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A World Climate Bank

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9.1 The Proposal

Because the emission of climate-damaging greenhouse gases (GHG), even with current policies in place, represents an incompletely corrected externality in the world economic system, standard economic welfare analysis implies the existence of policies to correct it that are Pareto-improving both within and across generations. The political economic problem of climate damage is the division of a potential surplus, not the allocation of a cost. The risk in this situation is that, through failing to agree on the distribution of the potential economic surplus conferred by correcting the GHG externality, current generations may fail to realize this large potential gain altogether. Pareto-improving policies shift resources from conventional investments to GHG mitigation. The reduction in climate damage compensates future generations for the reduction in conventional investment. We propose the issuance of World Climate Bonds through a World Climate Bank to finance the shift from fossil fuel to renewable energy and the compensation of those in the current generation who would be net losers from such a shift. The rise in world interest rates due to the issuance of these bonds will contribute to the reduction in conventional investment. In order to strengthen the market for the World Climate Bonds we argue for making them international reserve assets analogous to Special Drawing Rights at the IMF, and for capitalizing the World Climate Bank with irreversible commitments of shares of national tax revenues from carbon taxes and other sources.

9.2 Introduction

It is commonly assumed that responding to climate change requires the current generation to make a sacrifice. But actually no sacrifice or burden is

necessary. Climate change can be controlled without a sacrifice by anyone. This means literally anyone: each person in every generation. A response without any sacrifice is not ideal, as we shall explain, but we believe it is the best that can actually be achieved. To make it possible in practice, there needs to be a major development in the international financial system. We need a new financial institution, a World Climate Bank.

9.3 Externalities and Inefficiency

Burning fossil fuels entails an economic externality. When people burn carbon, they balance the costs of doing so against the benefits they derive. The costs they take into account include the price of the fuel, but they do not include the 'external cost' that is caused by emitting greenhouse gas. This external cost is the harm done to people all over the world by adding to climate change. Emitters of greenhouse gas normally ignore this cost, with the result that they emit more than is efficient.

An externality leads to what is technically known as 'inefficiency'. A situation is inefficient if a Pareto improvement is possible, and a Pareto improvement is a change that is better for some people without being worse for anyone. We are in an inefficient state as a result of greenhouse-gas emissions. No trade-off is therefore necessary between the welfare of present and future generations in controlling climate change; policies are available that will benefit both. Correcting the greenhouse-gas externality provides an economic benefit that can be distributed to people in both present and future generations.

There are some rare exceptions to the rule that an externality leads to inefficiency, and it is tempting to assume that the intergenerational aspect of climate change is one. Here is an analogy. Suppose the wind blows from Windward Island to Leeward Island. Industrial processes on Windward Island benefit the Windward Islanders, but they harm the Leeward Islanders by bathing them in smog. The smog is an externality, and it leads to inefficiency. A Pareto improvement is possible. Since at present it costs the Windward Islanders nothing to emit smog, they emit so much that the marginal benefit to them of emissions is zero. Consequently, even a small fee would compensate them for reducing their emissions a little. They could accept the fee, reduce emissions, and end up better off. The Leeward Islanders could pay them a fee set at a level the Leeward Islanders find worth paying. Reducing emissions in exchange for this fee will benefit both sides.

So far all is as expected: the externality causes inefficiency. But now suppose the wind blows so strongly that the Leeward Islanders can send nothing

upwind to Windward Island. Paying a fee is impossible. Then no Pareto improvement is possible. Reducing emissions would make the Leeward Islanders better off, but it would make the Windward Islanders worse off, and they cannot be compensated for their loss. In this case, even though there is an externality, there is no inefficiency. This example may seem to be a metaphor for intergenerational relations, since later generations can do nothing for earlier ones. The current generation emits greenhouse gas, which harms future generations, but future generations have no means of compensating the present generation for reducing its emissions. So after all, greenhouse-gas emissions do not cause inefficiency between generations. The damage they do can be reduced only by the present generation's making a sacrifice. That is how it may seem.

