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THE ECONOMICS OF CLIMATE ENFORCEMENT

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INTRODUCTION

Climate change is the highest-stake issue of our generation. It is at the forefront of the international agenda, and intensely debated in domestic politics. Because climate is a public good, climate change is a global problem. As a result, individual countries are less likely to reduce their greenhouse gas emissions unilaterally. Any state acting in self-interest would seek to free ride on the efforts of other states to protect the environment, while continuing itself to deplete the common resource. This familiar “tragedy of the commons” suggests that all solutions lie in the agreement over, and compliance with, an international climate treaty.

Despite the critical need to assume binding international obligations to prevent climate disasters, international law has failed to generate necessary compliance mechanisms. Individual countries’ incentives to defect from the joint effort have made it difficult to agree on the treaties in the first place, and enforce the modest ones that are enacted. In December 2009, over 190 countries gathered in Copenhagen seeking to launch negotiations of a new climate change treaty. In all meaningful aspects, the negotiations ended in a failure, with no legally binding agreement or any quantified emission reduction targets set by the parties.¹

Scientists can debate the evidence on climate change; scholars can argue the historical blameworthiness of states’ relative contributions to climate change; and politicians can marshal the public opinion for or against climate legislation. They all seek to formulate an optimal climate change policy, identify desirable targets for reducing emissions, and allocate relative burdens in doing so. But none of these debates—and none of the proposals for climate policy that have emerged from these debates— have any practical traction unless the problem of compliance with any chosen policy is solved.

¹ Cite press on failure.

Accordingly, the premier task of international climate policy is to develop a mechanism that solves the compliance problem. In the presence of the free-rider problem, the question is how to create incentives for individual countries to comply with their treaty obligations. Indeed, the failure to resolve this question was the primary reason why the Copenhagen meeting failed to generate a global climate treaty.²

This article offers a solution to the compliance problem. It does not merely explain the cooperation failure; it seeks to resolve it. It argues that a new, rational, scheme of enforcement can implement significantly more compliance than any of the existing proposals purport to make possible. It demonstrates how even notorious offender states can be induced to comply at a lower cost. Thus, it offers a blue print for a more efficient enforcement scheme that the states committed to solve the climate problem can implement.

The basic set up that the article examines is one in which some states—*Violators*—refuse to join a treaty seeking to preserve the public good or, should they join the treaty, defect from their commitments. Other states—*Enforcers*—are eager to protect the public good and seek to establish and enforce international norms aimed at preserving it. The challenge is for the Enforcers, acting collectively, to induce the Violators to cease the violations.

There are various ways for the Enforcers to change the incentives of the Violators, but they are all severely limited by the costs involved in implementing them. Enforcers could threaten to *sanction* the Violators, in the hope that such sanctions would either deter or cease the violations. But such sanctions—trade remedies, other economic restrictions, use of force—are often more burdensome to the Enforcers than the violations that they address. Alternatively, the Enforcers could promise to *reward* the Violators in exchange for their voluntary compliance.

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But, again, such rewards are costly and hard to justify to domestic constituents. The challenge, then, is to devise incentive schemes that would have the maximum effect on the behavior of the Violators at a minimum cost to the Enforcers.

The key analytical insight developed in the article is to identify a novel enforcement scheme, which is unambiguously superior to any enforcement mechanism based on either sanctions or rewards. Under the proposed scheme, the Enforcers could induce more compliance at a lower cost, rendering enforcement more efficient and, in turn, making it more likely for countries to enter a binding climate treaty.

The proposed scheme, which we call “Rewarding the Punisher,” combines both sanctions and rewards in the following simple but subtle manner. Enforcers have to set up a “fund”—a pool of money that can be used for two purposes only. The first purpose is to finance rewards: the money in the fund would be offered to the Violators as a reward for ceasing their climate violations and meeting the treaty’s targets. However, in the event that the Violators turn down the reward and continue their violations, the money in the fund can be used for the second purpose—to reimburse the Enforcers for the cost of levying sanctions on the Violators. That is, with the money that was initially earmarked to “bribe” the Violators, the Enforcers would now be “rewarded” for punishing the Violators.

We use a rigorous framework to demonstrate that this scheme induces compliance at a substantially lower cost to the Enforcers. The reason why it works better than simple sanctions or simple rewards is that the money put forth by the Enforcers “works twice,” so to speak. The contribution by the Enforcers is used not only to bribe the Violators and thereby furnish them with incentives to comply, but also to compensate the Enforcers for the costs of inflicting

sanctions. If the Violators fail to comply, they lose twice. First, they lose the direct reward offered to them out of the fund. Second, they are more likely to face sanctions, because the Enforcers expect to be reimbursed for the cost of punishing the Violators. In effect, a dollar of the fund money doubles the deterrent effect relative to a dollar of pure sanction or pure reward. Intuitively, this is similar to using a defendant's bail money to fund bounty hunters. The defendant recognizes that by fleeing he would not only forfeit the bail, but would also face a higher likelihood of apprehension.

Another, more subtle, reason why this technique works is that it solves a *credibility* problem for the Enforcers. Because sanctions are costly, it is often against the interest of the Enforcers to actually carry out their threats to inflict sanctions on Violators. For each individual Enforcer, it may be rational to endure the violation rather than bear the cost of sanctioning. But when the cost of inflicting sanctions is already sunk—when the money has already been deposited to the fund and can be recouped only as a reimbursement for the cost of sanctioning—the Enforcer does not have to bear any net cost by proceeding with the sanctions. In this scenario, the threat to sanction becomes credible and has a more imposing deterrent effect.

Finally, the Rewarding the Punisher scheme is effective because it offers Enforcers a better opportunity to coordinate their collective action. It decouples the two crucial stages—the set-up of the fund and the implementation of the enforcement measures—and thus allows different Enforcers to play different roles. Some states could participate in contributing to the fund; others could be designated to carry out the sanctions, if necessary. This modular structure, we argue, makes it easier to assemble a stable coalition of Enforcer states, and thus addresses the fragility of the collective action exposed at the Copenhagen conference.

The article demonstrates the optimal design of a hybrid mechanism consisting of both rewards and sanctions. It does so in two stages. First, in Part I, it develops the analytical argument through a simple model, fleshed out via a set of numerical examples. The discussion in this part is “generic”—it does not address the details of the current climate problem. Indeed, the insights we advance on an efficient enforcement method are general and can be applied to many other contexts, including other international cooperation issues as well as domestic enforcement problems. Part II then applies the general lessons to the global climate change problem.

I. THE ANALYTICAL ARGUMENT

A. Sanctions versus Rewards

Consider the following scenario. A state—denoted as the Violator—may engage in a violation that is harmful to another state—denoted as the Enforcer—but beneficial to itself. The Enforcer can either sanction the Violator in retaliation, or it can reward the Violator conditional on the Violator ceasing the violation. Sanctions are costly for the Enforcer. We assume that in order to inflict a sanction S on the Violator, the Enforcer has to incur a cost greater than S . For simplicity, assume that there is a fixed cost of 30 to any sanction. Thus, to impose a sanction S , the Enforcer has to incur a cost of $S + 30$. Let us assume that payoffs to the parties are as follows:

Net Benefit to Violator	Harm to Enforcer	Cost of full sanction
80	100	110

The Enforcer can impose any level of sanction. We assume that in order to deter the violation, the sanction has to be at least 80, which is the Violator’s benefit from violation. Thus,

such a sanction would cost the Enforcer at least 110.

In the absence of any enforcement, the Violator will commit the violation. Can the threat of sanctions deter the Violator? The answer here is no. The Enforcer can threaten to inflict a sanction of 80 that would strip the Violator of its benefit. But the cost of such a sanction to the Enforcer would be at least 110, which exceeds the harm of 100 the Enforcer suffers from the violation. Thus, the Enforcer's threat is not credible. A rational Enforcer would prefer to absorb the harm from violation (100) rather than incur the total cost of sanctioning (110). A Violator, recognizing this, would not be intimidated by the threat of a sanction.

Alternatively, the Enforcer can induce the Violator to cease its violation by offering a reward. Since the Enforcer has more to lose from violation than the Violator has to gain—since violation is inefficient—there is room for a Coasian bargain, a “bribe.” Any reward of at least 80 and of no more than 100 would make both parties better off. Assuming, for the moment, that the Enforcer has all the “bargaining power,” it can offer a reward of slightly more than 80 and induce the Violator to comply. In reality, of course, there are various transactions costs that might impede such a bargain. One such cost is that of collective action: the “Enforcer” is actually a combination of several states that need to cooperate to offer the bribe. Another cost is that of detection: a bribe is worth paying only if Violator's compliance can be verified. What this example shows, then, is *not* that a reward would necessarily succeed. All it shows is that, *at best*, if conditions are perfect, the reward is going to cost at least 80.

