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Carbon Pricing and Intergenerational Fairness

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Abstract: John Broome and Duncan Foley have proposed an ingenious way to transfer benefits backwards in time, from people who are not here yet to people who will not be here in the future. Present people can crowd out conventional, and often brown, investments by issuing global climate bonds (GCBs). The debate about GCBs has focused on whether it is justified to use this financial instrument to allow future people to buy off present people for climate mitigation. In this article, I ask whether it is fair to use GCBs to share the cost of a global carbon price between present and future people. My answer is that it depends on the approach used to calculate the carbon price and, of course, on the normative claims underlying the different approaches. Specifically, I argue that the internalisation principle underlying the cost-benefit approach does not justify intergenerational cost-shifting if, as in most cases, the social cost of carbon is determined using, inter alia, a social discount rate. Instead, the conservative justifications underlying a cost-effective carbon price consistent with the Paris mitigation target allow for intergenerational cost-shifting, but only to the extent of the difference (if any) between the Paris-consistent and the Pareto-efficient carbon price.

Keywords: carbon price; climate bonds; intergenerational justice; social cost of carbon; world climate bank

1 Introduction

Carbon pricing is usually defended by economists and policy experts as the cornerstone of climate change policy because it is both effective and efficient. If everyone today had to pay a social cost for their emissions-generating actions, in addition to the simple private cost, global emissions would fall rapidly, and capital investment would shift from brown to green. Moreover, the collective cost of mitigation would be minimised compared to other policy instruments that do not

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rely on market mechanisms, as the greatest reductions in emissions would be made by those with lower marginal abatement costs (Baranzini et al. 2017; Hassler, Krusell, and Nycander 2016; Stern and Stiglitz 2021; Nordhaus 2019).

Of course, effectiveness and efficiency do not always go hand in hand with fairness. Indeed, a uniform and relatively high carbon price would impose an unfair mitigation burden both on the poor, who would in many cases pay more carbon taxes relative to their income than richer people, and on those who polluted less in the past and/or benefited less from past emissions, who would bear the same mitigation burden for the same current emissions as those who polluted more in the past and/or benefited more from past emissions (Köppl and Schratzenstaller 2023; Tank 2020).

The solution to this seemingly tricky trilemma, involving effectiveness, efficiency and fairness, lies in distinguishing between what Caney (2021, 2014a) famously called the climate action question and the burden-sharing question of climate justice and, in this case, carbon pricing. The former question focuses on who is responsible for doing what climate actions in the collective interest. The latter question is about who should bear the costs of climate actions. Putting a uniform price on carbon for all is a convincing answer to the question of climate action, as it allows for ambitious reductions in CO_2 emissions at the lowest possible cost to society with potential benefits for all. However, this is not sufficient to provide an adequate answer to the question of burden sharing, which should instead be sought both in the use of carbon revenues and, more generally, in the redistributive levers of government (Boyce, Ash, and Ranalli 2023; Mintz-Woo 2021a).

On the one hand, the government can use all or part of the carbon revenues to target the worst-off and/or those least responsible for climate change – which tend to be the same people. One option is equal per capita carbon dividends, which, when combined with a uniform carbon price, can lead to increases in after-tax income for the worst-off and reductions for the best-off, thus having a redistributive effect (Budolfson et al. 2021; Boyce, Ash, and Ranalli 2023). Another more radical option is to allocate all or part of the carbon revenues to the worst-off (Vogt-Schilb et al. 2019). Yet another option is to earmark carbon revenues for green investments that reduce the mitigation burden induced by the carbon price on the most vulnerable, for example, by improving public transport, providing new unemployment benefits for those at risk of losing their jobs due to the energy transition, and so on (Bachus, Van Ootegem, and Verhofstadt 2019).

On the other hand, the government could decide to allocate not only the carbon revenues to the worst-off, but also an amount of resources equivalent to the efficiency gains generated by the carbon price, compared to alternative policies such as command-and-control regulation. The idea would be that everyone participates in the most cost-effective transition possible, but then the benefits of these collective advantages, compared to other policy instruments, only accrue to those

who have less moral responsibility for CO_2 emissions and less ability to contribute to climate mitigation. This can be achieved through specific strategies of wealth redistribution.

In short, carbon pricing plus redistribution (of carbon revenues and/or additional government revenues) seems to be the formula for combining effectiveness, efficiency and fairness of climate change mitigation. An issue that is often under-discussed, however, is what cost responsibility (if any) future people should have for the carbon price paid by present people. To address this question, I will refer to present people as all people who are alive at the time you are reading this text. Past people are those who are unfortunately no longer here. Future people are those who have not yet been born.

Importantly, if present people were to take responsibility for climate action through carbon pricing, they would be the first in human history to do so since the Industrial Revolution. In fact, people in the past have systematically externalised the social costs of their emissions into the future, leading to the build-up of CO_2 in the atmosphere that has today raised the Earth's average temperature to 1.2 °C above pre-industrial levels (Hickel 2020). Moreover, the more ambitious the carbon price introduced by people today, the greater the decarbonisation achieved and the lower the carbon intensity of the society inhabited by people in the future. In a hypothetical future where global CO_2 emissions become net zero, the carbon-price burden would be significantly lower because people could meet most of their needs while emitting far less CO_2 than people do today. Given, among other things, the circumstances just described, is it fair for future people to share some (or all) of the cost of an ambitious carbon price imposed on present people? And if so, how?

2 Is it Possible to Hold Future People Cost-Responsible for the Carbon Price Paid by Present People?

It is useful to address the 'how' question first, because if a convincing answer cannot be provided, the 'whether' question may be superfluous insofar as 'ought' implies 'can'. You might think, for example, that it is impossible for people in the future to transfer economic resources to people in the present, so asking whether this is fair or not is a pointless mental exercise.