But let us change the example once again. Suppose the Windward Islanders regularly float nice things downwind to the Leeward Islanders as a gift. Perhaps they do this out of pure altruism, or perhaps they think they owe the Leeward Islanders some compensation for the harm done by their smog. Then the situation is inefficient once again; a Pareto improvement is possible. The Windward Islanders have the option of withholding some of the gifts they send to Leeward Island, and keeping them for their own enjoyment. So they can choose to reduce their emissions and compensate themselves for doing so by withholding gifts. Since the marginal benefit to the Windward Islanders of emissions is zero, any small quantity of gifts withheld will be enough to compensate for a small reduction in emissions, and make them better off on balance. The amount can be so small that the Leeward Islanders are also better off. The change is a Pareto improvement.

This last version of the example is a better metaphor for intergenerational relations. The current generation leaves greenhouse gas for future generations, but it also leaves them nice things. It leaves conventional capital such as roads and cities, and it leaves natural resources, because it does not use up all the natural resources it could. It can therefore compensate itself for reducing its emissions of greenhouse gas. By reducing its transfer of resources forward in time, it can in effect transfer resources backwards from future generations to itself. This transfer can serve as compensation from future generations to the present. In effect, the current generation has only to switch some of its investment from building conventional capital to reducing greenhouse-gas emissions. By this means, a Pareto improvement is possible.

What if the current generation leaves goods for future generations only as a by-product of doing the best it can for itself? For example, it develops technological knowledge for its own advantage, and future generations

automatically benefit from this knowledge. If the current generation acts out of pure self-interest in this way, no reduction in investment can benefit it. But it is implausible that members of a generation act only for themselves. Most people who possess wealth leave some of it to posterity, whereas they could keep it all for themselves by converting it to an annuity before they die. There is evidence that people they have a 'bequest motive', which means they value leaving money to their heirs (Lockwood 2012). But even if, implausibly, the present generation is purely self-interested, it has another means of compensating itself for reducing emissions. It can exploit the fact that generations overlap.

Suppose generation A and generation C do not overlap each other, but generation B overlaps both. Suppose A harms C by its emissions of greenhouse gas but (suppose for simplicity) it does not harm B. B can serve as a conduit for transferring resources from C to A. B can hand over resources to A at the beginning of B's life when it overlaps with A, and collect resources from C at the end of B's life when it overlaps with C. This would make B worse off when young but better off when old, and the quantities may be adjusted to make B equally well off overall. Then the net result of this transaction is to benefit A at a cost to C; it is a transfer from C to A. It can be used to compensate A for reducing the harm it does to C by cutting its emissions. Both A and C can be made better off this way, so once again the externality creates inefficiency.

One way of implementing this sort of transfer is through old-age pensions. Pensioners consume goods at a time when they do not produce them; pensioners' goods are produced for them by the young. If there is a pension scheme in our example, B hands over goods to A when A is old, and C hands over goods to B when B is old. To compensate A for reducing its emissions, pensions can simply be increased.

In sum, there are no good grounds for doubting that the greenhouse-gas externality causes inefficiency between generations. It clearly causes inefficiency within a generation. These inefficiencies can be corrected in a way that requires a sacrifice from no one. However, it is true that the degree of intergenerational inefficiency, and so the potential for Pareto improvement, is constrained by the opportunities there are for backwards intergenerational transfers.

9.4 Injustice and Maldistribution

Inefficiency is not the only bad consequence of greenhouse-gas emissions. Two others are injustice and maldistribution.

Doing harm to another person is generally an injustice done her. This is not an invariable rule; there are some exceptional cases. For example, harm done in self-defence is often permissible. When a person emits greenhouse gas she harms others. This is an injustice done them; it is not one of the exceptional cases where harm is permissible. Suppose this person reduces her emissions in a way that leads to a Pareto improvement; this could be achieved by her victims paying her a fee to do so. Although there is a Pareto improvement, the injustice remains. Suppose you unjustly harm someone every day, but then your victim pays you a fee to stop harming her. Then the transaction is a Pareto improvement—it is better for both you and her—but the injustice remains. Removing inefficiency by compensating emitters does not remove injustice.

