Pricing Greenhouse Gas Emissions and Sharing the Proceeds Globally

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Abstract

Efficient control of greenhouse gas emissions requires globally uniform taxes on emissions, but less developed countries tend to find such taxes unacceptably burdensome. If we regard the atmosphere as a global asset owned equally by all humanity, then, after relocation payments to those who must leave their homes because of rising seas and rising temperatures, the proceeds of globally uniform taxes on emissions of greenhouse gases should be used for a global basic income. Such a system can be expected to appeal to less developed as well as more developed nations. The efficient levels of taxes are derived in two steps. In the first step, the current generation sets taxes that ensure that future generations have opportunities at least as valuable as their own. There is no discounting of the consequences for future generations. In the second step, the current generation asks themselves how much of their own consumption they are willing to sacrifice to improve the lives of future generations who will be richer than themselves. Benefits for future generations are discounted according to the preferences of the current generation. Different analyses lead to global sharing of the proceeds of both steps of emissions taxes.

**Introduction**

Any well-trained economist knows that, to motivate people to cut back efficiently on emissions of carbon dioxide, methane, and other greenhouse gases, there must be prices for emissions equal to the global marginal social costs of those emissions. In principle, these prices can be achieved *either* by taxes equal to the global marginal social costs *or* by tradable permits, with the quantities set to levels that achieve market prices for permits equal to the global marginal social costs. In practice, the desired result is much more feasible with taxes than with tradable permits.

**Why Taxes and Not Tradable Permits?**

There are two reasons why taxes are better than tradable permits. The first is that, even though there is great uncertainty regarding the optimal rate of reduction in greenhouse gases, we have better information about the right prices than the right quantities. We know that if emissions of a greenhouse gas are controlled efficiently, the prices of emissions will rise over time, as population and average incomes rise. The efficient quantity, on the other hand, will fluctuate with fluctuations in the level of economic activity. An agency responsible for setting quantities of emission permits cannot reasonably be expected to predict accurately the fluctuations in the overall level of economic activity and adjust the quantities of permits accordingly. On the other hand, putting the price on a path of the proper shape is relatively straightforward.

The second reason for favoring taxes over tradable permits is related to politics and fairness. If permits are to be created, there may be a political scramble over who receives them, leading to arbitrary, unfair allocations of permits and decisions that some emitting activities (zookeeping, perhaps) do not need permits. There would be no reason for concern about the fairness of the outcome of a political scramble if all emitting activities that might be taxed required permits and the permits were simply auctioned to the highest bidders. However, when there are things that might be allocated, politicians are rarely able to resist the temptation to allocate those things to their friends.

One reason that tradable permits seem appealing is that they make it possible to create a plan with a goal and a date and know that if the plan is adhered to, the goal will be achieved. Just reduce the number of tradable permits at a constant rate until there are zero, and voilà, there will be no emissions. There are two issues with this reasoning.

The first issue is a practical one that is solvable in principle. To have such a system succeed, it must be global. Efficiency requires that if there are tradable permits, they must be globally tradable, with the same price everywhere at any given time since the global harm from emissions of greenhouse gasses is the same no matter where the gasses are emitted. It would be challenging to devise a system of globally tradable emission permits for greenhouse gases, though it is possible in principle.

The second issue with a fixed reduction schedule is that it relies on the fallacy that there is something wonderful about achieving the goal of net zero emissions of greenhouse gases by a particular date. It would be a bit better to achieve net zero emissions a bit sooner, a bit worse to achieve it a bit later. There is nothing economically heroic about continuing to seek to achieve net zero emissions by a pre-set date in the face of costly unforeseen consequences.

**Why not Command and Control?**

Another way that greenhouse gas emissions might be managed is by a system that specified what emitting activities were permitted and what mechanisms to control emissions were required. There are two reasons why such a “command-and-control” mechanism is inappropriate.

The first reason is that it results in inappropriate prices. A command-and-control system does not charge people for costs that are not subject to control. If there are cattle burps of methane that contribute to climate change but are regarded as not controllable, then no payment is required for those methane emissions. This leaves the costs of these methane emissions out of the selling prices of meat and milk, so that the quantities of meat and milk sold will be greater than they would be if the full social costs were reflected in their prices.

