THE WORLD VS. THE UNITED STATES AND CHINA? THE COMPLEX CLIMATE CHANGE INCENTIVES OF THE LEADING GREENHOUSE GAS EMITTERS

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It is generally agreed that the world would be better off with an international agreement to control greenhouse gas emissions. But it is not entirely clear that the leading emitters—the United States and China—would be better off with the agreement that would be in the world's interest. The first problem is that as the largest emitters, the United States and China would probably have to bear a disproportionate cost of any significant emissions reduction effort. The second problem is that on prominent projections, the United States and China are unlikely to be the most serious losers from climate change. According to some analyses, the two nations are thus anticipated to bear disproportionately high costs from emissions controls and to gain disproportionately little from such controls. There are two ways to eliminate the resulting obstacle to an international agreement. The first is through altering the perceived cost-benefit analysis for both countries. The second is through an understanding that both nations, and the United States in particular, are under a moral obligation not to inflict serious harm on the highly vulnerable citizens of Africa, India, and elsewhere. Existing proposals for unilateral action on the part of the United States seem to stem from an unruly mixture of confusion, hope, and a sense of moral obligation.

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INTRODUCTION

It is now sufficiently clear that the world as a whole would benefit from an international agreement to control climate change.[1] For all the continuing controversy,[2] the central features of a desirable agreement are not obscure. First, all significant contributors, most prominently the United States and China, should be included, because the benefits of greenhouse gas reductions depend on broad participation.[3] A partial agreement, even one that includes all of the nations of Europe, will make only an exceedingly modest dent in anticipated warming.[4] Second, economic incentives are indispensable. A carbon tax or a global emissions trading system would be far cheaper than more rigid alternatives.[5] Third, emissions reductions should grow or ramp up over time.[6] Some people support aggressive reductions at an early date;[7] but the consensus is against them, and it is clear that the largest reductions cannot be immediate.[8]

My goal in this Article is to identify and explore a serious obstacle to the achievement of an agreement that is, by all accounts, in the world's interest. The obstacle lies in the fact that the principal contributors to climate change, the United States and China, do not perceive themselves as

1. *See, e.g.*, WILLIAM NORDHAUS, A QUESTION OF BALANCE: WEIGHING THE OPTIONS ON GLOBAL WARMING POLICIES (forthcoming 2008); NICHOLAS STERN, THE ECONOMICS OF CLIMATE CHANGE: THE STERN REVIEW (2007).

2. *Compare* NORDHAUS, *supra* note 1, at 23–29 (calling for modest carbon taxes), *and* BJØRN LOMBORG, COOL IT: THE SKEPTICAL ENVIRONMENTALIST'S GUIDE TO GLOBAL WARMING 211 (2007) (calling for modest carbon taxes), *with* STERN, *supra* note 1 (calling for aggressive carbon taxes).

3. *See* NORDHAUS, *supra* note 1, at 122; Sheila M. Olmstead & Robert N. Stavins, *A Meaningful Second Commitment Period for the Kyoto Protocol*, THE ECONOMISTS' VOICE, May 2007, at 1, *available at* http://www.bepress.com/cgi/viewcontent/cgi?article=1230&context=ev.

4. *See, e.g.*, NORDHAUS, *supra* note 1, at 152. Consider here the fact that by one assessment, the Kyoto Protocol would itself reduce anticipated warming by only 0.03°C by 2100, reducing anticipated warming of 1.8°C to 4.0°C by that very modest amount. WILLIAM D. NORDHAUS & JOSEPH BOYER, WARMING THE WORLD: ECONOMIC MODELS OF GLOBAL WARMING 152 (2000).

5. *See* NORDHAUS & BOYER, *supra* note 4, at 134–35; Olmstead & Stavins, *supra* note 3, at 3.

6. *See, e.g.*, NORDHAUS, *supra* note 1, at 166; Olmstead & Stavins, *supra* note 3, at 3.

7. *See* STERN, *supra* note 1, at 218–37 (arguing for rapid stability to reduce harms).

8. *See* NORDHAUS, *supra* note 1, at 216 n.3.

likely to be its principal victims. As a result, the two leading contributors lack a strong incentive to help to solve the problem. It is clear that unilateral emissions reductions by either the United States or China would not be in the domestic self-interest, narrowly conceived, of either the United States or China. The reason is that unilateral reductions would impose significant costs and by themselves produce no significant benefits. By contrast, the principal victims of climate change, above all in sub-Saharan Africa and India,[9] are not the principal contributors; their own efforts at emissions reduction will do nothing (in the context of Africa) and close to nothing (in the context of India) about the problem.

My primary goal in this Article is to explain the complex climate change incentives of the United States and China, to connect those incentives to the current stalemate, and to offer some broader lessons about both the favorable and unfavorable conditions for an international agreement to control climate change (and other international problems). But I also mean to provide an account of how the stalemate might be broken. As we will see, the easiest route would be to convince the United States and China that they do, in fact, have a great deal to gain from an international agreement. Perhaps existing perceptions of domestic costs and benefits are biased or erroneous; perhaps they omit important variables.[10] If the effort to reconsider domestic benefits and costs fails, the best alternative is to convince either or both nations that they have a moral obligation to act to protect those nations that are most vulnerable. There is a strong argument that the United States, in particular, should scale back its emissions in order to reduce threats to people who are simultaneously poor and at grave risk.[11] We shall also see that notwithstanding what I have said here, unilateral action by the United States might well turn out to be feasible, through some combination of confusion, hope, and a sense of moral responsibility.

9. *See, e.g.*, NORDHAUS & BOYER, *supra* note 4, at 82.

10. *See* Bryan K. Mignone, *The National Security Dividend of Global Carbon Mitigation*, 35 ENERGY POL'Y 5403, 5404 (2007).

11. One option, of course, is for the United States to assist with adaptation by poor countries, in addition to reducing its own emissions rate. For a discussion of some of the issues involved in mitigation and adaptation, see INDUR M. GOKLANY, THE IMPROVING STATE OF THE WORLD 326–50 (2007); STERN, *supra* note 1, at 622–38.

I. THE MISMATCH BETWEEN THE LARGE EMITTERS AND NATIONS AT MOST SERIOUS RISK

A. Favorable and Unfavorable Conditions

It is tempting to see international environmental problems as prisoner's dilemmas, in which nations have no adequate incentive to reduce harmful emissions on their own, but in which all nations would benefit from an enforceable agreement, requiring reductions on the part of all.[12] In situations of this kind, nations gain from coercion to which they mutually agree. At first glance, climate change might seem to present a problem of this kind. But as we shall see, the actual picture is far more complex, and the conditions that have faced the world in connection with the two leading environmental problems of the last decades (ozone depletion and climate change), do not fit the model of the prisoner's dilemma at all.