The question then is whether the Enforcer can do better? Can it induce compliance without having to spend this much money as a reward? The answer is yes, and this is where the core of our contribution lies. The Enforcer can devise a mechanism that uses both rewards and

sanctions in the following way. The Enforcer sets up a reward fund that is substantially lower than 80, and offers it to the Violator in return for Violator's full compliance. In addition, the Enforcer backs up this offer with an explicit threat: if the Violator fails to cease the violation, not only will it forfeit the reward, but the Enforcer will also then punish the Violator. The cost of inflicting the sanction in this case would be reimbursed to the Enforcer from the fund—using money which the fund has available now that the Violator cannot claim it. That is, if the Enforcer has to resort to punishing, it is “rewarded” for doing so. Finally, if the Enforcer fails to punish an ongoing violation, the money remains in the fund and cannot be claimed by the Enforcer. This gives the Enforcer an incentive to carry out the punishment, *ex ante* bolstering the credibility of its threat to do so.

Under this scheme, we can show that it is enough to put slightly more than 55 in the fund (say, 60) and offer this as a reward to the Violator. This would induce the Violator to cease the violation. To see why, consider first how severe a sanction would the Enforcer be willing to impose if violation continues. Expecting to be reimbursed up to 60, the maximum sanction that the Enforcer would have an incentive to inflict is $S = 30$. This sanction would cost the Enforcer $S + 30 = 60$, exactly the amount that he would get reimbursed from the fund. Thus, the threat to inflict a sanction of 30 would be credible. A lower sanction would also be fully reimbursed and thus would also be credible, but the Enforcer gains nothing by lowering the sanction. As the Enforcer cannot reclaim any money that remains in the fund, there is no additional cost for the Enforcer to increase the sanction all the way to 30. Finally, a sanction exceeding 30 would not be fully reimbursed and thus the threat to impose it would not be credible.

Recognizing the credibility of the threat to inflict a sanction of $S = 30$, the Violator has to

choose between two options: a violation, which would entail a net payoff of 50 (that is, a benefit of 80 from continued violation minus a sanction of 30); or compliance, which would yield a payoff of 60, directly from the reward fund. In this scenario, the Violator would choose compliance. Hence, a Rewarding the Punisher scheme with a fund of 60 (or, more precisely, a fund of at least 55) can lead to full compliance.

B. Rewarding the Punisher: Why It Works?

The example above illustrated that the Rewarding the Punisher scheme can succeed where simple sanctions fail, and that it costs less than a simple reward. Three distinct arguments explain why the success of this scheme is general, not merely an artifact of the particular example we chose: (1) eliminating the *excess cost* associated with sanctions; (2) the *double effect* of the expenditure, funding both the reward and the punishment; and (3) solving the problem of the credibility of threats to sanction through a *pre-commitment* device that the fund provides.

1. Eliminating the Excess cost

A threat of sanctions always presents a cheaper deterrent than a reward as long as the Enforcer never needs to carry out his threat. Reliance on a mere *threat* of sanctions, however, is feasible only when the threat is credible. In the above example, no credible threat to sanction exists given that the Enforcer would need to incur a greater cost in sanctioning than in enduring the violation. To proceed with sanctions, the Enforcer would have needed to absorb a fixed cost of 30. A reward scheme, in contrast, relies on a simple transfer of money, which does not involve such an excess cost: Every \$1 that is being offered to the Violator costs \$1 to the Enforcer.

Sanctions entail an excess cost element not only because of the fixed cost, but also because it could be costly to produce each additional unit of “pain” on the Violator. Call this the

“multiplier” effect: to produce a sanction of S , the Enforcer might have to bear a cost of θS , for some $\theta > 1$. Thus, in the above example, imagine a sanction that entails no fixed cost but instead a multiplier of 1.5—every \$1 of pain to the violator costs \$1.5 to the Enforcer. Again, sanctions alone would not work: to inflict a sanction of 80 that is necessary to stop the violation, the Enforcer would need to incur a cost of $80 \times 1.5 = 120$, more than the harm (110) from the violation. In this scenario, a simple reward would reduce the cost of inducing compliance from 120 to 80. The Rewarding the Punisher scheme would further reduce the cost by merely requiring a reward fund of 48.³ Similarly, if $\theta = 2$, compliance could be achieved with a reward fund of 54.⁴

This argument—that rewards succeed where sanctions fail—applies to a simple reward as much as it applies to the more complex Rewarding the Punisher scheme. A simple reward involves no sanctions and thus the costs of sanctions—fixed costs or multipliers—are irrelevant to it. In the example, it would always take a simple reward of 80 to induce compliance. A Rewarding the Punisher scheme relies on two elements. The reward element has no fixed cost or cost multiplier: every \$1 of reward costs \$1. The sanction element does involve the excess cost, which is why the sanction that can be imposed is less than the nominal value of the fund (in the original example, recall, the reward fund was 60 but maximum sanction that could be credibly threatened was $S=30$). Thus, the higher the excess cost of sanction, the larger the necessary fund. But since the threat of sanction merely provides an *added* incentive to comply, bolstering the

³ Under a reward fund of 48, the maximal sanction that the Enforcer can credibly threaten to impose is 32. With a multiplier of 1.5, such a sanction would cost exactly 48. Thus, if the Violator complies, it gets the reward of 48; and if it violates, it also nets 48 (a benefit of 80 minus a sanction of 32).

⁴ Under a reward fund of 54, the maximal sanction that the Enforcer can credibly threaten to impose is 27. With a multiplier of 2, such a sanction would cost exactly 54. Thus, if the Violator complies, it gets the reward of 54; and if it violates, it nets 53 (a benefit of 80 minus a sanction of 27).

effectiveness of the reward element of the mechanism, it does not undermine the benefit that the reward generates—namely removing the excess cost of sanction.

2. The Double Effect

The Rewarding the Punisher scheme uses the same money twice. It is offered first as a reward incentive for the Violator and, second, as a sanctioning incentive for the Enforcer.⁵ Put differently, the incentive to comply is generated by a “wedge” between the payoffs from violation and from compliance. The greater this wedge, the stronger the incentive. This wedge can be “stretched” in two directions: a higher payoff for compliance, and a lower payoff for violation. A simple reward operates in a first direction by offering a higher payoff for compliance. A simple sanction operates in the second direction by offering a lower payoff for violation. The Rewarding the Punisher scheme operates in both directions by doubling the wedge and thus doubling the effect of the money spent by the Enforcer.

We use the term “double” effect loosely. More precisely, the effect is somewhat less than double, because the money used to finance the sanction is still subject to the problem of excess cost. Thus, in the original example where a sanction entailed a fixed cost of 30, a fund of 60 created a wedge of 90 (enabling the Enforcer to offer a reward of 60 plus inflict a sanction of 30), more than enough to bribe the Violator to forgo a benefit of 80 from violation. In the subsequent example containing a sanction cost multiplier, a fund of 48 created a wedge of 80 (enabling the Enforcer to offer a reward of 48 or inflict a sanction of 32). In all these cases, the cost of sanction mitigates to some extent the effect the fund has in generating a threat of sanctions. But since the mitigated effect is still positive and substantial, it has the implication of

⁵ To be sure, in equilibrium it can be used at most once, but because it is factored into the off-equilibrium moves—because parties act in the “shadow” of what this money can do—it has a double effect.

stretching the wedge and thereby providing additional deterrence.

3. *Credible Commitment*

Finally, the Rewarding the Punisher scheme succeeds in generating the added incentive to comply by rendering the threat to sanction credible. It does so through a *pre-commitment* to fund the sanction. Recall that the sanctions alone do not work because of their cost; the Enforcer's threat to punish is not credible when the cost of sanctions exceeds the cost of enduring a continuing violation. But if the money in the fund is pre-committed—if at the time the Enforcer decides whether to inflict a sanction the funds are already sunk and can be reclaimed only as a reimbursement for sanction costs—the Enforcer has nothing to lose by carrying out the threat. With the fund already sunk, the effective cost of sanctioning is reduced to 0, and the threat becomes credible.

Consider again the initial example, in which the Enforcer sets up a fund of 60. Suppose the Violator turned down the reward and continued the violation. If the fund was not pre-committed, the Enforcer would have no incentive to impose any sanction. At this point, the strategic situation would be identical to that of a simple sanctioning scheme. Since the cost of carrying out the sanction exceeds the harm to the Enforcer from violation, the Enforcer would not sanction. Recognizing this, the Violator would not be deterred by the threat of sanction.