The second reason that a command-and-control mechanism is inappropriate is that no controlling agency can be expected to have the information needed to do the job well. Here is an example. It was reported in 2021 that the addition of seaweed (a source of tribromomethane) to cattle feed can reduce the amount of methane that cattle emit in their burps by up to 82%, without any harm to the cattle.[[1]](#footnote-1) If the cost of carbon dioxide emissions is $100 per ton, then the cost of the methane emissions by cattle is about $1.00 per day. So, a technique for reducing these emissions substantially could be quite valuable. If there was a tax on cattle feed for the global harm from the emissions of methane caused by these methane emissions, with an 82% discount on the tax for feed with the right amount of seaweed added, the news of the impact of seaweed would have been followed by an explosion of economic adjustment. The price of seaweed would have gone through the roof. Abundant effort would have been put into expanding seaweed production. Emissions of methane by cattle would have been brought down with all deliberate, economically reasonable speed.

An agency with the power to command cattlemen to reduce emissions of methane would have a very difficult time replicating what the market could do. Such an agency would not know how to expand the production of seaweed. It would not know the rapidity with which expansions should be sought. When more seaweed was produced, it would not know to which cattle operations should be told that they must add seaweed, and which should be told to wait until later. We cannot expect an agency with command-and-control powers to replicate the market. For efficient control of greenhouse gases, we need prices of emissions equal to the global marginal social costs of emissions.

**Resistance to Globally Uniformity**

Efficiency requires that the prices of emissions of greenhouse gases be globally uniform. The consequences of emissions are the same no matter where on earth the emissions occur, so the prices of emissions should be the same everywhere. Less developed countries balk at this idea. Their argument against globally uniform prices for emissions has two strands. First, representatives of less developed countries say that they simply cannot afford to pay what the developed countries can. Second, they say that the world would not have the climate problems that it now has if the developed countries had not been so extravagant in their emissions of greenhouse gases for so many years.

These are not adequate reasons for not applying greenhouse gas taxes in less developed nations. The low incomes of less developed nations are indeed a serious problem, a problem that ought to be addressed by policies that raise the productivity of these nations. It is not good policy to maintain an artificially low price of any one item, including emissions of greenhouse gases. An artificially low price of greenhouse gas emissions for some economies will distort those economies in favor of the production, and especially the export, of goods that are high in greenhouse gas emissions.

Furthermore, while it is true that past emissions have not been taxed in the way that efficiency would have required, leaving future emissions in less developed countries untaxed does not correct this error; it adds an additional error. The adjustment for less developed countries should come not by leaving some emissions untaxed, but by better distribution of the tax revenues.

**The Distributive Analytics of a Greenhouse Gas Tax**

Figure 1 shows the distributive analytics of a greenhouse gas tax. Line AB represents the rate of emissions of a greenhouse gas (say carbon dioxide, on the horizontal axis) as a function of the price that is charged for emissions (on the vertical axis). It is equivalent to a demand curve. Line CD is set at the level of the tax on carbon dioxide. The level of the tax can be chosen, and as the tax varies, the quantity of emissions varies, as specified by line AB. Line CD can be considered a horizontal supply schedule, chosen by the world community, for the right to emit carbon dioxide.

**Figure 1:** **The Distributive Analytics of a Greenhouse Gas Tax**

$/ton

A

D

E

C

Efficiency gain from proper pricing of emissions

Transfer from emitters of gas to recipients of tax revenues

Loss of
current output
for the sake of future benefits

B

tons/day

0

F

For the level of the tax on carbon dioxide that is chosen, the level of emissions is given by line EF. The revenue per day generated by the tax is the rectangle 0CEF. Area BEF is the loss of output per day from actions taken to reduce carbon dioxide emissions. Area BED is the estimated efficiency gain from eliminating emissions that are not worth what they cost. Rectangle BDEF is the estimated reduction in environmental harm that results from reduced emissions.

