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THE MODEL OF AN INTERNATIONAL ENVIRONMENTAL AGREEMENT AMONG ASYMMETRIC NATIONS APPLIED TO DEBRIS MITIGATION

Abstract

The need for space traffic management for earth-orbiting satellites has risen to a near-critical level. International agencies have established legal principles to mitigate debris growth, and there is growing interest in identifying ways to strengthen commitments to mitigation measures.

This paper builds on recent research in the use of game theory to analyze the formation and stability of International Environmental Agreements (IEAs) in pollution reduction. Such IEA coalitions are stable when the aggregate payoff to members is greater than the sum of individual payoffs from leaving the coalition. McGinty (2006) found that the asymmetries between nations in costs and benefits related to greenhouse gas reduction introduced opportunities for gains from international trade in pollution permits sufficient to reduce the incentive to deviate from a properly designed agreement.

We investigate whether McGinty's approach is equally promising for a debris mitigation IEA between space-faring nations. Similarities and differences between the greenhouse gas abatement and debris mitigation scenarios are explored. Issues considered include pricing schemes, technology, security, monitoring and enforcement specific to debris mitigation. The model incorporates a proposed system of transfers between coalition members. Simulations of all possible coalitions of n nations showed that there are reasonable assumptions for asymmetries and transfers under which a self-enforcing IEA for debris mitigation would be stable. In particular, the asymmetries of benefits and asymmetries of (marginal) costs of information-intensive debris mitigation efforts, such as tracking data collection and collision avoidance maneuver planning, are promising areas for significant coordination benefits in such an IEA.

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