Climate Change Justice

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Reductions in greenhouse gas emissions would cost some nations much more than others and benefit some nations far less than others. Significant reductions would likely impose especially large costs on the United States, and recent projections suggest that the United States is not among the nations most at risk from climate change. In these circumstances, what does justice require the United States to do? Many people believe that the United States is required to reduce its greenhouse gas emissions beyond the point that is justified by its own self-interest, simply because the United States is wealthy, and because the nations most at risk from climate change are poor. This argument from distributive justice is complemented by an argument from corrective justice: The existing "stock" of greenhouse gas emissions owes a great deal to the past actions of the United States, and many people think that the United States should do a great deal to reduce a problem for which it is disproportionately responsible. But there are serious difficulties with both of these arguments. On reasonable assumptions, redistribution from the United States to poor people in poor nations would be highly desirable, but expenditures on greenhouse gas reductions are a crude means of producing that redistribution: It would be much better to give cash payments directly to people who are now poor. The argument from corrective justice runs into the standard problems that arise when collectivities, such as nations, are treated as moral agents: Many people who have not acted wrongfully end up being forced to provide a remedy to many people who have not been victimized. Without reaching specific conclusions about the proper response of any particular nation, and while emphasizing that welfarist arguments strongly support some kind of international agreement to protect against climate change, we contend that standard arguments from distributive and corrective justice fail to provide strong justifications for imposing special obligations for greenhouse gas reductions on the United States. This claim has general implications for thinking about both distributive justice and corrective justice arguments in the context of international law and international agreements.

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INTRODUCTION

The problem of climate change raises difficult issues of science, economics, and justice. Of course the scientific and economic issues loom large in public

debates, and they have been analyzed in great detail.[1] By contrast, the question of justice, while also playing a significant role in such debates, has rarely received sustained attention.[2] Several points are clear. Although the United States long led the world in greenhouse gas emissions, China is now the world's leading emitter.[3] The two nations account for about 40% of the world's emissions, but to date, they have independently refused to accept binding emissions limitations, apparently because of a belief that the domestic costs of such limitations would exceed the benefits.[4]

The emissions of the United States and China threaten to impose serious losses on other nations and regions, including Europe but above all India and Africa.[5] For this reason, it is tempting to argue that both nations are, in a sense, engaging in tortious acts against those nations that are most vulnerable to climate change. This argument might seem to have special force as applied to the actions of the United States. While the emissions of the United States are growing relatively slowly, that nation remains by far the largest contributor to the existing "stock" of greenhouse gases. Because of its past contributions, does the United States owe remedial action or material compensation to those nations, or those citizens, most likely to be harmed by climate change? Principles of corrective justice might seem to require that the largest emitting nation pay damages to those who are hurt[6]—and that they scale back their emissions as well.

Questions of corrective justice are entangled with questions of distributive justice. The United States has the highest Gross Domestic Product of any nation in the world, and its wealth might suggest that it has a special duty to help to reduce the damage associated with climate change. Are the obligations of the comparatively poor China, the leading emitter, equivalent to those of the comparatively rich United States, the second-leading emitter? Does it not matter

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1. For a useful but controversial overview of both, see NICHOLAS STERN, THE ECONOMICS OF CLIMATE CHANGE (2007). On the economics, see generally William Nordhaus, The Challenge of Global Warming: Economic Models and Environmental Policy (2007), *available at* http://nordhaus.econ.yale.edu/dice_mss_072407_all.pdf (unpublished manuscript); for an overview of the science, see generally JOHN HOUGHTON, GLOBAL WARMING: THE COMPLETE BRIEFING (3d ed. 2005). The most detailed reports come from the International Panel on Climate Change [hereinafter IPCC], *available at* http://www.ipcc.ch/index.htm.

2. Valuable treatments include Dale Jamieson, *Adaptation, Mitigation, and Justice*, *in* PERSPECTIVE ON CLIMATE CHANGE: SCIENCE, ECONOMICS, POLITICS, ETHICS 217 (Walter Sinnott-Armstrong & Richard Howarth eds., 2005); Julia Driver, *Ideal Decision Making and Green Virtues*, *in id.* at 249. Some of the ethical issues are also engaged in STERN, *supra* note 1.

3. *See* Audra Ang, *China Overtakes U.S. as Top CO_2 Emitter*, ASSOCIATED PRESS ONLINE, June 21, 2007, *available at* http://abcnews.go.com/International/wireStory?id=3299098.

4. See SCOTT BARRETT, ENVIRONMENT & STATECRAFT (2004), for a good overview of the American position, with particular reference to the Kyoto Protocol; see NAT'L DEV. & REFORM COMM'N, PEOPLE'S REPUBLIC OF CHINA, CHINA'S NATIONAL CLIMATE CHANGE PROGRAMME (June 2007), for an overview of the Chinese position.

5. *See* WILLIAM NORDHAUS & JOSEPH BOYER, WARMING THE WORLD 91 (2000).

6. *See, e.g.*, Jagdish Bhagwati, *A Global Warming Fund Could Succeed Where Kyoto Failed*, FIN. TIMES, Aug. 16, 2006, at 13.

that China's per capita emissions remain a mere fraction of that of the United States? Perhaps most important: Because of its wealth, should the United States be willing to sign an agreement that is optimal for the world as a whole—but not optimal for the United States?

These are large questions, and we do not attempt to give complete answers here. Our narrow goal is to evaluate the arguments from corrective justice and distributive justice. To motivate the analysis, and to put those arguments in their starkest form, we start with two admittedly controversial assumptions. First, the world, taken as a whole, would benefit from an agreement to reduce greenhouse gas emissions.[7] This assumption is reasonable because increasing evidence suggests that the global benefits of imaginable steps—such as a modest carbon tax, growing over time[8]—are significantly larger than the global costs.[9] Second, some nations, above all the United States (and China as well), might not benefit, on net, from the agreement that would be optimal from the world's point of view.[10] Suppose, for example, that the world settled on a specified carbon tax—say, $40 per ton. Such a tax would be likely to impose especially significant costs on the United States, simply because its per capita emissions rate is so high.[11] Suppose also that the United States is less vulnerable than many other nations to serious losses from climate change, and that the expected damage, in terms of health and agriculture, for example, is comparatively low—and that in those terms other nations, such as India and those in Sub-Saharan Africa, are likely to lose much more.[12] If so, the United States might be a net loser from a specified worldwide carbon tax even if the world gains a great deal. Perhaps the optimal carbon tax, for the world, would be $40 per ton, but the United States would do better with a worldwide carbon tax of $20 per ton, or $15 per ton, or even $10 per ton.

We have said that both assumptions are controversial, and we are aware that they might be questioned. We do not question the claim that the domestic cost-benefit analysis for the United States justifies participation in a suitably designed international agreement, and many people may believe that the opti-

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7. *See* Nordhaus, *supra* note 1, at 15; STERN, *supra* note 1, at 131. For the most comprehensive evidence, see generally IPCC, *supra* note 1.

8. *See* Nordhaus, *supra* note 1, at 11.

9. *See id.* For an especially low but still positive figure, see BJØRN LOMBORG, COOL IT 153 (2007) (suggesting, on the basis of remarks by economist Richard Tol, a $2-per-ton carbon tax).

10. On the plausibility of this assumption, see Cass R. Sunstein, *The Complex Climate Change Incentives of China and the United States*, 55 UCLA L. REV. (forthcoming 2008), *available at* http://www.law.uchicago.edu/files/352.pdf.

11. Note that carbon dioxide is not the only greenhouse gas, and so a carbon tax would be only a partial solution. For expository clarity, however, we will focus on carbon taxes and similar regimes.

12. *See* NORDHAUS & BOYER, *supra* note 5, at 91. Broadly in accord are WILLIAM CLINE, GLOBAL WARMING AND AGRICULTURE: IMPACT ESTIMATES BY COUNTRY 67–71 (2007); Richard Tol, *Estimates of the Damage Costs of Climate Change*, 21 ENVTL. & RESOURCE ECON. 135, 157 (2002). Cline's most noteworthy conclusion is "that the composition of agricultural effects is likely to be seriously unfavorable to developing countries, with the most severe losses occurring in Africa, Latin America, and India." *Id*. at 2. The effects on wealthy nations are far more modest. CLINE, *supra*, at 67–71.

mal agreement for the world is not terribly far from the optimal agreement for the United States.[13] But even if this is so, it remains important to specify the content of that agreement.[14] Suppose, as seems clear, that India and Africa would pay little and gain a great deal from an agreement, whereas the United States would pay somewhat more and gain somewhat less. What, if anything, does this point suggest about the proper content of the agreement?

Let us assume, most starkly, that the United States would lose, on net, from a climate change agreement that is optimal from the standpoint of the world taken as a whole. As a matter of actual practice, the standard resolution of the problem is clear: The world should enter into the optimal agreement, and the United States should be given side-payments in return for its participation.[15] The reason for this approach is straightforward. On conventional assumptions, the optimal agreement should be assessed by reference to the overall benefits and costs[16] of the relevant commitments for the world. To the extent that the United States is a net loser, the world should act so as to induce it to participate in an agreement that would promote the welfare of the world's citizens,[17] taken as a whole. With side-payments to the United States, of the kind that have elsewhere induced reluctant nations to join environmental treaties,[18] an international agreement could be designed so as to make all nations better off and no nation

13. *See* RICHARD STEWART & JONATHAN WIENER, RECONSTRUCTING CLIMATE POLICY: BEYOND KYOTO 49–53 (2003) (suggesting that participation by the United States is in that nation's interest and suggesting steps that might make participation worthwhile for China as well). For a recent study, arguing for significant steps for the United States and suggesting significant losses for a large part of the United States, see generally PETER FRUMHOFF ET AL., CONFRONTING CLIMATE CHANGE IN THE U.S. NORTHEAST (2007), *available at* http://www.climatechoices.org/assets/documents/climatechoices/confronting-climate-change-in-the-u-s-northeast.pdf.

14. An illuminating discussion of some of the complexities here can be found in SCOTT BARRETT, WHY COOPERATE? (2007).

15. On side-payments in general, see BARRETT, *supra* note 4, at 335–58. Side-payments might take various forms, as we shall see—one possibility would be cash, whereas another would be technological assistance, and yet another would be initial allocations under a cap-and-trade program. *See* STEWART & WIENER, *supra* note 13, at 15. An important clarification that will emerge from the discussion: We are not suggesting that as a matter of first principle, this approach is the correct one. If the United States loses more than the world gains, for example, an agreement might be justified on welfare grounds even without side payments.

16. We are not contending that benefits and costs should be understood in purely monetary terms, nor are we saying anything contentious about what benefit-cost analysis should entail. For general discussion, see MATTHEW ADLER & ERIC A. POSNER, NEW FOUNDATIONS FOR COST-BENEFIT ANALYSIS (2005).

17. In referring to citizens, we do not mean to take a stand on the interests of nonhuman animals at risk from climate change. *See* Wayne Hsiung & Cass R. Sunstein, *Climate Change and Animals*, 155 U. PA. L. REV 1695 (2007).

18. Thus, for example, Russia and Eastern Europe were given emissions rights worth billions of dollars in the Kyoto Protocol. *See* NORDHAUS & BOYER, *supra* note 5, at 162. Significant side-payments were given to poor nations in connection with the Montreal Protocol. *See* BARRETT, *supra* note 4, at 346–49. See the general treatment of the "Side Payments Game" in *id.* at 335–51.

worse off. Call this a form of *international Paretianism*.[19] Who could oppose an agreement based on international Paretianism?

Our puzzle is that almost everyone does so. No one is suggesting that the world should offer side-payments to the United States. Indeed, the United States is not even arguing for side-payments, perhaps on the ground that the argument would be regarded as preposterous. One reason involves distributive justice. The United States is the richest nation in the world, and many people would find it odd to suggest that the world's richest nation should receive compensation for helping to solve a problem faced by the world as a whole, and above all by poor nations.[20] On this view, wealthy nations should be expected to contribute a great deal to solving the climate change problem; side-payments would be perverse. If ideas of distributive justice are at work, it might be far more plausible to suggest that nations should pay China for agreeing to participate in a climate change agreement. And indeed, developing nations, including China, were given financial assistance as an inducement to reduce their emissions of ozone-depleting chemicals.[21] Some people think that a climate change agreement should build on this precedent,[22] and indeed the "Bali Roadmap" seems to do so, by suggesting financial assistance to developing nations.[23] No one thinks that assistance to the United States, or to other wealthy countries, is in order.

But claims about distributive justice are only part of the story here. Corrective justice matters as well.[24] The basic thought is that the largest emitters, above all the United States, have imposed serious risks on other nations. Surely it cannot be right for nations to request payments in return for ceasing to harm others.[25] On the conventional view, wrongdoers should pay for the damage that they have caused and should be asked to stop. They should not be compensated

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19. In economics, the Pareto principle is satisfied when a project makes at least one person better off without making anyone else worse off. *See generally* RICHARD A. POSNER, ECONOMIC ANALYSIS OF LAW 10–16 (6th ed. 2003).

20. In the exhaustive analysis in STERN, *supra* note 1, for example, there is no suggestion of side-payments to the United States. The dominant view among philosophers is decidedly to the contrary. *See, e.g.*, PETER SINGER, ONE WORLD (2002); Henry Shue, *Subsistence Emissions and Luxury Emissions*, 15 LAW & POL'Y 39 (1993).

21. *See* Cass R. Sunstein, *Of Montreal and Kyoto: A Tale of Two Protocols*, 31 HARV. ENVTL. L. REV. 1, 16–17 (2007). For other examples of side payments in environmental treaties, see Mark A. Drumbl, *Northern Economic Obligation, Southern Moral Entitlement and International Environmental Governance*, 27 COLUM. J. ENVTL. L. 363 (2002).

22. Sheila Olmstead & Robert N. Stavins, *A Meaningful Second Commitment Period for the Kyoto Protocol*, THE ECONOMISTS' VOICE, May 2007, *available at* www.bepress.com/ev.

23. *See* United Nations Framework Convention on Climate Change [UNFCCC], Bali Action Plan, *available at* http://unfccc.int/files/meetings/cop_13/application/pdf/cp_bali_action.pdf [hereinafter Bali Action Plan], also discussed *infra* note 167.

24. *See, e.g.*, Daniel A. Farber, *Basic Compensation for Victims of Climate Change*, 155 U. PA. L. REV. 1605, 1641 (2007); Eric Neumayer, *In Defense of Historical Accountability for Greenhouse Gas Emissions*, 33 ECOLOGICAL ECON. 185, 187 (2000) (noting that "almost every scholar and policy maker from the developing world" supports taking into account differences in historical emissions).