1. Favorable Conditions

In the environmental domain, a favorable circumstance for a successful international agreement is simple to describe: The major contributors to the problem have a great deal to lose if the problem is unsolved. The situation is more favorable still if two specific conditions are met: (1) from the standpoint of major contributors, unilateral action to reduce emissions is desirable; and (2) the major contributors would gain even more from an international agreement than from unilateral action. Under these conditions, the major contributors will both act on their own and work aggressively to ensure that other nations act as well. And in that event, the likelihood of an international agreement will be exceedingly high.

In the context of the problem of ozone depletion, both of the two conditions were met.[13] An international agreement was possible in large part because the relevant officials in the United States, the leading contributor to the problem, were entirely aware that the nation's own citizens were at grave risk from depletion of the ozone layer.[14] Indeed, the United States had so much to lose from depletion of the ozone layer that even purely unilateral

12. For the best general treatment of this topic, see generally SCOTT BARRETT, ENVIRONMENT AND STATECRAFT: THE STRATEGY OF ENVIRONMENTAL TREATY-MAKING (2005).

13. *See* BARRETT, *supra* note 12, at 102; Cass R. Sunstein, *Of Montreal and Kyoto: A Tale of Two Protocols*, 31 HARV. ENVT'L L. REV. 1, 2–3 (2007).

14. *See* BARRETT, *supra* note 12, at 230; RICHARD ELLIOT BENEDICK, OZONE DIPLOMACY 5–6 (1991).

action was very much in the nation's interest.[15] (Several other nations also concluded that unilateral action was justified.)[16] In addition, the United States had even more to gain from international action; emissions from other nations would eventually pose significant threats to American citizens.[17]

Consider the contemporaneous account, by the Environmental Protection Agency, of the costs and benefits of the Montreal Protocol.

TABLE 1: COSTS AND BENEFITS OF THE MONTREAL PROTOCOL TO THE UNITED STATES (IN BILLIONS OF 1985 UNITED STATES DOLLARS)[18]

	Montreal Protocol	Unilateral Implementation of Montreal Protocol by the United States
Benefits	3575	1373
Costs	21	21
Net Benefits	3554	1352

These figures were generated by a projection of over five million skin cancer deaths by 2165, together with over twenty-five million cataract cases by that year—figures that would be cut to 200,000 and two million, respectively, by a 50 percent chlorofluorocarbons reduction.[19] What is most noteworthy here is that the costs of significant emissions controls were dwarfed by the benefits of unilateral action. What is almost equally noteworthy is that the benefits to the United States would be nearly tripled by a worldwide agreement.

With these figures before the White House, President Reagan—not known as an environmental president—pushed aggressively for the Montreal Protocol.[20] Facing strong pressure from the world's leading contributor, other countries were willing and able to agree.[21] Indeed, a near-unanimous Senate asked President Reagan to seek aggressive controls well before the agreement

15. *See* BARRETT, *supra* note 12, at 228.

16. *See* James C. Murdoch & Todd Sandler, *The Voluntary Provision of a Public Good: The Case of Reduced CFC Emissions and the Montreal Protocol*, 63 J. PUB. ECON. 331, 347 (1997) (discussing rationality of unilateral action).

17. *See* BARRETT, *supra* note 12, at 227–29.

18. *See id.* at tbl.8.1

19. *See* Stephen J. DeCanio, *Economic Analysis, Environmental Policy, and Intergenerational Justice in the Reagan Administration: The Case of the Montreal Protocol*, 3 INT'L ENVTL. AGREEMENTS: POL., L. & ECON. 299, 302 (2003). See *id.*, for more information on how these harms were turned into monetary equivalents and, in particular, for a discussion of the choice of a low discount rate.

20. *See* BENEDICK, *supra* note 14, at 65–67.

21. *See* BARRETT, *supra* note 12, at 227.

was negotiated[22]—and later the Senate unanimously ratified the Montreal Protocol—on the basis of its general awareness of the underlying facts.[23]

2. Unfavorable Conditions

We can also imagine a situation at the opposite pole, in which the major contributors to an environmental problem have little to lose from it, and in which those who are most vulnerable contribute essentially nothing to the problem. In the most poignant version of this situation, an international agreement would produce overall welfare gains, because the most vulnerable nations stand to lose more from the problem than the contributors would lose from reducing it. Under the assumptions given, unilateral action by the major contributors would make no sense, certainly not from the standpoint of national self-interest. Worse still, the major contributors would also be expected to be highly resistant to an international agreement, because emissions limitations would produce small domestic benefits and high domestic costs.[24] In the extreme case, an international solution might not be feasible, at least if the principal contributors are both self-interested and powerful. If those contributors would gain nothing and lose much from emissions reductions, they have no incentive to act even if all or most other nations act as well.

The American refusal to ratify the Kyoto Protocol had everything to do with a perception of this general kind.[25] On the numbers as they were generated at the time, the United States would have to spend over $300 billion to comply with the requirements of the Kyoto Protocol, and the monetized benefits, for the United States, would be about 4 percent of that amount.[26] Consider the following projection of the costs and benefits of the Kyoto Protocol for the United States alone—a projection designed not to offer an unimpeachable point estimate, but to describe what prominent analysts suggested when the United States was making its key decisions.

22. *See* BENEDICK, *supra* note 14, at 61–62.

23. *See* President's Statement, *President Signs Protocol on Ozone-Depleting Substances*, DEP'T ST. BULL., June 1998, at 30, 30.

24. A qualification, discussed below, is this: If the contributor nation might benefit from technological innovations, which could be sold elsewhere, it might be willing to support limits even if it is not greatly at risk.

25. *See* Press Release, George W. Bush, U.S. President, Text of Letter From the President to Senators Hagel, Helms, Craig, and Roberts (Mar. 13, 2001), *available at* http://www.whitehouse.gov/news/releases/2001/03/20010314.html.

26. CASS R. SUNSTEIN, WORST-CASE SCENARIOS 95 (2007).

TABLE 2: COSTS AND BENEFITS OF THE KYOTO PROTOCOL FOR THE UNITED STATES (IN BILLIONS OF 1990 UNITED STATES DOLLARS)[27]

	Kyoto Protocol	Unilateral Action to Comply with Kyoto Protocol
Benefits	12	0[28]
Costs	325	325
Net Benefits	–313	–325

From these figures, it should be clear that if the United States acted on its own, or acted with a small subset of emitters, the gains from greenhouse gas reductions would be quite small. In 1997, a unanimous Senate, apparently aware of this second point, adopted Senate Resolution 98, which asked President Clinton not to agree to limits on greenhouse gas emissions if the agreement would injure the economic interests of the United States or if it would "mandate[ ] new specific scheduled commitments to limit or reduce greenhouse gas emissions for Developing Country Parties within the same compliance period" as for the United States.[29] Indeed, the unanimous Senate concluded that any "exemption for Developing Country Parties is inconsistent with the need for global action on climate change and is environmentally flawed" and indicated that it "strongly believe[d]" that the proposals under consideration "could result in serious harm to the United States economy, including significant job loss, trade disadvantages, increased energy and consumer costs, or any combination thereof."[30]

Because the developing nations were not going to agree to emissions limitations, this request effectively ensured that the United States would not ratify the resulting agreement.[31] And after the negotiation, the Senate unanimously refused to ratify the Kyoto Protocol on the basis of a perception that the United States had far more to lose than to gain.[32] With meaningful participation by the developing nations, those benefits would have significantly

27. This chart is developed from the figures in NORDHAUS & BOYER, *supra* note 4, at 156–67.

28. This estimate is, of course, rough. It is based on the assumption that unilateral action would have no significant effect in reducing the harms associated with climate change for the United States—and that any such effect might be counteracted by benefits.

