Global Trade Analysis Project

The Role of International Trade in Climate Change

Angel Aguiar

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"Global Economic Analysis Beyond 2020"

Outline

- **Motivation**
  - What we know and expect
- **Data and Model**
  - Simulation design
- **Results**

Motivation

- **2 papers that use a very rich data set on agriculture & land**
  - FAO's Global Agro-ecological zones (5 arc-minute level)
- **Costinot, Donaldson & Smith (2016)**
  - Trade adjustments have a small role to mitigate climate change effects
- **Gouel & Laborde (2018)**
  - Find trade has an important role in adapting to climate change effects
- **Model framework and data are similar**
  - Functional form and parametrization are different

Motivation and objective

- **Consider impact functions due to climate change**
  - Under different trade scenarios using the GTAP framework
- **Review output, emissions and welfare results**
  - For the world and distribution across countries

What we know? What we expect?

- **Climate change effects vary by crop and location**
  - Production patterns within country will be different
- **If there is trade**
  - Welfare could be negative, if production shifts to developed countries with high level of support (Randhir & Hertel, 2000)
- **If there is not trade**
  - Welfare could also be negative, if countries (less efficiently) produce for the domestic market, what could be (more efficiently) produced elsewhere

Data and Model

- **GTAP framework has sufficient regional and agricultural detail**
  - GTAP 10A, ref. year 2014 (Aguiar et al. 2019)
    - **Consider 13 countries and regions**: China, Indonesia, Rest of East Asia, India, Rest of South Asia, Rest of Europe and Central Asia, Middle East and North Africa, Sub-Saharan Africa, Brazil, Rest of Latin America and Caribbean, European Union, United States, Rest of high-income countries
    - **16 sectors:** Paddy Rice, Wheat, Other grains (maize), Rest of Agriculture (including forestry and fishing), Coal, Oil, Gas and distribution, Oil products, Electricity, Energy intensive industries, Food, Other industries, Other transport, Air transport, Water transport, Other services
  - GTAP-E model, release 6 (McDougall and Golub, 2009)
    - Track CO2 emissions and welfare

Simulation Design

- **Base case simulation relies on estimates of the climate impacts by Roson and Sartori (2016)**
  - These affect the availability of land and the productivity of rice, wheat and other grains for all GTAP regions
  - Consider 3 degrees increase by 2050
- **To contrast the base case results:**
  - Restrict exports and trade balance via closure,
  - Reduce trade elasticities,
  - Reducing trade via tariff increases (uniformly or by targeting),
  - Increasing trade via liberalization

Experiment shocks: increase in 3C by 2050 (CC_RS)

Aggregate regions	% change in land stock due to sea level rise	% variation in multi-factor productivity		
		Maize	Wheat	Rice
China, P.R.	-0.001	-4.68	-8.46	-2.23
Indonesia	-0.020	-9.63	-19.19	-3.88
Rest of East Asia	-0.015	-8.05	-13.40	-3.33
India	-0.001	-6.63	-12.69	-2.88
Rest of South Asia	-0.001	-6.06	-10.47	-2.79
Europe and Central Asia	-0.004	-2.17	-2.87	-1.21
Middle East and North Africa	-0.003	-5.20	-9.51	-2.52
Sub-Saharan Africa	-0.001	-8.57	-14.50	-3.53
Brazil	-0.001	-7.08	-13.66	-3.03
Rest of Latin America and Caribbean	-0.008	-6.25	-10.92	-3.32
European Union	-0.004	-2.86	-4.22	-1.88
United States	-0.003	-4.45	-7.98	-2.15
Rest of high-income countries	-0.013	-2.78	-5.42	-2.33

Climate Change Simulation Results

- **Not all sectors reduce their volume**
  - Maize would increase due to reallocation of resources

World production	% change	Land CNT	Rice CNT	Wheat CNT	Maize CNT
Rice	-0.43	-0.002	-0.028	-0.277	-0.124
Wheat	-0.23	0.00003	-0.108	-0.083	-0.039
Maize	0.36	-0.0002	-0.027	-0.037	0.420

Increase in output of Maize by country

Output	Simulation	Domestic Sales	Exports
China	2.42	2.43	-0.02
Europe and Central Asia	0.96	-0.02	0.98
EU28	0.82	0.32	0.50
USA	0.09	-0.20	0.29
Rest of high income countries	2.92	0.77	2.15