Now consider Figure 2, which shows the consequences of a small change in the price of emissions. When the tax on emissions rises to the level represented by line C⸍D⸍, the quantity of emissions falls to the level represented by line E⸍F⸍. Area EE⸍F⸍F represents resources that had previously been received as revenue from the greenhouse gas tax but are now allocated to reducing emissions, because of the higher price of emissions. The restriction in emissions represents a loss of current well-being for consumers of goods and services that cause emissions and for owners of factors of production that are specialized in the production of goods and services that cause emissions. It also represents a gain of well-being now and into the future for people who would have been affected by the emissions that were avoided. The reduction in emissions tax revenue is an off-setting gain for those who lose from the added control and a loss for the recipients of the tax revenues.

**Figure 2:** **The Consequences of an Increase in a Greenhouse Gas Tax**

$/ton

A

E⸍

D⸍

C⸍

E

D

C

B

F

F⸍

tons/day

0

Area CEE⸍C⸍ represents money that had previously been kept by emitters but is now paid as additional greenhouse gas taxes. It is a gain for the recipients of greenhouse gas taxes and a loss for the producers and consumers of goods and services that cause emissions. Whether the total amount paid in greenhouse gas taxes rises or falls (combining the addition from CEE⸍C⸍ and the subtraction from EE⸍F⸍F) depends on the elasticity of the demand for being allowed to emit greenhouse gases (the ratio of the percentage change in quantity to the percentage change in price as one moves along curve AB). If the elasticity is less than 1, then tax revenues increase as the tax rate increases. If the elasticity is greater than 1, then tax revenues fall as the tax rate increases.

Economic efficiency requires that the height of line CD be the global marginal social cost of emitting a ton of carbon dioxide. However, once carbon dioxide is emitted into the atmosphere, it persists and has consequences for centuries. This makes any notion of an identification of the marginal social cost of such emissions tenuous at best. It is better to think of the choice of the height of line CD as a global collective decision that ought to be made on the basis of understanding of the consequences of the decision and the equities that are involved in it.

**Ensuring that Future Generations are Not Worse Off**

The first equity that ought to be addressed in the choice of a level of tax for emitting carbon dioxide or some other greenhouse gas is the obligation of the current generation to ensure that future generations do not inherit a world that gives them opportunities that are less valuable than those available to the current generation. If the overall quality of life is going down, then the current generation is indulging too much in its own consumption and not doing enough for future generations. Emissions of carbon dioxide and other greenhouse gasses affect the well-being of future generations because such emissions cause:

* Atmospheric temperatures to rise
* Ocean temperatures to rise
* Storms to become more frequent and more severe
* Ice caps to melt
* Sea levels to rise and shorelines to contract
* Some inhabited island to become totally submerged in the oceans
* The pH of the oceans to fall, coral reefs to die, and various sea creatures to have difficulty making their shells
* Some cold areas to become more habitable by humans and more fertile
* Changes in the plants and animals that thrive in various places, with some species becoming extinct.

Despite the negativity of almost all these consequences, we cannot know whether people are better or worse off overall until we take account of other dimensions of human well-being. The most obvious additional component of human well-being is income. The most available global measure of income is per capita GDP. It is highly inadequate as a measure of income, but it is a starting point.

Figure 3 shows the history of global per capita GDP since 1960. The following things might be noted with respect to Figure 3. First, global real per capita GDP roughly tripled between 1960 and 2023. Second, line is more linear than exponential, implying that the annual percentage rate of growth has been declining over time. For the 10 years beginning in 1960, real per capita GDP grew at an average annual rate of 3.0, while for the 10 years ending in 2023 it grew at an average annual rate of 1.7%. Third, the growth of real per capita GDP has been rather steady, with just a few slips for economic difficulties.

It is reasonable to expect global real per capita GDP to continue to grow at a declining rate. Technology continues to improve. Capital continues to accumulate. Children receive more and more education. Birth control is available to more and more women, permitting them to have no more children than they want and spend more time in the workforce. For all these reasons, global real per capita GDP can be expected to continue to grow at a rate of about $250 per year.

However, while global per capita GDP is probably reasonably well correlated with the measure of well-being that interests us, for several reasons it is not the right measure of whether future generations have life prospects as good as our own. First, simply as a measure of economic income, one would want to use net domestic product (NDP) rather than GDP. NDP subtracts the value of the capital that is used up in the production process. But that depreciation is hard to measure, so people are often content to act as if GDP measures income.

