" is "a matter of belief"[8] at the end of the day, even though "a persuasive case" can be made for the preservation of some (especially life-supporting) forms of natural capital, as the likelihood of these being substitutable is slim (Neumayer 2013: 99). He continues that as there are no "hard numbers" when it comes to climate change, policies cannot be based on them (Neumayer 2013: 44). Economics thus cannot provide a clear answer on what to do about climate change, i.e. to invest heavily in mitigation or not, but it can make the choices more rational and transparent. It is up to us to decide politically if growth in consumption can compensate losses to natural capital. While the question of substitutability of natural capital with human capital cannot be settled by economists or philosophers alone, it does not follow that it is a matter of mere belief and all is up for grabs within political decision-making process. Instead, the next sections demonstrate that a strong case for mitigation can be built based on intergenerational justice.

A matter of intergenerational justice

Considerations of intergenerational justice should compel us to invest substantially in mitigation to protect critical forms of natural capital at minimum, and to keep as many options open for future generations as possible. The idea about freedom of choice in intergenerational justice is of course nothing new. Already in 1987 the Brundtland Report argued that as few future options as possible should be foreclosed.[9] Various arguments have been given to the same effect (in addition to those discussed below, see e.g. Beekman 2004; Dobson 2003; Holland 1999; Norton 1999; Norton and Toman 1997; Weikard 1999). This is not a problem, as the goal of this chapter is not to present some novel argument about intergenerational justice. It is rather to argue that (on a minimal account) the non-substitutability of critical natural capital, and the climate change mitigation investments which that entails, can be defended without empirical data about preferences or the need to view the environment somehow as a superior good.[10]

Capital is a stock that provides flows of service, both current and future. It comes in various forms: natural capital, financial capital, real capital (consumer and investment goods, infrastructure), cultural capital (institutions), social capital (social contacts), human capital (abilities and knowledge, health) and knowledge capital (non-person-bound knowledge). These categories are not absolutely fixed: sometimes it is not possible to give a clear-cut answer whether something is human-made or a form of natural capital. For example, with cultivated natural capital such as farmlands, the difference between natural and artificial is a matter of degree (Tremmel 2009: 66–7).

Despite this, natural capital has many distinguishing features that make it different from all other forms of capital. It is essential to human survival and thus has a basic life-support function. Natural capital is a necessary input for production, transformable and deployable by everyone. Some forms of natural capital are limited in supply and there is irreversibility to their destruction, as natural capital such as minerals are not created or produced by humans. Using up natural capital potentially causes dangerous waste and pollution, and there is an inbuilt rivalry in consumption: if we consume more now, there will be less for future generations. Natural capital comes in many forms: plants, species, resources, ecosystems. Some forms of natural capital have more of the distinctive features listed above, while others are more substitutable. Because resources are limited – and uncertainty, ignorance and ubiquitous risk plague our world – we cannot simply preserve all natural capital. Knowing what to preserve is not easy, though: because we do not have perfect information, we also cannot say for certain which forms of natural capital should be preserved (Casal 2011: 313, 2012: 421; Neumayer 1998: 28–9). Natural capital is not equally distributed across people and nations. Paula Casal (2011, 2012) also points out that, while the distribution is arbitrary, natural resources are easy to redistribute compared to, say, natural talents. Therefore there is no prima facie reason for them to be a source of inequalities.

Environmental economics began tackling sustainability in the mid-1970s (gaining mainstream popularity in the 1990s) to deal with the issue of how much and in which ways the economy can grow without impoverishing the future. Robert Solow (1974: 41) influentially argued that a finite pool of resources should be used optimally, but if there is elasticity of substitution between natural capital and other capital, the pool can be drawn down as long as the stock of capital is added to. The central tenet of weak sustainability is that we can cause pollution and use non-renewable resources as long as we compensate for this with enough man-made capital, be it infrastructure, material goods, education or advances in medicine. Strong sustainability denies this and maintains that some forms of natural capital are non-substitutable, for example that critical forms of natural capital should be preserved. In a continuum of sustainability, weak sustainability is associated with a high degree of substitutability and therefore a lot of flexibility over what capital to consume, whereas strong sustainability is more stringent on substitutability. However, it should be noted that weak sustainability is also compatible with some limitations to substitutability.[11] Economist Wilfred Beckerman (1994: 200) argues that implicit in any definition of sustainability is the idea that any substitution of natural capital by man-made capital is only justified if it contributes equally to human welfare. Strong sustainability always maintains that some forms of natural capital cannot be substituted (perhaps some man-made capital could be branded as non-substitutable also, like unique

artworks or historical buildings). John O'Neill (2014) distinguishes between technical and economic substitutability. A thing that realises the same purpose or a goal is a technical substitute for something (saccharine for sugar). Much of the empirical debate around climate change is about technological substitutability. Technical substitutes are not, however, needed if economic substitutes are available: substituting A with B does not change the overall welfare of the agent. Weak sustainability allows for wide economic substitutability and tends to be linked to high technological optimism, unlike strong.