25. Note, however, that one of the most influential articles in tort law explores this possibility. *See* Guido Calabresi & A. Douglas Melamed, *Property Rules, Liability Rules and Inalienability: One View of the Cathedral*, 85 HARV. L. REV. 1089, 1115–25 (1975).

for taking corrective action.

We shall raise serious questions about both accounts here. Rejecting international Paretianism, we agree that in many domains, resources should be redistributed from rich nations and rich people to poor nations and poor people.[26] Such redistribution might well increase aggregate social welfare, since a dollar is worth more to a poor person than to a wealthy one;[27] prominent nonwelfarist arguments also favor such redistribution.[28] But significant greenhouse gas reductions are a crude and somewhat puzzling way of attempting to achieve redistributive goals. The arc of human history suggests that in the future, people are likely to be much wealthier than people are now.[29] Why should wealthy countries give money to future poor people, rather than to current poor people?[30] In any case, nations are not people; they are collections of people. Redistribution from wealthy countries to poor countries is hardly the same as redistribution from wealthy people to poor people. For one thing, many poor people in some countries will benefit from global warming, to the extent that agricultural productivity will increase[31] and to the extent that they will suffer less from extremes of cold.[32] For another thing, poor people in wealthy countries may well pay a large part of the bill for emissions reductions; a stiff tax on carbon emissions would come down especially hard on the poor.[33]

The upshot is that if wealthy people in wealthy nations want to help poor people in poor nations, emissions reductions are unlikely to be the best means by which they might to do so. Our puzzle, then, is why distributive justice is taken to require wealthy nations to help poor ones in the context of climate change, when wealthy nations are not being asked to help poor ones in areas in which the argument for help is significantly stronger.

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26. *See* Eric A. Posner, *International Law: A Welfarist Approach*, 73 U. CHI. L. REV. 487, 500–09 (2006).

27. *Id.* at 505.

28. *See generally* MARTHA C. NUSSBAUM, FRONTIERS OF JUSTICE (2006).

29. *See* Jagdish N. Bhagwati et al., *Expert Panel Ranking*, *in* GLOBAL CRISES, GLOBAL SOLUTIONS 605, 630, 635 (Bjørn Lomborg ed., 2004) (remarks of Vernon Smith); *id.* at 627 (remarks of Thomas Schelling). This is a claim about history, and we do not contend that increasing wealth is built into the fabric of the universe. Catastrophic climate change, for example, could make the future far less wealthy than the present.

30. Current emissions reductions will generally fail to help current poor people, simply because the effects of such reductions will not be felt for many years.

31. *See* NORDHAUS & BOYER, *supra* note 5, at 76 (showing benefits in China, Japan, and Russia); CLINE, *supra* note 12, at 67–71 (showing agricultural benefits in New Zealand without carbon fertilization, and agricultural benefits in Argentina, Belgium, Canada, China, France, Germany, Russia, Spain, and the United States, with carbon fertilization).

32. *See* LOMBORG, *supra* note 9, at 12.

33. It is possible, of course, that such a tax could be accompanied with economic assistance for those who need it.

We also accept, for purposes of argument,[34] the view that when people in one nation wrongfully harm people in another nation, the wrongdoers have a moral obligation to provide a remedy to the victims. It might seem to follow that the largest emitters, and above all the United States, have a special obligation to remedy the harms they have helped cause and certainly should not be given side-payments. But the application of standard principles of corrective justice to problems of climate change runs into serious objections. As we shall show, corrective justice arguments in the domain of climate change raise many of the same problems that beset such arguments in the context of reparations more generally. Nations are not individuals: they do not have mental states and cannot, except metaphorically, act. Blame must ordinarily be apportioned to individuals, and it is hard to blame all greenhouse gas-emitters for wrongful behavior, especially those from the past who are partly responsible for the current stock of greenhouse gases in the atmosphere.

Our principal submissions are that the distributive justice argument must be separated from the corrective justice argument, and that once the two arguments are separated, both of them face serious difficulties. If the United States wants to assist poor nations, reductions in greenhouse gas emissions are unlikely to be the best way for it to accomplish that goal. It is true that many people in poor nations are at risk because of the actions of many people in the United States, but the idea of corrective justice does not easily justify any kind of transfer from contemporary Americans to people now or eventually living in (for example) India and Africa.

This conclusion should not be misunderstood. We do not question the proposition that an international agreement to control greenhouse gases, with American participation, is justified,[35] and all things considered, the United States should probably participate even if the domestic cost-benefit analysis does not clearly justify such participation.[36] We reject international Paretianism. We favor a welfarist approach to international questions, including those raised by climate change, and we would approve of a situation in which wealthy nations are willing to engage in a degree of self-sacrifice and would urge only that they should choose the most efficient method for aiding others. Consider the example of genocide: If a nation could prevent genocide at a modest cost to itself, it should do so, even if that nation is a net loser. Nor do we exclude the possibility that some idea of "rough justice," attentive to the difficulty of achieving optimal redistribution or corrective justice in its standard form, might ultimately justify American participation in an agreement that is not in the

34. We would prefer to understand the issue in welfarist terms. Corrective justice might well be seen as a kind of heuristic for welfarism, but this view is controversial, and we do not attempt to defend it here.

35. *See* Nordhaus, *supra* note 1, at 137. Notably, Lomborg's skeptical treatment of many arguments on behalf of greenhouse gas reductions argues for a significant tax on carbon emissions. LOMBORG, *supra* note 9, at 152.

36. *See* STEWART & WIENER, *supra* note 13, at 49–52.

nation's domestic self-interest. Our goal here is not to question these propositions or to suggest any particular approach to the climate change problem, but more narrowly to show that contrary to widespread beliefs,[37] standard ideas about distributive or corrective justice poorly fit the climate change problem.[38]

As we shall see, identification of the underlying difficulties has general implications for thinking about distributive and corrective justice in the context of international law and international agreements. In many domains, distributive justice might seem to require wealthy nations to make special contributions.[39] Such nations would do well to pay their proportionate share or even more, but it is important to see that other redistributive strategies might be much better for helping those who are most disadvantaged. Corrective justice arguments arise in many areas in which previous generations in one nation acted in a way that harmed or threatened to harm those in another nation. Our argument suggests that if the goal is to act in accordance with corrective justice, it is important to identify both the actors and the victims; abstract references to nations as wrongdoers, and to nations as victims, often beg or obscure the key questions.

The rest of this Article comes in four parts. Part I briefly outlines relevant facts about the climate change problem. Parts II and III turn to the questions of distributive justice and corrective justice, respectively. Part IV discusses the view, pressed by China in particular, that emissions rights should be allocated on a per capita basis. As we will see, this claim amounts to a plea for significant redistribution from wealthy countries, above all the United States, to poor countries, above all China and India.

I. ETHICALLY RELEVANT FACTS

It is an understatement to say that there is a voluminous literature on the science and economics of climate change.[40] We concentrate in this Part on a review of those facts that are most relevant to the questions of justice and that help establish the complex relationship between the interests of the world, taken as a whole, and the interests of the United States. As we shall see, different nations stand to gain and to lose significantly different amounts both from climate change and from emissions reductions. Because it pro-

37. *See, e.g.*, Jamieson, *supra* note 2.

38. Among international lawyers, distributive justice and corrective justice ideas are invoked in favor of the principle of "common but differentiated responsibilities," the idea that wealthier and more-at-fault nations should contribute disproportionately to the creation of international public goods. *See* U.N. CONF. ON ENV'T & DEV. RIO DECLARATION ON ENVIRONMENT AND DEVELOPMENT at 877, UN DOC. A/CONF. 151/5/REV. 1 (1992), 31 ILM 874 (1992). For a valuable discussion that touches on both the distributive justice and corrective justice problems with this view, see generally Christopher D. Stone, *Common but Differentiated Responsibilities in International Law*, 98 AM. J. INT'L L. 276 (2004). *See also* LAVANYA RAJAMANI, DIFFERENTIAL TREATMENT IN INTERNATIONAL ENVIRONMENTAL LAW (2006). We turn to the notion of common but differentiated responsibilities in Part III.

39. See the brief discussion of biodiversity in BARRETT, *supra* note 14, at 350.

40. *See supra* note 1.

vides an illuminating comparison, with important implications for questions of justice, we shall draw special attention to the situation of China as well.

A. IN GENERAL

As we have noted, a strong consensus supports the view that the world would benefit from significant steps to control greenhouse gas emissions.[41] If all of the major emitting nations agreed to such steps, the benefits would almost certainly exceed the costs.[42] To be sure, specialists continue to disagree about the appropriate timing and severity of emissions reductions and about the relationship between such reductions and adaptation; perhaps aggressive reductions are justified in the near future,[43] or perhaps adaptation deserves at least equal priority. But as compared to "business as usual," much would be gained, and less lost, if modest reduction policies were adopted soon, followed by larger ones over time.[44]

There is also a consensus that if the world does undertake an effort to reduce greenhouse gas emissions, it should select one of two possible approaches.[45] The first is an emissions tax, designed to capture the externalities associated with climate change.[46] A worldwide tax on carbon emissions might start relatively low—at, say, $10 per ton—and increase as technology advances.[47] On an approach of this kind, it is generally assumed that the tax would be uniform. Citizens of Russia, China, India, the United States, France, and so forth all would pay the same tax (on the theory that the relevant amount would reflect the social cost of the emissions). There is a disagreement about the magnitude of the optimal tax,[48] and as we shall see, different nations would gain and lose different amounts from any given tax.

The second approach would involve a system of cap-and-trade, akin to that in the Kyoto Protocol.[49] Under such a system, nations might create a worldwide "cap" on aggregate emissions—calling, say, for a 10% reduction, by a specified

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41. *See supra* note 1.

42. *See* Nordhaus, *supra* note 1, at 171 (claiming a $3.4 trillion net present-value benefit of an "optimal" climate change policy).

43. *Compare* STERN, *supra* note 1 (arguing for aggressive, immediate restrictions), *with* LOMBORG, *supra* note 9, at 25 (arguing for modest carbon tax). Much of the disagreement between Stern and those who favor a more modest approach stems from a difference over the appropriate discount rate; Stern's conclusion is driven by a choice of a discount rate close to zero. *See* Nordhaus, *supra* note 1, at 108–09. For our purposes it is not necessary to explore the resulting debates. For discussion, see generally *Symposium on Intergenerational Equity and Discounting*, 74 U. Chi. L. Rev. 1 (2007).

44. *See* Nordhaus, *supra* note 1, at 137–38. Diverse perspectives and vigorous debates can be found in the various contributions to Symposium, *Climate Change*, WORLD ECON., Apr.–June 2007, at 133–258; Symposium, *Climate Change*, WORLD ECON., Jan.–Mar. 2007, at 75–238; Symposium, *Climate Change*, WORLD ECON., Oct.–Dec. 2006, at 165–250.

45. For discussion, see STERN, *supra* note 1, at 530–53; STEWART & WIENER, *supra* note 13, at 64–80.

46. *See, e.g.*, Nordhaus, *supra* note 1, at 121–36 (defending carbon tax).

47. *See id.*; LOMBORG, *supra* note 9, at 152 (suggesting a range of between two dollars and fourteen dollars per ton).

48. For one treatment, see Nordhaus, *supra* note 1, at 86–90.

49. *See* STEWART & WIENER, *supra* note 13.

date, from worldwide emissions in 2007, with further reductions over time. A cap-and-trade system would require a judgment about the appropriate cap and also an initial allocation of emissions rights. On one version, roughly embodied in the Kyoto Protocol, existing emissions levels would provide the foundation for initial allocations; nations would have to reduce levels by a certain percentage from those existing levels.[50] As we will see, the use of existing levels is highly controversial and in a sense arbitrary.[51] But analytically, it is close to a uniform carbon tax; in both cases, current practices are the starting point for regulatory measures.

It is important to see that an agreement to control greenhouse gas emissions loses nearly all of its point if only a few nations are willing to participate. If any particular nation—the United Kingdom, France, Germany, or even the United States—stabilized its emissions rate at 2000 levels, the effect on warming would be very small, both because of the large existing "stock" of greenhouse gases, and because global increases in greenhouse gas emissions would not be much affected if only a single nation stabilized or even reduced its emissions. The Kyoto Protocol, for example, required most of the industrialized world to cut emissions significantly, but because developing nations refused to accept any emissions restrictions, the actual effect on anticipated warming would not have been large. A prominent study offers this stunning finding: *Full compliance with the Kyoto Protocol would have reduced warming by merely 0.03°C by 2100*.[52] Consider the fact that the Intergovernmental Panel on Climate Change now provides a "best estimate" of warming ranging from 1.8°C to 4.0°C by 2100,[53] under a "business as usual" scenario. The gains would be quite limited if all nations complied with their Kyoto obligations and reduced those figures to a range of 1.77°C to 3.97°C.[54]

A more optimistic estimate finds that full compliance with the Kyoto Protocol might reduce global warming by as much as 0.28°C by 2100, and the difference between "business as usual" warming and warming between 1.52°C and 3.72°C is not exactly trivial.[55] But if developing nations were included, far more significant reductions could be anticipated.

The need for broad participation has important implications for questions of efficiency, effectiveness, and justice. Suppose, for example, that Northeastern states followed what has been vigorously urged as a "3% solution," in the form of annual emissions reductions of 3%. This is an exceedingly ambi-

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50. *See* ROBERT PERCIVAL ET AL., ENVIRONMENTAL REGULATION 50–53 (5th ed. 2006).

51. *See* NORDHAUS & BOYER, *supra* note 5, at 167–68; STEWART & WIENER, *supra* note 13, at 85–88.

52. NORDHAUS & BOYER, *supra* note 5, at 152.

53. *See* IPPC, CLIMATE CHANGE 2007: THE PHYSICAL SCIENCE BASIS 824, fig.1 (Susan Solomon et al. eds., 2007); Nordhaus, *supra* note 1, at 11.

54. For an estimate of the savings from a 0.3°C reduction in warming, see NORDHAUS & BOYER, *supra* note 5, at 156–67 (suggesting $96 billion in worldwide benefits).

55. *See* LOMBORG, *supra* note 9, at 22 (finding that the Kyoto Protocol, with American participation, would reduce warming by 0.1°F by 2050 and by 0.3°F by 2100); STEWART & WIENER, *supra* note 13, at 45–46.

tious proposal. But even with such reductions, the total effect on warming by 2100 would be very small—undoubtedly well under 0.01°C—simply because Northeastern states are such a small contributor to anticipated warming. By itself, such an approach would impose significant costs, including some hardship on people who are not wealthy, in return for trivial gains.[56] Or suppose that the United States committed to significant reductions on its own—by, say, capping emissions at the rates prevailing in 2000. If so, the commitment would have little discernible effect on climate change by 2100 (again probably under 0.01°C).[57] By itself, such an approach would impose real costs on the United States, while benefiting that nation very little or perhaps not at all, and failing to do much for the world as a whole.[58] As we will see, China's emissions already exceed and will soon dwarf those of the United States, but if China acted on its own to freeze its emissions as of 2007, the effects would also be modest.