Many believe that debt financing is a simple way of borrowing money from future generations. But this is not quite the case, at least not always. If country X issues government bonds that are bought by the citizens of X, it is indeed

creating new revenue, but the money is not coming out of the pockets of future people, it is money provided by X's current investors. What's happening is a redistribution of resources within X. If, on the other hand, country X were to sell government bonds to the citizens of country Y, Y's investors would be injecting new resources into X's economic system, and consequently the people of X would have to repay the heirs of Y's current creditors in the future. In other words, through Y, the present people of X borrow from the future people of X. The limitation of this strategy, however, is that it cannot be applied globally, otherwise we would again be in a closed system with no injection of new resources – as in the case of the government bonds of X sold to the people of X (Gosseries 2023, 140–141). And this, of course, is a problem for the intergenerational shifting of the carbon price burden, since the carbon price needs to be adopted by a sufficiently large number of countries for it to halt global warming.[1]

It is therefore impossible for the unborn to transfer anything, now in the present, to present people, taken globally – at least in the strict sense of the word. However, the recent literature on the idea of setting up a World Climate Bank (similar to the World Bank) sparked by Broome and Foley (2022, 2016) seems to lead both economists and philosophers to the conclusion that it is possible to shift at least some of the global costs of the carbon price (as well as of any other climate policy) to future people by transforming the intergenerational investments of present people. In other words, it is not future people who can give to present people, at least not in the present, but it is present people who can take from future people, by withholding what the former would otherwise have passed on to the latter. In general, present people pass on two types of benefits to future people, those from conventional investments – such as infrastructure, scientific know-how, art, industrial product design, and so on – and those from climate mitigation. Putting a price on carbon means that present people will increase their mitigation efforts, and this will of course come at a cost to them, which will be reflected in reduced carbon consumption – for the simple reason that anything that involves the production of CO_2 will cost more and generate revenue for the government. However, if today's people simultaneously reduce their conventional investments, and thus the benefits that flow from these investments to future people, this may free up economic resources that allow today's people to maintain their consumption more or less unchanged in the face of the carbon price. This would result in an intergenerational cost shift.

1 A different and interesting view is put forward by Rendall (2021), who suggests that one or more 'vanguard' countries should borrow on the global market to finance the development of new green technologies, which could then be transferred to other countries. However, this is not directly applicable to the carbon pricing case we are discussing here.

The financial instrument to put all this into practice would be global climate bonds (GCBs) to be issued by the new international financial institution Broome and Foley (2022, 2016) propose, a World Climate Bank. The mechanism is as follows. National governments would put a price on carbon, either different carbon prices at the national level, more or less homogeneous to avoid/limit carbon leakage, or a global carbon price. At the same time, national governments would also set up a World Climate Bank, which in turn would issue long-term bonds that anyone could buy, in return for a regular interest payment, of course. The creditworthiness of such long-term bonds would be ensured by the fact that many countries would stand behind the World Climate Bank.

With both the carbon price and the World Climate Bank in place, present people buying GCBs would perform a dual function that enables intergenerational cost-shifting. On the one hand, people who buy GCBs do so with money that they would otherwise have invested, at least in part, in conventional activities (e.g. buying property, shares in companies, business assets, etc.). Why should people choose to put their money in GCBs rather than in conventional investments? The first reason is that the revenue-generating activities of the World Climate Bank would increase the global demand for financial capital, leading to higher interest rates. The higher cost of capital would discourage conventional investments, which would require high rates of return to be profitable – this is known as the crowding-out effect. The second reason is that the carbon price would make many conventional investments more expensive and therefore less profitable. In short, the crowding-out effect combined with the carbon price would reduce conventional investments relative to the status quo scenario, to the detriment of future people.

On the other hand, buyers of GCBs would provide the World Climate Bank with money that can be used to reduce the carbon price burden on present people, for example by lowering other taxes or paying carbon dividends (i.e. cash transfers). Present people could choose to use this extra money to cover carbon price-induced increased costs, thus maintaining their brown consumption unchanged, or to enjoy additional green goods and services – of course, the more people who choose the second option and seek to maximise their bank balances, the better for the climate. The revenue generated by the World Climate Bank through the GCBs, it is true, would come from current investors. But it is money that present people are withholding from conventional investments that, if realized, would have increased the consumption of future people.

In short, we could say that the combined effect of carbon pricing and GCBs allows present people to leave future people a world with fewer conventional economic assets, but a better climate, while freeing up economic resources that reduce the carbon price burden on present people. The latter thus bear a lower carbon price

burden than they would have done without GCBs, while future people forego some of the conventional investment that present people would have made without GCBs.

According to Broome and Foley (2022), GCBs could, given our current inefficiencies, lead to efficient climate mitigation at no cost to anyone, whether present or future people (see also Broome 2018; Foley 2009). Their theory is based on what we might call a double equivalence assumption. On the one hand, they assume that it is possible to fully compensate future people for the decline in conventional investment through increasing green investment and reducing climate harms. On the other hand, they also assume that it is possible to compensate present people for the loss of brown consumption by increasing green consumption, with the money coming from the GCBs.

