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Beyond Kyoto: North-South Implications of Emissions Trading and Taxes

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As scientific evidence of the human causes and consequences of global climate change mounts, there is renewed urgency to reduce global emissions of carbon dioxide and other greenhouse gases responsible for climate change.[2] One of the most significant political-environmental debates surrounding climate change involves the participation of developing countries in international climate control efforts. At the heart of this controversy lies the preferential treatment afforded to developing countries by the Kyoto Protocol, the prevailing international treaty on climate change. Critics allege that the Kyoto Protocol prioritized equity for developing countries at the expense of efficiency in international climate control, and as a result, failed to elicit the level of international cooperation necessary to prevent potentially catastrophic climate change.[3] Implicit in this critique is an assumption, common within the mainstream of the economics profession, that equity and efficiency are separable issues.[4] In this paper, I argue that this assumption has falsely framed the debate over the participation of developing countries in international climate control as an either/or phenomenon: either the Kyoto Protocol sacrifices efficiency in the pursuit of equity by exempting developing countries from mandatory emissions limits, or it improves efficiency by eliminating special exemptions for these countries.

I argue that a critical rethinking of the relationship between equity and efficiency in global climate control is long overdue. As the international community embarks on the next round of climate negotiations and debates the role of developing countries in global climate control efforts, clarifying

the tradeoffs between equity and efficiency takes on renewed importance. I argue that it is possible to improve efficiency in global climate control without sacrificing equity for developing countries. A climate control treaty that is efficient will shift more emissions abatement to the South, where many countries have lower cost options for reducing greenhouse gas emissions than in the North. A climate control treaty that is equitable will shift more of the costs of emissions reduction to the North, where the countries most responsible for climate change and most able to pay to prevent climate change are located. Therefore, to improve equity and efficiency in international climate control, mechanisms for locating emissions reduction in the South while distributing the resulting costs to the North need to be further explored. Ironically, emissions taxes and trading, what the mainstream of the economics profession hails as "market friendly" mechanisms, can be used to shift abatement to the South while redistributing the cost to the North. Typically, economists emphasize the cost-savings associated with these mechanisms, preferring to treat the efficiency of these mechanisms separately from equity.[5] I argue that emissions taxes and trading should be more fully incorporated in global climate control efforts if policy makers maintain their commitment to fairness for developing countries in climate control and use these mechanisms deliberately to reduce North-South inequalities.

In Section I of this paper, I explain the special relationship between equity and efficiency in the case of climate control and other global public goods and highlight the challenges for policy makers. In Section II, I describe the history of international climate control efforts thus far, with particular attention to how a commitment to fairness for developing countries may have limited the potential efficiency of these efforts. In Section III, I introduce emissions taxes and trading as potential mechanisms for improving the efficiency of international climate control efforts and demonstrate how these mechanisms can be used deliberately to reduce

North-South inequalities. In Section IV, I conclude with my prediction of the direction global climate control negotiations will likely take.

I. EQUITY, EFFICIENCY, AND CLIMATE CHANGE

Understanding the relationship between equity and efficiency in climate control and its implications for policy makers is complicated by the fact that climate control is a global public good.[6] Because greenhouse gases are transboundary pollutants that yield the same impact on global climate regardless of where they are produced, reducing greenhouse gases in any one country, to the extent that it mitigates the threat of global climate change, generates a public good benefit for all countries. Economists have long demonstrated the fundamental problem with public goods: there is insufficient incentive for any one individual to provide them.[7] In the case of climate change, individual countries are reluctant to incur the costs of emissions abatement if other countries benefit at their expense. Rather, the rational strategy for any one country is to "free-ride" on the emissions abatement of others. A country will only voluntarily reduce its emissions if its own private benefit from emissions reduction outweighs its own cost. However, this level of abatement is less than optimal from a global perspective. Because every unit of emissions reduction benefits all countries, the global benefit from any one country's emissions reduction likely exceeds its cost. A country that voluntarily reduces emissions incurs the entire cost of its abatement but captures only a fraction of the total global benefit it creates. Because the demand for global emissions reduction is greater than any one individual country's demand for emissions reduction, each country abates less than what is globally optimal.

The implication of the public good problem for international climate control is clear: international cooperation is necessary to achieve the optimal level of global emissions abatement. Absent cooperation, countries will choose abatement levels on the basis of their own private costs and benefits, ignoring the greater global benefit their abatement provides. An

international climate control agreement can overcome the "free-rider" problem and achieve the optimal level of global emissions abatement.

For economists, the optimal, or efficient, level of global emissions abatement is the level that maximizes the net global benefit from emissions abatement.[8] Economists would describe an international climate control treaty as "efficient" if it satisfies two conditions. First, it must guarantee that individual countries reduce emissions sufficiently such that the optimal global level of emissions abatement is achieved.[9] Second, the treaty must minimize the cost to individual countries of reducing their emissions to ensure that the optimal level of global abatement is achieved at the lowest possible global cost. The total global cost of abatement is minimized when the cost of the last unit of emissions reduction in any one country, the marginal cost, is the same for all countries.[10] For example, if the last unit of emissions abatement in country X exceeded the cost of the last unit of abatement in country Y, shifting abatement from X (the country with the higher marginal abatement cost) to Y (the country with the lower marginal abatement cost) would lower the total global cost of emissions abatement. For this reason, an efficient climate control treaty will equalize marginal abatement costs among all countries. An inefficient treaty will either produce too little global abatement and/or fail to produce that level of global abatement at the lowest possible total global cost.