In the context of ozone-depleting chemicals, the analysis was altogether different. Unilateral action by the United States, restricting the emissions of such chemicals, was very much in the interest of the United States.[59] Such unilateral action was relatively inexpensive and by itself promised to produce significant gains in the form of reduced cases of skin cancer and cataracts.[60] For greenhouse gases, by contrast, it is plain that unilateral action by the United States would not be in the domestic interest of that nation, simply because the cost would be significant and the benefits necessarily small.[61]

B. EMITTERS

To understand the issues of justice and the motivations of the various actors, it is important to appreciate the disparities in emissions across nations. We do not have clear data on the costs of emissions reductions

56. *See* FRUMHOFF ET AL., *supra* note 13. It is possible, of course, that steps of this kind could spur other such steps, in which case the benefits would increase.

57. This judgment comes from the finding that the Kyoto Protocol itself, with American participation, would reduce warming by 0.3°C. If the United States stabilized emissions at 2000 levels, elementary logic shows that it would produce a small fraction of that benefit, first because the United States is only one nation, and second because Kyoto called for a percentage reduction (8%) from 1990.

58. We are not arguing against such a step, which could spur additional ones. There is a complex question whether unilateral action—by, say, California, the United States, or the United Kingdom—might be justified on the ground that it could stimulate technological innovation or spur a cascade of action that might eventually have higher benefits than costs. For an interesting related discussion, see generally Ulrich J. Wagner, *Estimating Strategic Complementarities in a Dynamic Game of Timing: The Case of the Montreal Protocol* (2007) (unpublished manuscript), *available at* http://www.columbia.edu/uw2101/Wagner_JobMarketPaper.pdf.

59. *See* BARRETT, *supra* note 14, at 228.

60. *See id.*

61. Note as before that unilateral action might be justified as a way of spurring activity by a range of nations, above all the developing world, which is most unlikely to act if the United States does not. Our goal is to state the consequences of unilateral action, not to argue against it.

for different nations, but it is reasonable to predict that the largest carbon emitters would bear the largest burdens from (say) a worldwide carbon tax.[62] Consider, for example, the Kyoto Protocol, which on a prominent estimate would have cost the United States $325 billion[63]—to say the least, a substantial amount, and more than ten times the cost of the Montreal Protocol.[64] Indeed, the United States would have had to pay more than half of the entire cost of the Kyoto Protocol and, on some estimates, as much as 80% of the world's total cost.[65] To get ahead of the story, an obvious question is this: If the United States is going to spend hundreds of billions of dollars to help poor people in poor nations, are emissions reductions the best option?

For a snapshot of the recent situation, consider the following:

Table 1. Share of Global Emissions, 2003 and 2004[66]

	2003	**2004**
United States	22.7%	22.0%
OECD Europe[67]	16.9%	16.3%
China	15.3%	17.5%
India	4.1%	4.1%
Japan	4.9%	4.7%
Africa	3.5%	3.4%
Russia	4.2%	4.2%

As early as 2004, then, the United States and China emerged as the top emitters, accounting for nearly 40% of the world's total. If the goal is to understand the costs of controls, however, this table does not tell us nearly enough; we need to know future projections as well. Estimates suggest that the largest contributors are likely to continue to qualify as such, but that major shifts will occur, above all with emissions growth in China and India and emissions reductions in Russia and Germany.

62. This judgment is crude. If a high-emitting nation could reduce its emissions at a relatively low cost, perhaps because of technological innovation, its burdens of course would be lower.

63. *See* NORDHAUS & BOYER, *supra* note 5, at 161.

64. *See* CASS R. SUNSTEIN, WORST-CASE SCENARIOS 83 (2007).

65. *See* STEWART & WIENER, *supra* note 13, at 10.

66. *See* DEP'T OF ENERGY, INTERNATIONAL ENERGY OUTLOOK, DOE/EIA-0484, 81 tbl.A8 (2007), *available at* www.eia.doe.gov/oiaf/ieo/index.html. Here and in other tables we provide data for carbon dioxide emissions. Carbon dioxide is the most important greenhouse gas but is not the only one. For statistics involving all greenhouse gases, see UNFCCC, NATIONAL GREENHOUSE GAS INVENTORY DATA FOR THE PERIOD 1990–2005 (2007), *available at* http://unfccc.int/resource/docs/2007/sbi/eng/30.pdf.

67. OECD Europe refers to those European countries in the Organization for Economic Cooperation and Development. A list of members can be found on OECD's website, http://www.oecd.org/pages/0,3417,en_36734052_36761800_1_1_1_1_1,00.html.

Table 2. Carbon Dioxide Emissions Changes, 1990–2004[68]

	1990–2004
China	108.3%
United States	19.8%
India	87.5%
South Korea	104.6%
Iran	110.7%
Indonesia	137.7%
Saudi Arabia	85.6%
Brazil	67.8%
Spain	59.0%
Pakistan	96.6%
Poland	-15.3%
EU-25	1.6%
Germany	-12.2%
Ukraine	-47.1%
Russia	-24.8%

Table 3. Relative Contributions of Annual Carbon Dioxide Emissions by Country/Region (Approximate Percentage of Worldwide Emissions)[69]

	1990	2003	2004	2010	2015	2020	2025	2030
United States	23.5%	22.7%	22.0%	20.1%	19.4%	18.8%	18.7%	18.5%
OECD Europe	19.3%	16.9%	16.3%	14.6%	13.4%	12.4%	11.6%	10.9%
China	10.5%	15.3%	17.5%	21.1%	22.4%	23.9%	25.0%	26.2%
India	2.7%	4.1%	4.1%	4.2%	4.4%	4.7%	4.9%	5.0%
Japan	4.8%	4.9%	4.7%	4.1%	3.8%	3.5%	3.3%	3.0%
Africa	3.1%	3.5%	3.4%	3.7%	3.8%	3.9%	3.9%	3.9%

With these trends, we can project changes to 2030. At that time, the developing world is expected to contribute no less than 55% of total emissions, with 45% coming from developed nations.[70] At that time, the United States is expected to be well below China.

68. Emissions of CO_2 from energy-related sources only. *See* Int'l Energy Agency, CO_2 Emissions from Fuel Combustion 1971–2004 II.4–II.7 (2006). The large reductions in Eastern European countries are a product of economic contractions, leading to lowered emissions. *See* SUNSTEIN, *supra* note 64, at 98–99.

69. *See id.*

70. *See* DEP'T OF ENERGY, *supra* note 66, at 93 tbl.A10 (2007).

This projection is fairly recent, but with explosive emissions growth in China, it is already out of date. China apparently surpassed the United States in CO_2 emissions in June 2007 or perhaps earlier.[71]

The numbers we have presented refer to *flows*: how much a given nation emits on an annual basis. Also relevant for claims of justice, as we shall see, are the *stocks*: how much a given nation has, over time, contributed to the current stock of greenhouse gases in the atmosphere. Table 4 tells the story.

Table 4. Cumulative Emissions (1850–2003)[72]

	CO_2	**Rank**	**Share**
United States	318,740	1	29%
China	85,314	4	8%
European Union	286,764	2	26%
Russia	88,302	3	8%
Japan	45,198	7	4%
India	24,347	9	2%
Germany	78,499	5	7%
United Kingdom	67,348	6	6%
Canada	23,378	11	2%
South Korea	8500	23	1%

The countries are listed in the order of their total emissions as of 2003. Column 3 shows that while the United States is by far the highest ranked contributor to the stock as well as to flows, China drops to a distant fourth, India to ninth, and South Korea to twenty-third.

The reason for these disparities is that greenhouse gases dissipate very slowly, so countries that industrialized earlier have contributed more to the stock than countries that industrialized later, even though the latter might today contribute more on an annual basis. About half of the CO_2 emitted in 1907 still remains in the atmosphere.[73] If by some miracle the world suddenly stopped emitting CO_2 today, the stock of CO_2 in the atmosphere in 2107 would remain at about 90% of what it is now.[74] This point greatly matters to many issues; it helps to explain, for example, why even significant emissions reductions will reduce but hardly halt anticipated warming. We are now in a better position to

71. *See* Ang, *supra* note 3.

72. *See* World Resources Institute's Climate Analysis Indicators Tool, *available at* http://cait.wri.org/. CO_2 is in megatons. The emissions data reflect only carbon dioxide from fossil fuel combustion and not from other activities, such as land use change.

73. *See* IPCC, *supra* note 53.

74. *Id.*

see why unilateral action, even by the largest emitters, will accomplish so little. Such action cannot affect the existing stock, and by definition, it will do nothing (directly) about the rest of the flow.

C. VICTIMS

Which nations are expected to suffer most from climate change? Of course the precise figures are greatly disputed; the extent of the damage in 2100 cannot be specified now, in part because of a lack of information about each nation's ability to adapt to warmer climates. There is a great deal of guesswork here. But it is generally agreed that the poorest nations will be the biggest losers by far.[75] The wealthy nations, including the United States, are in a much better position for three independent reasons.[76] First, they have much more in the way of adaptive capacity. Second, a smaller percentage of their economies depend on agriculture, a sector that is highly vulnerable to climate change. Third, the wealthy nations are generally in the cooler, higher latitudes, which also decreases their vulnerability.[77]

To get a handle on the problem, let us assume that warming will be 2.5°C and consider a prominent estimate of how the harms are likely to vary across nations and regions:

Table 5. Damages of a 2.5°C Warming as a Percentage of GDP[78]

India	4.93
Africa	3.91
OECD Europe	2.83
High-income OPEC	1.95
Eastern Europe	0.71
Japan	0.50
United States	0.45
China	0.22
Russia	-0.65

75. *See, e.g.*, STERN, *supra* note 1, at 139; Richard Tol, *Estimates of the Damage Costs of Climate Change*, 21 ENVTL. & RESOURCE ECON. 135, 157 (2002); CLINE, *supra* note 12, at 67–71.

76. STERN, *supra* note 1, at 139.

77. *Id.* Some of the most systematic analysis of nation-by-nation variations with respect to agriculture can be found in CLINE, *supra* note 12.

78. *See* NORDHAUS & BOYER, *supra* note 5, at 91. For a more recent effort that uses different climate forecasting models, see Robert Mendelsohn, Ariel Dinar & Larry Williams, *The Distributional Impact of Climate Change on Rich and Poor Countries*, 11 ENV'T & DEV. ECON. 158 (2006). They find even more extreme variation across nations. For a study of anticipated effects on agriculture, see CLINE, *supra* note 12, at 67–71 (also finding extreme variations in effects across nations).

To be sure, these rough estimates are at best only suggestive. We do not yet have anything like precise understandings of the effects of climate change on different regions of the world. Because nations are economically interdependent, significant adverse effects on India, Africa, and Europe would probably have a major impact on the United States, China, and Russia. But on these estimates, or any reasonable variation, it is readily apparent that some nations are far more vulnerable than others.[79] On some estimates, the United States, China, and Russia are expected to lose relatively little from 2.5°C warming; indeed, Russia is expected to gain.

By contrast, India and Africa are anticipated to be massive losers. India is expected to experience devastating losses in terms of both health and agriculture.[80] In terms of health alone, India has been projected to lose 3,600,000 years of life because of climate-related diseases, with 769,000 years of life lost from malaria.[81] For Sub-Saharan Africa, the major problem involves health, with a massive anticipated increase in climate-related diseases.[82] Sub-Saharan Africa has been projected to lose 26,677,000 years of life because of climate-related diseases, with 24,385,000 coming from malaria.[83] And if warming exceeds 2.5°C, these estimates will have to be revised upwards.

The United States faces significant but unquestionably more limited threats to both agriculture and health. Consider a careful study of the long-run effects of climate change on a range of economic variables in the United States.[84] The study offers both optimistic projections by 2100, including a high level of adaptation and low warming, and pessimistic projections, involving less adaptation and higher warming. For 3°C warming, the most optimistic case projects an increase of 1% in GDP;[85] the benefits are highest at 2°C warming and decline from 3.5°C.[86] The most pessimistic case projects losses of 1.2% of GDP at 3°C.[87] These estimates, too, should hardly be taken as undisputed, and the risk of catastrophe greatly complicates matters.[88] But to the extent that the United

79. *Accord* Tol, *supra* note 75; WILLIAM CLINE, CLIMATE CHANGE, *in* GLOBAL PROBLEMS, GLOBAL SOLUTIONS 13 (Bjørn Lomborg ed., 2004); CLINE, *supra* note 12, at 67–71; and FRANK ACKERMAN & IAN FINLAYSON, THE ECONOMICS OF INACTION ON CLIMATE CHANGE: A SENSITIVITY ANALYSIS (forthcoming 2008) offer a picture of more serious monetized damage from climate change.

80. NORDHAUS & BOYER, *supra* note 5, at 81. CLINE, *supra* note 12, at 68, finds that India will face, by 2080, between 28% and 38% output losses from agriculture.

81. NORDHAUS & BOYER, *supra* note 5, at 81.

82. *Id.*

83. *See id.*

84. *See* DALE JORGENSON ET AL., U.S. MARKET CONSEQUENCES OF GLOBAL CLIMATE CHANGE (2004), *available at* http://www.pewclimate.org/global-warming-in-depth/all_reports/marketconsequences; *see also* STERN, *supra* note 1, at 147–48 (providing a brief summary of climate change effects on the United States' GDP).

85. STERN, *supra* note 1, at 148.

86. *Id.*

87. *Id.*

88. *See generally* NAT'L RESEARCH COUNCIL, ABRUPT CLIMATE CHANGE: INEVITABLE SURPRISES (2002); AVOIDING DANGEROUS CLIMATE CHANGE (Hans Schellnuber et al., eds., 2006). For a technical discussion, see Martin Weitzman, *Structural Uncertainty and the Value of a Statistical Life in the Economics of*

States anticipates that it is likely to lose little, on net, from climate change, its incentive to agree to expensive emissions reductions will not be very high.[89] And if the United States anticipates a less-than-alarming "worst case"—1.2% loss of GDP at 3°C warming by 2100—the incentive is relatively weak.

