Forecasting Voluntary Investments for Mitigations in Global Warming: A Public Choice Analysis

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ABSTRACT

Diverse discussions are taking place over what the next international effort against global warming should be. The cornerstone in global efforts to cope with global warming has been the Kyoto Protocol. Its establishment was a milestone in the field of global warming for enjoining international coordinated efforts. That being said, the Kyoto Protocol has much room for improvement.

Two major issues have interfered with international efforts. One has been the nonparticipation of the United States. The other has been the non-inclusion of obligations on developing countries to reduce emissions.

Based on public choice literature, politicians, bureaucrats and pressure groups are thought to favor the increasing of public expenditures. It would therefore follow that politicians, bureaucrats and pressure groups would support anti-warming projects financed by public monies. In addition, an assumption can be made that a segment of voters would also favor such projects out of concern for environmental issues and policies.

In this paper, a public choice analysis is applied to forecast voluntary investments in efforts to mitigate global warming, and it shows that voluntary investment activities can be ensured if voters are provided with accurate information about global warming and rules are established to restrict rent seeking activities.

Key words: *environmental policy, global warming, public choice*
JEL Classification: H0, N50

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1. Introduction

Serious problems about global warming face us today. In answer to the problem, the current international system is based primarily on the Kyoto Protocol. However, as pointed out by many authors, the protocol itself is hampered by many difficulties.[1]

The nonparticipation of the United States continues to be a major problem. The next major problem is that developing countries have no obligations to reduce emissions. The US is the world's largest source of greenhouse gas, with China following closely in second place. The quantity of greenhouse gas emissions among the developing countries including China continues to increase[2].

Needless to say, without aggressive efforts on the part of the US and developing countries including China, any international cooperative effort will fall short. Therefore, the main issues for discussion in preparation for the next commitment period will focus on securing the participation of the US, and securing the commitment of developing countries to reductions in greenhouse gas emissions.[3]

Each and every country fully appreciates the importance of effective international cooperation, but each and every country also has its own self-interests and strategies. In the case of the US, its reason for nonparticipation in the Kyoto protocol is to protect the competitiveness of its own industries from being eroded as a result of developing countries not being bound to reduce emissions.

Developing countries, on the other hand, have rejected the imposition of any obligations to reduce their greenhouse gas emissions on the argument that the developed countries are to be held responsible for causing the global warming, whereas the developing countries need to protect their rights to pursue their own economic growth. The assertions and interests of the developed countries and the assertions and interests of the developing countries are in direct

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[1] For example, Bohringer, C. and Vogt, C. (2003) points out that the Kyoto Protocol has not resolved any of the fundamental incentive problems inherent to the voluntary provision of climate protection as a pure global public good. Horesh (2002) describes a sort of bond, which directly targets climate stability itself, whereas the Kyoto Protocol targets greenhouse gas emissions.

[2] Fig.1-1-1, *White Paper on Environment* (2002) shows changes in CO2 emissions, with CO2 emissions from developing countries on the increase from the 1980s.

[3] Under the Byrd-Hagel Resolution (1997) passed by the Senate, the US will not be a signatory to any protocol or other agreement which does not assign duties equally to the developing countries and developed countries, and which would result in serious harm to the economy of the United States. Regarding the Clinton administration's response to the resolution, see Kameyama (2002).

conflict with each other.

The conflict in interest between developed countries and developing countries is apparently a very difficult issue to resolve[4].   Without dismissing the importance of efforts to relax this conflict, we simultaneously need to move forward on efforts to mitigate global warming through an international policy against global warming.

If each country were to voluntarily make commitments to invest in anti-warming projects unencumbered of any emission reduction quotas, then the problems posed by US nonparticipation and developing countries' no-obligations on emission reductions would not be of much consequence.   In this paper, a public choice analysis is applied to forecast voluntary public investments in anti-warming projects and the necessary conditions.

2. The Democratic Decision-making Process

In contemporary democracies, the typical collective decision-making process is based on an electoral system and a bureaucracy.   Within this political process, politicians, voters, pressure groups, and bureaucrats play important roles in collective decision-making with everyone involved behaving according to self-interests.

Politicians need to increase votes to win elections.   Voters choose the candidate with a campaign pledge that is beneficial to the voter.   Special interest lobby groups need to maximize government favors.   Bureaucrats act to maximize their benefits by expanding the budget, which they control.   Everyone is acting strategically in a political process.[5]

In such a political process, a public budget is determined to serve as an equilibrium strategy in a political game.   In the next section, a simple political game is presented, and an equilibrium strategy is determined.

