The Absurdity of Economists' Sacrifice-free Solutions to Climate Change

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Abstract

John Broome and Duncan Foley have argued that it is a "misperception" that the "control of global warming is costly" (Foley, 2009, p. 125) and that we can make "sacrifices unnecessary". (Broome, 2012, p. 38)

There are a number of assumptions that are essential for this idea to work. These assumptions can be challenged. Furthermore, my claim is not merely that the Broome/Foley argument is flawed, and therefore unlikely to be successful. I will argue that it is potentially harmful, leading to harms for the present generation and for future generations.

The Argument for a Solution Without Sacrifice

In the chapter on economics in his book *Climate Matters*, the economist and philosopher John Broome makes two striking claims. The first claim is that it is possible to reduce our emissions without requiring any sacrifice from anyone. He writes:

> Political progress over climate change has almost ground to a halt because governments are unwilling to commit their people to sacrifices. Making sacrifices unnecessary is a way to break the logjam and get the process moving again. (Broome, 2012, p. 38)

The second claim – even more striking than the first – is that the first claim can be established purely by appealing to economic theory.

He writes:

> Greenhouse gas causes inefficiency, and the definition of inefficiency tells us that it would be technically possible to make some people better off without making anyone worse off. Further, it is technically possible to eliminate the inefficiency in a way that no one ends up any worse off. No sacrifice is required. (Broome, 2012, pp. 43-4)

And he continues:

> Just because the emissions are inefficient, we know that a transfer is possible that is enough to compensate emitters fully and yet still leaves receivers [i.e. future generations] better off than they were originally. This is a consequence of elementary economics of externalities: it is possible to benefit some people without leaving anyone worse off. After emitters have reduced their emissions and received a suitable transfer in compensation, they will be no worse off, and receivers will end up better off. (Broome, 2012, p. 44)

Broome acknowledges that the key ideas presented in his chapter on economics were originally presented in a paper by Duncan Foley. (Broome, 2012, p. 194) Foley claims that:

> The resistance to investing in mitigation of global warming is most often expressed on the grounds that the resources diverted to mitigation would reduce 'economic growth'. The present analysis makes clear that this simply is not true. (Foley, 2009, p. 123)

He explains:

> Correcting the externality by imposing a price on greenhouse gases, whether through regulation, taxation, or a system of tradable emission permits, together with appropriate compensation measures, can increase the consumption of economic goods and services of *both* future and current generations. (Foley, 2009, p. 115)

Foley claims that "The essential economic elements of the global warming scenario can be expressed in a simple economic model involving four elements." (Foley, 2009, p. 116) Those four elements are:

1. C – the "consumption of the present generation".
2. F – the "consumption of future generations, ".
3. K – the "*conventional capital stock* resulting from the investment of current generation".
4. E – the "*climatological capital stock* representing the reduction in the stock of greenhouse gases in the atmosphere due to investments of the current generation in the mitigation of global warming". (Foley, 2009, pp. 116-7)

Essentially, the idea is that we – the current generation – can invest in E, to mitigate against climate change, benefitting future generations, but this doesn't need to involve any sacrifice for us because we can compensate ourselves for this by investing less in conventional investments, K.

Essentially, Foley's characterisation of the issue (based on his simple model) is based on the following:

$GDP^{i} = K + C + E^{ii}$

To make the future generation better off than they would be otherwise, we need to invest more in E. Now, if the extra money for E came from C then we would be making a sacrifice in order to make the future generations better off. But Foley's claim is that we can reduce K instead, leaving C unchanged, thus making sacrifices unnecessary.

"Such a diversion would leave the consumption of the current generation unchanged, and would increase the consumption of future generations", (Foley, 2009, p. 117) because the benefits to the future generations resulting from the mitigation of climate change would be greater than the costs resulting from the reduction in conventional investment in the future.

In fact, Foley thinks that we ought to identity the "price in terms of conventional investment" that "future generations would pay for any degree of abatement of global warming". This, Foley claims, is because "that price determines the *correct price* at which current investments in greenhouse gas abatement should be valued."[iii] (Foley, 2009, p. 116. My italics.)

The appeal of a sacrifice-free solution is not limited to Broome and Foley, however. Nicholas Stern considers it "surprising that it has been so under-emphasised in the economic discussion of climate change" (Stern, Ethics, equity, and the economics of climate change paper 1: Science and philosophy, 2014, p. 427)[iv] and J. Paul Kelleher also defends a sacrifice-free solution. Kelleher's argument is based primarily on philosophical argument[v] rather than economic theory but Kelleher's argument relies on the same core assumptions as the Broome-Foley argument (Kelleher, 2015, p. 76) and he reaches the same conclusion, and ultimately his paper urges "economists and policymakers to help make this a reality." (Kelleher, 2015, p. 68)

Broome's book is a high profile book, with a readership that goes beyond academic philosophers and economists.[vi] As such, if the Broome/Foley argument could potentially be harmful – to both the present generation and future generations – it is important to highlight these flaws.

