Trade Policy as Climate Policy: Payoffs and Tradeoffs

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Tariffs and Climate Mitigation Strategies

- Carbon Border Adjustment Mechanism (CBAM)
  - EU27 taxes carbon
  - Impose tariffs on imports from regions without a carbon tax
    - Tariff rate based on the carbon content in production in the exporting region
      - Direct CO_2 emission
      - Direct and indirect CO_2 emission
    - Initially for 5 dirty sectors: Fertilizer, Iron & Steel, Aluminum, Cement, and Electricity
    - Offset the production advantage in exporters who do not impose a carbon tax
- Climate Club (Nordhaus, AER 2015)
  - Agree to a tax on carbon
  - Impose punitive tariffs on countries not in the coalition

Key Findings

- CBAM tariffs offset the unfair competitive advantage of non-compliant countries
  - Little effect on the trade of affected countries (because of trade diversion)
  - Little impact on global CO_2 emissions.
- A large climate club works
  - Little opportunity for non-members to divert trade => incentive to join club
  - Reduce global CO_2 emissions
- A climate club is complicated
  - Likely holdouts – US or China – integrated with countries in their region
  - Club members strongly linked to holdout may suffer trade losses, possibly threatening the stability of the club

GLOBE Model - overview

- Multi-sector, multi-region computable general equilibrium (CGE) model
- Product differentiation
  - Sensitivity to trade elasticities
- GTAP v10 data (2014)
  - Social Accounting Matrices for 19 regions
  - Energy sectors
  - CO_2 emitted per unit of energy used in production

GLOBE Model – Relevant Behavior

- Nested trade structure
  - Represent the integration of production and trade in regions such as NAFTA, Europe and East and Southeast Asia
- Energy inputs in value added nest for production
  - Data on CO_2 per unit of energy input used in production
  - Carbon tax in the first order condition
    - Producers can substitute away from energy inputs in response to increase in input cost due to a carbon tax

Production: nested CES functions with energy

Producers can substitute away from energy inputs when the cost of those inputs increases

CES aggregate of aggregate energy and capital

CES aggregate of fossil fuel inputs

CES aggregate of electricity and non-electricity energy inputs
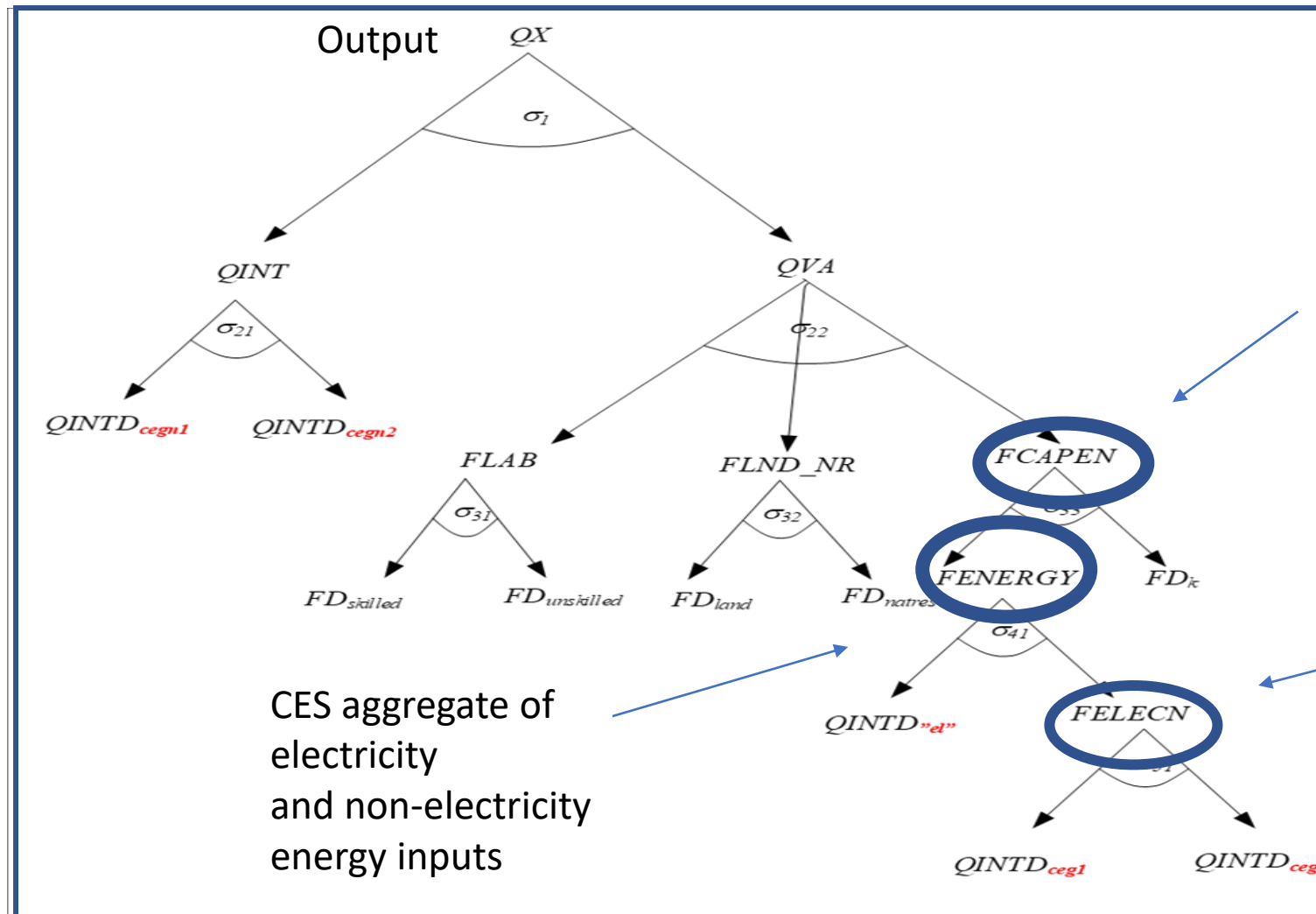
Background

