Economics of climate change II

Lecture 12

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Kyoto Protocol

1. Background
   - Toronto 1988 (emissions 80% below 1988 level by 2000)
   - Intergovernmental Panel on Climate Change (IPCC, 1988)
   - Rio 1992
   - Berlin 1995
   - Kyoto 1997
   - Ratified in 2005
2. Content
   - Explicit targets for so called Annex I countries (no developing countries), 2008-12
   - Flexible mechanisms: Annex 1 trading, Joint Implementation (JI), Clean Development Mechanism (CDM)
   - Problems: limited participation, developing countries, carbon leakage

Kyoto problems

- The main problem of Kyoto: participation is limited
- Why is full co-operation so difficult? Economists have good explanations for this, but remedies are limited, i.e., what should be done to improve participation
- Prisoners' dilemma (PD) explanation

		Player Y	
		C	D
Player X	C	$2, 2$	$-1, 4$
	D	$4, -1$	$0, 0$

The Prisoner's Dilemma in the reading assignment:

In what follows, W = total economic welfare, A = abatement cost, D = damages, Q = output, E = actual emissions, $\overline{E}$ = uncontrolled emissions, and μ = emissions control rate $[= (\overline{E} - E)/\overline{E}]$. A key variable is the social cost of carbon (SCC), which is the marginal damage from a unit of emissions. The global SCC is denoted by γ, while θ is the country share of world output and other variables. This first

The basic identity for country i is that welfare equals output minus abatement cost minus damages. Abatement costs are assumed to be quadratic in the emissions reduction rate, $A_i = \alpha\mu_i^2 Q_i = \alpha\mu_i^2\theta_i Q_w$, where α is the identical abatement-cost parameter and Q_w is world output. Damages are proportional to global emissions. All these imply for region i:

$$(1) \qquad W_i = Q_i - A_i - D_i = \theta_i Q_w - \alpha\mu_i^2\theta_i Q_w - \gamma\theta_i(E_i + \sum_{i\neq i} E_j).$$

$$(4) \qquad \overline{\mu}^{NC} = \sum_i \theta_i\mu_i = \sum_i \theta_i^2[\gamma\sigma/2\alpha] = (\gamma\sigma/2\alpha)H(\theta) = \overline{\mu}^{C}H(\theta)$$

$$(5) \qquad \overline{\tau}^{NC} = \sum_i \theta_i\tau_i = \sum_i \gamma\theta_i^2 = \gamma H(\theta) = \overline{\tau}^{C}H(\theta).$$

In these equations, $H(\theta)=\sum_i \theta_i^2$ is the Herfindahl index of country size.

Figure: Nordhaus, AER 2015

How can one sustain cooperation?

- Internal penalties from deviation
  - countries can penalize or reward others by selecting different combinations of strategies
- External penalties
  - linkage to other issues
  - trade sanctions such as those currently on Russia
  - International Monetary Fund or the World Trade Organization
- Nordhaus proposes trade tariffs as sanctions
  - when a country does not participate, the penalty tariff could be 2 percent on imports
  - tariffs is that they are external to the climate game: note that they imply costs through loss of free trade
  - penalties are easy to implement: trade sanctions do not always harm the importer

Some results

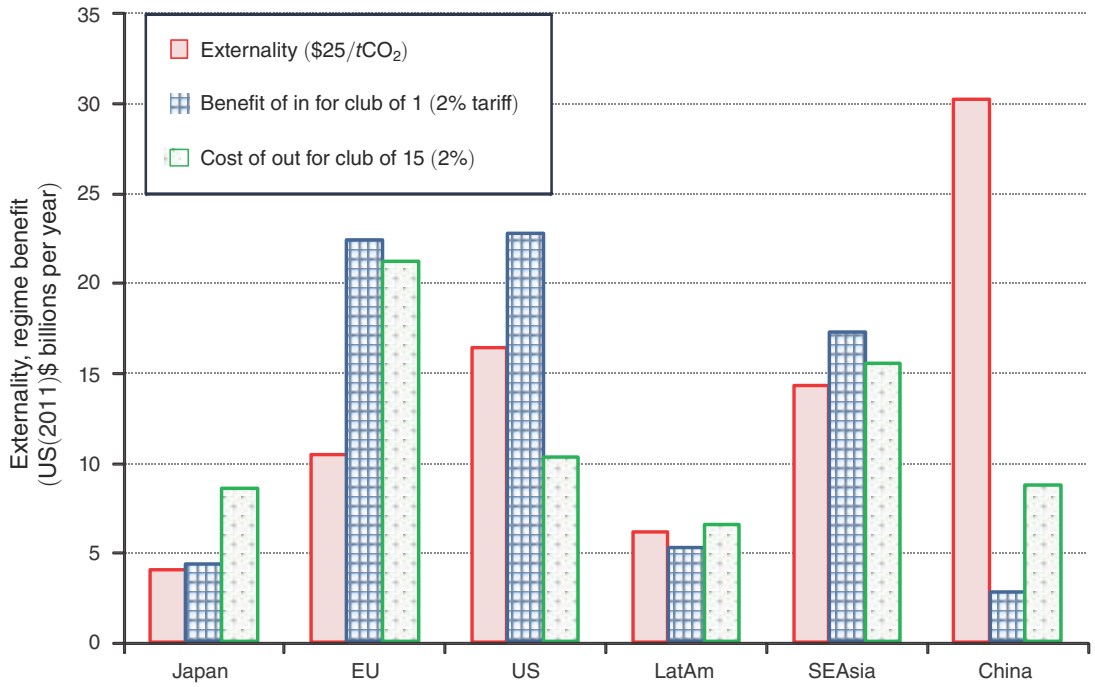

FIGURE 1. COMPARISON OF THE TRANSNATIONAL EXTERNALITY AND THE IMPACTS OF PENALTY TARIFFS BY REGION

Notes: The left-hand externality bar shows the transnational spillover for each region for a $25 per ton global social cost of carbon. The middle benefit bar shows the benefit of participating in a Climate Club with a penalty tariff of 2 percent for clubs of 1 (that is, the region is the only participant). The right-hand cost bar shows the cost of not participating in a Climate Club with a penalty tariff of 2 percent for clubs of 14 (that is, the region is the only nonparticipant).

Figure: Nordhaus, AER 2015