

Potsdam Institute for Climate Impact Research

Quantifying an efficiency-sovereignty trade-off in (international) climate policies

PIK Lectures NAVIGATE webinar, February 18, 2021

Nico Bauer, @NB_pik Christoph Bertram, Anselm Schultes, Ottmar Edenhofer, Elmar Kriegler, Gunnar Luderer, Alex Popp Potsdam Institute for Climate Impact Research (PIK), Germany





Introduction

- How to achieve well-below 2°C target with equitable effort sharing
 → Avoid regressive economic effects across economies
- Sovereignty
 - This study: Limit international transfer payments
 - Not: avoiding mitigation policies, but rather free-riding
 - (Achieve targets uni-laterally without international offset mechanisms; no Art. 6 PA)
- Not focus here, but ongoing work at PIK
 - Efficiency gains from integrating fragmented NDC policies \rightarrow Edmonds, et al., in prep.
 - − Need to strengthen NDCs to achieve Paris targets → Kriegler et al., in revision
 - Intranational distribution and poverty eradication (SDG1) → e.g. Sörgel, accepted
 - CDR, overshoot flexibility and distribution of mitigation costs → e.g. Strefler, in prep.;
 Bauer et al., in prep.
 - − Climate change impacts and distributional issues → EU-NAVIGATE, CHIPS



Introduction – International inequality and climate policies



- OECD countries have high per-capita incomes
- ... high CO_2 emissions per capita
- high carbon productivity
- high energy productivity
- Climate change is a global commons good problem
- Each ton of CO₂ is equal
- International agreement required among sovereign nation states
- Nordhaus (2015): Westphalien problem (Refers to peace treaty of 1648 ending Europes 30 year war. But it is a flawed comparison, if you dig a bit deeper.)





- 1. Transition pathways
 - i. Usually, effort sharing not the focus
 - ii. Assumption: unifom C-price w/o transfer
 - iii. Regressive policy effect





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Differences of emission reductions in 2040

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REMIND-MAgPIE



Differences of mitigation costs in 2040

GRAPE

REMIND-MAgPIE

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1. Transition pathways

2. Effort-sharing

- i. Cap-and-trade system
 - → uniform C-price implies cost-efficiency
- ii. Permit allocation neutralizes regressive effects
- iii. Inverse approach of equal effort sharing
- ➔ Huge financial transfers via permit trade
- → (Usually) transition pathways not affected





Leimbach & Giannousakis (2019)





- 1. Transition pathways
- 2. Effort-sharing

3. This study

- i. Exogeneous: emission target & equal effor
- ii. Differentiate C-prices and vary transfers
- iii. Cost-efficiency not maintained
- iv. Transition pathways change



Methodology Integrated Assessment Models



Methodology – REMIND-MAgPIE model



Energy-economy and land-use model

12 regions up-until 2100

Trade in goods, energy and food

All GHGs from all sources

SSP2 drivers applied

2020 fixed to NDC policies

Carbon tax starts 2025 growing at 5% p.a.

Total budget 2016-2100 is 1300GtCO2

Effort indicator: equal relative income loss 2021-2100 discounted at 5% p.a.

➔ Avoid regressive income effects



Results

Corner solutions of the Trilemma



Trilemma: Cost-efficiency, sovereignty and equity



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Trilemma: Cost-efficiency, sovereignty and equity



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Trilemma: Cost-efficiency, sovereignty and equity



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Results The trade-off curve





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Computing the trade-off curve



- 1. Compress set of regional carbon prices
- Shift set of carbon prices to comply with global carbon price using REMIND-MAgPIE
 → mitigation costs
- 3. Compute transfers to fulfill equal effort criterion





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[max. ratio regional carbon prices]



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[max. ratio regional carbon prices]



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Results Timing of mitigation





Scenarios Uniform Baseline











Discussion and conclusion

- Inequality is a crucial point for international climate policy
- Trilemma: costs, equity and sovereignty
- Corner solutions lead to excessive outcomes
 - Cost-efficient w/o transfers → rel. mitigation costs vary by factor 10
 - − Cost-efficient w/ transfers → huge transfer sums
 - Fully differentiated \rightarrow carbon prices differ by a factor more than 100
- Small transfers and off-set mechanisms reduce policy differentiation
 - Global costs decrease substantially
 - Market distortions are reduced reducing carbon leakage and CDR
 - Regional transition and mitigation timing more synchronous (e.g. carbon neutrality)
 - Technology road maps become asynchronized
- Additional sectoral and technology policies can help to reduce inefficiencies and market distortions



Future Research

- Different metrics and treatment of pre-existing taxes
- Include damages and adaptation
 - Sensitivity to damage functions?
 - Effects of equity weighing?
- How do get onto the trade-off curve?
 - Conditional mitigation commitments
 - Form & broaden climate clubs with tax harmonization and external tariffs
 - Alternative: how to shift the feasibility frontier?
- What are substitutes for transfers?
 - Technology development and transfers
 - Adaptation assistance
 - Debt relief
 - Issue linkage with other SDGs



Transfers over time



Region — non-OECD — OECD



Methodology – The broader perspective



Hard-link and soft-link: Bauer, Nico, Ottmar Edenhofer, and Socrates Kypreos, 'Linking Energy System and Macroeconomic Growth Models', *Computational Management Science*, 5 (2008), 95–117 https://doi.org/10.1007/s10287-007-0042-3