Interpreting Broome and Foley

The argument is presented boldly, insisting that it is a "misperception" that the "control of global warming is costly" (Foley, 2009, p. 125) and claiming that we can make progress in controlling climate change by making "sacrifices unnecessary" (Broome, 2012, p. 38) and that the "analysis makes clear" that it "simply is not true" that diverting resources "to mitigation would reduce 'economic

growth'." (Foley, 2009, p. 123) But note that Foley's analysis does not include any reference to empirical evidence. It relies entirely on abstract economic theory – and a model with only four elements. This means that Foley is committed to something radical: he is committed to the claim that the conclusion that sacrifices are unnecessary can be established by economic theory alone, without any need to appeal to empirical evidence.

So what is the argument that is supposed to support these two radical claims? At this point, we need to consider different interpretations, and slight variations between the arguments.

Broome writes:

> If we make a sacrifice by emitting less greenhouse gas, we can *fully compensate ourselves by using more* of those artificial and natural resources for ourselves. We can *consume more, and invest less* in the future. (Broome, 2012, pp. 44-5. My italics.)

Occasionally, Foley also talks in terms of *increasing* consumption. (Foley, 2009, p. 115) In general though, and in contrast with Broome, Foley talks about an approach which would "leave the consumption of the current generation unchanged". (Foley, 2009, p. 117)

Unless stated otherwise, this paper will focus on Foley's version of the argument, based on the following:

GDP = K + C + E

So we can reduce K and increase E, leaving C unchanged. Here there is a crucial question of interpretation. What do we mean when we say that C is unchanged? Do we just mean it is quantitatively unchanged, in the sense that the *numbers* that would go into the equation above remain the same? Or do we mean that C is qualitatively unchanged, in the sense that we consume the exact same goods?

It is clear that Broome and Foley are *not* claiming that we can carry on consuming the exact same goods. For example, Foley talks about regulation and taxation, combined with "appropriate compensation measures". (Foley, 2009, p. 115) Presumably, regulations may prohibit the consumption of some goods, and a carbon tax will make certain goods more costly. Clearly, this suggests that C will change (qualitatively). For example, people will drive less, fly less, and eat less meat.[vii] Clearly, these would be sacrifices, in *some sense*. The claim, therefore, must be that we can *compensate* people for these sacrifices, such that there are no sacrifices, *all things considered*.

Once we recognise that the claim needs to be understood quantitatively not qualitatively, we should recognise that there are a number of implications, which give us reason to challenge Broome and Foley. My aim in this paper will be to make *explicit* the assumptions that are often only implicit in the Broome/Foley argument, and to emphasise that they can – and should – be challenged. Even more

importantly, I will emphasise that an appeal to actual data from empirical research cannot simply be replaced by an appeal to economists' assumptions.

In addition, there appears to be an inconsistency in Foley's presentation of the issue. Sometimes, he seems to suggest that we can simply spend more on E, and less on K. For example, he claims that "the consumption of future generations, F, could be raised by lowering K and increasing E" and states that "Such a diversion would leave the consumption of the current generation unchanged" (Foley, 2009, p. 117) On other occasions, however, he suggests that this isn't true. He suggests that there is likely to be a shortfall, but suggests that "The remaining revenue shortfall could and should be met by borrowing". (Foley, 2009, p. 122)

Ultimately though, it is clear that borrowing is part of Foley's picture so it seems that borrowing must be a part of the correct interpretation. Specific concerns about the borrowing aspect of Foley's view will be considered later in the paper.

Finally, there is another issue to highlight, in relation to the interpretation of the Broome/Foley argument – but this time it is less obvious what the correct interpretation should be. What exactly are Broome and Foley claiming? Is the claim that we can address climate change without requiring anyone to make a sacrifice? (Broome, 2012, pp. 38, 44) Or is the claim that we can do so with "no real economic opportunity cost"? (Foley, 2009, p. 125) Or is the claim simply that we can do so without reducing GDP (Foley, 2009, pp. 115-116)? It is not obvious that these are just three different ways of saying the same thing. They are distinct claims. In some cases, my objections may apply more obviously to one interpretation than others. The key arguments, however, have force whichever interpretation we choose.

