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Thomas Bourany

University of Chicago

The Optimal Design of Climate Agreements

Inequality, Trade, and Incentives for Climate Policy

EUROPEAN CENTRAL BANK

EUROSYSTEM

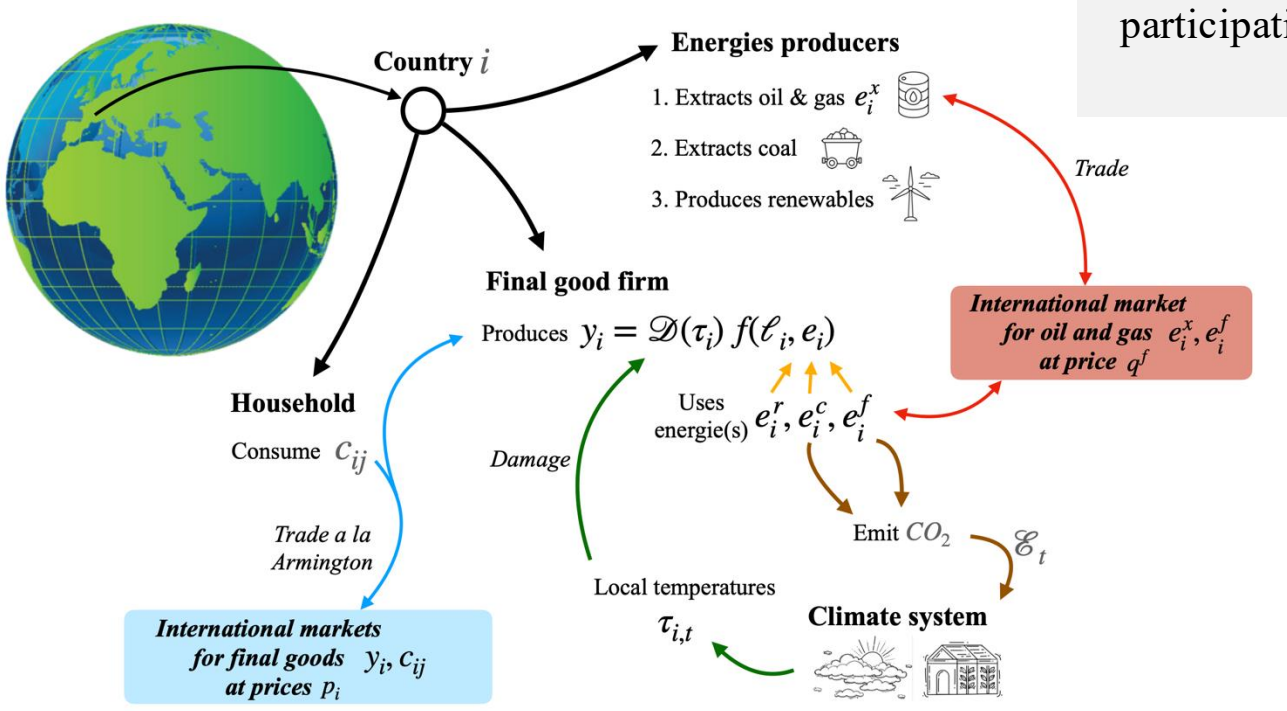
The free-riding problem of climate policy

Despite urgency, nations fail to enact strong climate policies.
The cause: **free-riding incentives**, exacerbated by inequalities, climate change, and redistributive effects of carbon taxation – on energy markets and carbon trade leakage.

- *Traditional answer:* international climate agreements, e.g. UN's COP
- *Trade policy:* potential to incentivize foreign emissions reductions
- *Climate Club:* Nordhaus (2015), idea of clubs where members set a carbon tax and impose tariff retaliation to foster participation

Question: What is the optimal design of the climate club ?

This paper: Determines the optimal taxation of carbon in the presence of inequality, trade, and endogenous participation due to free-riding strategic incentives.



