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Green International Political Economy: Issues And Policy Concerns

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Executive Summary

Policy-makers across the global spectrum and in the United States (US) in particular, are grappling with the classic problem of an 'environment-economy tradeoff.'

The phenomenal increase in the emission of greenhouse gases has contributed to erratic climate changes. The insatiable appetite for energy due to an exploding global population has also led to a gross mismatch of energy demand-supply dynamics. With the US struggling to recover from the global financial crisis, there is an ever-increasing pressure on the US government to take urgent measures culminating in economic recovery. But any such acceleration could also come at the cost of our environment. So how does government effectively design optimal policies that would simultaneously address both of these problems?

This policy brief suggests economically viable and politically feasible policy instruments that the US could consider in order to solve this conundrum.

Policy Recommendations

(i) Consider "distribution neutral" pricing instruments to reduce carbon emissions.

(ii) Invest substantially in "green technology" through raising federal grants for research and development.

(iii) Use targeted expansion of "green stimulus" measures to post an economic recovery and an environmental resurrection, through generating "green jobs."

(iv) Promote consensus-building and shared understanding of responsible behavior across society.

1. Introduction

Turbulent developments characterize both today's global environment and economy. Policy makers across the global spectrum and in the United States (US) in particular, are grappling with a classic 'environment-economy tradeoff' problem—the inability to design optimal policy choices that would simultaneously address their multi-dimensional environmental challenges, as well as finding ways and means to stimulate and revitalize their crisis-torn economies.

Recovery from the global financial crisis seems a painfully tall order for the US, with the country still reeling under a near ten percent unemployment figure. Meanwhile, the potentially irreversible damages inflicted on the global environment (to which the US has been and continues to be a substantial contributor) threaten to calamitously affect the world in the near future.

Hence, a policy conundrum appears to have engulfed the US—whether to focus on fostering economic growth in the light of the current economic crisis or to opt for a stronger energy/climate policy that would imply among other things, a stricter emission control mechanism. If a prioritization of the latter could have a potentially significant negative implication on the former, then what should be discounted? If a well balanced policy could be designed that is Pareto-efficient, then what intricate issues must be considered before designing such a policy? This policy brief makes an attempt to resolve this conundrum. We present the political economy of the global environmental challenge with a focus on US policies in section 2. It will be followed by section 3, which provides the policy recommendations, by discussing in detail the various plausible mitigation mechanisms that could be adopted to address the above

challenges. In section 4 of the paper, we employ a simple game theoretic framework to identify different possible policy outcomes and suggest techniques helpful in designing future policies. Section 5 concludes.

2. The Threat is Real

Largely, there appears to be an increasing consensus among the scientific community that our global environment is undergoing testing times and that the situation is only likely to deteriorate going forward. The two interrelated dimensions of this global environmental challenge pertain to problems concerning global climate change as well as the supply-demand dynamics of global energy.

On the one hand, the number of disturbing and intimidating developments on the environmental front has increased. Erratic climate changes could have potentially destabilizing effects on the world at large. The root cause for those developments is a phenomenal increase in the emission of Green House Gases (GHGs), which are in turn, an offshoot of the patterns of excessive consumption of fossil fuels. Rapid climate changes have manifested in an unprecedented rise in global temperatures, the quick melting of glaciers and ice caps, an alarming rise in sea levels, sporadic rainfall patterns and the increased frequency of natural disasters.[1]

On the other hand, the insurmountable appetite for energy due to exploding global population (more so in the developing world) has resulted in a gross mismatch of energy demand-supply dynamics. The current "inefficient" energy system remains the primary

[i] Some key research studies that provide ample statistical evidence for the presence of such trends include World Bank (2010), Greenstone (2010), United Nations (2010), Friedman (2009), Jones and Keen (2009), Elmendorf (2009), Lewis (2009) and Parker and Blodgett (2008).

contributor to climate change, "representing around 60 per cent of the total current GHG emissions," underlining the key point that the present "unsustainable patterns of energy production and consumption" could destabilize the local and global environment substantially[1]

In "Hot, Flat and Crowded" Thomas Friedman succinctly captures the emergence of three different phenomena: global warming, a growing middle class worldwide (and along with it their appetite for energy) and a rapidly expanding population (particularly in the developing countries). He warns that the dangerous convergence of these factors could be a source of grave instability to the planet and presents a strong case for the United States to move towards greener development.