Sacrifice and Compensation[viii]

Broome suggests that we know that we can do better just because "emissions are inefficient". If we can remove (or reduce) the inefficiency, then – according to Broome – it follows that "[a]fter emitters have reduced their emissions and received a suitable transfer in compensation, they will be no worse off, and receivers will end up better off." (Broome, 2012, p. 44)

However, this ignores the empirical evidence that indicates that transfers to compensate people for losses are, themselves, inefficient. Or, to put it another way, Broome and Foley are, implicitly, appealing to the assumption that there are no costs involved in compensating people for losses. However, the empirical evidence suggests that we should not accept these assumptions. Kahneman et al demonstrate that there is often a discrepancy between "willingness to pay (WTP) for a good and minimum compensation demanded for the same entitlement (willingness to accept [WTA])" and they argue that "many discrepancies between WTA and WTP, far from being a mistake, reflect a genuine effect of reference positions on preferences". (Kahneman, Knetsch, & Thaler, 1990, p. 1326)

Kahneman et al continue:

> Thaler… labelled the increased value of a good to an individual the "endowment effect." This effect is a manifestation of "loss aversion," the generalisation that losses are weighted substantially more than objectively commensurate gains in the evaluation of prospects and trades… (Kahneman, Knetsch, & Thaler, 1990, p. 1326)

This then has implications for the efficiency of transfers that aim to provide individuals with gains to compensate them for their losses. That is, if losses are given more weight than gains, even when they are "objectively commensurate", and if we want to give people compensation that *they* will consider adequate, such that they do not feel that they have made a sacrifice, we will have to compensate them according to the WTA value, rather than the WTP value. In other words, we have to compensate them with gains that have a value *greater* than what would be "objectively commensurate". This is inefficient.

To illustrate this, imagine that you have just bought a house for £350,000.[ix] And assume also that you wouldn't have been willing to pay any more than that. Shortly after moving in, however, you are informed that the local government wants to knock your house down (perhaps because they are developing new rail links), and so you are offered compensation. In the specific case of buying a house, there are particular costs involved. Solicitor's fees and stamp duty, so compensation would need to cover these. However, even if we ignore these practical costs, it is likely that you would want more than £350,000 in compensation for having your home taken away from you. At least, this is what the empirical evidence suggests. Losses are often given more weight than gains.

Because of the discrepancy between the WTA and the WTP, compensation is inefficient. But Broome doesn't consider these nuances. He does not consider the effects of loss aversion, and does not consider possible discrepancies between WTA and WTP. Essentially, this leaves Broome with a dilemma. If he ignores this human element, and compensates people according to what would be "objectively commensurate", he will fail to compensate people to the extent that would be required for a sacrifice-free solution (as highlighted by the example above). Alternatively, if he does compensate people to the extent that no one is required to make a sacrifice, people's loss aversion and the discrepancy between WTP and WTA means that compensation will be inefficient. If Broome is defending a sacrifice-free solution, he must choose the second option.

It is possible that Broome could accept this, and simply accept that this would require us to offer people *more* compensation to cover the discrepancy between WTA and WTP. But note that – even if this might be possible – we must recognise that this is now an empirical question: which inefficiency is greater? Therefore, even if it might be possible, this cannot be established by economic theory alone, without considering the empirical evidence.

This, however, is not the most damning objection. Even if compensation was efficient, Broome and Foley would still have significant problems.

Available Goods

Foley's economic model, with only four elements, does not include any data about whether resources are finite or infinite, or whether they are replenishable or non-replenishable (not to mention any more nuanced considerations). Likewise, Broome's claim that "We can consume more, and invest less in the future" assumes that there is a plentiful supply of things that we can consume but which don't, themselves, contribute to our emissions.

Even if we ignore the possible problem of compensation being inefficient, we can only compensate people if there are goods (or services) available to offer as compensation. And the compensation will only be considered sufficient if people value these new goods as much as they valued the goods that they will now have to do without.

The use of fossil fuels and the depletion of rain forests are significant parts of the problem. The problem for Broome and Foley, however, is that they also provide some of *the most valuable* resources for the current generation. It is far from clear that there are other resources available that will be valuable enough to compensate us for reducing our use of these key resources. And, whether there are or not, the key point is that this is, again, an empirical question.

Foley claims that

> It would *in theory* be possible to compensate current energy users for an increase in carbon-intensive energy prices by a combination of increases in public expenditure for education, health care, and transportation combined with general reduction in income, property, sales, and employment taxes, for example. (Foley, 2009, p. 112. My italics.)

But this is based on a theory that is unusually simplisitic even by the standards of economists. Remember, Foley's theoretical model has only four elements. What reason do we have to think that we can extrapolate from this to the real world?

Transport is likely to involve carbon emissions, even if it is public transport. Of course, I do not deny that investing in public transport while banning private transport, such as cars, would reduce carbon emissions, but even if this is true, this is not a fact that can be established by abstract economic theory. It is an empirical question. Even if we assume that this would result in a reduction in carbon emissions (as surely it would), it is still an empirical question how great the savings would be. It is an empirical question whether we could reduce our emissions sufficiently by simply changing *how* we travel, or whether we would also have to reduce the *amount* we travel. Maybe we will not be able to have foreign holidays. Maybe we will not be able to visit friends and family in other cities every other weekend – even if we relied on public transport. Will we have alternative

goods and services available that would be sufficient to compensate us for these losses?[x]

These are empirical questions which cannot be established by economic theory. If we focus on transport alone, this needn't be a problem for Broome and Foley. They will simply insist that our reduced ability to travel would be another thing we would have to be compensated for, and we could compensate ourselves by consuming other less carbon intensive goods.

