Introduction

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The pace and face of globalization in the twentieth-first century will be critically influenced by whether or not some specific issues that call for collective action by countries are properly addressed. The evolution of globalization and its capacity to facilitate convergence of standards of living among all countries will not be independent of how well the provision of some key global public goods is organized by the international community. Peace and security, financial stability, open markets, and prevention of pandemics are obvious examples of public goods that cannot possibly be delivered without international coordination and whose persistent shortage would impair global integration and prosperity. Assuming that the scientific consensus on climate change is ultimately confirmed, then mitigation of global warming and, to some extent, adaptation to it constitute another global public good whose provision will influence how the global economy and geopolitics look in the future.

Since political borders cannot, of course, enclose climate variability, there should be no question that mitigation of climate change is a global public good. Mitigation manifestly poses the problems typically encountered in the provision of global public goods, such as issues of sovereignty, the temptation of free riding, differing preferences and priorities across societies, and the summation problem.[1] Collective action is a requisite to address this set of problems. On the other hand, given that the purported direct consequences of global warming would be felt locally, one could posit that adaptation to this phenomenon does

not really constitute a global public good. This is true to some extent—but not to the full extent. The local consequences of global warming, as argued by various authors in this volume, would in turn lead to economic and social effects that irremediably would spill across borders. If the decision were taken to prevent or contain those effects, then international cooperation would also be required. Consequently, the two generally acknowledged public policy challenges stemming from the risk of climate change, mitigation, and adaptation cannot be properly undertaken without international collective action.

Leaving aside the continuing debate on whether mitigation of climate change is more urgent than providing other global public goods, it is clear that the phenomenon and its implications must be subjected to serious analysis with the goal of providing a sound basis for coherent policies. In fact this is what the international community has intermittently tried to do for almost two decades. The Intergovernmental Panel on Climate Change (IPCC)—charged with scientifically assessing the pertinent information—was established in 1988, and in 1992 most countries, including the United States, adopted the United Nations Framework Convention on Climate Change (UNFCCC), with the objective of stabilizing greenhouse concentrations in the atmosphere at a safe level. Subsequently, as a measure for implementing the UNFCCC, the Kyoto Protocol—by which the developed countries that are part of it committed to specific reductions of greenhouse gas emissions—was adopted in 1995 and came into force in 2005.

Nevertheless, the issue is far from settled. For one thing, the science of climate change is still evolving, a fact that in and of itself helps to explain why the policy decisions so far adopted must necessarily be seen as partial or trial steps. This is clearly the case with the Kyoto Protocol. It stipulates only short-term emissions targets, limited to the so-called first budget period, 2008–12; however its goal is to address a long-term challenge. Furthermore, the treaty excludes the largest emitters: by withdrawal, in the case of the United States, and by exemption at the protocol's negotiation, in the case of large developing countries like China. On all fronts—scientific, economic, and geopolitical—building international cooperation to deal with climate change is a work in progress.

In this process, what comes after Kyoto's first budget period constitutes the most important challenge for both analysts and policymakers. The Yale Center for the Study of Globalization has adopted the discussion of the global climate change challenge as one of its core topics. As part of this endeavor, in October 2005 the center convened a group of leading experts and policymakers from various parts of the world to debate global climate policy after 2012. Following up on the presentations, a significant number of the participants formalized their papers, utilizing their notes and the transcriptions we provided, and were kind enough to submit the documents that are now included in this volume.