However, much of the literature has raised legitimate doubts about this. The main concern is that Broome and Foley underestimate the negative consequences of the crowding-out effect. At present, almost every country relies on debt to finance some of its public spending, and even more so during periods of global turmoil such as those experienced in recent years, from the Covid-19 pandemic to the recent wars. GCBs would limit the ability of national governments to borrow for purposes other than climate change mitigation, and it would be necessary to understand whether and under what circumstances the revenues generated by GCBs would be sufficient to compensate for this opportunity loss (Lawlor 2016, 359; see also Maltais 2015). In addition, Broome and Foley assume that any behavioural sacrifice induced in the present can be compensated with additional money, but this is probably too simplistic a view. For example, if you were a coal miner and lost your job as a result of an accelerated energy transition, would you feel fully compensated by an unemployment benefit equal to your last salary? For some people, money is probably unlikely to be sufficient compensation for the identity loss that comes with being out of the labour market. One could argue that the revenues generated by GCBs, plus the dynamic efficiency induced by the carbon price, could create new green job opportunities for you. But again, we risk getting bogged down in empirical speculation (see also Caney 2014a, 133–134).

I will take a step back from the 'efficiency without sacrifice' debate and accept the more realistic assumption that mitigating the climate crisis will undoubtedly cost someone something compared to a business-as-usual scenario. What interests me for the purposes of this article is that no one seems to object to the idea that through GCBs, issued by something like a World Climate Bank, it is possible to transfer *at least part* of the costs of the carbon price, paid by present people, to future people. In other words, even if the double equivalence assumption were not given, and the combined use of the carbon price and GCBs would cost present people something, that something would still be less than the carbon price burden that present people would have to bear without GCBs. In the following section, I will examine whether

and under what circumstances present people are morally justified in using the intergenerational redistributive lever of GCBs in relation to the carbon-price burden.

3 Is it Fair to Hold Future People Cost-Responsible for the Carbon Price Paid by Present People?

Broome and Foley (2016, 160) explicitly state that passing on the full cost of the carbon price to future people is unfair, but nevertheless justified – or at least trying to pass on the full cost. Whether this succeeds is a question that, as we have seen, it would be wise to at least keep open. GCBs should therefore be seen as a pragmatic response to the climate inertia of present people, who are held hostage by powerful economic interests in the continued exploitation of fossil fuels. Intergenerational cost-shifting allows future people to buy ambitious climate action from present people. Just like a kidnapping, where the family of the kidnapped person has the option of paying a ransom (Broome and Foley 2022, 7–8).[2]

In a recent paper, Gardiner (2023) argued that it might be fair to pass on some of the costs of the climate transition, and thus of a carbon price we can assume, to future people, provided this is done on the basis of justice criteria rather than (solely) pragmatic considerations. More specifically, Gardiner suggested that instead of a World Climate Bank, which would undermine any norms of intergenerational ethics, we could envisage a Climate Justice World Bank, whose aim would not be to zero out the costs of mitigation for present people, but to involve future people in a scheme of fair mitigation-burden sharing, grounded in principles of intergenerational justice rather than the logic of self-interest and Pareto improvements over morally problematic baselines. In Gardiner's own words (2023, 144–145):

2 I will not discuss whether it is morally justifiable to allow future people to buy off present people in order to mitigate climate change. According to some, Broome and Foley's pragmatic argument rests on a flawed premise: namely, that climate ethics is ill-equipped to deal with the climate challenge because people today would only engage in more ambitious mitigation if it came at little or no cost to them (see Gardiner 2017). Indeed, it could be argued that not everyone acts, or is willing to act, to mitigate climate change solely on the basis of self-interest. As Arrhenius (2022) rightly points out, major policy reforms do not require the unanimous support of political stakeholders. In the case at hand, for example, all that is needed is for a sufficiently strong majority of people to mandate government authorities to force fossil fuel investors to renounce profit maximisation at the expense of the global community, both present and future. Whether it is more or less possible to build this political majority without the promise of efficiency without sacrifice is an empirical question that obviously cannot be answered here.

> Couldn't this bank legitimately impose some burdens on the future? Perhaps it could. After all, many approaches to climate responsibility might endorse the contribution principle ('making the future contribute' to climate action), including ones based in justice. For instance, in general, it seems plausible that most ethical approaches would allow that both future generations and the current generation should contribute something to climate mitigation as part of an intergenerational burden-sharing scheme. Indeed, as far as I know, no one has insisted that the current generation should bear all of the burdens of climate mitigation, no matter what the wider circumstances. On the contrary, it often seems plausible that some burden-sharing across generations is appropriate.

A similar point is made by Rendall (2021; see also 2011), who focuses not only on the costs of mitigation, but also on the future benefits of rapid climate change mitigation. In his own words (Rendall 2021, 978): 'That a given generation must act against a threat need not mean it has the duty to bear the whole burden of doing so … The case for public debt is least controversial when it will benefit multiple generations. The paradigmatic example is funding a major and justified war. Considerations both of fairness and of motivating the war effort speak for debt financing.'

I think both Gardiner and Rendall are right.[3] However, neither of them clarifies what ethical principles should guide this intergenerational distribution, nor what part of the mitigation burden should be passed on from present to future people. Moreover, these authors are interested in the mitigation burden in general, whereas my intention in this paper is to focus on the burden induced by a specific mitigation tool, the carbon price.

The starting point is that there are indeed different carbon prices, which can be distinguished on quantitative, applicative and methodological grounds. First, a carbon price can be more or less modest in terms of the effective rate carbon emissions are taxed at. This typically depends not only on considerations of effectiveness and efficiency, but also on social acceptability and political feasibility (Budolfson 2023). In 2022, for example, several countries responded to inflation caused by international instability, most notably the conflict in Ukraine, by postponing otherwise planned increases in national carbon prices (World Bank 2023, 16–17). Second, a carbon price can be applied in either a carbon tax or a cap-and-trade system. In the case of a carbon price, it is necessary to take into account differences in possible statutory incidence, that is, the higher or lower level of the fossil fuel distribution chain at which the tax is applied, for example, at refineries, petrol pumps, etc. In the case of a cap-and-trade system, it needs to be considered whether the emissions trading process is open only to companies that need the permits to

3 I also believe that Broome and Foley are biting a normative bullet that they should not bite, or at least not fully. They are so concerned with pre-empting normative criticism that they too readily concede that the use of GCBs, however justified on non-normative grounds, always violates norms of intergenerational justice.

cover their own emissions, or whether other intermediaries such as investment firms or banks are also allowed to participate in the primary and secondary markets for emission permits (see Metcalf 2019, 73–85; Cludius and Betz 2020).