Three problems arise for policy makers charged with designing an efficient climate control treaty.[11] First, not all countries may benefit equally from climate control. Second, equalizing marginal abatement costs among countries may mean that some countries—countries that can abate emissions at comparatively lower cost—will abate much more than others. These two possibilities suggest that some countries will benefit more from participating in an efficient treaty, whereas other countries could potentially be worse off for their participation.[12] Countries anticipating lower climate change related damages, and/or countries with relatively low abatement costs, will derive a lower (or negative) net benefit from an efficient treaty

than countries who benefit more from preventing climate change and whose relatively high abatement costs mean they have to abate less.[13] Therefore, differences in countries' abatement costs and benefits are significant, because for an international climate control agreement to be self-enforcing, all sovereign countries must find it in their self-interests to voluntarily participate.[14]

The third problem policy makers confront in designing an efficient climate control treaty is that not all countries are equally responsible for the accumulation of greenhouse gases in the atmosphere that is driving climate change.[15] Nor do all countries demonstrate equal ability to pay for the costs of reducing greenhouse gas emissions.[16] For equity reasons, policy makers may want to shift the burden of emissions reduction more heavily to those countries that share greater responsibility for climate change and can better afford abatement.[17] If satisfying these equity concerns requires shifting abatement from low-cost, high-benefiting countries to high-cost, low-benefiting countries, the treaty will fail to elicit sufficient participation, and it will fail to minimize the total global cost of mitigating climate change.[18] The treaty will produce too little global abatement at too high a global cost.

I argue that these problems that policy makers confront in designing an efficient and equitable climate control treaty are not intractable, though their existence predictably complicates negotiations.[19] As compared to a non-cooperative, non-treaty outcome where countries choose abatement levels independently of each other, an efficient climate control treaty can increase global abatement to optimal levels and reduce the global cost of achieving that abatement. The change from a non-cooperative outcome to an efficient treaty can produce benefits in excess of costs, i.e., an efficiency gain. Generating this efficiency gain means that an efficient treaty *can* make all countries better off. Whether or not an efficient treaty *actually* renders every country better off will depend on how that efficiency gain is distributed among countries.

To ensure that the efficiency gain from an efficient international climate control treaty is distributed fairly among countries, I argue that it is necessary to distinguish between where abatement takes place and who pays for it. Mechanisms such as emissions trading and taxes can accomplish this. These mechanisms can be used to lower the costs of global emissions abatement and to fairly distribute the costs and benefits of global abatement among countries. I argue that using emissions trading and taxes as deliberate means of fairly distributing the costs and benefits of global climate control is a better approach than the current approach of exempting developing countries from emissions quotas. Both mechanisms, deemed "market-friendly" alternatives to a "command-and-control" regulatory approach by mainstream economists, can be used to improve efficiency in international climate control without necessarily compromising fairness for developing countries.[20]

II. INTERNATIONAL CLIMATE CONTROL EFFORTS

Examining the history of international climate control sheds valuable light on the deficiencies of the prevailing approach to mitigating climate change and illuminates an alternative path for future policy makers to take. Attempts to forge international cooperation on mitigating climate change began in 1992 with the United Nation's Framework Convention on Climate Change (UNFCC) in Rio de Janeiro, Brazil.[21] At that time, the participating industrialized countries agreed to voluntarily reduce their greenhouse gas emissions.[22] However, the need to strengthen the UNFCC soon became evident as most of the industrialized countries failed to meet their voluntary targets and emissions in some countries actually increased.[23] More than one hundred and fifty countries convened in Kyoto, Japan, in 1997 to negotiate binding emissions quotas.[24] The product of those negotiations, the Kyoto Protocol, remains the prevailing international agreement on combating climate change to date.

The Kyoto Protocol establishes binding emissions limits for industrialized countries and a range of mechanisms to promote cost-effective compliance. Following the framework of the UNFCC, the Kyoto Protocol differentiates between two groups of countries worldwide: "Annex I" countries, which are subject to emissions limits, and "non-Annex I" countries, which have no binding commitments. The list of non-Annex I countries consists of developing countries. The list of Annex I countries is comprised of thirty-nine industrialized countries and countries with economies in transition.[25] These countries account for two-thirds of global carbon emissions.[26] The United States alone, accounting for less than 5 percent of the world's population, produces 25 percent of global carbon emissions.[27] Although individual country commitments vary, Annex I countries, on average, are required to reduce emissions by 5.2 percent of their 1990 emissions levels during the commitment period from 2008-2012.[28]

Policy makers confronted three challenges in designing the Kyoto Protocol. First, in keeping with the original UNFCC mandate, they were to establish emissions targets compatible with stabilizing greenhouse gas concentrations in the atmosphere at levels that would prevent catastrophic human-induced climate change.[29] Second, to improve efficiency and increase the willingness of countries to participate, policy makers needed to include mechanisms such as emissions trading to minimize the costs to countries of meeting their targets.[30] Lastly, to address historical imbalance in greenhouse gas production and differences in countries' abilities to pay for abatement, policy makers had to distribute the costs of preventing climate change equitably among countries.[31]

It can be argued that the Kyoto Protocol represents a truly remarkable and unprecedented example of the willingness of the global community to prioritize fairness for developing countries in an international agreement. Equity concerns motivated a climate control framework that assigned countries differentiated responsibilities for reducing emissions in

recognition of their ability to pay and their historic contribution to the build-up of greenhouse gases in the atmosphere.[32] But what price, if any, did the international community pay for this commitment to fairness?