Global CO2 Emissions
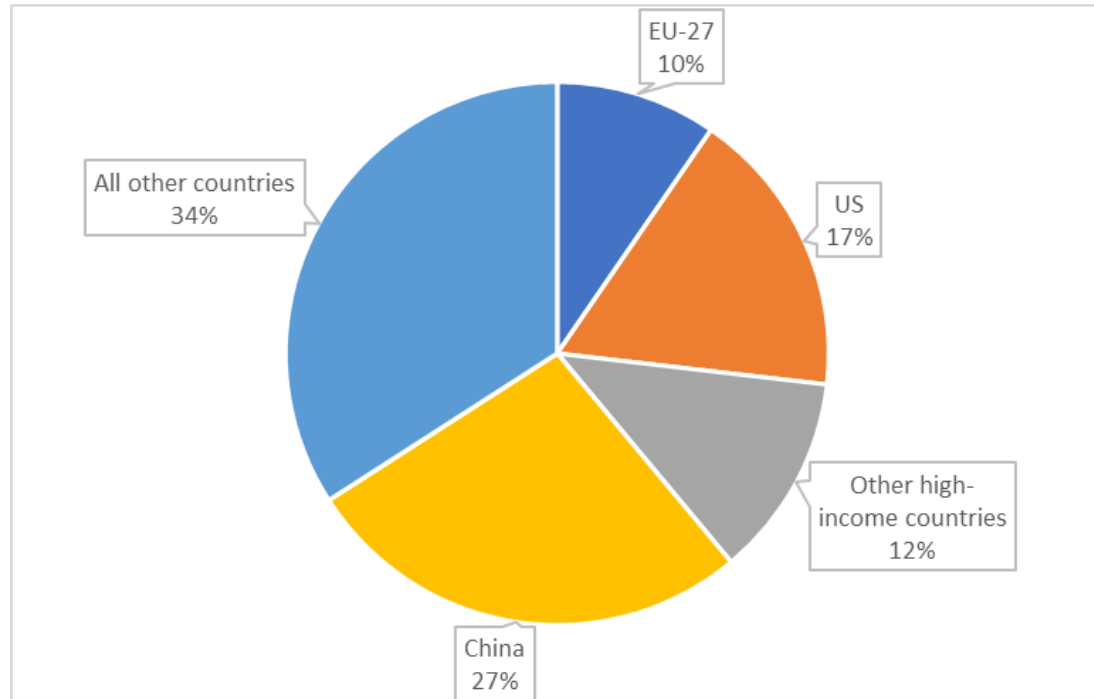
Global Trade
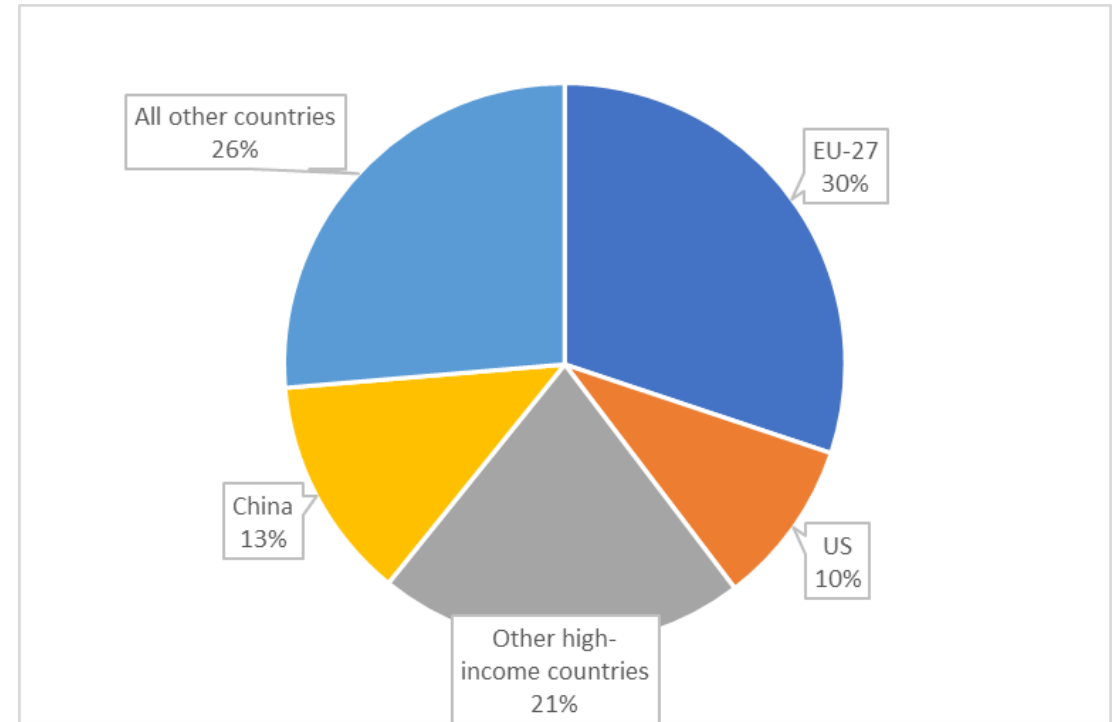
The share of global CO2 emissions is higher than the share of global trade for the US and China (source: GTAP v10, 2014 data)