Third, the carbon price can be set using two different approaches. The cost-benefit approach suggests that the carbon price should be as close as possible to the social cost of carbon, that is, the discounted economic value of the marginal economic damage caused by an additional tonne of CO_2 worldwide. This calculation is made using so-called integrated assessment models, which bring together Earth and economic systems and analyse how climate-induced changes in the former translate into negative or positive impacts on the latter. Under ideal market conditions, where climate change is the only externality, a carbon price equal to the social cost of carbon allows for Pareto efficiency, as it pushes social actors towards the point of climate optimisation, that is, the point beyond which the global costs (social and private) of emitting an additional tonne of CO_2 are greater than the benefits (social and private). Climate optimisation also leads to effective mitigation, but effectiveness is constrained by efficiency in the sense that mitigation is justified before the optimisation point, but not beyond it (Broome 2012; Heath 2021; Nordhaus 2019).

The cost-effectiveness approach, on the other hand, argues that the carbon price should be that which achieves a given climate mitigation target, which is politically determined rather than based solely on Paretian considerations, at the lowest possible cost to society. The cost-effective carbon price is calculated using economic models that combine a range of data on production systems, emission sources and technological developments to design the cheapest carbon price trajectory consistent with the desired mitigation target. This second approach prioritises effectiveness over efficiency (Boyce 2019; Kaufman et al. 2020; Stern, Stiglitz, and Taylor 2022). With the Paris Agreement, the international community has adopted a target-consistent orientation in the broader climate mitigation discourse, committing to limit global warming to between 1.5 °C and 2 °C above pre-industrial levels, based on a combination of ethical, political and science-based considerations (UNFCCC 2015).

My main argument is that while the quantitative and applicative aspects of carbon pricing are of no help in answering the question of whether it is more or less fair to pass on the costs of carbon pricing to future generations, the methodological aspects are crucial. More specifically, I will argue that the cost-benefit approach to carbon pricing does not justify intergenerational cost-shifting insofar as it relies, inter alia, on a social discount rate in setting the socially optimal level of global warming, whereas the cost-effectiveness approach does, but only for the price difference (if any) between the Paretian and the cost-effective carbon price. More specifically, within the cost-effectiveness analysis, a social discount rate can be used as one of the criteria for choosing between two or more carbon price trajectories that

are compatible with a given mitigation target (see Emmerling et al. 2019) – for example, a trajectory that starts immediately high versus one that starts lower and then gradually rises. However, the social discount rate does not determine the choice of mitigation target (which different carbon price trajectories might enforce), as this is exogenous to the economic analysis.

There are different estimates of both the Paretian carbon price and the cost-effective carbon price. The former change depending on what is included in the integrated assessment models used to calculate the social cost of carbon, and the latter depend mainly on the chosen mitigation target. Typically, however, the carbon price consistent with the 1.5°/2 °C target tends to be significantly higher than that based on the social cost of carbon, since many economists believe that the socially optimal level of global warming at the end of this century is above 2 °C (see Stern and Stiglitz 2021; Murphy 2018).[4]

4 Carbon Pricing and Internalisation Duties

It is commonly thought that people have a moral obligation not to impose negative externalities on others, unless this is justified by some relevant moral facts. For the same reason, people in the present are usually seen as having an obligation not to impose the social costs of their emissions on future generations, as this would be a form of extortion facilitated by a position of temporal power (see Gardiner 2017). What we could call, for simplicity's sake, the internalisation principle should be seen as a mid-level principle, that is, a non-foundational principle that people can agree on despite starting from different foundational principles such as fairness, welfare maximisation, no-harm rule, etc (see Bayles 1986). More specifically, the internalisation principle can find normative justification in at least four lower-level principles (see also Mintz-Woo 2024).

First, the welfare-maximisation principle, according to which climate externalities are morally bad insofar as they are inefficient, that is, they reduce social welfare in a diachronic perspective (Sandmo 1975). Second, the backward-looking principle of remedial responsibility, according to which whoever causes a certain harm must take it upon themselves to remedy and/or compensate for it, especially if the harm is foreseeable and avoidable at a reasonable cost (Tan 2023). Third, the principle of market reciprocity, which holds that negative externalities are morally problematic because they allow individuals to take more from market exchanges than they contribute (Heath 2021, 153). Finally, the fairness-based intuition that it

4 There are exceptions to this, however. See for example Hänsel et al. 2020.

is generally wrong to take most of the benefits of an action and pass on all of the costs to other people (Shue 2015, 20–21).

I believe that present people are not justified in a partial application of the internalisation principle, even if past people did not respect the principle and future people could be significantly relieved of the burden of respecting it, at least in relation to CO_2 emissions. More precisely, if present people could claim that they must bear the internalisation burden only for the temporal position they occupy, that is, following a series of generations that have violated the internalisation principle (at least with respect to CO_2 emissions), then they would be morally entitled to invoke a fair sharing of this burden with future persons, provided that the technical conditions permit. However, present people cannot claim to be disadvantaged because of their position in time, since they would have had to comply with the internalisation principle even if past people had complied with it.