Summary

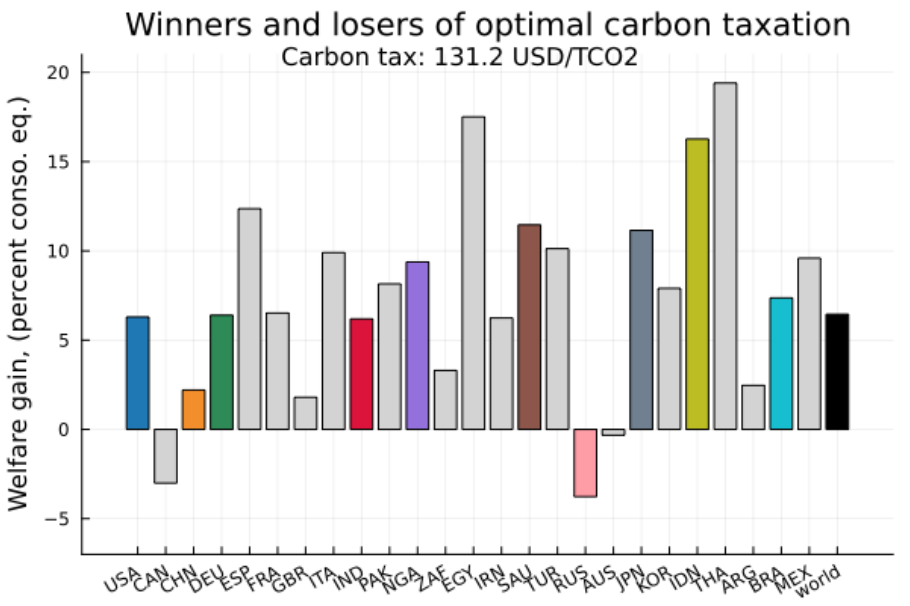
I design the optimal climate agreement – or "climate club" (Nordhaus) – in the presence of inequality, trade, and free-riding incentives.

1. Trade-off between **extensive margin** – higher participation of countries in a "climate club" – and **intensive margin** – fewer countries with larger emission reductions and higher carbon tax.
2. The optimal climate club: (i) gathers all the countries in the world except oil producers (Russia, Iran, Saudi Arabia, Nigeria), (ii) **carbon tax is \$110**, which is \$20 lower than the globally optimal tax absent free-riding (iii) moderate **tariffs of 50%** important to incentivize participation, but not enough to encourage the whole world

Climate – Economy model (IAM) with inequality, energy, and trade

Rich quantitative model with heterogeneity across countries in:

- Income (TFP/GDP)
- Trade flows
- Energy-mix: oil-gas, coal, renewables.
- Fossil-fuel exports/imports
- Damages from climate (temperature)



Benchmark – Optimal carbon policy

Second-Best Pigouvian-Ramsey taxation problem:

Absent Free-riding, the Planner chooses a uniform carbon tax t^{ε} to maximizes world welfare:

$$\mathcal{W} = \max_{\mathrm{t}^{\varepsilon}} \sum_{i \in \mathbb{I}} \omega_i \, \mathcal{U}_i(\mathbb{I}, \mathrm{t}^{\varepsilon})$$

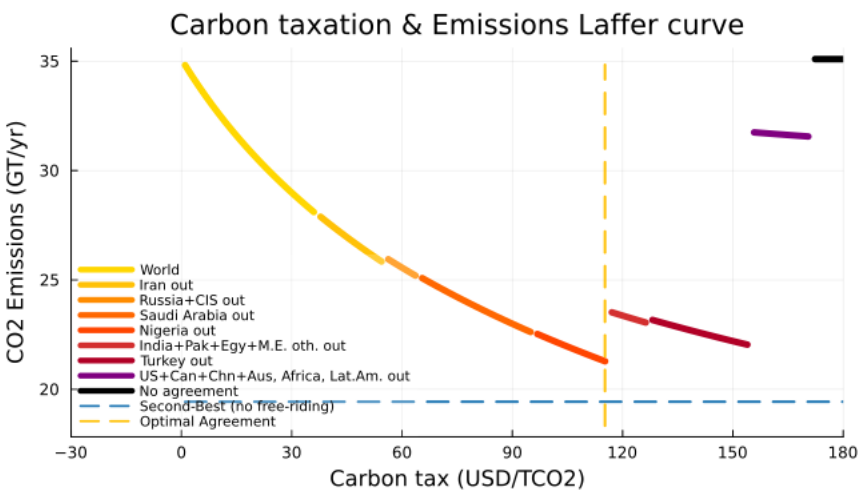
No redistributive instruments:
Carbon tax differs from the Social Cost of Carbon $\Rightarrow$ $\mathrm{t}^{\varepsilon} \neq SCC$