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	0.5	19.2	0.4
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
Other America	11.1	21.5	15.9	24.8

Source: GTAP v10, 2014

Bilateral Trade
(as a percent of total trade)

	NAFTA	Europe	ESE Asia	Other	Total
NAFTA	5.4	2.9	2.9	2.4	13.6
Europe	3.4	21.1	4.5	6.6	35.6
ESE Asia	5.4	4.9	13.5	5.9	29.7
Other	2.7	6.2	6.2	6.1	21.1
Total	16.9	35.1	27.0	21.0	

Source: GTAP v10, 2014

Exports Among Integrated Regions
(percent of each region's total exports)

	NAFTA	Europe	ESE Asia	Other	Total
NAFTA	40.0	21.1	21.2	17.7	100.0
Europe	9.5	59.3	12.6	18.6	100.0
ESEAsia	18.2	16.6	45.3	20.0	100.0
Other	12.6	29.3	29.3	28.8	100.0

Exports are from row region to column region.
Source: GTAP v10, 2014

Scenarios

- CBAM
  - EU27 has a carbon tax of $75 per ton of CO_2
  - Tariffs on imports of Fertilizer, Iron & Steel, Aluminum, Cement, and Electricity
    - Direct CO_2 emissions
    - Direct and Indirect CO_2 emissions
- Climate Club
  - Club members impose a carbon tax of $75 per ton of CO_2
  - Punitive tariff against non-club members of additional 30% on all goods
  - Membership includes all regions except one holdout
    - US
    - China