Even more perturbing is the threat of inaction, reflected in the visible absence of substantive policy responses to handle these issues, both in the US and in the rest of the world[ii]. Various international summits including Copenhagen (2009) have disintegrated, unable to cope with "inflated expectations" of all stakeholders. The most recent summit in Cancun (December 2010) followed recent history, and it too failed to produce any binding treaty, which could have been a potential successor to the Kyoto protocol. However, the outcome of the summit has been regarded as a considerable advancement compared to the previous summits because negotiators were able to reach a consensus on the need to undertake urgent measures. Yet, there is still a lot of uncertainty in trusting that those promises would be fully executed.

[ii] A caveat is in order. By substantive policy responses, we refer to those initiatives that have actually been translated into effective policy action that could result in tangible policy outcomes. Mere efforts to draft bills, though honorable, are grossly inadequate to address the fundamental problem.

While major developing economies like China have taken some notable initiatives to reduce their carbon emissions[iii], the US is yet to set a leading example. The US and China together, account for 45 per cent of the annual carbon emissions. There is a strong expectation that the US should push for desired legislative changes to cap carbon emissions. Studies also point out that a domestic bill in the US could potentially prove to be the "circuit breaker," triggering other countries such as Canada, Australia, Japan, and Korea to follow suit and implement similar pieces of legislation, impacting the global environment.[2]

Recent policy developments on this front do not augur well for proponents of reducing carbon emissions. The most recent US Energy-Climate bill (known as the Waxman-Markey bill) failed in the Senate (after barely managing to pass in the House of Representatives). An added reason for pessimism stems from the resounding victory of the Republican Party in the 2010 mid-term elections. The party change may delay a climate bill of the kind needed for a long time to come[iv].

While a lack of political consensus regarding the costs of climate change could be a reasonable explanation for the stalled efforts to pass a climate bill in the US Congress, there is yet another complicating dimension to this story. The fact that the global economy is slowly recovering from the worst economic recession experienced since the 1930s means any policy or legislation that effects the costs of production and consumption of energy is likely to be unpopular (Figure 1). There is an urgent need to recognize that a kick-start to the economy should not compromise a new climate change policy initiative. Although there are signs that the

[iii] See Jiahua (2009) for a brief overview of these measures.

[iv] Especially keeping in mind the "climate denial" propaganda that has gained momentum recently in the US Republican circles. The propaganda simply refuses to acknowledge that the threat of climate change and global warming is real.

financial crisis reduced the emissions of GHGs, albeit marginally, the nature of the environmental threat has more to do with the accumulated stock of GHGs that already prevail in the atmosphere. It is then all the more important to ensure that comprehensive climate policies that target reductions in carbon emissions are drafted earliest.[3]

3. Mitigation Policy Instruments

Having established the urgent need to take corrective steps to promote sustainable growth, this section will discuss some of the instruments that could be considered best practices in climate change mitigation. The focus will be on the viability of *two important policy channels*:

(a) Designing a suitable instrument for *pricing carbon* that would tackle the negative externalities resulting from carbon emissions.

(b) Investing in *green technology* that would both explore the possibility of engineering a conscious shift of reliance away from non-renewable energy sources to renewable sources and simultaneously facilitate a "green recovery" through generating "green jobs."

3.1. *Pricing Externalities*

Pricing negative externalities that arise from emissions dates back to the idea advocated by Arthur Pigou in 1920, popularly referred to as "Pigouvian taxes," when he suggested a "polluter pay principle" of taxation forcing the emitter to internalize the environmental damage he is responsible for creating. The two most widely discussed instruments in the literature are carbon taxes and cap-and-trade schemes, which broadly follow a Pigouvian framework. While the former represents a price based mechanism, the latter is quantity based.

The policy debate in the US regarding the choice of an appropriate instrument to reduce carbon emissions has revolved around a cap-and-trade system as opposed to a carbon tax. This is not entirely surprising given the history of US aversion towards taxes. Including the most recent Waxman Markey bill, the various bills introduced in the US Congress tended to focus on tradable permits, though occasionally a weak support for carbon taxes was expressed[4].