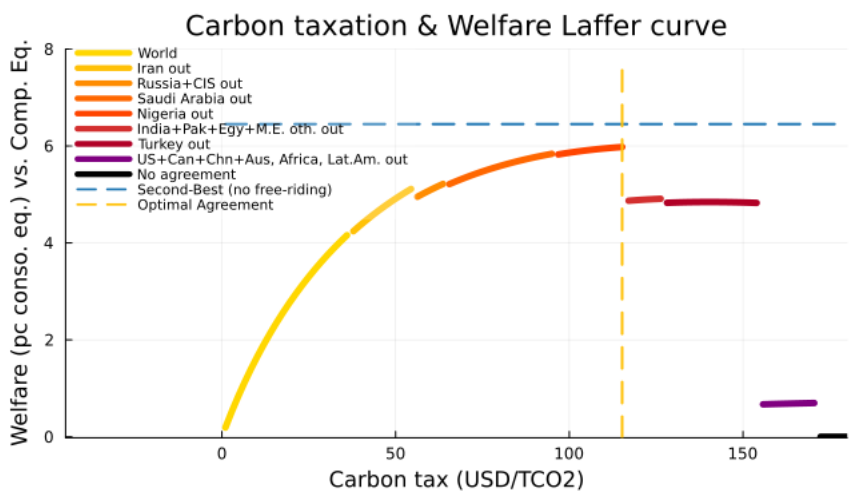
Climate agreement design as a "Climate Club"

Def: A climate agreement is a set $\{\mathbb{J}, \mathrm{t}^{\varepsilon}, \mathrm{t}^{b}\}$ with $\mathbb{J} \subseteq \mathbb{I}$ countries s.t.:

- Countries $i \in \mathbb{J}$ are subject to a carbon tax t^{ε} on fossil fuels e_i^f, e_i^c
- If country j exits the agreement, club members $i \in \mathbb{J}$ impose uniform tariffs $\mathrm{t}^{b}_{ij} = \mathrm{t}^{b}$ on goods from j.
- Exit unilateral deviation of j : $\mathbb{J}\backslash\{j\}$ $\Rightarrow$ **Nash-Equilibrium**
- Participation constraints, indirect utility $\mathcal{U}_i(\mathbb{J}, \mathrm{t}^{\varepsilon}, \mathrm{t}^{b}) \equiv u(c_{i(\mathbb{J},\mathrm{t}^{\varepsilon},\mathrm{t}^{b})})$

$$\mathcal{U}_i(\mathbb{J}, \mathrm{t}^{\varepsilon}, \mathrm{t}^{b}) \geq \mathcal{U}_i(\mathbb{J}\backslash\{i\}, \mathrm{t}^{\varepsilon}, \mathrm{t}^{b}) \qquad \forall i \in \mathbb{J}$$





Optimal Design of Climate agreements

World Social Planner searching for the optimal climate club

$$\max_{\mathbb{J},\mathrm{t}^{\varepsilon},\mathrm{t}^{b}} \mathcal{W}(\mathbb{J}, \mathrm{t}^{\varepsilon}, \mathrm{t}^{b}) = \max_{\mathrm{t}^{\varepsilon},\mathrm{t}^{b}} \max_{\mathbb{J}} \sum_{i \in \mathbb{I}} \omega_i \, \mathcal{U}_i(\mathbb{J}, \mathrm{t}^{\varepsilon}, \mathrm{t}^{b})$$

$$s.t. \qquad \mathbb{J} \in \mathbb{C}(\mathrm{t}^{\varepsilon}, \mathrm{t}^{b}) = \left\{ \mathcal{J} \;|\; \mathcal{U}_i(\mathbb{J},\mathrm{t}^{\varepsilon},\mathrm{t}^{b}) \geq \mathcal{U}_i(\mathbb{J}\backslash\{i\},\mathrm{t}^{\varepsilon},\mathrm{t}^{b}), \quad \forall i \in \mathcal{J} \right\}$$

Current design: (i) choose taxes $\{\mathrm{t}^{\varepsilon}, \mathrm{t}^{b}\}$
(ii) choose the coalition $\mathbb{J}$ s.t. participation constraints hold

Trade-off: cost of carbon tax vs. cost of tariffs

- Countries participate depending on:
  - (i) the cost of distortionary carbon taxation
  - (ii) the cost of tariffs (= the gains from trade)
- Russia/Middle East/South Asia do not join the club for high carbon tax, *for any tariffs*, because cost of taxing fossil-fuels ≫ cost of tariffs / autarky

Result: need to decrease carbon tax, from \$130 to 110/tCO$_2$