CBAM: Real output EU-27

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

No impact of CBAM tariffs on global carbon emissions
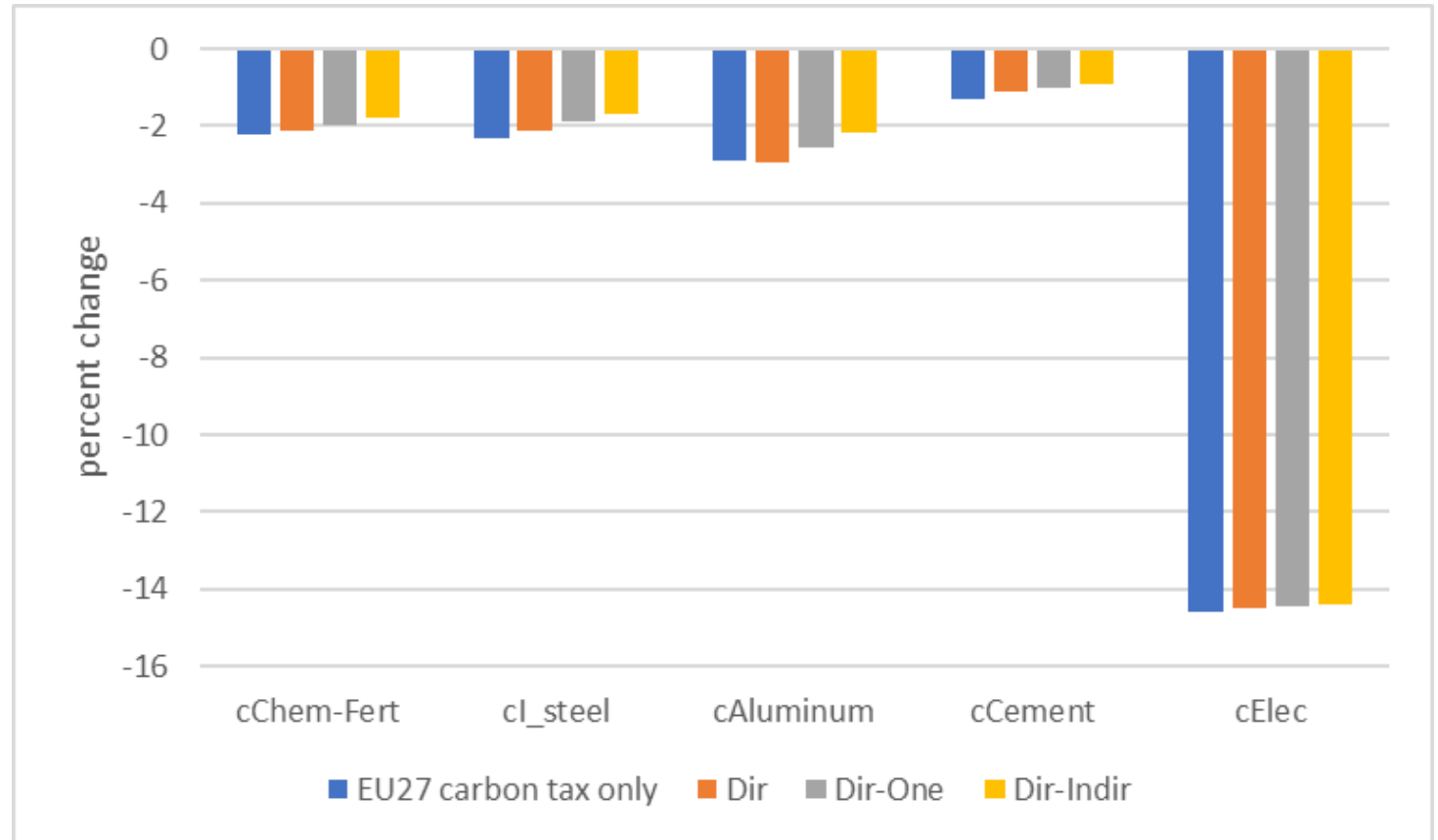
Exports of CBAM Commodities to EU-27

Countries that depend on EU-27 for 5 CBAM commodities can diversify exports.

Compare exports to EU-27 to total exports for India and SACU

	Percent change in exports to	
	EU-27	Total
USA	-1.85	-0.47
Canada	-2.69	-0.06
Mexico	-3.07	-0.08
EU 27	-1.68	-2.40
Other Europe	-0.72	-0.73
China	-6.37	-0.52
Japan	-3.36	-0.04
Other High-income Asia	-3.93	-0.10
Indonesia	-4.54	-0.25
Other Southeast Asia	-5.81	-0.27
India	-11.33	-1.37
Other South Asia	-5.19	-0.71
Russian Federation	0.51	5.22
West Asia	-7.59	-0.80
Middle East	-2.04	1.27
SACU	-10.49	-1.15
Other Africa	-0.51	1.56
Brazil	-0.94	-0.16
Other America	-2.39	0.40