The primary feature of a cap-and-trade program is to set an overall limit on the level of carbon dioxide (CO2) emissions. As evident from the name of the mechanism, there are two steps involved in implementing a cap-and-trade instrument. First, the policymakers establish an overall cap on such emissions and second they issue allowances (tradable permits) to the individual firms to trade those emissions among themselves. The rationale is to target the quantity of emissions through a market based mechanism with adequate monitoring and enforcement by the regulatory authority to ensure that there is a limited supply of those emissions permits. The scarcity created should lead to price determination for emissions permits in an emissions trading market or a government auction. The increase in prices that would result from the cap should theoretically force households and businesses to consume smaller amounts of fossil fuels, eventually leading to a reduction in carbon emissions. Also, the permit trading would incentivize emission reductions by allowing firms to sell some of their permits at a profit to firms that face relatively higher costs to restrain their emissions levels. As a result, "a cap-and-trade program would achieve the targeted emission reductions at the lowest possible cost . . . ."[5]

A carbon tax or emissions fee on the other hand, equates to an energy tax of the Pigouvian variety that involves a price based mechanism. It disciplines the firms to pay a fixed fee for every ton of CO2 emissions. Should the cost of paying taxes be greater than the costs of cutting down emissions, following economic logic, the individual firms would be encouraged to

practice abatement strategies and the desired reductions in emissions levels could be achieved by using a carbon tax.

One of the important distinctions noted in literature between these two instruments is the adjustment process when unexpected changes in costs occur. While a cap-and-trade system follows an adjustment path by holding constant the levels of emissions and letting the prices of permits vary within a band, a price system holds the associated price of emissions constant and allows variations in the level of total emissions.[6]

However, several economists, despite being divided in their choice of preferred instrument, have noted that both mechanisms could be used to achieve similar policy results, leading them to the assertion that the "two approaches are more similar than different."[7] Though there is enough theoretical and empirical evidence discussing the potential benefits and costs involved in pursuing either of the tools,[v] as noted earlier, there appears to be an implicit preference in the US for tradable permits. It is highly likely that the equity or distributional concerns that any form of a Pigouvian tax would bring about could be a possible reason for such a preference. Since a carbon tax could translate into an increase in energy prices by deterring consumption of carbon intensive products by households and firms, this tool has been shunned by the policy makers concerned that an increase could disproportionately impact relatively poorer households and businesses.

Yet a similar fate met the Waxman-Markey bill despite its advocacy of a cap-and-trade system. Recent research highlights that policy makers opposed the bill primarily on the grounds

[v] In fact there is a consensus that at times of cost uncertainty, a price system works better than a quantity system.

of treating "cap-and-trade" as "cap and tax," and that such a measure could negatively impact distribution and equity arising from escalating energy costs.[8]

The above analysis suggests that any effective instrument for reducing carbon emissions cannot be successful without adequately addressing the distributional consequences of such a move. If "revenue neutrality" and "distributional neutrality" are integral components of such an instrument, would it pass through the Senate?

An influential paper by Gilbert Metcalf (2009a) titled, "Designing a Carbon Tax to Reduce U.S. Greenhouse Gas Emissions" suggests policies that satisfy these requirements. While the paper recommends the use of a carbon tax as opposed to a cap-and-trade tool, the significant contribution of the paper comes from the idea of distributing revenues generated from a carbon tax to reduce payroll taxes. This payroll alternative would balance the adverse impact on distribution for poorer households by offsetting the total tax burden. The proposal suggested in the paper includes a tax of $15 per metric ton of CO2 emitted along with a rebate of the federal payroll tax on the first $3,660 of earnings for each worker. This "carbon tax swap" assumes distributional neutrality by utilizing the revenues generated "in a way that offsets the regressivity of the carbon tax."[9]

While the efficacy of a cap-and-trade system depends entirely on the allocation mechanism of the carbon allowances, the equity of a carbon tax rests on offsetting the "regressivity" that it entails. Recognizing the inequities associated with cap-and-trade systems, Gilbert Metcalf proposed a series of offsetting measures similar to those he proposed to offset distributional effects associated with carbon taxes. Testifying before the US Senate in October 2009, Metcalf explained the distributional considerations needed in order to make it more

"acceptable" to all stakeholders.[10] Incorporating insights from proposals such as Metcalf's should facilitate the new Congress passing a comprehensive climate bill.