This argument rests on the assumption that sanctions are merely retaliatory and have no incapacitating effect. In some settings, it is possible that sanctions would have the effect of ceasing the violation (*e.g.*, using force to take over the Violator's facilities). But, in general, sanctions in the international context are retributive or retaliatory, and thus generate no ex-post direct benefit to the Enforcer. If the Violator already turned down the reward and decided to

continue the violation, it is likely too late to try to deter and it is impossible for the Enforcer to put a stop to the ongoing violation by inflicting a sanction.

In the absence of any ex-post incentive to punish, there is no way for the Enforcer to combine a promise for reward with a threat of sanction, unless he can pre-commit to inflicting of sanction. Thus if the money in the fund is sunk and can only be recouped as reimbursement for sanctioning costs, the Enforcer would be willing to spend up to entire fund—60 in our example—to inflict a sanction. Refraining from sanctions would not benefit the Enforcer because he cannot reclaim any money left in the fund. Thus, any sanction that costs up to 60 is effectively free for the Enforcer. A threat to impose a sanction of 30 (costing the Enforcer 60) is therefore credible. The Violator, recognizing this, would now be deterred by the threat of sanction.

Notice that a pre-committed fund can also improve the credibility of a threat to impose sanctions under a pure sanctions regime. Thus, if sanctions are purely retaliatory, the Enforcer (who has no ex-post incentive to impose them) can successfully deter violations by pre-committing the money to an irrevocable fund. As long as the amount in the fund is high enough to impose a sanction that is higher than the benefit the Violator is enjoying, the violation would be deterred. The problem with such a fund—intended solely for financing the cost of sanctions—is that there is no incentive to set it up in the first place. As demonstrated above, the amount of money needed to put in the fund would exceed the cost of the violation to the Enforcer.

4. Bargaining Power

The success of the Rewarding the Punisher scheme can be analyzed through the lens of a bargaining model. The interaction between the Enforcer and the Violator can be viewed as a pure negotiation problem in which the parties bargain over the price that needs to be paid to buy off

the Violator's compliance. This price depends on the parties' relative bargaining power—the factors that affect their respective abilities to extract a favorable concession from the other side. At the basic level, the greater the harm suffered by the Enforcer, the more it is willing to pay for the violation to stop. Likewise, the greater the benefit enjoyed by the Violator, the more it demands as a reward for its compliance. A simple reward is merely a bargain struck within these outside options available to the parties—between the harm or the benefit of the violation—such that makes both sides better off.

The ability to inflict sanctions adds to Enforcer's bargaining power because it changes the outside option available to the Violator. The prospect of being subject to an ensuing sanction causes the Violator to value a violation less. However, to be a factor in the bargain, the Violator must regard the threat to sanction as credible. A Rewarding the Punisher scheme is one way in which the Enforcer “ties its own hands” – commits to a (conditional) future course of conduct that would otherwise be against its own instantaneous interest at that future period. Here, the pre-commitment is accomplished through pre-payment: the money in the fund is sunk. With this plan in place, the Enforcer changes the bargaining range and achieves a better bargain. The reward it can negotiate is reduced by an amount equal to the sanction the Enforcer credibly threatens to inflict.

We note that the reward and the reimbursement for the sanction do not necessarily need to come from the same fund. However, the benefit of using a unified fund that finances both functions—rewards and sanctions—is that the same money can be used twice. This eases the “participation constraint” of the Enforcer by requiring a substantially smaller outlay to implement a successful enforcement policy.

II. APPLICATION: INTERNATIONAL COOPERATION ON CLIMATE CHANGE

This Section applies the insights derived from Part I to the problem of international climate change cooperation. It explores potential new pathways to enhance participation in, and compliance with, a Global Climate Change Treaty (“GCCT”).

Before proceeding, we briefly review the strategic situation underlying international climate change cooperation, and identify potential Enforcers and Violators of the Treaty and their defining characteristics. We then turn to examine how an Enforcer can use sanctions or rewards to entice a Violator to comply with the GCCT. As the above example predicts, we show that a simple punishment mechanism, if at all feasible, can effectively deter only the most egregious violations of the GCCT. Violations below a certain threshold remain undeterred because it is too costly for the Enforcer to inflict a sanction. We then show how the use of rewards can improve compliance versus the use of sanctions, but still leads to sub-optimal level of compliance. Ultimately, we argue that the Rewarding the Punisher mechanism has the potential to furnish superior incentives for the Violator to comply with the GCCT beyond the use of either simple rewards or sanctions.

A. Why Climate Cooperation is Difficult?

There is a broad agreement among states that substantive international cooperation to fight climate change is vital to global welfare and security. Because the occurrence of and resulting damage from climate change is a global phenomenon, it cannot be solved by any nation alone. Even while states have gradually acknowledged that that they must collectively reduce the total quantity of green house gases (“GHG”) that they emit into the atmosphere, there is no consensus on how to allocate this responsibility (*i.e.* cost) among all states. No state wants to

bear a disproportionate cost of cutting down its emissions while allowing other states to continue to pollute the atmosphere. This distributional tension and the incentives to free ride on other states' cooperation have frustrated all efforts to find a solution and overcome the collective action problem underlying climate change.⁶

Several possibilities to allocate responsibility for GHG emission cuts exist and have been proposed by various actors. One option is for states to freeze their emissions on the current, or some historical, baselines.⁷ The Kyoto Protocol adopted this method by mandating developed countries to freeze their GHG emissions at the 1990 level. However, this method is controversial because it favors states that have historically emitted most, effectively “locking in” emissions for those responsible for the most emissions to date and “locking out” developing economies before they receive the economic benefits of industrialization.

Another policy option is the “polluter pays” principle, which adopts a uniform global tax on GHG emissions or a global cap-and-trade system that obliges all GHG producers to pay an equal amount of their emissions.⁸ Here, too, developing countries oppose the idea of assigning responsibility equally among states, given that they have historically contributed less to climate change and are yet to consume their “equal share”.⁹

⁶ James Fearon, *Bargaining, Enforcement and International Cooperation*, *International Organization*, 52, 2 Spring 1998, pp. 269-305. The distributional conflict undermines the bargaining stage and the incentives to defect undermine the enforcement stage of international climate change cooperation.

⁷ See Kyoto Protocol, Lieberman-Warner bill.

⁸ Statistics from 2006 indicate that China's share of the total carbon dioxide emissions is 21.5%. The United States' share is 20.5%. See Carbon Dioxide Information Analysis Center (CDIAC). Note that the data includes only carbon dioxide emissions from the burning of fossil fuels and excludes, for instance, rising emission levels due to deforestation.

⁹ See Michael P. Vanderbergh, *Climate Change: The China Problem*, 81 S. Cal. L. Rev. 905, 918 (2007–2008). Since the beginning of the industrial revolution, China has emitted approximately 7.8% of the total world emissions whereas the United States is responsible for approximately 27.8% of the emissions released in 1750-2005. See Paul Higgins, *So What's the Problem with China?* *Climate Policy*, April 20, 2007 (figure 2).

Developing countries favor other approaches. Having a lower economic and technical capacity to avert or adapt to global climate change, they insist that wealthier countries should bear the primary responsibility of reversing the climate change.¹⁰ They further emphasize that the GCCT should focus on countries' per capita emissions instead of their total emissions, a model that would minimize any burden on developing countries.¹¹

Many developed countries, including the United States, refuse to bear the cost of reducing their emissions while developing countries are exempted from similar burdens. The current treaty, the Kyoto Protocol, does free most developing countries from any obligation to reduce their GHG emissions. This was one of the stated reasons for refusal by the United States to ratify the Protocol.¹² With developing countries exempted from targets and the United States not participating, too many significant players were left outside of the treaty framework, largely compromising the effectiveness of the Protocol. Any post-Kyoto GCCT without the full participation of the developing countries—the fastest growing GHG emitters—will do little to halt climate change and is likely to be rejected by the United States, among others. Therefore, the greatest challenge of achieving meaningful consensus beyond Kyoto and slowing the

¹⁰ This view rests on the familiar international law principle of “common but differentiated responsibilities”.

¹¹ For instance, while China's total GHG emissions exceed those of the United States today, China's per capita emissions amount to a mere one-sixth of the emission levels in the United States. See Vanderbergh, p. 917. [confirm: compare Levi estimating China's per capita emission to be one-tenth of the US]

¹² There are several reasons why the United States would want to be able to enforce the GCCT against developing countries such as China. A ton of CO₂ contributes to the global warming regardless which country emits it. A GCCT without the participation of developing countries remains ineffective given that developing countries combined are projected to account for two thirds of global CO₂ emissions in the course of this century. Second, if China stayed outside the GCCT, the United States fears that the carbon-intensive production from developed countries may migrate to China or some other “pollution haven”. This is a phenomenon known as “leakage”. Leakage means that global emissions would not be reduced; they would merely be shifted from the jurisdiction of Enforcers to that of the Violators. Third, the United States fears that its domestic energy-intensive industries will be placed at competitive disadvantage compared to similar industries in China.

emission of GHGs is to entice these developing country violators to sign onto, and fully comply with, the GCCT.