In economics, the essential problem of sustainability is often presented as lack of decisive information about what future generations would want us to do: their desires and preferences are uncertain to us. Neumayer (2013: 79–80) argues that to defend strong sustainability on empirical grounds, "the proponents of strong sustainability would have to show that individuals have lexicographic preferences with respect to environmental amenities", i.e. they display preference of environmental capital over other capital, and there just isn't empirical evidence to back up the claim. Contingent valuation surveys do indicate that, regardless of costs, substantial minorities of respondents (14–24 per cent of sample) exhibit preferences towards environmental protection. However, these still remain minorities and the preferences indicated remain hypothetical. Neumayer therefore concludes that without "the acid test of real sacrifices" one cannot infer that strong sustainability would in fact be preferred. Daniel W. Bromley (1998) is critical of sustainability and laments that it "is at once a fine idea and a hopeless concept". The present people thus "stand as dictators over the future" as our actions violate all three constituents of freedom: autonomy, opportunity and immunity with regards to the people who come after us. Our dictatorship concerns not so much the amounts of capital to be preserved, but what capital to preserve, what judgements will be of value to the future generations. Maintaining choices for future generations restricts choices for the present people. What sustainability can be, according to Bromley (1998: 234–9), is to provide "suggestion and direction", but what we should do is a question of ethics. I agree we cannot settle the debates of sustainability without basing our arguments on justice.

Usually when natural capital is transformed into man-made capital, it limits the range of options to what use it can be put into. It has been observed that natural capital's paradox "is that the realization of its potential is at one and the same time the limitation of its potential" (Holland 1999: 64). Therefore a balance between natural and man-made capital should exist: if not, we could be locking future generations into a lifestyle of our choice. If we try to act with the best interests of the future generations in mind, surely the best course of action is to keep as many options open for them as is

feasible. Since we do not know what future generations want or prefer, it is good that they have options among which to choose. The question here is not about making the wrong decision for future generations; it is about the possibility of exhausting the future generations' opportunities for making any real decisions for themselves. According to Brian Barry (1997: 104–6), we should sustain the conditions that make it possible to realise a range of conceptions of what a good life is: we should not pre-empt future people's choices, but instead "respect the creativity of people in the future" and maintain equal opportunities across generations. What intergenerational justice demands is that we leave the future generations with a range of choices open to them, instead of some predefined amount of utility. The current generation is not the sole creator of the majority of our capital stock and technology: new generations do not start from scratch. Intergenerational justice, then, requires the maintenance of capital as far as possible, and, when this is not feasible, the creation of additional capital (including technology) and alternative productive opportunities to compensate for the depleted resources and to replace the productive opportunities we have destroyed (Barry 1991: 260–9). Clive Spash (1993: 130) argues similarly when he labels the intergenerational transfers that occur in daily lives – advances in technology, investments in capital and direct bequests – as equity payments that should be made to provide some minimal standard of living. According to Spash, long-term environmental damages are not covered by equity payments, but present a case for liability responsibilities and corresponding compensation. More recently, Joseph Mazor (2010: 408) has argued that present people owe to each other an obligation to conserve natural resources for future people, based on a principled commitment to equal shares to natural resources among contemporaries and the fact that generations always overlap. The older people alive at the moment are thus confronted with demands by their younger contemporaries, who in turn "can anticipate being confronted with the demands of the members of the following generation and so on". O'Neill (2014) makes an important observation that we do not only want to pass on options, but also particulars: this building, this work of art. The relationship between (overlapping) generations is one of deliberation, not of coercion, and the dialogue about the nature of good life is ongoing.