3.2. *Investments in Green Technology*

While designing instruments to cap carbon emissions is definitely crucial, policies promoting sustainable development in the long run are necessary. Promoting a green economy is one such useful policy channel. A transition towards a green economy implies substantial public and private investments in energy efficient technologies and the development of renewable energy resources.[vi]

As the specter of political infeasibility shrouds the use of instruments like cap-and-trade or carbon tax, economists and scientists have been near unanimous in their support for increasing investments in research and development into new green technologies that promise to reduce fossil fuel dependence.

Such a transformation is ambitious because of extreme global dependence on fossil fuels. Fossil fuels along with nuclear energy contribute 93 per cent of the total world's energy resources.[11] In the US alone, fossil fuel dependence extends to more than 85 per cent of all the energy consumed and produced. Such a disproportionately high dependence on fossil fuels, coupled with a soaring global energy demand, leaves a herculean task for the alternative forms of renewable energy resources—especially the cleaner energy variety that includes solar, wind, hydroelectric, etc. With fossil fuel stocks running out, it becomes all the more necessary to tap these alternative sources of energy to sustain the energy demands in future.

[vi] The most popular forms of renewable energy sources that are projected as alternatives to the current dependency patterns on fossil fuels (non-renewable) are wind, solar, geo thermal and biomass. Popular examples of clean energy technologies would include wind turbines, solar panels etc.

Several economists strongly agree that these much touted alternative sources of energy are grossly inadequate to cope with global energy demands. For example, a recent study by Green and Galliana (2009) examining non-carbon-based energies including nuclear, wind, solar, and geothermal concluded that these alternative energy sources combined produce "less than half the power needed to stabilize carbon emissions by 2050." In addition, realizing such carbon cuts by 2050 will likely prove impractical considering the range of "recommended" required investments--"30 new nuclear plants, 17,000 windmills, 400 biomass power plants, two hydroelectric facilities the size of China's massive Three Gorges Dam; and 42 coal and gas power plants with yet-to-be-developed carbon-capture technology."[12]

So given the supposed "non-viability" of renewable energy sources (however cost efficient, better and cleaner they turn out to be), a more efficient alternative already proposed is concrete well-targeted investments in Research and Development (R&D). An example campaign would be to promote investments in climate engineering technology like "marine cloud whitening" that has the potential to delay the effects of global warming. Likewise, providing the resources to transition away from fossil fuels gradually could very well create the break-through necessary to reduce long term fossil fuel dependency. Some estimates say that devoting just about 0.2 per cent of the global Gross Domestic Product (GDP), or roughly US $100 billion, to green energy R&D could substantially help in addressing the problem of reducing carbon emissions.[13] There is ample scope for stepping up such R&D investments in the US, especially given that in 2009, "federal R&D spending on energy totaled just about US $1.7 billion which translates into a little more than 1/100 of 1 per cent of the US GDP."[14]

While increased R&D investments are an option, there is not enough consensus regarding funding sources.[vii] Recommendations to generate revenue for funding such investments include: developing "green bond" markets; using the proceeds from a carbon tax or cap-and-trade mechanism towards building green technology; substantially reducing the massive subsidies doled out to fossil-fuel industries thus easing financing constraints for cleaner technology investments; and allocating a percentage of the existing economic stimulus packages towards green investment, stimulating an economic recovery as well as helping the environment.

As evident from our earlier discussion, given the political infeasibility of using carbon pricing instruments that are not "distribution neutral," it is hard to consider the likely proceeds emanating from a future carbon tax or cap-and-trade system as a reliable source of finance.

