The Park Place Economist

Volume 10 | Issue 1 Article 19

2002

An Economic Analysis of the Kyoto Protocol

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Abstract
Global climate change represents a serious im pending issue that must be addressed in the present, not the distant future, in order to avoid irreversible, adverse consequences. Due to externalities— intertemporal and locational—markets will not reach an efficient outcome. Present generations bear the cost of reducing greenhouse gas (GHG) emissions and do not experience the negative repercussions of global climate change, while future generations reap the benefits of avoiding global warming without enduring the initial monetary cost of emission reductions. Also, since the stratosphere is a public good for the entire world, the free rider problem occurs on a global scale (Rao, 2000). Each country has an enticing incentive to allow other nations to reduce GHG emissions without contributing to emission reduction efforts themselves. Due to these inevitable externalities, government intervention and international cooperation is not only justifiable but a necessity.

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I. Introduction

Global climate change represents a serious impending issue that must be addressed in the present, not the distant future, in order to avoid irreversible, adverse consequences. Due to externalities—intertemporal and locational—markets will not reach an efficient outcome. Present generations bear the cost of reducing greenhouse gas (GHG) emissions and do not experience the negative repercussions of global climate change, while future generations reap the benefits of avoiding global warming without enduring the initial monetary cost of emission reductions. Also, since the stratosphere is a public good for the entire world, the free rider problem occurs on a global scale (Rao, 2000). Each country has an enticing incentive to allow other nations to reduce GHG emissions without contributing to emission reduction efforts themselves. Due to these inevitable externalities, government intervention and international cooperation is not only justifiable but a necessity.

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The Kyoto Protocol reflects an attempt to correct these externalities by imposing GHG emission reduction standards upon current generations, thereby combating global climate change. Unfortunately, this treaty fails to present a valid solution to global warming. The Kyoto Protocol neglects economic as well as scientific realities, and therefore, qualifies as a fundamentally flawed treaty. Nevertheless, global warming represents an inevitable, formidable threat to human welfare that merits a pro-active approach characterized by efficiency, cost-effectiveness, flexibility, and equitability.

II. Background

Global climate change results, according to a widely accepted scientific consensus, from the accumulation of GHG's in the atmosphere, which absorb infrared radiation, causing global temperature to rise. Scientists hypothesize with a considerable amount of evidence that the burning of fossil fuels, which emit carbon dioxide (CO_2), contributes to the increasing concentrations of GHG's in the atmosphere and, therefore, creates global climate change (Rao, 2000). The exact effect of increasing average global temperatures remains uncertain, but simulations project rising of the sea level, unstable weather patterns, extension of climate-sensitive diseases, and disruption of agricultural productivity (Chandler, 1999). The scientific community predicts that the mean global temperature will rise 3°C to 4°C over the next century if GHG emissions continue to increase unabated (Easterbrook, 2001).

Considering the potential for drastic, irreversible consequences, international policy should reflect the precautionary principle, which implies society is risk-averse and ensures against the possibility of a global warming catastrophe (Kellow, 1998). Therefore, despite the lack of complete scientific evidence, global warming represents a formidable threat to human welfare and merits global action.

As a result of this growing, widespread concern of global climate change, developed nations met in December of 1997 and formed the Kyoto Protocol, a treaty intended to counteract the trend of global warming by instituting legally binding GHG emission reduction standards. Under the Kyoto Protocol, Annex I nations, which encompass 39 high in-

come, developed countries, must reduce their emissions of six GHG's, including CO_2, methane, nitrous oxide, hyrdoflorocarbons, polyflorocarbons, and sulfur dioxide by an average of 5% from 1990 levels. The treaty stipulates that this reduction occur during the commitment period extending from 2008-2012. The Kyoto Protocol will become effective once 55 participating parties, representing at least 55% of CO_2 emissions, ratify the treaty (Rao, 2000)

III. Benefit-Cost Analysis of the Kyoto Protocol

Despite the treaty's many flaws, the Kyoto Protocol allows several innovative, theoretically cost-effective approaches to attaining the emission reduction quotas instead of relying upon the standard command and control approach. Unfortunately, many of these strategies remain dangerously vague, and the treaty compromises economic theory in favor of politics. In theory, the Protocol permits a considerable amount of flexibility in achieving these emission reductions. This flexibility, in turn, could greatly reduce the total cost of obtaining the desired emission reductions. However, in practice, potentially flexible mechanisms become inflexible due to restrictions and regulations (Tol, 1998).

