GLOBAL CLIMATE CHANGE AND THE EQUITY - EFFICIENCY PUZZLE

Key Question

Under what conditions is the Pareto-efficient stock of atmospheric carbon independent of the initial distribution of carbon rights?

Policy Relevance

• The equity conflict could be separated from the issue of efficiency
• Equity could be based on allocating emission shares to individual nations
• Efficiency could be achieved through trading these rights internationally
Analysis Relevance

- Integrated Assessment Analyses typically employ a Negishi procedure.
- If there is separability between equity and efficiency in greenhouse gas abatement, Negishi weights do not change.

Small-scale Analytical Model

- R regions cooperate in the solution of the global climate problem.
- One internationally traded, private good and a common good, “climate quality”
- Two cases: market damages only, both market and non-market damages.
Market effects

Damages can be directly expressed in units of GDP, e.g., losses in agricultural production

Non-market effects

refer to those not included in the national income accounts, e.g., the impacts on biodiversity, environmental quality and human health

Market Damages Only

\[
\begin{align*}
\text{max} & \quad \sum_r \omega_r U_r[c_r] \\
\text{s.t} & \quad \sum_r \Phi_r(Q)_r y_r \geq \sum_r c_r + \sum_r g_r(a_r), \\
& \quad Q = \sum_r a_r \\
& \quad \text{Negishi weights do not affect optimality} \\
& \quad g'_r(a_r) = \left[ \sum_{j=1,...,R} \Phi'_j(Q) y_j \right] \forall r \\
& \quad \text{Separability is observed}
\end{align*}
\]
**Market & non-Market Effects**

\[
\max \sum_r \omega_r U_r[c_r, Q]
\]

- Optimality depends on Negishi weights

\[
g'(a) = \left[ \sum_j \Phi'_j(Q) y_j \right] + \sum \omega_j / \frac{\partial U_j}{\partial Q}
\]

\[
g'(a) - \left[ \sum_j \Phi'_j(Q) y_j \right] = \sum_j \left[ \frac{\partial U_j}{\partial Q} \frac{\partial U_j}{\partial c_j} \right]
\]

**First Conclusions**

Separability prevails if income effects do not affect aggregated willingness-to-pay (i.e., the price of the global common)

- or willingness-to-pay is independent of income
- or identical homothetic preferences
- or income effects are small
Large-scale numerical model

Simulations are based on MERGE 3 assignment rules for emission rights:

- **Egalitarian**: in proportion to initial population
- **Grandfathering**: in proportion to initial emissions
- **Pragmatic**: transition from grandfathering to egalitarian

Global Emissions

[Graph showing global emissions from 2000 to 2100 with trends for business-as-usual and three alternative burden-sharing rules.]
Price of Emission Permits

Negishi weights for the different assignment rules

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