Like Russia, China has been projected to benefit in terms of agriculture,[90] and while it will suffer health losses, they are comparatively modest, far below those expected in Africa and India.[91] On one projection, 2.5°C warming will cause China to lose 603,000 years of life from climate-related causes and just 8000 from malaria.[92] The loss of more than 600,000 years of life is highly significant, but it is far below the corresponding losses for the most threatened nations. To the extent that the losses are not overwhelming, we might expect that China would be unlikely to be particularly interested in reducing greenhouse gas emissions, at least on these figures; thus far, the nation's behavior is consistent with that prediction.[93] For China, a higher priority might well be, and indeed has been, economic growth, even or perhaps especially if the goal is to prevent premature death.[94] Note in this regard the striking fact that the citizens of China and the United States are less concerned about climate change than are the citizens of Japan, France, Spain, India, Britain, and Germany.[95] Of course, it is possible that new estimates will suggest that China has a great deal more to lose than is suggested by the evidence sketched here. If warming is above 2.5°C, the damage will be higher. But on any current estimate, China faces lower risks than India and Africa.

From this brief survey, it seems useful to analyze the questions of justice by assuming that the world would benefit from an agreement to control greenhouse gas emissions; that the United States would have to pay a significant amount to reduce its emissions;[96] that some nations would benefit far more than others from world-wide reductions; and that the United States would not be the largest beneficiary and could even be a net loser from a large uniform carbon tax or from a cap-and-trade program that requires major reductions from existing

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Catastrophic Climate Change (AEI-Brookings Joint Ctr. for Regulatory Studies, Working Paper No. 07-11, 2007), *available at* http://www.aei-brookings.org/publications/abstract.php?pid=1196.

89. For a dated but helpful overview of various assessments, see NORDHAUS & BOYER, *supra* note 5, at 70. CLINE, *supra* note 12, at 71, finds between a 5.9% loss in agriculture output (without carbon fertilization) and an 8% gain (with carbon fertilization) by 2080.

90. *See* NORDHAUS & BOYER, *supra* note 5, at 76. CLINE, *supra* note 12, at 68, finds between a 7.2% loss (without carbon fertilization) and a 6% gain in agricultural output (with carbon fertilization) for the United States by 2080.

91. *See* NORDHAUS & BOYER, *supra* note 5, at 81.

92. *See id.*

93. *See* Geoffrey York, *Citing "Right To Development," China Rejects Emission Cap*, GLOBE & MAIL, June 5, 2007, at A1.

94. *Id.*

95. *See Doing It Their Way*, THE ECONOMIST, Sept. 9, 2006, at 22.

96. This point is confirmed in the context of the Kyoto Protocol—the United States would have had to pay by far the most of any atio to comply with its obligations. NORDHAUS & BOYER *supra* note 5, 15 91.

emissions levels.

Our primary question is how to understand the moral obligations of the United States; we are secondarily interested in the proper approach of and toward China. Assume, simply for purposes of clarifying the problem, that the optimal global carbon tax is $40 per ton of carbon. On the basis of the evidence above, it could well be that the optimal tax for the United States is just $20 per ton, while the optimal tax for China is only $10 per ton. If we assume that nations are motivated by domestic self-interest, this means that a $10 per ton agreement should be feasible; a $20 per ton agreement is feasible too, but only if others pay China $10 per ton to reduce its emissions; and a $40 per ton agreement is feasible as well, but only if others pay the United States $20 per ton, and China $30 per ton, to reduce their emissions.

It is tempting to think that, on the assumptions that we have given, the United States should actually pay $40 per ton, and perhaps that China should too. On one view, the United States, at least, should face special obligations in the context of climate change—special in the distinctive sense that the United States should sign an agreement that is in the world's interest but not its own. It would be possible to go further and to suggest that the United States is obliged to transfer large sums of money to compensate (poor? all?) countries at risk from climate change. We now turn to two popular arguments on behalf of these conclusions.

II. CLIMATE CHANGE AND DISTRIBUTIVE JUSTICE

To separate issues of distributive justice from those of corrective justice, and to clarify intuitions, let us begin with a risk of natural calamity that does not involve human action at all.

A. THE ASTEROID

Imagine that India faces a serious new threat of some kind—say, a threat of a collision with a large asteroid. Imagine too that the threat will not materialize for a century. Imagine finally that the threat can be eliminated, today, at a cost. India would be devastated by having to bear that cost now; as a practical matter, it lacks the resources to do so. But if the world acts as a whole, it can begin to build technology that will allow it to divert the asteroid, thus ensuring that it does not collide with India a century hence. The cost is high, but it is lower than the discounted benefit of eliminating the threat. If the world delays, it might also be able to eliminate the threat or reduce the damage if it comes to fruition. But many scientists believe that the best approach, considering relevant costs and benefits, is to start immediately to build technology that will divert the asteroid.

Are wealthy nations, such the United States, obliged to contribute significant sums of money to protect India from the asteroid? On grounds of distributive justice, it is tempting to think so. But if we reach that conclusion, how is the case different from one in which India contends, now, that it would be able to

prevent millions of premature deaths from disease and malnutrition if the United States gave it (say) some small fraction of its Gross Domestic Product? If one nation is threatened by malaria or a tsunami, other nations might well agree that it is appropriate to help; it is certainly generous and in that sense commendable to assist those in need. But even generous nations do not conventionally think that a threatened nation has an entitlement to their assistance. For those who believe that there is such an entitlement,[97] the puzzle remains: Why is there an entitlement to help in avoiding future harm from an asteroid, rather than current harms from other sources?

The problem of the asteroid threat does have a significant difference from that of climate change, whose adverse effects are not limited to a single nation. To make the analogy closer, assume that all nations are threatened by the asteroid in the sense that it is not possible to project where the collision will occur; scientists believe that each nation faces a risk. But the risk is not identical. Because of its adaptive capacity, its location, its technology, and a range of other factors, assume that the United States is less vulnerable to serious damage than (for example) India and the nations of Africa and Europe. Otherwise the problem is the same. Under plausible assumptions, the world will certainly act to divert the asteroid, and it seems clear that the United States will contribute substantial resources for that purpose. Suppose that all nations favor an international agreement that requires contributions to a general fund, but, because it is less vulnerable, the United States believes that the fund should be smaller than the fund favored by the more vulnerable nations of Africa and Europe, and by India. From the standpoint of domestic self-interest, then, those nations with the most to lose will naturally seek a larger fund than those nations facing lower risks.

At first glance, it might seem intuitive to think that the United States should accept the proposal for the larger fund simply because it is so wealthy. If resources should be redistributed from rich to poor on the ground that redistribution would increase overall welfare or promote fairness,[98] the intuition appears sound. But there is an immediate problem: If redistribution from rich nations to poor nations is *generally* desirable, it is not at all clear that it should take the particular form of a deal in which the United States joins an agreement that is not in its interest. Other things being equal, the more sensible kind of redistribution would be a cash transfer, so that poor nations can use the money as they see

97. Some scholars believe that poor nations have an entitlement to help from wealthy nations. *See, e.g.*, NUSSBAUM, *supra* note 28, at 316–17, 324 (arguing that among the principles required to achieve social justice by meeting basic human needs is an obligation of richer nations to provide "a substantial portion of their GDP to poorer nations"). And on welfarist grounds, we accept the conclusion that wealthy nations should transfer resources to poor people in poor nations. Posner, *supra* note 26, at 499–500. But even if this is so, assistance in the case we are describing is less valuable than direct financial aid—a point we shall be emphasizing.

98. *See* Posner, *supra* note 26, at 499–500 (discussing global welfarism as a goal for international law reform); NUSSBAUM, *supra* note 28, at 316–17.

fit.[99] Perhaps India would prefer to spend the money on education, or on AIDS prevention, or on health care generally. If redistribution is what is sought, a generous deal with respect to the threat of an asteroid collision seems a crude way of achieving it.

Analytically, that deal has some similarities to housing assistance for poor people when recipients might prefer to spend the money on food or health care.[100] If redistribution is desirable, housing assistance is better than nothing, but it remains puzzling why wealthy nations should be willing to protect poor nations from the risks of asteroid collisions (or climate change), while not being willing to give them resources with which they can set their own priorities. Indeed, a generous deal with respect to the asteroid threat may be worse than housing assistance as a redistributive strategy because, by hypothesis, many of the beneficiaries of the deal are in rich nations and are not poor at all—a point to which we will return.

There is a second difficulty. We have stipulated that the asteroid will not hit the earth for another 100 years. If the world takes action now, it will be spending current resources for the sake of future generations, which are likely to be much richer.[101] The current poor citizens of poor nations are probably much poorer than will be the *future* poor citizens of those nations. If the goal is to help the poor, it is odd for the United States to spend significant resources to help posterity while neglecting the present.[102] Thus far, then, the claim that the United States should join what it believes to be an unjustifiably costly agreement to divert the asteroid is doubly puzzling. Poor nations would benefit more from cash transfers, and the current poor have a stronger claim to assistance than the future (less) poor.

From the standpoint of distributional justice, there is a third problem. Nations are not people; they are collections of people, ranging from very rich to very poor. Wealthy countries, such as the United States, have many poor people, and poor countries, such as India, have many rich people. If the United States is

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99. Unfortunately, cash transfers have generally not had their intended effect of promoting economic growth in poor countries. *See, e.g.*, Simeon Djankov et al., *Does Foreign Aid Help?*, 26 CATO J. 1, 14, 17 (2006). However, there is a difference between economic growth and (at least, short-term) welfarist benefits; as long as the aid reaches the intended recipients (which it sometimes, but not always, does), there should be short-term welfare gains.

100. Economists have long criticized such in-kind programs as paternalistic and as less likely to be in the interest of beneficiaries than cash transfers. *See, e.g.*, JOSEPH E. STIGLITZ, ECONOMICS OF THE PUBLIC SECTOR 55, 92–93 (1986) (discussing the view that government policies that intervene in consumer choices on the grounds that individuals will not act in their own best interests are paternalistic). And although a case can be made for paternalism when governments attempt to aid citizens who suffer from self-control problems, or are poor and uneducated, this case is far weaker and provokes politically explosive memories of rationalizations of imperialism in the context of government-to-government foreign aid.

101. *See* Bhagwati et al., *supra* note 29, at 627 (remarks of Schelling).

102. We are putting to one side the possibility that technological change will make it easier to divert the asteroid in the future. By hypothesis, specialists do believe that cost-benefit analysis justifies immediate action. But it is possible that because of technological advances, future generations will be able to eliminate the threat more cheaply than present generations can.

paying a lot of money to avert the threat of an asteroid collision, it would be good to know whether that cost is being paid, in turn, by wealthy Americans or by poor Americans. Suppose, for example, that greenhouse gas reductions lead to a significant increase in the cost of energy. Any such increase—from either carbon taxes or cap-and-trade—would be regressive, in the sense that it would hit poor people harder than wealthy people, who spend a smaller portion of the income on energy costs. We agree that products should be priced at their full social cost and thus that an externality-correcting tax would have strong justifications here as elsewhere. But if the concern is to help people who need help, such a tax is hard to defend.[103]

If redistribution is our goal, it would also be good to know whether the beneficiaries are mostly rich or mostly poor. Many of the beneficiaries of actions to reduce a worldwide risk are in wealthy nations, and so it should be clear that the class of those who are helped will include many people who are not poor at all. Because the median member of wealthy nations is wealthier than the median member of poor nations, it is plausible to think that if wealthy nations contribute a disproportionately high amount to the joint endeavor, the distributive effects will be good. For example, the Americans who are asked to make the relevant payments are, on average, wealthier than the Indians who are paying less. But asking Americans to contribute more to a joint endeavor is hardly the best way of achieving the goal of transferring wealth from the rich to the poor.

B. CLIMATE CHANGE: FROM WHOM TO WHOM?

In terms of distributive justice, the problem of climate change is closely analogous to the asteroid problem. From that problem, three general questions emerge. First, why should redistribution take the form of an in-kind benefit, rather than a general grant of money that poor nations could use as they wish? Second, why should rich nations help poor nations in the future, rather than poor nations now? Third, if redistribution is the goal, why should it take the form of action by rich nations that would hurt many poor people in those nations and benefit many rich people in rich nations? To sharpen these questions, suppose that an international agreement to cut greenhouse gas emissions would cost the United States $325 billion.[104] If distributive justice is the goal, should the United States spend $325 billion on climate change, or instead on other imaginable steps to help people who are in need? If the goal is to assist poor people, perhaps there would be far better means than emissions reductions.

In fact, the argument from distributive justice runs into an additional problem in the context of climate change. No one would gain from an asteroid collision,

103. Of course creative systems might be developed in which externality-correcting taxes are combined with subsidies to offset burdens imposed by such taxes on the poor.

104. *See* NORDHAUS & BOYER, *supra* note 5, at 159, 161 (estimating $325 billion in abatement costs imposed on the United States by the Kyoto Protocol).

but millions of people would benefit from climate change.[105] Many people die from cold, and to the extent that warming reduces cold, it will save lives.[106] Warming will also produce monetary benefits in many places, such as Russia, due to increases in agricultural productivity.[107] Indeed, many millions of poor people in such countries may benefit from climate change.[108] Some of them will live when they would otherwise die from extreme cold.[109] In China, many millions of people living in rural areas continue to be extremely poor despite the increasing prosperity of the nation as a whole. These people are among the poorest in the world. For at least some of these people, climate change could well provide benefits by increasing the productivity of their land.[110]

In addition, many millions of poor people would be hurt by the cost of emissions reductions. They would bear that cost in the form of higher energy bills, lost jobs, and increased poverty. Recall too that industrialized and relatively wealthy European nations have been found to be at greater risk than the relatively poorer China.[111]

It follows that purely as an instrument of redistribution, emission reductions on the part of the United States are quite crude. True, a suitably designed emissions control agreement would almost certainly help poor people more than it would hurt them, because disadvantaged people in sub-Saharan Africa and India are at such grave risk.[112] And true, an agreement in which the United States pays more than its self-interest dictates might well be better, from the standpoint of distributive justice, than the status quo, or than an agreement that would simply require all nations to scale back their emissions by a specified amount.[113] But there is a highly imperfect connection between distributive goals on the one hand and requiring wealthy countries to pay for emissions reductions on the other.

To see the problem more concretely, suppose that Americans (and the same could be said about citizens in other wealthy countries) are willing to devote a

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105. *See* TODD SANDLER, GLOBAL PUBLIC GOODS (2004); LOMBORG, *supra* note 9.

106. *See* LOMBORG, *supra* note 9.

107. *See* NORDHAUS & BOYER, *supra* note 5, at 91 tbl.4.10; CLINE, *supra* note 12, at 67–71.

108. *Cf.* NORDHAUS & BOYER, *supra* note 5, at 91 tbl.4.10 (estimating agricultural benefits from warming in China and Russia—both countries with substantial low-income populations); CLINE, *supra* note 12, at 67–71 (showing agricultural benefits without carbon fertilization to New Zealand and agricultural benefits with carbon fertilization to many nations, including China, Russia, and the United States).