29. S. Res. 98, 105th Cong. (1997).

30. *Id.*

31. *See* Sunstein, *supra* note 13, at 33.

32. *See id.* at 27.

increased,[33] and the United States would have been more receptive. But to say this is to get ahead of the story.

There were large efforts, by the United States above all, to convince China and other developing nations to agree to emissions limitations in the Kyoto Protocol.[34] These efforts were unsuccessful. China did indicate its willingness to ratify the agreement,[35] but its own decision was essentially meaningless, because the protocol imposes no obligations on China at all. In refusing to agree to emissions limitations, China made an array of equitable arguments, emphasizing its relative poverty, its relatively low per capita emissions, and the fact that the existing stock of greenhouse gas emissions is a product of the industrialized nations, which benefited from those emissions.[36] But there is no question that China was greatly influenced by two perceptions: it would not greatly benefit from emissions reductions, and those reductions would cost a great deal. At least as much as the United States, China was affected by a purely domestic cost-benefit analysis, which argued strongly against acceptance of international requirements.[37]

Now let us turn to the contemporary situation.

B. Climate Change Losers

Which nations are expected to suffer most from climate change? Of course, the precise figures are greatly disputed,[38] and the extent of the damage cannot be specified in advance. But it is generally agreed that the poorest nations will be the biggest losers by far.[39] The wealthy nations, including the United States, are in a much better position for three independent reasons.[40] First, they have much more in the way of adaptive capacity. Second, a small

33. *See* Olmstead & Stavins, *supra* note 3, at 4.

34. *See* ROBERT V. PERVICAL ET AL., ENVIRONMENTAL REGULATION: LAW, SCIENCE, AND POLICY 1063 (4th ed. 2003) ("The U.S. effort to obtain some expression by the largest developing nations of their willingness to constrain their emissions at some future time was completely unsuccessful.").

35. *See* BENEDICK, *supra* note 14, at 196.

36. *See* JIAHUA PAN, COMMON BUT DIFFERENTIATED COMMITMENTS: A PRACTICAL APPROACH TO ENGAGING LARGE DEVELOPING EMITTERS UNDER L20, at 3 (2004), *available at* http://www.l20.org/publications/6_5c_climate_pan1.pdf (referring to cumulative emissions but emphasizing the period of 1990–2000, when consequences were widely known).

37. *See id.* at 12.

38. For two accounts, see WILLIAM R. CLINE, GLOBAL WARMING AND AGRICULTURE: IMPACT ESTIMATES BY COUNTRY (2007); STERN, *supra* note 1, at 138–58. On the grave difficulty of reliability in this domain, see Daniel Farber, *Modeling Climate Change and Its Impacts: Law, Policy, and Science* (Univ. of Chicago Law & Politics Workshop, Working Paper 2008), *available at* http://www.law.uchicago.edu/files/law-politics-wkshp-faber.pdf.

39. *See, e.g.*, STERN, *supra* note 1, at 106–14.

40. *See id.* at 139.

percentage of their economy depends on agriculture, a sector that is highly vulnerable to climate change. Third, the wealthy nations are generally in the cooler, higher latitudes, which also decrease their vulnerability.[41]

In its latest report, the International Panel on Climate Change projected warming of between 1.8°C and 4.0°C by 2100.[42] For essentially all nations, the anticipated damage would of course be far higher with an increase of 4.0°C than with an increase of 1.8°C. To get a handle on the problem, let us assume that warming will be 2.5°C, and consider one estimate of how the harms are likely to vary across nations and regions.

TABLE 3: DAMAGES OF A 2.5°C WARMING AS A PERCENTAGE OF GDP[43]

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

In light of the uncertainties, it is an understatement to say that these estimates must be taken with many grains of salt. We lack precise figures here, and point estimates of this kind require much guesswork. But it is readily apparent that some nations are far more vulnerable than others.[44] For current purposes, the most noteworthy parts of the list in Table 3 are the bottom and the top, respectively. 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. A central reason is that India is expected to experience devastating losses in terms of both health and agriculture.[45] In terms of health alone, India is

41. *Id.*

42. *See* NORDHAUS, *supra* note 1, at 3.

43. NORDHAUS & BOYER, *supra* note 4, at 91 tbl.4.10; *see also* CLINE, *supra* note 38, for comparable estimates.

44. *See generally* CLINE, *supra* note 38; Frank Ackerman & Ian Finlayson, *The Economics of Inaction on Climate Change: A Sensitivity Analysis* (Global Dev. & Env't Inst., Working Paper No. 06-07, 2006), *available at* http://ase.tufts.edu/gdae/Pubs/wp/06-07EconomicsInaction.pdf (offering a picture of more serious monetized damage from climate change).

45. *See* NORDHAUS & BOYER, *supra* note 4, at 76 tbl.4.4, 81 tbl.4.7.

expected to lose 3,600,000 years of life because of climate-related diseases, with 769,000 years of life lost from malaria alone.[46] For Africa, the major problem involves health, with a massive anticipated increase in climate-related diseases.[47] Sub-Saharan Africa is expected to lose 26,677,000 years of life because of climate-related diseases, with 24,385,000 coming from malaria.[48]

By contrast, the United States faces limited threats to both agriculture and health. Consider a recent study of the long-run effects of climate change on a range of economic variables in the United States.[49] The study offers both optimistic projections, including a high level of adaptation and high warming, and pessimistic projections, involving little adaptation and lower warming. For 3°C warming, the most optimistic case projects an increase of 1 percent in GDP; the benefits are highest at 2°C warming and decline from 3.5°C. In this study, the most pessimistic case projects losses of 1.2 percent of GDP at 3°C. It should be clear to the extent that the United States anticipates that it is likely to lose little, on net, from climate change, its incentive to participate in an international agreement will not be very high. And if the United States anticipates a worst case, at 3°C warming, of 1.2 percent loss in GDP, the incentive is relatively weak.

Like Russia, China has been projected to benefit in terms of agriculture, and while it will suffer health losses, they are relatively modest and far below those expected in Africa and India.[50] On one projection, China will lose 603,000 years of life from climate-related causes, and just 8000 from malaria.[51] The loss of 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 these 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.