The most immediate implication of the Kyoto Protocol's exemption of developing countries is that developing countries lack direct incentives to limit their emissions. This is especially problematic given the predicted rate of emissions increase in these countries in the near future.[33] As long as developing countries can ignore the negative external effects of their emissions production on global climate, emissions production in developing countries will exceed optimal levels.[34] By imposing limits on developed countries, however insufficient those levels may prove to be in preventing climate change, the Kyoto Protocol imputed a cost to emissions in developed countries that is (theoretically) accounted for in decisions regarding emissions activity. For every ton of emissions they produce, developed countries must either pay to offset those emissions in order to meet their Kyoto targets, or forgo the revenues they could have earned from selling emissions reduction credits to other countries.[35] The Kyoto Protocol ensures that every ton of emissions produced in the developed world has an implicit price attached to it. Whether that price is sufficiently high to capture the full global cost of emissions is an important point worth debating and one that speaks to the overall efficiency of the Kyoto Protocol. However, it is clear that as long as developing countries are exempt from emissions quotas the Kyoto Protocol cannot achieve the optimal level of global abatement.

The second implication of exempting developing countries from mandatory emissions quotas is that the Kyoto Protocol concentrates abatement in the areas of the world where abatement may cost most. Marginal abatement costs typically increase with the level of emissions abatement.[36] Countries exhaust least-cost options for reducing emissions first, such that subsequent abatements cost increasingly more. Developed countries, because they have engaged in more emissions abatement on

average than developing countries, tend to exhibit higher marginal abatement costs.[37]

In addition, some of the least-cost methods for reducing emissions stem from forest resources that are relatively more abundant in the developing world. Forests sequester carbon emissions from the atmosphere and store the carbon long-term in vegetation and soils. Land use change that contributes to deforestation reduces carbon sequestration and releases stored carbon back into the atmosphere.[38] Restoring, expanding, or preserving forest areas are effective means for mitigating climate change.[39] The relatively low opportunity costs of protecting and expanding tropical forests would make this an attractive abatement option for many developing countries if the Kyoto Protocol provided these countries with incentives to offset their emissions.[40]

To minimize the total global cost of emissions abatement, the Kyoto Protocol would have needed to allocate abatement across countries to equalize countries' marginal abatement costs. If marginal abatement costs are lower in developing countries, efficiency should have required the Kyoto Protocol to shift more abatement activity to the developing world. The problem, of course, was that shifting abatement to developing countries violated the international community's commitment to fairness in climate control. The Kyoto Protocol concentrates abatement in the developed world instead, despite the fact that global abatement costs are likely higher as a result. By exempting developing countries from mandatory emissions limits, the Kyoto Protocol increased the cost of global climate control and diminished the incentive of other countries to participate. Simulations reveal that the highest net global benefits from climate control manifest under scenarios that include the full participation of both developing and developed countries, and where international emissions trading ensures that emissions activity is concentrated in the countries where it costs least.[41]

The most significant problem with the Kyoto Protocol, however, is that it fails to generate sufficient abatement to prevent climate change. The United

States dealt a potentially lethal blow to international climate control efforts with its decision in 2001 to withdraw from the Kyoto Protocol after years of active negotiating to shape the treaty's framework in its own best interests.[42] The United States cited the lack of participation of developing countries and the resulting high cost-to-benefit ratio of the Kyoto Protocol as its primary reason for withdrawal.[43] To enter into force, the Kyoto Protocol required ratification by at least 55 countries representing at least 55 percent of emissions in the developed world. Without the United States, which is the world's largest emissions producer, implementation of the Kyoto Protocol required the participation of almost every other developed country. When the Kyoto Protocol finally entered into force in February 2005, it included 161 nations representing 62 percent of developed country emissions. On average, these nations will reduce their emissions by 5.2 percent from their 1990 levels.[44]

According to most climate scientists, an effective solution to climate change will require more emissions reduction than the Kyoto Protocol requires during its initial 2008–2012 commitment period.[45] If net emissions from human sources remain at current levels, atmospheric concentrations will soon climb to roughly twice their preindustrial levels.[46] Stabilizing atmospheric concentrations at their current levels would require an immediate 50–70 percent reduction in global emissions and further reductions thereafter.[47] Stabilizing atmospheric concentrations at current levels would only limit the increase in average global temperature to 3.5 Celsius degrees or less by the year 2100.[48] The Kyoto Protocol, though it is an important first step toward mitigating climate change, cannot prevent climate change.

The international community has already begun the next stage of climate negotiations. In December 2005, the parties to the Kyoto Protocol met in Montreal to plan for emissions reduction beyond Kyoto's initial 2008–2012 commitment period.[49] During the next commitment period, more extensive reductions, upwards of 30–60 percent, will have to be achieved.[50] The

participation of the United States is absolutely critical in this regard. However, inducing cooperation from the United States will likely prove to be the most difficult problem for international climate negotiators to solve. Negotiators will also have to grapple with developing countries, and whether exemptions for equity reasons should continue to be granted in this next round of climate action. If the potential efficiency loss from exemptions undermines the effectiveness of global climate control efforts, the issue becomes one of whether equity for developing countries can be achieved through means other than exemptions.

