Supply-side environmental policy - Part B

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Literature - Carbon leakage

- Many countries are unlikely to participate in a climate coalition
  - Dixit and Olson '00, Barrett '05, Bernauer '11, Dutta&Radner '11, Karp '11, Kolstad '11, Urpelainen '11
- Creates fear of carbon leakage (Markusen '75, Hoel '94...)
  - If coalition reduces consumption, price declines, nonparticipants consume more
  - If coalition reduces supply, price increases, nonparticipants produce more
- Costly
  - Crowding out in addition to free-riding
  - Coalition sets policies/tariffs which distort trade
  - Green paradox and time-inconsistent policy (Sinn '08)
  - ...

Basic Model (Hoel '94)

- Two set of players, M and N
- $U_i = B_i(y_i) - C_i(x_i) - p(y_i - x_i)$ if $i \in N$
- $U_i = B_i(y_i) - C_i(x_i) - p(y_i - x_i) - H\left(\sum_{M \cup N} y_i\right)$ if $i = M$
- $\sum_{M \cup N} y_i = \sum_{M \cup N} x_i$
- At the first best,

$$\begin{aligned} B_i'(y_i^*) &= B_j'(y_j^*) \quad \forall i, j \in M \cup N \\ C_i'(x_i^*) &= C_j'(x_j^*) \quad \forall i, j \in M \cup N \\ B_i'(y_i^*) &= C_i'(x_i^*) + H'\left(\sum x_i^*\right) \quad \forall i \in M \cup N \end{aligned}$$

The Market for Fuel

The Market for Fuel

- For every $i \in N$,

$$\left\{ \begin{array}{l} B_i'(y_i) = p \\ C_i'(x_i) = p \end{array} \right\} \Rightarrow \left\{ \begin{array}{l} y_i = D_i(p) \equiv B_i'^{-1}(p) \\ x_i = S_i(p) \equiv C_i'^{-1}(p) \end{array} \right\}$$

- $i \in N$ produces and/or consumes too much

The Equilibrium Policy

The Equilibrium Policy

- At stage one, M maximizes

$$\begin{aligned} U_M &= B_M(y_M) - C_M(x_M) - H\left(x_M + \sum_N x_i\right) - p(y_M - x_M) \\ \text{s.t.} & \\ y_i &= D_i(p) \;\; \forall i \in N, \;\; D(p) \equiv \sum_N D_i(p) \\ x_i &= S_i(p) \;\; \forall i \in N, \;\; S(p) \equiv \sum_N S_i(p) \\ \sum_{M \cup N} y_i &= \sum_{M \cup N} x_i. \end{aligned}$$

- Carbon leakage:
  1. If $y_M \downarrow$, then $p \downarrow$ and $y_i \uparrow$
  2. If $x_M \downarrow$, then $p \uparrow$ and $x_i \uparrow$

The Equilibrium Policy

Proposition

- *M's equilibrium policy implements:*

$$\begin{aligned} B'_M(y_M) - p &= \left(\frac{S'(p)}{S'(p) - D'(p)}\right) H' + \frac{y_M - x_M}{S'(p) - D'(p)}, \\ p - C'_M(x_M) &= \left(1 - \frac{S'(p)}{S'(p) - D'(p)}\right) H' - \frac{y_M - x_M}{S'(p) - D'(p)}. \end{aligned}$$

- Implemented by a tax on consumption and production (Hoel, 1994):

$$\begin{aligned} \tau_y &= H' \cdot \left(\frac{S'(p)}{S'(p) - D'(p)}\right) + \frac{y_M - x_M}{S'(p) - D'(p)} \\ \tau_x &= H' \cdot \left(1 - \frac{S'(p)}{S'(p) - D'(p)}\right) - \frac{y_M - x_M}{S'(p) - D'(p)} \end{aligned}$$

The Equilibrium Policy

Proposition

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- or a tax on production and a tariff (Markusen, 1975; Hoel, 1996):

$$\begin{aligned} \tau_x &= H' \\ \tau_I &= H' \cdot \left(\frac{S'(p)}{S'(p) - D'(p)}\right) + \frac{y_M - x_M}{S'(p) - D'(p)}. \end{aligned}$$

A Basic Model (Golombek, Hagem and Hoel '95)

Fossil-fuel deposits can have different emission content. So, if country $i \in N$ supplies x_i units, let its total emission be $E_i(x_i)$, where $E_i'(x_i)$ is the marginal emission content of a deposit located at x_i.

Proposition

M's equilibrium policy is given by:

$$\tau_x = \left(E_M'(x_M) - \frac{\sum_N E_i'(x_i) S_i'(p)}{S'(p) - D'(p)} \right) H' - \frac{y_M - x_M}{S'(p) - D'(p)} \quad (1)$$

$$\tau_y = \frac{\sum_N E_i'(x_i) S_i'(p)}{S'(p) - D'(p)} H' + \frac{y_M - x_M}{S'(p) - D'(p)} \quad (2)$$