There is maldistribution of wealth both between generations and within the current generation. That is to say, the world would be a better place if its wealth was distributed differently. Maldistribution is sometimes called 'distributive injustice', but it is not the same as the injustice of harming another person that is described in the previous paragraphs. Indeed, it may pull in the opposite direction. In the island example, the Windward Islanders do an injustice to the Leeward Islanders by their emissions of smog. However, their emissions may not cause maldistribution. If the Windward Islanders are less prosperous than the Leeward Islanders, their emissions may actually improve the distribution of wealth by decreasing inequality.

Some of the world's maldistribution is caused by greenhouse gas. By and large, those in the present generation who benefit from emitting greenhouse gas are better off than those of the present generation who are harmed by their emissions. In this respect, climate change exacerbates the intragenerational maldistribution that results from other causes. Other causes include colonial exploitation over centuries, and more than 200 years of very unequal economic development. By contrast, the economic effects of climate change have become significant only in the last few decades. Climate change is too recent to be a major contributor to the maldistribution that exists within the current generation.

Between generations things are different. Unless climate change becomes extreme, future generations will on average be better off than us. Our present emissions will diminish the quality of life of those better-off generations. So they actually increase equality between generations. However, if we give value to aggregate well-being as well as to equality in well-being, the best distribution is unequal rather than equal. This is because we possess a productive technology that can, in effect, convert a quantity of goods at one time into a greater quantity of goods at a later time. Delaying consumption of goods consequently adds to the total of goods that are eventually consumed. It is therefore better to allow future generations to consume more than earlier

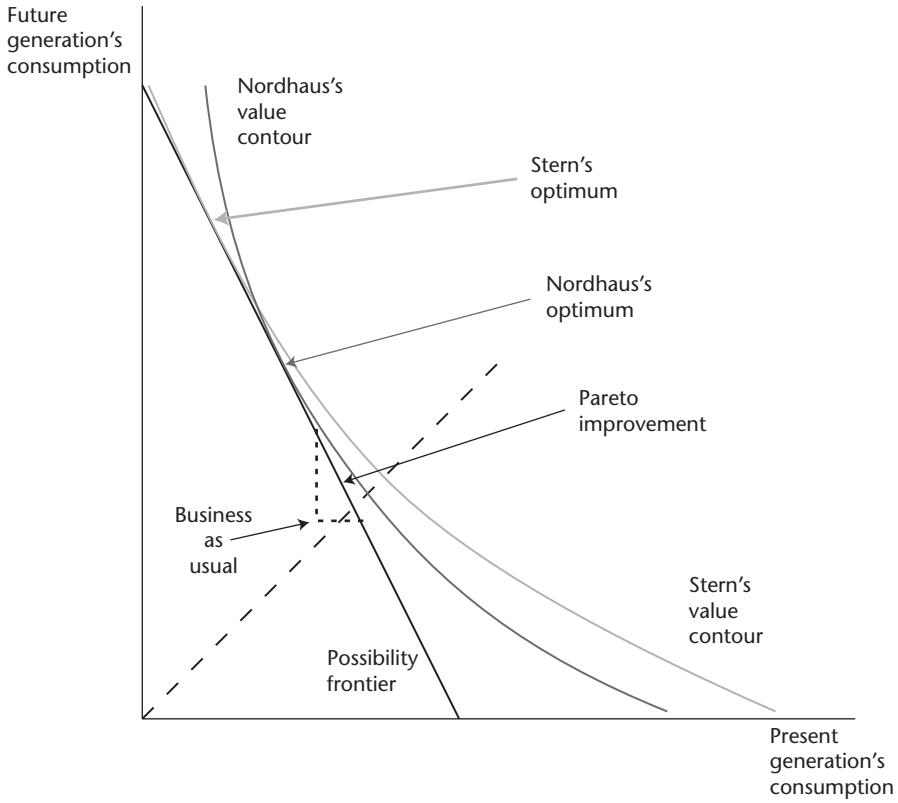

Figure 9.1. Future and Present Generations' Consumption

ones. Given that, climate change may add to maldistribution even as it makes the distribution between generations more equal.