III. BEYOND KYOTO: EQUITY AND EFFICIENCY RECONSIDERED

Mainstream economics has falsely framed the debate over the participation of developing countries in international climate control as an either/or phenomenon: either a climate control treaty sacrifices efficiency to achieve fairness for developing countries by exempting developing countries from mandatory emissions limits, or it sacrifices equity to improve efficiency by eliminating such preferential treatment. Efficiency in global climate control requires two things: (1) that all countries internalize the external costs of their emissions such that the optimal level of global abatement is achieved, and (2) that the global cost of achieving optimal abatement is minimized by distributing abatement to the countries where it costs least.[51] These efficiency conditions imply that not only should limits be placed on developing countries' emissions, but that global abatement should be centered in the developing world because of its comparatively lower abatement costs. The global community is right to reject such an outcome as grossly unfair *if* further mechanisms are not put in place to redistribute the costs of abatement from developing countries to developed countries. The issue of where abatement takes place in the world is separable from the issue of who pays for it. Where abatement takes place is largely an efficiency issue. Who pays for abatement is an issue of fairness. In the case of global climate control, equity and efficiency are not separable

issues. An international climate control treatment can be both fair and efficient *if* the appropriate redistributive mechanisms are implemented.

Emissions trading and emissions taxes can improve efficiency in international climate control without necessarily compromising fairness for developing countries. An emissions tax charges emissions producers a fee equivalent to the marginal damage of their emissions for every unit of emissions they produce.[52] Emissions trading requires emissions producers to obtain a permit in order to emit. The total amount of emissions is capped by the number of permits issued and producers are allowed to buy and sell permits among themselves as they deem necessary.[53] Mainstream economics treat emissions taxes and emissions trading as theoretical equivalents in terms of efficiency.[54] Both mechanisms can achieve the socially desirable level of emissions reduction by forcing emissions producers to internalize the external costs of their emissions.[55] Whether producers are required to pay a tax equal to the marginal damage of their emissions, or producers are required to obtain an emissions permit with a price equal to the marginal damage of their emissions, the penalty for emitting and the producer's incentive to reduce emissions is the same.[56]

Moreover, both mechanisms can lower the costs of reducing emissions in comparison to a standard regulatory approach.[57] Regulations typically mandate that emissions producers adopt a specific technology to reduce emissions (e.g., scrubbers), or mandate that all producers reduce their emissions by a certain percentage.[58] While this approach should produce the socially desired level of emissions reduction, it often inflates costs by failing to account for differences in abatement costs between different producers and technologies. In comparison, emissions taxes and emissions trading introduce more flexibility to help insure that the least-cost methods for reducing emissions are adopted.[59] Producers who can find ways to abate emissions at a relatively low cost will reduce emissions to avoid the more costly emissions tax or tradable permit price. Producers who can reduce emissions at a relatively high cost will pay the tax or obtain a permit to

avoid more costly abatement activities.[60] Mainstream economists typically prefer emissions taxes and emissions trading over regulation because they can produce the same level of abatement as regulation at a potentially lower cost.[61]

While emissions taxes and trading may be equivalent in many respects, they differ significantly in their distributional consequences. Emissions taxes adhere to the principle that the "polluter pays," which means that those responsible for generating societal costs are required to pay for the damages.[62] Not only is this deemed fair by most in society, but it is also efficient in that it provides the right incentives to producers to minimize the social costs of their production. An emissions trading scheme could be designed in such a way that the polluter also pays, but this is neither required in theory nor common in practice.[63] Whether or not the polluter pays under an emissions trading scheme depends on the initial allocation of the permits.[64] When permits are sold to emissions producers, emissions producers pay for the right to emit and this payment theoretically compensates for the damages caused by their emissions. When permits are sold to emissions producers, they force the polluter to pay and their distributive effects are equivalent to taxes.[65]

Permits, however, can be awarded for free to emissions producers.[66] In this case, polluters are granted the right to emit pollutants up to a certain level while the public essentially surrenders its right to fair compensation for harms generated by the emissions. For mainstream economists trained to prioritize efficiency over equity, the distributional differences between permits and taxes are inconsequential, for even when permits are awarded for free, permits theoretically provide the same incentives to reduce emissions as taxes as long as the permits are tradable.[67] An emissions producer who is awarded free permits can always sell those permits to another emissions producer. By emitting, producers forego the lost revenue they could have earned from the sale of their permits to other producers.

This theoretically provides an incentive to lower emissions to even those producers who are awarded permits for free.[68]

A. Emissions Trading

The structure and design of the Kyoto Protocol embodies many of the principles of an emissions trading scheme. The Kyoto Protocol is essentially an emissions trading scheme whereby the rights to emit at the levels specified by individual country quotas were awarded freely. Though proponents of the Kyoto Protocol are often hesitant to portray it in this way, what the Kyoto Protocol did was create and award property rights over the atmospheric commons. The initial assignment of emissions rights under the Kyoto Protocol determined the distribution of the net benefits from the treaty's implementation. The right to produce a certain level of emissions without penalty is highly valued, especially if that right can be sold to other countries. If emissions rights are transferable, countries can choose to meet their emissions target by reducing emissions or by purchasing those rights from other countries. As long as marginal abatement costs are different between countries, countries with lower marginal abatement costs will have an incentive to reduce emissions and sell their unused rights to countries with relatively higher marginal abatement costs. The more emissions rights granted to countries, the more countries can benefit from a climate control treaty that allows them to sell those rights to other countries.