To be effective, efforts to negotiate such a version of the GCCT must adequately address both *participation* and *compliance* of signatories. Specifically, relevant emitters that stayed out of the Kyoto Protocol need to be enticed to sign into the GCCT. Once signed, all parties need to fully comply with the GCCT. For simplicity, the analysis below does not distinguish these two steps of effective international cooperation. Instead, we assume that Enforcers can employ the same punishment and reward strategies to induce participation in the first place, and compliance down the road.

B. Enforcers and Violators

At the risk of over-simplifying, we divide the states participating in GCCT negotiations fall two categories: “Enforcers” and “Violators”. We assume that both public welfare and public choice considerations determine any given state’s status as an Enforcer or a Violator. The higher the costs of experiencing climate change and the lower the cost of fighting it, the more likely the state is to assume the role of the Enforcer. Similarly, the more influential the pro-environment lobby and the more marginal the counter-lobby of the carbon-intensive industries in the state is, the more likely the state is to be an Enforcer. When the reverse conditions dominate, the state is expected to be a Violator.

By examining these characteristics, the European Union appears to be the most likely Enforcer of the GCCT. Although European countries are not as geographically vulnerable to

climate change as India, Africa, or some small island nations,¹³ they are more vulnerable than places like China.¹⁴ Most threatened among them are the many coastal, low-lying European countries, including the Netherlands. Europe also bears low costs in reducing its GHG emissions, compared to carbon-intensive economies like the United States, China and Australia. Most European countries are not major producers of fossil fuels (including coal) or energy-intensive products (including aluminum, steel, iron, cement, glass and chemicals). Due to their lower carbon/GDP ratio, they do not expect to suffer as many costs in moving away from fossil fuels. With its heavy investment in non-carbon emitting nuclear power, France is an example of a country that faces relatively low costs of switching to low-carbon economy as a result.¹⁵ European countries are also committed to taking action to curb their emissions because of their heightened domestic awareness of the dangers of climate change. A presence of many active environmental NGOs and the participation of green parties in many coalition governments ensure that political support for environmental policies is strong.

Indeed, in preparation for the Copenhagen Climate Conference, the European Union led the compliance charge by promulgating the commitment to cut its emissions to at least 20% below the 1990 emission levels by 2020. The European Union further pledged to increase its total emission cuts to 30% (against the baseline of 1990) on the condition that other developed

¹³ Small island nations are most vulnerable to climate change. They will become uninhabitable, if at all survive, the changing temperatures caused by climate change. These nations are vocal yet largely powerless proponents on tough international commitments to cut emissions. They support the GCCT but have little capacity to enforce it against larger Violators. India and Africa are similarly expected to be most vulnerable to climate change, likely experiencing deteriorating conditions for agriculture and large-scale health problems caused by climate-related diseases. *See* Posner and Sunstein, p. 13. *See* Nordhaus and Boyer.

¹⁴ Cite statistics referred to in Posner and Sunstein.

¹⁵ Other European countries may be more exposed than France, but even their favorable energy- and carbon-intensity versus the United States makes switching less costly.

countries agree to make similar reductions and assuming that developing countries also subscribe to the GCCT.¹⁶ These were the most ambitious commitments made by any major participant to the negotiations, further validating Europe's status as a likely Enforcer of the GCCT.

Conversely, the definitional characteristics suggest that China is most likely a Violator of the GCCT. Politically, China maintains that the primary responsibility of cutting down the GHG emissions lies with developed countries and insists on the continuing adherence to the principle of "common but differentiated responsibilities" that the Kyoto Protocol reflects. Economically, China has weaker incentives to join the climate policies. China is expected to feel the adverse effects of climate change to a lesser extent than many nations.¹⁷ At the same time, China's abatement costs of fighting climate change are especially high. China recently overtook the United States as the largest emitter of GHG in the world,¹⁸ and its emissions are constantly growing because of its thriving economy.¹⁹ China's comparative advantage in international manufacturing is partly based on low energy costs due to its enormous coal reserves. Chinese government also sees economic growth as fundamental for the prosperity and stability of the state, and is unlikely to prioritize environmental protection over meeting this goal for decades to

¹⁶ Reference: MEMO/09/493 Date: 09/11/2009

¹⁷ Some estimates suggest that China may even benefit from the climate change as its agricultural sector is likely gain in productivity due to a warmer climate, *see* Posner and Sunstein. *See also* Richard Tol, New Estimates of the Damage Costs of Climate Change, Part II: Dynamic Estimates (estimating that China's benefit from moderate global warming would amount to two percent of its GDP over the next century). *Environmental and Resource Economics* 21 (2002), 135. In contrast, *see* discussion on the harm the coastal China would suffer from climate change through rising sea levels that would, according to some estimates, lead to displacement of 250 million people. Similar adverse effects would stem from the dry north getting even dryer and the wet south ever wetter, adversely affecting agriculture and drinking water. *See Vanderbergh* p 919-921.

¹⁸ Gas Exchange: CO2 Emissions 1990-2006, 447 *Nature* 1038, 1038 (2007).

¹⁹ *See Vanderbergh*, p. 914. China's emissions are growing at 4.2% rate per year. According to some estimates, China's projected GHG emissions alone may be sufficient to trigger a disastrous climate change even if all other states reduced their emission levels close to zero (taking into account the existing GHG levels in the atmosphere). *Vanderbergh*, p. 908.

come. China would face distinctly high opportunity costs of fighting climate change in terms of forgone allocation of resources to pressing societal needs such as poverty alleviation, nutrition and health care.²⁰

Recently, China has shown some willingness to engage in the global fight against climate change. It has imposed ambitious fuel-economy standards for its vehicles and adopted energy-efficiency codes for its buildings. It has also invested in renewable energy and more energy-efficient coal plants.²¹ Further, China has indicated that it intends to reduce the energy-intensity of its emissions (emissions per unit of GDP) by 40-45% by 2020 compared to the 2005 levels.²² Given China's growth projections, however, it is unclear that the pledged cuts in energy-intensity will bring down China's total emissions at all from their current level.

Compared to the European Union or China, the role of the United States is more ambiguous. Historically, the United States has resisted international efforts to combat climate change. It has a relatively high adaptive capacity to climate change²³ and is not expected to suffer from climate change to the extent that many other states will.²⁴ The United States' reliance on abundant domestic coal creates a high carbon/GDP ratio, resulting in high costs in moving to a low-carbon economy.

²⁰ For instance, in 2030, 55% of the total emissions are expected to originate from developing countries, most notably from China and India. *See* Stewart and Wiener, p 102.

²¹ Michael Levi, Copenhagen's inconvenient truth, *Foreign Affairs*, 2009.

²² *See* Chinese Premier Hu Jintao's statement [].

²³ Developed countries, the United States included, are generally less vulnerable to climate change because of their superior economic and technical resources to prepare for and respond to the effects of climate change. They are also less dependent on agriculture, which is the most vulnerable sector of the economy facing the threat of climate change. Further, developed countries are generally cooler places that can handle the warming effects unlike many developing countries that already struggle with heat and drought. *See* Posner and Sunstein, p. 12

²⁴ Nicholas Stern, *The Economics of Climate Change* (2007) p. 139. William Nordhaus and Joseph Boyer, *Warming the World: Economic Models of Global Warming* (2000) p. 91 (table 4.10). *See also* Posner and Sunstein.

However, the environmental lobby, which in the past was feeble relative to more powerful private interests (such as the automotive, mining, and utility sectors) , has recently garnered more influence within the Obama Administration and the Congress.²⁵ Further, the United States has access to effective domestic substitute technology, which could limit its costs of fighting climate change. It also has indicated that it is prepared to participate in international climate change cooperation assuming it can ensure participation by others states, including the developing countries.²⁶ Indeed, in the wake of the Copenhagen summit, the United States pledged to cut its emissions to 17 % below its 2005 emission levels by 2020 pending congressional approval.²⁷ This was the first time the United States expressed willingness to commit to any numerical targets. This suggests that if the GCCT were to include strong enforcement measures against major violators, most notably China, the United States is likely to play the role of the Enforcer.²⁸

In the discussion to follow, we focus on the United States as the Enforcer and on China as the Violator. Many of the claims we make would apply to the European Union as the Enforcer and to other countries (*e.g.*, India, who maintains that it cannot currently afford to divert resources to fighting climate change) as Violators. The focus on the United States as the Enforcer

²⁵ The Obama administration is actively seeking to limit GHG emissions domestically. The United States Congress is also for the first time expected to impose quantitative limits to curtail the GHG emissions. [cite bills]. According to the Pew Research Center for the People and the Press survey of September/October 2009, 65 percent of the U.S. public considers climate change to be a "very serious" or "somewhat serious" problem.