3. Model

3.1The First Stage Game

Let us consider a two-stage game.   The first stage game is between a bureaucratic office and the ruling party.   Suppose the object of the bureaucratic office is to increase their budget

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[4] Arasawa (2002) pointed out that because participation in international agreements is voluntary, countries have the right to withdraw from the Kyoto Protocol at will, and that it is asking too much of a country to bear costs greater than it gains in benefits. (pp. 82-83)

  Wake (2002) also explains the difficulties of effective international environmental policy. In her opinion, governments are concerned over the impact of environmental policies on industries and macroeconomic conditions, and therefore we will be faced with a political diplomatic dilemma by setting a low level international common baseline. (p.115)

[5] Muller (1996) gives a good survey of public choice.

and it has developed two strategies, A and B.   Strategy A is the "Project A" plan, an anti-warming project.   Strategy B is a conventional public works project, "Project B", which has no special relevance to global warming issues.

Suppose the object of the ruling party is to win the next election and has developed two strategies, E and S.   Strategy E is to execute the project planned by the bureaucratic office. Strategy S is to scrap the planned project.   If the ruling party chooses Strategy E, there is an increase in the budget of the bureaucratic office.   If the ruling party scraps the project, Strategy S, there is no increase in the budget of the bureaucratic office.

Suppose the bureaucratic office chooses Strategy A.   If the ruling party chooses Strategy E, to execute the project, the ruling party is labeled as a pro-environmental party; and if it chooses Strategy S, to scrap the project, it is labeled as an anti-environmental party.   Suppose the bureaucratic office chooses strategy B.   Then, if the ruling party chooses Strategy E, to execute the project, the ruling party is labeled as an anti-environmental party; and if it chooses Strategy S, to scrap the project, it is labeled as a pro-environmental party.

The first stage game in extensive form is the game tree shown in **Figure-1**. $Rb(X,Y)$ is the payoff to the bureaucratic office when the bureaucratic office chooses Strategy $X(X=A$ or $B)$ and the ruling party chooses Strategy $Y(Y=E$ or $S)$. $Rp(X,Y)$ is the payoff to the ruling party when the bureaucratic office chooses Strategy $X(X=A$ or $B)$ and the ruling party chooses Strategy $Y(Y=E$ or $S)$.

Figure-1: First Stage Game Tree

A		B	
E	S	E	S
Rb(A,E)	Rb(A,S)	Rb(B,E)	Rb(B,S)
Rp(A,E)	Rp(A,S)	Rp(B,E)	Rp(B,S)
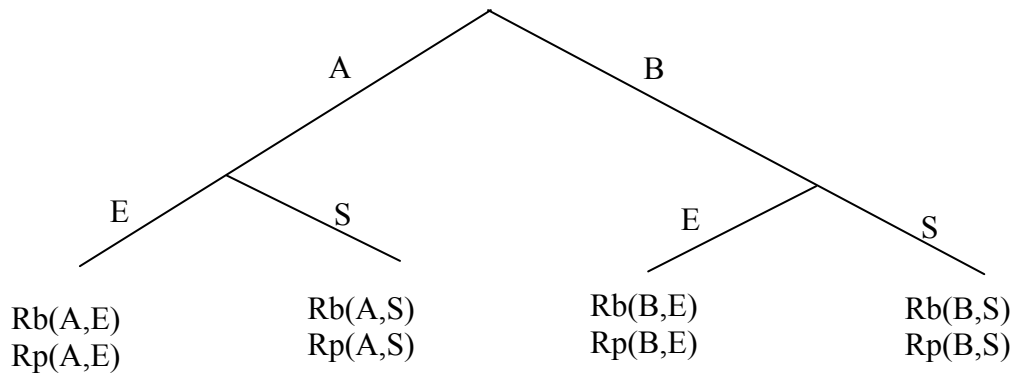
3.2 The Second Stage Game

The second stage game is an election game played with players comprising of the ruling party, the opposition party, and the voters.   In the first move, the ruling party chooses between being pro-environmental, Strategy Pro, or anti-environmental, Strategy Anti, based on its decisions in the first stage.   The opposition party's position is opposite that of the ruling party. Therefore, if the ruling party chooses to be pro-environmental, then the opposition party's position will be anti-environmental.   Similarly, if the ruling party chooses to be anti-environmental, the opposition party's position will be pro-environmental.   The opposition party is a passive player, and its strategy is automatically determined by the strategy chosen by the ruling party.