A more relatable example may help to illustrate this. Suppose a tennis club has a rule that each pair of players has 60 min to play, but must use the last 10 min to sand the court before the next pair can play. Like the internalisation duty, the club rule can be normatively grounded in either consequentialist, remedial or fairness arguments. However, the first pair of the day does not fulfil its duty and leaves an unpolished court to the second pair, forcing them to play on a spoilt court. Can the first pair's breach of the club rule justify the second pair's breach of the rule to the third pair's detriment? No, because the club rule refers to the moral obligations that each pair of players has towards their own game and the players following them. This also means that the second pair cannot expect to share the cost of dealing with their own externalities with the third pair just because the first pair has violated the club rule – for example, by asking the third pair to give them, the second pair, 10 min of their playing time. A possible injustice suffered by the second pair can only be resolved with the first pair, if they are still present, but not with the third pair.

However, it could be argued that the case of carbon pricing differs from that of the tennis club for a relevant reason. The number of people who have breached the internalisation duty in the past significantly increases the cost to current people of complying with the same duty. In fact, the social cost of carbon of a tonne of CO_2 emitted at time t_1 measures the climate damage that this tonne will cause between t_1 and t_n, adding to the stock of CO_2 that has accumulated in the atmosphere up to t_1. The greater this stock, the greater the climate damage caused by a marginal tonne of CO_2 from t_1 onwards. Given that most of today's carbon stock is attributable to people who are no longer here, it could be argued that it is unfair for today's people alone to bear the burden of the Paretian carbon price, at least as far as that part of the burden that is a function of past emissions is concerned. This would in fact penalise present people only because of their temporal position, and one could therefore apply

Gardiner and Rendall's argument that future people can be asked to share the cost of a burden that there is no moral reason for present people to bear alone.

The question, however, is what (if any) principle of burden-sharing responsibility can justify intergenerational cost-shifting in the context of a Paretian carbon price. We can certainly rule out fault-based principles, since future people have done nothing wrong, or at least not yet. The two main candidates are the beneficiary pays principle, in the unjust enrichment version (Page and Duus-Otterström 2023), and the capacity principle (Caney 2010a, 213–218). The former principle holds that 'beneficiaries of the activities that caused climate change should shoulder the burdens associated with its management' (Page 2011, 421). Both present and future people benefit from the emissions of people now past to the extent of the fossil-based wealth they inherit. However, past emissions increase the Paretian carbon price that present people must implement to comply with the internalisation principle – and as we have said, the implementation of an ambitious carbon price by present people contributes significantly to the decarbonisation of society, which in turn substantially reduces the carbon price burden on future people. On the one hand, it would therefore be unfair for future people to inherit the benefits of past emissions without having to share in the associated management costs. On the other hand, it would not make sense to say that future people have an obligation to forgo the benefits of unjust enrichment in favour of present people, given the temporal distance between them. However, the beneficiary pays principle could justify present people 'withholding' some of the costs of implementing the carbon price from what they would otherwise have passed on to future people, precisely through GCBs. Broadly speaking, we can say that the richer future people are expected to be, the more resources present people are justified in withholding from them, because the development opportunities of future people will be largely shaped by the socio-economic legacy of present people, which in turn is largely shaped by past emissions (see Baatz 2013, 102). And it should also be emphasised that the unjust enrichment version of the beneficiary pays principle does not require any wrong doing with respect to past emissions (see also Truccone-Borgogno 2023); it is sufficient that past people, more or less culpably, have externalised the social costs of their emissions onto present and future people and that the benefits of a carbon price implemented by present people will accrue to future people, whether or not future people seek those benefits.

A similar conclusion could be reached using the capacity principle, according to which 'the duty to address some problem (in this case, bearing the burdens of climate change) should be borne by the wealthy, and, moreover, that the duty should increase in line with an agent's wealth' (Caney 2010a, 213). The capacity principle would hold that the burden of past emissions should be shared between present and future people according to their respective ability to contribute. The number of

future people is potentially infinite, but the temporal scope of fair burden-sharing is constrained by the financial instrument at our disposal, namely GCBs. And this severely limits the number of future people who can be asked by present people to bear the cost of the carbon price. However, if we assume that future people reachable by GCBs will be richer and more numerous than today's people, the capacity principle would justify a significant intergenerational shift in the carbon price burden.

Both the beneficiary pays principle and the capacity principle may work for the case we are considering, but there is a reason to refrain from using either principle to justify the use of GCBs to shift the costs of a Paretian carbon pricing onto future people: namely, the intergenerational cost-shifting is already implicit in the Paretian approach to carbon pricing, and it lies in the social discount rate used to calculate the social cost of carbon (Fleurbaey and Zuber 2021). The latter, as mentioned, is the discounted economic value of the damage that a marginal tonne of CO_2 will do to the world for as long as it remains in the atmosphere. There are two arguments for discounting the social cost of carbon.

The first and most controversial reason for discounting is pure time preference. For the same induced loss of utility, a climate damage that affects a present person must be given a higher value than a climate damage that affects a future person, from the point of view of present people, because of the simple time distance separating the two persons. The second reason is that of growth discounting. If we assume that a future person is, on average, wealthier than a present person, then it is fair that, other things being equal, the future person spends more money on climate mitigation than a present person. In other words, we must spend less to secure the future person's consumption than we spend to secure the present person's consumption.