True, since we held the conference, many events on the subject have taken place, some with significant intellectual content and others rendering meaning-

ful policy decisions. For example, the *Stern Review on the Economics of Climate Change* was published, the reports of the three working groups of the IPCC Fourth Assessment Report were released, the European Union pledged unilaterally to reduce carbon emissions by 20 percent by 2020 as measured against 1990 levels, and the United States government began to engage again more actively in the international discussion on climate change.[2] In fact, thanks to the generosity of Sir Nicholas Stern and other authors, the Yale Center for the Study of Globalization had the opportunity of hosting a stimulating symposium on the *Stern Review* in February 2007.[3] Notwithstanding the latest analyses, the contributions stemming from our fall 2005 Yale conference retain a significant degree of pertinence that makes it worth publishing them as a volume. Although the authors were not required to update their chapters in light of recent evidence, some of the chapters do take it into account. In particular, in this introduction I have taken the liberty of making reference to some of the presentations that were made at our symposium on the *Stern Review.*

Recent events have scaled up the discussion of the issues tackled at the 2005 Yale conference. The debate on the science of climate change, reflected in the contributions by R. K. Pachauri, Richard Lindzen, Stefan Rahmstorf, and Stephen Schneider, has acquired a higher profile with the publication of the IPCC's Fourth Assessment Report.[4] Pachauri's contribution to this volume underlines the report's conclusion that the warming of the climate is unequivocal and that most of the observed warming over the last fifty years is *very likely* (rather than *likely,* as submitted in the IPCC's previous report) due to the observed increase in anthropogenic greenhouse concentrations.[5]

Lindzen does not dispute that there is global warming, although he considers it to have been relatively small over the past century; furthermore, he is skeptical of the evidence provided to impute the concentration of greenhouse gases as the cause of that warming. Essentially, he argues that the present climate alarmism is not warranted by the scientific evidence and he claims that the alarm has been unduly created by predictions based on models that exaggerate climate sensitivity to added greenhouse gases. He maintains that there are climatic processes, not yet properly represented in the prediction models, that will mitigate the impact of increasing atmospheric concentrations of greenhouse gases.

Rahmstorf, who differs strongly with Lindzen's argumentation, believes that the available evidence, which he reviews in his chapter, indeed proves that human activities already have altered the global climate, and in the absence of effective climate policies those activities will lead to significant global warming, which is highly likely to come with major risks and extreme events. Rahmstorf, in other words, endorses the consensus idea that the world is already in a trend of dangerous climate change.

Precisely this scrutiny of the notion of key vulnerabilities of climate change (meaning severe or dangerous impacts) is the subject of Schneider's contribution.

This author examines in detail why it is not possible to provide an unambiguous definition of dangerous climate change. Since individuals across regions and countries have different stakes in aspects such as productive capacity, biodiversity, and cultural traditions that could be affected by climate change, the concept of dangerous human interference with the climate system cannot be free of value judgments. Schneider points out that scientific knowledge can only inform the political processes by which conflicting judgments of what is valuable are settled and, furthermore, that knowledge by itself is not unequivocal, since it is based on limited information and projections generated by models that are semi-empirical constructs. The assessment of climate vulnerability, observes Schneider, requires risk analysis, which in turn calls for probability distributions over outcomes instead of single-value expectations.

The fact that the impacts of climate change will not be uniform across countries is also highlighted in Robert Mendelsohn's chapter. This author estimates that, under either moderate or severe climate change scenarios, most of the damages will fall most heavily on the poorest countries, while the richest countries would actually benefit under both scenarios. This asymmetry, in his view, calls for "a compensation package" for poor countries, aimed at helping them grow faster so that their economies can move away more easily from climate-sensitive activities. Mendelsohn recommends, however, spending only limited resources on climate change mitigation in the near term. Relying on estimates of the net present value of future damages in various climate change scenarios, he concludes that it would be uneconomical for present generations to invest heavily in abatement.

The latter policy recommendation contrasts significantly with the chief conclusions of the *Stern Review*: climate change is a serious and urgent issue that warrants strong and urgent action to reduce greenhouse gas emissions around the world; the benefits of strong and early action far outweigh the economic costs of not acting; the overall costs of climate change will be equivalent to losing at least 5 percent, and as much as 20 percent, of global GDP each year; and the cost of mitigation can be limited to around 1 percent of GDP each year.