Figure 9.1 shows a 'production possibility frontier' in which future generations have the possibility of greater consumption than the present one. It also shows contours of value that illustrate—in a very schematic way—the value theories of two different economists. The best situation according to both theories gives more consumption to future generations than to the present generation. The *Stern Review* (Stern et al. 2007) recommends us to accept a small reduction in our income (perhaps 2 per cent) in order to bring about a much larger increase in world income in 150 years' time. William Nordhaus (2008) also suggests that an optimal response to climate change involves a reduction in present consumption. Both theories imply that achieving the best possible outcome, starting from business as usual, requires the current generation to reduce its consumption. It follows that removing the inefficiency caused by greenhouse gas through a Pareto improvement does not achieve the best possible outcome. It results in maldistribution.

How much of this maldistribution between generations should be attributed to climate change? This is hard to judge. A potentially large source of intergenerational maldistribution is that people may persistently save less for the future than they should save if they are to achieve the best result. Perhaps their bequest motive is less strong than it should be. In principle there is a way of testing whether this so. The correct social discount rate measures how much value should be given to the future compared with the present. The market rate of interest on risk-free assets reveals how much value people actually give to the future compared with the present in their savings behaviour. If the two rates are about equal, inadequate saving is not a big source of maldistribution. However, there is not even good agreement among economists about what the market risk-free rate of interest is, let alone about what the correct social discount rate is. So this test is hard to apply. Still, Nordhaus (2008) takes the risk-free interest rate to be about 6 per cent, and Stern et al. (2007) take the social discount rate to be 1.25 per cent. Given this very big difference, there is no good reason to think that a large proportion of maldistribution between generations is caused by climate change.

We accept the conclusion of Stern and Nordhaus that achieving the best outcome would require a sacrifice by the present generation. However, the long record of unsuccessful negotiations under the United Nations Framework Convention on Climate Change lead us to believe this ideal outcome is unattainable. It demands a sacrifice from the present generation, which national negotiators have shown they will not accept. For reasons of practical politics, we think that negotiations should aim instead to achieve efficiency through a Pareto improvement that benefits everyone. In effect, it buys off any opposition there might be. It should therefore be attainable. To continue to aim for the best outcome is to make the best the enemy of the good.

We do not mean to suggest that members of the current generation have a right to be compensated for reducing their emissions of greenhouse gas. They do not. We are simply accepting the disappointing fact that the representatives of the current generations who have power in the negotiations will not accept a sacrifice.

Eliminating the externality of climate change can bring a huge benefit to the current generation. The lion's share of it should go to the poor and to those who have emitted little; the rich and the big emitters should receive only a small share. If the gains are appropriately distributed, a Pareto improvement can mitigate injustice and maldistribution.

Nevertheless, if efficiency is achieved through Pareto improvement, maldistribution will remain. Maldistribution is always with us. It should be reduced, but it is politically extremely difficult to reduce it. If maldistribution were particularly the effect of climate change, there might be a case for coupling the effort to control climate change with the aim of reducing

maldistribution. This is what we do if we continue to aim for the best outcome in climate change negotiations. But we have seen that intragenerational maldistribution is not much caused by climate change, and there is no good reason to think that intergenerational maldistribution is. Coupling the two projects is therefore saddling the effort to control climate change with a different, very intractable problem that climate change is not much responsible for. Dealing with climate change is very urgent. Maldistribution should be tackled separately.

9.5 Transforming Investment

The theory tells us that a Pareto improvement is possible. How, in more detail, can it be achieved? This question can be answered on several different levels. There is first of all a real macroeconomic answer—real in the sense that it mentions concrete goods and services rather than money. Then there is a microeconomic answer. Finally there is a financial answer.