Output by the different scenarios

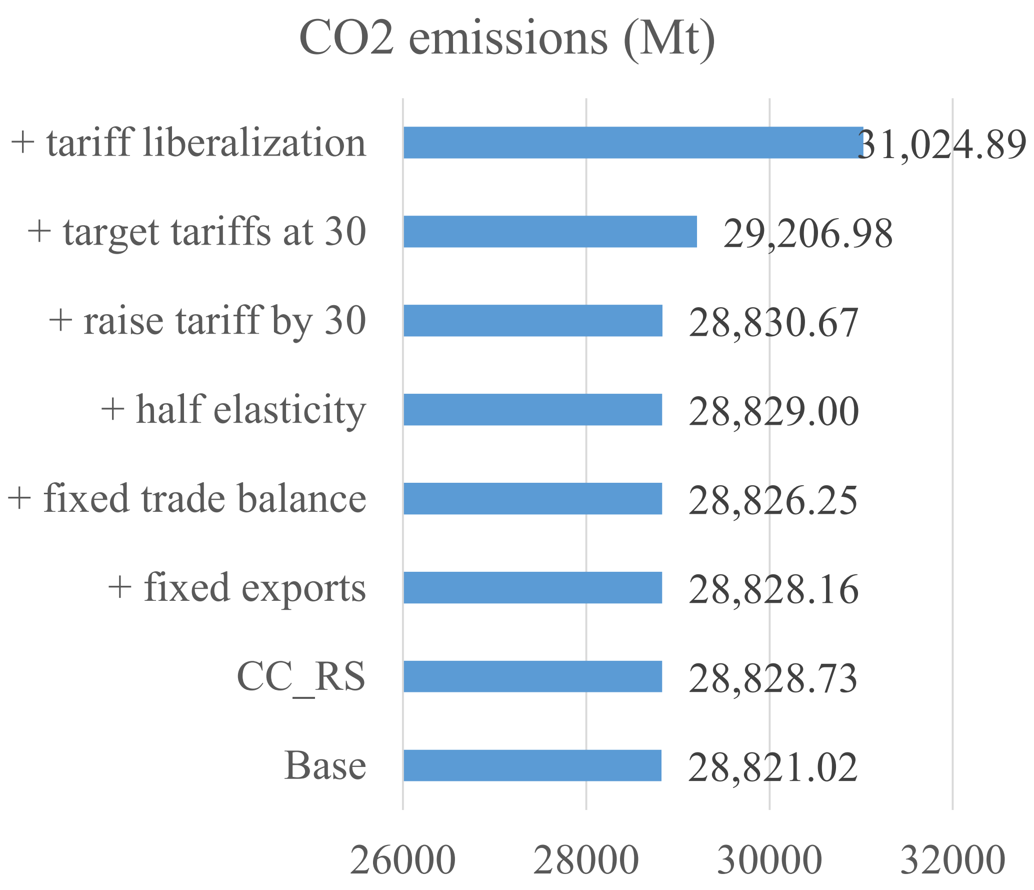
- World production reacts to trade environment

World production	CC_RS	+ fixed exports	+ fixed trade balance	+ half elasticity	+ raise tariff by 30	+ target tariffs at 30	+ tariff liberalization
Rice	-0.43	0.06	-0.44	-0.26	-0.27	-1.37	-0.87
Wheat	-0.23	0.15	-0.24	-0.17	0.27	0.48	-2.16
Maize	**0.36**	**0.36**	0.35	0.35	0.43	-1.19	0.77