Hence, the initial allocation of emissions rights becomes an important tool for redistributing the net benefits from global climate control. This tool can be wielded in more or less equitable ways. However, by exempting developing countries from mandatory emissions limits, the Kyoto Protocol granted developing countries unlimited property rights to the global atmospheric commons. The exemptions created an undeniable windfall gain to developing countries, which could benefit from the emissions abatement of other countries without paying for any of the cost. Had the rights awarded to developing countries been fully transferable, the benefits

to developing countries would have been greater even still. However, the Kyoto Protocol limited trade in emissions rights, thereby lowering the value of those rights granted to developing countries.

The Kyoto Protocol does allow for emissions trading between developed countries and does not specify an explicit limit on the use of emissions trading to satisfy countries' commitments.[69] In an implicit way, however, the use of emissions trading is limited by the requirement that domestic action constitutes a "significant element" of a country's emissions reduction efforts.[70] The clear intent of the Kyoto Protocol is that countries cannot meet their entire emissions target with permits purchased abroad.

Emissions trading is extended to developing countries through the Clean Development Mechanism (CDM).[71] The CDM allows developed countries to receive "credits" towards their own emissions quotas for financing projects that reduce emissions in developing countries.[72] CDM projects can also be unilateral, such that developing countries undertake CDM projects on their own without an explicit developed country partner and market the resulting emissions credits themselves.[73] The essential requirement for CDM projects is that they reduce emissions below what would have occurred in the absence of that particular CDM project.[74] For this reason, extending CDM credit to forest conservation and reforestation in developing countries is problematic. It would require establishing reliable baselines for forest cover in developing countries with which to gauge the additionality of CDM forestry-based activities—a difficult task.[75] Accordingly, the application of CDM credits to forestry-based emissions reduction activity in the developing world is limited to only 1 percent of a country's emissions target in any given year.

The Kyoto Protocol limits the transferability of rights to the global commons by limiting the use of emissions trading and the CDM. Concerns that emissions trading and the CDM could allow countries like the United States to escape the burden of costly emissions reduction and forestall the transition away from fossil fuels prompted the Kyoto Protocol's current

limitation on emissions trading. The efficiency loss associated with the exemption of developing countries from emissions quotas stems not from the transfer of property rights to developing countries for equity reasons, but because those property rights are not fully transferable. As long as developing countries are awarded unlimited property rights, as they are currently by the Kyoto Protocol, developing countries could benefit more from unlimited emissions trading. Allowing unlimited trading could increase the demand for low-cost abatement options in developed countries, thereby facilitating more investment in emissions abatement in the developing world. It could provide incentives to developing countries to reduce emissions, as every ton of emissions produced would imply foregone earnings from the sale of emissions credits. Accordingly, full emissions trading can improve the efficiency of the Kyoto Protocol and benefit developing countries, provided the initial allocation of property rights continues to favor developing countries. This is ironic given that the usual arguments for extending emissions trading under the Kyoto Protocol cite the potential cost-savings for developed (not developing) countries and that objections to full emissions trading have been waged on these grounds.

Moving forward beyond Kyoto, using full emissions trading to the benefit of developing countries will depend on two things. First, it will depend on the initial allocation of rights to the atmospheric commons. If exemptions are still granted to developing countries, they will have nothing to lose but something to gain from emissions trading. Exemptions cast developing countries in the role of seller, not buyer. Second, it will depend on the price paid by developed countries for the emissions rights developing countries sell. The price, in turn, will depend on the extent of emissions reduction required by the developed world. Consequently, a treaty that requires more extensive reductions in the developed world will not only be more successful in preventing climate change, but also will generate a larger windfall for developing countries.

The political obstacle, of course, is to convince developed countries to accept more extensive emissions reductions. It is unlikely that developed countries, particularly the United States, will agree to more extensive reductions unless developing countries are required to limit their emissions growth. In this case, the next stage in international climate negotiations will likely involve a very different initial allocation of property rights, and the net benefits to developing countries would be unclear.[76] If this is the direction climate negotiations take over the next decade, explicit acknowledgement of the distributional consequences of the initial allocation of emissions rights is crucial if the global community is to retain its current commitment to fairness for developing countries.

B. Emissions Taxes

If full emissions trading offers a more efficient approach to fairly distributing the net benefits from global climate control than exemptions for developing countries, global emissions taxes are better still. A global emissions tax can achieve the same emissions abatement as emissions trading, while providing a more direct and transparent method of income redistribution. Emissions taxes also avoid the predictable shortfalls of imperfect markets for emissions credits. For example, large countries like the United States could drive up the demand for emissions credits, effectively pricing them beyond the ability of small countries to afford. This is problematic, particularly if developing countries are required to reduce emissions in the future and would have to compete against countries with significant market power to purchase those rights. Historically, market mechanisms have worked more to the advantage of developed countries, and support for global emissions trading should be guarded for this reason alone.

A global emissions tax adheres to the logic that the polluter pays, thereby providing the right incentives to all countries to reduce emissions. To provide the right incentives to developing countries to reduce emissions, the

global emissions tax would have to apply to developed and developing countries. If developing countries are exempt from a global emissions tax, the same inefficiencies that plague the Kyoto Protocol may still remain. Again, the exemptions would grant unlimited rights to the atmospheric commons, but unlike in the case of emissions trading, under an emissions tax scheme, developing countries would have no opportunities to benefit from the sale of those rights to other countries.