Sometimes options should be closed, of course, for example when doing so eliminates a major threat. If we were given the option of eradicating AIDS or malaria forever, we should do so. However, most of the time when future options are closed, it is for a mundane and simple reason: it is simply inevitable. Whenever we make choices, we incur opportunity costs, i.e. we won't be able to enjoy the benefits that the alternatives would have brought us. We cannot help but close a number of options for future generations in the course of our lifetimes, while opening others:

> Certain alternatives that otherwise would be open for choice in the future are eliminated by acts performed in the present. This is an inescapable fact of life. But another fact of life is that the acts we perform in the present may either increase or diminish the freedom of future generations, depending upon which acts we perform. As civilization develops, later generations are free from certain natural limitations from which earlier generations were not free. (Lemos 1986: 175)

Climate change, however, is not an inescapable fact of life. Climate change – and environmental damage more generally – runs a great risk of foreclosing a wide range of opportunities to act out, or perhaps even conceive, some versions of a good life for future generations (in a runaway climate change scenario, perhaps it may threaten even life itself). Therefore we have to immediately invest in mitigation. We could complicate the argument by talking about capabilities as the metric of intergenerational justice (Sen 1985; Alkire and Deneulin 2009; Gutwald et al. 2011), but the main idea remains the same: intergenerational justice calls for mitigation. In economics, the argument could take the form of the value of capital being a function of the opportunities associated with it. Since future generations cannot have a common social preference ordering with us, the range of choice must be what counts. The range of alternatives in each opportunity set is what allows for freedom of choice to be upheld (Perrings 1994: 96–103). Another possible way of formulating this argument would be to present climate change as a threat to the liberal idea of neutrality.[12] We should try to secure conditions to realise pluralistic ways of conceiving the good life, as destroying certain physical environments irreversibly narrows options (Dobson 2003: 163–9). We might also block future innovations, such as when a plant is found to have new medicinal properties.

Because critical forms of natural capital provide life-support functions, they have lexical priority among natural capital. Such critical forms of natural capital include at least ecosystem services – the benefits we get from ecosystems – for instance, controlling the climate or providing clean drinking water. On the minimal account, intergenerational justice demands that we preserve these for future generations. Without mitigating climate change we are running the risk of serious damage for example to the Earth's atmosphere and climate regulation, critical capital that cannot be substituted. If we had a time machine that could take into account and calculate all future preferences, this would not change the fact that critical forms of natural capital remain non-substitutable, they are not optional: they are the backbone of life on Earth. The important point is that sustainability is a normative issue, not just a technical optimisation puzzle waiting to be solved.

Would you like your sustainability weak, strong or normative, Sir?

This section attempts to separate the normative debate around sustainability from the convoluted usage of the terms associated with it. In climate ethics, the debate is essentially about how immediate and drastic the action to reduce emissions should be, i.e. how much to invest in mitigation efforts. Some of the general debate around weak and strong sustainability (largely predating climate ethics and economics) is generated by the genuine difficulty of working in an interdisciplinary field, and I have begun to doubt if it is useful to employ the terms in climate ethics and economics. Not only do they have a different flavour across disciplines, the problem with using such long-debated concepts is that they have come to mean different things to different commentators. For example, some use "strong sustainability" to denote the idea that none or very few forms of natural capital are substitutable, whereas others link it to the non-substitutability of critical forms of natural capital, as we will soon see below. This is why the term *normative sustainability* is introduced, to try to tease out what the weak/strong debate has been about and to defend the importance of normativity in climate policy discussions.

Beckerman (1994: 194–5) has criticised strong sustainability as unacceptable and totally impractical. He questions the sense of conserving all plant and animal species just for the sake of it, and reminds us that about 98 per cent of all species that have existed during Earth's history are already extinct. Still, does anyone lose sleep over dinosaurs? Beckerman brands strong sustainability as "an absolutist concept" and "morally repugnant":

> Given the acute poverty and environmental degradation in which a large part of the world's population live, one could not justify using up vast resources in an attempt to preserve from extinction, say, every one of the several million species of beetles that exist. (Beckerman 1994: 194)

He clearly defines strong sustainability along the lines of keeping natural capital intact. However, strong sustainability must not be blind to the differences between types of natural capital. Not all natural capital was created equal: some forms are more critical to support life on Earth than others and are therefore always non-substitutable. If we save several million species of beetles, it is of no use if climate change deteriorates the Earth's atmosphere. The key is not to exceed the regenerative capacity of life-supporting, critical forms of natural capital, so that their function is maintained.

