Trade Policy and Climate Change: Carbon Tariffs and Climate Clubs

Shantayanan Devarajan
Delfin S. Go
Sherman Robinson
Karen Thierfelder

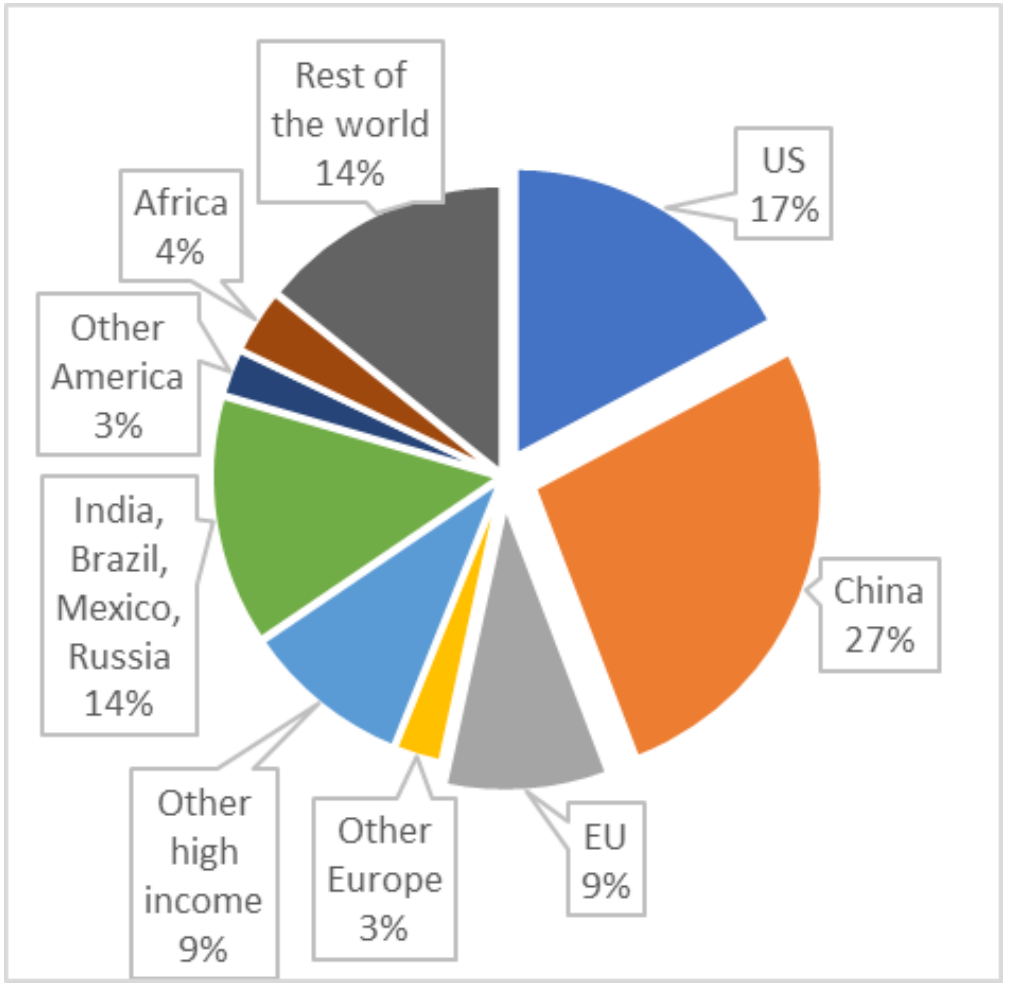
Presented at the 25th Annual Conference on Global Economic Analysis "Accelerating Economic Transformation, Diversification and Job Creation," June 8 – 10, 2022

Policy Question: How effective is trade policy in inducing countries to decarbonize?