C. Emitting Nations

But how much do nations stand to lose from reductions? It is clear that the costs of the Kyoto Protocol were anticipated to be especially high for the

46. *Id.* at 81 tbl.4.7.
47. *See id.*
48. *Id.*
49. *See* STERN, *supra* note 1, at 147–48.
50. *See* NORDHAUS & BOYER, *supra* note 4, at 81 tbl.4.7.
51. *Id.*

United States; indeed, the costs for the United States would be much greater than the corresponding costs for any other signatory nation, and even for all other signatory nations combined.[52] Unfortunately, we do not have recent estimates of the costs of emissions reductions for various nations. As a rough proxy for those costs, it makes sense to see which nations are principal contributors to the problem. If an international agreement is struck, the largest contributors are likely to have to bear the highest costs. Suppose, for example, that a worldwide carbon tax is imposed, beginning at a cost of $27 per metric ton.[53] It stands to reason that the largest carbon emitters would face the most significant burden. (I will qualify this point below.[54])

To get a handle on the problem, consider the following table, offering a snapshot of global contributors in 2003 and 2004 (limited to carbon dioxide, the leading greenhouse gas).

TABLE 4: SHARE OF GLOBAL EMISSIONS[55]

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

Fortunately, the information here is less speculative than the judgments about the damages from climate change. As early as 2004, then, the United States and China emerge as the top emitters, accounting for nearly 40 percent of the world's total. If our goal is to project the costs of emissions reductions in the future, of course, this table does not tell us nearly enough; it is necessary to understand the trends over time. The most significant contributors in the past may not be the most significant contributors in the future. Existing projections suggest that the largest contributors are likely to continue to

52. *See* NORDHAUS & BOYER, *supra* note 4, at 168.

53. *See* NORDHAUS, *supra* note 1, at 15 (suggesting a tax in that vicinity).

54. See the discussion below, Part II.A.2, of technological innovation at DuPont that significantly drove down the costs of substitutes for CFCs, and thus made it far less expensive for the United States, the world's leading contributor, to comply with strict emissions limits.

55. U.S. ENERGY INFO. ADMIN., INTERNATIONAL ENERGY OUTLOOK 2007, at 73–80 (2007), *available at* http://www.eia.doe.gov/oiaf/ieo/pdf/0484(2007).pdf.

qualify as such—but that major shifts will occur, above all with emissions growth in China and India, and emissions reductions in Germany and Russia.

TABLE 5: CARBON DIOXIDE EMISSIONS CHANGES (1990–2003)[56]

Countries	1990–2003
Indonesia	117.1%
Iran	99.1%
South Korea	98.2%
India	75.6%
Pakistan	75.3%
Saudi Arabia	73.7%
China	64.9%
Brazil	57.4%
Spain	51.5%
United States	18.3%
EU-25	1.4%
Germany	–11.6%
Poland	–16.1%
Russia	–24.5%
Ukraine	–50.1%

Here we can see rapid emissions growth in some places, above all China, Indonesia, Iran, Pakistan, Saudi Arabia, and South Korea. With these trend lines, we can project changes by 2030. At that time, the developing world is expected to contribute no less than 55 percent of total emissions, with 45 percent coming from developed nations. At that time, the United States is expected to be well below China. Consider the figures for anticipated growth in Table 6.

56. *See* INT'L ENERGY AGENCY, CO_2 EMISSIONS FROM FUEL COMBUSTION: 1971–2003 pt.II, at 4–6 (2005).

TABLE 6: AVERAGE ANNUAL PROJECTED CHANGES IN CO_2 EMISSIONS (2004–2030)

Country	Reference Case	High Economic Growth Case	Low Economic Growth Case
China	3.4%	3.8%	3.0%
India	2.6%	3%	2.2%
Mexico	2.3%	2.7%	1.9%
Brazil	2.3%	2.8%	1.7%
South Korea	1.3%	1.8%	0.7%
United States	1.1%	1.5%	0.7%
OECD Europe	0.3%	0.6%	–0.1%
World	1.8%	2.2%	1.4%

TABLE 7: PERCENTAGE CHANGE IN CO_2 EMISSIONS PROJECTED (2004–2030)

Country	Reference Case	High Economic Growth Case	Low Economic Growth Case
China	139%	167%	115%
India	94%	116%	74%
Mexico	82%	102%	63%
Brazil	79%	104%	57%
South Korea	39%	60%	21%
United States	34%	47%	21%
OECD Europe	7%	17%	–3%
World	59%	77%	43%

Notice three key points in Table 6 and in Table 7: While the United States and China had essentially the same level of aggregate emissions in 2007, China's emissions are projected to grow over three times as fast as those of the United States; China's growth rate is more than double the world's average; and according to this projection, China's growth rate will dwarf the corresponding rates of India, Mexico, and South Korea. In terms of aggregate contributions, these changes mean that there will be significant shifts among contributors (Table 8).

TABLE 8: RELATIVE CONTRIBUTIONS OF ANNUAL CARBON DIOXIDE EMISSIONS BY COUNTRY/REGION (APPROXIMATE PERCENT OF WORLDWIDE EMISSIONS)

	1990	2003	2004	2010	2015	2020	2025	2030
China	10.5%	15.3%	17.5%	21.1%	22.4%	23.9%	25.0%	26.2%
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%
India	2.7%	4.1%	4.1%	4.2%	4.4%	4.7%	4.9%	5.0%
Africa	3.1%	3.5%	3.4%	3.7%	3.8%	3.9%	3.9%	3.9%
Japan	4.8%	4.9%	4.7%	4.1%	3.8%	3.5%	3.3%	3.0%

This projection is fairly recent, but with explosive emissions growth in China, it is already out of date. Some studies indicate that China has passed the United States in CO_2 emissions.[57]

D. The Problem

We can now identify a real obstacle to an international agreement to control greenhouse gases. The United States and China are the largest emitters, and on prominent projections, they also stand to lose relatively less from climate change. In terms of their own domestic self-interest, these projections greatly weaken the argument for stringent controls. African nations stand to lose a great deal, but they are trivial greenhouse gas emitters. India is even more vulnerable, and its contribution, while rapidly growing and far from trivial, is comparatively modest.

It follows that the current situation is no simple prisoner's dilemma, in which nations lose from unilateral action but gain from enforceable limitations on one another's behavior. Even though an international agreement would be in the world's interest, taking the world as a whole,[58] neither the United States nor China might perceive the optimal agreement from the global standpoint as in their interest, simply because both nations seem to have

57. Roger Collier, *China About to Pass U.S. as World's Top Generator of Green House Gases*, S.F. CHRON., Mar. 5, 2007, at A1; Elisabeth Rosenthal, *China Increases Lead a Biggest Carbon Dioxide Emitter*, N.Y. TIMES, June 14, 2008, *available at* http://www.nytimes.com/2008/06/14/world/asia/14china.html; Press Release, Neth. Envtl. Assessment Agency, China Contributing Two Thirds to Increase in CO_2 Emissions, June 13, 2008, *available at* http://www.mnp.nl/en/service/pressreleases/2008/20080613ChinacontributingtwothirdstoincreaseinCO2emissions.html.