From the perspective of developing countries, this approach is far less preferable. To maintain the commitment to fairness under an emissions tax scheme, the revenues from those taxes would have to be recycled back to the developing world to offset the costs of their participation in global climate control. Recycling can take the form of technology transfers or more direct payments. Revenue recycling does not negate the incentive to abate emissions as long as the amount of revenue recycled back to any one country is independent of that country's level of emissions reduction.[77]

The potential to use global emissions taxes as an alternative to emissions trading, particularly if revenues are recycled back to developing countries, may seem politically untenable. Many have rejected the possibility of global emissions taxes on this ground. However, the redistributive transfers implicit in emissions trading schemes generally, and in the Kyoto Protocol more specifically, are no less potentially objectionable. Not only did the Kyoto Protocol award a windfall gain to developing countries, but it also distributed the net benefits from climate control in arbitrary and far less obvious ways. For example, by specifying emissions targets as a percentage of 1990 emissions levels, countries with higher emissions levels in 1990 benefit more than others. Russia, because its emissions dropped significantly with the decline in its industrial activity post-1990, is now in a position to sell its emissions rights to other developed countries.

IV. CONCLUSION

The Kyoto Protocol is remarkable for its explicit commitment to fairness and the windfall gain it provides to developing countries. This commitment to fairness, however, is currently jeopardized by the conventional economic treatment of equity and efficiency as separable issues. Pressure to remove the exemptions currently granted to developing countries is mounting under the guise that equity compromises efficiency. If exemptions are removed, alternative mechanisms must be used to ensure fairness for developing countries. If market-based mechanisms like emissions trading or taxes play a greater role in future climate negotiations, as proponents of greater efficiency in global climate control would like them to, it is imperative that these mechanisms are used deliberately to distribute the net benefits of climate control fairly and not just to increase efficiency. Whatever direction the next round of global climate negotiations take, advocates for developing countries should remain clear on the relationship between equity and efficiency. Beyond Kyoto, it is possible to improve efficiency in global climate control without sacrificing fairness, as long as the initial distribution of property rights continues to favor the developing countries.

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[2] Climate change refers to a change in the earth's climate in excess of natural climate variability that is attributed directly, or indirectly, to human-induced changes to the atmosphere's composition. Climate change is the result of global warming. Global warming is caused by increased atmospheric concentrations of greenhouse gases, the most significant of which is carbon dioxide. Atmospheric concentrations of carbon dioxide and other greenhouse gases trap a portion of the sun's outbound energy reflected by the earth and raise the earth's surface temperature. *See generally* INTERGOVERNMENTAL PANEL ON CLIMATE CHANGE, CLIMATE CHANGE 2007: THE PHYSICAL SCIENCE BASIS (2007) [hereinafter IPCC REPORT 2007].

[3] Efficiency in international climate control refers to whether emissions reduction occurs at the lowest possible total cost. Equity in international climate control refers to the distribution of the costs and benefits of emissions reduction among countries. *See* J. P.

Weyant & J. M. Hill, *Introduction and Overview, The Costs of the Kyoto Protocol: A Multi-Model Evaluation,* ENERGY J. (SPECIAL ISSUE) vii-xliv (1999).

[4] The First and Second Fundamental Welfare theorems of neoclassical economics affirm the seperability of equity and efficiency. *See generally* ROBIN HAHNEL & MICHAEL ALBERT, A QUIET REVOLUTION IN WELFARE ECONOMICS (1990).

[5] Most environmental economics textbooks will go to great lengths to explain how emissions trading and taxes can lower the costs of emissions abatement. More careful treatments may also note the different implications for equity depending on whether taxes or emissions trading is used, but will not recommend a specific distributional outcome. *See generally, e.g.,* TOM TIETENBERG, ENVIRONMENTAL AND NATURAL RESOURCE ECONOMICS (2d ed. 1988). This is consistent with the tendency in mainstream economics to treat equity and efficiency as separable issues. From an economics perspective, all efficient outcomes are equally desirable regardless of their distributional implications. *See* HAHNEL & ALBERT, *supra* note 4.

[6] The definition of a public good is that it is non-rival and non-exclusive. If a good is non-rival, one person's benefit from the good does not preclude another's. If a good is non-exclusive, it is either impossible, or too costly, to prevent another person from using that good once it is provided.

[7] For an interesting discussion, see HAHNEL & ALBERT, *supra* note 4.

[8] *See generally* Kristen A. Sheeran, *Side Payments or Exemptions: The Implications for Equitable and Efficient Climate Control,* 32 E. ECON. J. 515 (2006).

[9] Theoretically, the optimal level of global abatement would be the level that maximized the difference between the total global benefit of emissions abatement and the total global cost of emissions abatement. In reality, it would be practically impossible to estimate the precise level of global emissions reduction that would maximize the differences between the total global benefit and total global cost. Therefore, I use the term "optimal level of global abatement" to refer to the level of global abatement that avoids potentially catastrophic climate change. As discussed in Section III of this paper, the Kyoto Protocol uses this same notion of optimal global abatement.

[10] TIETENBERG, *supra* note 5.

[11] For additional discussion on these problems, *see* Sheeran, *supra* note 8.

[12] A country that is worse off will incur costs from mitigating climate change in excess of benefits.