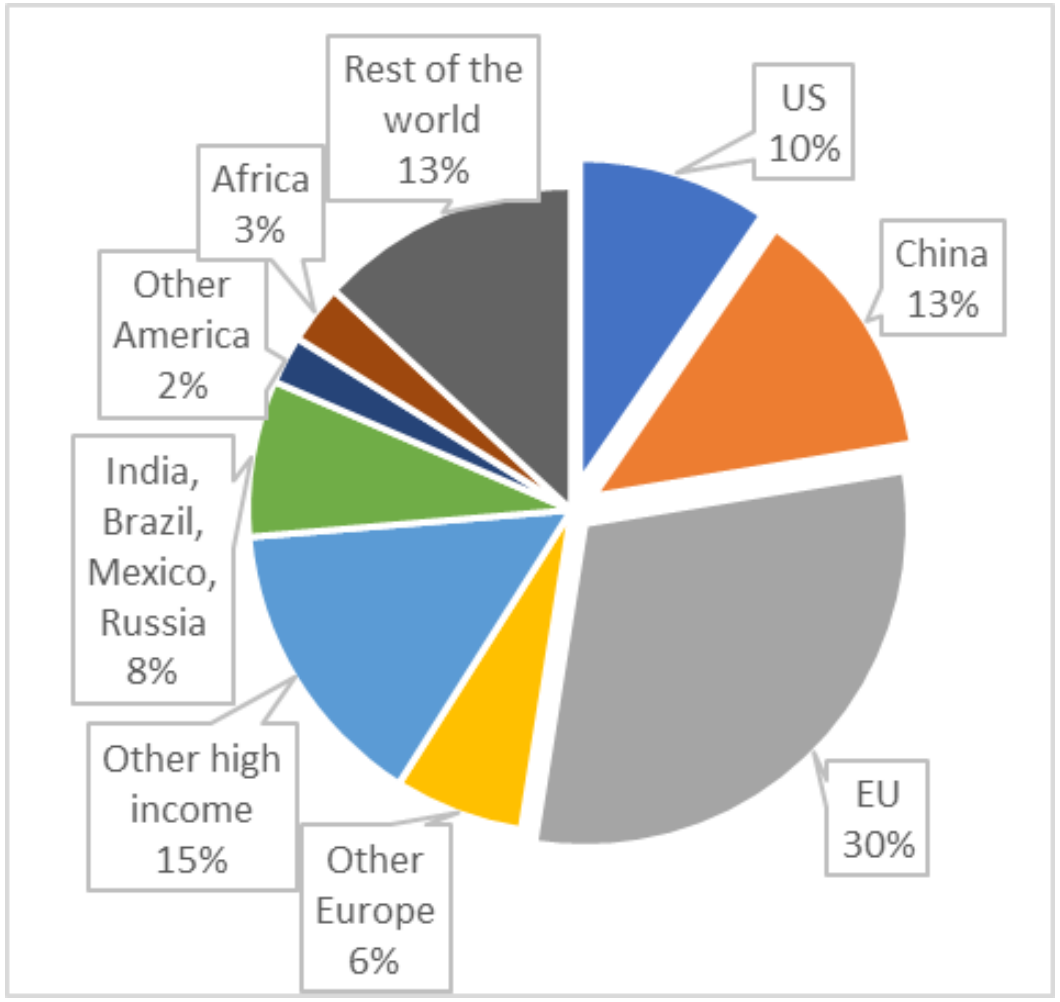
- Recent application:
  - Carbon Border Adjustment Mechanism (CBAM)
    - EU policy “level the playing field”
    - General policy to correct for an unfair distortion in trade
  - Climate clubs
    - Nordhaus (2015)
    - Trade is an instrument to induce countries to participate in CO2 mitigation
      - A Club’s “club”
- Recommend trade policy to help achieve climate policy objectives

Background

Global CO2 Emissions



Global Trade



Direct CO2 Intensity: Millions of tons of CO2 per billion USD of output

HIGH

LOW

	Production of:				
	Fertilizer	Iron & Steel	Aluminum	Cement	Electricity
USA	0.1	0.2	0.1	0.7	4.7
Canada	0.1	0.3	0.0	0.8	1.8
Mexico	0.3	0.4	0.0	1.3	3.3
EU 27	0.1	0.1	0.0	0.5	1.9
Other Europe	0.1	0.4	0.0	0.6	1.9
China	0.3	0.4	0.1	2.2	8.2
Japan	0.2	0.1	0.0	0.8	2.3
Other High-income Asia	0.1	0.1	0.1	0.9	3.6
Indonesia	0.2	0.4	0.4	1.3	10.2
Other Southeast Asia	0.2	0.4	0.1	2.6	4.9
India	0.3	1.9	0.2	3.8	4.7
Othr_S_Asia	0.5	0.5	0.1	2.1	3.2
Russian Federation	0.4	0.5	0.0	1.8	4.6
West Asia	0.4	0.6	0.2	1.7	4.8
Middle East	0.7	0.3	0.2	0.9	5.0
SACU	0.2	0.7	0.2	2.9	15.2
Other Africa	0.2	0.4	0.0	1.0	3.5
Brazil	0.1	0.3	0.5	0.8	1.1
Other America	0.3	0.6	0.1	0.8	2.9