Each voter plays to maximize his own utility.   If a voter's utility is increased by a pro-environmental policy as compared to an anti-environmental policy, the voter will choose a pro-environmental party, and vice versa.   Voters have two strategies.   One is Strategy P, to vote for the ruling party; the other is Strategy N, to vote for the opposition party.[6]

Suppose that there is a single-seat electoral district where voters choose only 1 representative for the game.   And suppose the distribution of voters' utility is single-peaked. In this situation, the median voter theorem is considered to operate.   Therefore, the party that attracts the vote of the median voter will win the election.   Essentially, the second stage game is played between the ruling party and the median voter.

The second stage game is also shown in extensive form in **Figure-2**.   Rp(C,D) is the payoff to the ruling party when the ruling party chooses Strategy C (C=Pro or Anti) and the median voter chooses Strategy D (D=P or N).   Um(C,D) is the utility to the median voter when

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[6]For the sake of simplicity, the possibility of abstentions in voting is neglected.

the ruling party chooses Strategy C (C=Pro or Anti) and the median voter chooses Strategy D (D=P or N).

Figure-2: Second Stage Game Tree
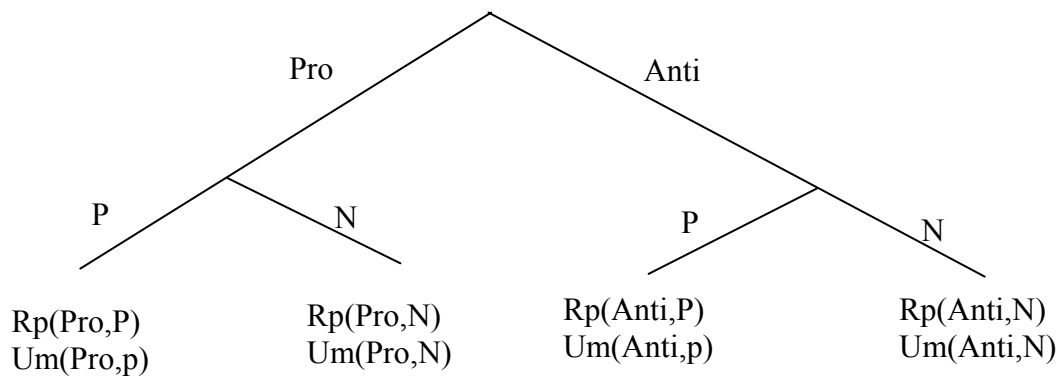
3.3 Payoffs

The second stage game is a sub-game of the total game.   The total game is depicted in **Figure-3**.   If, in the first stage game, either (A,E) or (B,S) is chosen, the ruling party will choose Strategy Pro in the second stage game.   If in the first game either (A,S) or (B,E) is chosen, the ruling party will choose Strategy Anti in the second stage game.
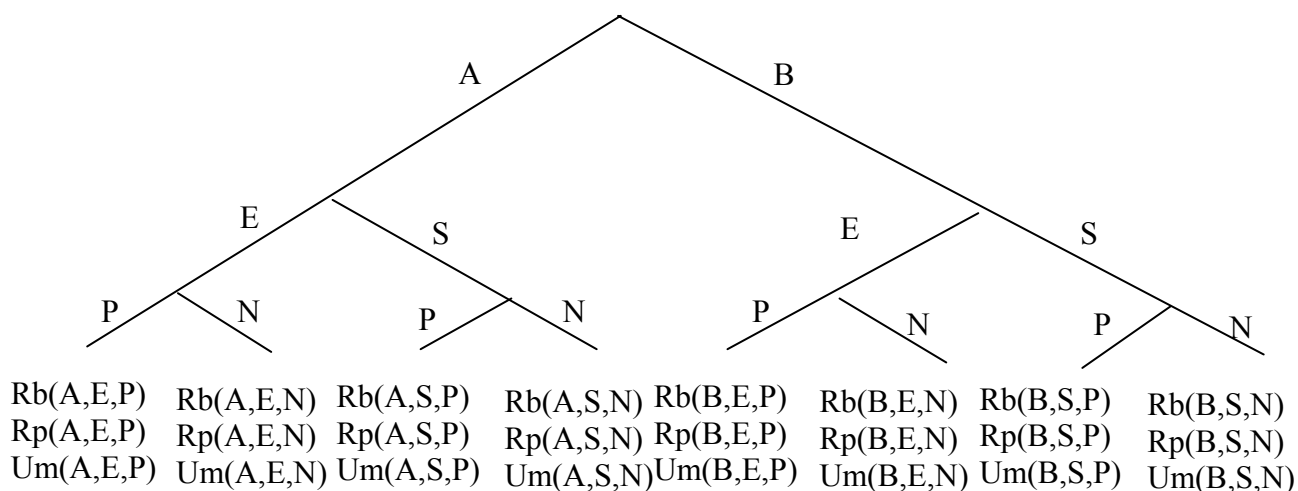
  The payoff to the bureaucratic office is positive when, in the first stage game, the ruling party chooses Strategy E; and becomes zero when the party chooses Strategy S.   Then we see that,