William Nordhaus, a pioneer and a most distinguished scholar in the field of climate change economics, who long ago submitted that unchecked warming may lead to enormous and costly long-run ecological and economic impacts, does not fully concur with Stern's policy recommendations. Shortly after the publication of the review and at the aforementioned Yale symposium, Nordhaus showed that Stern's economic case for strong and early action stems crucially from an intertemporal cost-benefit analysis that, by virtue of using a near-zero social discount rate, exaggerates manyfold today's valuation of damages that may occur in the very remote future.[6] This approach is what allows the *Stern Review* to validate the near-term cost of the mitigation effort that it recommends. Nordhaus suggests that, had the review used a more conventional real interest rate, it

would have found it very hard to justify urgent and large investments for climate change mitigation. He believes that there are no new reasons to invalidate the prescription provided by mainstream environmental economic analysis, which recommends that our generation should certainly contribute to ameliorating the risk of global warming, but that the proportion of resources diverted to this should be stepped up only as subsequent generations become richer. From this viewpoint, it is better to invest now in solving growth and development problems, thereby bequeathing bigger economies to future generations, who subsequently will be better endowed to mitigate and adapt to climate change.

Stern has responded that the review's use of formal modeling with a low discount rate is just one part of its argument for stronger action now.[7] Moreover, Stern also suggests that his results stemming from the integrated assessment model used in the review differ from those provided in previous analyses: that model uses the latest climate change science, which reveals larger temperature changes than previously thought, as well as the latest probabilistic assessments of climate sensitivity. Furthermore, Stern has insisted on the validity of a low discount rate; he is of the opinion that discounting at a high rate is unethical, for it involves discrimination among individuals by date of birth.

In his comments on the *Stern Review,* Scott Barrett granted that ethics are important in discussing the impact of climate change on different groups of people but explained that there are several ethical dimensions to it, not just one.[8] The issue is not only about comparing the well-being of future generations relative to ours but also about comparing the well-being of richer and poorer societies, today and in the future. Barrett indicated that the review's purported equity concerns are not well served by proposing that today's relatively poorer generations should help richer generations in the future to live better. One could add that this proposition would be particularly hard to sell to the present citizens of poor developing countries who will have to sacrifice if the review's prescription of strong and early action across all countries is embraced by the international community.

Interestingly, it appears that the prescription can be rescued even if the issue of how to compare the well-being of different groups across countries and over time is not fully settled. In critiquing the *Stern Review,* Martin Weitzman has suggested that if investing in climate change mitigation were seen less as a problem of long-term cost-benefit analysis and more as a problem of deciding how much insurance to buy to offset the slight chance of a future catastrophe that could ruin the entire world, then perhaps it would be more efficient and fair for our generation to more seriously entertain harsher measures now than those it is presently willing to undertake.[9] Weitzman's analysis implies that the *Stern Review* may be right for the wrong reason. The chapter by Schneider in this volume also makes reference to the normative challenge when one is dealing with uncertainty and insists on the need to determine the thresholds at which the

chance of catastrophic climate impacts will not be taken without some hedging strategies to mitigate them.

Irrespective of the ultimate choice made between early aggressive mitigation or ramped-up mitigation, internationally coordinated policy action is needed, an undertaking that from any perspective poses a huge and complex challenge, as suggested by various contributions in this volume. Thomas Heller is markedly pessimistic about the chances of building any time soon a regime congruent with the objectives established in the UNFCCC. In fact he predicts that current attempts to extend the framework enshrined in the Kyoto Protocol will meet a dead end. He does not see in that architecture the elements that would make a cooperative solution feasible. Not only is he skeptical that a Kyoto-based regime will succeed in attracting the effective participation of the leading emitters, who so far have been absent, but he also observes little enthusiasm among many of the previously engaged parties to deepen their commitments at the forthcoming negotiation of the second-period obligations.

