Optimal Degree of Decentralisation in the Disposal of Waste: a Welfare Approach

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Motivation

- Waste prevention is the top aim of European policy’s ‘waste hierarchy’
- By 2020 waste generation should be in absolute decline, according to the EU’s Roadmap to a Resource Efficient Europe
- Still little evidence of permanent decoupling
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Mostly empirical and related to the existence of decoupling

Theoretical literature does not agree on which Government level is more efficient to reduce the negative impacts of waste disposal activities
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Research Questions

- Which level of centralisation is more efficient from a welfare point of view?
- Final waste disposal across Regions should be encouraged?
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- Final waste disposal across Regions should be encouraged?
Main findings.

- Centralisation in decision maximises total welfare, but it may not be the preferred solution from a Regional perspective.
- Waste disposal across Regions may improve welfare provided that the price takes spillovers into account.
- Marginal cost pricing may produce a “race to the bottom” effect.
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The model (1)

- Community divided into two equally sized Regions 1 and 2 endowed with a fixed income $Y$ and an environmental good $z$
- Income generates waste $(q_i)$, $w_i$ is the quantity disposed of in region $i$. Waste reduces the environmental good at rate $v$
- Waste can be treated to reduce environmental damage. Cost is region-specific and equal to $p_i$
- Pollution can be reduced by investing in a technology that lowers emissions by a quantity $r_i$.

$$v \left( w_i^2 - \alpha_i r_i w_i \right); \quad i = 1, 2$$  \hspace{1cm} (1)

$\alpha_i =$ productivity of the region-specific investment.
Community divided into two equally sized Regions 1 and 2 endowed with a fixed income $Y$ and an environmental good $z$.

Income generates waste $(q_i)$, $w_i$ is the quantity disposed of in region $i$. Waste reduces the environmental good at rate $\nu$.

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$$v \left(w_i^2 - \alpha_i r_i w_i\right); \quad i = 1, 2 \tag{1}$$

$\alpha_i$ = productivity of the region-specific investment.
Pollution spillovers at rate $k$

the environmental good, net of the damage produced by waste disposal activities, can be written as:

$$z - v \left[ (w_i^2 - \alpha_i r_i w_i) + k (w_j^2 - \alpha_j r_j w_j) \right]$$

Investment to protect the environment has a cost equal to

$$\frac{\theta_i}{2} r_i^2 w_i$$

where $\theta_i$ is a productivity parameter

$\alpha$ and $r_i$ are positively correlated
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Welfare:

\[ W_i = Y_i + \beta \left( z - v \left( (w_i^2 - \alpha_i r_i w_i) + k (w_j^2 - \alpha_j r_j w_j) \right) \right) \]
\[ \frac{\theta_i r_i^2 w_i}{2} - p_i w_i - m^c (q_i - w_i) \]

\( m \) = the price paid by each local authority for waste to be disposed of in the other region.
**FB solution**

**Total welfare**

\[
W^\text{FB} = \sum_{i=1}^{2} Y_i + z - \nu \left( (w_i^2 - \alpha_i r_i w_i) + k \left( w_j^2 - \alpha_j r_j w_j \right) \right) - \frac{\theta_i r_i^2 w_i}{2} - p_i w_i - m^\text{FB} (q_i - w_i)
\]

\[
w_i = q + \frac{\beta \nu (1+k)}{8} \left( \frac{\alpha_i}{\theta_i} - \frac{\alpha_j}{\theta_j} \right) - \frac{1}{4} \frac{p_i - p_j}{\beta \nu (1+k)}
\]

\[
r_i = \frac{\beta \nu \alpha_i (1+k)}{\theta_i}
\]

\[
m^\text{FB} = 2q\beta \nu (1-k) + \frac{\beta^2 \nu^2 (3k^2 + 2k - 1)}{4} \left( \frac{\alpha_i^2}{\theta_i} + \frac{\alpha_j^2}{\theta_j} \right) + \frac{p_i + p_j}{2}
\]
Total welfare

\[ W^{FB} = \sum_{i=1}^{2} Y_i + z - \nu \left( (w_i^2 - \alpha_i r_i w_i) + k (w_j^2 - \alpha_j r_j w_j) \right) \]

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Centralisation

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Table: Optimal solution for the Centralised case

- Solution with mobility preferred to no mobility from a total welfare point of view
- For each Region the choice depends on the level of $m$ chosen. If $m$ equal to marginal cost, most efficient Region prefers no mobility to mobility
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