But my objection was not meant to be transport-specific. My point is that, for any consumable, it will be an empirical question whether we can consume it without adding to the carbon emissions. More generally, the question is, is there anything that we would want to consume, that we could consume, that will not itself be part of the problem? And if there are, will there be many or few? And, of course, looking at the other side of the equation, these would need to be weighed against the various things that we would be required to give up. Abstract economic theory cannot tell us how these things will weigh against each other.

In short, we are comparing bundles of consumables. Whether we can reduce our emissions and *still* produce a bundle of consumables that would be attractive enough to compensate ourselves for the bundle we would have to give up cannot be established by economic theory, with no empirical data.

Foley or Broome may argue that I can be compensated by a reduction in income tax, and other taxes, leaving me wealthier, with more disposable income – allowing me to consume more to compensate myself. But additional disposable income is of little value if there is nothing of value for me to spend my money on. This then brings us back to the key empirical issue: are there enough things that we can consume that will be sufficient to compensate us for the changes we make to reduce our emissions.

The ideas above suggest a further problem, which is really the problem at the heart of the concerns raised in this section.

Economic Growth and Fossil Fuels

Remember that Foley's argument is based on a simple economic model involving just four elements:

1. C – the present generation's consumption
2. F – the future generation's consumption
3. K – conventional capital stock
4. E – climatological capital stock

Essentially, Foley's argument is simply that we should spend less on K, allowing us to spend resources on E without limiting C.

There are two central problems with this. First, it focuses on just two time periods: the present and the future. Second, Foley treats this as if it is a case of dividing up a cake, rather than recognising that the choices that we make will also determine the size of the cake. That is, he assumes that economic growth will continue, without considering whether our actions to mitigate climate change may have significant impacts which might hinder growth in the next few decades, affecting the present as well as the future generation(s).

Essentially, our economy relies on energy. If we stop burning fossil fuels, and switch to more sustainable energy, will we be able to produce the same amount of energy, or will we have to make do with significantly less energy than we have grown used to? Even if renewable energy and/or nuclear power can replace fossil fuels, how long will it take to build the wind farms, power stations et cetera? If we have less energy to fuel our economy (whether temporarily or permanently), will we be able to produce the consumables we need to compensate people for the consumables lost? These, again, are empirical questions – and Foley provides no way of answering these questions.

On the interpretation of Foley that focuses on GDP = K + C + E, suggesting that we can simply increase E and reduce K, the idea seems to be that there will be no impact on the current generation. Of course, this is not realistic.

In the real world, any lack of energy, and the resulting loss of productivity, would be likely to have significant impacts within a lifetime. Richard Heinberg, for example, argues that the economic growth that we have enjoyed in recent times were not a result of advancements in social institutions, such as Capitalism. Growth resulted, primarily, from our ability to utilise fossil fuels. Heinberg argues that if we radically reduce our consumption of fossil fuels, this is likely to lead to the end of economic growth. Unless we plan for this, he claims, there are likely to be major recessions and hyperinflation. (Heinberg, 2011) Heinberg writes:

> The subsuming of *land* within the category of *capital* by nearly all post-classical economists had amounted to a declaration that Nature is merely a subset of the human economy – an endless pile of resources to be transformed into wealth. It also meant that natural resources could always be substituted with some other form of capital – money or technology. The reality, of course, is that the human economy exists within and *entirely depends upon* Nature, and many natural resources *have no realistic substitutes*. (Heinberg, 2011, pp. 39-40. My italics.)

These are the sorts of considerations that simply cannot be factored in if we adopt an approach to economics that focuses only on "consumption and exchange", simply ignoring details about production and natural resources. (Chang, 2014, p. 121)

In *Beyond Growth*, Herman E. Daly criticises mainstream economics, criticising the common approach of studying the economy without considering its place in the physical world:

> Standard growth economics ignores finitude, entropy and ecological interdependence because the concept of throughput is absent from its preanalytic vision, which is that of an isolated circular flow of exchange value… as can be verified by examining the first few chapters of any basic textbook… The physical dimension of commodities and factors is at best totally abstracted from (left out altogether) and at worst assumed to flow in a circle, just like exchange value. (Daly, Beyond Growth: The Economics of Sustainable Development, 1996, pp. 33-34)

He continues:

> It is as if one were to study physiology solely in terms of the circulatory system without ever mentioning the digestive tract. The dependence of the organism on its environment would not be evident. (Daly, Beyond Growth: The Economics of Sustainable Development, 1996, p. 34)

In another paper, Daly uses another analogy, suggesting that thinking about economics while ignoring the environment, and natural resources, is like providing a recipe that "calls for making a cake with only the cook and his kitchen":

> We do not need flour, eggs, sugar and so on, nor electricity or natural gas, nor even firewood. If we want a bigger cake, the cook simply stirs faster in a bigger bowl and cooks the empty bowl in a bigger oven that somehow heats itself. (Daly, How long can neoclassical economists ignore the contributions of Georgescu-Roegan?, 2007, p. 128)[xi]

So let us consider the ingredients. What cakes can we make if we have less fossil fuels to use, and have to find other energy sources instead?