109. *See* LOMBORG, *supra* note 9.

110. *See* NORDHAUS & BOYER, *supra* note 5, at 76 (showing agricultural gain of $3 billion from CO_2 doubling); CLINE, *supra* note 12, at 68 (showing significant benefits to China, at least with carbon sequestration).

111. *See* Table 5 *supra*. We acknowledge that greenhouse gas reductions might be accompanied by efforts to soften the economic hardship faced by poor people, as, for example, by cash subsidies to offset the increase in energy prices.

112. *See* NORDHAUS & BOYER, *supra* note 5, at 81 tbl.4.7, 82, 83 tbl.4.8, 91 tbl.4.10; CLINE, *supra* note 12, at 67–71.

113. On some of the complexities here, see Eric A. Posner & Cass R. Sunstein, *Should Greenhouse Gas Permits Be Allocated on a Per Capita Basis?*, CAL. L. REV. (forthcoming 2009).

certain portion, X, of their national income to helping people living in poor countries. The question is, How is X best spent? If X is committed to emissions controls, then X is being spent to benefit wealthy Europeans as well as impoverished Indians, and X is also being spent to harm some or many impoverished people living in China and Russia by denying them the benefit of increased agricultural productivity that warming will bring. And if all of X is spent on global emissions control, then none of X is being spent to purchase malaria nets or to distribute AIDS drugs—which are highly effective ways of helping poor people who are alive today rather than poor people who will be alive in 100 years.[114]

One response to this argument is that Americans should pay more than X: they should pay 2X or 5X or 100X. But this argument is not responsive. If Americans are willing to pay 2X or 5X or 100X, the question remains how this money should be used, and it is quite possible that 100X is better spent on malaria nets and AIDS drugs than on global emissions control, if the only goal is to help the poor. To be sure, it may be that, in fact, the best way to spend X is to cut greenhouse gas emissions. It is possible, for example, that more lives are saved from cutting greenhouse gas emissions than from distributing malaria nets and AIDS drugs, given a constant amount of money and taking into account that future lives and current lives must be put on a common metric. We cannot exclude this possibility, but we can say that the match between greenhouse gas reductions and distributive justice is quite crude.

C. TWO COUNTERARGUMENTS

There are two tempting counterarguments. The first involves the risk of catastrophe. The second involves the fact that cash transfers will go to governments that may be ineffective or corrupt.

1. Catastrophe

On certain assumptions about the science, greenhouse gas cuts are necessary to prevent a catastrophic loss of life.[115] Suppose, by way of imperfect analogy, that a genocide is occurring in some nation. For multiple reasons, it would not be sensible to say that rich countries should give money to such a nation, rather than acting to prevent the genocide. Or suppose that a nation is threatened by a natural disaster that would wipe out millions of lives; if other nations could eliminate the harms associated with such a disaster, it would be hard to object that they should offer cash payments instead. One reason is that if many lives are at risk, and if they can be saved through identifiable steps, taking those steps would seem to be the most effective response to the problem, and cash transfers

114. For this argument in the more general context of tort and regulatory standards, see Eric A. Posner & Cass R. Sunstein, *Dollars and Death*, 72 U. CHI. L. REV. 537, 583–84 (2005).

115. *See* Weitzman, *supra* note 88, at 7–8 (discussing potential impacts from dramatic increases in global temperatures).

would have little or no advantage.

Suppose that climate change threatens to create massive losses of life in various countries. In light of the risk of catastrophe, perhaps emissions reductions are preferable to other redistributive strategies. The catastrophic scenario is a way of saying that the future benefits of cuts could be exceptionally high rather than merely high. If poor people in poor nations face a serious risk of catastrophe, then greenhouse gas abatement *could* turn out to be the best way to redistribute wealth (or, more accurately, welfare) to people who would otherwise die in the future.

Ultimately the strength of the argument turns on the extent of the risk. To the extent that the risk of catastrophe is not low, and to the extent that it is faced mostly by people living in difficult or desperate conditions, the argument from distributive justice does gain a great deal of force. To the extent that the catastrophic scenario remains highly unlikely,[116] the argument is weakened. We cannot exclude the possibility that the argument is correct; it depends on the scientific evidence for the truly catastrophic scenarios.

2. Ineffective or Corrupt Governments

We have emphasized that development aid is likely to be more effective than greenhouse gas restrictions as a method of helping poor people in poor nations. A legitimate response is that cutting greenhouse gas emissions bypasses the governments of poor states more completely than other forms of development aid do. This might be counted as a virtue because the governments of many poor states are either inefficient or corrupt (or both), and partly for that reason, ordinary development aid has not been very effective.[117]

But here too there are counterarguments. As we have stressed, this form of redistribution does not help existing poor people at all; it can, at best, help poor people in future generations. And it is far from clear that donor states can avoid the pathologies of development aid by, in effect, transferring resources to the future rather than to the present, or by transferring resources directly to the people rather than to corrupt governments. Benefits received by individuals can be expropriated, or taxed away, by governments that do not respect the rule of law. This is just as true for the future as for the present. If abatement efforts today result in higher crop yields in Chad in 100 years than would otherwise occur, Chadians might be better off, of course, but it is also possible that a future authoritarian government would expropriate these gains for itself, or that they would be squandered as a result of bad economic policy, or that in the meantime Chad has become a completely different place that does best by

116. *See, e.g.*, NORDHAUS & BOYER, *supra* note 5, at 81–83 (noting vulnerabilities to climate change in India and sub-Saharan Africa).

117. *Cf.* WILLIAM EASTERLY, THE WHITE MAN'S BURDEN 131–34, 136–37, 147–57 (2006) (discussing corruption in some poor countries receiving development aid and recommending new aid strategies for donor countries and institutions, including bypassing corrupt governments when direct aid to government does not produce results for the poor).

importing food from elsewhere.

Even more important, the claim that emissions reductions avoid corruption overlooks the fact that emissions abatement does not occur by itself but must take place through the activity of governments, including those in developing countries. In cap-and-trade systems, for example, the government of a poor country would be given permits that it could then sell to industry, raising enormous sums of money that the government could spend however it chose. Corrupt governments would spend this money badly, perhaps using it to finance political repression, while also possibly accepting bribes from local industry that chooses not to buy permits, in return for non-enforcement of the country's treaty obligations.[118] To be sure, significant emissions reductions by wealthy nations would directly benefit poor nations.

Notwithstanding the complexities here, the basic point remains: in principle, greenhouse gas cuts do not seem to be the most direct or effective means of helping poor people or poor nations. We cannot exclude the possibility that the more direct methods are inferior, for example because it is not feasible to provide that direct aid; but it would remain necessary to explain why a crude form of redistribution is feasible when a less crude form is not.

D. PROVISIONAL CONCLUSIONS

It is worth emphasizing the narrowness of our claims thus far. As we have said, there are strong arguments, rooted in both welfarism and fairness, to support the view that rich countries should be making large lump-sum payments to poor ones. But rich countries are not now making such payments.[119] There are strong arguments on behalf of a uniform carbon tax and a worldwide cap-and-trade program. What is puzzling is the claim that on distributive justice grounds, the best approach is for the United States to try to assist poor people and poor nations through a climate change agreement, rather than to take more direct steps to help those who need it. (Recall the possibility that the optimal carbon tax for the world, assuming universal participation, is higher than the optimal carbon tax for the United States, again assuming universal participation.)

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118. *Cf.* Nordhaus, *supra* note 1, at 130–31 (noting that limitations on emissions creates resource rents that can be exploited or abused under corrupt regimes).

119. Rich nations do make small foreign aid contributions, much but not all of which appears to be designed to address specific political and strategic goals. *See* Alberto Alesina & David Dollar, *Who Gives Foreign Aid to Whom and Why*, 5 J. ECON. GROWTH 33, 33–34, 40 (2000). It is noteworthy that while many people argue that distributive goals justify imposing special economic burdens on wealthy nations (above all the United States) in an international cap-and-trade system, few people argue that if an international agreement requires a carbon tax, wealthy nations should be transferring some of their tax revenues to poor ones. That is, it is not being urged that the United States should give (say) 10% of the domestic revenue from a carbon tax to (say) India and China. It is interesting that distributive goals seem to provide an inadequate intuitive basis for transferring tax revenue, while such goals have intuitive force in the context of cap-and-trade—even though there is no relevant distinction, in principle, between the two. We speculate that one reason for the difference is a widely held intuition that nations are entitled to keep tax revenues from their own citizens.

We agree, however, that if the United States does spend a great deal on emissions reductions as part of an international agreement, and if the agreement does give particular help to disadvantaged people, considerations of distributive justice support its action even if better redistributive mechanisms are imaginable. As compared to the status quo, or to an agreement that requires all nations to freeze their emissions at existing levels, it is better, from the standpoint of distributive justice, for the United States to join an agreement in which it agrees to provide technological or financial assistance to poor nations, and it may even be better, from that standpoint, to scale back emissions more than domestic self-interest would dictate. We cannot exclude the possibility that desirable redistribution is more likely to occur through climate change policy than otherwise, or to be accomplished more effectively through climate policy than through direct foreign aid.

Our only claims are that the aggressive emissions reductions on the part of the United States are not an especially effective method for transferring resources from wealthy people to poor people, and that if this is the goal, many alternative policies would probably be better. It should be clear that these claims apply broadly to efforts to invoke distributive justice when asking wealthy nations to participate in international agreements from which other nations might gain.

III. CORRECTIVE JUSTICE

Climate change differs from our asteroid example in another way. In the asteroid example, no one can be blamed for the appearance of the asteroid and the threat that it poses to India (or the world). But many people believe that by virtue of its past actions and policies, the United States, along with other developed nations, is particularly to blame for the problem of climate change.[120] In the international arena, the argument that the United States has an obligation to devote significant resources to reducing greenhouse gas emissions is not solely and perhaps not even mainly an argument about distributive justice. The argument also rests on moral intuitions about corrective justice—about wrongdoers and their victims.[121]

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120. *See, e.g.*, JIAHUA PAN, COMMON BUT DIFFERENTIATED COMMITMENTS: A PRACTICAL APPROACH TO ENGAGING LARGE DEVELOPING EMITTERS UNDER L20 (2004), *available at* http://www.l20.org/publications/6_5c_climate_pan1.pdf; SINGER, *supra* note 20, at 44–45.

121. We do not address whether there are *legal* challenges, specifically tort challenges, to greenhouse gas emissions. There is an extensive literature on this topic. *See, e.g.*, David A. Grossman, *Warming Up to a Not-So-Radical Idea: Tort-Based Climate Change Litigation*, 28 COLUM. J. ENVTL. L. 1 (2003); David Hunter & James Salzman, *Negligence in the Air: The Duty of Care in Climate Change Litigation*, 155 U. PA. L. REV. 1741 (2007); Eduardo M. Penalver, *Acts of God or Toxic Torts? Applying Tort Principles to the Problem of Climate Change*, 38 NAT. RESOURCES J. 563 (1998). For a discussion of the possibility of tort claims brought under the Alien Tort Statute, see Eric A. Posner, *Climate Change and International Human Rights Litigation: A Critical Appraisal*, 155 U. PA. L. REV. 1925 (2007). However, the tort claim and the moral claim are overlapping.

A. THE BASIC ARGUMENT

Corrective justice arguments are backward-looking, focused on wrongful behavior that occurred in the past.[122] Corrective justice therefore requires us to look at stocks rather than flows. Even though China is now the world's leading greenhouse gas emitter, the United States has been the largest emitter historically and thus has the greater responsibility for the stock of greenhouse gases in the atmosphere.[123] Of course, a disproportionate share of the stock of greenhouse gases can be attributed to other long-industrialized countries as well, such as Germany and Japan, and so what we say here about the United States can be applied, *mutatis mutandi*, to those other countries. The emphasis on the United States is warranted by the fact that the United States has contributed more to the existing stock than any other nation (nearly 30%).

In the context of climate change, the corrective justice argument is that the United States wrongfully harmed the rest of the world—especially low-lying states and others that are most vulnerable to global warming—by emitting greenhouse gases in vast quantities. On a widespread view, corrective justice requires that the United States devote significant resources to remedying the problem[124]—perhaps by paying damages, agreeing to extensive emissions reductions, or participating in a climate pact that is not in its self-interest. India, for example, might be thought to have a moral claim against the United States—one derived from the principles of corrective justice—and on this view the United States has an obligation to provide a compensatory remedy to India. (Because India is especially vulnerable to climate change,[125] we use that nation as a placeholder for those at particular risk.)

This argument enjoys a great deal of support in certain circles and seems intuitively correct. The apparent simplicity of the argument, however, masks some serious difficulties. We shall identify a large number of problems here, and the discussion will be lamentably complex. The most general point, summarizing the argument as a whole, is that the climate change problem poorly fits the corrective justice model because the consequence of tort-like thinking would be to force many people who have not acted wrongfully to provide a remedy to many people who have not been victimized. Some of the problems we identify could be reduced if it were possible to trace complex causal chains with great precision; unfortunately, legal systems lack the necessary tools to do so.

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122. For this reason, corrective justice claims will not be appealing to welfarists, who tend to think that corrective justice is relevant, if at all, because it serves as a proxy for what welfarism requires. *See* LOUIS KAPLOW & STEVEN SHAVELL, FAIRNESS VERSUS WELFARE 12 (2005). We tend to think that welfarists are generally correct here but bracket that point and the associated complexities for purposes of discussion.

123. We assume this point throughout, but if current trends continue, China will, in a matter of decades, exceed the United States in terms of both stocks and flows. We put this point to one side for now.

124. *See, e.g.*, Daniel A. Farber, *Basic Compensation for Victims of Climate Change*, 155 U. PA. L. REV. 1605, 1641–42 (2007).

125. *See* NORDHAUS & BOYER, *supra* note 5, at 91; CLINE, *supra* note 12, at 69.

B. THE WRONGDOER IDENTITY PROBLEM

The current stock of greenhouse gases in the atmosphere is a result of the behavior of people living in the past. Much of it is due to the behavior of people who are dead. The basic problem for corrective justice is that dead wrongdoers cannot be punished or held responsible for their behavior, or forced to compensate those they have harmed. At first glance, holding Americans today responsible for the activities of their ancestors is not fair or reasonable on corrective justice grounds, because current Americans are not the relevant wrongdoers; they are not responsible for the harm.

Indeed, many Americans today do not support the current American energy policy and already make some sacrifices to reduce the greenhouse gas emissions that result from their behavior. They avoid driving, they turn down the heat in their homes, and they support electoral candidates who advocate greener policies. Holding these people responsible for the wrongful activities of people who lived in the past seems perverse. An approach that emphasized corrective justice would attempt to be more finely tuned, focusing on particular actors, rather than Americans as a class, which would appear to violate deeply held moral objections to collective responsibility.[126] The task would be to distinguish between the contributions of those who are living and those who are dead.