Millions of tons of CO2 emissions per billion dollar of intermediate input use

		Production of:				
		Fertilizer	Iron & Steel	Aluminum	Cement	Electricity
US	Coal	26.6	27.1	31.5	26.6	26.6
	Oil	1.8	0.0	0.0	0.0	4.6
	Gas	3.6	11.6	5.8	11.8	9.4
	Petroleum	0.2	2.6	0.6	2.5	1.4
	Gas distribution	8.9	13.4	13.2	13.5	12.8
EU-27	Coal	19.6	18.3	25.6	19.1	21.3
	Oil	2.3	0.0	0.0	5.4	5.3
	Gas	2.5	4.6	4.7	4.5	4.5
	Petroleum	0.4	2.8	2.0	2.7	2.4
	Gas distribution	1.8	5.4	5.3	5.8	5.0
China	Coal	31.8	31.6	32.1	32.5	32.4
	Oil	0.2	0.0	0.0	343.9	5.1
	Gas	8.7	18.3	16.1	17.3	12.7
	Petroleum	1.4	3.5	3.4	2.9	2.3
	Gas distribution	17.6	33.0	27.8	31.6	24.5

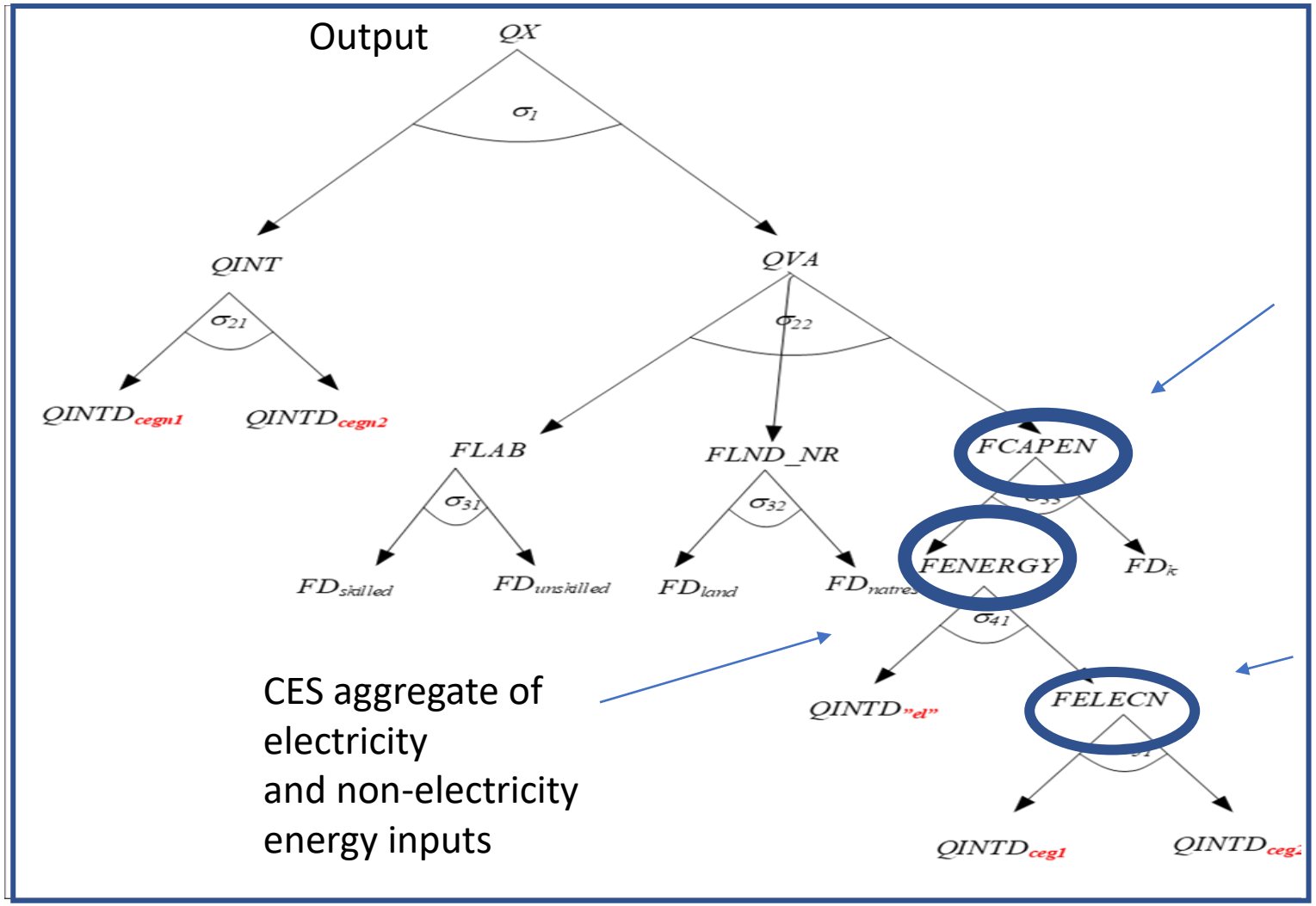
Bilateral trade with US and China (% of total)

