International Environmental Agreements, Fiscal Federalism, and Constitutional Choice

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1. Motivation

- Most environmental problems are inter-regional (within and between countries).
- Within jurisdictions, the power to decide on environmental policy often lies with lower levels of governments.
- 'Double' externality:
  - Externality within each country
    → internalisation induced by federal government
  - Externality between countries
    → IEA between polluting regions

1. Motivation

- Issues:
  - Design of intra-country transfer scheme?
  - Implications for IEAs?
  - Decentralisation of environmental policy as endogenous constitutional choice?

- Framework:

  Two-country, four-region model with Nash bargaining and intra-country transfer scheme (matching grants and compensation payments).

1. Motivation

- Related literature:
  - Fiscal Federalism

    (e.g., Oates, 1972; Guttman, 1978; Danziger and Schnytzer, 1991; Kaul et al., 2003; Boadway et al., 2007)

  - Strategic delegation (and other strategic actions) prior to environmental negotiations

    (e.g., Copeland, 1990; Hoel, 1991; Buchholz and Konrad, 1994; Buchholz and Haslbeck, 1997; Segendorff, 1998; Eckert, 2003; Buchholz , Haupt, Peters, 2005; Beccherle and Tirole, 2011; Harstad, 2012)

2. Model

- Two countries, each consists of two regions.
- One region of each country generates emissions e_i.
- Environmental damage in country i: $D_i = e_i + se_j$, $s \in (0,1]$
- Emissions e_i depends on abatement a_i: $e_i = \bar{e} - a_i$
- Damage without/with abatement:

$$\bar{D} = (1+s)\bar{e}, \quad D_i = \bar{D} - (a_i + sa_i)$$

2. Model

- Abatement costs: $E(a_i),\ E'(a_i) > 0,\ E''(a_i) > 0$
- Total costs of country *i*:

$$TC_i^F = \left[\overline{D} - \left(a_i + sa_j\right)\right] + E(a_i)$$

2. Model

- Damage share borne by the polluting/non-polluting region:
  αD_i and $(1-\alpha)D_i$, $\alpha \in (0,1)$

- Transfer scheme:
  - Matching grant: $m_i E_i(a_i)$, $m_i \in [0,1]$
  - Compensation payment: $\beta_i D_i$, $\beta_i \in [0, 1-\alpha]$

- Total costs of country i's polluting region:

$$TC_i^R = (\alpha + \beta_i)\left[\overline{D} - (a_i + sa_i)\right] + (1 - m_i)E(a_i)$$

2. Model

- Timing:
  1. Federal governments non-cooperatively decide on transfer schemes:

     matching grants m_i, compensation payment β_i

  2. Two polluting regions bargain over abatement levels and side payments (Nash bargaining):

     abatement a_1 and a_2; side payment S_i

- (Extension:
  - Stage 0: constitutional choice on decentralisation.)

2. Model

- Subgame-perfect equilibrium.

- Benchmark: globally efficient abatement policy.

  Minimising $\max \sum_{i=1}^{2} TC_i^F$ yields first-order condition:

$$E'(a^{opt}) = 1 + s$$

3. Bargaining between the Polluting Regions

- Threat point:
  - Each polluting region minimises TC_i^F, leading to the first-order condition:

$$(1-m_i)E'(a_{in}) = \alpha + \beta_i .$$

  - Comparative statics:

$$\frac{da_{in}}{d\beta_i} > 0, \quad \frac{da_{in}}{dm_i} > 0.$$

3. Bargaining between the Polluting Regions

- Nash bargaining with side payments:
  - Governments of the two polluting regions minimise their aggregate costs $\sum_{i=1}^{2} TC_i^R$, yielding the foc:

$$(1-m_i)E'(a_{ic}) = \alpha + \beta_i + s(\alpha + \beta_j)$$

  - Comparative statics:

$$\frac{da_{ic}}{d\beta_i} > 0, \quad \frac{da_{ic}}{dm_i} > 0, \quad \text{and} \quad \frac{da_{ic}}{d\beta_j} > 0$$