58. *See* NORDHAUS, *supra* note 1, at 122.

disproportionately little to lose from climate change and disproportionately much to lose from emissions reductions. At least on prominent projections, China and the United States could be net losers from an international agreement that would produce significant benefits to the world as a whole.

The analysis has an additional complexity. Some nations, above all China, might reasonably object that their own contribution is smaller than the aggregate figures suggest. In assessing relative contributions, we might be interested in cumulative emissions rather than annual emissions.[59] The overall stock matters, not only the current flow. Table 9 contains the relevant data.

TABLE 9: CUMULATIVE CO_2 EMISSIONS (1850–2002)[60]

Countries	Cumulative CO_2 Emissions
United States	29.3
EU-25	26.5
Russia	8.1
China	7.6
Germany	7.3
United Kingdom	6.3
Japan	4.1
France	2.9
Ukraine	2.2
India	2.2

Notice in this regard that for a long period, China's emissions were a small fraction of those of the United States. Even though China's emissions rates have now passed those of the United States, it might well insist that it should not bear the same economic burden as a nation that is responsible for a much larger percentage of aggregate emissions. The economic burden should instead be a product of total contribution to the problem, extending over time.

China could add that its per capita emissions are far lower than those of the United States, and it might suggest that per capita emissions are what matter. To illustrate this point, imagine a world with only three nations, with populations of one billion, one hundred million, and one million,

59. *See, e.g.*, PAN, *supra* note 36.

60. KEVIN A. BAUMERT ET AL., NAVIGATING THE NUMBERS: GREENHOUSE GAS DATA AND INTERNATIONAL CLIMATE POLICY 32 (2005), *available at* http://pdf.wri.org/navigating_numbers.pdf.

respectively. Imagine too that all three nations have the same level of aggregate greenhouse gas emissions—and that the third nation, with a much higher per capita emissions rate, asks the other two to scale back their emissions by the same rate. The nation with one billion people could quite plausibly argue that what matters is the per capita rate, and that it is absurd to think that a nation with one million people should have the same emissions rate as a nation with one billion. No one doubts that a purely domestic calculus—of costs and benefits—will play a significant role in any nation's decisions. But fairness judgments, attending to cumulative contributions and to per capita rates, are unlikely to be irrelevant.[61]

II. SOLUTIONS?

If the United States and China are to agree to emissions limitations, a method must be found to overcome their complex motivations. The first method would appeal to self-interest; the second would attempt moral suasion. The first method is more likely to work,[62] but we cannot exclude the possibility that one or more nations might respond to moral arguments.

There is a puzzle to be identified at the outset: Notwithstanding what I have said thus far, unilateral action by the United States has attracted considerable support domestically at the national and state levels. In June 22, 2005, the U.S. Senate approved a resolution stating that "[i]t is the sense of the Senate that Congress should enact a comprehensive and effective national program of mandatory market-based limits and incentives on greenhouse gases that slow, stop and reverse the growth of such emissions . . . ."[63] A fairly aggressive legislative proposal, from Senators John McCain and Joseph Lieberman in 2003, would have capped greenhouse gas emissions at 2000 levels. The proposal was defeated by a vote of 55–43.[64] Many prominent

61. *See* PAN, *supra* note 36, at 3–4.

62. *See* ROBERT A. KEOHANE, AFTER HEGEMONY 110–32 (1984) (discussing the importance of domestic self-interest).

63. H.R. 6, 109th Cong. (2005); 151 Cong. Rec. S7036–37 (2005); DANIEL R. ABBASI, AMERICANS AND CLIMATE CHANGE 20 (2006).

64. For an overview of the Climate Stewardship Act of 2003, S. Res. 139, 108th Cong. (2003), see Press Release, Joe Lieberman, Statement of Senator Joseph I. Lieberman on the McCain-Lieberman Climate Stewardship Act Amendment (S. 139) (Oct. 29, 2003), http://lieberman.senate.gov/newsroom/release.cfm?id=214240; for an analysis of the proposal, see SERGEY PALTSEV ET AL., MIT JOINT PROGRAM ON THE SCI. & POLICY OF GLOBAL CHANGE, EMISSIONS TRADING TO REDUCE GREENHOUSE GAS EMISSIONS IN THE UNITED STATES: THE MCCAIN-LIEBERMAN PROPOSAL (2003), *available at* http://web.mit.edu/globalchange/www/MITJPSPGC_Rpt97.pdf.

members of Congress have supported similar legislation,[65] and it would not be at all surprising to find some kind of national cap-and-trade program implemented in the near future.

Far more has happened at the state level. In December 2005, the governors of seven states signed a Memorandum of Understanding, designed to create a regional cap-and-trade plan to reduce power plant emissions.[66] The mayors of over 500 cities have pledged to meet city-level goals corresponding with the requirements of the Kyoto Protocol.[67] In June 2005, Governor Arnold Schwarzenegger pledged to reduce California's greenhouse gas emissions to 1990 levels by 2020,[68] a pledge that helped lead to the West Coast Governor's Global Warming Initiative, which includes California, Washington, and Oregon.[69] California has enacted legislation to reduce emissions of greenhouse gases from automobiles, with a 22 percent reduction target by 2012 and a 30 percent reduction target by 2016.[70]

If the analysis thus far is correct, these steps are indeed puzzling. Why do national legislators support unilateral steps that would cost a significant amount but deliver trivial domestic benefits? Why do state officials favor steps that would do essentially nothing to reduce the problem of climate change, but that would impose real costs on their citizens? I will attempt to answer these questions below.

A. Self-Interest

The most obvious solution would be to show that the numbers just given are misleading, incomplete, or simply wrong. Suppose that it could be

65. For a list of proposals, see PEW CTR. ON GLOBAL CLIMATE CHANGE, SENATE GREENHOUSE GAS CAP-AND-TRADE PROPOSALS IN THE 110TH CONGRESS 1 (2007), *available at* http://www.earthscape.org/l2/ES17454/PEW_SenateGreenhouse.pdf. For an illuminating comparison of the climate policy proposals, see Pew Ctr. on Global Climate Change, Comparison of Climate Change Policy Proposals, http://www.pewclimate.org/policy_center/analyses/csia_ceia_comparison (last visited Mar. 18, 2008).

66. Regional Greenhouse Gas Initiative, Multi-State RCCI Agreement, http://www.rggi.org/agreement.htm (last visited Mar. 18, 2008) (These seven states include Connecticut, Delaware, Maine, New Hampshire, New Jersey, New York, and Vermont.).

67. *See* Mayors Climate Protection Center, U.S. Conference of Mayors Climate Protection Agreement (2007), http://usmayors.org/climateprotection/agreement.htm. For information on the Kyoto Protocol in general, see NORDHAUS & BOYER, *supra* note 4, at 145–46. *See also* United Nations Framework Convention on Climate Change, Kyoto Protocol, Dec. 10, 1997, 37 I.L.M. 22, http://unfccc.int/resource/docs/cop3/07a01.pdf (last visited Mar. 18, 2008).

