The Global Effects of Carbon Border Adjustment Mechanisms

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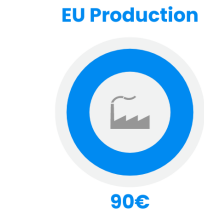
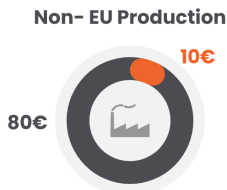
Carbon border adjustment mechanism (CBAM)





EU production is subject to the **EU-ETS***

(Assuming an ETS allowance price of 90€ per tonne of CO2)

Non-EU production is subject to a lower **ETS** and **CBAM certificates**

This paper

- Quantitative analysis of European CBAM policies
  - Global equilibrium framework
  - Microdata on key target sectors

- CBAM impacts for a $100 European carbon tax
  - Improved competitiveness and leakage
  - Some improved incentives
  - Similar incidence for lower-income trading partners

This paper

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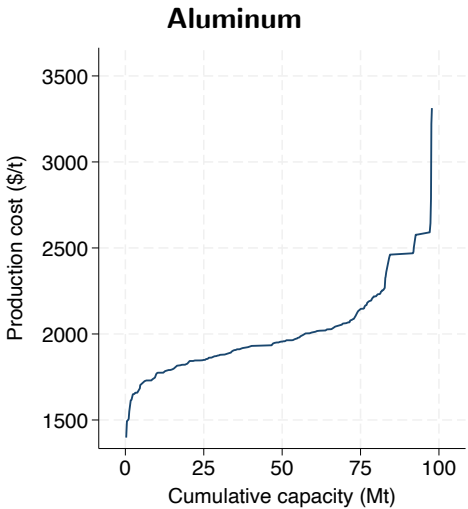
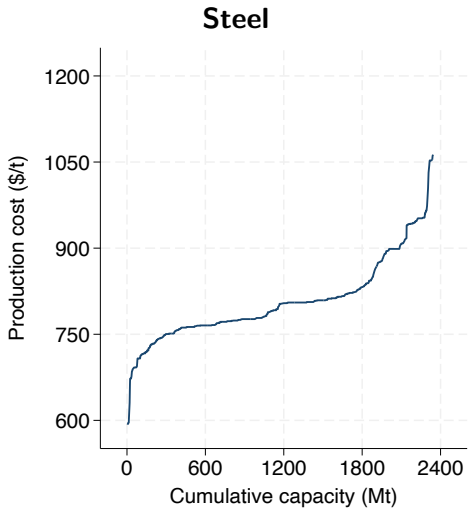
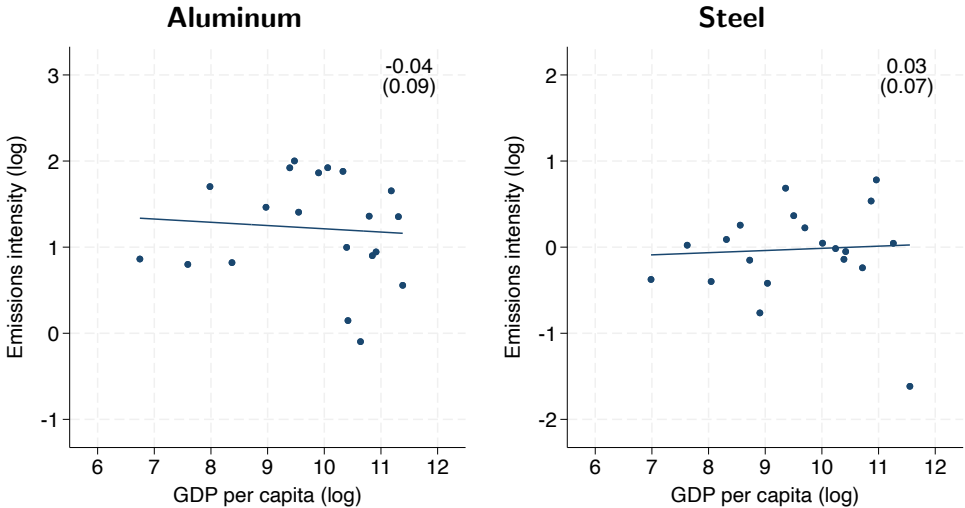
Data