3. Bargaining between the Polluting Regions

– Side payments such that both negotiating regions enjoy the same reduction in total costs compared to threat point:

$$TC_i^R\left(a_{in}, a_{jn}\right) - TC_i^R\left(a_{ic}, a_{jc}\right) - S_i =$$
$$TC_j^R\left(a_{in}, a_{jn}\right) - TC_j^R\left(a_{ic}, a_{jc}\right) + S_i$$

4. The Strategic Choice of the Transfer Scheme

- Each federal government minimises the total costs of country *i* including side payments, $P_i^F = TF_i^F + S_i(\tau)$:

$$P_i^F = \left[\overline{D} - \left(a_{ic}(\tau) + sa_{ic}(\tau)\right)\right] + E(a_i(\tau)) + S_i(\tau)$$

- First-order conditions ('interior' solution):

$$\frac{\partial P_i^F}{\partial \beta_i} = -\left(\frac{\partial a_{ic}}{\partial \beta_i} + \frac{\partial a_{jc}}{\partial \beta_i}\right) + E' \frac{\partial a_{ic}}{\partial \beta_i} + \frac{\partial S_i}{\partial \beta_i} = 0$$

$$\frac{\partial P_i^F}{\partial m_i} = -\frac{\partial a_{ic}}{\partial m_i} + E' \frac{\partial a_{ic}}{\partial m_i} + \frac{\partial S_i}{\partial m_i} = 0$$

4. The Strategic Choice of the Transfer Scheme

Proposition 1: symmetric subgame-perfect equilibrium.

- The compensation rate internalises the domestic externality only partially, i.e. $\beta^* < 1 - \alpha$.
- The polluting regions' shares of the abatement costs exceed its share of the environmental damage including compensation payments, i.e. $1 - m^* > \alpha + \beta^*$.
- The abatement levels are inefficiently low, i.e. $a^* < a^{opt}$, and thus environmental damage is inefficiently high.

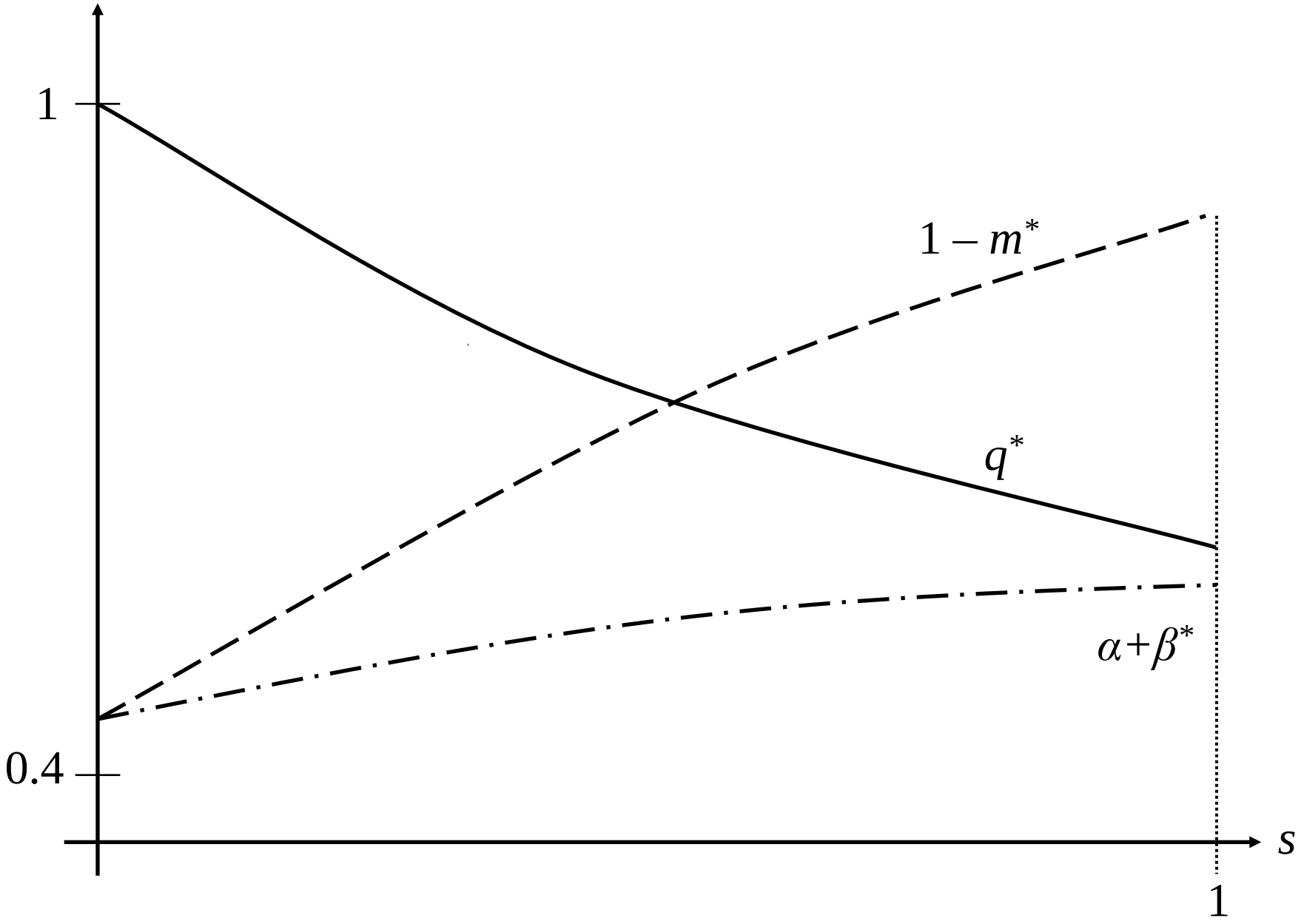
5. Policy Mix and International Spillover