More generally, pure time preference is contested by many, especially philosophers, who argue that it is a form of time discrimination no less serious than those based on ethnic origin, gender, age, etc. (Caney 2014b, 323–325; see also Gosseries 2023, 145–146). Those who defend it, on the other hand, take a 'positive' (or descriptive) approach, assuming that individuals, through their market choices, show a preference for present consumption over future consumption and that policymakers must therefore simply aggregate these individual preferences by discounting future collective welfare for the sole reason that it is future; to ignore individual preferences with respect to intertemporal choices would be a form of elitism on the part of policymakers (see Fleurbaey and Zuber 2021). The issue is open and interesting, but of limited practical relevance because, as Mintz-Woo (2021b, 98–99) rightly points out, in the Ramsey formula normally used in integrated assessment models, pure time preference has a much smaller impact on the social discount rate than growth discounting.

However, it is on growth discounting that economists and philosophers seem to find common ground. From a philosophical perspective, as Caney (2014b, 334) notes, growth discounting is justified by a convergence of three classes of normative principles. First, both the utilitarian principle, because of diminishing marginal utility, and the prioritarian principle, which justifies an even higher growth discount rate than the utilitarian principle, because it assigns a lower utility weighting factor to the future person than to the present person (given the difference in wealth). Second, egalitarian principles in the broad sense, which, when applied on an intergenerational basis, should lead us to argue that climate mitigation policies should not exacerbate the expected inequalities between present and future generations. Third, the sufficiency principle, which might justify making people today bear only part of the social cost of their emissions, if it could be shown that the obligation to fully internalise the social cost of carbon risks placing a certain number of people today below a minimum threshold of welfare. Whether and when the latter scenario might occur is a question that I think is best left open, both because in many cases it is possible to satisfy basic needs without emitting CO_2, and because any cost difference between green and brown consumption by the worst-off could be covered by a contribution from the richest of today's people without burdening future people. So, to be cautious, I would say that growth discounting is justified by the convergence of utilitarian, prioritarian and egalitarian principles.

In short, any Paretian carbon price is calculated using, among other things, a social discount rate. The latter is a form of intergenerational cost-shifting. Indeed, by applying a discount rate to the future climate damage caused by present emissions, present people face a Paretian carbon price that is lower than if all the externalities of today's emissions reached (also) present people. The lower the carbon price, in part due to the effect of growth discounting, the less emissions will be reduced in the present, and thus the greater the climate threats to future people. The latter could take the form of either economic losses or the need to invest in adaptation to minimise these losses. This mechanism is justified, as we have seen, by a convergence of intergenerational justice claims, all based on the assumption that the more distant future people are from the present, the greater their wealth advantage and hence their level of social and technological development.

My point is that asking future people to bear the cost of absorbing a discounted social cost of carbon through GCBs is morally speaking too much. It means using the wealth advantage argument to impose a double cost responsibility on future people. This is like saying, for example, that richer people should not only contribute more to the financing of public health care because they are better able to do so, but that they are also entitled to a lower level of public health care than others because they are better able to find alternative health care services in the private market. Once the 'fair' amount to be paid by the rich for healthcare has been established, for example,

as a higher income tax rate than other people, the capacity principle cannot be used a second time to justify reduced access for the rich to the same health services that the rich have 'fairly' helped to pay for. Similarly, once present people are allowed to internalise an economic value of climate externalities that is lower than if these externalities were all manifested in the present, and this is justified on the basis of (only or also) growth discounting, present people cannot re-use the wealth advantage argument, whether in the form of the capacity principle or the beneficiary pays principle, to ask future people to help present people bear the burden of internalising, via the carbon price, climate externalities that have already been discounted. Therefore, in the case of the Paretian carbon price, the GCBs and the social discount rate (in its growth discounting component) should be seen as alternative and/or complementary rather than additional.

It could be argued that to overcome the double counting objection, present people should use GCBs to shift some of the burden of an undiscounted Paretian carbon price onto future people. This is, for example, the solution envisaged by Caney (2014b, 329), albeit in more general terms, when he writes that: 'the *Delaying Action Version* [of growth discounting] is implausible but … the *Deferring Cost Version* is more reasonable (though not problem free)'. Applying Caney's reasoning to the carbon pricing case, it could be said that the fact that future people are wealthier cannot justify a partial (i.e. discounted) application of the internalisation principle, as this would delay climate action, but can instead justify a partial cost responsibility on the part of present people with respect to the internalisation obligation – in other words, 'no' to the social discount rate, and 'yes' to the GCBs.

In summary, both the social discount rate and the GCBs are morally legitimate ways of making future people pay for the Paretian carbon price implemented by present people, but they cannot be implemented simultaneously. Thus, if a government has introduced a Paretian carbon price equal to the discounted social cost of carbon, it is not legitimate to ask future people for money to maintain present people's consumption in the face of the discounted carbon price. Nevertheless, the GCBs could become justifiable if we abandoned, or at least substantially reduced, the social discount rate, thereby raising the carbon price.

There are at least two reasons, however, why the latter strategy is unattractive, at least from a Paretian perspective. First, if we replaced growth discounting entirely with the GCBs, the carbon price would no longer guarantee efficiency, because people would cut emissions beyond the point of global warming optimization (too much, in other words), which would contradict one of the desired tenets of the Paretian approach to carbon pricing. Second, almost all major integrated assessment models use a social discount rate. And the latter is also a clear parameter for translating predictions of future economic growth into a single figure. Abandoning the social discount rate removes a common and relatively precise economic tool for

allocating cost responsibility across generations. Since the social discount rate and the GCBs are normatively equivalent, the practical reasons outlined above should lead to the conclusion that, all things considered, the social discount rate is preferable.