The most natural and best response to this point is to insist that all or most Americans today benefit from the greenhouse gas emitting activities of Americans living in the past, and therefore it would not be wrong to require Americans today to pay for abatement measures. This argument is familiar from debates about slave reparations, where it is argued that Americans today have benefited from the toil of slaves 150 years ago.[127] To the extent that members of current generations have gained from past wrongdoing, it may well make sense to ask them to make compensation to those harmed as a result. On one view, compensation can work to restore the status quo ante, that is, to put members of different groups, and citizens of different nations, in the position that they would have occupied if the wrongdoing had not occurred.

In the context of climate however, this argument runs into serious problems. The most obvious difficulty is empirical. It is true that many Americans benefit from past greenhouse-gas-emissions, but how many benefit, and how much do they benefit? Many Americans today are, of course, immigrants or children of immigrants, and so not the descendants of greenhouse-gas-emitting Americans of the past. Such people may nonetheless gain from past emissions, because they enjoy the kind of technological advance and material wealth that those emissions made possible. But have they

126. *See, e.g.*, H.D. Lewis, *Collective Responsibility*, *in* COLLECTIVE RESPONSIBILITY: FIVE DECADES OF DEBATE IN THEORETICAL AND APPLIED ETHICS 17, 17–34 (Larry May & Stacey Hoffman eds., 1991).

127. *See* Stephen Kershnar, *The Inheritance-Based Claim to Reparations*, 8 LEGAL THEORY 243, 266–67 (2002) (describing and criticizing these arguments). These arguments are often analogized to unjust enrichment arguments. *See* Eric A. Posner & Adrian Vermeule, *Reparations for Slavery and Other Historical Injustices*, 103 COLUM. L. REV. 689, 698 (2003).

actually benefited, and to what degree? Further, not all Americans inherit the wealth of their ancestors, and even those who do would not necessarily have inherited less if their ancestors' generations had not engaged in the greenhouse-gas-emitting activities. The idea of corrective justice, building on the tort analogy, does not seem to fit the climate change situation.

Suppose that these various obstacles could be overcome and that we could trace, with sufficient accuracy, the extent to which current Americans have benefited from past emissions. As long as the costs are being toted up, the benefits should be as well, and used to offset the requirements of corrective justice. We have noted that climate change is itself anticipated to produce benefits for many nations, both by increasing agricultural productivity and by reducing extremes of cold.[128] And if past generations of Americans have imposed costs on the rest of the world, they have also conferred substantial benefits. American industrial activity has produced products that were consumed in foreign countries, for example, and has driven technological advances from which citizens in other countries have gained. Many of these benefits are positive externalities, for which Americans have not been fully compensated. To be sure, many citizens in, say, India have not much benefited from those advances, just as many citizens of the United States have not much benefited from them. But what would the world, or India, look like if the United States had engaged in 10% of its level of greenhouse gas emissions, or 20%, or 40%? For purposes of corrective justice, a proper accounting would seem to be necessary, and it presents formidable empirical and conceptual problems.

In the context of slave reparations, the analogous points have led to interminable debates, again empirical and conceptual, about historical causation and difficult counterfactuals.[129] But-for causation arguments, used in standard legal analysis and conventional for purposes of conventional justice, present serious and perhaps insuperable problems when applied historically. We can meaningfully ask whether an accident would have occurred if the driver had operated the vehicle more carefully, but conceptual and empirical questions make it difficult to answer the question whether and to what extent white Americans today would have been worse off if there had been no slavery—and difficult too to ask whether Indians would be better off today if Americans of prior generations had not emitted greenhouse gases. What kind of a question is that? In this hypothetical world of limited industrialization in the United States, India would be an entirely different country, and the rest of the world would be unrecognizably different as well.

Proponents of slave reparations have sometimes appealed to principles of corporate liability. Corporations can be immortal, and many corporations today benefited from the slave economy in the nineteenth century. Corporations are

128. *See* CLINE, *supra* note 12, at 67–71; LOMBORG, *supra* note 9, at 14, 104; NORDHAUS & BOYER, *supra* note 5, at 76.

129. *See* Posner & Vermeule, *supra* note 127, at 699–703.

collectivities, not individuals, yet they can be held liable for their actions, which means that shareholders today are "punished" (in the sense of losing share value) as a result of actions taken by managers and employees long before the shareholders obtained their ownership interest. If innocent shareholders can be made to pay for the wrongdoing of employees who are long gone, why can't citizens be made to pay for the wrongful actions of citizens who lived in the past?

The best answer is that corporate liability is most easily justified on grounds other than corrective justice. Shareholder liability can be defended on the basis of consent or (in our view most plausibly) on the welfarist ground that corporate liability deters employees from engaging in wrongdoing on behalf of the corporate entity.[130] A factor that distinguishes corporate liability is that purchasing shares is a voluntary activity and one does so with the knowledge that the share price will decline if a past legal violation comes to light, and this is reflected in the share price at the time of purchase. (One also benefits if an unknown past action enhances the value of the company.) But because the corporate form itself is a fiction, and the shareholders today are different from the wrongdoers yesterday, corporate liability cannot be grounded in corrective justice.[131] Thus, it provides no analogy on behalf of corrective justice for the climate change debate.

C. THE VICTIM/CLAIMANT IDENTITY PROBLEM

As usually understood, corrective justice requires an identity between the victim and the claimant: the person who is injured by the wrongdoer must be the same as the person who has a claim against the wrongdoer.[132] In limited circumstances, a child or other dependent might inherit that claim, but usually one thinks of the dependent as having a separate claim, deriving from the wrongdoer's presumed knowledge that by harming the victim she also harms the victim's dependents.

Who are the victims of climate change? Most of them live in the future. Thus, their claims have not matured. To say that future Indians might have a valid claim against Americans today, or Americans of the past, is not the same as saying that Americans today have a duty to help Indians today. To be sure, some

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130. *See id.* at 703–08.

131. In recent years, some philosophers have challenged traditional criticisms of collective responsibility, but these philosophers tend to ground collective responsibility in individual failures to act when action was possible and likely to be effective, and when the person in question knew or should have known that she could have prevented the harm. *See, e.g.*, LARRY MAY, SHARING RESPONSIBILITY 1 (1992); *cf.* BRENT FISSE & JOHN BRAITHWAITE, CORPORATIONS, CRIME AND ACCOUNTABILITY 50 (1993) (explaining why collective responsibility is appropriate in terms of corporate wrongdoing); CHRISTOPHER KUTZ, COMPLICITY: ETHICS AND LAW FOR A COLLECTIVE AGE 166–253 (2000) (explaining why individuals should be held accountable for certain collective harms); David Copp, *Responsibility for Collective Inaction*, J. SOC. PHIL., Fall 1991, at 71, 71 (explaining that "certain collective entities . . . have moral responsibility for their actions"). These arguments do not carry over to the greenhouse gas case.

132. *See* Posner & Vermeule, *supra* note 127, at 699.

people are now harmed by climate change.[133] In addition, people living in low-lying islands or coastal regions can plausibly contend that a particular flood or storm has some probabilistic relationship with climate change—but from the standpoint of corrective justice, this group presents its own difficulties (a point to which we will return shortly). What remains plausible is the claim that future Indians would have corrective justice claims against current and past Americans.

A successful abatement program would, of course, benefit many people living in the future, albeit by preventing them from becoming victims in the first place or reducing the magnitude of their injury, rather than compensating them for harm. One might justify the abatement approach on welfarist grounds: perhaps the welfare benefits for people living in the future exceed the welfare losses to people living today. One could also make an argument that people living today have a nonwelfarist obligation to refrain from engaging in actions today that harm people in the future. The point for present purposes is that both arguments are forward-looking: the obligation, whether welfarist or nonwelfarist, is not based on past actions, and thus a nation's relative contribution to the current greenhouse gas stock in the atmosphere would not be a relevant consideration in the design of the greenhouse gas abatement program, as we have been arguing. By contrast, the corrective justice argument is that the United States should contribute the most to abatement efforts because it has caused the most damage to the carbon-absorbing capacity of the atmosphere.[134]

The argument that we owe duties to the future, on welfarist or other grounds, seems right, but as a basis for current abatement efforts, it runs into a complication. Suppose that activities in the United States that produce greenhouse gases (a) do harm people in the future by contributing to climate change, but also (b) benefit people in the future by amassing capital on which they can draw to reduce poverty and illness and to protect against a range of social ills. Supposing, as we agree, that present generations are obliged not to render future generations miserable, it is necessary to ask whether current activities create benefits that are equivalent to, or higher than, costs for those generations. As our discussion of distributive justice suggests, it is possible that greenhouse gas abatement programs—as opposed to, say, research and development or promoting economic growth in poor countries—are not the best way to ensure that the appropriate level of intergenerational equity is achieved. This point is simply the intertemporal version of the argument against redistribution by greenhouse gas abatement that we made above. Of course, it remains empirically possible that abatement programs would produce significant benefits for future generations without imposing

133. The World Health Organization estimates that climate change produces 150,000 annual deaths and 5 million annual illnesses. *See* Jonathan Patz et al. *Impact of Regional Climate Change on Human Health*, 438 NATURE 310, 313 (2005); Juliet Eilpern, *Climate Shift Tied to 150,000 Fatalities*, WASH. POST, Nov. 17, 2005, at A20, *available at* http://www.washingtonpost.com/wp-dyn/content/article/2005/11/16/AR2005111602197.html.

134. We might also think that Americans of, say, the last decade or two can be held responsible for their greenhouse gas emissions; because most of them are alive today, they might be considered obliged to provide a remedy.

equally significant burdens—in which case they would be justified on welfarist grounds. And we have agreed that, on those grounds, some kind of greenhouse gas abatement program, including all the leading contributors, would be justified. But this is not a point about corrective or distributive justice.

D. THE CAUSATION PROBLEM

Corrective justice requires that the wrongdoing cause the harm. In ordinary person-to-person encounters, this requirement is straightforward. But in the context of climate change, causation poses formidable challenges, especially when we are trying to attribute particular losses to a warmer climate.

To see why, consider a village in India that is wiped out by a monsoon. One might make a plausible argument that the flooding was more likely than it would otherwise have been, as a result of rising sea levels caused by climate change. But it might well be impossible to show that greenhouse gas emissions in the United States "caused" the flooding, in the sense that they were a necessary and sufficient condition, and difficult even to show that they even contributed to it.[135] If the flooding was in a probabilistic sense the result of greenhouse gas activities around the world, its likelihood was also increased by complex natural phenomena that are poorly understood. And to the extent that the United States was involved, much of the contribution was probably due to people who died years ago.

Causation problems are not fatal to corrective justice claims, but they significantly weaken them. In tort law, courts are occasionally willing to assign liability according to market share when multiple firms contribute to a harm—for example, pollution or dangerous products whose provenance cannot be traced.[136] Perhaps scientific and economic studies could find, with sufficient accuracy, aggregate national losses (as suggested in Table 3 above). And it would be plausible to understand corrective justice, in this domain, in probabilistic terms, with the thought that victims should receive "probabilistic recoveries," understood as the fraction of their injury that is probabilistically connected with climate change. It is unclear, however, that statistical relationships can be established with sufficient clarity to support a claim sounding in corrective justice.[137]

E. THE CULPABILITY PROBLEM

Philosophers disagree about whether corrective justice requires culpability.[138] Intentional, reckless, or negligent action is usually thought to be required for a

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135. *See* R.A. Pielke et al., *Hurricanes and Global Warming*, 86 BULL. AM. METEOROLOGICAL SOC. 1571, 1574 (2005) (discussing the uncertain connection between increased hurricane intensity and climate change).

136. *See generally* Michael Saks & Peter Blanck, *Justice Improved: The Unrecognized Benefits of Aggregation and Sampling in the Trial of Mass Torts*, 44 STAN. L. REV. 815 (1992).

137. For more on the causation problem, see generally Posner, *supra* note 121.

138. *See generally* Stephen R. Perry, *Loss, Agency, and Responsibility for Outcomes: Three Conceptions of Corrective Justice*, *in* TORT THEORY 24, 24–26 (Ken Cooper-Stephenson & Elaine Gibson eds., 1993).

corrective justice claim. While some people do support strict liability on corrective justice grounds, a degree of culpability is required to make the analysis tractable. Because multiple persons and actions (including those of the victim) are necessary for harm to have occurred, identification of the person who has "caused" the harm requires some kind of assignment of blame.[139] At a minimum, the case for a remedy is stronger when a person acts culpably rather than innocently, and so it is worthwhile to inquire whether the United States or Americans can be blamed for contributing to climate change. Indeed, the notion that Americans have acted in a blameworthy fashion by contributing excessively to climate change is an important theme in popular debates.[140]

1. Negligence in General

The weakest standard of culpability is negligence: if one negligently injures someone, one owes her a remedy. Economists define negligence as the failure to take cost-justified precautions.[141] Lawyers tend to appeal to community standards.[142]

Today, a scientific consensus holds that the planet is warming and that this warming trend is a result of human activity.[143] But this consensus took a long time to form. In the modern era, the earliest work on global warming and greenhouse gases occurred in 1957,[144] and the modern consensus is a product of the 1990s.[145] Greenhouse-gas-emitting activities could not have become negligent, under existing legal standards, until a scientific consensus formed and it became widely known among the public—a fairly recent occurrence.[146]

Even today, it is not clear when and whether engaging in greenhouse-gas-emitting activities is properly characterized as negligent. The scientific consen-

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139. *See* Matthew D. Adler, *Corrective Justice and Liability for Global Warming*, 155 U. PA. L. REV. 1859, 1859–61 (2007).

140. *See* SINGER, *supra* note 20, at 43–49.

141. *See* RICHARD A. POSNER, ECONOMIC ANALYSIS OF LAW 179–83 (5th ed. 1998).

142. For simplicity, we will rely on the legal view. However, the legal standard does not, strictly speaking, require culpability. *See* A.P. Simester, *Can Negligence Be Culpable?*, *in* OXFORD ESSAYS IN JURISPRUDENCE 85, 87 (Jeremy Horder ed., 2000).

143. *See, e.g.*, Nordhaus, *supra* note 1, at 10–11; STERN, *supra* note 1, at 4–15. *See generally* IPCC, *supra* note 53. We refer to a scientific consensus, but there are dissenting voices. *See, e.g.*, Nir J. Shaviv, *The Spiral Structure of the Milky Way, Cosmic Rays, and Ice Age Epochs on Earth*, 8 NEW ASTRONOMY 39, 41 (2003) (arguing that cosmic rays are responsible for most recent variations in global temperatures); Nir J. Shaviv & Ján Veizer, *Celestial Driver of Phanerozoic Climate?*, GSA TODAY, July 2003, at 4, 4. For a response, see Stefan Rahmstorf et al., *Cosmic Rays, Carbon Dioxide and Climate*, EOS TRANSACTIONS AM. GEOPHYSICAL UNION, Jan. 27, 2004, at 38, 38.