But reducing the massive subsidies for US fossil fuel industries could yield significant benefits and help finance green investments. A recent study stresses that between 2002 and 2008 the US spent close to US $72 billion on fossil fuel subsidies, which stands in stark contrast to a mere US $29 billion spent on renewable energy resources[viii15] While it is true that US lobbying interests challenge this option's political viability, the high cost of fossil fuel extraction justifies recognizing alternative investments as fundamental to future sustainability. The cost figures are indeed staggering. US national spending on fossil fuels totaled more than US $ one trillion in 2008. It is projected that the US will spend another estimated US $23 trillion on fossil fuels

[vii] It is useful to note that the nature of these concerns for the US to raise adequate sources of financing differs substantially from those of the developing countries. Given that developing countries face a steeper resource constraint for making sufficient investments in developing green technology, there seems to be a growing consensus among the developing block that the developed countries should facilitate the process of "technology transfers" arising out of their R&D efforts, which would also require them to relax stringent intellectual property requirements. The access to such technology could benefit the developing world by significantly reducing their cost burden.

[viii] It is interesting to note that nearly 60 per cent of those subsidies (US$ 17 billion) was directed towards corn-based ethanol subsidies. Corn based ethanol has come under serious criticism for being "non-carbon-neutral" as it inflicts greater damage to environment through deforestation (ELI, 2009).

between 2010 and 2030 if the current rate of increase in energy consumption and fossil fuel prices continues to follow the projections. The total worth of this expenditure translates into an amount equivalent to nearly "three years' worth of income for the entire American workforce at current earning rates."[16] The key point implicit here is that the outlays involved in building alternative sources of energy through investments in R&D stand meager in comparison to the expensive nature of fossil fuels. Hence policymakers should reduce fossil fuel subsidies enough to facilitate a transfer of financial resources spent on said subsidies towards promoting investments in green technology.

Finally, yet another important source for financing clean technology involves incorporating green elements into economic stimulus programs[ix]. Such provisions were incorporated in two major laws in the US as a part of the larger economic stimulus.[x] While the EESA with US $185 billion in tax cuts and credits features a green allocation of US $18.2 billion for clean energy, the ARRA has apportioned a US $94 billion "green spending" element in the total US $787 billion package (about 12 per cent) that encompasses expenditures on energy efficiency, renewable energy, water and waste, mass transit and rail.[17]

Such "green stimulus" packages are also crucial in the context of generating significant employment opportunities (the so called "green jobs") to the larger public. Twenty other countries have incorporated similar green measures into their stimulus programs. These recovery plans channeled about 15 per cent of additional aggregate expenditure towards promoting green objectives.[18] Such investments, especially in the US, made a notable difference by generating

[ix] Howsoever time sensitive and short term these measures might be, every opportunity to undertake a concerted action to promote a low carbon intensive future should not be missed out on.

[x] The Emergency Economic Stabilization Act (EESA) of October 2008 and the American Recovery and Reinvestment Act (ARRA) of February 2009.

green jobs and triggering investments in alternative sources of energy.[xi] But as observers have warned, care must be taken to avoid the pitfalls of "dirty investments"[xii] that could potentially negate the stimulus benefits. Nevertheless, green investment should continue in some form even if countries choose to opt for "exit policies" to achieve fiscal responsibility because it is expected that any well targeted public investment "in low-carbon energy infrastructure" could greatly assist in "helping cushion the environmental burden of future energy needs."[19]

4. Playing the Global Energy Game - A Game Theoretic Framework

The preceding analysis suggests that cooperation and coordination among the various national and international players emerge as both necessary and sufficient conditions to yield the desirable payoffs from a "global energy game." Devising a comprehensive "Energy-Climate Bill" nationally or internationally thus becomes an extremely challenging task because appropriate strategies have to be designed and employed to join multiple stakeholders with conflicting interests.

In this section, we characterize the complicated process of national and international negotiations and coalition formations amongst the various actors, by employing a game theoretic framework. We present a non-technical overview of a highly selective set of game theoretic models that can be applied to understand the policy dilemmas (highlighted in the previous

[xi] Recent research studies point out the reasonable success of such stimulus programs in the US. One such example is provided by the Lawrence Berkley National Laboratory (as reported by the American Wind Energy Association) on the 1603 tax credit scheme that was part of the American Recovery and Reinvestment Act of 2009, which states that "the 1603 tax credit program supported shovel-ready projects and over 50,000 American jobs." For more details, see http://awea.org/newsroom/releases/10_14_10_Renewable_Energy_Tax_Credits.html and http://www.americanprogress.org/issues/2010/10/clean_energy_jobs.html, accessed on October 26, 2010.

