The Role of International Trade in Climate Change

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Outline

- **Motivation**
  - A bit of literature review
  - What we know and expect
- **Data and Model**
  - Simulation design
  - Results

Motivation

- **Trade can help ameliorate the effects of climate change**
- **Review the role of international trade when considering impact functions due to climate change**

Literature review…

- **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

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 agricultural detail and support**
  - Use special version that applies FAO sourced agricultural production targeting (APT) to 133 countries on GTAP 9.2 ref. year 2011 -141 regions (Chepeliev and Aguiar, 2018)
  - GTAP 6.2 model, std GE closure, expected rate of return equate
- **APT aims to improve agricultural IOTs**
  - Currently based on what is available at the OECD PSE
- **Consider 13 countries and regions**
  - 23 sectors: 12 agricultural products, 1 processed foods, 2 services, other
  - 5 factor endowments: skilled and unskilled labor

Simulation Design

- **Base case simulation relies on the meta-analysis estimates of the climate impacts by Roson and Sartori (2016)**
  - These affect the availability of land and the productivity of crops (rice, wheat and other grains) for all 140 GTAP 9 regions
  - For five levels of temperature increase, 1 to 5 degrees C, by 2050 or 2100
- **To contrast the base case results:**
  - Restrict trade at initial level (no change in exports)

Base case

- **Consider an increase in average temperature of +3°C by 2100**
  - No adaptation behavior
- **Interpret the Climate Change Damage Functions by Roson and Sartori (2016) as Hicks-neutral changes in crop productivity.**
  - Climate change will affect the productivity of all inputs in the same way, the magnitude does not effect on the levels of these inputs.
- **Also considering the change in land availability, but this is not as precise as it could be with detailed land use and cover information**
  - Not considering potential benefits of soil conditions

Experiment shocks

Aggregate regions	% change in land 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	-0.013	-2.78	-5.42	-2.33

Results

World output	% change Base	Land CNT	Rice CNT	Wheat CNT	Maize CNT
Rice	-0.566	-0.002	-0.249	-0.193	-0.122
Wheat	-0.236	-0.0001	-0.056	-0.107	-0.073
Maize	0.099	-0.0003	-0.024	-0.060	0.183

Results

World output	% change Base	% change w/ unemployment
Rice	-0.566	-0.80
Wheat	-0.236	-0.44
Maize	0.099	-0.11

World output of Maize increases, why?

Output by Ctry	Sim.	Land CNT	Rice CNT	Wheat CNT	Maize CNT
CHN	2.20	0.0001	-0.06	-0.06	2.32
ECA	0.91	-0.01	-0.84	0.07	-2.10
E28	0.84	-0.01	-0.75	0.06	-1.36
USA	0.09	0.0007	-0.09	-0.36	-0.69
XHY	2.94	0.0004	-0.25	-0.27	-0.34

Decomposing Maize output sales

	Domestic Sales	Exports	Total effect
CHN	**2.210**	-0.014	2.196
ECA	0.006	0.905	0.911
E28	0.341	0.502	0.843
USA	-0.170	0.265	0.095
XHY	0.784	**2.157**	2.941

Initial shares (Maize)

	Domestic Sales	Exports
CHN	**0.997**	0.003
ECA	0.74	0.26
E28	0.75	0.25
USA	0.77	0.23
XHY	0.58	**0.42**

% change in variables (Maize)

	Domestic Sales	Exports
CHN	2.22	**-4.57**
ECA	0.01	3.41
E28	0.46	1.92
USA	-0.22	1.18
XHY	1.37	**5.05**

Changes in maize exports

$$qxs(i,r,s) = qim(i,s) - ESUBM(i) * [pms(i,r,s) - pim(i,s)]$$

- Substitution effect dominates expansion effect
- For China, bilateral price > aggregate import price
- For Rest of High Income countries, bilateral price < aggregate