Harvesting can be done at the optimally sustainable yield, as long as stocks are not deteriorated. In case of sinks, pollution should not exceed the natural absorptive capacity (Neumayer 2013: 26). By emphasising the importance of some forms of natural capital over others, this understanding of strong sustainability avoids the theoretical pitfalls and practical implausibility of preserving everything in nature. As Bromley (1998: 237) puts it, what we should conserve is not species per se (that would be species fetishism), but rather "the conditions for the recreation of ecosystems". This is not to ignore the very real difficulty of identifying the forms of natural capital that must be preserved, or finding suitable measures and indicators to keep tabs on how well we are doing with sustainability.

Beckerman would probably not be satisfied with this response as he has also criticised proponents of strong sustainability for failing "to indicate the criteria that are relevant in deciding when one is faced with 'absurdly strong sustainability' and when one is not – i.e. by what rule does one decide when there may be some trade-off, after all" (Beckerman 1995: 175). What he abhors are those who claim to know what is good for others without detailed logical arguments, and argues that economists show humility to the plurality of values within democratic societies by concentrating on individual preferences, while at the same time being aware of the limitations of this approach.

However, with climate change it is clear to see that ecosystem services are already under serious threat and the uncertainty that plagues our future calls not just for risk management, but the ethical choice of investing substantially in mitigation. In any case, presenting normative arguments does not translate into thinking that one occupies some moral high ground and knows what is good for others. It is – no more and no less – putting forward an argument about what should or should not be done, the strength of which is to be decided in public discourse. What separates normative arguments from merely voicing one's opinion is that the former should come with an explanation of their logic attached. There needs to be nothing suspicious about normativity. Quite the contrary, it is about facing up to the ethical questions that living together in societies present to us. Normative arguments aim to change the way we think and, most importantly, the way we act. They attempt to bring the ethical issues that demand an open debate to the front. This is why philosophers can be wary of the mask of objectivity that ethical issues can take within economic framework. When new circumstances arise, new ethical issues need to be discussed and weighted. This is of course very much the case with climate change at the moment.

The way sustainability is understood in economics can make it seem somewhat redundant to separate weak and strong versions. This is due to both being compatible with limitations to substitutability. The difference is that in strong sustainability a normative line is drawn at some resource x, depending on the theory, whereas with weak sustainability the non-substitutability of x is always an empirical issue. When economists are wary of strong sustainability, they aren't taking a moral stand against conserving critical natural capital. Beckerman (1995: 178) writes that when a natural resource becomes scarce "its relative price will rise and this will set up a chain of market responses which will tend to discourage its use and encourage the development of substitutes". He continues that, unlike in science fiction, natural resources do not suddenly disappear overnight, and therefore societies have time to adapt to changes in demand and supply.

While Beckerman might be right in most cases, does this really apply to sudden changes in the ecosystem services, such as the ones caused by anthropogenic climate change? Do the markets really have enough time to react, especially as the resource becoming scarce is still (mostly) outside the markets? Even if they did, the argument would remain problematical. After all, it is not purely an empirical issue whether coal is substitutable by solar power, as clean technology needs initial investments to make it a viable alternative. Investments are largely a political decision, as government incentives and available infrastructure affect the kind of energy sources it makes economic sense to concentrate on. Delaying investments in clean technology is an ethical issue also, as mitigation becomes more costly with each passing year. In this way, the substitutability of many forms of natural capital becomes an empirical issue only after the fact, after ethical decisions have already been taken.

While it may be that in economics weak and strong sustainability collapses into one another, philosophically the emphasis between the terms is slightly different. It is not about future shortage of some natural capital that is either met or unmet by technological innovations, thus affecting its market price and demand and supply. Rather, acknowledging the need to maintain critical natural capital like ecosystem services is a normative position about how we are not allowed to knowingly jeopardise the lives and well-being of future people. A line is drawn based on normative arguments over what is an acceptable harm that can be compensated (what is substitutable, if you like) and what is not. Taking an openly normative position, versus belief in the ability of the markets to self-regulate scarcity with market responses, lies at the heart of much of the interdisciplinary literature on strong versus weak sustainability. Due to the various uses of the terms, both of the sides are right

in their own way, but the terms also mask this underlying difference across disciplines. There is thus a risk that the commentators speak past each other.