²⁶ The inability to entice the developing countries to assume binding obligations under the Kyoto Protocol was an important reason that the Senate opposed the United States participation in the Protocol. See S. Res. 98 105th Congress (1997). See also 143 Cong. Rec. S5623 (daily ed. June 12, 1997) Statement of Sen. Byrd).

²⁷ Cite.

²⁸ This assumption is consistent with the Waxman-Markey climate change bill that is currently pending before the Congress. H.R. 2454 (Waxman-Markey), 766-769.

is intended to show how the design of an effective enforcement policy can have effect not only on disciplining the Violators, but inducing more tentative participants to assume the role of Enforcer. Thus, if the United States can identify a way to enforce the GCCT on China, it is feasible that both the United States and China—the top two GHG emitters comprising nearly half of the total world emissions—will participate and comply with the GCCT.

C. Sanctions

1. What Sanctions Can Be Used?

It is plausible, yet highly doubtful, that some supranational enforcement mechanism will be incorporated into the proposed GCCT.²⁹ Should that be the case, China would be even less likely to sign onto it.³⁰ This has led the Enforcers to contemplate unilateral sanctions, including border measures.³¹ For instance, if the United States adopts a domestic cap-and-trade scheme, it could require importers to buy emission allowances as a condition for entering the United States market. Alternatively, if the United States adopts a domestic carbon tax, it could impose a carbon border tax (“carbon tariff”) on products that are imported from countries that do not sign onto the GCCT or that do not otherwise assume comparable commitments domestically. Thus, if China fails to charge its domestic producers for their GHG emissions (*i.e.*, does not force them to pay a carbon tax), the price of those products would be “adjusted” to reflect the price that similar domestic products bear once the foreign products cross a border. These measures only target Chinese exports that are destined for the United States market, and do not reach

²⁹ This would present a significant improvement to the Kyoto Protocol, which lacks such a mechanism. The only sanction mechanism embedded in the Kyoto Protocol is that a violating party’s emission quota for the following year is reduced by an amount equal to 1.3 times the excess emissions.

³⁰ If China refused to sign the Treaty, the GCCT’s enforcement mechanism would not be available vis-à-vis China as a non-signatory state. International treaties rest on the principle of state sovereignty; a state can only be bound by a treaty to which it consents.

³¹ Add support.

Chinese emissions that “stay” in China. However, given that the United States and the European Union account for 41% of Chinese exports (and 14-28% of all Chinese carbon dioxide emissions) and acknowledging the importance of exports to China’s economic growth, targeting exports can be an effective way of influencing China’s incentives to transform its energy infrastructure.³²

The minimum effective carbon tariff would have to equal the benefit Chinese manufacturers derive from externalizing the carbon cost. Such a tariff would eliminate the unfair comparative advantage of Chinese manufacturers relative to domestic producers that are subject to GHG emission caps or a domestic carbon tax.³³ It would also mitigate the so called leakage problem as producers that would have relocated to “pollution havens” would not be able to export their products to countries applying a carbon tariff. Finally, the tariff would also generate direct revenue to the United States government, and could be further invested in the domestic efforts to fight climate change.

Another type of sanction that the United States might use is the withdrawal of the preferential trade treatment, foreign aid or military assistance that it currently extends to a Violator. These can be effective ways to secure compliance of a country that is economically or militarily dependent on the United States. However, sanctions that can effectively be employed vis-à-vis a superpower that has significant economic and political leverage are much more

³² Vanderbergh, p. 905, 911. However, see Hufbauer statement noting that the United States imports carbon-intensive goods primarily from Canada and the EU and that in 2007, for instance, China accounted for only 11% of the carbon-intensive imports in five key product groups (steel, aluminum, chemicals, paper, cement).

³³ Various bills that have been proposed or that are currently pending in the United States Congress, including the Lieberman-Warner Bill and Waxman-Markey Bill, both of which contain a provision calling for border measures to be imposed on goods that originate from countries that do not limit the carbon-content of their products. [Cites]

limited. Targeting China's imports on the border is at least theoretically a feasible strategy, given China's preoccupation with economic growth and the importance of its access to export markets to fuel that growth. Carbon tariffs are attractive because they are available vis-à-vis China irrespective of its decision of joining the international treaty. For the purpose of the below discussion, we therefore assume carbon tariff to be the primary sanctioning mechanism on which the United States relies in seeking to enforce the GCCT against China.

2. Why Sanctions Are Costly

Several costs are embedded in the system of applying a carbon tariff. First, there are direct implementation costs. The border measure would require the United States to set up an office to administer the tariff, or to devote new resources to the existing United States Customs and Border Protection agency. It would also require an evaluation of the carbon-content of the products on the border, a task that would be complicated by the absence of accurate information on the production methods employed by the Chinese producers.³⁴

Second, a tariff regime could lead to retaliation by China. The United States would need to be prepared for a costly litigation before the WTO Dispute Settlement Body, which might come out in China's favor, authorizing it to retaliate against American exporters.³⁵ This is a primary reason why some United States exporters have opposed the idea of imposing border

³⁴ The United States could rely on the information Chinese producers provide regarding the amount of carbon involved in the production method of each product they import to the United States, subject to some method of verifying the information. This method of relying on self-reporting is currently used in anti-dumping investigations. Alternatively, the United States could use the "best available technology" or the "predominant method of production in the United States" as a basis for calculating the carbon tariff. None of these methods, however, are costless; nor do they guarantee accuracy. See discussion in Weisbach. See also Pauwelyn.

³⁵ There is an extensive literature discussing whether a carbon tariff would be consistent with the WTO regime. . [see Pauwelyn, Bhagwati & Mavroidis; the joined report by the head of the WTO and the UNEP, 122 WTO, 6/12/09]

measures to seek compliance with the GCCT. These exporters also fear the prospect that the United States trading partners will follow the United States' lead and impose similar border adjustment measures vis-à-vis them, should these countries determine that the United States producers fall short of their obligations under the GCCT.³⁶ At worst, a conflict over carbon tariffs could escalate into a full-blown trade war across a range of economic sectors, or disruption of the United States' relations with China on critical issues like cooperating to prevent North Korea or Iran from acquiring nuclear weapons.

Third, a tariff regime would raise prices of Chinese carbon-intensive products in the United States. Consumers in the United States would have to pay higher prices, as would the manufacturers who rely on Chinese supply of inputs (*e.g.*, a car manufacturer who relies on Chinese steel).³⁷ While these price adjustments are an intended consequence of the carbon tariff, they also add to the cost of sanctioning, and are born disproportionately by residents of the sanctioning state.

3. *The Limit of Sanctions*

That sanctions are costly does not mean that the threat to impose them is never credible. The United States would have the incentive to punish China if the harm caused by China's GHG emissions exceeds the cost of imposing the border tariff on China. Recognizing this, however, China can strategically choose the level of emissions that inflicts harm on the United States which remains below the cost the United States bears when punishing. This will allow China to engage in the maximum violation of the GCCT that remains unpunished.³⁸

³⁶ This prospect is also discussed in Pauwelyn, p. 15.

³⁷ See Pauwelyn, Testimony before the House, p. 15.

³⁸ Uncertainty for either actor can complicate the analysis. Because errors are not symmetrically costly,

There are several ways in which China can preempt the use of sanctions. One way, which is socially desirable, is for China to reduce the extent of harm that the United States suffers from China's emissions. China could limit its GHG emissions in certain sectors of the economy in order to bring down its overall level of emissions while allowing some other sectors—in particular those that are the key to its economic growth—to continue polluting. China may also selectively reduce its emissions only in export-oriented sectors in order to limit its exposure to border measures, yet retain an overall level of GHG emissions that continue to contribute to climate change. Similarly, China may be able to divert trade in its most carbon-intensive products to markets which it does not expect to impose border measures on its products.³⁹ China might, also limit its export of steel, glass and other carbon-intensive products yet continue to export so called “carbon-derivatives”—products whose carbon content is difficult and costly to determine. These measures would reduce the direct harm the United States suffers, and consequently, the attractiveness for the United States to administer a costly system of border measures.⁴⁰

Another way in which China could forestall the use of sanctions is by making it more costly for the United States' to inflict them. By threatening to retaliate China increases the

uncertainty would give both sides an incentive to act with greater caution. All else equal, China would set a level of violation below what it would otherwise allow for itself, and the United State would set a threshold of punishment more lenient that it would otherwise employ, if detection were perfect. See, generally, Craswell & Calfee, JLEO 1986.