5 Carbon Pricing and Exogenous Mitigation Targets

The cost-effectiveness approach to carbon pricing is lighter on value judgments than the cost-benefit approach, or to be more precise, its value judgments relate to the objective that the carbon price is intended to achieve and can therefore vary. In general, the only value judgement underlying a cost-effective carbon price is that it is better to achieve a desired mitigation target at a lower cost to society than at a higher cost – the mitigation path with the lower total cost may initially be more unfair or penalising to some than the more expensive one, but it is always possible to remedy this by redistributing the costs and benefits of the lower-cost mitigation path (thus making it superior in all respects to the more expensive one).

The adoption of the Paris Agreement's long-term temperature target, including for the purpose of setting the carbon price, rests on a set of epistemic, axiological and moral justifications that are intertwined in ways that are not always well defined and may vary from person to person – for simplicity, I will refer to them as conservative justifications. First, some people may want to take a precautionary stance in the face of epistemic uncertainty. There are so many more or less known risks associated with the destruction of the climate system that it is audacious, to say the least, to think that we can quantify them using economic models. Rather than aiming for the optimal level of global warming above pre-industrial levels, it may therefore make sense to aim for a mitigation target that significantly reduces what scientists consider to be the greatest risks of global warming and that is reasonably achievable given the technological and economic hurdles identified by economists and policy experts (Stern, Stiglitz, and Taylor 2022). Second, some people place either intrinsic or relational value on nature (Deplazes-Zem 2023). This should be taken into account when aggregating individual preferences into societal goals and may justify much more ambitious mitigation than is optimal for a Paretian approach based on integrated assessment models, which tends to view nature losses primarily as income losses (see Fleurbaey et al. 2019, 102–103). Third, some people may believe that the cost-benefit approach to climate policy is morally problematic and that in many cases it is right to protect individual rights, even if this implies deadweight losses (see Caney 2010b).

The conservative justifications that underpin the Paris mitigation target are not antagonistic to the internalisation principle, but rather subsidiary to it. Those who support a Paris-consistent carbon price have no reason, at least prima facie, to deny the moral obligation to internalise the social cost of carbon. However, they might want to say that if meeting the internalisation duty is not sufficient to meet the Paris target, then additional Paris-consistent duties come into play. If people had not recklessly emitted CO_2 in the past (whether more or less culpably does not matter), then meeting the internalisation duty would have been sufficient for people today to keep global warming below the 1.5 °C/2 °C threshold – in other words, a Paretian carbon price today would also have been Paris-consistent. This is for the simple reason that the Earth's temperature inherited by past people would have been much lower than it is today, so that present people would have controlled a larger carbon budget relative to any mitigation target, including the Paris target. There is therefore no obvious reason why today's people should bear the Paris burden alone, provided the technical conditions are in place to share it with future people.

Returning to the tennis example may help to clarify this point. Recall that the club's rule states that each pair has 60 min to play, but that they must use the last 10 min to sand the court – by doing this, the pair internalises the externalities caused by trampling the court for the previous 50 min, and allows the next pair to play on a court that is as good as it was at the start of the day. Suppose, however, that the first pair violates the internalisation duty – whether they do so out of malice, or because they ignore the rule in question, or because they underestimate the problem for the next pair of playing on an unsettled field is irrelevant. The second and third pair do the same. The fourth pair is in a special situation. They know that continuing to play on such a ruined court would cause so much damage that the final 10 min of tidying up would not be enough to allow the fifth pair to play in decent conditions. The fourth pair therefore has three main strategies available.

Strategy 1. The fourth pair starts their game, taking advantage of the fact that the court conditions are still decent, but not good, and then breaks the internalisation duty. The fourth pair therefore plays 60 min instead of 50, to compensate for the damage suffered from the previous pairs.

Strategy 2. The fourth pair starts their game and then sands the clay in the last 10 min. This would not be enough to repair the damage caused by the previous pairs, although it would improve the conditions of the court compared to the first strategy. The fourth pair plays for 50 min.

Strategy 3. The fourth pair spends the first 30 min restoring the court to its original condition using the rake, shovel, water and so on. This would allow all subsequent pairs to play on a court in good condition, provided that all pairs (including the fourth) then sand the clay after the match. The fourth pair loses 30 min of play in addition to the last 10 min of tidying up.

Strategy 1 is morally flawed in that the breach of the internalisation duty by the previous pairs does not justify the breach of duty by the fourth pair towards the fifth, as we have argued before. In both strategies 2 and 3, the fourth pair fulfils the internalisation duty. However, the fourth pair may have moral reasons for preferring strategy 3 to 2. On the one hand, there are reasons of justice. The fourth pair may feel that they have a duty to ensure that no pair plays in conditions below a minimum standard of decency, or that no pair has to choose between playing on a ruined pitch, also risking injury, and not playing at all. On the other hand, there are axiological reasons. The fourth pair might feel that the game of tennis is inherently important, and that it is morally wrong for court conditions inherited from previous pairs to prevent subsequent pairs from playing their best tennis, or even for the game to stop at some point.

The fourth pair therefore chooses strategy 3, sacrificing 30 min of their time slot for court renovation (or in other words incurring extra costs, as those who support the Paris mitigation target are committed to doing). Is it fair for the fourth pair to bear the renovation burden alone, or should they share it with the following pairs? If the previous pairs had complied with the internalisation duty, the fourth pair could have simply complied with the same principle without leaving the following pairs with a pitch in an unacceptable state. Instead, the externalities left by the previous pairs oblige the fourth pair to go beyond internalising its own externalities. There is therefore no moral reason why the fourth pair should be the only one to lose some of its playing time due to the earlier pairs, provided of course that the conditions for inter-pair cost-shifting are given. There are several inter-pair distributions of the renovation burden that are compatible with strategy 3. I will focus on some of them.