This is why I propose the term *normative sustainability* to refer to the line that can – and should – be drawn over what natural capital must be preserved for future generations based on normative considerations alone, prior to waiting for market signals over substitutability. Where the line is drawn naturally varies between writers, but here it is on risks to critical life-supporting functions. Inflicting harm can only be done when it is unavoidable and even then it should be compensated for. Harm here means depriving someone of a fundamental interest (Cripps 2013: 10–12).[13] On this minimal account, fundamental interests can be linked to life-supporting ecosystem services. Jeopardising them is a risk too big for us to take. That is why normative sustainability calls for urgent and strong mitigation measures on the policy front. Laissez-faire policies based on watch-and-wait and unrealistically high technological optimism are not acceptable.

Why normative arguments about sustainability need not to be unfeasible

This section defends a plausible reading of normative sustainability to anticipate possible objections, in order to show that normative arguments based on intergenerational justice need not disregard the reality of the world we live in, at least when the concept is applied in climate ethics and economics. I begin with some examples of how easily normative arguments can be misunderstood.

Economists tend to see themselves as technicians and therefore some of them view normative arguments with suspicion. I will use Neumayer as an example of an economist who misconstructs normative arguments on sustainability, as he has written a textbook on sustainability that is already on its fourth edition. While he bases his analysis on the economic methodology, he is not blind to normative issues in economics, and considers – but rejects as implausible – arguments based on intergenerational justice by Barry (1991) and Amartya Sen (1984). Neumayer (1999, 2013) claims that they brand any action that could inflict harm on future generations as unjustified and non-compensable. Great opportunity cost is incurred if we decide not to impose any harm on future generations. Instead, everything depends on what is the compensatory benefit (Neumayer 1999: 40). Neumayer writes: “The verdict that any action that inflicts some harm on coming generations is

unjustified and cannot be compensated for calls for a virtual standstill in economic actions of the present generation."

It is worth spending a moment to dispel the misunderstandings in Neumayer's reading, as they represent quite a common line of argument in the sustainability literature in economics. The suggestion that philosophers, especially the more environmentally minded ones, are simply widely implausible in their recommendations is nothing new. Indeed, if normative sustainability really demanded avoiding all possible harm to future generations, they would be worse off as technological development would be halted and brakes put on, for example, research on renewable energy sources and medicines. Luckily while intergenerational justice arguments might be thin on practical recommendations, they need not be implausible. Industrialisation and technological advances have raised the living standards, conditions and life-expectancy of people around the world (albeit very unequally), reducing human suffering and making human flourishing possible on a wider scale than ever possible, with the possibility for much more. Normative sustainability simply requires that we take the (however unintended, or conveniently ignored) negative effects of these developments seriously, and do not ignore environmental pollution and degradation. The gravest one of the long-term harm caused is climate change, and it might even have the power to wipe out the gains development has brought. Of course it matters if natural capital is converted into things that benefit humankind now and in the long run, such as education for girls or medical advances, instead of some activity with short-lasting benefits conferred upon only a few individuals. Still not everything is up for grabs: future generations will not be compensated by bigger homes, smarter phones or even advances in medicine if climatic stability is jeopardised.

Neumayer's criticism of Barry and Sen seems to be based on misreading the normative arguments he considers. Sen argues that long-term environmental pollution resulting of deliberate action could be seen as a form of oppression of present generations towards future generations (Sen 1984: 194–6; Sen's 1982 paper quoted by Neumayer is republished in Sen 1984). According to Neumayer, Sen ignores the reality of trade-offs. When quoting Sen to support his point, Neumayer importantly omits the original quote's last sentence: "The avoidance of oppression of the future generations has to be given a value of its own" (Sen 1984: 195). This points to considerations of foreseeable, lasting harm being taken properly into account, but not necessarily overruling everything. In fact, Sen (1984: 199) writes that he does not doubt that compromises can be reached. While Sen was quoted out of context, Barry's argument is completely misrepresented by Neumayer. Neumayer (1999: 40) claims that, according to Barry, any environmental damage imposed on future generations

represents a harm that is both unjustified and not amenable to compensation.[14] To support this conclusion, he quotes the example Barry (1991: 264) gives about how doing harm is in general not cancelled out by doing good, and how doing some good does not license one to do harm:

> For example, if you paid for the realignments of a dangerous highway intersection and saved an average of two lives a year, that would not mean that you could shoot one motorist per year and simply reckon on coming out ahead.

However, Barry clarifies that the above example involves "gratuitous infliction of harm" and that the argument *does not apply to resources*. His claim is only that not *all* violations of rights can be acceptably compensated. Barry (1991: 264) continues:

> In the case of resources and future generations, the crucial feature is that we cannot possibly avoid harming them by using up some non-renewable resources … the choice is not between reducing the resource base for future generations and keeping it intact, but between depletion with compensation and depletion without compensation.