³⁹ Attempts to divert trade may not be socially desirable depending on whether China can retain the total volume of its export flows the same. At worst, China is able to locate alternative export markets, retaining the existing level of emissions yet reducing its exposure to sanctions at the United States border. The harm the United States suffers would be the same irrespective of the ultimate destination of Chinese carbon-intensive products but its ability to sanction China require the goods to be shipped to the United States.

⁴⁰ China could also seek to mobilize interest groups within the United States, assuming those interest groups benefit from China's non-compliance (*i.e.*, manufacturers who use Chinese inputs).

United States' expected cost of administering a sanctioning regime. This allows more of China's violations go unpunished and, consequently, undeterred.

Thus, while threats of sanctions could operate in the background to create deterrence, they would be effective in deterring only China's most egregious violations, while failing to deter the more moderate (but nevertheless socially costly) levels of violations.

D. Rewards

Recognizing the limits of the sanctioning strategy, the Enforcers could offer the Violators rewards as an alternative in return for their compliance with the GCCT. The analysis in Part I suggests that rewards could induce more compliance than sanction because they save the deadweight loss associated with sanctions.

1. The Advantage of Rewards

Rewards—or “side payments”—are commonly used to forge international cooperation.⁴¹ For instance, in negotiating the Montreal Protocol that regulates emissions of ozone-depleting substances, China received financial assistance as a side payment for its participation. The rewards could consist of a cash transfers, technology transfer, free allowances in a carbon trading scheme, or other ways to incentivize Violators to switch to a less carbon-intensive energy production.⁴²

The idea of rewards has been central to the discussions about the GCCT.⁴³ Throughout

⁴¹ See Side payments game in Barrett.

⁴² See discussion in Levi.

⁴³ Jeffrey Sachs has called for two global trust funds to be established: A mitigation fund that would offer transfer payments for the purpose of adopting new emission technologies and a technology transfer fund that would provide poorer countries access to (often IP-protected) technologies that can be harnessed to reduce countries' GHG emissions. Sachs has stressed that the fund would require donor countries to commit approximately 0.5 % of their GNP to the fund. This would amount to \$170 billion dollars

the negotiation process, developing countries have insisted that their compliance with a GCCT will be conditional on securing a binding commitment from developed countries to finance the costs of their compliance. Recently, developed countries consented to these demands by stating their “intention” to provide the necessary funds. The Copenhagen Accord promulgates a goal of establishing a Copenhagen Green Climate Fund (“Climate Fund”), which would be aimed at assisting developing countries mitigate the effects of climate change. Specifically, developed countries would provide developing countries with financial support of \$100 billion annually by 2020, with an additional pledge to offer these countries \$10 billion of upfront financing annually by 2012. While lacking any binding force, the mere statement of this goal was considered a tangible achievement of otherwise disappointing negotiations.⁴⁴

That a tentative agreement on rewards was reached in Copenhagen while no mention of sanctions was incorporated into the Copenhagen Accord lends further support to the idea that rewards may, indeed, be superior to sanctions as an enforcement mechanism. Enforcers may well have concluded that raising the prospect of a carbon tariff or another sanctioning mechanism would have been too risky and, ultimately, too costly for the Enforcers themselves. A mere threat of applying trade sanctions would not have been sufficient to coerce the Violators

annually which could be directed to recipient countries to compensate them for their efforts to mitigate climate change. See “Climate change according to Jeffrey Sachs”. See also Sachs, *End of Poverty* p. 302; Most recently, see Gordon Brown, “All Together Now”, *NY Times*, September 22, 2009.

⁴⁴ The details of the management of the Climate Fund were also left open. One plausible option is to place the fund under the umbrella of the Global Environmental Facility (“GEF”). GEF is an independent financial organization, entrusted with the task of providing the financial mechanism for several international environmental conventions, including the United Nations Framework Convention for Climate Change. Developing countries, however, have expressed skepticism of a fund that is administered by the GEF, preferring to avoid a close involvement by the World Bank (acting as a trustee of the GEF) and a tight control of the funds by the donor countries. The GEF is also criticized for the high fees involved in its administration. See *NYT* 22.

sign the GCCT, forcing Enforcers absorb the excess costs involved in sanctions—hence their preference for rewards.

2. *Limits of Rewards*

While often superior to sanctions, rewards cannot eliminate all violations. Some violations are too beneficial to the Violator; others are not that costly to the single Enforcer. Even if we restricted our attention to violations that are inefficient—*i.e.*, those that impose a cost that exceeds the benefit of the violation—a reward fund could be limited in its effectiveness.

Critics point out that even if the Copenhagen Accord’s pledged funding materialized, it would fall short of the demands by developing countries, international organizations and NGOs.⁴⁵ Developing countries also fear that the funds to cover the reward would merely be diverted from existing development aid budgets, compromising the effectiveness of other development programs and initiatives in developing countries.⁴⁶ Thus, given the high economic benefits of continuing emissions, Violators may be better off violating the GCCT than accepting a (limited) reward from the Climate Fund.

It is also possible that the Enforcers would prefer to tolerate Violator’s behavior over disbursing the pledged funds in practice. There is significant uncertainty as to which countries would contribute to the Climate Fund, highlighting the collective action problem undermining any reward mechanism requiring cooperation among multiple Enforcers.⁴⁷ The European Union has pledged to contribute \$3.6 billion annually to the 2010-12 start-up fund whereas Japan has pledged the total of \$15 billion. The United States has merely stated that it would contribute but

⁴⁵ Cite their demands. UNFCC (check), Greenpeace(\$140 billion annually by 2020); Oxfam International (“\$100 billion is only half of what is needed”); China (\$300 annually)

⁴⁶ See NYT dec 2001. Cite Bill Gates’s comments in FT of Jan 25, 2010.

⁴⁷ Yvo de boer, Hillary Clinton.

refused to specify the level of its contribution. United States has further indicated that it will not participate in funding a relatively resourceful country like China.⁴⁸ According to China, the United States' position reflects "lack of common sense or extreme irresponsibility".⁴⁹

Extending a simple reward to a Violator like China may simply be too costly for the Enforcers—and thus impossible to garner domestic support for. Enforcer who funds the reward does not internalize all the costs associated with the violations. For instance, the United States only cares about the direct benefits that it derives from China's compliance, including mitigated risk of adverse consequences of climate change in the United States territory, reduced leakage of carbon-intensive production, the strengthening of its own producers' competitiveness, and expanded export opportunities for its own producers that manufacture clean technologies that China would possibly be required to purchase as a condition for obtaining the reward.⁵⁰ The United States is not generally expected to care about the benefits China's compliance would have on third countries (including Maldives not sinking or India's agricultural sector remaining productive). Thus, it is likely that the largest fund that the United States would be willing to support would not cover the benefit China would be asked to forgo, in particular if the United States applies a high discount rate in assessing the detrimental future effects of China's GHG emissions. A successful fund would therefore likely require a commitment from multiple Enforcers who first overcome the collective action problem of agreeing on a fair distribution of their respective levels of contributions. Even then, the individual contributions that would be

⁴⁸ See Todd Stern, U.S. Special Envoy for Climate Change's statement. The EU has also indicated that China would not be the "first candidate" for funding.

⁴⁹ Cite the vice premier.

⁵⁰ Assuming many of the technologies would originate from the United States, conditional reward to China may act like an (otherwise prohibited) export subsidy to the United States green industries that would transfer technology to China. See more generally discussion on benefits to donor countries in Stewart and Wiener p. 103.

required may remain too high given the significant gap between what Violators are asking as a reward and what Enforcers are likely prepared to contribute in the end.

E. Rewarding the Punisher

How much compliance can be induced with the contribution put forth by the Enforcers? The discussion above suggested that the answer is “very little,” because the Enforcers’ contribution seems to fall short of the Violators’ demands. What we plan to show now is that the answer could be dramatically different—that substantial compliance could be induced without raising the necessary contribution by the Enforcers—merely by resigning the fund mechanism. Thus, even in absence of successful coordination among the Enforcers, and even if a single Enforcer, *e.g.*, the United States or the European Union, has to operate alone, it may have sufficient incentives to set up a reward fund and secure compliance among one or more Violators.⁵¹

Thus, in demonstrating how the proposed mechanism work, we will focus on the incentives of a single Enforcer acting alone. This allows us to assume away the collective action problem undermining the proposed Climate Fund. Again, we choose to focus on the incentives of the United States to set up such a fund to entice China comply with the GCCT. However, the insights we derive from this setting translates to the setting in which the fund is set up collectively by numerous Enforcers to induce compliance by numerous Violators.

