Bargaining for an efficient allocation of emission permits to developing countries.

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(1) Overview

We propose a bargaining process as an efficient and fair alternative to the grandfathering or auctioning of emission permits over the participants of an emission permit market. The paper focusses on the negotiations over the allocation of permits between the developed countries currently implementing emission permit markets versus the developing countries who want to join this market. We model the negotiations according to the 'Alternating Offers Bargaining' model. The objective is to obtain an efficient allocation of tradable emission permits between these two players.

(2) Methods

We model the assignment of carbon emission targets as a negotiation game for the division of tradable emission permits. The economic model consists of an infinite repetition of the static GTAP-E model. The GTAP-E model allows for carbon emissions related to energy use in consumption and production decisions and for emission permits that enter as an endowment for the regional households. In contrast to the standard computable general equilibrium, the total level of permits and its distribution over households are endogenously determined by the negotiation game. Since any agreement on the allocation of emission permits and the global emission levels affect the efficient allocation of goods in the world economy, this means that the negotiations are over efficient allocations of goods that represent stationary contracts in our setup.

These negotiations follow the alternating offers bargaining model of Rubinstein (1982) extended to allow for an infinite stream of consumption and production decisions. This model is a game in extensive form with perfect information. One agent, the developed world, is the aggregation of the developed regions that participate in an existing emission permit market. The other agent, the developing world, is an aggregation of the developing regions, mainly China and India, who contemplate joining the emission permit market. This game is played between these two self-interested agents (or players) over an infinite and indexed set of time periods. The objective is to obtain an efficient allocation of tradable emission permits in this two player negotiation game. At each odd numbered period, the developed world proposes a feasible allocation of the goods in the economy for both players. Then the developing world either ends the negotiations by accepting the proposal, or prolongs the negotiations by rejecting it. If rejected, the allocation of permits, and hence the emission targets fails. Subsequently the agents take inefficient decisions due to the existence of externalities in the current round before we enter the negotiations at the next (even) round. This round is played with a certain probability, hence incorporating the possibility of a breakdown of negotiations. At each even numbered period, the developing world proposes a feasible allocation of the goods in the economy for both players. The developed world then either accepts this proposal, thereby ending the negotiations, or rejects it, and thereby it prolongs the inefficient decisions taken by the agents in the economy for at least one more round.

(3) Results

The equilibrium concept in this model is that of a sub-game perfect equilibrium. As stated in Rubinstein (1982), there exists a unique pair of stationary sub-game perfect equilibrium proposals in this bargaining model that requires a solution to a fixed point problem, which is computationally a hard problem. Furthermore, Binmore, Rubinstein and Wolinsky (1986) have shown that this equilibrium coincides with the asymmetric Nash bargaining solution if the offers and counter offers continue instantaneously. Mariotti (1999) has shown that the symmetric Nash bargaining solution is a fair allocation. The negotiations for tradable emission permits are, however, very sluggish and, therefore, these negotiations are better represented by an explicit bargaining procedure such as the alternating offers model.

Recently, Houba (2007) proved that the pair of stationary sub-game perfect equilibrium proposals in the alternating offers bargaining model also corresponds to the maximum of the asymmetric Nash product in a single convex program. This convex program allows for a numeric implementation, and sufficient conditions for uniqueness in the contract space can be explicitly stated.

More interestingly, this single program also specifies financial transfers between players and allows for an implementation of production and consumption decisions through decentralized market prices, an aspect that was thus far neglected in bargaining theory, see also the related Houba (2006). If the sufficient conditions for uniqueness in Houba (2007) are satisfied, then the negotiation process ends in a unique sub-game perfect equilibrium allocation of emission permit endowments that is both efficient and fair.

(4) Conclusions

The assessment of the impact of climate damages on the economy is a decisive factor in determining the optimal level of emission targets for the participants on the emission permit market. Currently, economic models lack a proper inclusion of the benefits of climate change policies as foregone damages, which results in far too low emission level targets to be set.

It is advantageous to be the proposing player in the bargaining process. This means that each player gets a better deal according to his own equilibrium proposal compared to what he gets from accepting his opponent's equilibrium proposal.

The underdeveloped world, which does not participate, is also gaining from the bargaining. This is due to trade effects, when energy intensive products of the bargaining parties become relatively more expensive causing consumers and producers to take more of these regions' alternatives into their product mix.

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