	Exports *fob* to:		Imports *cif* from:	
	China	US	China	US
USA	10.0	[illegible]	19.2	[illegible]
Canada	5.7	65.5	12.2	50.3
Mexico	2.9	69.9	18.8	51.4
EU 27	5.2	7.4	7.4	6.7
Other Europe	7.7	9.3	7.9	8.6
China	3.3	18.1	4.0	9.2
Japan	26.7	15.4	22.8	10.0
Other High-income Asia	29.5	9.4	18.5	11.5
Indonesia	12.9	10.3	20.7	5.3
Other Southeast Asia	19.5	12.1	26.2	6.0
India	7.3	13.5	14.4	5.4
Othr_S_Asia	6.0	17.4	25.4	4.0
Russian Federation	7.2	4.5	17.2	7.6
West Asia	12.5	9.3	15.4	7.4
Middle East	13.8	9.1	12.9	11.3
SACU	14.1	7.4	15.0	6.0
Other Africa	13.0	7.2	17.3	8.2
Brazil	19.1	12.8	15.4	16.1
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]

Methodology

- GLOBE model
  - Multi-region, multi-sector computable general equilibrium (CGE) model
  - Nested production function
    - Energy inputs are substitutable with capital
    - Producers respond to increases in prices of energy inputs by substituting less expensive inputs including capital
  - Carbon tax based on CO2 emitted per unit of energy commodity used
  - Data GTAP v10
    - 19 regions, 22 sectors (including “dirty” sectors for CBAM tariffs and 6 energy sectors)
    - Emissions data

Production: nested CES functions with energy



CES aggregate of aggregate energy and capital

CES aggregate of fossil fuel inputs

CES aggregate of electricity and non-electricity energy inputs

Carbon tax

Tax Instrument, included in first order condition in producer's optimization problem

=> Tax affects choice of intermediate inputs and linked primary input capital

Tax revenue collected

Carbon intensity can differ by production activity and region

$$TCARB_{c,a,r} = TC_r * \frac{CO2EMIT_{c,a,r}}{QINTD0_{c,a,r}}$$

$$CARBTAX_r = \sum_{c,a} TCARB_{c,a,r} * QINTD_{c,a,r}$$

Carbon Tariff

Use trade partner's CO2 emission coefficient to compute the carbon tariff

$$TMCARB_{w,c,r} = TMC_w * \sum_a mapa2c_{a,c,w} * \frac{\sum_c CO2EMIT_{c,a,w}}{QX0_{a,w}}$$