[xii] An example of "dirty investments" would be to promote construction of infrastructure projects like roads which could eventually encourage more automobile traffic that in turn has a bearing on increasing carbon emissions.

sections) and the resultant decision making processes, by drawing on the field's rich and extensive literature.[xiii]

At the most basic level, one can understand the global energy game as a form of non-cooperative game where the concerned players make their decisions independently. The implicit assumption here is that the players involved in the game make "rational choices" by having well defined utility functions (with stated constraints). The solution concepts developed are based upon the process of these players maximizing their utilities subject to those constraints.

The problem of achieving cooperation to reduce emissions of greenhouse gases can be explained using a prisoner's dilemma framework, which posits that though all actors in the game would be "collectively better off" if they cooperate to reduce their emissions and implement abatement strategies, since each player would be "individually better off" if he continues to pollute, the non-cooperative outcome that results is sub-optimal in nature and is commonly referred to as a "social dilemma."

Following the general framework elaborated in Rasmusen (1994) and the specific example cited in Wood[20] we present a simple prisoner's dilemma game with two players for greater clarity.

Each player has the choice to make two possible strategies which is to either pollute or abate. The payoffs for making their respective choices are represented in the payoff matrix given below.

	Player 2		
Player 1		**Abate**	**Pollute**
	Abate	(10; 10)	(0; 11)
	Pollute	(11; 0)	**(1; 1)**

[xiii] This section draws heavily on Barrett (2003) and Wood (2010).

The two rows indicate the possible action set of the first player and the two columns reflect the possible action set of the second player; the numbers in each box correspond to the payoffs for each player, with the first player's payoff listed first followed by the second. The choice {Pollute; Pollute} is referred to as the Nash equilibrium[xiv] because given that the second player chooses the option {Pollute}, the first player is better off choosing {Pollute} than choosing {Abate}, and vice-versa. None of the other combinations reflect a Nash equilibrium because in each case at least one player can improve his payoff by changing his strategy. As stated above, though the choice {Abate; Abate} could yield a higher "collective payoff," in this example, each individual is "better off" by choosing {Pollute; Pollute} and hence the non-cooperative equilibrium strategy that results is not the most desirable solution.

This theory gives important insights about the relationship between abatement costs that are primarily local or national and the resultant positive change on the global environment (global public good).[21] The costs of polluting the global environment are not borne entirely by the player who emits, while the benefits of a player's abatement efforts are shared among the other players. Therefore, there is a strong incentive to free ride as each player would try to capitalize on the benefits that accrue to them from the abatement strategies of other players, eventually limiting their need downsize emissions. The only rational course for each player is to engage in the minimum level of cooperation that is required for self protection if those benefits do not accrue from free riding.

This basic prisoner's dilemma framework builds a perspective into the strategic behavior and response of all the countries in order to address energy-climate issues. There are several extensions of this basic framework that suit the complexity of real world situations. For example,

[xiv] "A strategy profile is a Nash equilibrium if no player has an incentive to deviate from his strategy given that the other players do not deviate" (Rasmusen 1994, 23).

an immediate extension of this framework would be to relax the assumption that choices of the players (countries) involved in this process are dichotomous in nature –to pollute or not to pollute, to abate or not to abate--and instead solve for the decisions of the players to reduce the relative magnitude of their respective emission levels vis-à-vis other players. The solution thus arrived yields an equilibrium that involves emission reductions, though it still results in less than the optimal levels of reduction.

A particularly relevant game example can be found in the "Treaty Ratification" and the "Treaty Participation" game elaborated in Barrett[22]. Both these games assume an extensive form setup with perfect information and simultaneous moves by the players involved and make use of the sub game perfect equilibrium as a solution concept.

The treaty ratification game illustrates the need for the treaty in question to be adequately reflective of the interests of the domestic or national constituents in order to ensure its ratification at the national level. This is discussed in the context of the United States, where 67 out of the 100 votes are required in the Senate to ratify a treaty. The discussion pertaining to the recent climate bills such as the Waxman-Markey can be understood in this context.