68. Cal. Exec. Order No. S-3-05 (June 1, 2005), *available at* http://gov.ca.gov/index.php?/executive-order/1861.

69. *See* West Coast Governors' Global Warming Initiative, http://www.ef.org/westcoastclimate (last visited Mar. 18, 2008).

70. ABASSI, *supra* note 63, at 21.

established that the United States and China do, in fact, have a great deal to lose from climate change. Suppose that both nations could be convinced that the likely damage is very serious. In that event, the problem of unfortunate incentives would be greatly reduced. It should be clear that many of those interested in counteracting the problem of climate change have attempted to alter those incentives in exactly this way, by pointing to worst-case scenarios from which the United States would be greatly threatened.[71] Available incidents, such as Hurricane Katrina, might well heighten concern within the United States. But an obvious question is whether sustained analysis might support that concern.

1. Risks

Some projections do suggest that the United States may well have a great deal to lose. For catastrophic events, consider Table 10.

TABLE 10: EXPECTED PERCENTAGE LOSS OF GDP FROM CATASTROPHIC WARMING[72]

India	44.2
OECD Europe	44.2
Russia	33.2
Africa	22.1
China	22.1
Eastern Europe	22.1
Japan	22.1
United States	22.1

If the risk of catastrophe is perceived as high, the threat to the United States and China becomes far more severe—the same, in fact, to the threats to Japan and Africa.[73] For the United States, some pessimistic scenarios do suggest significant risks even if there is no catastrophe. One high climate change scenario projects an annual average of 13,080 additional deaths

71. *See* AN INCONVENIENT TRUTH (Lawrence Bender Productions & Participant Productions 2006). For an important technical discussion of the implications of structural uncertainty for the economies of catastrophes, see Martin L. Weitzman, *The Role of Uncertainty in the Economics of Catastrophic Climate Change* (AEI-Brookings Joint Ctr. for Regulatory Studies, Working Paper No. 07-11, 2007), *available at* http://papers.ssrn.com/sol3/papers.cfm?abstract_id=992873.

72. NORDHAUS & BOYER, *supra* note 4, at 90 tbl.4.9.

73. On analysis of catastrophe, see generally Weitzman, *supra* note 71.

during the period 2000–2100.[74] Because motor vehicle accidents produce over 40,000 deaths each year, 13,080 may not appear so alarmingly high; but to put it colorfully, this figure suggests that climate change would ensure, each year, deaths equivalent to those that would come from six attacks on the order of those of September 11, 2001. A similarly pessimistic scenario suggests 39 percent average annual percentage decreases in agricultural productivity and 31.3 percent average annual percentage increases in water costs.[75] To the extent that science converges on figures of this sort, the United States will have a much stronger incentive to seek an international agreement. And to the extent that catastrophic possibilities enter into the analysis, the expected benefits of emissions controls increase dramatically.[76]

There is another possibility. Emissions reductions might produce an array of ancillary benefits, including a "national security dividend."[77] To the extent that this dividend can be monetized, or at least included in the overall analysis, emissions reductions might seem more desirable even if the climate change gains are fairly modest. Analysis of effects on animals also increases the expected benefits.[78]

Comparable studies do not yet exist for China, but some scenarios suggest significant harm. A national report, *China's National Climate Change Programme*,[79] suggests a range of serious risks, including rising sea levels, greater desertification, retreat of glaciers, and more frequent occurrence of extreme weather/climate events, with significant adverse effects on socioeconomic development. To the extent that findings of this kind suggest that China has a great deal at stake, the incentive to join an international agreement will obviously increase.

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74. DALE W. JORGENSON ET AL., U.S. MARKET CONSEQUENCES OF GLOBAL CLIMATE CHANGE 9 (2004), *available at* http://www.pewclimate.org/docUploads/Market_Consequences-report.pdf. For a broadly similar conclusion, see Olivier Deschênes & Michael Greenstone, *The Economic Impacts of Climate Change: Evidence From Agricultural Output and Random Fluctuations in Weather*, 97 AM. ECON. REV. 354, 356–57 (2007) (finding weakly positive to weakly negative effects on agriculture).

75. *See* JORGENSON ET AL., *supra* note 74.

76. *See* Weitzman, *supra* note 71.

77. *See* Mignone, *supra* note 10, at 1.

78. *See* Wayne Hsiung & Cass R. Sunstein, *Climate Change and Animals*, 155 U. PA. L. REV. 1695 (2007).

79. NAT'L DEV. & REFORM COMM., P.R.C., CHINA'S NATIONAL CLIMATE CHANGE PROGRAMME (2007), *available at* http://en.nrdc.gov.cn/newsrelease/P020070604561191006823.pdf.

2. Decreased Costs

As the leading producer of ozone-depleting chemicals, the United States would be most likely to resist strong controls on such chemicals. But as the ozone depletion controversy intensified, the incentives of American companies turned out to be radically different from what many people anticipated. A key reason is that DuPont, the principal American producer of CFCs, was able to develop relatively inexpensive substitutes.[80] As a result, DuPont had an incentive to favor aggressive regulation of ozone-depleting chemicals, because such regulation could increase its market share. Because DuPont might well turn out to be the leading producer of CFC substitutes, aggressive regulation could easily turn out to be in its interest.

More generally, American producers saw that good commercial opportunities lay in the development and marketing of new products for which they had a comparative advantage over foreign producers.[81] Consider DuPont's warning "that international cooperation was essential, and that participation in an agreement to phase out CFCs needed to be as broad as possible, to avoid production by other manufacturers relocating to non-signatory states."[82] It is noteworthy in this regard that the European Community speculated that the Reagan Administration's support for aggressive controls was driven by the fact that American producers had "developed substitutes."[83]

This example suggests a promising possibility: Perhaps the United States or (less likely) China will innovate, ensuring that domestic companies will lose less or perhaps even benefit from aggressive regulation of greenhouse gases. If one or another nation believes that it is innovating, or might innovate, in a way that will produce significant economic benefits from aggressive regulation, the argument for greenhouse gas reductions will be doubly strengthened. First, the cost of such reductions will decrease. Second, a nation's companies might actually gain if other nations are looking for less expensive substitutes.

Return in this regard to California's tough emissions reduction initiative,[84] which is exceedingly difficult to justify on cost-benefit

80. *See* Sunstein, *supra* note 13, at 10, 21.

81. *See id.* at 14.

82. BARRETT, *supra* note 12, at 234.

83. James K. Hammitt, *Stratospheric-Ozone Depletion*, *in* ECONOMIC ANALYSES AT EPA: ASSESSING REGULATORY IMPACT 152, 157 (Richard D. Morgenstern ed., 1992).