Maize output by country and scenarios

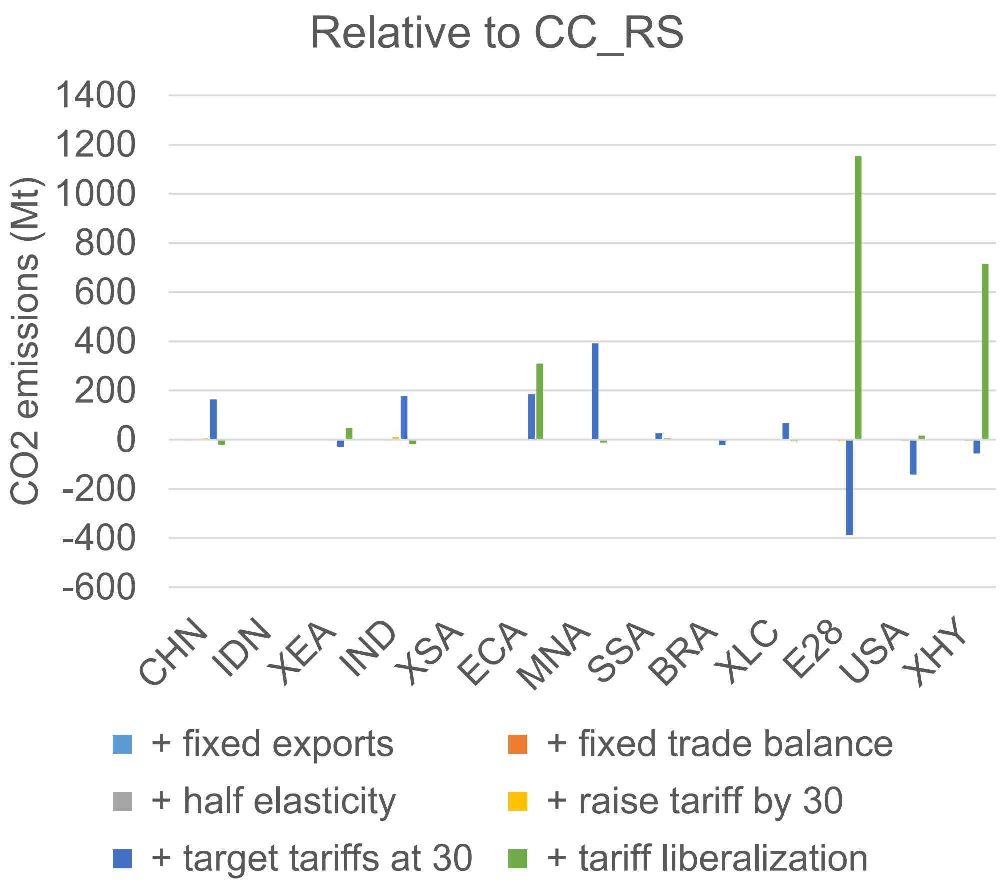
Output	CC_RS	+ fixed exports	+ fixed trade balance	+ half elasticity	+ raise tariff by 30	+ target tariffs at 30	+ tariff liberalization
China	**2.42**	**2.62**	2.40	2.44	2.55	1.96	1.73
Europe and Central Asia	**0.96**	**-0.03**	0.95	0.50	0.98	0.90	**-5.77**
EU28	**0.82**	**0.08**	0.82	0.49	0.75	3.31	2.54
USA	**0.09**	**-0.08**	0.10	-0.003	-0.48	-8.10	**2.50**
Rest of high income countries	**2.92**	**-0.50**	2.92	2.09	9.07	-20.32	-20.53

Emissions results



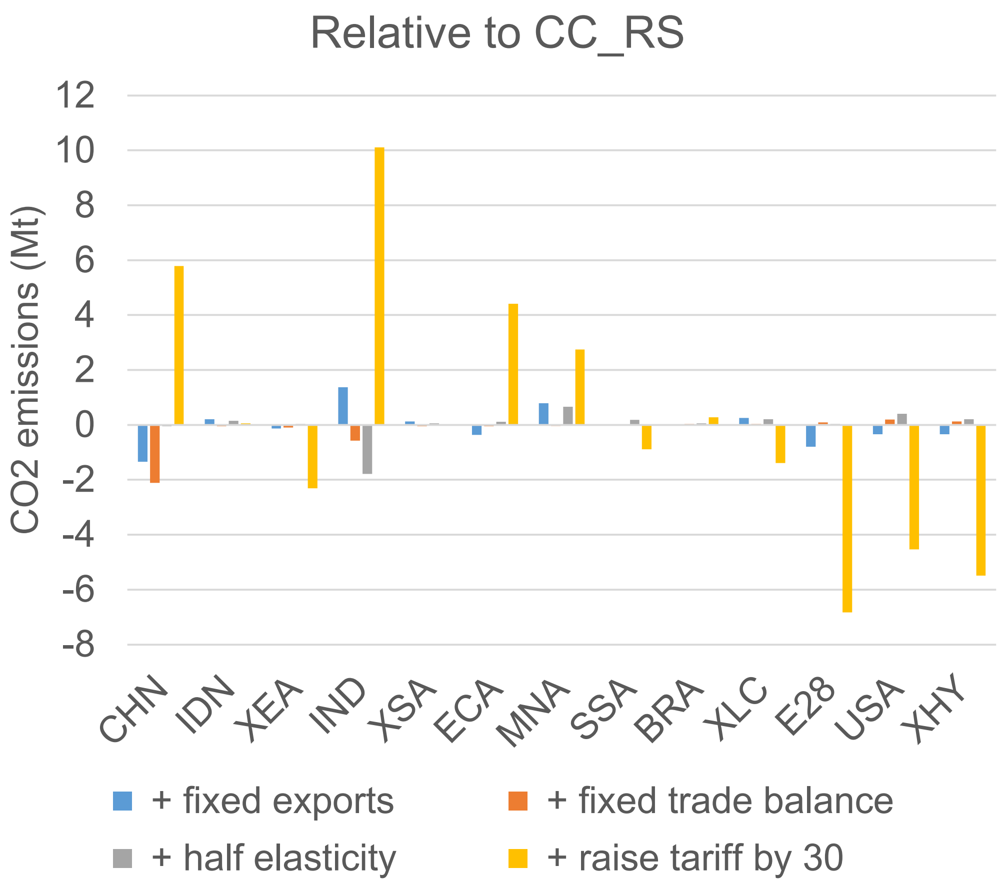
- **Relative to base:**
  - Climate change effects increase emissions by 7.71 Mt
- **Relative to CC_RS scenario:**
  - Fixed exports: -0.56 Mt
  - Fixed trade balance: -2.48 Mt
  - Reduced elasticities: 0.27 Mt
  - Raise tariffs by 30%: 1.94 Mt
  - *Target tariffs at 30%: 378.25 Mt*
  - *Tariff liberalization: 2203.87 Mt*