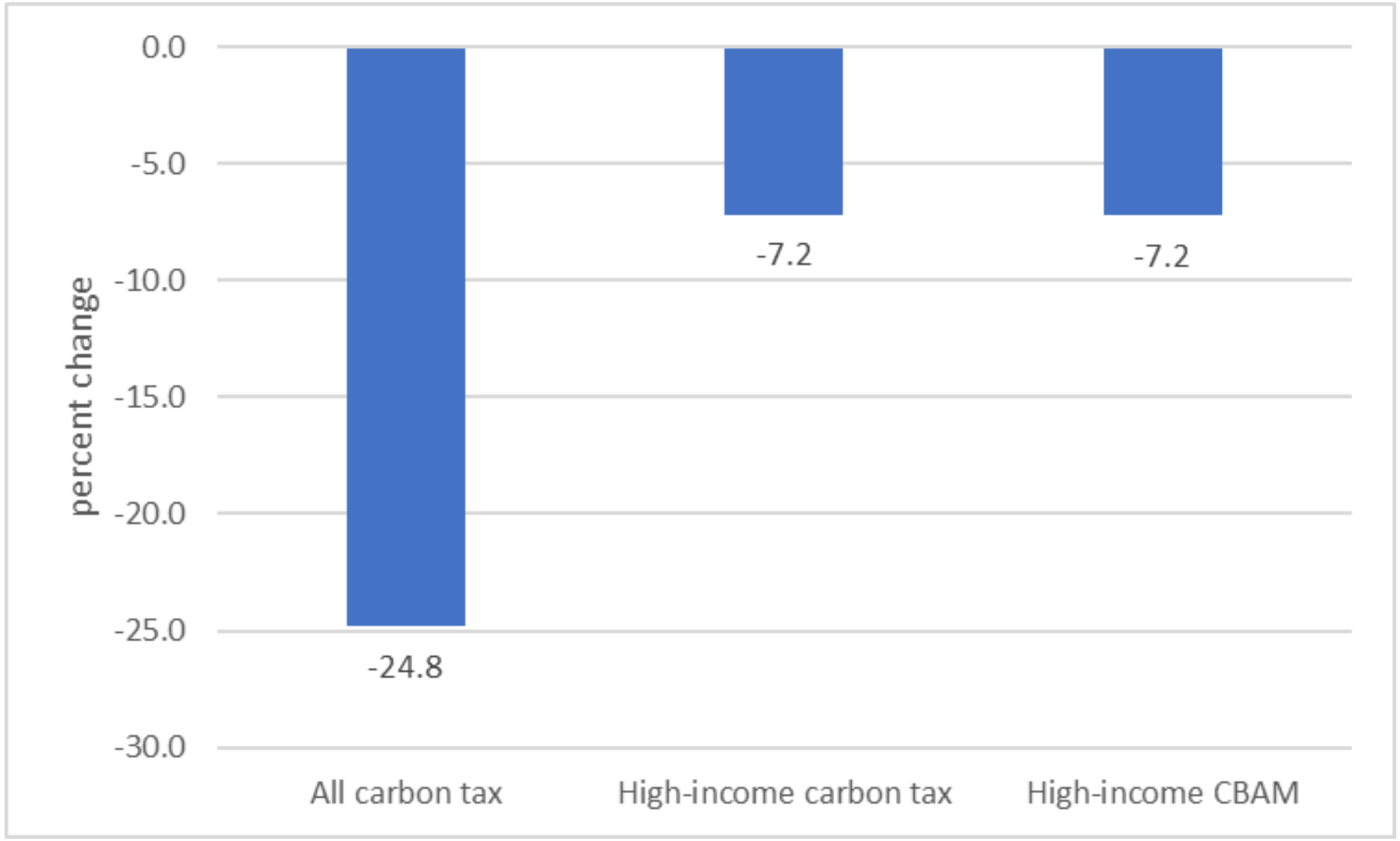
$$PMR_{w,c,r} = \left[PWM_{w,c,r} * \left(1 + tm_{w,c,r}\right) + TMCARB_{w,c,r}\right] * ER_r$$