Second NDP leaves out many things that affect well-being. Unpaid household production is left out. The quantity of desired leisure that people have is left out. (Undesired leisure from involuntary unemployment should count in a negative way.) Measures of health and longevity are relevant to a proper measure of well-being. To address the question of whether future generations have prospects of well-being as good as our own, we need a measure of global real well-being that incorporates all these things. This is understood, and people have been working on it.

One effort to provide a more meaningful measure of human well-being is the *capability approach*, developed by Amartya Sen[[2]](#footnote-2) and Martha Nussbaum.[[3]](#footnote-3) The capability approach identifies human well-being with such things as the ability to live to a healthy old age, the ability to choose from a variety of possible economic transactions and job possibilities, and the ability to participate meaningfully in political deliberations. Good nourishment, education, and physical and mental health are prerequisites for access to capabilities.

The capabilities approach has been an important source of inspiration for the *Human Development Index* produced by the United Nations Development Program. This is an index that combines measures of life expectancy, education, and per capita income on a scale of 0 to 1. Later, an adjustment for inequality was added to the index.

The goal toward which these efforts point is an agreed measure of what humanity accomplishes in human advancement. It should reflect real income, health, longevity, education, work/life balance, political liberty, economic liberty, social connectedness, environmental diversity and abundance, and perhaps other things as well. It should be measured not just as an average for a population, but as a distribution across a population.

Suppose that our efforts to agree on how to specify and measure such a concept are successful. Call the concept real well-being, or RWB. I would suggest that, like the human development index, RWB should be measured on a fixed interval, perhaps 0 to 100. Rather than being a weighted average of components, it should reflect the increasing scarcity value of scarce things as they become scarcer.

To attend to our responsibility to ensure that future generations are no worse off than ourselves, we will need a forecast of the distribution of RWB into the future. We should understand that we have an obligation to seek to ensure that the cumulative distribution of RWB be everywhere non-worsening. That is, for every level of RWB, the fraction of the global population who are forecast to have that level of well-being or less should be no greater for every future generation than it is today. Then we could say that we expect that future generations will be at least as well off as ourselves.

Thus, the goal of the first step in identifying the proper levels of greenhouse gas taxes is to identify the levels that are the greater of:

1. The levels needed to raise the revenue needed to pay the relocation costs of the people who will need to relocate because of rising sea levels and hotter temperatures, and
2. The levels needed to ensure that future generations will have distributions of real well-being that are uniformly at least as good as our own.

If, as is likely, B is greater than A, then the difference between B and A serves as the basis for a global basic income.

Note that in this analysis, all generations are treated equally. No discounting is involved.

**Global Sharing of the Proceeds of Global Greenhouse Gas Taxes**

When one imagines a system of globally uniform greenhouse gas taxes, the simplest version of such a system to imagine would be one in which every country levies a tax at the same rate and keeps for its own fiscal purposes the revenue that it collects. There are four important reasons for having, not such a system, but rather a system in which the revenues are shared globally among countries in proportion to their populations.[[4]](#footnote-4)

1. The first reason for sharing greenhouse gas revenues among nations in proportion to populations is simply because it may then be possible to get agreement that would otherwise be impossible. Trying to persuade less developed countries that they need to retard their economic development with greenhouse gas taxes is a very hard sell. Global sharing of all greenhouse gas revenue gives less developed nations an incentive to participate, in terms of the overall impact on their incomes.
2. The second reason for sharing greenhouse gas revenues among nations in proportion to populations is compassion. Less developed nations are struggling to succeed. Global sharing gives them a hand up.
3. The third reason for sharing greenhouse gas revenues among nations in proportion to populations is that there is a plausible theory of justice that requires it. Managing the levels of greenhouse gases in the atmosphere is a project that can only be accomplished with full global cooperation. Any emission anywhere on earth reduces the emissions that can be allowed everywhere else while maintaining a specified limit on environmental consequences. Since everyone on earth is affected in this way by each emission, it is reasonable to regard each emission as jointly allowed by every on earth, and therefore a source of compensation for everyone on earth.
4. The fourth reason for sharing greenhouse gas revenues among nations in proportion to populations is that the workability of the system may require it. If every nation keeps the revenue from the emissions that occur in that country, and if the tax rates are the same in all countries, then there will be a serious risk of corrupt bargaining for the opportunity to be the country where emissions occur. Imagine an entrepreneur planning the construction of a cement plant that will produce one million tons of cement per year and approximately one million tons of carbon dioxide. At $100 per ton, that would be $100 million per year in emissions taxes. The entrepreneur might say or hint that for the right consideration, the plant would be built in one country rather than another. Such bargaining for the opportunity to be the country where emissions occur would undermine the incentive effects of greenhouse gas taxes and turn the whole program into a sham.