Payoff Matrix: Climate Club, US holdout

Results are given for an aggregate of all club members and for individual NAFTA countries in the club		US	
		Holdout	Join Club
AO All other countries NOTES: Payoff = percent change in real absorption **Percent change in Global CO2 emissions**	**Holdout:** No tax on carbon and no additional tariffs	US: 0 **(0.0)** AO: 0 Mexico: 0 Canada: 0	US: 0.73 **(-7 %)** AO: -0.47 Mexico: -3.23 Canada: -3.24
	Join Club: Tax on carbon = $75 and punitive tariffs (30 percentage points) on all trade with non-club members	US -1.82 **(-33%)** AO -0.35 Mexico: 1.55 Canada: 1.29	US: -.44 **(-38 %)** AO: -0.81 Mexico: -1.01 Canada: -1.50

Key Findings

- NASH equilibrium: US join, all others holdout (US single member club)
  - Punitive tariff strategy does not work!
  - Real absorption losses for oil-exporters when there is a tax on carbon
  - Reduction in global carbon emission is not in the welfare function
  - Looks a lot like classic trade war in trade theory
    - Terms of trade gains for the country imposing a tariff
- If welfare measure were to include benefit from lower global carbon emissions (Nordhaus) – expect all to join the club
  - Big reduction in global CO_2 emissions, 38% vs. 7%
- When the US is not in the club, linked countries (Mexico and Canada)
  - Terms of trade gains with punitive tariffs against the US
  - Dramatic decline in trade

Club Membership and CO_2 Reduction

	All	US Only	China Only	All except US	All except China
			Club Membership		
USA	-37.6	-38.6	0.6	-6.5	-37.7
Canada	-27.7	-10.0	-0.2	-26.0	-27.7
Mexico	-26.5	-12.1	0.2	-26.7	-25.3
EU 27	-19.4	-0.9	2.7	-19.3	-20.3
Other Europe	-20.7	-0.6	1.6	-20.7	-21.4
China	-58.3	0.3	-60.0	-58.6	-7.5
Japan	-13.8	1.2	0.9	-14.1	-14.6
Other High-income Asia	-29.5	0.5	-0.5	-29.4	-31.0
Indonesia	-33.8	0.5	-2.2	-34.2	-33.0
Other Southeast Asia	-35.9	0.5	-4.4	-36.3	-34.4
India	-41.8	0.2	1.6	-42.1	-41.7
Other South Asia	-23.3	1.6	1.5	-24.3	-21.7
Russian Federation	-29.8	-0.1	-0.5	-29.8	-29.6
West Asia	-30.9	-1.5	-0.5	-30.5	-30.6
Middle East	-30.1	-0.3	-0.2	-29.8	-29.9
SACU	-60.0	0.9	0.6	-60.3	-60.1
Other Africa	-24.6	-0.8	0.0	-24.7	-24.2
Brazil	-18.6	-1.5	0.1	-18.5	-18.7
Other America	-24.0	-2.8	-0.2	-24.6	-23.9
Total	-38.0	-7.1	-15.9	-32.7	-24.3

Payoff Matrix: Climate Club, China holdout

Results are given for an aggregate of all club members and for individual East and Southeast Asia countries in the club		China (CHN)	
		Holdout	Join Club
AO All other countries	**Holdout:** No tax on carbon and no additional tariffs	CHN: 0 **(0.0)** AO: 0 Japan: 0 Other H-Asia: 0 Indonesia: 0 Other ESE Asia: 0	CHN: 2.13 **(-16 %)** AO: -0.77 Japan: -0.98 Other H-Asia: -2.03 Indonesia: -2.13 Other ESE Asia: -3.61
NOTES: Payoff = percent change in real absorption **Percent change in Global CO2 emissions**	**Join Club:** Tax on carbon = $75 and punitive tariffs (30 percentage points) on all trade with non-club members	CHN: -4.67 **(-24%)** AO : 0.02 Japan: 1.29 Other H-Asia: 0.71 Indonesia: -0.60 Other ESE Asia: 3.79	CHN: -0.71 **(-38%)** AO: -0.72 Japan: 0.57 Other H-Asia: -0.03 Indonesia: -2.22 Other ESE Asia:-0.40

Conclusion

- CBAM tariffs
  - Offset the production advantage in countries that do not have a carbon tax
  - **Do not reduce global CO2 emissions**

- Climate Club and punitive tariffs
  - If the club is large (we consider the extreme of only one holdout, all other regions in the club) **– tariff policy can reduce global emissions**
    - No trade diversion for holdout
    - **Inflict enough damage to induce the holdout to join the club**
  - In a more realistic model with product differentiation, many sectors, and integrated regions, **a MUCH higher punitive tariff is needed than suggested by Nordhaus**