- Quadratic abatement costs: $E(a_i) = (1/2)a_i^2$.
- Efficiency ratio:

$$q^* := \frac{\alpha + \beta^*}{1 - m^*},$$

  where $q^* = 1$ implies an 'efficient' transfer scheme.

- How does the spillover parameter *s* affect the transfer scheme and the efficiency ratio?


1
0.4
1 – m*
q*
α+β*
s
1

5. Policy Mix and International Spillover

Proposition 2: quadratic abatement cost function.

- The compensation rate increases, while the matching rate decreases, with the international spillover parameter.
- The efficiency ratio declines, as the spillover parameter increases.

5. Policy Mix and International Spillover

- Only one policy instrument and the inefficiency of transfer schemes?

- Two cases:

$$\beta^{**} = \beta^{*}\Big|_{m=0} \quad \rightarrow \quad q_{\beta}^{**},$$

$$m^{**} = m^{*}\Big|_{\beta=0} \quad \rightarrow \quad q_{m}^{**}.$$

5. Policy Mix and International Spillover

Proposition 3: Only one policy instrument.

- The rates β^{**} and m^{**} and the corresponding efficiency ratios q_{β}^{**} and q_{m}^{**} decline with the spillover parameter s.
- The rates β^{**} and m^{**} exceed the counterparts β^{*} and m^{*}, whereas the efficiency ratios q_{β}^{**} and q_{m}^{**} fall short of q^{*}.

6. Constitutional Choice

- Stage 0: the federal governments non-cooperatively decide whether they decentralise environmental decision making or not.

Proposition 3:

In a symmetric subgame-perfect equilibrium, both federal governments delegate the authority to decide on environmental policy and to negotiate IEAs to the government of their polluting region.

7. Concluding Remarks

- Incentives for federal governments to ‘distort’ intra-country transfer schemes when regional governments negotiate IEAs, leading to inefficient IEAs.
- Decentralisation emerges endogenously.
- ‘Mixed’ federalism: countries first decentralise, but then impose transfer schemes to steer the decisions of the polluting regions.

7. Concluding Remarks

- Decentralisation bad news for the environment and efficiency; however, given that the political system is decentralised, the inefficiency of IEAs will become worse if federal governments can only apply one instrument.

- Extensions: only transfer schemes that make all regions in a country better off feasible.

Many thanks for your interest.