Specific tariff

Scenarios

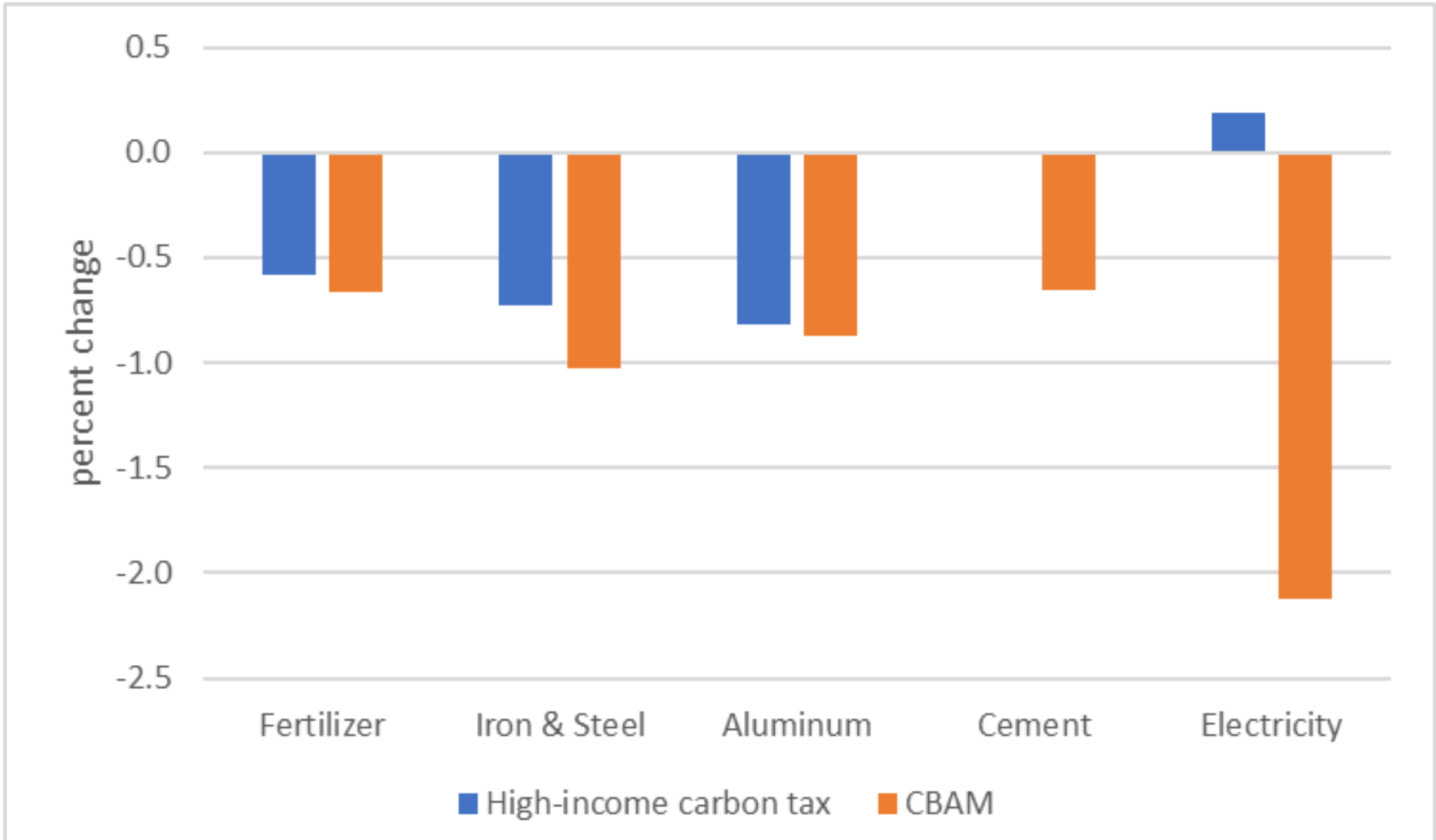
- High-income regions CBAM – **tariffs to level the playing field**
  - US, Canada, EU-27, Other Europe, Japan, Other High-income Asia
  - $75 tax on carbon only
  - $75 tax on direct carbon (not direct and indirect) and CBAM tariffs on imports of 5 dirty sectors: fertilizer, iron & steel, aluminum, cement and electricity
- Climate Club – **tariffs to induce changes in their domestic behavior in non-club regions**
  - Club members $75 tax on carbon and raise tariffs on ALL imports from non club members
  - China lone holdout region
  - US lone holdout region
  - China and US lone holdout regions