The real macroeconomic answer is that there must be a transformation of investment from conventional investment such as roadbuilding and shipbuilding to what we shall call 'green investment', which is investment aimed at reducing greenhouse-gas emissions. Examples of green investment are insulating houses and building wind farms. Investment can be shifted in this direction while leaving constant the aggregate consumption of the current generation. The current generation will therefore suffer no loss. To be sure, it will have to consume a new range of goods that are less carbon-intensive, but its overall standard of living need not deteriorate.

Leaving consumption constant ensures the present generation makes no sacrifice. Future generations benefit from the current generation's conventional investment, and there will be less of that, but they will gain a cleaner atmosphere instead. Provided the quantities are properly balanced, future generations will end up better off: the cleaner atmosphere will more than compensate for the smaller quantity of conventional capital they receive. We know that a proper balance can be found, because the theory tells us that a Pareto improvement is possible.

How could the needed transformation of investment be put into practice? If there was a world government that controlled investment, it could simply do it. It could switch some of its conventional investment towards reducing emissions. In a capitalist economy where investment decisions are made by private investors for the sake of profits, things have to be done differently, through the financial system. We shall come to switching investment under capitalism later.

9.6 Individual Compensation

Before that, we need to examine the transformation at the microeconomic level. Switching investment towards reducing carbon emissions is not only a matter of building less carbon-intensive power stations. Consumer behaviour also needs to be transformed. People need to switch their consumption towards less carbon-intensive goods.

They can be induced to do this by means of a rise in the price of these goods. To achieve efficiency, a price has to be set on carbon equal to the external cost of emissions. In practice this can be done through a carbon tax or by capping emissions, with or without the option of emissions trading. A carbon tax transparently raises the price of carbon. Cap-and-trade schemes raise the price by requiring the user of fossil fuels to buy a permit in addition to the fuel. An untraded cap has the same economic effect because users who are capped experience higher marginal costs of production due to the restriction on their use of fossil fuels.

Consumers and producers will spontaneously defend themselves from the effects of the carbon price by moving their consumption towards goods that are produced with less fossil fuel energy. Suburban sprawl will give way to more compact urban development; square feet of living space to better views through higher buildings; aluminium containers to cardboard; commuting automobiles to bicycles, and so forth. These defensive adjustments (economic 'substitution') are the point of the policy: they induce people to adopt a less carbon-intensive way of life.

To some extent substitution mitigates the harm individuals suffer as a result of higher energy prices. But it cannot entirely remove this harm. Consumers will inevitably be made worse off in material terms by a rise in energy prices. If there is to be a Pareto improvement, these losses have to be compensated for.

If there is to be a Pareto improvement, owners of fossil fuel reserves will also have to be compensated for their losses. Current owners of fossil fuel reserves will be losers if climate change policy succeeds in limiting the burning of carbon-based fossil fuels. From a political point of view buying off the opposition of this wealthy and powerful group with appropriate compensation is a critical aspect of a compensation-based policy aimed at a Pareto improvement.

Owners of fossil fuel reserves must be paid to keep carbon in the ground. The theory of efficiency tells us that they can be compensated, but only for the true value of their reserves. This is the value of the prospective revenue stream that would flow from exploiting the reserves. The market value of fossil fuel assets may be very different from this true value (Carbon Tracker 2013). Only a fraction of existing known reserves of fossil fuel can be used without causing extreme climate change. No more than this fraction can generate a revenue stream, since extreme climate change will destroy the economy that revenue

arises from. However, the present market value of fossil fuel stocks takes account of all known reserves. These stocks are therefore overvalued. Owners of stocks cannot be compensated for an exaggerated value, but only for what the stocks are really worth. They cannot be compensated for making a bad investment.

9.7 Paying Compensation

If there is to be a Pareto improvement, the compensation described in the previous section must be paid. Paying compensation may be thought of as a part of green investment. In real terms, compensation must be paid out of conventional investment. But it actually has to be paid in financial terms, as money. Where will the money come from? One source of revenue is from the carbon price itself. The carbon price can provide revenue to the government. If it is a carbon tax, the revenue goes to the government directly. If it is created by a cap on emissions, the government can raise revenue by selling emission permits. All this revenue can be returned to consumers and producers as part of their compensation, by reducing their other taxes.

