Paying for Climate Change

Governments must manage the incentives for households and firms to counter and adapt to climate change

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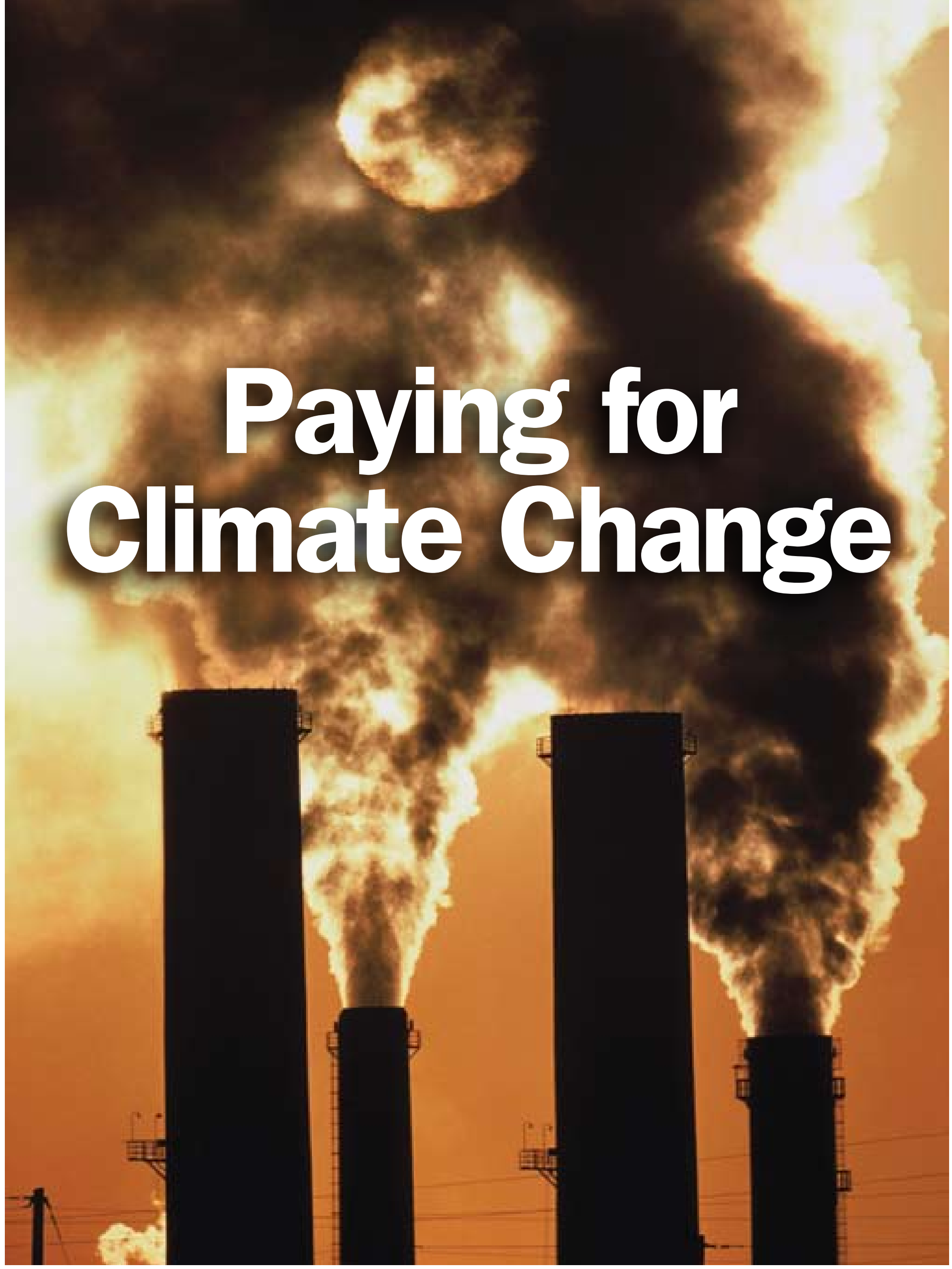


Smokestacks in Eureka, California, United States.

