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A game-theoretic approach to global warming

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Abstract. In the absence of a world government, stopping the advance of global warming requires implementation of self-enforcing treaties among the countries of the world. In the language of game theory, such treaties are Nash equilibria of an underlying dynamic "climate change game." In this paper, we report on the progress of a project to formulate and analyze models of such a game. The players are the sovereign countries of the world (say the roughly 200 members of the United Nations). The rules of this game are determined by the laws of physics and chemistry, and by the economic resources of the various countries. An important property of our models is the large multiplicity of equilibria. Indeed, this property enables us to find "Pareto-improving" equilibria, i.e., that improve the outcome for every country relative to the "business-as-usual equilibrium" we seem to be in at the present time. In each model we describe the set of equilibria, the business-as-usual equilibrium, and equilibria that are Pareto-improving relative to business-as-usual. Since much of the global warming is caused by the accumulation of greenhouse gases (GHGs) in the earth's atmosphere, and the GHGs dissipate very slowly, an appropriate model must be in the form of a dynamic game, with state variables that change over time as a consequence of the actions of the individual countries. Thus, the state variables include the global stock of GHG and the state of the relevant technology in each country.