It will not be enough to compensate them fully for paying the higher price of energy. A well-known theorem of welfare economics shows that consumers cannot be made better off by imposing a tax on a good and rebating the tax as a lump sum. But we are proposing a reduction in other taxes rather than a lump-sum rebate. Nearly all taxes, including income taxes, themselves create inefficiency. The proposal is to replace them with an efficient means of raising revenue, namely a carbon price. So taxation as a whole will become more efficient. This improvement makes it theoretically possible that every member of the current generation could be fully compensated for paying the carbon price out of the revenue that the carbon price itself raises. But this happy outcome can be realized in practice only if the present tax system is very inefficient. It cannot be expected.

So we must assume that not all the compensation required by the current generation can be paid from revenue raised from the current generation itself. Some compensation will have to be financed by borrowing. Governments or international organizations will have to borrow on a large scale.

9.8 The Need for Social Debt

We have arrived at the need for social borrowing from the direction of microeconomics. We can arrive at the same point from the direction of

macroeconomics by considering how a capitalist economy can manage the needed switch in investment from conventional to green investment.

If the allocation of resources were under direct central control, the switch could be achieved directly by administrative decisions. In a capitalist society where the allocation of resources is primarily determined by private investment and production decisions, government policy has to employ indirect means to influence the composition of investment.

One available means is to issue government or international bonds. The effect will be to push up interest rates, which in turn will crowd out some conventional investment. The bonds constitute an alternative asset that investors can choose to invest in, as an alternative to building conventional capital. In order to buy bonds, they will withdraw funds from conventional investment. These funds will come into the hands of the issuers of the bonds, who can use them to pay for reducing emissions of greenhouse gas through green investment. This includes compensating current consumers and producers for the increased cost of energy.

This transaction is sometimes seen as 'borrowing from the future'. This may be a politically attractive way to think of it: the present generation borrows from future generations to pay for improvements it makes for the sake of future generations. And it does have the effect of moving real resources from the future generations back to the present. It is in effect a real payment from future generations to the present generation, to compensate the present generation for its green investment.

However, it is not literally borrowing from the future. Borrowing and repaying debt are always transactions between contemporaneous agents. Present governments borrow money from present people. When the debt is repaid, the inheritors of the debt will repay the inheritors of the credit. That is to say, future governments will repay future people. It is not correct to say the the debt imposes a burden on future generations as a whole.

The purpose of the borrowing is to make it possible for the present generation to convert its investment policy from conventional investment towards green investment. Crowding out conventional investment by raising the interest rate is an economically efficient way to do this. It eliminates whatever private investment projects have the lowest rate of return, as efficiency requires.

9.9 Institutions to Support Climate Control Bonds

Is it institutionally feasible to issue all this debt? It certainly should be. We have shown how a Pareto improvement can be achieved in the real economy. Conventional investment needs to be shifted into reducing greenhouse-gas

emissions. The only remaining question is whether the world's financial system can make it happen. It would be a terrible indictment of the world order if the great gains that could be achieved by controlling climate change were prevented by the weakness of the financial system.

Bonds are far from the model of complete contracts on which much economic analysis depends, and bond markets as a result operate in rather different ways from markets in standardized commodities such as oil or winter wheat. Long-maturity bonds can be sold only by entities that bond purchasers regard as likely to persist and remain solvent for the maturity of the bond. For very long maturity bonds this implies that borrowers have to be governments, quasi-governmental organizations that share the credit of governments, or capitalist firms with very credible long-term prospects of survival and profitability.

Infinite maturity instruments have been issued by a few governments; British consols are an example. But what is called a 'long-term' horizon in existing bond markets is on the order of fifty years. Climate change unfolds over 200–400 years because carbon dioxide is removed from the atmosphere at an extremely low rate. What are the prospects for issuing bonds with a maturity of, say, 300 years on a large scale, to finance green investment?