CLIMATE science tells that the earth is warming as a result of human activities. But considerable uncertainty regarding the precise nature and extent of the risks remains. Economists are needed to develop sensible policies to address these risks, which account for the uncertainties. In particular, the world needs public finance economists to consider what role fiscal instruments—notably, taxing and public spending—have to play in dealing with climate change.

Country efforts to adapt to and mitigate climate change are interrelated—broadly speaking, they are substitutes—but differ in important respects. Most adaptation, often involving relatively modest changes in behavior, will be carried out through private markets, though policy interventions may be needed to facilitate it—for example, by improving weather forecasting.

Mitigation, by contrast, generally needs to be driven by deliberate policy to a greater extent. Much adaptation can, and should, wait until the climate process has evolved: it makes little sense to adapt now to changes that will materialize mainly in, say, 30–100 years. However, mitigation needs to start well in advance of the damage it seeks to avoid because damage arises not from current emissions but from the slow-moving stock of greenhouse gases (GHGs) cumulated in the atmosphere.

This article argues that the role of fiscal instruments is central—indeed indispensable—for both mitigating and adapting to climate change. It looks at how efficient fiscal policies can help minimize the negative effects of climate change and examines the policy options available to governments. Fiscal instruments cannot provide a complete solution. But taxes and public spending are key to getting the incentives right for households and firms, as well as to ensuring a fair distribution of the associated costs and benefits. They can help ensure that those whose GHG emissions affect climate developments pay a proper price for doing so, and they can provide the resources needed to pay for dealing with it.

Adaptation—how much could it cost?

Even with unchanged fiscal policies, climate change may have effects on both tax revenue (tax bases being eroded, perhaps, by declining agricultural productivity or by intensified extreme weather events, such as storms, flooding, and droughts) and public spending (perhaps to deal with increased prevalence of malaria). In some cases, the net effect might be beneficial, though the overall tendency is likely to amplify the problems faced by those countries—often among the poorest—most adversely affected in general by climate change.

The most likely negative effects of future climate change include sea-level rise, productivity losses in climate-exposed sectors such as tourism and agriculture, and more intense and perhaps more frequent and extreme weather events—all with potential adverse repercussions for fiscal positions and external stability.

Outside such catastrophic events as melting of the West Antarctic Ice Sheet, human societies are likely to adapt to most of these changes, although at a cost. How to minimize those costs, and how governments can best help, is not always clear. Typically, it will not be optimal to adapt so fully as to eliminate the entire climate effect: averting all damage may simply be too expensive. And difficult choices arise between taking early precautions and waiting for better information to become available. For example, whereas sinking costs into strengthening coastal defenses will seem a wise decision if future storm surge problems worsen, it will look like a white elephant if they do not.

Very little is known about the aggregate extent of the costs of adaptation, but there are some rough estimates. One survey concludes that these costs typically make up at most 25 percent of total climate impact costs (Tol, 2005). So if doubling GHG concentrations (a prospect under "business-as-usual" assumptions in this century) leads to an overall climate cost of 1–2 percent of world GDP, adaptation costs would be about 0.2–0.5 percent of world GDP, or about $70–150 billion a year. The World Bank (2006) also estimates adaptation costs for lower-income countries in the tens of billions of dollars annually.

Given the importance for adaptation of such public goods as coastal defenses and health provision, a substantial proportion of these costs can be expected to fall on the public sector, but how much that is likely to be is even less clear: the World Bank, for example, roughly estimated that about a third of adaptations costs could be public. However, a better understanding of the likely fiscal costs of adapting to climate change, at the country level, is urgently needed if the fiscal risks that it poses are to be properly prepared for.

Mitigation—dealing with market failures

Effective mitigation of GHG emissions is likely to require the use of fiscal instruments to overcome a deep market failure—a classic free-rider problem. The problem is simply that individuals, firms, and governments have insufficient incentives to limit their GHG emissions: whereas they incur the full costs of doing so, the benefits (from less global warming) accrue to the entire global community. The consequences are excessive emissions and too little effort in developing alternatives to fossil fuels.