$Rb(A,E,P)= Rb(A,E,N)=\alpha>0$

$Rb(B,E,P)=Rb(B,E,N)=\beta>0$

$Rb(A,S,P)= Rb(A,S,N)=Rb(B,S,P)=Rb(B,S,N)= 0$

Figure-3: Total Game Tree

The payoff to the ruling party is positive when the median voter chooses Strategy P (i.e., the ruling party will win the election); and is zero when the median voter chooses Strategy N (i.e., the ruling party will lose the election).   Then we see that,

Rp(A,E,P)= Rp(B,S,P)=γ>0

Rp(A,S,P)= Rp(B,E,P)=η>0

Rp(A,E,N)= Rp(A,S,N)=Rp(B,E,N)= Rp(B,S,N)= 0

The difference between α and β, and between γ and η reflects the effects of rent-seeking activities of pressure groups.   Although we suppose total governmental spending to remain the same regardless of the project adopted, gains in rents to the pressure groups can increase or decrease.

Utility to the median voter is assumed to be a dependent factor of which party wins. If the pro-environmental party wins, the utility to the median voter is expressed as,

    Um(Pro)=Vm(Pro)+Rm(Pro)

where Vm(Pro) is the benefit to the median voter as an ordinary citizen as a result of the pro-environmental policy, and Rm(Pro) is the rent to the median voter resulting from the policy.

Similarly, if the anti-environmental party wins, utility to the median voter is expressed as,

    Um(Anti)=Vm(Anti)+Rm(Anti)

where Vm(Anti) is the benefit to the median voter as an ordinary citizen as a result of the anti-environmental policy, and Rm(Anti) is the rent to the median voter resulting from the policy.   Then we see that,

Um(A,E,P)=Um(B,S,P)=Um(A,S,N)=Um(B,E,N)=Um(Pro)

Um(A,E,N)=Um(B,S,N)=Um(A,S,P)=Um(B,E,P)=Um(Anti)

In **Figure-4**, the payoff to each player based on the above equations is shown

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Figure-4: Total Game Tree and Payoffs
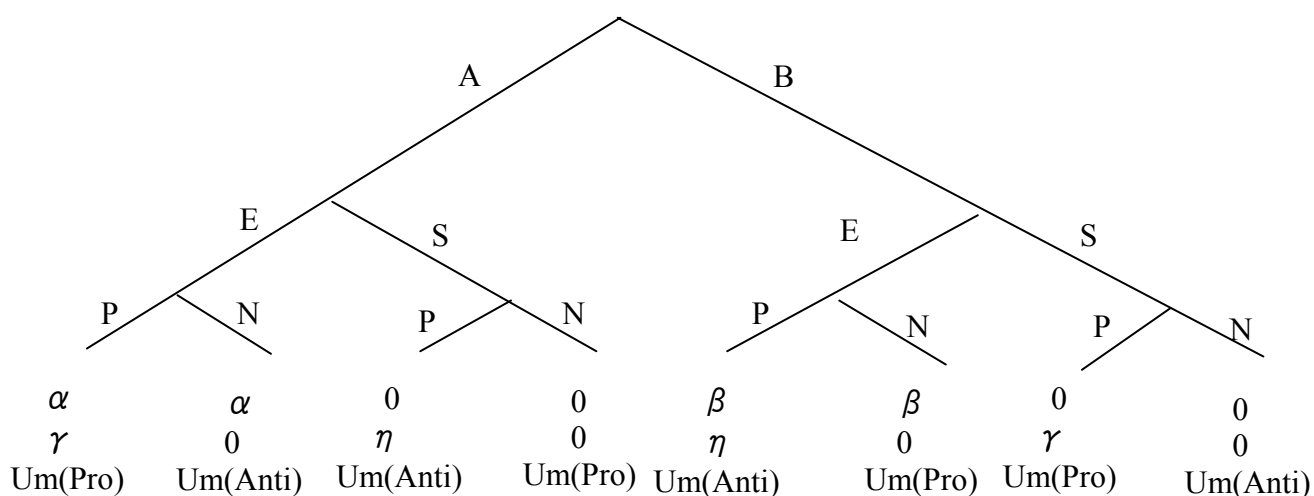
3.4 Results and equilibriums

(1) When Um(Pro)>Um(Anti)

The resultant set of strategies from backward induction in this game is (A,E,P).

The sub-game perfect equilibrium is (A,ES,PNNP).