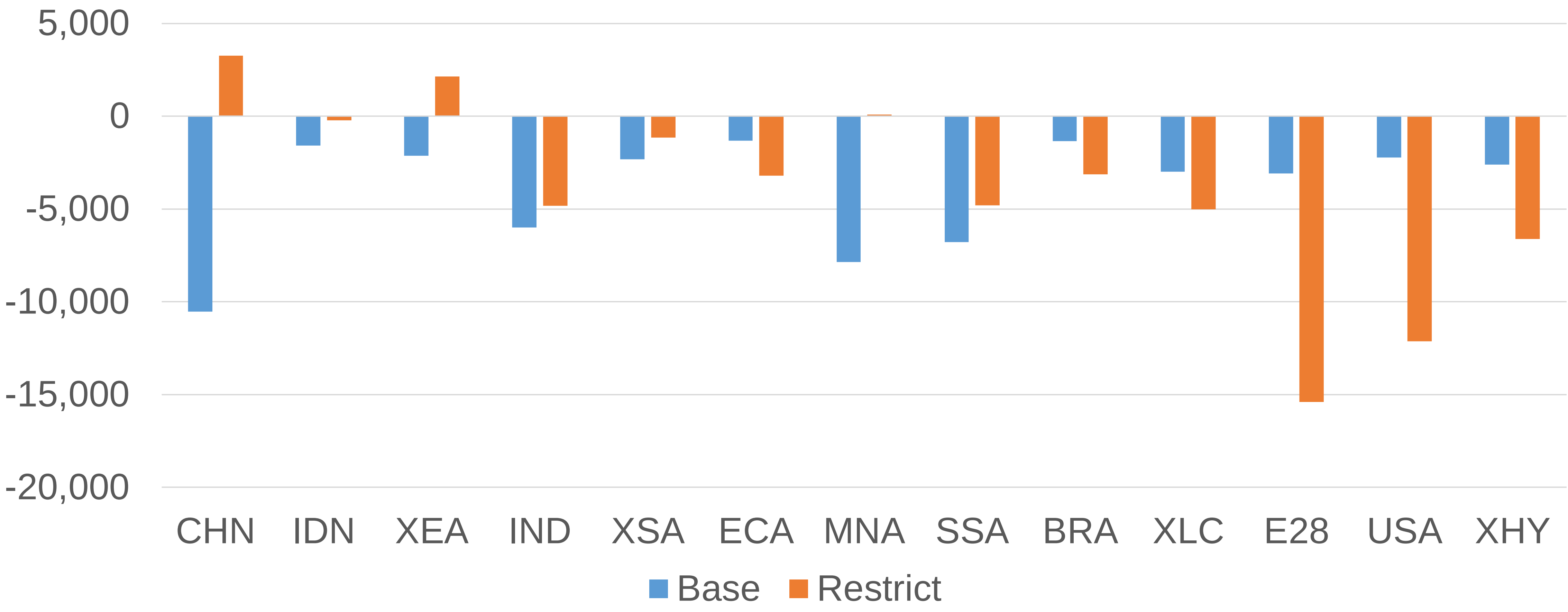
Comparing simulations

World output	% change -base	% change restricting trade	diff
Rice	-0.57	-0.27	0.30
Wheat	-0.24	0.31	0.55
Maize	0.10	0.07	-0.03

Comparison between simulations (Maize)

Output by Ctry	% change-base	% change rest. trade	Diff.
CHN	2.20	2.37	0.17
ECA	0.91	-0.04	-0.95
E28	0.84	0.04	-0.8
USA	0.09	-0.21	-0.3
XHY	2.94	-0.57	-3.51

Equivalent Variation (millions of USD)



Looking ahead…

- Keeping it simple, except for new dataset
- Need to do more analysis (i.e., Wheat increase with trade restrictions, EV decomposition)
- Could keep track of GHG emissions
- Model autarky to show trade relevance
- Switch to GTAP-AEZ framework

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Questions/Comments?
Thank you for your feedback.

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