The physicist David MacKay has argued that we are unlikely to be able to get all the energy we need from solar and wind power, unless we make lifestyle choices too, such that we *need* less energy.

> For any renewable facility to make a contribution comparable to our current consumption, it has to be country-sized. To get a big contribution from wind, we used wind farms with the area of Wales. To get a big contribution from solar photovoltaics, we required half the area of Wales. To get a big contribution from waves, we imagined wave farms covering 500 km of coastline. To make energy crops with a big contribution, we took 75% of the whole country. Renewable facilities have to be country-sized because all renewables are so diffuse… To sustain Britain's lifestyle on its renewables alone would be very difficult. A renewable-based energy solution will necessarily be large and intrusive. (MacKay, 2009, pp. 111-112)

Even if other scientists were to reject McKay's conclusion, or if you argue in favour of an energy mix that includes nuclear power as well as renewable energy, as MacKay does, my main point stands: the conclusions reached by Broome and Foley cannot be established by economic theory alone. There are a number of questions we need to consider:

Can we reduce our emissions even if we continue to use fossil fuels?

Can we maintain economic growth if we reduce our use of fossil fuels?

Can we use nuclear power without imposing risks on the present generation?[xii]

These are all empirical questions. If a reduction in fossil fuel use will leave us with less energy, and if less energy is likely to lead to the end of economic growth and a reduction of GDP in the *near* future, these facts upset Foley's simple model.

However, as we saw earlier, Foley does – in places – seem to acknowledge that these changes, like a reduction in fossil-fuel-use, could leave us with a "shortfall". Foley's response to this was to suggest that this "shortfall could and should be met by borrowing". (Foley, 2009, p. 122)

To put this in terms of the earlier analogy of dividing up the cake, it seems that Foley is *assuming* that the cake will be a bit smaller as a result of the new policies aimed to reduce emissions. So we need to make more cake (by borrowing) before we divide it up, to make sure that C can remain unchanged.

On the face of it, this may make Foley's position look more plausible, but it is not clear that this extra detail makes a significant difference. Even if Foley does acknowledge that our new policies are likely to have an impact on the current generation, what justifies Foley's assumption that the shortfall will be of a size that means that it can be met by borrowing? How can this be established by economic theory?

As an extreme example, imagine the case I will call *Zero Energy*.

> The only way to avoid catastrophic climate change is to stop using all fossil fuels immediately, and we must stop cutting down trees immediately. And imagine also that we do not have solar power or wind power or any other alternative. In such a situation, we would not have the energy sources that we need to fuel an economy. In such a situation, we clearly would not be able to produce a set of consumables that would be sufficient to compensate people for the set of consumables they had to give up.

Of course, this is a hypothetical case, and is not the situation we find ourselves in, but this cannot be established by economic theory. These are empirical questions. But as I have already stressed, Foley's simple model does not include empirical information, and does not include any details about energy sources. Of course, it is reasonable for Foley to work on the assumption that we have alternative energy sources – because we do. But a sacrifice-free solution depends on more than just a possibility of *some* energy. We need to know how good those energy sources will be compared to the ones that we will need to give up. But there is *no* attention to this in Foley's paper. This is why the arguments above, from Daly and Heinberg and others, are relevant even if Foley is assuming that there will be *some* shortfall.

Furthermore, it is worth noting that when Foley talks about a shortfall, he is talking about a shortfall in revenue, not a shortfall in energy supply. "The remaining *revenue* shortfall could and should be met by borrowing". The most important cake here is the energy cake, not the revenue cake. Suppose that we can increase our revenue by borrowing. How is that significant if we do not have enough energy? As stated earlier, additional income is of little value if there is nothing of value to buy, because we do not have the energy needed to produce new goods.

Herman Daly points out that "More capital does not substitute for less resources… You cannot make the same house by substituting more saws for less wood." (Daly, Beyond Growth: The Economics of Sustainable Development, 1996, p. 34) Similarly, increased revenue is not a substitute for energy, but Foley says nothing about energy sources. Foley seems to be another economist suggesting that we can make a bigger cake by "stirring faster" and putting an "empty bowl in a bigger oven that somehow heats itself."

Borrowing

Given the focus that is placed on borrowing, it is also worth highlighting a couple of specific concerns about this aspect of the argument for a sacrifice-free solution. I have already highlighted the fact that Foley does not provide us with any reason to believe that the shortfall will just happen to be one that could be covered by borrowing.[xiii] And I have also questioned how useful borrowing will be if the problem is not so much a lack of revenue but a lack of energy and other resources.

In addition though, there is a further worry. Even if borrowing could be a useful tool for funding climate change mitigation, it is far from clear that it would provide us with a sacrifice-free solution.