Only a few national governments could borrow on reasonable terms at this very long maturity. This observation argues for the creation of credible international institutions to underwrite the issuance of this type of debt. Let us call the prospective institutions the 'World Climate Bank' or WCB. How could this bank be governed, and how could it maintain its solvency, solidity, and credibility for the required period?

In order to pay the interest on the bonds, the WCB would have to command regular revenues. Two possibilities come to mind. The first is that the WCB would receive the proceeds of a global carbon tax directly, or have a first claim on them. In the case of a system of cap-and-trade permits, the WCB could be allocated a sufficient share of the permits so that the royalty revenue would cover the interest on its bond issuance. One advantage of carbon tax and cap-and-trade methods of controlling emissions is that they generate an immediate counterpart flow of revenue that would be available as direct or indirect financing for compensation.

The second is that the WCB could claim a share of national government revenues up to some limit that would allow it to pay interest on the appropriate quantity of debt, even as the revenues from the carbon tax or royalties decline with the declining use of fossil fuel. By this means, the WCB's source of revenue would be spread across many national governments, thereby increasing the credibility of the interest guarantees in the bonds.

One of the oldest forms of organization of banks is the mutual savings bank, in which the bank is owned by its depositors, rather than by some third party.

Supranational financial institutions such as the International Monetary Fund and the World Bank are organized legally as mutual banks, in which national governments contribute capital funds from which they can draw as borrowers. A mutual World Climate Bank could operate on the same principles. The capital of such a bank would consist of claims on national or regional carbon taxes or a share of emissions permits generating royalties. The WCB would then issue long-term bonds to finance investments for climate change mitigation, including compensation to consumers for the carbon price. The governance of the WCB could weight both the capital contributions of national governments and other relevant factors, such as the exposure of nations and regions to climate damage.

One risk the holders of WCB bonds would take is that individual nations might withdraw from the bank for some reason, leaving it insufficiently funded to meet its commitments. This consideration suggests that membership in the WCB should be a precondition for membership in other international organizations such as the World Trade Organization, the IMF, and the World Bank. There would then be strong incentives for individual nations not to withdraw from the WCB.

The ability of the WCB to borrow at long maturities and low rates of interest would depend both on the credibility of its promises to pay and on the creation of a market for its liabilities. One measure to support the market for WCB bonds would be to make them eligible to serve as international reserve assets, as are the Special Drawing Rights issued by the IMF. The goal is to situate WCB bonds at the very highest level of world debt obligations, as close as possible to the position now occupied by US Treasury bills, which are regarded as almost risk-free by international financial markets.

The low risk attributed to US Treasury bills by markets rests on the confidence markets place in the continued existence of the United States and in its commitment and ability to pay interest and principal on its obligations. It is also supported by the short maturities of Treasury bills, which renders them relatively free of inflation risk. WCB bonds, on the other hand, are inherently of long maturity. (If the WCB borrowed on shorter maturities, such as fifty years, then in order to extend the ultimate payment obligations to the more distant future it would have to plan to refinance its liabilities regularly. The credibility of such a sequence of shorter-term financing is effectively the same as the credibility of regular payment of interest over a long maturity of 250 years or more.) In order to avoid inflation risk, the WCB could index interest payments to the purchasing power of a broad basket of widely held world currencies.

If the WCB indexed long maturity bonds were widely held as international reserves, they would likely become a vehicle for private reserves seeking very low-risk havens, which would contribute to their marketability.

9.10 Conclusion

Greenhouse-gas emissions cause external costs. They create inefficiency on a huge scale. Eliminating the inefficiency would lead to very great benefits, which could be distributed to the people of the world in a way that improves the life of each of them. No one need make a sacrifice.

To achieve this result in real terms requires a transformation of the world's economy. Resources must be shifted out of conventional investment and into reducing greenhouse-gas emissions. To make this possible in practice puts a responsibility on the world's financial system. The transformation will have to be partly financed by very long-term loans. We need an international financial institution—a World Climate Bank—with enough stability and credibility to finance these large-scale changes.[1]

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