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

IEA, Fiscal Federalism, and Constitutional Choice
2. Model

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

\[
TC^F_i = [\bar{D} - (a_i + sa_j)] + E(a_i)
\]
2. Model

- Damage share borne by the polluting/non-polluting region: \( \alpha D_i \) 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:

\[
TC^R_i = (\alpha + \beta_i)[\overline{D} - (a_i + sa_i)] + (1 - m_i)E(a_i)
\]
2. Model

- Timing:
  1. Federal governments non-cooperatively decide on transfer schemes:
     matching grants \( m_i \), compensation payment \( \beta_i \)
  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 \( \sum_{i=1}^{2} TC_i \), 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:

\[ TC_i^R(a_{in}, a_{jn}) - TC_i^R(a_{ic}, a_{jc}) - S_i = \]
\[ TC_j^R(a_{in}, a_{jn}) - TC_j^R(a_{ic}, a_{jc}) + S_i \]
4. The Strategic Choice of the Transfer Scheme

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

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

- 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?
\[ \alpha + \beta^* \]

\[ 1 - m^* \]

\[ q^* \]
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:

\[
\beta^{**} = \beta^* \bigg|_{m=0} \rightarrow q^{**},
\]

\[
m^{**} = m^* \bigg|_{\beta=0} \rightarrow q^{**}.
\]
Proposition 3: Only one policy instrument.

- The rates $\beta^{**}$ and $m^{**}$ and the corresponding efficiency ratios $q_{\beta}^{**}$ and $q_{m}^{**}$ decline with the spillover parameter $s$.

- The rates $\beta^{**}$ and $m^{**}$ exceed the counterparts $\beta^{*}$ and $m^{*}$, whereas the efficiency ratios $q_{\beta}^{**}$ 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.