84. *See* ROBERT N. STAVINS ET AL., AEI-BROOKINGS JOINT CTR. FOR REGULATORY STUDIES, TOO GOOD TO BE TRUE? AN EXAMINATION OF THREE ECONOMIC ASSESSMENTS OF CALIFORNIA CLIMATE CHANGE POLICY 1 (2007), *available at* http://www.aei-brookings.org/publications/abstract.php?pid=1151.

grounds.[85] Standing by itself, the California initiative will cost a significant amount but deliver essentially no benefits to California or the world.[86] One argument in favor of California's initiative is that it will stimulate innovation that will ultimately benefit the innovators—which, it is hoped, will be in California. It is plausible to think that Californians thought that the initiative would produce new technologies that would ultimately help Californians.

More generally, the costs of regulation often turn out to be lower than anticipated.[87] Perhaps the projections just given are inflated, simply because technological innovations will drive down the cost of compliance. If this is so, and if prominent officials can be persuaded that it is so, the likelihood of a regulatory response will increase.

3. Special Provisions and Side Payments

In the context of ozone-depletion, the developing countries were initially skeptical about the idea that they should be subject to the restrictions of the Montreal Protocol.[88] Their skepticism was easy to defend by reference to domestic self-interest. For poor nations, such restrictions would impose significant costs for speculative gains. Self-interest aside, such nations reasonably contended that they should not be subjected to the same controls as wealthier nations, who were responsible for the problem in the first place. India and China emphasized that nations with less than 25 percent of the world's population had been responsible for over 90 percent of the world's CFCs.[89]

But wealthy nations could not easily rest content with an agreement excluding developing countries. While CFC consumption was low in those countries, their domestic requirements were increasing,[90] and a badly designed agreement could merely shift the production and use of CFCs from wealthy nations to poorer ones, leaving the global problem largely unaffected. The

85. *See id.* at 11.

86. *Id.*

87. It is often thought that the costs are wildly exaggerated before the fact, and that they turn out to be much lower than projected. *See, e.g.*, David M. Driesen, *The Economic Dynamics of Environmental Law: Cost-Benefit Analysis, Emissions Trading and Priority-Setting*, 31 B.C. ENVT'L AFF. L. REV. 501, 516 (2004) ("Regulated industry has an incentive to exaggerate control costs in order to persuade the regulator to adopt less stringent regulation."). The reality is more complicated. *See* John Graham, Lifesaving Regulation: Enhancing the Role of Benefit-Cost Analysis 102–07 (Sept. 2007) (unpublished manuscript), *available at* http://www.law.northwestern.edu/searlcenter/papers/Graham_CBApaper.pdf (exploring the value and uses of cost-benefit analysis).

88. *See* Sunstein, *supra* note 13, at 16–17.

89. PERVICAL ET AL., *supra* note 34, at 1052.

90. BENEDICK, *supra* note 14, at 93.

ultimate resolution was to overcome the resistance of the developing nations with several steps, including both loosened restrictions and financial assistance. Under Article 5 of the Montreal Protocol,[91] developing countries are authorized to meet "basic domestic needs" by increasing to a specified level for ten years, after which they are subject to a 50 percent reduction for the next ten years. In addition, a funding mechanism was created by which substantial resources—initially $400 million—were transferred to poor countries.[92]

Might it be possible to build on these ideas for climate change?[93] The rest of the world is unlikely to offer special deals for the United States. But it would not be at all surprising if wealthy nations decided to make special provisions for China (and other developing nations).[94] In 2001, the Marrakech accords led to innovations from the Kyoto Protocol, in which developing countries were made beneficiaries of funds to assist with technology transfer.[95] Although the level of the funds remains unspecified, donors led by the European Union pledged to grant $410 million annually.[96] For China's participation, the most promising route would be to take steps to make emissions reduction in that nation's self-interest. We could imagine four possibilities here: (a) technology transfers; (b) extended compliance periods,[97] building on the Kyoto Protocol; (c) allocation of initial emissions rights, perhaps based partly on per capita emissions, that would reduce the overall cost; and (d) direct cash payments.

B. Moral Considerations

Suppose that the United States and China do believe, with reason, that they have comparatively less to lose from climate change, and that aggressive emissions restrictions would impose significant economic burdens on them. Suppose too that climate change will impose severe harm on many nations, causing (for example) millions of premature deaths in Africa and India. If so, there remains a strong argument that the United States and China should reduce their emissions, even if the citizens in the United States and China

91. Montreal Protocol on Substances That Deplete the Ozone Layer, Sept. 15, 1987, S. Treaty Doc. No. 100-10, 1522 U.N.T.S. 3.

92. *See id.* at 154. *See generally* Rene Bowser, *History of the Montreal Protocol's Ozone Fund*, 14 INT'L ENV'T REP. 636 (1991).

93. *See* Olmstead & Stavins, *supra* note 3, at 4.

94. *See id.* at 3.

95. *See* PERVICAL ET AL., *supra* note 34, at 1072–73.

96. PERVICAL ET AL., *supra* note 34, at 1073.

97. *See* Olmstead & Stavins, *supra* note 3, at 3.

have little to gain from those reductions.[98] The adverse effects on Africa and India might even be considered a kind of tort, imposed on them by the United States and China. For example, energy and gasoline prices in the United States have been far lower than they would have been if those prices had included an amount attributable to the increased risks of climate change—risks that are most serious, and that threaten to impose devastating harm on people in other countries.[99] Perhaps the United States and China might be persuaded to act on the ground that they have a moral obligation to do so.

Billions of dollars are spent annually on foreign aid,[100] and an international agreement to control global environmental problems might operate as a form of such aid. If, for example, the citizens of the United States care a great deal about the welfare of endangered species, the nation may well be willing to enter into a costly agreement to protect endangered species. There can be little doubt that with respect to domestic climate change initiatives in the United States, a perception of moral obligation has played a significant role.[101]

To be sure, the analysis of the moral obligations of the United States is different from the corresponding analysis for China. First, the United States has contributed far more to the existing stock of greenhouse gases.[102] Even if its contributions will be lower than those of China in the future, the significant American contribution to the stock must be taken into account. Second, the United States is much richer than China, and its ability to pay is surely relevant to the overall assessment. Third, the United States has by far the highest per capita emissions rate, and it is plausible to think that this per capita rate is relevant to a nation's moral obligations. China may be the largest emitter of any nation, but its per capita emissions rate ranks it much lower. For these reasons, it is particularly clear that the United States is

98. *See, e.g.*, Julia Driver, *Ideal Decision Making and Green Virtues*, *in* PERSPECTIVES ON CLIMATE CHANGE: SCIENCE, ECONOMICS, POLITICS, ETHICS 249 (Walter Sinnott-Armstrong & Richard Howarth eds., 2005); Dale Jamieson, *Adaptation, Mitigation, and Justice*, *in* PERSPECTIVES ON CLIMATE CHANGE: SCIENCE, ECONOMICS, POLITICS, ETHICS, *supra*, at 217.