In the context of their assessment of the European Emissions Trading Scheme, Gernot Klepper and Sonja Peterson provide a more positive vision than Heller's about the future value of the Kyoto Protocol. They credit the UNFCCC with significant achievements, such as providing the broad objectives of climate policy, introducing emissions reduction (albeit insufficient), and constructing complex institutional structures that are beginning to be success stories. They count among the latter both the tools to certify projects for the flexible mechanisms of the Kyoto Protocol as well as the European Emissions Trading Scheme, which in these authors' view shows that international emissions trading is feasible. Klepper and Peterson are confident that the Kyoto Protocol will prove more valuable than now predicted by Kyoto skeptics.

In the case of the so-called Annex I group, it is obvious that each country's attitude toward a Kyoto framework for the post-2012 period will depend to some extent on its experience in meeting the first budget period target. These experiences are heterogeneous, as shown in some of the contributions to this volume.

Canada's experience, analyzed by John Stone, is expected to be one of noncompliance with Kyoto. Although the Canadian government has announced a long-term emission abatement policy that includes targets by 2050 and even will include regulation of specific sectors, it has already admitted that Canada will not meet its Kyoto targets. In fact, as reported by Stone, rather than delivering a 6 percent reduction of greenhouse gas emissions, Canada's 2008–12 emissions levels might be 28 percent *above* the 1990 level.

In contrast, as a result of policies that started to be developed in the late 1980s, the United Kingdom is on track to comply with its Kyoto targets. The chapter by Howard Dalton provides an account of how the United Kingdom has played a leading role in supporting climate science by introducing targets,

by trading greenhouse gas emissions, and also by promoting international negotiations on climate change.

Russia is another country that will meet its Kyoto targets. In fact it will have a surplus of emissions rights eligible to be placed on the international carbon market; but unlike the U.K. it has engaged rather cautiously in the Kyoto process. In his chapter, Alexander Golub relates how Russia, despite having a wide margin to comply with the previously agreed targets and despite being in the position to make an economic gain from joining Kyoto, not only delayed its ratification practically to the last moment but also is moving very slowly to put in place the infrastructure that it needs to participate in the treaty's flexible mechanisms. It is not audacious to anticipate a highly defensive, if not frankly oppositional, attitude on the part of the Russian government at the post-Kyoto negotiations.

Needless to say, strong defensive positions should also be expected from the developing countries, particularly the large emitters. In this respect, the contributions by Jyoti Parikh on India and Shen Longhai on China are quite suggestive. Both authors make clear that sustaining high growth and reducing poverty should be their respective countries' highest priority for a long time. They also consider that the burden of reducing carbon emissions within the next few decades should fall on the developed countries, given both their contribution to the world's accumulated greenhouse gases and also their much higher per capita emissions.

Parikh believes that India, with a low GDP per capita and a large proportion of its population without access to modern cooking and lighting energy sources, has a long way to go before it can accept binding commitments for carbon emissions reductions. Even more meaningful, this author rejects an idea that is gaining traction in places like the United States: that large emitters should be singled out among developing countries for future climate change policy decisions. She affirms that per capita emissions, rather than the sheer size of emissions, should be the defining criterion in whatever specific notion of differentiated responsibility is entertained in the future by the international community. Similarly, although Shen anticipates a sustained effort by China to improve its energy efficiency and also to reduce its dependency on coal (which will still provide 60 percent of its total energy consumption by 2020), he does not envision that his country will accept emissions targets anytime soon.

If Parikh's and Shen's opinions are representative of the way in which the large developing countries will go about negotiating a possible post-Kyoto regime, it is clear that achieving an agreement will be an enormously complex and difficult undertaking. Yet in his proposal for a post-2012 regime in this volume, Robert Stavins suggests that broad participation by key developing countries is essential to address the challenge of climate change, not only because of the absolute and mounting size of their emissions but also because, being relative latecomers to the energy markets, they have the greatest potential to adopt cost-effective, low-emissions technologies to satisfy their incremental energy demand.