Global data by plant for 2023





Flat emissions intensity by income



Emissions are not systematically higher in lower-income countries

- Even controlling for differences in production
  - For aluminum, because electricity is similarly emissions-intensive
  - For steel, because emissions intensities are compressed
- The CBAM generates a global green premium

Model

Environmental regulation with global trade

- Carbon tax τ in **regulated** market R; none in **unregulated** U
- Without CBAM, only R firms pay τ
  - Less competitive + leakage to U + free-riding by U
- CBAM pushes sales to U, such that $P^R > P^U$
  - More competitive + less leakage to U + fiscal incentive for U
- Incidence depends on firm **data**

Demand $D^m(P^m)$ by market m

$$\log D_{jt} = \delta_j + \delta_t + \varepsilon \log P_{jt} + \epsilon_{jt}$$

- Estimated with historical global data for metals j, years t
  - Assuming common elasticity and world prices
- Endogeneous prices
  - Instrument: Australia's share of global ore production

Supply $s_i^m(p_i^m)$ by plant i

$$
\begin{aligned}
u_{il}^m &= \overbrace{\beta(p_i^m - c_i) + \epsilon_i}^{v_i^m} + \epsilon_{il} && \text{choice to operate lines } l \\
o_i^m &= \exp(v_i^m)/[1+\exp(v_i^m)] && \text{capacity utilization} \\
s_i^m &= \bar{s}_i o_i^m && \text{production}
\end{aligned}
$$

- Price p_i^m, cost c_i, logit shocks ϵ_{il}, capacity $\bar{s}_i$

- Constant marginal costs: heterogeneity across plants, not across lines (CRS)
- No market power: unconcentrated with many plants and firms
- No dynamic response: new construction is expensive and slow

Logit estimation with plants i, metals j, countries k

$$\log\left(\frac{o_{ijk}}{1-o_{ijk}}\right) = -\beta(\bar{\tau}_{jk}\bar{e}_{ijk} + c_{ijk}) + \mu_{jk} + \epsilon_{ijk}$$

- Costs c_{ijk} are data, assuming $MC = AC$
  - Only need to estimate β, rather than full cost structure
- Endogeneous prices and costs
  - Fixed effects: compare similar plants within markets

Counterfactuals

Policy simulations

- **European carbon tax** at \$100 per ton of CO_2
  - With vs. without a **CBAM** in place
  - Isolates the marginal impact of the CBAM
- Evaluate welfare relative to zero regulation
  - Europe (R), China (U/R), and rest of world (U)

CBAMs boost competitiveness

Europe at $\tau^R = 100$

ΔPS (1B USD)	Europe	China	Rest of world
Without CBAM	-23.07	4.02	3.04
With CBAM	-22.07	3.17	2.61

- Without CBAM, R firms lose and U firms gain
- With CBAM, R loses \$1B less at cost to U

CBAMs curb leakage

Europe at $\tau^R = 100$

ΔE (Mt CO_2)	Europe	China	Rest of world	Global
Without CBAM	-24.81	4.85	2.84	-17.12
With CBAM	-24.03	3.34	2.23	-18.45

- Without CBAM, R emissions fall and U emissions rise
- With CBAM, global emissions fall by 1.33 Mt more