[13] Developing countries in the South are particularly vulnerable to the adverse effects of climate change, because of their climate, geography, and their lack of infrastructure and resources to effectively adapt their economies and protect their populations. *See* IPCC REPORT 2007, *supra* note 2 (providing the most recent evidence to this effect). This implies that the benefits of avoiding climate change will be relatively higher in the South than in the North. At the same time, the costs of mitigating climate change are likely to be lower in the South than in the North, for reasons to be discussed in Section III of this paper. The South's higher benefits from avoiding climate change, coupled with the South's lower costs for mitigating climate change, imply that more abatement should take place in the South than the North.

[14] *See* Sheeran, *supra* note 8, at 516; Scott Barrett, *Self-Enforcing International Environmental Agreements,* 46 OXFORD ECON. PAPERS 878-94 (1994).

[15] INTERGOVERNMENTAL PANEL ON CLIMATE CHANGE, CLIMATE CHANGE 1995: A REPORT OF THE INTERGOVERNMENTAL PANEL ON CLIMATE CHANGE 48 (1995) [hereinafter IPCC REPORT 1995].

[16] *Id.* at 48.

[17] As discussed in Section III, this is the notion of equity that policy makers were committed to when negotiating the Kyoto Protocol.

[18] *See supra* note 13 and accompanying text.

[19] The Kyoto Protocol is an excellent case in point. The Kyoto Protocol finally entered into force in February 2005, eight years after the ratification process began. *See* UNFCC, Kyoto Protocol, http://unfccc.int/kyoto_protocol/items/2830.php (last visited March 30, 2007).

[20] It is well accepted in the literature that taxes and tradable emissions permits reduce the total costs of pollution abatement as compared to "command-and-control." *See, e.g.,* TIETENBERG (1988), *supra* note 5, at 334-45. A command-and-control approach mandates a uniform pollution reduction or use of technology for all polluters, regardless of differences in polluter's abatement costs. As explained below in Section III, taxes and tradable permits can lower total abatement costs by shifting abatement activity to the polluters with the lowest abatement costs.

[21] HEIKE SCHRODER, NEGOTIATING THE KYOTO PROTOCOL: AN ANALYSIS OF NEGOTATION DYNAMICS IN INTERNATIONAL NEGOTIATIONS 19 (2001).

[22] *Id.* at 22.

[23] Under the UNFCC, countries were to reduce their emissions to 1990 levels by 2000. Since 1990, emissions in the United States have actually increased by 15 percent. *See* G. Marland, et. al., *Global, Regional, and National Fossil Fuel CO_2 Emissions*, *in* TRENDS: A COMPENDIUM OF DATA ON GLOBAL CHANGE (Carbon Dioxide Information Analysis Center, 2003), *available at* http://cdiac.ornl.gov/trends/ emis/em_cont.htm (last visited Mar. 15, 2007).

[24] SCHRODER, *supra* note 21, at 5.

[25] Kyoto Protocol to the United Nations Framework Convention on Climate Change, Dec. 10, 1997, 27 I.L.M. 22 (1998) [hereinafter Kyoto Protocol].

[26] *See* Marland, *supra* note 23.

[27] *Id*.

[28] Kyoto Protocol, *supra* note 25, art. 3.

[29] For further discussion, see Kristen A. Sheeran, *Equity and Efficiency in International Environmental Agreements: A Case Study of the Kyoto Protocol*, *in* THE HANDBOOK OF DEVELOPMENT POLICY STUDIES (M. Shamsul Haque & Gedeon M. Mudacumura eds., 2004). What exactly constitutes "catastrophic" climate change remains uncertain. According to the recent Stern Review, warming by 5 degrees Celsius or more over the next century would plunge humans into uncharted territories where the chances of abrupt and large-scale changes become more likely. Examples of possible abrupt changes include the collapse of the polar ice sheets and the resultant dramatic rise in sea levels, shifts in regional weather patterns like El Niño or South Asian monsoons, and the conversion of the Amazon rainforest to a savannah. *See generaly* STERN REVIEW: ECONOMICS OF CLIMATE CHANGE, ch. 3 (2006).

[30] *See* Sheeran, *supra* note 29.