CBAM: Global CO2 Emissions



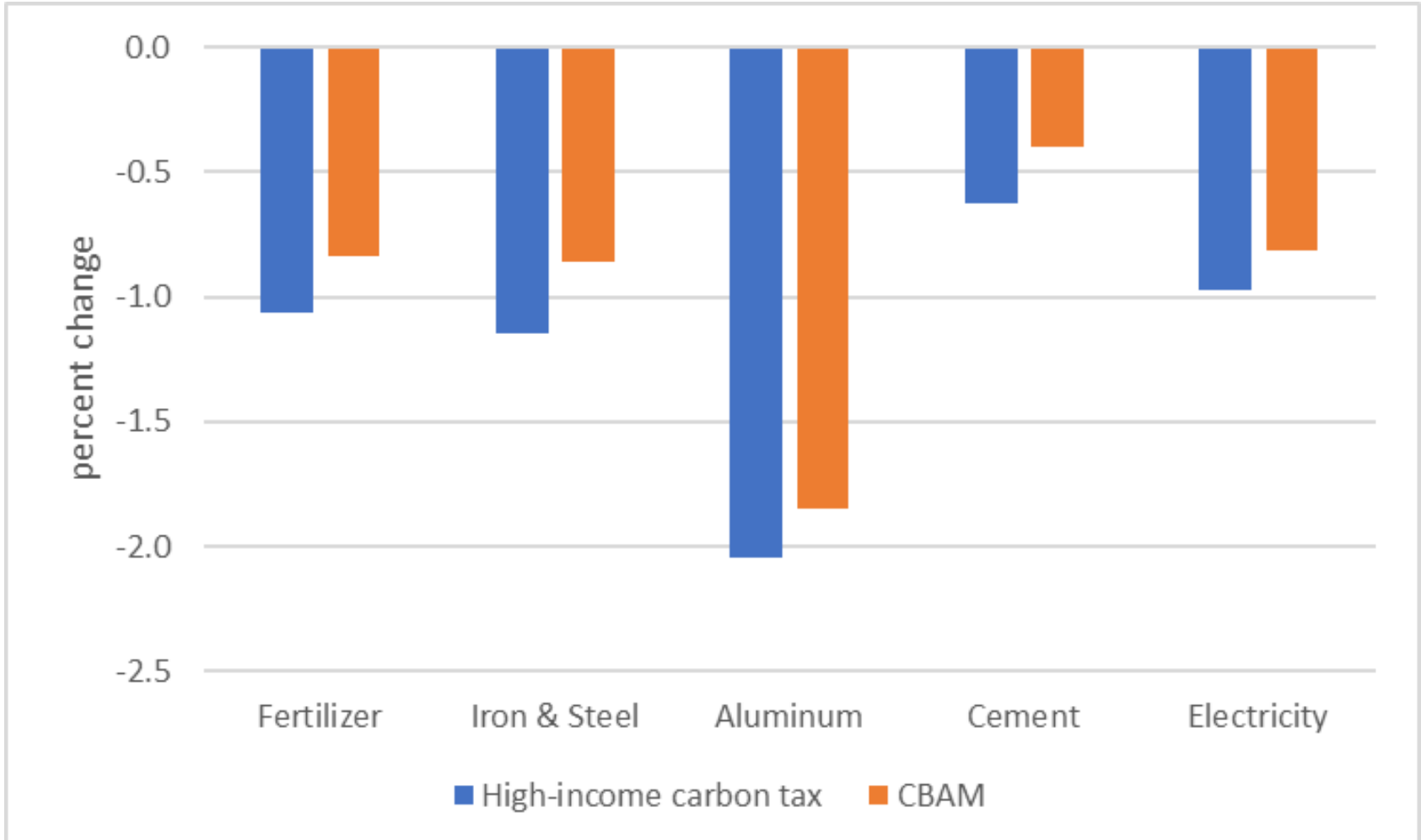
CBAM: Real imports EU-27

With CBAM tariffs, in addition to a tax on carbon, real imports decline slightly



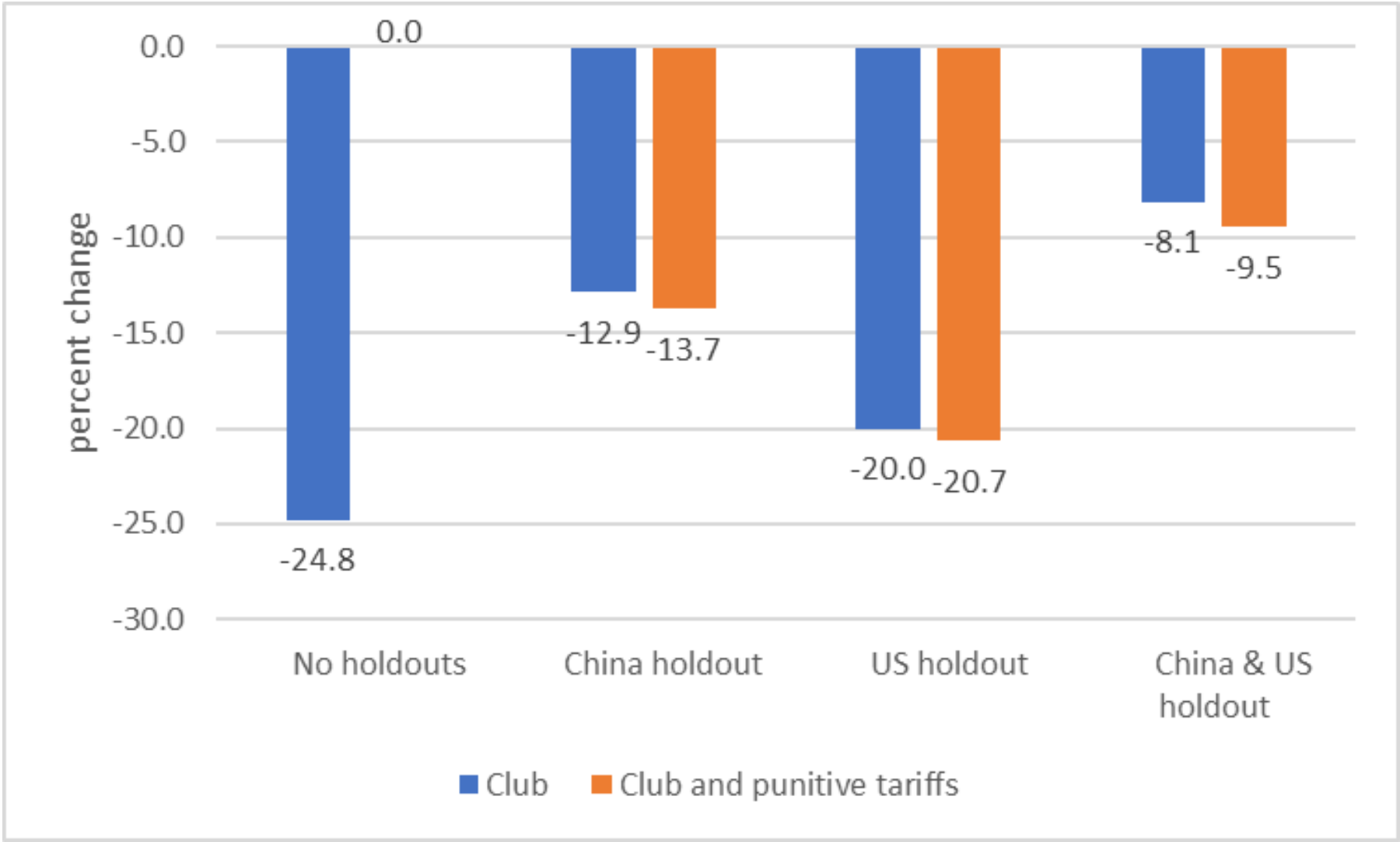
CBAM: Real output EU-27

With CBAM tariffs, in addition to a tax on carbon, real output declines less



Clubs: Global CO2 Emissions

Punitive tariffs against the holdout region(s) further reduce global emissions, slightly



Clubs: Damage to holdout region

	Holdout region			
	China	US	China & US	
			China	US
percent change in:				
Real exchange rate	31.5	18.5	24.0	18.1
Real absorption	-4.5	-1.7	-3.7	-1.3
Real imports	-16.3	-12.7	-13.7	-9.9
Real exports	0.7	-3.5	0.5	-3.3
Terms of trade (base = 1)	0.9	0.8	0.9	0.9
Tariff revenue collected as a share of export revenue	28.7	29.7	26.4	22.5

Clubs: Damage to members

	US holdout		China holdout		US & China holdout		
	Exports to US	Total Exports	Exports to China	Total Exports	Exports to US	Exports to China	Total Exports
Other NAFTA:							
Canada	-12.5	-8.8	-18.6	-2.4	-13.7	-18.0	-10.7
Mexico	-14.7	-11.2	-20.0	-4.6	-18.1	-19.4	-14.6
Asia:							
Japan	-12.2	-2.8	-17.4	-5.0	-12.5	-15.9	-6.4
Other High-income Asia	-13.2	-3.7	-16.4	-5.1	-12.5	-16.0	-6.7
Indonesia	-9.4	-4.2	-18.5	-5.5	-11.1	-16.4	-6.1
Other Southeast Asia	-13.4	-3.5	-20.2	-6.8	-15.6	-18.8	-7.8
India	-13.6	-4.1	-20.7	-4.9	-14.3	-18.3	-5.4