Emissions distribution



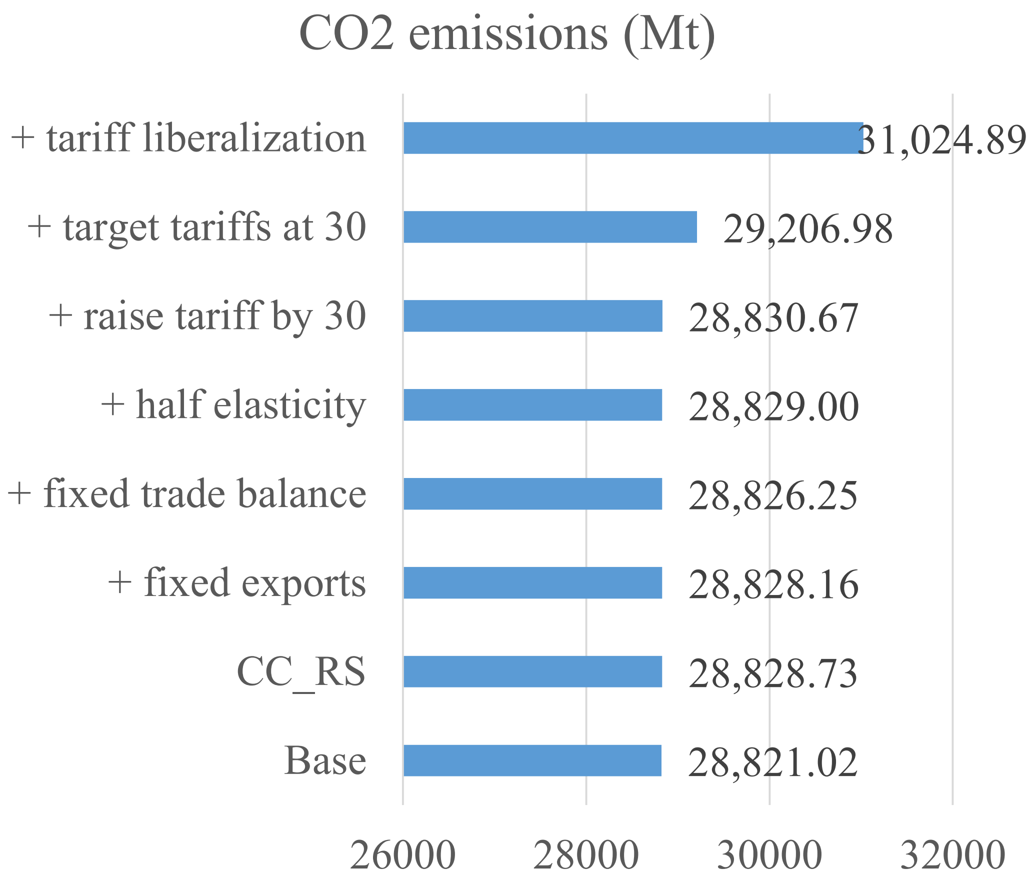
- **Relative to CC_RS:**
  - Target tariffs at 30%: increase emissions in China, India, Europe and Central Asia, MENA, but
    - Decrease in EU28, USA, XHY, BRA, XEA
  - Tariff liberalization: increase emissions in USA, XHY, USA, and ECA, but
    - Decrease in China, India, MENA, XLC