The treaty participation game on the other hand, involving more than two players, emphasizes the need to design binding international agreements that are "self enforcing" in nature. In a self enforcing nature, no signatory of the agreement can accrue benefits from breaking or dropping out of the agreement, and no non-signatory can experience free rider benefits. This restraint becomes important when players have an incentive to practice non-compliance with the rules of the agreement that is negotiated, and they refrain to participate in that agreement (non-cooperate) which could be a substantive impediment to realizing the collective payoffs of a cooperative outcome. It is in this context that the concept of

"punishments" for pursuing a non-cooperation strategy assumes significance. Instruments such as carbon tax or cap-and-trade emerge as "credible" threats, effectively binding parties so that countries eventually cooperate.[23] Borrowing from negotiations theory, one could also make use of the rationale of the "Best Alternative to a Negotiated Agreement" (BATNA). BATNA attempts to understand why players would engage in a non-cooperative strategy in the context of choosing a socially optimal outcome. It needs to be emphasized that the players would be inclined to be party to any treaty only if the value of that treaty yields them a higher payoff than the value of the BATNA, in a way, setting the reservation value that needs to be satisfied for cooperative moves to be played.[24]

Before we conclude this section, a few important extensions are worth summarizing. The dynamics of the non-cooperative games outlined above change when one considers the possibility of communication between players before the game is played. At the same time, it is also important to note that such cooperation could become difficult even if the assumption of players possessing complete information about each other's preferences is relaxed. In the event of information asymmetry, the incentive of the players to misstate their preferences or exaggerate their abatement costs is higher, placing them in an advantageous position in the negotiating process. A mechanism, based on auction pricing, that would induce the players to reveal their "true abatement costs" has been modeled by Montero (2007). While the details of the model are beyond the scope of this paper, the central take away from this model is that the auction mechanism can be treated as an equivalent of a carbon tax.[25]

The purpose of this section was to briefly provide an overview of the existing game theoretic models that have attempted to explain the plausible mechanisms and strategies employed in the process of international cooperation to address global climate change.

Overlooking model limitations, the insights derived from these tools are useful in educating policy makers about the social dilemmas confronting the various players and helping them design appropriate mechanisms to address these dilemmas.

5. Concluding Remarks - The Road Ahead

The difficulty in striking an optimal balance between environmentally sound policies and the need to revive the economy arises from the complex intertwining of the interactions between the two.

As overwhelming research suggests, high carbon emissions resulting from the excessive use of fossil fuels has been an extremely significant variable (though not the only one) in contributing to an already existing high stock of green house gases in the atmosphere. A possible way to address this problem of climate change could be to reduce carbon emissions that arise from the use of fossil fuels. While there is no consensus on the most effective methodology to realize that, the rationale is to achieve a likely increase in the prices of fossil fuels (like petroleum) that could in turn deter households and firms from their excessive consumption. Proceeds from increased fuel prices could be invested in environment friendly alternatives. The fallacy with this argument however, is that it would be politically infeasible to pass such a bill that could have a direct bearing on the prices of household utilities, as a result of a tax. Several attempts in the past to even draft a bill of this type have failed. But the potential of "distribution neutral" instruments have not been tested so far, and hence they should be considered seriously and promoted as effective alternatives.

A "green stimulus" program that would involve both an economic recovery and an environmental resurrection through "green jobs" could be an effective alternative. Investing in "green technology" to encourage more research and development of environment friendly

technology is yet another policy option. Tapping other alternative forms of renewable energy sources (e.g., solar and wind) effectively is another solution. However noble the idea may sound, like in the last scenario, government faces large constraints involving inadequate resources to invest in green technology (especially after being fiscally constrained following the financial crisis) and to address the urgency of short-run problems (when it takes a long time to develop such technologies). But success may lay in pruning down the massive subsidies generously granted to fossil fuel industries and channeling those resources toward productive green investments such as Research and Development (on alternative environment friendly technology). Nevertheless, raising adequate sources of financing would definitely remain a central challenge to policymakers, and hence a careful deliberation on all possible channels is called for before policies are designed.

While this does not mean that the environment and the economy are always mutually exclusive, with growth in one necessarily occurring at the cost of the other, consensus building and promoting a shared understanding of responsible behavior across all societies would be the step in the right direction.

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[1] United Nations 2010, 7.

[2] Howes, 2010.