Furthermore, if developing countries are not an effective part of a post-Kyoto agreement, Stavins indicates that the risk of an "emissions leakage" factor (distorting the international pattern of production and trade) would become significant—and inhibitory to industrialized countries' participation.

Stavins believes that engagement by developing countries is possible if, unlike in the present protocol, a truly long-term agreement is negotiated. He conceives of a regime with global emissions targets and trading but one whereby developing countries' commitments become binding only when their respective per capita gross domestic product reaches certain thresholds. This author essentially thinks that a suitable modified Kyoto architecture will provide the necessary and negotiable regime for the future.

In contrast, Nordhaus, in his contribution to this volume, opines that "life after Kyoto" should be different from Kyoto—or that at least alternative approaches should receive serious consideration from the pertinent stakeholders. He warns of, and explains, serious pitfalls in any climate change regime based on quantity targets, even if provided with trading and auction of permits. Nordhaus's preferred alternative would consist of internationally harmonized carbon taxes on emissions. His analysis implies that all in all the negotiation and administration of this option could prove less complicated than a quantity-based system. Taxing carbon emissions, by acting directly at the source of the problem, would be more effective and efficient than permits for coordinating policies and mitigating climate change. In Nordhaus's proposal the principle of common but differentiated responsibility would be instilled in a system in which developing countries commit to enact the agreed carbon taxes only as they achieve certain levels of per capita income; furthermore, poor countries would receive transfers of income to hasten their early participation.

What, then, after Kyoto?

The above summary makes clear that, even among people who take climate change seriously, views on the subject can be markedly dissimilar and even contrary. The mosaic of opinions in this volume is indicative of what lies ahead as the international community prepares to discuss what to do about climate change. Scott Barrett is probably right: climate change may not be the world's most pressing problem (as I am convinced it is not), but it still could prove to be the most complex challenge the world has ever faced.[10]

The problem is a multidimensional one, which eludes straightforward solutions. It is not only that governments and societies are facing the complications involved in the provision of a truly global public good but also that it entails unprecedented uncertainties about costs and benefits, and these benefits have a term for delivery much longer than in any previous international undertaking. Analyzing mitigation as a global public good is further complicated by the possibility of catastrophic climatic change with irreversible damages to the world's human, natural, and physical capital, damages that could prove immensely

asymmetric to the cost of preventing such disasters (even if such prevention required front loading the necessary expenditures, which involves sacrifice by the present generation and its immediate successors). Yet to be justifiable, a much larger expenditure early on and stronger action would have to be seen more as a payment toward insurance on the human habitat than as an investment with a sufficiently attractive expected social and economic return.

To think of climate change mitigation as insurance against an uncertain catastrophe rather than as an investment in the future may provide analysts with a more reasonable rationale for stronger action sooner rather than later, but it does not make it easier to design, agree on, and implement emissions reduction policies. Governments and the populations they represent must still grapple with tough choices under practically any policy strategy intended to modify the present trend of global emissions and warming. It is not possible to escape the fact that somebody, somewhere soon, will need to start paying the price for such a policy.

It does not seem useful or fair to represent mitigation to citizens as good business for society at large. It can certainly be good business for some—but hardly for all. The real deal is that a sacrifice of some sort will have to be incurred by the present generation for the sake of people who will exist many years from now, in richer societies than ours, and most probably in countries that are not our own. Full transparency on this essential fact may not be good short-term politics, but it is indispensable if serious long-term policies are to be adopted.

It is important to recognize that previous exercises resulting in effective coordination among members of the international community were undertaken to address issues for which the near-term cost of failing to act was relatively obvious to the parties involved. Think of the creation of the United Nations at the end of the monstrous Second World War; of the General Agreement on Tariffs and Trade (GATT) after the regression into impoverishing protectionism during the 1930s; of the International Monetary Fund after many years of international monetary chaos; and of the successes in preventing pandemics, even eradicating diseases like smallpox, which were scourges upon humanity for centuries.