Emissions distribution



- **Relative to CC_RS:**
  - Raising tariffs, similar to target tariffs but difference in scale
  - Fixed trade balance would result in lower emissions for China and India
  - Fixing exports would result in more emissions by India and less by China, EU, US, and XHY
  - Reducing trade elasticities would make India reduce its emissions
    - Increasing emissions everywhere else

Emissions results



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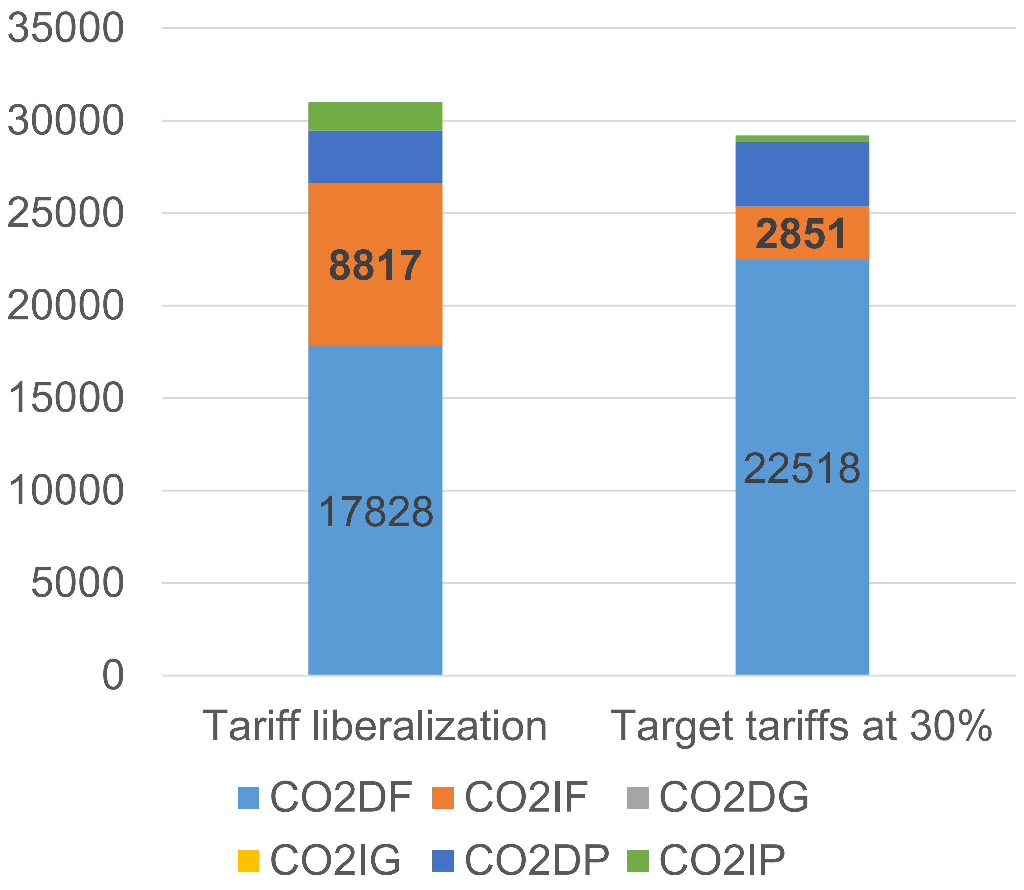
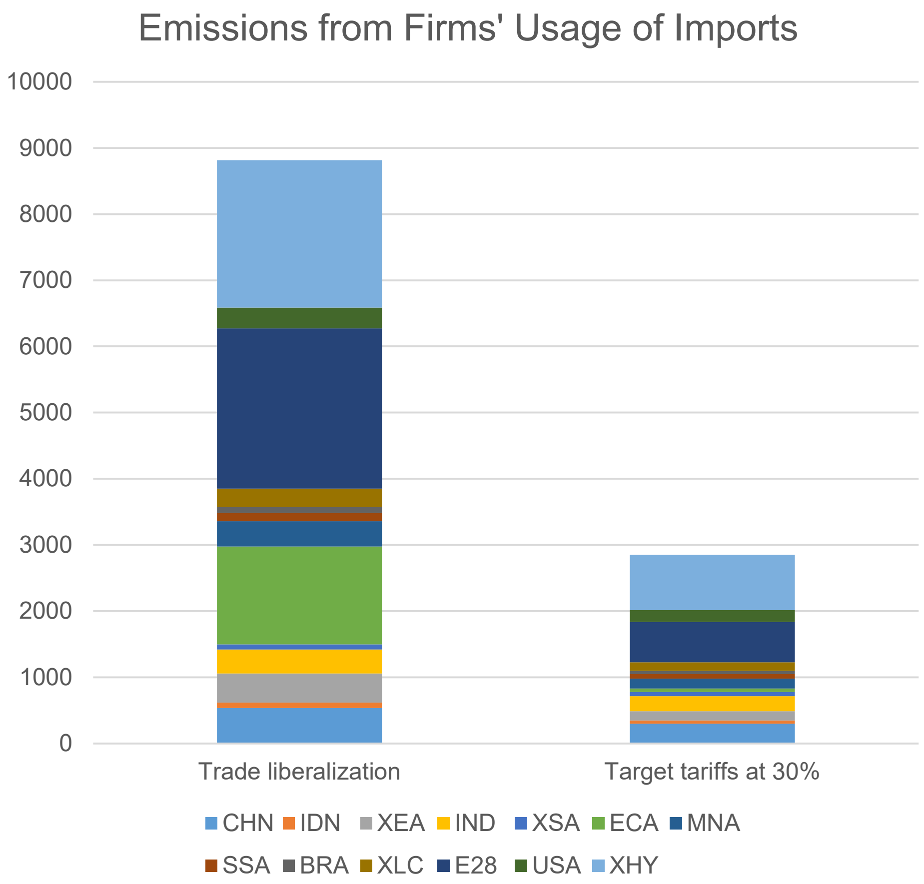
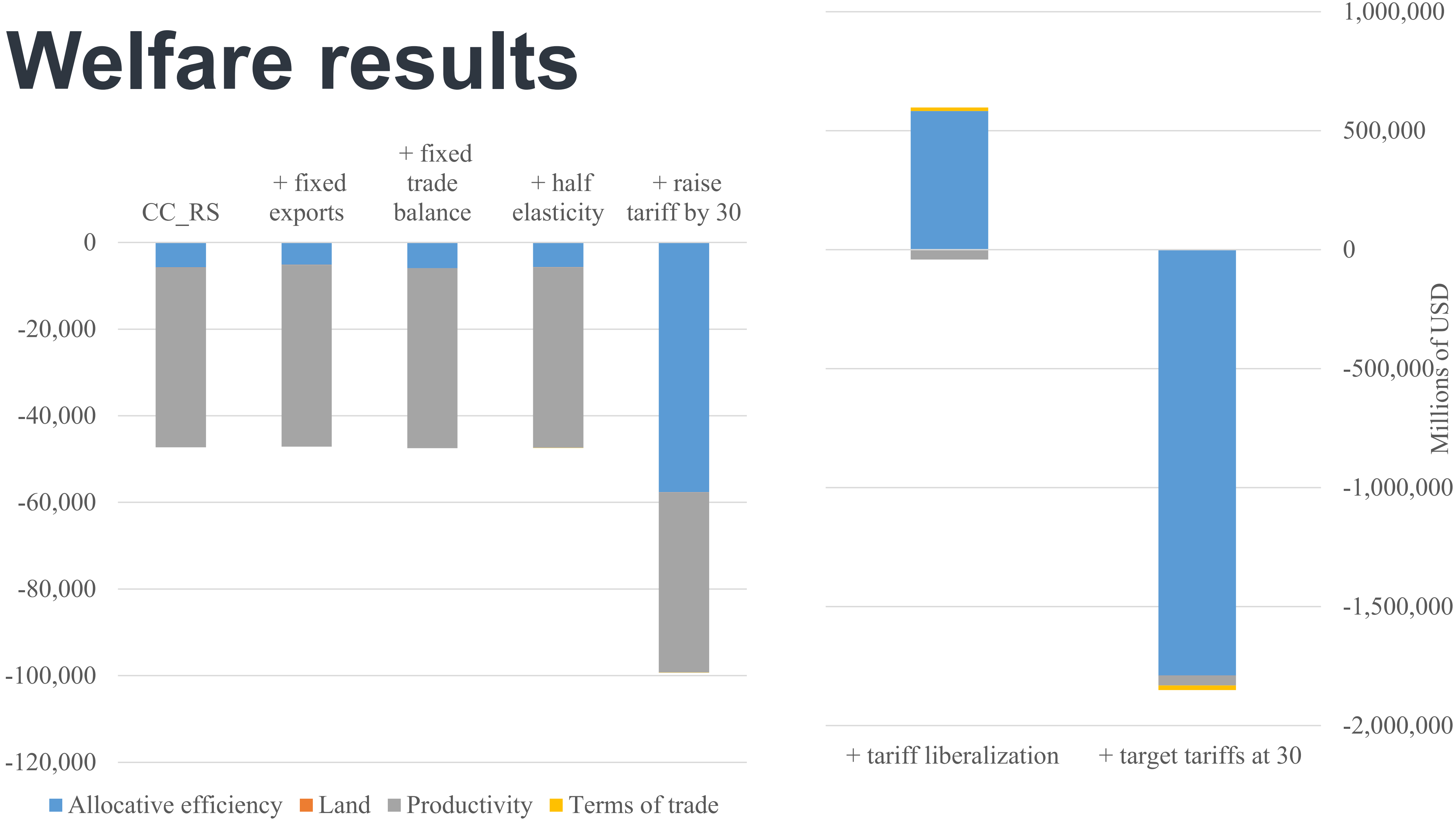
Emissions: selected scenarios (MtCO2)