At the local or national level, there may be some co-benefits from reduced burning of fossil fuels in the form of less local and regional pollution, but these do not eliminate the basic difficulty: everyone would prefer that others take the pain of reducing global emissions. Moreover, the benefits of current mitigation will accrue largely to future generations—so the extent to which the current costs are worth incurring depends on the weight one attaches to the well-being of future generations, and how much allowance to make for the likelihood that they will be better off than we are. The discount rate used to compare current costs and future benefits then proves critical in evaluating and forming climate-related policies—more so than in most other cost-benefit analyses because of the unusually long time horizons involved.

The second market failure relates to the development of new energy technologies that will permit substantial reductions in GHG emissions. Most such research and development (R&D) activity will—and, from efficiency considerations, probably should—be undertaken by individuals and businesses in pursuit of commercial gain. But they will typically not be able to appropriate all the social benefit of their innovations, so there is a risk of underinvestment in climate-related R&D.

The same considerations also apply, of course, to much R&D that has nothing to do with climate change, and many governments already offer generous tax breaks and other forms of fiscal support for commercial R&D. However, the importance now attached to climate- and energy-related research, including energy security considerations, and the particularly high risks for individual developers (in particular, related to developing more fundamental, "breakthrough" technologies—such as the capture and storage of CO_2 emissions and geo-engineering techniques for offsetting climate modifications), may argue for additional support of climate-related research. In practice, however, energy-related R&D remains well below its peak in the 1970s.

Pricing emissions

Another complex issue is how to price emissions. In principle, optimal policy to reduce GHG emissions is simple: every emitter should be charged a price per unit of emissions, equal to the (net present value of) damage it causes (this in addition to the price paid for the coal or other underlying resource). That is, to ensure that the cost of reducing emissions is minimized, the charge should be the same for all emissions, wherever and however they arise. The use of fossil fuels, for example, should be charged at a rate—a "carbon price"—that reflects the carbon content of each and, hence, the CO_2 that they emit when burned.

Though the principle is simple, its application is complex. Deciding the "correct" value of marginal damage from emissions—we shall speak of the carbon price, although the same principles apply to all GHGs—requires taking a view on matters ranging from the highly speculative (such as the likely pace and nature of technical progress) to the philosophical (in the choice of discount rate).

And it is not just (or even mainly) today's carbon price that matters. Investments decisions made today in risky R&D, or in developing power stations that will last decades, require some view on future fossil fuel prices, including carbon prices.

The carbon price is likely to increase over time in real terms, at least for the foreseeable future: as the time of most intense damage comes nearer, the carbon price rises in present value and, hence, so too does the charge. It may not be wise for the carbon price to increase too fast, however, because that could create an incentive for owners of fossil fuels to extract more rapidly now, when the charge is low, making future problems worse (Sinn, 2007). Although the appropriate rate of increase remains an open question, a key challenge for policymakers, which they are far from solving, is to find ways of making credible the expectation of reasonably rising carbon prices.

Chart 1 illustrates some of the ambiguities and uncertainties related to the correct emissions price path and is based on simulations under the U.S. Climate Change Science Program. It uses two integrated assessment models applied in that work: the IGSM model developed by the Massachusetts Institute of Technology, and the MiniCAM model, developed by teams at the Pacific Northwest National Laboratories and University of Maryland.

The assessment of future emissions prices varies widely—both for a given year and by time frame, across models and long-run GHG concentration targets. (In 2040, for example, the price will range from $13 per ton of carbon (tC) for MiniCAM given a long-run target of 650 parts per million (ppm) for atmospheric carbon to $562/tC for IGSM under a 450 ppm target.)