For whatever subset of these four reasons is convincing, there should be global sharing of the proceeds of globally uniform greenhouse gas taxes.

The program would entail a significant transfer of greenhouse gas tax revenue from developed to less developed countries. For this reason, developed countries would need to agree to the program out of conviction, while nearly every less developed nation would find it financially worthwhile to participate.

The possibility that some nation would decline to participate cannot be precluded. The exports of any such nation should have equalizing tariffs applied to them to charge for the greenhouse gas emissions in their production. This condition should induce all or nearly all nations to participate.

**Climate Improvement as Infrastructure Investment**

The analysis in this section is undertaken so that the idea it develops can be rejected.

Making current sacrifices for the sake of future climate benefits has an analog with infrastructure investments. When we build a bridge or make some other infrastructure investment, we sacrifice current consumption for the sake of future benefits. Such projects are often financed by borrowing. Future people need to pay the debt that was incurred to undertake the project, and we justify this by the fact that they also get benefits from the project. If the project is worthwhile, then there is a structure of repayments on the debt such that people in every period are better off.

Similarly, after we have ensured that future generations will be no worse off than ourselves, we have opportunities to sacrifice current consumption for future climate improvements. If instead of sacrificing current consumption we borrow and assign the repayment of our debt to the future generations who receive the climate benefits, we have a possibility of making all generations better off.

We should reject such an idea because requiring future generations to pay the debts we incurred infringes improperly on their liberty. What, then, of the justification of infrastructure investments? The ethical foundation of such assignment of debt to future generations can be problematic. Debt for infrastructure is potentially less problematic because worthwhile infrastructure raises surrounding land value, providing a source of financing for infrastructure that does not impinge on the earnings of future generations. Project that require collecting income taxes from future generations are problematic in impinging on the liberty of future generations. Thus, borrowing should not be used to offset the reduction in current consumption that is needed to provide climate benefits for future generations.

**Climate Management as a Gift to Future Generations**

After we have provided for paying the relocation expenses of those who need to move because of the climate change that we allow to occur, after we have ensured that future generations will have distributions of real well-being that are at least as good as our own, and after we have rejected the possibility of borrowing to finance climate management, there is a further reason to limit climate change by raising greenhouse gas taxes: We may care enough about future generations.

When we have done enough to ensure that future generations will be at least as well-off as we are, we may want to do more for them because we value the benefits for them more than the costs to ourselves. Parents often sacrifice so that their children can have lives that are better than their own. Similarly, a whole generation may want to sacrifice some consumption that they could have, to make life better for future generations, even though those future generations who will benefit will be richer than themselves.

Such a desire to sacrifice for future generations is likely to be more prevalent as incomes increase. So, for analytical purposes, divide the world into developed and less developed nations, and consider the calculation of the developed nations. Since they will be providing a gift to future generations, the gift can be whatever size they choose. Since they have the possibility of making different kinds of gifts, they would reasonably want a systematic process for comparing the value of different gifts. Such a process could be expected to involve a kind of discounting that would have a different foundation than the interest-based discounting that is customary in economics. Instead of asking about the rate of return on investments or the relative value of one’s own consumption at different times, one would ask how much this generation values an increase in the consumption of those who will be alive in 2040, or 2060, or 2080.