Part of the confusion might stem from Neumayer and Barry not spelling out what they mean by harm: I suspect Neumayer's conception of harm might be wider than Barry's. In any case, Barry is clearly not advocating some kind of a standstill in economic actions of the present generations. Quite the contrary, Barry (1991: 265) writes that it is possible that "in the absence of resource depletion, we would in fact be inclined to leave future generations with far less productive potential than, as a matter of justice, we ought to leave them with". Barry thus fully acknowledges the importance of human capital creation: that the generations before us have added to the capital stock that was passed on to us, and that this "thousands of years of technological development" has left us better off (Barry 1991: 266).

One more clarification is required to make clear what is *not* being proposed. Neumayer (2013: 8–10) defines sustainability as development that is able to maintain the capacity necessary to provide non-declining future utility (per capita utility for infinity). But the idea of non-declining future utility is neither convincing nor necessary. Bromley (1998: 238) asserts that the idea "that those of us now alive can never be better off than any representative future generation" places the current people "in a situation of guilt and insecurity". Here we are agreed. It is not irrelevant to intergenerational justice what the starting point of welfare is. But it is not possible to agree with

Barry (1997: 106) writing that “unless people in the future can be held responsible for the situation that they find themselves in, they should not be worse off than we are”.

To illustrate why I cannot agree, this scenario shows why it would be strange to demand that the baseline can never go down. Imagine some 25-year-period in the future where crop yields across the globe exceed all expectations. This could be due to exceptionally advantageous weather conditions caused by some planetary movements, but in any case something that is outside of human control. Previous records are broken everywhere and food supplies are plentiful, allowing for labour normally spent on agriculture to be utilised elsewhere. Once the weather conditions return to normal, why should there be any intergenerational injustice attached to the next generation not having it quite so easy anymore? This is not to argue that any kind of drop between generations is acceptable: at minimum, we should always aim to secure fundamental interests. Capabilities is (again) one route to try to flesh this out, and could be helped to identify what kind of options we should try to keep open, or try to obtain, for future generations. Inequality among people, or generations, who all do very well, is much less of a problem than inequality among people of whom some are seriously struggling while others have plenty. This is why it is unnecessary to demand that future generations must always be at least as well off as the present generation and therefore non-declining future utility would be misleading as a principle of intergenerational justice. Alas, this is (sadly) not a concern for the present moment, as we are very far away from a world where all are doing well, or even close to such a world.

Concluding remarks

Intergenerational justice demands that we invest in climate change mitigation considerably to preserve non-substitutable ecosystem services, and also aim to leave as many options open for future generations as is feasible. Normative sustainability requires that, at minimum, critical forms of natural capital should be preserved, and that inflicting harm can only be done when it is unavoidable, and even then it should be compensated for. How substantial should investment into mitigation be then? While this is a question for politics, the costliness of mitigation is relative: according to the latest IPCC report the financial sacrifices of the current generation would, for example, be below the recent spending on saving banks in the financial crisis.

Where, then, does this leave cost–benefit analyses in climate economics? We should not get rid of them completely; carefully done they can throw light on areas that require more work and help to identify problematic assumptions. As Robert C. Lind (1982: 24) put it, cost–benefit analysis "need not and cannot provide precise answers to policy questions. Rather it is a procedure that can provide a crude but highly useful picture of the relative merits of alternative policies." While welfare economists are aware that market prices are not perfect price signals (the difficult task of determining shadow prices for goods is a way of trying to represent the full social cost), non-substitutability does not get its proper attention. As discounting presupposes substitutability, non-substitutability of critical natural capital reveals the limits to its usefulness. Because of this, and other problematic assumptions (such as endless growth), the ethical assumptions and normative choices made in the calculations that compare different mitigation options should be made transparent. Policymakers and those who use cost–benefit analyses to guide their decision-making should be made fully aware of what they are comparing.