There are costs and risks involved in borrowing, and there are limits on how much we can borrow.[xiv] In addition, there are opportunity costs involved in borrowing to pay for climate change mitigation. Assuming that it is economically sensible to borrow more, we could borrow more in order to fund medical research, or to build new schools or new museums. Therefore, if ask people to agree to policies that involve borrowing in order to mitigate climate change to benefit future generations, instead of borrowing to pay for new schools and museums, we are asking them to make a sacrifice. Maltais sums up the problem as follows:

> Given limits to how much debt governments can take on… it seems to follow that a generation that is unwilling to take on significant sacrifices to mitigate climate change is also going to have a strong preference for using debt financing for the sake of more present-oriented goods rather than more future-oriented goods. In other words, there is an opportunity cost here that looks like it is very difficult to compensate. (Maltais, 2015, p. 101)

Cuts that Backfire

Yet there may still be an even more fundamental objection. The arguments above seem to lead to the conclusion that Broome and Foley are over-optimistic, pay insufficient attention to empirical details, and ultimately defend a proposal that is unlikely to work. But they don't seem to lead to the conclusion their proposals could actually be harmful (as I claimed earlier in the paper). This stronger claim is made primarily based on the arguments presented in this section and the next one.

The idea that we can compensate ourselves by choosing to "invest less in the future" assumes that we can make decisions that will impose costs on future generations, without also imposing costs on ourselves, in the *near* future. But it is not clear that this assumption is true.

Rather than the expenditure cuts *compensating* us for our sacrifices, I will argue that these cuts are more likely to have a *negative impact* on the current generation, in the near future.

Robert Frank talks about "Spending Cuts That Backfire" (Frank, 2011, pp. 51-55), giving examples such as cuts in America resulting in paved roads being replaced with gravel roads, or even just left to "erode to gravel". (Frank, 2011, p. 52) Frank states that the problem with these spending cuts is that they "actually end up costing us". He explains:

> Potholes and other road-surface irregularities cause an average of more than $100 in damage to every car and truck on the road, not to mention many needless deaths and serious injuries. (Frank, 2011, p. 52)

Similarly, considering things that we might want to *increase* spending on, Frank writes:

> [W]e could repair unsafe bridges, like the one on Interstate 35 that collapsed into the Mississippi River in downtown Minneapolis on August 1, 2007, killing 13 people and injuring 145. (Frank, 2011, p. 81)

If roads and buildings and other infrastructure etc. would all function perfectly without requiring maintenance for 100 years, and only then crumble and fail, then this might be an option (but we would still have to consider the objection given in the next section). These would be costs that we could leave to future generations. But if the problems, and associated costs, of *not* maintaining infrastructure, come within our own lifetimes, then the savings made by neglecting these things are not likely to compensate us for our sacrifices. On the contrary, they will be more examples of "Spending Cuts That Backfire", making our sacrifices even greater.

Some might challenge my argument here. You might complain, for example, that I have only considered a narrow range of options, and perhaps not the most promising ones. I have just focused on the maintenance of roads and buildings. This simply shows that we need to make cuts somewhere else.

First, in my defence, we should remember that Broome wrote, "We shall leave artificial resources in the form of economic capital: buildings, machinery, cultivated land, irrigation systems, and so on…" and he suggested that, in order to compensate ourselves, "We shall leave less of these resources to future generations". (Broome, 2012, pp. 44-5)

If this is Broome's suggestion, my focus on roads, buildings and infrastructure does not look to be unduly narrow or uncharitable. I am simply addressing the kind of infrastructure that Broome considered. It is not obvious that "buildings, machinery, cultivated land" or "irrigation systems" need significantly less maintenance than roads.

More importantly, my argument was not meant to be limited to these examples. Regardless of specific examples, my argument was meant to emphasise the fact that, if we cut investment – whether that is in roads, or in medical research, or any other example you can think of – it is not plausible to think that this will have no impact at all on those alive today.

Aaron Maltais suggests that "the majority of investments in capital" are intended to benefit the current generation, and only "benefit the future as a by-product". (Maltais, 2015, p. 99) If this is true, one might still argue that this leaves us with the possibility of identifying the minority of investments that benefit future generations without providing any benefit for the current generation. If we can do this, we will have identified the areas of investment where we can make cuts, allowing us to invest more in E, the climatological capital stock. In response to this, I will argue that Maltais seems to have *understated* the claim. It is not clear that we will be able to identify *any* conventional investments where we can make cuts without this having any impact on any of the current generation.

Without considering the empirical evidence for each particular form of investment, there are two reasons to think that Broome and Foley are unlikely to be able to identify even one area of investment where that investment benefits future generations, but brings no benefits to those already alive.

First, the empirical evidence from recent decades, regarding people's willingness to act to combat climate change, suggests that we are not very keen on doing things that benefit future generations but which have no benefit for ourselves. If this is right, it seems unlikely that we are currently investing in things that benefit future generations but do not bring any benefits within a lifetime.