In each of these examples—and any other from humanity's past—experience or even downright evidence on the immediate cost of failing to act proved crucial to trigger international cooperation. The case for collective action to mitigate climate change, at least for the foreseeable future, cannot be built on the same kind of manifest basis. Whoever is willing and possessed of the authority to promote that action will have to rely on materially distinct arguments. It is an ineluctable fact that, if the world truly is contending with an unprecedented phenomenon, then organizing the indispensable international cooperation to deal with it poses an unprecedented challenge.

Were the challenge to be taken on resolutely, then the principles inscribed in the UNFCCC would certainly prove fitting, and the knowledge gathered by the IPCC in its various reports would continue to be invaluable; still, the question of whether other parts of the available international structure would serve to build further the

system that is needed would remain a valid question. For one thing, the world does not have the right forum for leaders to discuss the issue in a way conducive to adopting policies to effectively reduce exposure to the catastrophic impacts of climate change potentially many years in the future. That forum will have to be convened not in lieu of the existing multilateral mechanisms but rather to catalyze decisions to enable those mechanisms to perform their intended function.

Moreover, the process of policy analysis, negotiation, implementation, and compliance will be well served by transparency and simplicity, two attributes not yet present in the ongoing deliberations to define a post-Kyoto Treaty regime. When one considers that to be effective this regime will have to overcome not only the challenges stemming from the sovereignty and free rider issues but also the challenges posed by the intercountry and intergenerational equity questions unique to climate change mitigation, then William Nordhaus's insistence on an international agreement focused on adopting harmonized carbon taxes rather than on emissions limits makes eminent sense.

Notes

1. These problems are discussed in International Task Force on Global Public Goods, *Meeting Global Challenges: International Cooperation in the National Interest,* Final Report (Stockholm, 2006). Hard copies of this report can be obtained from the Department for Development Policy, Ministry for Foreign Affairs, SE-103 39 (Stockholm). The full text is available at www.gpgtaskforce.org/bazment.aspx.
2. Nicholas Stern, *The Economics of Climate Change: The Stern Review* (Cambridge University Press, 2007).
3. The presentations and discussions of the symposium on the *Stern Review on the Economics of Climate Change* are available at www.ycsg.yale.edu/climate/stern.html.
4. The volumes of IPCC, *Climate Change 2007,* are *The Physical Science Basis,* Contribution of Working Group I to the Fourth Assessment Report (Bangkok, 2007); *Impacts, Adaptation. and Vulnerability,* Contribution of Working Group II to the Fourth Assessment Report (Bangkok, 2007); and *Mitigation of Climate Change,* Contribution of Working Group III to the Fourth Assessment Report (Bangkok, 2007).
5. Very likely > 90% probability of occurrence. Likely > 66% probability of occurrence.
6. See William D. Nordhaus, "A Review of the *Stern Review on the Economics of Climate Change,*" *Journal of Economic Literature* 45 (2007): 686–702; William D. Nordhaus, "Comments on the *Stern Review on the Economics of Climate Change,*" Symposium on the *Stern Review,* 2007, Yale Center for the Study of Globalization (www.ycsg.yale.edu/climate/stern.html).
7. Nicholas Stern, "Reaction to the Panelists," Symposium on the *Stern Review,* 2007, Yale Center for the Study of Globalization (www.ycsg.yale.edu/climate/stern.html).
8. Scott Barrett, "Comments on the *Stern Review on the Economics of Climate Change,*" Symposium on the *Stern Review,* 2007, Yale Center for the Study of Globalization (www.ycsg.yale.edu/climate/stern.html).
9. Martin Weitzman, "The *Stern Review on the Economics of Climate Change,*" *Journal of Economic Literature* 45 (2007): 703–24.
10. Barrett, "Comments on the *Stern Review.*"