[31] *Id*.
[32] *See* SCHRODER, *supra* note 21, at 64-68.
[33] In India, the world's fifth largest fossil-fuel emitting country, emissions increased 57 percent between 1990 and 1998. In China, the world's second largest fossil-fuel emitting country, emissions increased by 39 percent between 1990 and 1996. Marland, *supra* note 23.
[34] In this case, the optimal level of emissions production is the level that optimizes the difference between the benefit to developing countries of emissions production and the global cost of that emissions production.
[35] The Kyoto Protocol allows for emissions trading between Annex I countries. This means that a country that reduces emissions more than required by the Kyoto Protocol can sell the resulting credits to countries to use toward their emissions reduction targets. Kyoto Protocol, *supra* note 25, art. 17.
[36] TIETENBERG, *supra* note 5, at 342.
[37] *Id.* at 349-50.
[38] The conversion of forest land to alternative land use has reduced global forest area by more than 20 percent over the last 140 years. *See* INTERGOVERNMENTAL PANEL ON CLIMATE CHANGE, IPCC SPECIAL REPORT, LAND USE, LAND-USE CHANGE, AND FORESTRY 4-5, 14-15 (2000) [hereinafter IPCC REPORT 2000]. Deforestation has produced more than 25 percent of the carbon emissions from human activity over the last two decades. The largest terrestrial carbon stocks are located in forests in the tropics, where deforestation rates are highest. More than 90 percent of the carbon released from land use change during the 1980s resulted from deforestation in the tropics. *Id*.
[39] *See* Kristen A. Sheeran, *Forest Conservation in the Philippines: A Cost-Effective Approach to Mitigating Climate Change?,* 58 ECOLOGICAL ECON. 338, 344-48 (2006).
[40] The Intergovernmental Panel of Climate Change reviewed the costs of existing forest-based carbon mitigation projects and found that the costs range from $0.1-$28 per ton of carbon. IPCC REPORT 2000, *supra* note 38. For further discussion of forest-based mitigation options in the developing world, *see* Sheeran, *supra* note 39.
[41] *See* J. P. Weyant & J. M. Hill, Introduction and Overview, The Costs of the Kyoto Protocol: A Multi-Model Evaluation, ENERGY J. (SPECIAL ISSUE) viii-xliv (1999).
[42] *See* SCHRODER, *supra* note 21, at 34-38 (discussing U.S. approach to negotiations); *see also* Douglas Jehl, *U.S. Going Empty-Handed to Meeting On Global Warming*, NY TIMES, March 29, 2001, at A22 (reporting on the Bush administration's opposition to the Protocol, and refusal to submit it for Senate ratification).
[43] The behavior of the United States post-withdrawal, including its attempts to prevent the Kyoto Protocol from ever entering into force by trying to dissuade Australia, Japan, and Russia from ratifying the Kyoto Protocol, suggests that the lack of participation of developing countries was only a superficial excuse for the United States's recalcitrance.
[44] INTERGOVERNMENTAL PANEL ON CLIMATE CHANGE, CLIMATE CHANGE 2001: SYNTHESIS REPORT 4-8 (2001) [hereinafter IPCC REPORT 2001].
[45] *See,* e.g., Henry D. Jacoby, et. al., *Kyoto's Unfinished Business,* FOREIGN AFFAIRS, July-Aug. 1998 (asserting that the Kyoto Protocol is like a quick political fix for the vast problems of climate change, and more must be done to reduce greenhouse gas emissions).

[46] IPCC REPORT 2000, *supra* note 38.
[47] IPCC REPORT 2000, *supra* note 38.
[48] *See* IPCC REPORT 2001, *supra* note 44, at 27. To put this temperature change in context, recall that the earth was only 5 degrees Celsius (9 degrees Farenheight) cooler during the last ice age.
[49] *See* Press Release, UNFCC, Montreal Climate Conference Adopts 'rule book' of the Kyoto Protocol (Nov. 30, 2005) *available at* http://unfccc.int/files/press/news_room/press_releases_and_advisories/application/pdf/press051130_marrakesh.pdf.
[50] IPCC REPORT 2000, *supra* note 38.
[51] For more discussion, *see* Kristen A. Sheeran, *Side Payments or Exemptions: The Implications for Equitable and Efficient Climate Control,* 32 E. Econ. J. 515-32 (2006).
[52] Marginal damage is the incremental damage associated with each additional unit of emissions. *See* TOM TIETENBERG, ENVIRONMENTAL AND NATURAL RESOURCE ECONOMICS 342 (7th ed. 2006).
[53] It is well demonstrated in the economics literature that an emissions tax set equal to the marginal damage of emissions will generate the same level of emissions reduction as an emissions trading scheme where the amount of permits is capped at the socially optimal emissions level, where the marginal damage from emissions is equal to the marginal cost of emissions reduction. It is further shown that permit prices in this case will be equal to the marginal damage of emissions. In other words, permit prices and emissions taxes will be exactly the same. *See, e.g., id.* at 385-87.
[54] *See* TIETENBERG, *supra* note 52, at 348-353.
[55] *Id.* at 345-46.
[56] *Id.*
[57] *See generally id.* at 348-53.
[58] *Id.*
[59] *See, e.g., id.* at 385-86.
[60] *See, e.g., id.* at 385-86.
[61] The potential cost-savings from taxes or emissions trading is often over-stated. Generally, the greater the difference in abatement costs between producers, the greater the potential cost-savings in moving from regulation to market-based mechanisms.
[62] TIETENBERG, *supra* note 52, at 389.
[63] *See generally id.* at 385-86.
[64] *Id.*
[65] While taxes and permits may function equivalently when permits are sold, there is an important symbolic difference. Emissions taxes are perceived more clearly as punitive payments aimed at compensating society for harms generated by emissions producers. Permits, though they may cost the same as taxes, signify that the right to inflict societal harms can be purchased.
[66] This was the case with permits for SO_2 pollution, the first large scale experiment with emissions trading in the United States. *See* TIETENBERG, *supra* note 52, at 400-02.
[67] *Id.* at 352-53.
[68] *Id.*
[69] Kyoto Protocol, *supra* note 25, art. 17.
[70] *Id.*, art. 3, § 1.

[71] *Id.*, art. 12 § 12.
[72] *Id.*, art. 12 § 3(b).
[73] Converting coal-fired utility plants and installing energy efficient boilers are common examples of the types of projects that could readily qualify for credits under the CDM.
[74] Kyoto Protocol, *supra* note 25, art 12.
[75] *See* Sheeran, *supra* note 29.
[76] If developing country emissions are capped, they no longer derive a pure benefit from emissions reduction, but have to pay a cost. Whether the benefits outweigh the costs will depend on the benefits to individual countries of avoiding climate change and the costs to individual countries of complying with the caps.
[77] *See* TIETENBERG, *supra* note 52, at 354.