

MODELING INTERNATIONAL CLIMATE AGREEMENTS

TOWARDS GLOBAL COOPERATION ON MITIGATING CLIMATE CHANGE

Climate change mitigation provides a global public good: a stable climate system. Consequently, negotiations on climate agreements are suffering from free-riding. We model the economic incentive structures of climate agreements in order to identify treaty designs that strengthen the participation and effectiveness of the agreements.

RESEARCH OBJECTIVES

In absence of a global central authority, climate policy today depends on the voluntary participation of nation states. Theory and past experience suggest a lack of cooperation in mitigating climate change. We explore:

- How can supplementary policy increase the prospect of global environmental treaties?
- Particularly, what is the scope of
 - trade sanctions?
 - permit trade?
 - technology-oriented agreements?

MODELING CLIMATE AGREEMENTS

The main research tool is the Model of International Climate Agreements (MICA). MICA is a multi-region optimal-growth model with endogenous growth and trade. It is currently run for nine symmetric regions. Each region is a maximizer of social welfare (Fig. 1, left). Coalitions may benefit from tariffs or knowledge spillovers (Fig. 1, right).

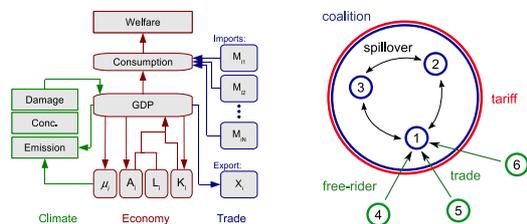


Fig. 1: MICA

EQUILIBRIA AND ALGORITHMS

MICA is solved for Partial Agreement Nash Equilibria, i.e. joint welfare maximization for coalition members and a Nash Equilibrium of the coalition and all non-members. Concepts from non-cooperative coalition theory are employed to identify (internally/externally) stable coalitions.

Solving for a Nash Equilibrium in a dynamic model with trade in the presence of market distortions requires a solution algorithm beyond fictitious play or Negishi's approach:

Repeat: adjust δ_i

$$\left. \begin{array}{l} \max \sum_i \delta_i \text{ Welfare}_i \\ \text{with fixed emissions} \end{array} \right\} \text{trade flows}^*$$

$$\left. \begin{array}{l} \forall_i \max \text{ Welfare}_i \\ \text{with fixed trade and fixed others' emissions} \end{array} \right\} \text{emissions}^*$$

Until the intertemporal budget is balanced

KEY RESULTS

Participation in an international climate agreement increases when signatories impose import tariffs against non-signatories. The effect varies with substitutability of goods and is due to the impact on relative prices (Fig. 2).

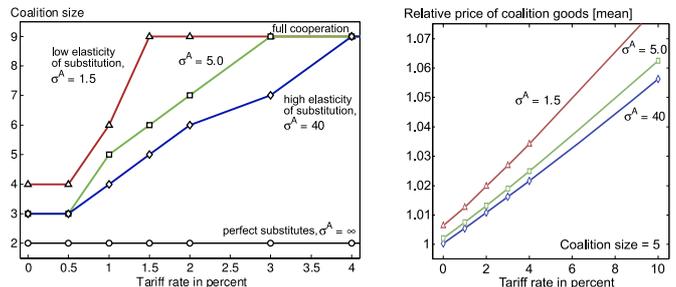


Fig. 2: Tariffs

When research cooperation exhibits spillovers within the coalition, participation rises with their intensity. Spillovers related to mitigation technology are a weaker incentive as their benefits extend also to non-members via reduced climate impacts (Fig. 3).

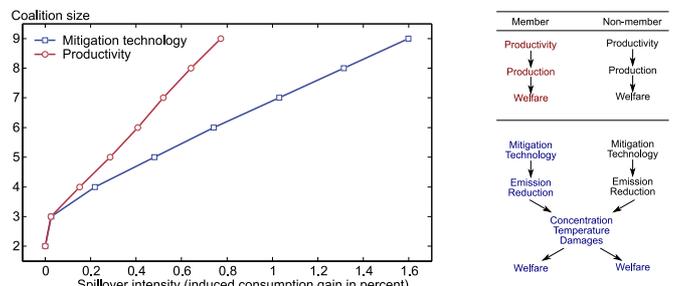


Fig. 3: Research cooperation

WORK IN PROGRESS

- Calibration, to discuss effects quantitatively
- Permit trade, Clean Development Mechanism (CDM)
- Emulation of REMIND-R

PUBLICATIONS

Lessmann, K., R. Marschinski, and O. Edenhofer (2009). *The Effects of Tariffs on Coalition Formation in a Dynamic Global Warming Game*. Economic Modelling 26, 641–649.

Lessmann, K. and O. Edenhofer. *Research Cooperation and International Standards in a Model of Coalition Stability*. Resource and Energy Economics, submitted.