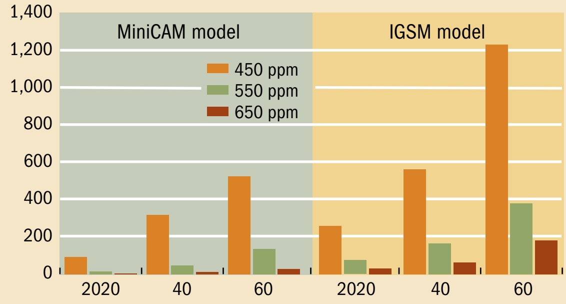
Differences between models represent uncertainties about such factors as mitigation costs and baseline energy use; the "correct" emissions target is also uncertain. Some types of uncertainty are not modeled: assumptions about discounting, for example, are the same in all these calculations (4 percent a year). For comparison, most assessments of the current "correct" emissions price are in the range $15–$60/tC (with the value proposed by the Stern Review at about $330/tC, something of an outlier).

Chart 1

Different rates

The IGSM model, which assumes a higher baseline growth in emissions than the MiniCAM model, requires higher tax rates to achieve targeted emissions levels.

(global carbon tax rates, dollars per ton of carbon)



Source: IMF staff calculations using MiniCAM output.

Carbon taxes, cap-and-trade, and all that

Further issues arise in implementing carbon prices. There are two archetypal market-based methods: carbon taxation and cap-and-trade schemes (under which rights to emit are issued—either sold or given away—up to some fixed amount and then bought by those who find abating relatively hard from those who find it relatively easy). Most schemes proposed in practice are hybrids: they may involve, for instance, permit trade but with the government ready to issue enough permits to keep the price above some floor. But these two polar forms illustrate many of the key choices to be made.

In the simplest case, no choice need be made. If all emission quotas under a cap-and-trade arrangement are auctioned to the highest bidders, and with full certainty about emissions (and the emissions price), the two mechanisms are equivalent: replacing a cap-and-trade scheme with a carbon tax at a rate equal to the market-clearing permit price, emissions, and government revenue will be exactly the same.

But in the presence of uncertainty, the equivalence breaks down. Cap-and-trade provides certainty on aggregate emissions; carbon taxes provide relative certainty on prices. In the face of uncertainty as to how costly reducing emissions will be, taxes may have some advantage as a mitigation device because they better match the marginal costs and benefits of mitigation.

Suppose, for example, that abatement proves much more costly than expected. Under cap-and-trade, emissions would be unaffected, but the necessary abatement would be very costly. Under a carbon tax, those costs would be avoided, but emissions would be higher than desired. Such a surge in emissions may be of relatively little concern, however, because emissions over any short period matter little to atmospheric concentrations, which are what really matter.

The equivalence will also fail if—as has often happened in practice—emissions rights under cap-and-trade are not auctioned, but given away. For example, under the current phase of the European Union Emissions Trading Scheme (EU-ETS), set up to help implement the EU's Kyoto Protocol commitments, no more than 10 percent of emissions quotas may be auctioned. This leads to an implicit revenue loss of about €40 billion a year and to a substantial and opaque measure of redistribution.

Such "grandfathering" of emissions rights can have other adverse effects too. Firms may expect future allocations to depend on current emissions, thereby blunting their incentive to abate now. Entry and exit rules also matter. If exiting firms lose their rights, for instance (rather than being able to sell them), they may be less likely to exit, making abatement more difficult. Grandfathering may have been reasonable for investments sunk before carbon pricing was even imaginable. But that is no longer the case. And, indeed, the European Commission proposes to eliminate grandfathering during the third phase of the EU-ETS, from 2013 to 2020—a firm step in the right direction, and an example for others.

What to do with the revenue?

How much money optimally imposed emissions taxes will raise for governments is an important fiscal issue. Chart 2 shows projected revenues from charges on carbon emissions in percent of world GDP by 2020, 2040, and 2060, with projected tax rates and emissions calculated by the integrated assessment models used in that exercise. We see that these numbers range from totally insignificant (0.1 percent of income under MiniCAM in 2020 with a 650 ppm target), to substantial (more than 3 percent of income under IGSM in 2060 with a 450 ppm target). While regional distributions are not given here, the share of total emissions for lower-income countries is projected to increase gradually (more so under the MiniCAM model), implying that these countries also will collect a greater share of overall tax revenue (exceeding 65 percent for non-OECD countries by 2060 under MiniCAM).