⁵¹ It is of course plausible that a single Enforcer would establish multiple such funds (or multiple “accounts” within a fund), including one to target China and another to target, for instance, India. In order to bring down the total emission levels, the United States and the European Union would most likely focus only on a few key polluters that, collectively, make up the majority of the GHG emissions emitted worldwide.

1. The Operation of the Fund

Assume that the United States is reluctant to resort to sanctions in enforcing a GCCT against China because the costs involved in sanctioning exceed the value to the United States from compliance. Further assume that while extending a simple reward to China could be a less costly strategy to the United States than using sanctions, the level of funding that would be required to “buy” China’s compliance exceeds the amount the United States is willing to pay. The United States could instead establish a Rewarding the Punisher fund that combines the two strategies—rewarding and punishing. As our analysis in Part I showed, this would require a substantially smaller contribution to the fund.

In extending a reward to China, the United States would need to determine *when* to reward China and by *how much*. For the reward scheme to work, it would need information on China’s actual (total) emission levels.⁵² Most developing countries, including China, do not currently have the capacity to credibly monitor their economy-wide emissions.⁵³ And even if they did, the United States would be unlikely to trust the numbers provided by China.⁵⁴ Thus, part of the reward fund’s fixed costs would need to be directed to monitoring, reporting and verifying (“MRV”) the emissions in order to determine whether country is meeting its target and whether it therefore remains entitled to its reward.⁵⁵ Alternatively, the GCCT itself may have

⁵² We acknowledge that while the need to institute a benchmark for compliance is equally important in the sanctioning system, Violators can be expected to sign into more ambitious commitments if they know that they can merely lose a reward (as opposed to be subject to punishment) if they fail to comply.

⁵³ Levi.

⁵⁴ Cite US demands in Copenhagen to have China commit to an external MRV mechanism.

⁵⁵ Note that the MRV system designed to support the system of rewards differs from the MRV costs that the United States would incur in administering a carbon tariff in that the rewards would most likely require information on country’s total emissions as opposed to emissions that can be attached to each individual product that crosses the United States border.

established a sufficiently reliable MRV system that the United States could rely on.⁵⁶ Should such an international MRV mechanism materialize, the additional MRV costs relating to the operation of the reward fund would be low. If the determination of China's compliance—and hence eligibility for the reward—was made by an objective third party instead of the United States, the determination would also benefit from an enhanced legitimacy in the eyes of the Chinese and third party states.

For the reward to be attractive to China, it would need to amount to at least the net costs of participating in the GCCT. It would need to cover 1) China's costs or cutting its GHG emissions, including the cost of adopting new energy solutions, 2) the costs of reduced growth rates that are likely to follow if the new energy solutions reduce China's industrial output, 3) forgone benefits from global warming that China would enjoy absent any action, and 4) the forgone benefits that China would enjoy through "leakage" of energy-intensive production to its territory. In setting the reward, the United States could deduct from these costs China's (discounted) long-term benefits of halting global warming and its more immediate co-benefits of any abatement action, including better air quality and the associated health benefits.⁵⁷ Still, the magnitude of the reward would need to be substantial. This is supported by China's explicit

⁵⁶ A tentative agreement to this effect was reached in Copenhagen where China made a significant concession of conceding to some international MRV mechanism.

⁵⁷ See discussion on side-benefits to China in Stewart and Wiener, p. 103. Further, the United States would need to decide whether any conditions (beyond compliance) would be attached to the reward. The United States might make the cash compensation conditional on China using the transfer payment for some agreed upon purpose. The fund could, for instance, require China to build plants that are using the carbon sequestration technology or to invest in renewable energy technologies. The fund could similarly finance China's capacity to monitor and enforce its energy-efficiency building codes or buy intellectual property licenses to employ new energy technologies developed in the United States and elsewhere. Alternatively, the cash compensation could be less directly tied to specific projects and policies. The United States may simply reward China for bringing its overall emission levels down to an agreed-upon level.

request that wealthy nations commit one percent of their GDP—which amounts to over \$300 billion annually—to a fund that would help developing countries, including China, to cut their emissions and adapt to climate change.⁵⁸ This gap between what China is asking and what the United States is likely to be prepared to offer underscores the key advantage of the Rewarding the Punisher mechanism—reducing the amount of money needed to incentivize China to comply.

2. *Leveraging Less Money to Generate More Incentive*

Recognizing the limited incentive of a single Enforcer to finance the cost of the sanctions or the simple rewards, our example demonstrated that the Violator will have a stronger incentive to comply and the Enforcer a strong incentive to fund the enforcement effort if we combine the system of rewards with a system of sanctions. The idea of the Rewarding the Punisher mechanism uses the fund created by the United States “twice”: once to lure China to comply by offering it a reward from the fund and another time to induce the United States to respond with sanctions if China fails to comply and hence rejects the reward. In other words, the United States would deposit the reward money in the fund. China would be entitled to collect it if meets the emission reduction targets set in the GCCT. If China fails to comply despite the prospect of the reward, the United States could withhold the reward and turn to the fund itself to lower its costs of inflicting sanctions against China.

Specifically, the reward that would be “freed up” in the case of China’s non-compliance could be used finance the costs of administering the carbon tariff, *i.e.*, salaries of the expanded staff of the United States Customs and Border Protection Agency that would need to spend resources in verifying the carbon content of the imports. The United States could also use the fund to pay for any litigation costs in defending its measures in the WTO. Similarly, if faced

⁵⁸ Levi.

with counter-retaliation, the United States could compensate its industries that would become targets of Chinese trade sanctions.⁵⁹

3. *Enhancing the Credibility of the Commitment*

A key advance of the Rewarding the Punisher mechanism is that it enhances the credibility of the Enforcer's sanctions. If China failed to comply, the United States would have a credible threat to administer costly sanctions because inflicting a sanction would entail no additional cost to the United States. The added cost would be fully reimbursed from the funds that were pre-committed and thus present a sunk cost for the United States. In the presence of this credible threat to punish, China would have a greater incentive to comply even when offered a lower reward in return for its compliance. Thus, under the Rewarding the Punisher mechanism, the United States needs to leverage fewer funds *ex ante* to create the incentives for China to comply with the GCCT.

Our example showed why it would be crucial for the funds to be truly sunk at the time the United States decides whether to sanction China. Consider the situation where the funds were *not* sunk. Knowing that the United States would factor in the full costs of sanctioning into its decision on whether to punish China, China would be more inclined to turn down the reward and violate the GCCT. If instead the funds are sunk and reclaimable only for the purpose of sanctioning the particular state that forwent the reward (*i.e.*, China), China would know that the United States has no incentive to abstain from sanctions that would be fully paid for. If the funds were released only to sanction China (and, in contrast, not released for a purpose unrelated to the

⁵⁹ The United States would not want to use the fund to cover the costs to its consumers and producers who would incur higher costs in buying Chinese carbon-intensive products because they would have faced similar higher costs in the event that China were to comply.

GCCT (*i.e.*, to reduce the deficit) or even for the purpose of sanctioning another GCCT Violator (*i.e.*, India)), China would internalize the cost of sanctions in its initial decision on whether to accept the reward.

But how could the fund be truly sunk? To credibly commit to both rewards and sanctions, the United States may choose to place the funds in the hands of a neutral third party who manages the funds as a trustee under an escrow arrangement. The idea of an escrow arrangement would have the distinct advantage of enhancing the credibility of the enforcement mechanism. China is likely to be suspicious of any commitment the United States makes in rewarding China, in particular if the reward is granted after China has undertaken significant (sunk) investments to transfer its energy infrastructure towards a low-carbon economy. If the funds are instead placed in an account controlled by an independent third party acting as a trustee, China can be confident that the funds will be released upon verification of China's compliance. Similarly, the United States can send a credible signal for its intention to punish China by subjecting its ability to access the funds to the trustee's verification that the United States has indeed proceeded to sanction China's non-compliance.