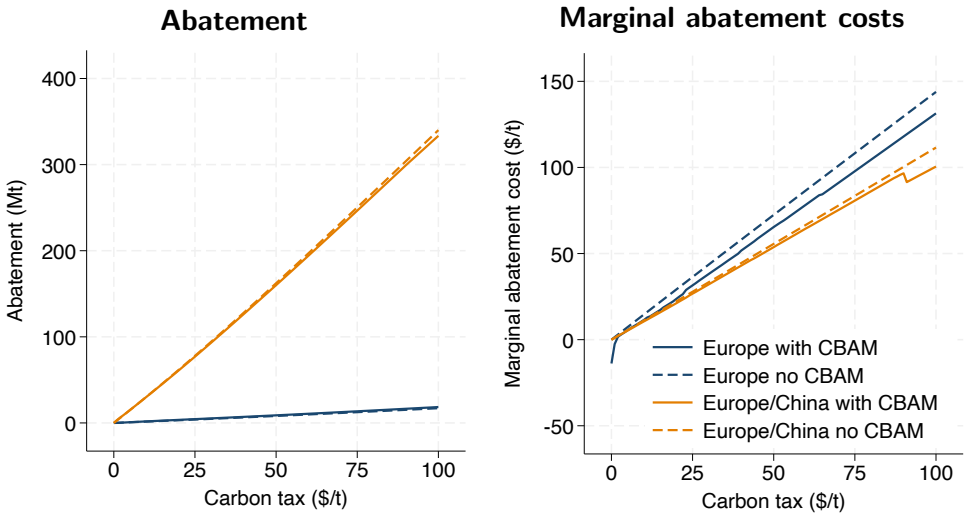
CBAMs encourage Chinese regulation

Europe at $\tau^R = 100$; China joining at $\tau^R = 100$

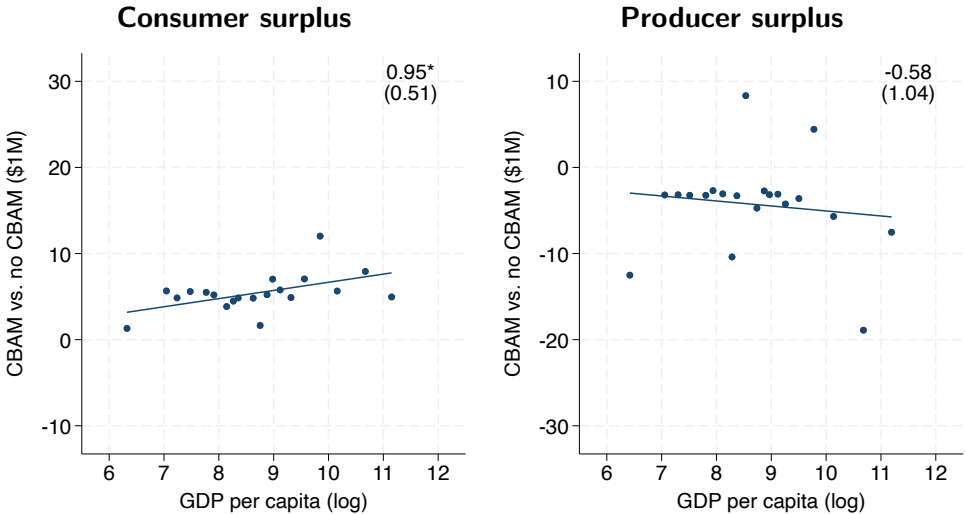
Europe:	With CBAM		No CBAM
China:	With CBAM	No CBAM	No CBAM
Chinese welfare ($1B)	-18.22	-20.05	-19.69
Global emissions (Mt)	-314.9	-321.6	-322.9
Average cost ($/t)	57.86	62.34	60.98

- Abatement is $3.12 cheaper for China with a Europe-China CBAM
- But $1.36 more expensive if China doesn't co-CBAM

China is crucial for global abatement



European CBAM impacts by income



European CBAM impacts by country

Consumer surplus

Largest gains		Largest losses	
($1M)		($1M)	
China	841	Germany	-340
USA	114	Italy	-221
India	79	France	-116
Japan	52	Spain	-109
South Korea	36	Poland	-88

Producer surplus

Largest gains		Largest losses	
($1M)		($1M)	
Germany	203	China	-847
Italy	167	India	-79
Norway	156	Russia	-66
France	87	Japan	-42
Iceland	77	Canada	-39

Other counterfactuals

- Implementing firm- vs. country-level regulation
- Green technology and expansion
- Phasing out EU allowances
- Partial border adjustment

Conclusion

Summary

- Quantitative equilibrium analysis of European **CBAM policies**
  - Boosts competitiveness, curbs leakage, and encourages regulation
  - Without disproportionate impacts on lower-income countries
- Domestic advantages may help
  - To establish carbon regulation in the first place
  - To sustain international coordination