144. *See* HOUGHTON, *supra* note 1, at 17.

145. *See* BARRETT, *supra* note 4, at 363–64.

146. One commentator suggests 1990 as a date for when emitting activities could have become negligent. *See* PAN, *supra* note 120, at 3–7. We put to one side the following questions: What if a consensus did not exist, but many experts believed that climate change was likely and that if it occurred, the damages would be massive? How should negligence be analyzed if there were (say) a 30% chance of enormous harm? In principle, the benefit-cost test might find negligence in such circumstances (if the discounted harm exceeded the cost of precautions).

sus does not answer the critical question, for the purpose of determining negligence, of how much any particular activity actually contributes to climate change. Indeed, a lively controversy exists about the overall costs and benefits of climate change in particular regions.[147] Suppose, for example, that a large company in New York emits a large volume of greenhouse gases—is it negligent? It is easily imaginable that the costs of emissions abatement would be significant; it is also easily imaginable that the benefits of emissions abatement, in terms of diminished warming, would be close to zero. (Even very large emitters produce, in any particular period of time, little in the way of warming.) We all understand what it means to drive a car negligently so as to put other drivers and pedestrians at risk, but the claim that driving a (non-hybrid?) car carefully is in fact negligent because of its impact on global warming, and the harm it causes to people living in India, is doubtful in light of the fact that the global warming cost of driving a car is trivial and the benefits, to the driver and others, may be significant. Heating a house, driving a car, running a freezer, taking an airplane—are all of these activities negligent? Even though the warming effects of the relevant emissions are essentially nil?

It would be possible to respond that, in fact, negligence has been pervasive. Although the harm caused by each of these activities in isolation is small, the cost of precaution is also often low. For example, Nordhaus calculates that, under certain assumptions, the optimal carbon tax as of 2010 would be about $34 per ton.[148] The calculation is based on the external cost of burning a ton of carbon as a consequence of greenhouse gas emissions. We calculate that this $34-per-ton figure translates to about an extra ten cents per gallon of gas.[149] Using the economic theory of negligence as the failure to take cost-justified precautions, we could conclude that a person is negligent when she drives rather than walks when the benefit she obtains from driving is less than ten cents per gallon consumed. The argument could be extended to the choice of driving rather than using convenient forms of public transportation and to other activities as well.

Many people do seem to be reducing their emissions on the basis of an assessment of roughly this kind. Those concerned about climate change rarely believe that they should altogether stop engaging in activities that produce greenhouse gases (a difficult task!); instead, they think that they should cut back on activities that generate unreasonable emissions of greenhouse gases in light of whatever benefits they produce. Some people go farther and purchase carbon offsets, but this type of activity seems, at present, supererogatory, whereas a case could be made today that a reasonable reduction of greenhouse gas

147. *See* LOMBORG, *supra* note 9, at 32–38.

148. *See* Nordhaus, *supra* note 1, at 88.

149. *See* Nordhaus, *supra* note 1, at 30; EPA, EMISSION FACTS: AVERAGE CARBON DIOXIDE EMISSIONS RESULTING FROM GASOLINE AND DIESEL FUEL, http://epa.gov/oms/climate/420f05001.htm. The figures in the text are very rough and are used for illustration only: what we say would be true even if the numbers are higher or lower, as long as they are not zero.

emitting activities is morally required—that it represents an emerging community standard or norm.

Even if this is so, there is a problem with this argument, which is that the calculation given above assumes that everyone around the world, or at least hundreds of millions of people, are also cutting back on greenhouse-gas-producing activities. If many or most people fail to pay a carbon tax or (as we argue) fail to act as if they pay it by cutting back on less important activities that produce greenhouse gases, then the contribution of Americans who do this is quite small. And if this is the case, it cannot be considered negligent for Americans to fail to reduce their greenhouse-gas-emitting activities. Put differently, it is not negligent to fail to contribute to a public good if not enough others are doing similarly, so that the public good would not be created even if one did contribute.[150] This is a "moral collective action problem,"[151] and however it should be assessed in moral terms, the failure to act when other people are not acting, so that positive action would generate no benefit, does not seem to constitute negligence.

2. Negligent Government?

What about the U.S. government? Perhaps one could argue that U.S. climate change policy—which is to say not much in the way of policy[152]—has been culpably negligent. The argument would be that, by failing to take precautions that would have cost the U.S. a lot but benefited the rest of the world much more, the U.S. government engaged in culpable behavior.

In the context of ozone-depleting chemicals, this argument is plausible; the global cost of U.S. emissions exceeded, by a large measure, the global benefits.[153] In the context of climate change, one problem is that, as we noted above, it is far from clear that the United States could have taken unilateral action that would have created benefits for the rest of the world greater than the cost to the United States. Unilateral reductions in greenhouse gas emissions would have little effect on overall climate change—not so far from zero even if aggressive and effective, and zero or very close to it if industry simply migrated to foreign countries. The Kyoto Protocol imposed no obligations on China, now the biggest emitter, and placed heavy burdens on the United States.[154] In this light, the claim that American policy has been negligent, under prevailing legal standards, is far-fetched.

Nothing that we have said is inconsistent with the view that American policy has been wrong or misdirected—especially insofar as the United States has not sought to

150. Matthew Adler makes this point in criticizing Farber's corrective justice argument, *see* Farber, *supra* note 24. *See* Matthew D. Adler, *Corrective Justice and Liability for Global Warming*, 155 U. PA. L. REV. 1859, 1862–63 (2007). However, we disagree with Adler's argument that corrective justice can justify government-to-government claims, *see id.* at 1866, for reasons given below.

151. *See id.* at 1862.

152. For an overview, see generally SUNSTEIN, *supra* note 64.

153. *See id*.

154. *See* NORDHAUS & BOYER, *supra* note 5, at 162.

persuade the world to address the problem.[155] But it is not easy to say that the benefits of significant unilateral reductions would clearly exceed the costs.[156]

3. The Government vs. the Public

Even if one could conclude that the U.S. government behaved negligently, it may not follow that the American people should be held responsible for their government's failures. The government itself does not have its own money to pay the remedy; it can only tax Americans. To justify such a tax, one would need to conclude that Americans behaved culpably by electing or tolerating a government that failed to take actions that might have conferred benefits on the rest of the world of greater value than their costs.

There is a strong impulse to blame members of the public for the failures of their political system. In some cases, the impulse is warranted, but in others, the impulse should be resisted. The last example of such a policy was the war guilt clause of the Versailles Treaty, which held Germany formally responsible for World War I and required Germany to pay massive reparations to France and other countries. Germans resented this clause, and conventional wisdom holds that their resentment fed the rise of Nazism. After World War II, the strategy shifted; rather than holding "Germany" responsible for World War II, the allies sought to hold the individuals responsible for German policy responsible—these individuals were tried at Nuremberg and elsewhere, where defendants were given a chance to defend themselves. The shift from collective to individual responsibility was a major legacy of World War II, reflected today in the proliferation of international criminal tribunals that try individuals, not nations.

To be sure, no one is accusing the American government or its citizens of committing crimes. But the question remains whether Americans should be blamed, in corrective justice terms, for allowing their government to do so little about greenhouse gas emissions. It is one thing to blame individual Americans for excessive greenhouse gas emissions; it is quite another to blame Americans for the failure of their government to adopt strict greenhouse gas reduction policies. It is certainly plausible to think that voting for politicians who adopt bad policies, or failing to vote for politicians who adopt good policies, is not morally wrong except in extreme or unusual cases. Recall in this connection that even if Americans had demanded that their government act to reduce greenhouse gas emissions in the United States, the effect of unilateral reductions on climate change would be very small.

155. A vigorous argument in favor of such engagement can be found in STEWART & WIENER, *supra* note 13.

156. *See* Sunstein, *supra* note 10, at 3.

F. ROUGH JUSTICE

However appealing, corrective justice intuitions turn out to be a poor fit with the climate change problem—where the dispute is between nations, and where an extremely long period of time must elapse before the activity in question generates a harm. This is not to deny that a corrective justice argument can be cobbled together and presented as the basis of a kind of rough justice in an imperfect world.[157] Perhaps the argument, while crude, is good enough to provide a factor in allocating the burdens of emissions reductions. Unfortunately, even that conclusion would rely on notions of collective responsibility that are not easy to defend. Most of the attractiveness of the corrective justice argument derives, we suspect, from suppressed redistributive and welfarist assumptions, or from collectivist habits of thinking that do not survive scrutiny.

It is sometimes argued that because people take pride in the accomplishments of their nation, they should also take responsibility for its failures.[158] Americans who take pride in their country's contributions to prosperity and freedom should also take responsibility for its contributions to global warming. This argument, however, is especially weak. Many people are proud that they are attractive or intelligent, or can trace their ancestry to the Mayflower, or live in a city with a winning baseball team, but nothing about these psychological facts implies moral obligations of any sort. A person who is proud to be American, and in this way derives welfare from her association with other Americans who have accomplished great things, perhaps should be (and is) less proud than she would be if she were not also associated with Americans who have done bad things. She does not have any moral obligation, deriving from her patriotic pride, to set aright what other Americans have done wrong.

Here too, the argument has general implications. It is often tempting to invoke principles of corrective justice to ask one nation to compensate another. But especially when long periods of time have passed since the initial wrongdoing, the corrective justice argument runs into serious problems, and it is probably better to think in terms of redistribution or welfare.

IV. PER CAPITA EMISSIONS

We turn now to an especially pressing issue of climate change justice, one that is likely to play an increasing role in the next decade and beyond. Along

157. *Cf.* Adrian Vermeule, *Reparations As Rough Justice* 15 (Univ. Chi. Law Sch., John M. Olin Law and Economics Working Paper No. 260; Univ. Chi. Law Sch., Public Law and Legal Theory Working Paper No. 105), *available at* http://www.law.uchicago.edu/law-pdf/law-econ/260.pdf (explaining that rough justice might be the best justification for reparations).

158. *Cf.* JACOB T. LEVY, THE MULTICULTURALISM OF FEAR 242–43 (2000). Levy argues that such people should feel shame about national failures, and not exactly that they have any moral obligations. However, the latter view seems to reflect many people's intuitions.

with other developing nations, China has urged that the analysis ought to focus on a nation's per capita emissions, not its aggregate emissions.[159] This argument might even be connected with a general "right to development," on the theory that a worldwide carbon tax, for example, would forbid poor nations from achieving the levels of development already attained by wealthy nations.[160] Perhaps an imaginable climate change agreement, one that would actually be effective and efficient, would violate the "right to development."

A. FACTS

With respect to China, the factual predicate for this argument is that China's population is the largest on the planet, and notwithstanding its explosive emissions growth, its per capita emissions remain well below those of many nations. For a general overview, consider the following:

Table 6. Tons of CO_2 Emitted Per Capita in 2004[161]

United States	19.73
Russia	10.63
Germany	10.29
Japan	9.52
United Kingdom	8.98
EU-25	8.46
Ukraine	6.42
France	6.22
China	3.66
India	1.02

159. *See* CHINA'S NATIONAL CLIMATE CHANGE PROGRAMME, *supra* note 4, at 2, 58. Many economists and policy makers from the developing world have made similar arguments. *See* Neumayer, *supra* note 24, at 187.

160. China has made just this argument. *See* York, *supra* note 93. The UN General Assembly declared the existence of a right to development in 1986. *See* Declaration on the Right to Development, G.A. Res. 41/128 (Dec. 4, 1986), *available at* http://www.un.org/documents/ga/res/41/a41r128.htm. The issues discussed in this section are elaborated in more detail in Posner & Sunstein, *supra* note 113.

161. Energy-related CO_2 emissions only. *See* Int'l Energy Agency, *supra* note 68, at II.49–II.51.

For a more detailed ranking, consider the following:

Table 7. GHG Emissions—Tons CO_2 Per Person in 2004 (Excludes Land Use Change)[162]

	Country	Tons CO_2 Per Person
1	Qatar	50.3
2	Kuwait	28.6
3	Luxembourg	25.8
4	Brunei	24.4
5	United Arab Emirates	24.1
6	Bahrain	22.9
7	United States	20.1
8	Equatorial Guinea	18.0
9	Australia	17.5
10	Canada	17.2
11	Trinidad & Tobago	16.8
12	Saudi Arabia	15.2
13	Finland	13.8
14	Estonia	13.3
15	Oman	12.6
16	Czech Republic	12.3
17	Taiwan	12.2
18	Palau	11.9
19	Kazakhstan	11.9
20	Singapore	11.8
21	Netherlands	11.5
22	Belgium	11.4
23	Nauru	11.2
24	Russian Federation	11.0
25	Ireland	10.7
26	Korea (South)	10.5
27	Germany	10.4
28	Japan	10.2
29	Cyprus	9.8
30	Denmark	9.7

162. Tables generated by World Resources Institute, Climate Analysis Indicators Tool, *available at* http://cait.wri.org/cait.php?page=yearly.