Other South Asia	-14.7	-3.9	-23.6	-6.6	-18.2	-20.8	-7.3

US currency depreciates 18.4% **China's currency depreciates 31.7%**

US currency depreciates 18.0%
China's currency depreciates 24.2%

Conclusions - CBAM

- The first-best policy is for every country to institute a tax on CO2 emissions
- China’s participation in carbon tax is crucial to reduce global CO2 emissions
- CBAM tariffs
  - Do NOT contribute towards a reduction in global CO2 emissions
  - Correction to unfair advantages of exports from non-tax countries

Conclusions – Club and Punitive Tariffs

- Potentially a powerful mechanism for achieving global cooperation in carbon reduction
- Impose serious costs to the holdout regions
  - Reduce aggregate final demand (absorption)
  - Major adjustments to the structure of production and trade
  - The tariff revenue goes to the club members => an effective transfer of potential export revenue to club members
  - Non-tax countries lose the potential government revenue from a carbon tax

Conclusions – Club and Punitive Tariffs

- Impact on club members
  - depends on the magnitude and structure of their trade with holdout countries
  - countries with “deep” trade relations (e.g., Mexico and Canada with the US, East and Southeast Asia with China)
    - Overall exports decline substantially
  - Punitive tariffs may not be supported by club members who are trade-dependent on the holdout region