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A cost effectiveness differential game model for climate agreements

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In this paper we propose a differential game model with coupled constraint to represent the possible effects of climate negotiations between industrialized and developing countries. Each group of countries is represented by an economic growth model where two different types of economies, called respectively "clean" and "dirty" can co-exist, each of which having different productivities of capital and of emissions due to energy use. We assume that each group of countries participating in the negotiations has identified a damage function, which determines a loss of GDP due to warming and has also a possibility to invest in a capital permitting adaptation to climate change. The climate agreements we consider have two mains components: (i) they establish an international emissions trading scheme, where each group of countries has the total control on the cap they decide for each year, or in other words, their supply of emission quotas; (ii) the agreement defines a total emissions budget for the next 50 year period and impose it as a limit on emissions. This implies that the game has now a coupled constraint for all participants in the negotiations. The outcome of the agreement is therefore obtained as a generalized or "Rosen" equilibrium which can be selected among a whole manifold of such solutions. Finally, we show that the agreement can include a distribution of the total budget among the different parties and we propose an equity criterion to determine a fair division of this total emission budget.

This is a joint work with O. Bahn.

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