

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?

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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

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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

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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

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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

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Market Damages Only

$$\max \sum_r \omega_r U_r[c_r]$$

$$\text{s.t. } \sum \Phi_r(Q) y_r \geq \sum_r c_r + \sum_r g_r(a_r),$$

$$Q = \sum_r a_r$$

- Negishi weights do not affect optimality

$$g'_r(a_r) = [\sum_{j=1, \dots, R} \Phi'_j(Q) y_j] \quad \forall r$$

- Separability is observed

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Market & non-Market Effects

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

- Optimality depends on Negishi weights

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

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

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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

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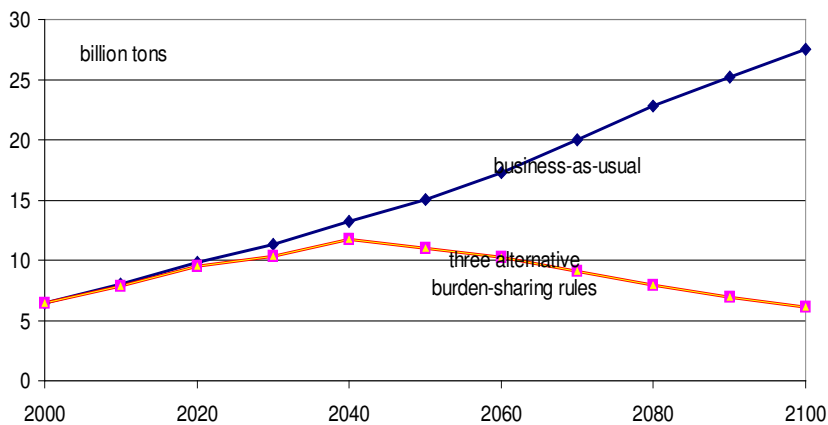
Large-scale numerical model

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

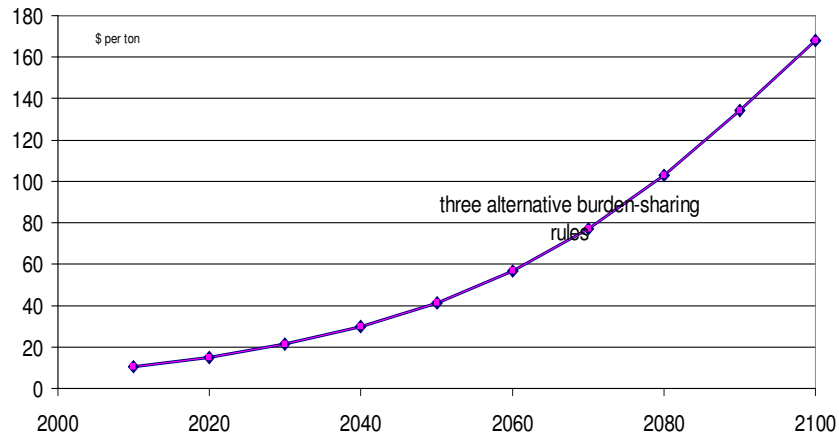
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Global Emissions



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Price of Emission Permits



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Negishi weights for the different assignment rules

	Egalitarian	Pragmatic	Grand-fathering	Egalitarian/Grandfathering
USA	0.224516	0.224759	0.225367	0.996
WEUR	0.225625	0.225738	0.226022	0.998
JAPAN	0.089233	0.089272	0.089370	0.998
CANZ	0.032243	0.032280	0.032371	0.996
EEFSU	0.044120	0.044191	0.044370	0.994
CHINA	0.094155	0.094065	0.093837	1.003
INDIA	0.044032	0.043879	0.043492	1.012
MOPEC	0.047114	0.047117	0.047130	1.000
ROW	0.198962	0.198700	0.198041	1.005
TOTAL	1.000000	1.000001	1.000000	

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