The treaty allows an international emission reduction trading system, which creates a limited global market for emission reduction units among Annex I countries (Rao, 2000). Countries with a lower marginal cost (MC) of reduction will reduce their emissions and sell their excess emission reduction credits to countries with a higher MC of reduction. Therefore, MC's will equalize; countries will engage in mutually beneficial transactions to achieve emission reductions in the most cost effective method possible. The existence of tradable emission reduction units potentially could drastically reduce the total cost of Kyoto's standards.

However, considering that Kyoto only legally obligates developed nations to alter GHG emissions, the treaty limits permit trading to Annex I nations (Rao, 2000). Since most Annex I countries have relatively similar MC's of emission reduction, the benefits of an international trading system cannot be fully realized. Although this theoretically cost effective system demonstrates a less expensive method than a standard command and control approach, this diluted permit trading system will not approach the least cost method. According to a study conducted by William Nordhaus (1998), a complete international emission reduction trading system could reduce the massive cost of Kyoto by a factor of nine. However, a trading system restricted only to Annex I nations produces a less impressive decline in cost, and reduces the total cost of Kyoto by less than a factor of two. Clearly, a globally inclusive trading system could achieve GHG emission reduction goals in a more cost efficient manner, thereby lessening the financial burden of Kyoto.

In addition, the international emission reduction trading system could drastically impact individual economies. Due to the increasing costs of production in Annex I countries, companies may elect to shift production to developing nations, which will have a substantial lower MC of production. This shift will negate Kyoto's efforts to reduce global GHG emissions, because firms will be able to pollute freely in these non-Annex I nations. Goods produced in Annex I nations will become more expensive, while non-Annex I goods will become comparatively less expensive. Consequently, Annex I nations will experience a comparative disadvantage. Also, these permits may discourage development in certain countries. Russia and Eastern Europe will possess an excess of emission reduction credits due to the collapse of the Soviet Union that occurred after 1990 (Tol, 1998). Consequently, these countries will experience a windfall and reap unearned profits. These countries will benefit more from selling emission reduction permits than developing efficient, environmentally friendly policies. Consequently, total output will decrease significantly, though their income will actually increase due to large transfers from Annex I countries (Nordhaus, 1998). Although their GDP may reflect prosperity, the reduction of output has serious implications for their economy.

Kyoto also permits other methods of achieving GHG emission reductions. Through "joint implementation," Annex I countries can achieve their emission reduction quotas by undertaking projects in other Annex I countries to reduce GHG emissions (Chandler, 1999). However, the MC of reductions lack significant variability among these nations, and this strategy will not radically mitigate the costs of Kyoto. In addition, the treaty provides Annex I nations with the opportunity to fulfill emission reduction requirements in developing nations, under the "clean development mechanism" (CDM). The MC of reduction is significantly lower in developing nations that will allow developed nations to capitalize off these lower cost op-

portunities. Developed nations can undertake projects in developing nations, which will reduce emissions, while encouraging technological innovation and economic development in these underdeveloped areas (Chandler, 1999). Kyoto also allows emission reduction flexibility, because the treaty allows countries to achieve emission reduction credits through reforestation. Forests qualify as emission reduction units, because they are CO_2 "sinks," which absorb CO_2 and prevent GHG's from entering the stratosphere. Therefore, the presence of forests can significantly mitigate global climate change (Sutherland, 2000).

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Kyoto contains several innovative approaches to combating global climate change that encourage flexibility, thereby lowering total costs. However, the Protocol states many of these emission reduction mechanisms in very vague terms and limits the use of these alternative methods. Regardless of varying MC of reduction, international efforts and reforestation projects may only supplement domestic efforts (Nordhaus, 1998). Therefore, the Kyoto Protocol will not achieve an efficient outcome.

Perhaps the most fundamental flaw of Kyoto involves the lack of mandatory participation of developing nations. The treaty fails to impose legally binding emission reduction standards upon Non-Annex I countries, which encompass 134 developing nations (Tol, 1998). Some proponents of Kyoto argue that the developed world, specifically the US and Europe, pioneered the use of fossil fuels during industrialization and therefore, created the current global warming predicament. Also, developed nations account only for 20% of the global population yet emit 60% of the world's CO_2 emissions (Easterbrook, 2001). Even more alarming, the US composes only 5% of the world population yet accounts for 30% of CO_2 emissions. According to per capita calculations, a Chinese person generates 1/10 of the GHG emissions of an American. Nevertheless, even the most ardent supporters of Kyoto admit that the treaty cannot stabilize GHG emission without meaningful participation of developing countries, which represent 80% of the global population (Tol, 1998).