(2) When Um(Pro)<Um(Anti)

The resultant set of strategies from backward induction in this game is (B,E,P).

The sub-game perfect equilibrium is (B,SE,NPPN).

Results and equilibriums are independent of the relative size of both α to β and of γ to η. On the other hand, they are dependent to the relative size of Um(Pro) to Um(Anti). This means the results are not affected by whether the pressure group expends more or less on rent-seeking activities. Utility to the median voter is the single factor determining equilibrium and results.

4. Implications and Remaining Problems

In democratic countries, it is possible to undertake anti-warming projects without

international cooperation if the median voter favors it.   However, this may not be sufficient investment to stop global warming.   It is not sufficient that the median voter has accurate information and fully understands the utility to be gained from anti-warming projects and other public projects, nor even that the median voter does not derive any rents (that is, the median voter knows Vm(·) and Rm=0.),   because the democratic process itself cannot provide the conditions necessary to an efficient allocation of resources.   The democratic decision-making in this model only indicates that the median voter favors one project over another.

Nevertheless, in terms of increasing public spending to accelerate anti-warming efforts, the results of this model do suggest that the median voter needs to choose the pro-environmental party.   For the median voter to choose the pro-environmental party and to have the anti-warming project executed, this condition is expressed as Um(Pro)>Um(Anti). That is, Vm(pro) - V(anti) + Rm(Pro) - Rm(anti) > 0.

In addition, if rents from conventional public work projects, such as roads and dams, are significantly greater than that for anti-warming projects (Rm(Pro)-Rm(anti)<<0), we can see that despite the benefits to society and the median voter, (Vm(pro)-V(anti)>0), the conditions leading to anti-warming projects are not satisfied.   Therefore, it would be necessary to have regulations on rent-seeking activities for anti-warming policies to succeed.   This is the first implication we can derive from this model.[7]

If rents are too small to be of any significance, the median voter may choose his strategy based on the benefits between Vm(pro) and Vm(anti).   It may be more difficult for voters to accurately understand the utility gained from anti-warming projects as compared to understanding the utility they gain from road or dam projects, thus leading to the possibility of the voter underestimating the utility gained from anti-warming projects.   In this case, providing voters with accurate information on the value of anti-warming projects becomes critical.   This is the second implication we can derive from this model.

In this sense, the quotas set forth in the Kyoto Protocol on greenhouse gas emission reductions serves as an announcement, a wake-up call to the gravity of the global warming situation.

Without agreements on international cooperation or numerical limits on greenhouse gas emissions, anti-warming projects may be relegated to the initiative of democratic countries. The US may not be a participant to the Kyoto protocol, nevertheless, it does have its own

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[7] To reduce rents derived from conventional public work projects and to increase rents from anti-warming projects has the effect of enhancing anti-warming projects.   Also, political difficulties arise when attempting to restrict on rent-seeking activities.   Therefore, it may be more effective to allow active rent-seeking activities in environmental issues.

anti-warming projects.   This is an example of voluntary investments for mitigations in global warming.

As stated above, voluntary investments in anti-warming projects alone does not lead to sufficient reductions in emissions.   The populace generally does not accurately understand the danger posed by the cumulative effects of greenhouse gas emissions, and by the time they do realize the risks, it may be too late to stop global warming.

In order to encourage voluntary investments, the dissemination of accurate information cannot be overly emphasized.   In the event of inadequate voluntary decisions to anti-warming projects, some degree of international commitments or international restrictions may play a significant role.   In this scenario, US nonparticipation and the non-inclusion of obligations on developing countries to reduce emissions will be major stumbling blocks.

Developing countries can be classified as one of two types; the democracies and the non-democracies.   It can be expected of developing countries that are democracies to implement some degree of anti-warming projects according to utility to their median voter. It can also be expected that the level of their efforts may be lower, since the marginal rate of substitution of anti-warming projects to conventional public works projects is greater when the income level is higher.   In underdeveloped countries, the relative importance of marginal increase on road, dam, or airport projects is greater than in affluent countries.

In non-democracies, there is no electoral system for choosing voluntary anti-warming investments.   Non-democracies, regardless as to whether they are developed or developing countries, may simply free-ride on the anti-warming efforts of democracies without themselves making any commitments to the international community on emission reductions.

International relations, however, is beyond the scope of this paper.   There may be some countries, democracies and non-democracies, which play strategically and free-ride on the efforts of others.   The median voter may also consider the investments made by other countries when making his choice, with the effect of reducing the marginal rate of substitution with new investments in anti-warming projects in his country.   The reduction in the marginal rate of substitution might cause the median voter to change his choice.   Further study is required on these issues and strategic international relationships.

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