Second, economists in particular should see this clearly. Typically, when economists and policy makers consider the costs and benefits of conventional investments, they work within a rather limited time frame.

> The analyst must select a suitable *time horizon*, that is, the time frame of benefit and cost streams in the analysis. (Fuguitt & Wilcox, 1999, p. 133)

They do not, typically, work with a time frame of hundreds of years. They do not advise governments by saying, "I recommend project P. The benefits will start to

come in sometime around 2265, and the investment will prove to have been money well spent by the year 2300." Their timeframes tend to be significantly shorter than this.

Presumably, the sort of project most likely to have the longest time horizon for the cost benefit analysis would be larger projects. As such, it is telling that, in the book *Decision-making on Mega-projects: Cost-benefit Analysis, Planning and Innovation*, Bert van Wee and Lóránt A. Tavasszy write:

> Due to the generally used discount rates, longer construction periods can significantly reduce the benefits of a project. It is therefore important that a relatively long time horizon is included in a CBA. This should be at least two or three decades. (van Wee & Tavasszy, 2008, p. 43)

It is worth pausing at this point to emphasise that 20 to 30 years is considered a relatively long time horizon. Not standard, or average, but *relatively long*. Admittedly, they do say "*at least* two or three decades", so this of course suggests that some time frames will be longer. Nevertheless, if 20 or 30 years is considered relatively long, this doesn't look good for Foley. Furthermore, we also need to consider the impact of discount rates, and to consider the fact that, if there is a discount rate, the last few years of this time horizon will be given significantly less weight than the more immediate benefits. Van Wee and Tavasszy continue:

> Benefits in the very long term hardly affect the net present value due to the generally used discount rates. (van Wee & Tavasszy, 2008, p. 43)

Thus, it is clear that, even if policy makers opt for a longer time horizon, a discount rate will still result in a greater weight being put on the more immediate benefits. For example, in *Cost-benefit Analysis for Public Sector Decision Makers*, Fuguitt and Wilcox point out that

> [A]fter some 60 to 75 years, the discount factors are extremely low. For example, a benefit of $1 occuring in 60 years, if discounted at 5%, has a present value of only 5.35 cents, and if discounted at 15%, the present value is only two hundredths of a cent. (Fuguitt & Wilcox, 1999, pp. 133-4)

So even if we are using a long time horizon, close to the average life expectancy of an individual, the discount rates commonly used by economists put greater weight on the more immediate benefits than on the benefits that will come after 60 years.

If this is the process that is used to decide which policies and which projects to pursue, this suggests that it is unlikely that there will be even one example of a conventional investment that *only* benefits future generations, with no benefits for people who are already alive. Therefore, if we reduce expenditure on K, believing that we are compensating ourselves for other sacrifices, we will in fact be *adding one sacrifice on top of the other.*

Cuts that Backfire on Future Generations

Related to this, there is a further empirical question that Broome and Foley ignore. What makes a greater contribution to climate change: maintaining goods or replacing them? Franks writes:

> When road maintenance is postponed by even two to three years, the cost of repairs more than doubles. (Frank, 2011, p. 52)

Presumably this will differ, depending on the goods. In most cases, however, it will be better to prolong the life of goods, rather than just replacing them.[xv] We can recycle, but recycling isn't perfect. As Daly emphasises,

> Finitude would not be so limiting if everything could be recycled, but entropy prevents complete recycling. (Daly, Beyond Growth: The Economics of Sustainable Development, 1996, p. 33)

It is very likely, therefore, that Broome's proposal could be counter-productive.

Imagine a number of (non-overlapping) generations, G1, G2, G3, G4 et cetera and consider a resource, R, which the present generation, G1, inherited from the previous generation. If maintained, R will last for many generations. If not maintained, however, R will become unusable for generation G2. Assume also that G2 will not want to be without R, and so will build a new R. Now I will also stipulate that building a new R will result in emissions 100 times greater than would have been required to maintain R. If our aim was to limit climate change in the future, it is quite possible that deciding not to maintain R, diverting money instead into renewable energy, for example, may actually be counterproductive, because generation G2 will build a replacement for R. If later generations also take Broome's advice, G3 too will have to build again, and G4, and so on – each time with emissions far greater than would have been required to maintain R through the generations.

Again, this highlights another limitation of Foley's simplified model, with only two generations. His claim that "The essential economic elements of the global warming scenario can be expressed in a simple economic model involving four elements" (Foley, 2009, p. 116) is clearly false.

Conclusion

The basic claim that we can reduce our emissions significantly without involving any sacrifice does not stand up to examination, and the suggestion that this claim could be established purely by appeal to abstract economic theory is frankly absurd.

Heinberg and Daly emphasise the need to recognise the relation between the economy and the environment, and the link between economic growth and natural resources. In contrast, Foley claims that it "simply is not true" that diverting resources "to mitigation would reduce 'economic growth'" (Foley, 2009, p. 123) without even considering empirical questions about alternative energy sources, and without considering what levels of production would be feasible while limiting the use of fossil fuels.