As developing nations advance, their GHG emissions will rapidly increase due to industrial development, which relies heavily upon high CO_2 emitting fossil fuel sources, including coal. According to widely accepted projections, China will surpass the US as the largest CO_2 emitter by 2015, and the developing world will overtake the developed world in CO_2 emissions by 2020 (Tol, 1998). Therefore, the actions of 39 Annex I nations cannot significantly counteract the trend of global climate change, while 134 non-Annex I nations continue to exponentially increase GHG emissions (Nordhaus, 1998). Any progress accomplished by developed nations will be more than offset by increasing emissions of developing nations. According to Nordhaus, Kyoto will only decrease global mean temperature by 0.13°C from the projected baseline temperature increase during the next century. This insignificant decrease in average global temperature cannot mitigate the global warming trend. Therefore, the Kyoto Protocol lacks scientific validity. Kyoto cannot possibly achieve its ultimate goal of reversing the global climate change trend.

In addition, the chosen emission reduction targets lack any scientific or economic foundation. The Protocol stipulates that each Annex I nation reduce GHG emissions by an average of 5% from 1990 levels. These historical baseline targets lack any relation to global CO_2 concentrations, projected temperature increases, or MC of emission reduction (Kellow, 1998). The Kyoto Protocol sets completely arbitrary emission reductions quotas, which prevent an efficient, effective outcome. Efficient emission reduction standards would reflect economic and scientific factors, including GHG concentrations and MC's of emission reduction.

Also, the impending emission reduction target deadlines approach economic and scientific impossibility. Kyoto requires the US to reduce GHG emissions by 7% of 1990 levels. According to projections, if emissions continue to increase at the current rate, the US will be over 20% above 1990 CO_2 levels by 2008 (Tol, 1998). Consequently, the US must reduce it emissions by 27% of its projected level in less than a decade. The European Union (EU) faces similar, though not quite as daunting, emission reduction challenges as the US. The next few years do not constitute sufficient time to institute such drastic emission reductions.

The presence of relatively uniform emission reduction standards, without the mitigating presence

of significant market incentives, creates very cost ineffective results. Standard emission reductions among Annex I nations neglect to consider the individual circumstances of each country under the guise of equality. Kyoto ignores factors which significantly affect a nation's ability to reduce domestic emissions, including level of wealth, population growth rate, type of energy supply, transportation system, rate of economic growth, past investment selections, and existing infrastructure (Kellow, 1998). For example, the treaty allows Eastern Europe, as well as nations included in the former Soviet Union to benefit from their historically incredibly inefficient energy systems by using 1990 levels as a baseline (Nordhaus, 1998). These countries could easily reduce emissions at a minimal cost. Also, the collapse of the Soviet Union, which greatly affected industry and therefore, reduced GHG emission from 1990 levels, allows Russia a huge windfall. Russia would be able to meet its target without any modifications of its current emission level.

Also, enforcement of the Kyoto Protocol remains a perplexing, unresolved problem. Due to the extremely high projected cost of Kyoto, countries will have a strong incentive to cheat. As a result, high transaction costs to ensure enforcement will add to the already burdensome cost of Kyoto. The treaty fails to address the specifics of enforcement and consequently, punishment. Even more problematic, there is no precedence for a global enforcing agency of the magnitude Kyoto requires. Doubts arise as to the practical possibility of implementing and enforcing Kyoto.

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More than any other factor, the unbelievably high cost of implementing Kyoto effectively eradicates any possible value of the treaty. Nordhaus estimates the global cost of Kyoto to total $828 billion (1998). Annex I nations bear this economic burden, while non-Annex I countries benefit, albeit comparatively insignificantly. Eastern Europe and Russia emerge as beneficiaries. However, these gains are merely transfers from the US, due to the tradable emission reduction credits, and do not represent true economic benefits.

If implemented, the US will bear the brunt of Kyoto's massive cost, paying over 2/3 of the total global cost, which reaches approximately $517 billion (Nordhaus, 1998). The treaty requires 2-5% of the US's GDP annually (Murkowski, 2000). Implementing Kyoto will cause serious economic ramifications. By 2050, the US will transfer over $40 billion annually to Russia and Eastern Europe to purchase emission reduction permits (Nordhaus, 1998). This large transfer of wealth will deplete funds for capital investment within the US and discourage domestic growth of the economy.