Distribution 3.1: The fourth pair spends 30 min renovating the court, 20 min playing and 10 min sanding the clay. The fourth pair plays only 20 min, leaving the fifth pair with a perfectly good court.

Distribution 3.2: The fourth pair spends 30 min renovating the court, 20 min playing and 10 min sanding the clay. In addition, the fourth pair takes 40 min from the fifth pair, suggesting that the fifth pair do the same with the sixth pair. The fourth pair plays for 60 min, leaving the fifth pair with a perfectly good court.

Distribution 3.3: The fourth pair spends 30 min renovating the court, 20 min playing and 10 min sanding the clay. In addition, the fourth pair takes 30 min from the fifth pair, suggesting that the fifth pair does the same with the sixth pair. The fourth pair plays for 50 min, leaving the fifth pair with a perfectly good court.

Distribution 3.4: The fourth pair spends 30 min renovating the court, 20 min playing and 10 min sanding the clay. In addition, the fourth pair takes 20 min from the fifth pair, suggesting that the fifth pair takes 10 min from the sixth pair. The fourth pair plays for 40 min, leaving the fifth pair with a perfectly good court.

Distribution 3.1 penalises the fourth pair simply because of their temporal position in the sequence of playing pairs and is therefore unfair and must be excluded. Distribution 3.2 allows the fourth pair to pass on not only the renovation burden but also the internalisation burden to the following pairs and is therefore also unfair. Distribution 3.3 allows the fourth pair to bear the internalisation burden, but to pass on the entire renovation burden to the subsequent pairs. This distribution is also unfair because there is no valid moral reason why the fourth pair should be relieved of the renovation burden. Distribution 3.4 implies that the fourth pair bears the internalisation burden and also one third of the renovation burden. It is difficult to say how fair Distribution 3.4 is, as it depends on how many other pairs follow and how likely it is that subsequent pairs will stick to the distribution pattern drawn by the fourth pair. For example, if the sixth pair refused to give up 10 minutes to the fifth pair, the latter would lose 20 min and be the worst-off pair of the day. Furthermore, if there were pairs other than the sixth willing to take on the burden, then the fourth, fifth and sixth pairs might want to include pairs from the seventh onwards in the distribution of the renovation burden.

All these circumstances cannot be taken into account here, mainly for reasons of space. The simple point I want to make is that Distribution 3.4 is fairer than Distributions 3.1–3. The fourth pair has to bear both the internalisation burden and a part of the renovation burden, the latter being calculated by dividing the renovation burden by the number of consecutive pairs that can be included in the distributive scheme. This is implied by the application of a general principle of equality in the distribution of a burden between actors with equal capacity to contribute (each pair has 60 min of playing time), equal costs/benefits at stake, and no causal/moral responsibility for externalities produced in the past (see Miller 2001).

Moving from the tennis case to the carbon price case, however, complicates matters considerably. In the first place, it cannot be assumed that all the people who can be involved in the fair distribution of the mitigation burden have the same ability to contribute. In fact, as noted above, it is generally assumed that future people will be wealthier on average than present people as a result of sustained positive rates of global economic growth. Moreover, the instrument of intergenerational distribution at stake in the carbon price (i.e. GCBs) is much more sophisticated and much less flexible than the one discussed in the tennis case.

At this point, I think we have two possible argumentative strategies. The first strategy is to settle for a modest distributive claim: namely, if a mitigation target has been identified that is, all things considered, just and if the most credible estimate of the target-consistent carbon price is higher than the most credible estimate of the Paretian carbon price (or the average of estimates within a range of up-to-date, credible estimates), then present people are morally justified in passing on to future people *some of* the cost difference between the two carbon price estimates. It is then

up to economists to calculate the fair amount of money that present people can demand from future people through the GCBs, taking into account the difference between the two different carbon price estimates.

The second strategy, on the other hand, is less precise but immediately applicable at the policy level. It is based on a number of empirical considerations that make it sufficiently reasonable. Future people are likely to be wealthier than today's people, especially if the latter do not shy away from ambitious climate mitigation. Among other things, the climate transition could enable people in the future to produce energy at a lower cost than today, thanks in part to present people's investments in renewable energy infrastructure. Moreover, because of population growth, there will be many more people in the near future than there are today. We can therefore safely assume, even in the absence of precise economic parameters, that present people are morally justified in passing on to future people an enormous part of the conservation burden, only *slightly less than the total*. However, even if we could quantify the part of the difference between the target-consistent and the Paretian carbon price that present people would not have to pass on to future ones, it would still be so small that it would be extremely difficult to calibrate the GCBs to exclude exactly this part from the calculation of intergenerational cost-shifting. From a practical point of view, the most logical course of action is to make an approximation and assume that present people can pass on to future people a burden equal to the *entire* difference between the two different estimates of the carbon price.

6 Conclusions

In this article I have addressed two questions. The first question is whether it is possible to make future people pay some of the costs associated with the carbon price that both economists and policy experts recommend that present people pay. The answer is yes, and it is based on Broome and Foley's idea of creating a World Climate Bank that issues GCBs in order to, among other things, change the composition of present people's intergenerational investments. The second question is whether this is morally justified. The answer is yes in theory, but more no than yes in practice. If the carbon price that we want to impose on present people takes into account the discounted value of climate externalities, as is usually the case in estimates of the social cost of carbon, then intergenerational cost-shifting would hold future people doubly cost-responsible for the carbon-price burden, as it would be on top of growth discounting. On the other hand, if the carbon price is set according to a mitigation target and is higher than a range of credible estimates of the social cost of carbon, then present people are justified in passing on some of the price difference to future people, which we can say as an approximation is almost all of the difference.

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