In any case, discretion is required in using cost–benefit analyses. They should never be viewed as neutral tools for policymakers, as normative considerations always come into choosing the discount rate and in deciding whether this can be uniform across different types of capital. This chapter does not claim that economists are unaware of the value judgements that go into making cost–benefit analyses. But the way they are utilised in the political arena with regards to climate change belies the not-so-objective nature of economics. The ethical choices that go into making the formulas should be spelled out and there should be honesty about the moral implications of different options. In other words, these calculations should come with a warning about their limited applicability. Political decision-making will most definitely be needed and not all decisions around mitigation and adaptation will be easy. Awkward trade-off decisions cannot be avoided and it is unlikely that a neat, clear formula can be discovered that would cover all cases. However, the requirements of normative sustainability underline the importance of taking immediate and decisive action on mitigation.

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[2] WCED 1987: 43. This definition has been hugely influential, but also heavily criticised for being ambiguous enough to encompass a wide variety of non-compatible interpretations (Robinson 2004).

[3] IPCC reports show that climate change is already making lives harder for the worst-off. In general, intra- and intergenerational justice issues should both be taken into account when drafting climate change policies. See also note 6 below and Casal (2011, 2012).

[4] Brennan argues that the focus on discount rates in intergenerational justice literature is misleading, as prices are relevant to normative reasoning only derivatively, not intrinsically. Moreover, the whole problem might not even exist due to rising welfare. He does, however, allow that climate change might be a legitimate concern for intergenerational justice.

[5] To give examples, some countries have experienced a drop in their standard of living in the past decades, such as Tajikistan after the collapse of the Soviet Union. Another example is how the introduction of agriculture originally worsened the average person's physical condition for a long stretch of time (Diamond 1987; Larsen 2006).

[6] Azar and Sterner (1996) argue that because developing countries are more vulnerable to climate risks and have less adaptation capacity than OECD countries, the cost to a poor person in a developing country should be valued as a higher welfare cost compared to an equivalent cost to an average citizen of developed countries. Neumayer (2013: 35–9) argues that this reasoning leads to inefficiency problem. With education, for example, real rates of return to investment are very high in poor countries, some 13–26 per cent. Investments in climate change mitigation would be very inefficient in comparison, so the global poor would arguably prefer immediate development assistance.

[7] The Nordhaus and Stern debate is about the social discount rate. Another prominent discounting debate is about the pure rate of time preference. Broome (1992), for example, has argued that inter-generational fairness demands that future generations should not be excluded from political and economic decisions made today. The pure rate of time preference should therefore be set equal to zero, since being later in time should not mean that you count for less. Other prominent philosophers who have criticised pure time discounting in economics include Rawls and Parfit. For a summary of their accounts and an overview of the issues involved, see Van Liedekerke (2004). Beckerman (1994: 198–9) argues that using a discount rate does not mean that we value future generations less: on the contrary, it is a tool for maximising future welfare.

[8] "Whether one believes in one paradigm or the other is ultimately just that: a matter of belief. Hence there is no clear-cut answer on what to do with global warming." (Neumayer 1999: 41). Neumayer's claim in 2013 is more toned down. He writes that "it is hubris to believe that natural or social scientists can make the decision on what should be regarded as 'unacceptably high' costs in society's stead" (Neumayer 2013: 129). However, the book still misrepresents intergenerational justice arguments.

[9] "Economic growth and development obviously involve changes in the physical ecosystem. Every ecosystem everywhere cannot be preserved intact…. Sustainable development requires that the rate of depletion of non-renewable resources should foreclose as few future options as possible." (WCED 1987: 45–6)

[10] I am not taking a stand against theorists who argue that intrinsic value can be found in nature; this chapter leaves the question open. I am merely arguing that normative sustainability can be defended on anthropocentric grounds alone.

[11] An anonymous referee rightly pointed out that if a (non-substitutable) resource that contributes to human

welfare approaches a critical threshold, the shadow price of that resource rises to infinity in a neoclassical growth model. This limitlessly large marginal rate of substitution would then be a signal of non-substitutability.

[12] For a discussion on the common core of forms of liberalism, see Waldron (1987).

[13] Cripps's definition is meant to be as uncontroversial as possible. For a broader discussion on harm, see Shiffrin (2012). Harming future generations inevitably raises the non-identity problem identified by Derek Parfit (1984). There is no scope to discuss that here, but for possible solutions see Cripps (2013: 15–18), Harman (2004) or Meyer (2003).

[14] In his later work, Neumayer (2013: 79) repeats his criticism of Barry, but with a significant addition: "The problem with Barry's argument is that *taken to its logical conclusion* it would imply that the current generation must not impose any harm on the future [my emphasis]." However, he seems to again ignore Barry's distinction between gratuitous infliction of harm and depletion of resources without adequate compensation.