There are two reasons why we are likely to value benefits for future generations less and less as time extends into the future 1) we identify less with them, and 2) they are likely to be richer and richer as time goes on. Thus, to set the right price on emissions of greenhouse gases, we need to ask, for each increase in the tax (as from C to C⸍ in Figure 2), involving the loss of current consumption of EE⸍F⸍F and the extra taxes CEE⸍C⸍ that need to be paid, do we find these costs adequately compensated by the combination of the benefits to future generations (valued as we choose to value them) plus the extra income for the recipients of the tax revenue represented by CEE⸍C⸍ minus EE⸍F⸍F. We want to continue raising the greenhouse gas tax until the additional benefits of a further rise are no longer greater than the additional costs.

Now consider the less developed nations. We might expect them to say, “These gifts are your idea. We do not value the opportunity to make future generations even richer than they will already be. Count us out.”

The first reply of the developed nations should be, “Yes, we have no right to make you participate, but you should understand that, since efficiency requires globally uniform taxes on greenhouse gases, we will need to apply equalizing tariffs on your exports for the greenhouse gas emissions in their production if you do not participate.”

The second reply of the developed nations should be, “Equalizing tariffs are a pain, and we really don’t like the idea of impoverishing you to make a gift to future generations, so how about agreeing that you and we will have the same greenhouse gas taxes, and we will share all the revenue globally equally?” It is likely to be economically advantageous for every less developed nation to agree.

**How Much Money Will There Be for Each Person?**

Suppose that the equilibrating price for emissions of carbon dioxide is $100 per ton. And suppose, for the sake of discussion, that charging $100 per ton for emissions of carbon dioxide causes emissions to fall by one-half. Global emissions of greenhouse gases in 2023 were estimated to be an average of 6.76 tons of carbon dioxide equivalent per person.[[5]](#footnote-5) If this falls by one-half because taxes motivate control, it becomes 3.38 tons per person per year. At $100 per ton, this is $338 dollars per person per year, or 92.6 cents per person per day. For purposes of discussion, call it $1 per person per day. This amount would not mean much to most citizens in developed countries, but for the one billion people on earth with incomes of less than $1 per day,[[6]](#footnote-6) it would more than double their incomes. It could make a huge difference in the lives of the poorest people on earth.

**Summary**

Efficient control of greenhouse gas emissions requires globally uniform emission taxes, not tradable permits and not a system of command and control. Less developed countries have tended to regard globally uniform taxes as unacceptable. That resistance is likely to fade if the preponderance of the revenues from such taxes are used to provide a globally uniform basic income. Under such a system, less developed countries will receive much more in basic income payments than they pay in emissions taxes.

If, as seems likely, people in the future will be better off than people today, then contributing to their well being by reining in greenhouse gas emissions is something we do because we care for them, and not something that we owe them. In deciding the levels of greenhouse gas taxes and by implication the levels of emissions, we are free to discount benefits for our richer progeny as we choose. We should look for levels of greenhouse gas taxes that have the approval of a consensus of all nations, and we should expect nearly all nations to find it better to participate in the global system than to be outside the system and face the equalizing tariffs that would be imposed on those outside.

1. https://caes.ucdavis.edu/news/feeding-cattle-seaweed-reduces-their-greenhouse-gas-emissions-82-percent [↑](#footnote-ref-1)
2. Sen, A.K. (1985b) Commodities and Capabilities. Amsterdam: North Holland; Sen, A. K., Development as Freedom (1999), Oxford University Press, Oxford. [↑](#footnote-ref-2)
3. Nussbaum, Martha C. (2011). Creating capabilities: The human development approach; Cambridge: Harvard University Press. [↑](#footnote-ref-3)
4. Such a system was proposed in N. Tideman and P. Walag, “Global Sharing of the Proceeds of Global Carbon Tax,” Proceedings of the 36th IBIMA Conference: 4-5 November 2020, Granada, Spain. [↑](#footnote-ref-4)
5. https://edgar.jrc.ec.europa.eu/report\_2023 [↑](#footnote-ref-5)
6. https://www.un.org/en/chronicle/article/surviving-pennies-we-must-help-worlds-most-deprived. [↑](#footnote-ref-6)