[3] Jones and Keen 2009

[4] Parker and Blodgett 2008, 13

[5]Dinan and Shackleton 2005, 1

[6] Pizer 2003, 47

[7] Stavins 2010, 16

[8] Krugman 2010

[9] Metcalf 2009a, 64

[10] Metcalf 2009b, 9

[11] Mclamb 2010.

[12] Lomborg 2010

[13] Galiana and Green 2009; Lomborg 2010

[14] Greenstone 2010, 8

[15] ELI, 2009

[16] Payne et al. 2009, 2-3

[17] UNEP 2009, 9

[18] HSBC, 2009

[19] Jones and Keen 2010, 9

[20] Wood 2010, 6

[21] Nordhaus 2010, 11725

[22] Barrett 2003, chapter 7

[23] Wood 2010, 17

[24] Weiler 2010, 15

[25] Wood 2010, 32

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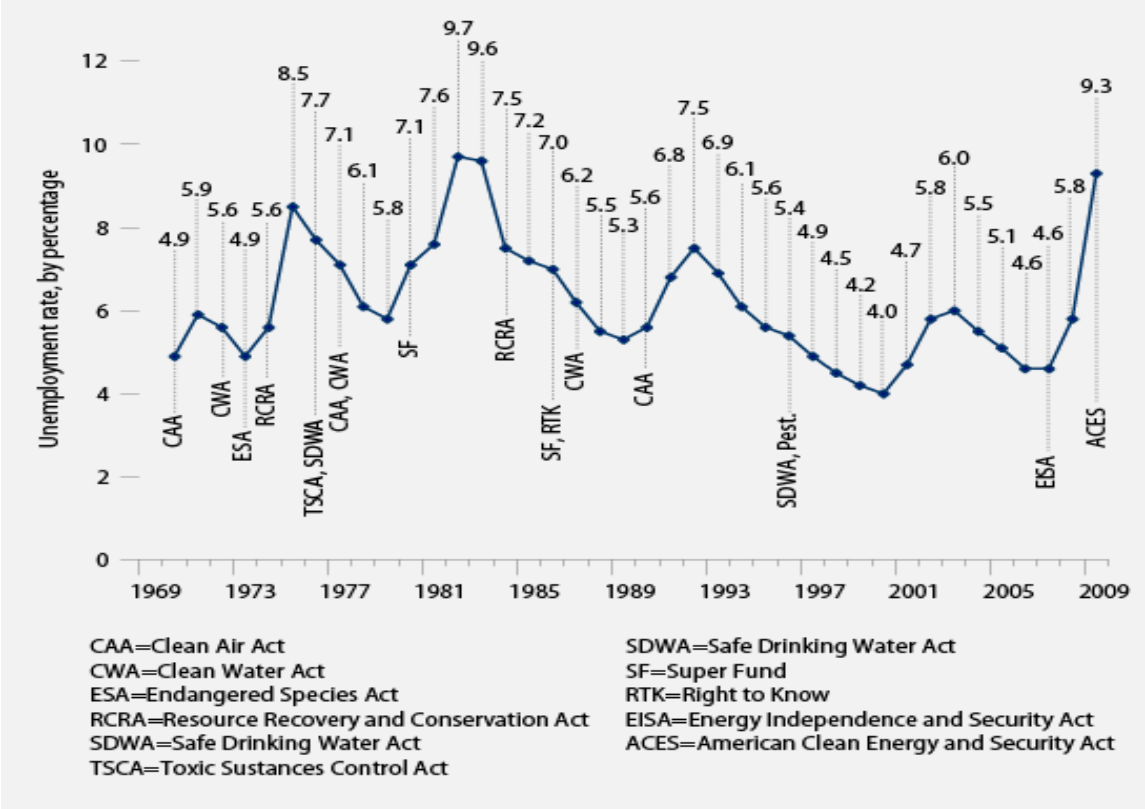
Appendix

Figure 1

Unemployement Levels When Environmental Laws Passed



Source: Reproduced from Weiss (2010). "Anatomy of a Senate Climate Bill Death", Center for American Progress, October 12, 2010, available at http://www.americanprogress.org/issues/2010/10/senate_climate_bill.html, accessed on October 25, 2010.