Escrow arrangements have been used in international law in instances where sovereign states do not trust each other and require additional safeguards to reinforce commitments they make to one another. One of the most famous escrow arrangements was established in connection with the Iran-United States Claims Tribunal, which was set up to provide a negotiated solution to the Iran hostage crises following Iran's Islamic Revolution.⁶⁰ Iran had seized 53 Americans from the United States embassy in Teheran and held them hostage for 444

⁶⁰ Another well known example comes from the Libyan government's payment to families of Pan Am Flight 103 Victims (using an escrow arrangement at the Bank of International Settlements)

days from 1979 to 1981. The United States responded by freezing all Iranian assets in the United States. To unlock the crises, the two countries established an escrow arrangement whereby the Banque Centrale d'Algerie in the Bank of England held funds (the frozen Iranian assets) that the United States had agreed to transfer to Iran in return for the release of the hostages. When the aircraft carrying the hostages left Iran, the Banque Centrale d'Algerie released the agreed amount of the funds to Iran. Similar escrow arrangement was made for the purpose of handling the payment of contested awards to the United States claimants rendered by the tribunal. This time funds were held in escrow by the Banque Centrale d'Algerie in the Settlement Bank of the Netherlands, pending decisions by the Tribunal.⁶¹

In the case of settling the dispute between the United States and Iran, a private bank was used as an escrow agent. Similarly, the United States could turn to, for instance, a private bank in a neutral country (*i.e.*, Switzerland) to manage the escrow account used for rewarding China for its compliance with the GCCT. The choice of an escrow agent would be crucial in conferring the required legitimacy and credibility for the arrangement. For the United States' offer to reward China to be credible, China would need to trust the escrow agent to release the funds when China's compliance is verified. Thus, the United States would need to credibly tie its hands and thus choose a neutral third party, which would only agree to release the funds to China—in case of its compliance—or to the United States upon providing proof of sanctioning China following China's non-compliance. Any third party escrow account manager over which the United States has any leverage would not be credible. A private bank would soon lose its credibility to act as a trustee should it be shown to bow to any outside pressure to breach the trustee arrangement. This is the reason China would most likely distrust a fund managed by an

⁶¹ Christopher Pinto, Iran-United States Claims Tribunal.

international organization including the United Nations, the World Bank or the IMF, over which the United States wields significant power.⁶² By choosing an independent third party, the United States can send a strong signal of its commitment to reward—and, if necessary, to sanction China.

An additional benefit of an escrow arrangement is that it does not only offer a credible way for a government to make a commitment to a foreign government. If the United States established a fund described above, it would obviously tie the United States hands vis-à-vis China. But it would also allow the current United States' administration to tie the hands of the successive administration which might not be as committed to funding climate compliance. This can be an attractive strategy for an administration that wants to pursue a long-term policy in an uncertain political environment. Without an escrow arrangement, the next administration may well choose to divert the funds for a purpose other than climate change compliance, including national security missions or even tax cuts to individuals and corporations.

4. Additional Benefits of the Rewarding the Punisher Mechanism

The primary advantage of the Rewarding the Punisher mechanism is the “double deterrent” it provides. The escrow arrangement can be further used to bolster the credibility of both the commitment to reward and to sanction. But we see at least three additional benefits attached to this mechanism. First, the Rewarding the Punisher scheme will not eliminate but it

⁶² Contrast this to the discussion on how the Copenhagen Climate Fund would be managed. Some have proposed to place fund under the umbrella of the Global Environmental Facility (“GEF”), which is entrusted with the task of providing the financial mechanism for several international environmental conventions, including the United Nations Framework Convention for Climate Change. The World Bank serves as a Trustee for the GEF. Developing countries, however, have expressed skepticism of a fund that is administered by the GEF, preferring to avoid a close involvement by the World Bank and a tight control of the funds by the donor countries. The GEF is also criticized for the high fees involved in its administration.

can mitigate the collective action problem. By decoupling the two elements of the enforcement scheme—rewarding and sanctioning—the mechanism allows different Enforcers to participate at different stages of the enforcement scheme. Some states may choose to contribute to the fund whereas others may volunteer to carry out the punishment, if necessary. Benefiting from the threat of sanctions looming on the background, the “rewarder” states need to contribute less to the fund. These could be the states that are not in the position to carry out punishment or that would face a distinctly high cost of doing so.⁶³ Similarly, given the lower cost of sanctioning, the “punisher” states can lower their costs of carrying out the punishment.

Second, the system of rewards lends legitimacy to the decision to inflict sanctions. Resistance to the United States’ unilateral decision to impose a carbon tariff is likely to be more restrained if the United States combined its punishment strategy with first offering China the opportunity to accept the reward. Third, we believe that it will be easier to harness domestic political support for the Rewarding the Punisher Mechanism than to a simple reward mechanism. The United States public is unlikely to be receptive to the idea of a large wealth transfer to China and prefers the pursuit of sanctions instead. Reducing the total amount of wealth transfer necessary to buy China’s compliance and preserving the option to inflict sanctions is likely to garner greater acceptance among the United States tax payers.

5. Challenges of the Rewarding the Punisher Mechanism

The Rewarding the Punisher mechanism would present a number of challenges that the United States would need to solve before setting up the fund. First, the problem of measuring emissions and monitoring and verifying compliance, discussed in connection with the simple

⁶³ For instance, consider net-exporter states that import few goods from the Violators and that therefore have few opportunities to impose border measures on the Violators’ carbon-intensive goods.

reward mechanism, would equally apply to the Rewarding the Punisher mechanism. In order to know how to set the level of reward and how to determine whether a Violator is entitled to that reward, a MRV mechanism is necessary. Thus, some portion of the reward fund would still need to be channeled towards this task, unless the fund would rely on a possible MRV mechanism embedded in the GCCT itself. Still, while the fixed costs of the monitoring tasks would remain the same, the model showed that the actual size of the reward would be lower. As the “lost rewards” would be circulated back to the Enforcers to finance (part of) their costs of punishment, the Enforcers would need to set up a smaller reward fund initially.

In setting up the fund, the United States would need to verify that only credible Violators benefit from the reward. Unlike sanctions, in the case of rewards violators are eager to be the target of enforcement action. If a reward fund is set as a general policy to induce compliance, it could attract “frivolous violators” who seek to qualify as Violators in the hope of collecting the reward. Alternatively, existing Violators would raise their GHG emission levels in an effort to ratchet up the magnitude of the reward that the Enforcer would offer for their compliance.

The United States could determine that a “genuine” Violator is a state 1) that stands to be a net loser under the GCCT; 2) that is economically dependent on outside funding to comply with the GCCT; and 3) that cannot be deterred by sanctions alone. The first condition limits the recipients of the reward to states that can objectively be verified to either benefit from climate change or who face significant costs of reducing their GHG emissions. The second condition limits the beneficiaries to developing countries that need outside funding to finance the technological change required to meet their emission reduction targets. The third condition

effectively limits the beneficiaries to “large” violator countries that are more difficult to deter through sanctions alone.⁶⁴

While China’s GDP and enormous currency reserves may call into question its inability to finance the expected targets set by the GCCT,⁶⁵ its relatively low GDP per capita and per capita societal challenges are likely to continue to qualify China as a low income country in need for an outside assistance. We have also established above that China is likely a net loser under the GCCT. The United States is also unlikely to successfully deter China through simple sanctions, suggesting that China would, indeed, be entitled to a reward in return for its compliance with the Treaty.⁶⁶ Still, the possibility remains that China would intentionally increase its GHG emissions in order to collect a larger reward initially.

A similar problem stems from the need to determine when to reward the punisher. It is feasible that the United States may be motivated by the opportunity to collect a reward in situations where punishment is not welfare-enhancing. The United States may also seek to attain the reward yet not use it to carry out punishment. This would, obviously, dilute the entire “double leverage” mechanism that makes the Rewarding the Punisher model attractive in the first place. Thus, it may be necessary to monitor not only the conduct of the Violator but that of

⁶⁴ Large Violators like China are generally more resilient and able to retaliate against the Enforcer.

⁶⁵ With GDP approaching \$4 trillion, China is the third largest economy in the world after the US and Japan. See The World Bank, *Gross Domestic Product 2008*, <http://siteresources.worldbank.org/DATASTATISTICS/Resources/GDP.pdf>. China is also the third largest exporter with a massive trade surplus that has allowed it to accumulate \$1 trillion in foreign exchange reserves. See CENTRAL INTELLIGENCE AGENCY, *Country Comparison: Exports*, in THE WORLD FACTBOOK, <https://www.cia.gov/library/publications/the-world-factbook/rankorder/2078rank.html>. See June news/Bloomberg, citing China’s reserves being 2 trillion.

⁶⁶ We note that China’s entitlement to a reward is not based on a conception of “merit.” It is based on a pragmatic view that all participants, including the United States., would benefit from buying off China’s cooperation.

the Enforcer in order to guarantee the effectiveness of the fund. Placing the funds in an escrow account, as suggested above, should mitigate this problem.

Conclusion

[To be written]