More worryingly, the Broome/Foley solution is not only absurd, but also potentially harmful. Rather than making everyone better off, the Broome-Foley proposal, which promises to "break the logjam" by making "sacrifices unnecessary" (Broome, 2012, p. 38), could even make everyone *worse* off. Both current and future generations are likely to suffer from the loss of infrastructure. At the same time, the proposals are likely to be counterproductive in relation to the aim of reducing our emissions, because they discourage the proper maintenance of infrastructure.

Some may ask, if we reject this claim, what do we do now? Well, to a large extent, this paper is primarily negative. Its aim was not to provide a positive proposal. However, some conclusions do seem to follow from – or, at least, are suggested by – the arguments presented in this paper. First, we should recognise the severe limitations of mainstream economics, and we should recognise that neoclassical economics relies heavily on assumptions that are simply false. Broome claims that the conclusion that a sacrifice-free solution is possible is a consequence of elementary economics. So much the worse for elementary economics. We should not give such priority to the claims of economists and the conclusions of economic models. We should consider the evidence and arguments from a wider range of disciplines, even if their claims cannot be captured by mathematical models, and even if they talk about a range of conflicting considerations, which don't give a neat answer.[xvi]

If we want to consider whether it is feasible to mitigate climate change, with little or no sacrifice, we need to talk to engineers not to economists.[xvii] If a sacrifice-free solution is not plausible, we must continue to make the moral case for mitigating climate change, arguing that we need to take action even if mitigation will require some level of sacrifice. If there are economic policies that can help, such as implementing a carbon tax and reducing income tax, we should of course consider these options. However, we should not expect economists to provide us with solution that is entirely a sacrifice-free, and we should be careful to make sure that their flawed arguments, based on false assumptions, do not persuade us to adopt policies that are likely to make everyone worse off.

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[i] Of the current generation.

[ii] Thanks to Stefan Kesting for presenting my argument back to me in this form, and encouraging me to present my argument against Foley using this characterisation of the argument.

[iii] Ethically, the claim that this is the "correct price" is controversial to say the least. This paper, however, will not focus on this aspect of the debate. For a better discussion of the ethics, see (Broome, 2012, pp. 45-47) and (Maltais, 2015).

[iv] Stern also presents a similarly simple model. However, Stern's version doesn't focus on one type of consumption, and two types of investment. Rather, Stern simply focuses on two goods, A and B, one of which pollutes, and one doesn't. This, I think, makes Stern's model quite different from Foley's. Stern also seems to show more awareness of the limits of his model, and the (empirical) contingencies that the argument relies on. (Stern, Ethics, equity, and the economics of climate change paper 1: Science and philosophy, 2014, p. 426)

[v] Kelleher appeals to the non-identity effect. I will not address this here, but the argument Kelleher relies on is challenged in my paper "Taking Future Generations Seriously: Rejecting the Non-identity Argument without Solving the Non-identity Problem" (under review).

[vi] My evidence for the this is that, unlike most academic books, Broome's book is available not only as a hardback, but also as a cheap paperback, suggesting a relatively large print run, a cheap kindle e-book, and – most notably – an audio download. Also, anecdotally, when I organised an event on climate change, with the Royal Academy of Engineering, one of the engineers suggested Broome as a speaker, as he had read Broome's book.

[vii] For example, Fredrik Hedenus, Stefan Wirsenius, and Daniel J. A. Johansson claim that "reduced ruminant meat and dairy consumption will be indispensable for reaching the 2°C target with a high probability, unless unprecedented advances in technology take place." (Hedenus, Stefan, & Johansson, 2014) (Also see (Cox, 2013, p. 193) And (McMichael, Powles, Butler, & Uauy, 2007) And (Scarborough, et al., 2014))

[viii] This section owes a lot to Stefan Kesting, who urged me to think of the issue in terms of the inefficiency of compensation, and who also recommended the Kahneman et al paper.
[ix] I thank Elizabeth Ellis for encouraging me not to overcomplicate things, and to focus on this simple example.
[x] Also see (Maltais, 2015, pp. 98-102).
[xi] Thanks to Stefan Kesting for bringing the work of Herman E. Daly – and this analogy in particular – to my attention.
[xii] Not all sacrifices are economic. A reduction in safety and security would also be sacrifices. See (Shrader-Frechette, 2011) and (MacKay, 2009) for radically different answers to this question.
[xiii] Also see (Maltais, 2015, p. 102)
[xiv] See (Maltais, 2015, p. 101) and (Heinberg, 2011, pp. 72-81)
[xv] Also see (Lawlor, 2015)
[xvi] For example, see (Urry, 2015)
[xvii] For example, see (von Weizsäcker, Hargroves, Smith, Desha, & Stasinopoulos, 2009), though I do not believe that this book argues that no sacrifice will be required from anyone.