When equivalence of the kind described above holds, the same total revenue could also be achieved under a cap-and-trade arrangement with full auctioning of emissions rights. But the revenue distribution across countries could be quite different.

The widespread presumption under carbon taxation is that revenues would accrue to the country in which the carbon is used (although this would not prevent subsequent international transfers). Under cap-and-trade, however, some rule must be adopted for allocating the total emissions rights across countries. And how that is done—in proportion to emissions under business as usual, for instance, or in proportion to population—can have powerful implications for the direction and extent of international trade in permits.

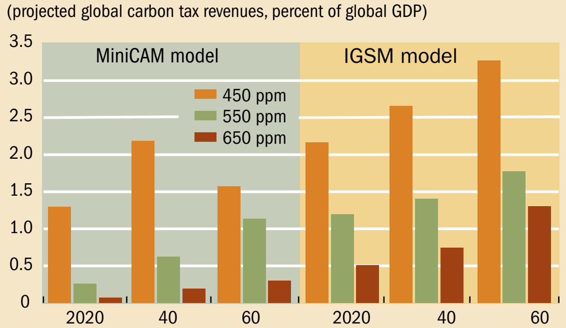
Different exercises give somewhat different results but tend to agree that Africa and India would likely be sellers of permits (forcing them with an incentive to participate in the scheme), whereas the industrial countries would be buyers. Such schemes, on top of having deterrent effects on

Chart 2

Money maker

The IGSM model produces higher revenues than the MiniCAM model, mainly due to higher tax rates on emissions.

(projected global carbon tax revenues, percent of global GDP)



Source: IMF staff calculations using MiniCAM output.

emissions, would imply an effective resource transfer from high-income to lower-income countries. Clearly, the implementation of such transfers would raise difficulties: it would need, in particular, some agreed system by which each country can be assured that others are indeed emitting no more than allowed by the permits they hold.

For cash-strapped governments, the potential revenue from carbon pricing would seem to provide at least one benefit from climate change. And, indeed, it would enable them to make less use of more distortionary taxes and deal more confidently with the potential revenue challenges arising from trade liberalization and globalization. (Some, of course, will worry that they will instead simply waste this additional revenue.)

But carbon pricing may well worsen the distortions caused by the existing tax systems, tending, broadly, to reduce the level of economic activity and so exacerbate marginal disincentives caused by the tax system. So it is generally a good use of the revenue from carbon pricing to shift away from more distorting tax instruments. Exactly what those other instruments are may vary across countries. Several European countries, for example, have sought to alleviate labor market problems by using increased energy taxes to reduce social contributions. Others might see the corporate tax as a prime candidate for reduction.

Participation and fairness

Not the least of the potential roles for fiscal design is to encourage wide participation in mitigation—to limit emissions at least possible cost—and, a related challenge, to help spread the burden of climate change in ways that are perceived to be fair. This means, for example, using other instruments to soften the distributional impact of carbon pricing within countries (which can be particularly difficult when it comes to raising unduly low energy prices in low-income countries) and addressing such controversial issues as the potential use of border tax adjustments if neighboring countries do not have similar carbon tax rates.

Thus, it is increasingly clear that fiscal design issues will be central to any effective response to the difficulties posed by climate change. ■

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References:

Sinn, Hans-Werner, 2007, "Public Policies Against Global Warming," CESifo Working Paper No. 2087 (www.csfinfo.de).

Stern, Nicholas, and others, 2007, The Economics of Climate Change *('The Stern Review") (Cambridge: Cambridge University Press).*

Tol, Richard S. J., 2005, "Adaptation and Mitigation: Trade-Offs in Substance and Methods," Environmental Science and Policy, *Vol. 8, pp. 395–418.*

Weitzman, Martin L., 1974, "Prices Versus Quantities," Review of Economic Studies, *Vol. 41, pp. 477–91.*

World Bank, 2006, Clean Energy and Development: Towards an Investment Framework *(Washington).*