Table 7. GHG Emissions—Tons CO_2 Per Person in 2004 (Excludes Land Use Change) (Continued)

	Country	Tons CO_2 Per Person
31	Austria	9.4
32	Israel	9.4
33	South Africa	9.2
34	Norway	9.2
35	United Kingdom	9.2
36	Greece	8.9
37	European Union (25)	8.8
38	Libya	8.7
39	Spain	8.3
40	Italy	8.3
41	Turkmenistan	8.3
42	Slovenia	8.2
43	New Zealand	8.1
44	Poland	8.0
45	Iceland	7.9
46	Slovakia	7.4
47	Serbia & Montenegro	7.0
48	Ukraine	6.9
49	Belarus	6.7
50	France	6.6
51	Seychelles	6.5
52	Bahamas	6.3
53	Malta	6.3
54	Sweden	6.2
55	Portugal	6.2
56	Bulgaria	6.1
57	Iran	6.1
58	Switzerland	6.0
59	Malaysia	6.0
60	Hungary	5.8
61	Venezuela	5.4

Table 7. GHG Emissions—Tons CO_2 Per Person in 2004 (Excludes Land Use Change) (Continued)

	Country	Tons CO_2 Per Person
62	Barbados	5.3
63	Suriname	5.2
64	Uzbekistan	5.1
65	Antigua & Barbuda	5.1
66	Croatia	5.0
67	Lebanon	4.8
68	Romania	4.4
69	Macedonia, FYR	4.3
70	Jamaica	4.1
71	Mexico	4.1
72	Bosnia & Herzegovina	4.0
73	China	4.0
74	Chile	3.9
75	Lithuania	3.8

The most striking point here is that while China has become the world's leading national emitter of greenhouse gases, its per capita contributions remain fairly modest, ranking it near the bottom of the list of the seventy-five highest contributors. China's per capita emissions are merely one-fifth those of the United States, making it natural to question whether the two nations should be treated similarly in a climate change agreement. The case of India may be even more pertinent. India's rapidly growing contributions rank it among the world's leaders on an absolute basis, but its per capita emissions are less than a third of those of China, about a sixth of those of France, and about one-fifteenth of those of the United States, ranking it 122nd in the world.[163]

China might well urge that its low per capita emissions rate—not only below that of the United States, but also below such nations as Japan, India, Russia, Germany, the United Kingdom, and Ukraine as well—should be taken into account in deciding on appropriate policy. To clarify the claim, assume that the world consists of only two nations, one with two billion people and one with one million people. Suppose that the two nations have the same aggregate

163. *Id.*

emissions rate. Would it make sense to say that the two should be allocated the same level of emissions rights, for purposes of a system of cap-and-trade? Intuition suggests not. China therefore argues that all citizens should have a right to the same level of opportunity, which means that emissions rights should be allocated on a per capita basis.[164]

B. A LITTLE DOUBLESPEAK? OF "COMMON BUT DIFFERENTIATED RESPONSIBILITIES"

China's argument for taking account of per capita emissions is connected with its support for and understanding of the principle of "common but differentiated responsibilities," set forth in the United Nations Framework Convention on Climate Change.[165] On the surface, this principle means that a nation's obligations on climate issues are to be determined by two factors: its responsibility for climate change and its capacity to cut emissions.[166] Beneath the surface, the principle means that the developed nations have to spend a great deal to reduce their emissions, while the developing nations do not.[167]

Invoking this principle, Chinese officials have called on developed countries to take the lead in cutting their emissions and have argued that developing countries such as China are bound only to take account of environmental issues as they continue to ensure that their economies grow.[168] Chinese officials insist that raising the standard of living for their citizens is their first priority.[169] With this point in mind, China has emphasized that any actions it takes in regard to climate change will be "within its capability based on its actual situation."[170]

China further argues that developed countries have an obligation to assist the developing world with the challenges of climate change; the assistance might include financial assistance or technology transfer to allow sustainable development.[171] This moral obligation, China argues, arises because the developed world bears the greatest share of responsibility for climate change.[172] Since

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164. *See* Jiahua Pan, *Emissions Rights and Their Transferability: Equity Concerns over Climate Change Migration*, 3 INT'L ENVTL. AGREEMENTS: POL. L. & ECON. 1 (2005).

165. *See* CHINA'S NATIONAL CLIMATE CHANGE PROGRAMME, *supra* note 4, at 58.

166. *See* PAN, *supra* note 120, at 3–4; Stone, *supra* note 38, at 289–90.

167. Note here the "Bali Roadmap," which distinguishes clearly between developed and developing countries. *See* Bali Action Plan, *supra* note 23. For developed nations, the plan asks for "consideration of measurable, reportable, and verifiable nationally appropriate mitigation commitments or actions, including quantified emission limitation and reduction objectives." For developing nations, the plan asks for "consideration of nationally appropriate mitigation actions . . . in the context of sustainable development, supported and enabled by technology, financing and capacity building, in a measurable, reportable and verifiable manner." *Id.* An important point here is the idea that "mitigation actions" by developing nations will be "supported and enabled by technology, financing and capacity building."

168. Liu Jiang, Vice-Chairman, Nat'l Dev. and Reform Comm'n of China, Keynote Speech at the Round Table Meeting of Energy and Environment Ministers from Twenty Nations: The Challenge of Climate Change and China's Response Strategy (2005) (transcript available at http://www.ccchina.gov.cn/en/NewsInfo.asp?NewsId=5348).

169. *Id.*

170. *Id.*

171. *See id.*; CHINA'S NATIONAL CLIMATE CHANGE PROGRAMME, *supra* note 4, at 60–61.

172. *See* CHINA'S NATIONAL CLIMATE CHANGE PROGRAMME, *supra* note 4, at 2.

developed countries appropriated more than their share of "climate resources" in the past, they should now use their wealth to help poor countries develop in a world in which warmer climates are a serious threat.[173]

C. A (MILDLY) DISGUISED CLAIM FOR CROSS-NATIONAL REDISTRIBUTION

Some of these arguments have considerable intuitive appeal.[174] But to the extent that China's claim is that emissions rights should be allocated on a per capita basis, it is asking for massive redistribution from the developed nations, above all the United States, to the developing nations, including China, and it is most puzzling to suggest that the redistribution should occur in the context of climate change policy.

To see the point, we need to distinguish between greenhouse gas taxes and cap-and-trade programs. Many people favor the latter.[175] A large challenge for such programs is to decide on the initial allocation of entitlements. An obvious possibility would be to require that all of the major emitters reduce their emissions by a stated amount from a specified date—by, say, 10% from 1995. Analytically, this approach would be similar to a tax in terms of its distributional consequences: both take existing emissions rates as the starting point. The alternative possibility, which would be attractive to China, would be to give each nation a right to emit a specified amount per person. Under this approach, the United States (with 300 million people) would have less than 30% of the emissions rights of either India or China (each of which has over 1 billion people). The key point is that such an approach would represent a significant transfer of resources from the United States to other nations—indeed, the transfer would be worth hundreds of billions of dollars and perhaps more.

Suppose, for example, that total global emissions were capped at their 2005 level, and that emissions rights were allocated on a per capita basis. For the United States, maintaining 2005 emissions levels, or anything like that, would require American companies to purchase hundreds of billions of dollars in emissions rights from other nations, such as China and India.

We have said that there are strong arguments for redistribution from wealthy people in wealthy nations to poor people in poor nations. But there is no sign that the United States wants to give hundreds of billions of dollars to China or India. Indeed, any proposal that it should do so, in general or in the context of climate change, would be unpopular to say the least; domestic political constraints would probably doom any such proposal. And if the United States does decide to give hundreds of billions of dollars to poor nations, why should the gift take the form of emissions rights?

One answer is that the gift would represent a side-payment, designed to ensure that

173. *See* PAN, *supra* note 120, at 5–6.

174. For a detailed treatment, see Posner & Sunstein, *supra* note 113.

175. *See, e.g.*, STEWART & WIENER, *supra* note 13, at 11–14.

developing nations—above all China—participate in the deal.[176] Such an approach would be very similar to what happened in connection with the Kyoto Protocol, where Russia and Eastern Europe were given side-payments, in the form of emissions rights worth over 100 billion dollars.[177] (By the way, that amount is about one-third the total cost of the Kyoto Protocol to the United States, had the United States agreed to the emissions reductions requirements.[178]) That particular side-payment was understandable, especially for Russia; recall that on prominent projections, Russia would be a net gainer from 2.5°C climate change.[179] The question is whether the United States, which has comparatively less to lose from climate change, is willing to give poor countries large sums of money as part of a climate change agreement. It is far more likely that the United States would say: We would not like to be punished for our willingness to enter into an agreement that does not appear to be in our interest.

There are other problems with the proposal for per capita emissions rights. China's population grew by about eight million people in 2006; the United States' population grew by about three million that same year.[180] If China's proposal were in place, then presumably China's entitlement would increase relative to America's (at least if per capita rights were not frozen as of a particular date). Many if not most of China's new inhabitants would produce very little in the way of greenhouse gas. Thus, the increase in entitlements would be enjoyed by China's relatively wealthy urban population.

At the same time, countries would be given an incentive—or at least no disincentive—to increase their populations. Perhaps it would be better if governments took account of greenhouse gas effects when determining population policy. If China demands or deserves a side-payment, that is a separate question, not to be confounded by reference to per capita emissions rights. As we have seen, developing nations, including China, were given a set of side-payments in connection with the Montreal Protocol, and China may well demand such payments in the context of climate change.[181]

Let us add a few final points about practicalities and politics. If China must be paid to reduce greenhouse gas emissions, then probably most of the developing world will also have to be paid to reduce greenhouse gas emissions. This step would significantly increase the effective carbon tax that would be paid by developed countries. It would also be necessary to obtain a commitment from the payees that they not further develop greenhouse-gas-emitting industries just to increase their bargaining power for future renegotiations—and this could be

176. *See* Bali Action Plan, *supra* note 23.

177. NORDHAUS & BOYER, *supra* note 5, at 162.

178. *Id.* (specifying cost to United States of $325 billion in the event of cost-reducing emissions trading).

179. *See id.* at 91.

180. U.S. Census Bureau International Data Base, http://www.census.gov/ipc/www/idb (last visited Jan. 9, 2008).

181. Note that payments are contemplated by the agreement at Bali. *See* Bali Action Plan, *supra* note 23, at 3 (proposing consideration of "[i]nnovative means of funding to assist developing country Parties that are particularly vulnerable to the adverse impacts of climate change in meeting the costs of adaptation").

extremely difficult. And if the United States refuses to pay more than the carbon tax that is optimal for it, and thus underpays relative to the global optimum, other rich nations (and not inconceivably even poor nations) could offer to pay the United States to reduce its greenhouse gas emissions—at the least, an offer that would be politically delicate.

D. A FINAL NOTE ON FAIRNESS

The argument for per capita emissions rights is rooted in some intuitions about fairness. A related but distinct claim is that if states cooperate to reduce global warming, the costs should be distributed *fairly*. Although this point has not yet featured prominently in public debate, we should explain its relationship to our arguments so far.

Suppose that persons A, B, and C each incur a $10 cost in the course of producing a benefit worth $90. Fairness might seem to require that the $90 be divided evenly among the three, so that each nets $20. It follows that if A contributes $20 and C contributes $0, but C enjoys the benefit to the same extent as A, C should pay $10 to A.[182]

Similarly, one might think that all states should receive the same net benefit from greenhouse gas abatement. If it turns out that some states receive a large benefit (because they benefit more from a given level of abatement or can reduce their greenhouse gases to an agreed-upon level at low cost) and other states receive very little, the first group of states should make a side payment to the second group. Equivalently, one might argue that states that gain a great deal from greenhouse gas abatement should have stricter obligations than those that gain very little. Finally, one needs to take a position on whether states count equally for purposes of determining fairness, or whether states with larger populations are entitled to larger shares (China's position and India's as well).

This fairness argument differs from the corrective justice argument because a state's earlier contribution to the stock of greenhouse gases is not relevant for determining its fair share. And this argument differs from the redistributive justice argument because a state's wealth is not relevant to determining its fair share. Is the fairness argument, then, more plausible?

Welfarists will have little use for the argument, but it might well seem reasonable to others.[183] If the argument is plausible, the point for present purposes is that corrective justice and distributive justice concerns remain irrelevant. What has perhaps been overlooked is that if the fairness argument is

182. Fairness is, of course, used more broadly; it often includes notions of desert and need, for example. These other ideas, however, are similar or identical to the corrective and distributive justice concerns that we discussed above. We define fairness narrowly to mean equal division of benefits.

183. In the analogous situation where valuable mineral deposits are discovered in the deep sea, outside the jurisdiction of any state, states have agreed that the gain should be divided "equitably." United Nations, U.N. Convention on the Law of the Sea art. 140(2), Dec. 10, 1982. However, the treaty does not define this term and it is too soon to say whether it will have meaningful effect. The United States has not ratified this treaty; most other states have.

accepted, it is a decisive objection to the Kyoto Protocol, which puts a large burden on the United States and no burden at all on developing countries that would benefit greatly and probably most from greenhouse gas abatement.

CONCLUSION

It is increasingly clear that an international agreement to control climate change would be in the world's interest.[184] Either a worldwide carbon tax[185] or some kind of cap-and-trade program[186] would be suitable for the purpose. But the agreement that is optimal for the world may not be optimal for the United States, which would probably have to bear a large burden for significant domestic emissions reductions and which is not among the nations most gravely threatened by climate change. There are also important questions about how to distribute the costs of global emissions reductions. Many people believe that because the United States is wealthy, and because it has contributed a great deal to the existing stock of emissions, it should bear a large share of the global cost. As we have seen, the United States would have borne the lion's share of the expense of the Kyoto Protocol, if it had agreed to the relevant emissions restrictions: indeed, the cost to the United States might have been as high as 80% of the total.[187]

Our narrow goal has been to investigate considerations of distributive justice and corrective justice. If the United States wants to use its wealth to help to protect India or Africa or impoverished people generally, there can be no reason for complaint. The question remains, however, what is the best way to help disadvantaged people around the world. It is plausible that protecting other countries from genocide or poverty or famine is such a way. It is far from clear that greenhouse gas restrictions on the part of the United States are the best way to help the most disadvantaged citizens of the world.

It is tempting to treat climate change as a kind of tort, committed by the United States against those who are most vulnerable. But we have seen that principles of corrective justice have an awkward relationship to the problem of climate change. Many of the relevant actors are long dead, and a general transfer from the United States to those in places especially threatened by climate change is not an apt way of restoring some imagined status quo. In this context, the idea of corrective justice is a metaphor, and a highly imperfect one.

If the United States agrees to participate in a climate change agreement on

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184. For the best discussion of this, see generally Nordhaus, *supra* note 1.

185. Nordhaus vigorously defends a carbon tax. *Id.* at 181–82.

186. Stewart and Wiener vigorously defend a cap-and-trade program. STEWART & WIENER, *supra* note 13, at 65–80.

187. *See id.* at 10. Nordhaus estimates that the United States would have borne about two-thirds of the cost. *See* William Nordhaus, After Kyoto: Alternative Mechanisms to Control Global Warming 24 (Jan. 4, 2001) (paper prepared for a joint session of the American Economic Association and the Association of Environmental and Resource Economists), *available at* http://www.econ.yale.edu/nordhaus/homepage/PostKyoto_v4.pdf.

terms that are not in the nation's interest, but that help the world as a whole, there would be no reason to object, certainly if such participation is more helpful to poor nations than conventional foreign-aid alternatives. Compared to continued inaction, participation on those terms would be entirely commendable. But the commendation should not be muddied by resort to crude arguments from distributive and corrective justice.

Our argument here has been narrowly focused on those arguments; we have made no effort to sketch a positive approach to climate change. We are inclined to believe the proper approach to climate change should depend on welfarist considerations, for which considerations of corrective justice are irrelevant; but we do not attempt to defend that judgment here. Our goal here has been to clarify the uses and limits of two influential arguments in a way that might bear not only on climate change, but also on a wide range of other questions raised when some nations make claims on others.