99. *See* NORDHAUS & BOYER, *supra* note 4, at 81 tbl. 4.7.

100. *See, e.g.*, CONG. RESEARCH SERV., FOREIGN AID: AN INTRODUCTORY OVERVIEW OF U.S. PROGRAMS AND POLICY 4, 6 (2005), http://www.fas.org/sgp/crs/row/98-916.pdf (reporting that Congress appropriated, among other things, $7.35 billion for development assistant and $2.68 billion for programs in humanitarian assistance in 2005).

101. *See supra* page 16.

102. *See supra* tbl.8. For a detailed discussion of the moral issues, see Eric A. Posner & Cass R. Sunstein, *Climate Change Justice*, 96 GEO. L.J. (forthcoming 2008); Eric A. Posner & Cass R. Sunstein, *Should Greenhouse Gas Permits Be Allocated on a Per Capita Basis?*, CAL. L. REV. (forthcoming 2008).

obliged either to scale back its emissions or to provide financial assistance to those nations that are at risk because of what the United States has done.

None of this means that China is not obliged to take action as well. Whether or not China is wealthy, it should not be entitled to impose significant damage on the citizens of India and Africa. The analysis of moral obligations must disentangle the three considerations referred to above. The obligations of wealthy nations present a simple question of distributional fairness; the climate change setting is not unique on that count. The question of whether per capita emissions should be taken into account presents thorny ethical and pragmatic problems; China reasonably argues that any international agreement should consider the fact that its large aggregate emissions disguise the fact that its per capita emissions rate is not terribly high.

It should be easy to handle the question of past contributions by separating existing stocks and current flows.[103] To come to terms with past contributions, nations might participate in the creation of some kind of fund for climate change damages, with their participation reflecting their contributions to the total existing stock of emissions. China need not contribute so much to such a fund; the United States would be required to contribute a great deal. A step of this kind would be a sensible response to the fact, shown by the table above, that different nations have added dramatically different amounts to the current situation.[104] A separate step would involve the response to existing flows. Perhaps a polluter pays principle could be made a part of an international agreement, so that nations would pay an amount to reflect their continuing contributions.[105]

C. Of Confusion and Hope

Notwithstanding the thrust of my argument here, aggressive action by the United States, and indeed unilateral action, would not exactly be a stunning surprise. Recall that unilateral action has obtained considerable support in Congress and that California has taken significant steps on its

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

104. To be sure, there are complexities here. (a) Most of the emissions by the United States occurred in any period in which the United States did not know or have reason to know of the risk of harm. Should climate change be seen as a kind of strict liability tort, or must some kind of negligence be shown? (b) Many of the beneficiaries of greenhouse gas emissions in the United States are long dead. Should their descendents have to pay for those emissions? Perhaps so, if the descendants have benefited from the emissions. This point suggests that the climate change problem has some overlap with questions relating to reparations. I am grateful to Eric Posner for this insight.

105. *See* Bhagwati, *supra* note 103.

own, even though the cost is likely to be significant and the benefits are likely to be essentially zero. How can such support and actual legislation be plausibly explained?

The best answer points to the relationship between moral considerations and a mixture of confusion and hope. In many domains, the essential problem is not widely understood; many people appear not to appreciate the fact that significant steps, by states or even regions, will have no significant impact on climate change. Recall that on one estimate, the Kyoto Protocol was expected to reduce warming by only 0.03°C by 2100, even though many nations were involved;[106] a key reason is that the Kyoto Protocol does not control the explosive growth in emissions from developing nations. It follows that by itself, California's initiative will do exceedingly little to reduce warming. It is not at all clear that those who supported the initiative appreciated that fact.

But there is a hope here, not merely confusion. The hope is reflected in the thought that if California acts, other states might do so as well, eventually to be followed by the nation as a whole. Perhaps a single state can start a cascade.[107] Those who call for unilateral action by the United States may well believe that the developing nations, most importantly China, are unlikely to act if the United States does not do so, and that action by the United States is an indispensable start toward an agreement of the sort that is generally believed to be in the world's interest.[108] To this point it might be added that unilateral action could spur technological innovation that would be in the interest of the United States as well as the world as a whole.[109]

For those who are concerned about domestic self-interest, there is an evident problem with these arguments for unilateral action: It is not clear that the domestic benefits of greenhouse gas reduction would justify the domestic costs. But for reasons explored above, the existing numbers, raising doubts about the domestic cost-benefit analysis, may not be the right ones.

106. *See* NORDHAUS & BOYER, *supra* note 4, at 152.

107. For a discussion of cascades in general, see Sushil Bikhchandani et al., *Learning From the Behavior of Others: Conformity, Fads, and Informational Cascades*, J. ECON. PERSPECTIVES, Summer 1998, at 151. For a discussion of cascades across nations, see Eric A. Posner & Cass Sunstein, *The Law of Other States*, 59 STAN. L. REV. 131, 160–64 (2006). For relevant discussion, see Ulrich J. Wagner, Estimating Strategic Complementarities in a Dynamic Game of Timing: The Case of the Montreal Protocol (Jan. 2008) (unpublished manuscript), *available at* http://www.columbia.edu/~uw2101/Wagner_JobMarketPaper.pdf.

108. *See* Olmstead & Stavins, *supra* note 3, at 4.

109. *See* RICHARD A. POSNER, CATASTROPHE: RISK AND RESPONSE 161 (2004).

CONCLUSION

If the world consisted of simply one nation, there would be little difficulty in settling on significant reductions in greenhouse gases, either through a cap-and-trade system or through a carbon tax. And if the world's leading emitters also had the most to lose from climate change, the problem would be more tractable, simply because those nations would seek an international accord. The easiest situation would be one in which the principal emitters would gain from unilateral action, as in the context of ozone-depleting chemicals. The problem of climate change does not have this characteristic. Neither the United States nor China would gain much from unilateral action, which would also impose significant costs. On existing projections, it is less than entirely clear that either nation would benefit much, on balance, from the most sensibly designed international accord, even though the world as a whole would gain a great deal.

Both the United States and China would be far more likely to participate in such an accord if the perceived costs decreased or if the perceived benefits increased. The simplest way to decrease the perceived costs would involve technological innovation, for example via energy sources that do not produce high levels of carbon emissions. The simplest way to increase the perceived benefits would involve clearer evidence of significant losses for both nations, including evidence of catastrophic risk. Ancillary benefits, involving (for example) energy self-sufficiency and national security, could also alter the calculus.

It is far from clear that either the United States or China would be willing to sacrifice large sums of money simply because of a perception of their moral obligations. But there can be no doubt that a sense of moral obligation is playing a significant role in both national and international debates, especially with respect to the actions of the United States. Because the citizens of Africa, India, and similarly situated nations have a great deal to lose, and indeed because millions of lives are at risk, there is good reason for the United States and China to act whether or not such action is in their self-interest.[110]

110. It is important to note that financial help with adaptation might well supplement emissions reductions.