In addition, energy prices will dramatically increase. In order to achieve Kyoto's emission reduction standards domestically, the US will need to decrease energy consumption by raising prices, which will eventually decrease demand. However, the inelastic demand for energy predicts that prices must drastically increase before consumers respond. Energy prices will increase by 33% by 2010. Implementing Kyoto will impose a tax on carbon exceeding $250 per ton by 2050 (Nordhaus, 1998). Kyoto will consume an average of $2,728 of household income annually, eradicate 2.4 million jobs, and decrease the US living standard (Murkowski, 2001).

Proponents of the treaty argue that the high costs of global climate change justify the extremely large price tag of the treaty. Although the estimated total cost of unabated global climate change varies, relatively conservative estimates total $1.8 trillion, which clearly validates the devotion of resources to combat this environmental problem. However, as stated earlier, Kyoto does not effectively mitigate global warming. Kyoto's benefits only total $0.12 trillion, while the costs total more than $0.8 trillion. Therefore, the Kyoto Protocol clearly fails the benefit-cost test; the benefit-cost ratio equals 1/7 (Nordhaus, 1998). The Kyoto Protocol is an extremely inefficient, cost ineffective approach that fails to produce results.

IV. Conclusion

Although the dynamics of global climate change necessitates both government intervention and international cooperation, the Kyoto Protocol lacks the ability to counteract the global warming trend but retains a prohibitively high price. Both the economic and ecological ramifications of Kyoto raise concern. Implementing Kyoto would result in both economic and ecological disaster. Kyoto would cause an incredible amount of strain upon the US and other An-

nex I economies. In addition to the inevitable economic crisis, the global climate change would continue to occur at an alarming rate, aiding a possible ecological disaster. However, the world would lack necessary resources to devote to combating global climate change due to the high costs of Kyoto. Ironically, implementing the Kyoto Protocol, a treaty designed to reduce global warming, would actually increase the severity of this environmental problem, because large quantities of valuable resources would be devoted to a fundamentally, flawed, ineffective treaty. Kyoto imposes a large opportunity cost upon the world. The financially depleted world would lack the necessary resources to solve global climate change.

Achieving an efficient global climate change policy is a very challenging goal, but several fundamental guidelines exist. Global climate change necessitates decisive global action. Each country will not individually elect a globally optimal policy, because the stratosphere is a public good. Therefore, global climate change requires enforceable, binding worldwide cooperation. Both developed and developing countries must play active, meaningful roles. Without the participation of developing nations, any policy will be rendered ineffective. Obviously, or perhaps not so obviously, total benefits must outweigh total costs. In order to achieve a globally optimal policy, each country must individually experience a positive net gain. Any successful policy must create the proper incentives for participation, which implies positive net benefits. Logically, global participation will not occur, in the absence of prohibitively high enforcement costs, unless each country experiences positive benefits. Efficiency and cost effectiveness constitute important goals. Ideally, the marginal cost of emission reduction should equal the marginal benefit emission reduction, which indicates efficiency. However, practicality eliminates the possibility of complete efficiency. Nevertheless, global warming policies should strive towards efficiency. Flexibility in achieving reductions in GHG emission will lessen the cost of implementing the policy and result in a more efficient outcome. International tradable emission permits will promote efficiency by minimizing marginal cost as well as encouraging technological innovations. Also, reduction standards should reflect scientific findings, which indicate that any policy must actually reduce global warming, thus producing benefits. A scientifically ineffective policy wastes valuable resources.

Fortunately, the US faced economic and scientific realities, and President George W. Bush terminated Kyoto Protocol negotiations in March of 2001. However, many Annex I nations remain in the negotiations. Although some environmentalists and politicians view the US's rejection of the treaty as shortsighted and ignorant, the rejection of Kyoto appears logical and prudent, in terms of both the short and long run. Allocating additional resources to Kyoto, a profoundly flawed treaty, would represent waste of limited, valuable resources. The US now possesses the opportunity to pursue an economically and scientifically valid alternative to the Kyoto Protocol. As the largest CO_2 emitter and an influential world power, the US has an obligation to take a pro-active stance towards climate stabilization in order to ensure the welfare of future generations across the globe.

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