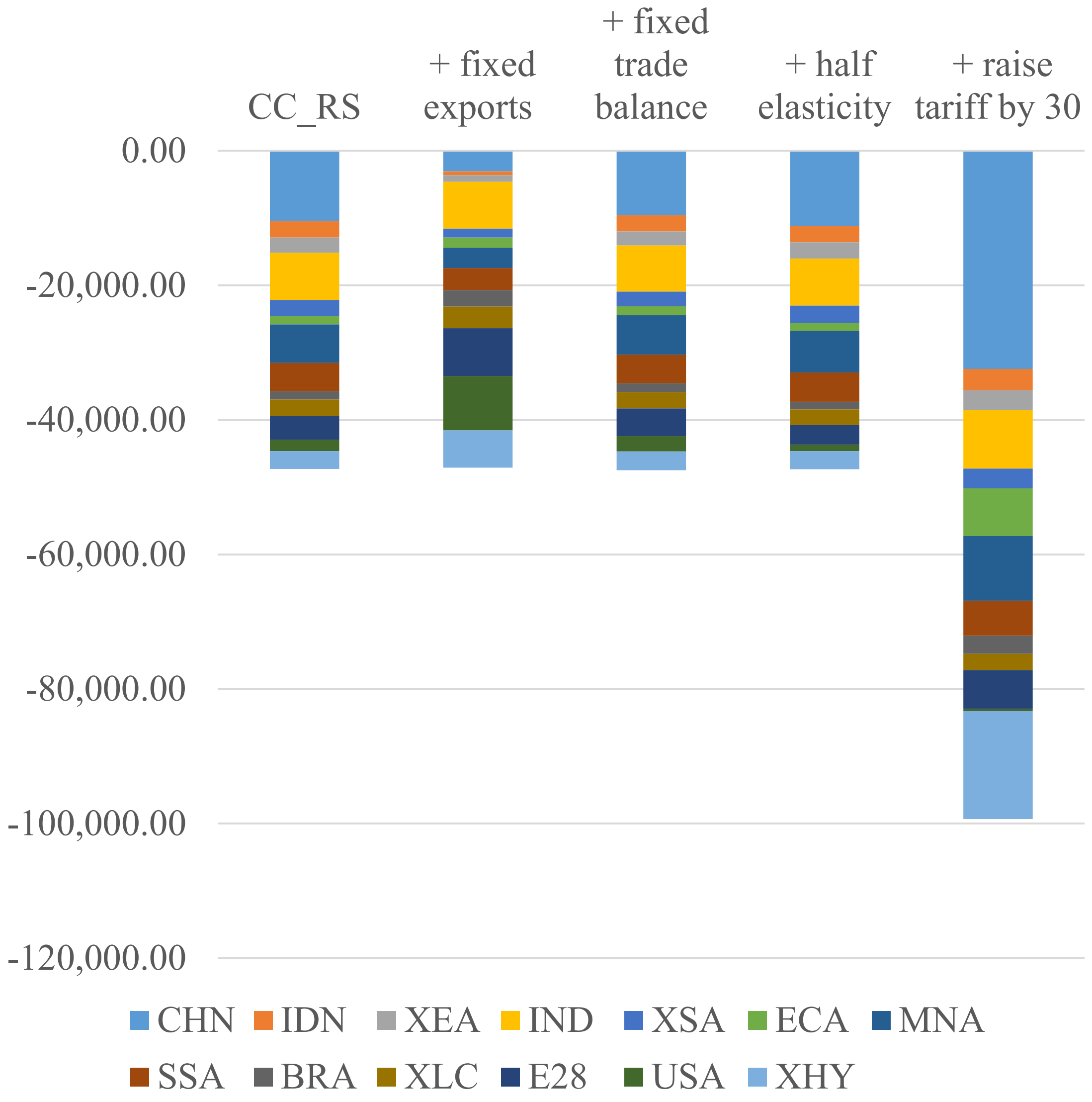


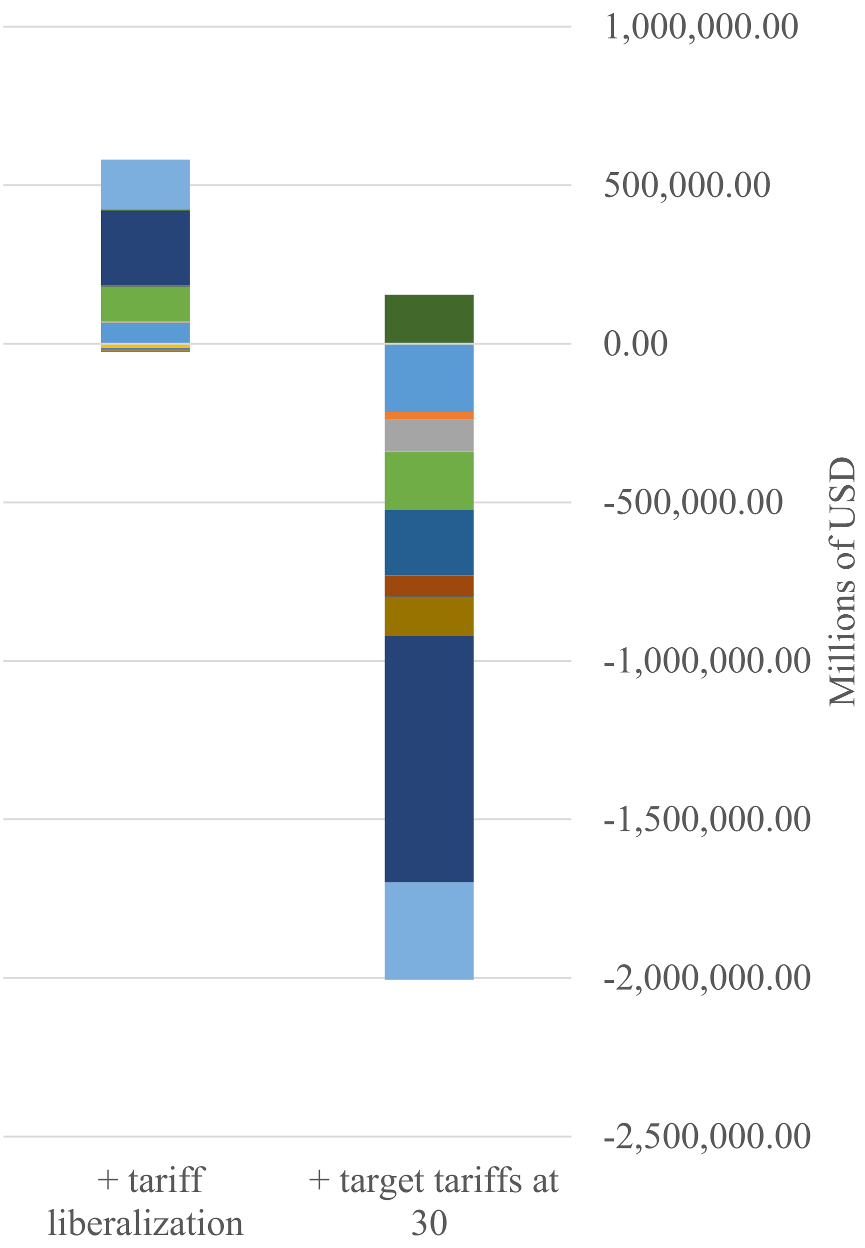


Welfare results



Welfare distribution





Final Remarks

- **Not all negative shocks produce negative output**
  - There is reallocation of production and this is affected by trade environment
- **Welfare results of climate change are negative and driven by loss in productivity**
  - Except when shocking taxes on trade
- **Emissions could increase the most by trade liberalization**
  - Only scenario with (+) welfare, but not for all regions

Limitations and wish list

- **Keeping it simple, except for new dataset**
  - GTAP-AEZ to capture land heterogeneity within countries
- **Land allocation in GTAP is modelled as CET function**
  - Changes in allocation does not add up to total available land
  - Use CRETH function to make quantities add up (Li et al., 2012; Horridge,2019)
- **Use more recent estimates**
  - Armington elasticities at HS6 (Fontagné et al., 2019)
- **Consider GDP losses by 2050 (Johnson et al. 2020)**
  - Instead of sea level rising shocks

Questions/Comments?
Thank you for your feedback.

aaguiar@purdue.edu

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