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# Increased economic integration in the Asia-Pacific region

## What might be the potential impact on agricultural trade?

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# Trans-Pacific Integration & Agriculture

- CPTPP - trade agreement among 11 countries
  - Would eliminate many agricultural tariffs and increase access for other products
- Substantial agricultural trade among CPTPP countries + U.S.
  - 51% of agricultural imports from within CPTPP+U.S.
  - 43% of agricultural exports to CPTPP+U.S.
- CPTPP important U.S. trading partners
  - 47% of U.S. agricultural imports from CPTPP countries
  - 43% of U.S. agricultural exports to CPTPP countries
- What are the potential trade impacts within CPTPP+U.S.?



# Our Approach

1. Characterize global trade using a GE gravity model with systematic heterogeneity in agriculture
   - Multi-sector extension of Eaton and Kortum (2002)
   - Systematic heterogeneity (SH) gravity (Heerman 2016)



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   - Multi-sector extension of Eaton and Kortum (2002)
   - Systematic heterogeneity (SH) gravity (Heerman 2016)
     - Land & climate characteristics identify close competitors
       - Ex. Lower Canadian tariffs have a larger effect on U.S. exports to CPTPP countries than they do on Colombia's
     - Allows product-level policy changes



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     - Land & climate characteristics identify close competitors
     - Allows product-level policy changes
2. Scenario analysis - lower trade costs at product level
   - CPTPP tariff schedule at full implementation



# Road Map

- Introduce GE gravity model
  - Focus on agricultural sector
- Describe agricultural sector parameterization
  - SH gravity estimates
- Present GE results from two Trans-Pacific integration scenarios
  - CPTPP tariffs on primary agricultural products
    1. Among CPTPP members
    2. Among CPTPP + U.S.



# Systematic Heterogeneity Model Overview



# About the Model

- $I$ countries engaged in bilateral trade
  - Exporter indexed by $i$
  - Importer index by $n$
- Two tradable sectors: Agriculture and Manufacturing
  - A continuum of products in each sector indexed by $j$
- Production technology is heterogeneous across products
  - Agriculture: Climate and land endowments influence which products have the best technology
  - Manufacturing: As in Eaton and Kortum
- All markets are perfectly competitive
- Trade occurs as buyers look for the lowest price



# Model Overview

## Agriculture Production Technology Country $i$, product $j$ technology

$$q_i(j) = z_i(j) \times (N_i^{\beta_i}(a_i(j)L_i)^{1-\beta_i})^{\alpha_i} Q_i^{1-\alpha_i}$$

- Input bundle is the same for all ag products
  - $N_i$ is labor
  - $L_i$ is land
  - $Q_i$ is intermediate inputs



# Model Overview

## Agriculture Production Technology Country $i$, product $j$ technology

$$q_i(j) = z_i(j) \times (N_i^{\beta_i}(a_i(j)L_i)^{1-\beta_i})^{\alpha_i} Q_i^{1-\alpha_i}$$

- $z_i(j)$ Technological productivity-enhancing Frechet r.v.

$$F_i(z) = exp\{-T_i z^{-\theta}\}$$

  - $T_i$ drives average technological productivity in country $i$ ag
  - $\theta$ drives dispersion of technological productivity
  - Independently distributed across products



# Model Overview

## Agriculture Production Technology Country $i$, product $j$ technology

$$q_i(j) = z_i(j) \times (N_i^{\beta_i}(a_i(j)L_i)^{1-\beta_i})^{\alpha_i} Q_i^{1-\alpha_i}$$

- $a_i(j)$ is deterministic variable representing land productivity
  - Value reflects the coincidence of product requirements and country ecological characteristics
    - Ex., Coffee
  - Country-specific parametric density, independent of $z_i(j)$



# Agricultural Trade



# Model Overview

Comparative Advantage Probability country $i$ has the lowest price in product $j$ in market $n$

$$\pi_{ni}(j) = \frac{T_i(\tilde{a}_i(j)c_i\tau_{ni}(j))^{-\theta}}{\sum_{l=1}^{N} T_l(\tilde{a}_l(j)c_l\tau_{nl}(j))^{-\theta}}$$

- $\tau_{ni}(j) \geq 1$ is exporter $i$'s cost to export products to market $n$
  - Deterministic variable with parametric density
  - Independent of $z_i(j)$ and $\tilde{a}_i(j)$



# Model Overview

**Market Share** Exporter $i$ share in country $n$ ag expenditure

$$\pi_{ni} = \int \frac{T_i(\tilde{a}_i c_i \tau_{ni})^{-\theta}}{\sum_{l=1}^{N} T_l(\tilde{a}_l c_l \tau_{nl})^{-\theta}} dF_{\tilde{a}_n}(\tilde{\mathbf{a}}) dF_{\boldsymbol{\tau}_n}(\boldsymbol{\tau})$$

- $F_{\tilde{a}_n}(\tilde{\mathbf{a}})$ is the distribution of $\tilde{\mathbf{a}_n} = [\tilde{a}_1, ..., \tilde{a}_I]$ across all products consumed in market $n$
- $F_{\boldsymbol{\tau}_n}(\boldsymbol{\tau})$ is the distribution of $\boldsymbol{\tau} = [\tau_{n1}, ..., \tau_{nI}]$ across all products consumed in market $n$



# Model Overview

**Market Share** Exporter $i$ share in country $n$ ag expenditure

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- Gravity-like relationship between trade flows, exporter characteristics and trade costs



# Estimation of Agricultural Productivity and Trade Cost Distribution Parameters

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# Random Coefficients Logit Specification Example

Dependent variable: Market share ($\pi_{ni}$)

- Calculated for 63 countries from year 2006 FAO production and bilateral trade flows in 134 primary products



# Random Coefficients Logit Specification Example

Dependent variable: Market share ($\pi_{ni}$)

Land Productivity: Interact exporter characteristics and product requirements

- Exporter characteristics: Arable land per capita; rural elevation; and climate distribution (World Bank, CIESIN, GTAP)
- Product requirements: Constructed distribution of production across land & climate (Above sources + FAO); normal random variable



# Random Coefficients Logit Specification Example

Dependent variable: Market share ($\pi_{ni}$)

Land Productivity: Interact exporter characteristics and product requirements

Trade costs: Interact gravity variables and product costs

- Gravity variables: border, language, distance
- Product-specific costs: Normal random variable



# Random Coefficients Logit Specification Example

Dependent variable: Market share ($\pi_{ni}$)

Land Productivity: Interact exporter characteristics and product requirements

Trade costs: Interact gravity variables and product costs

Estimation methodology: Simulated method of moments

- Nevo (2000), Train (2003)

▸ Parameter Estimates



# Multisector General Equilibrium



# General Equilibrium

## Model Solution

- Estimate structural gravity for agriculture and manufacturing
  - Data, 2006
    - Agricultural trade and production, FAO
    - Arable land, World Bank
    - Climate distribution, GTAP
    - Elevation, CIESIN
    - Manufacturing trade and production, CEPII
    - Gravity variables, CEPII
- Use parameter estimates with calibrations and data to solve
  - Data, 2006
    - Land and labor, World Bank
    - Input-Output Matrices, OECD



# General Equilibrium

## Scenario Analysis: CPTPP tariffs

1. Reduce product-specific bilateral trade cost estimates in the amount of tariff cut
   - Tariff cut = % change between 2006 MFN and CPTPP
     - Data: UNCTAD TRAINS, WTO
   - Exceptions in this version
     - RTA Treatment
       - No tariff cuts between pairs with pre-2006 RTAs
       - No extra cuts for pairs with post-2006 RTAs
     - Specific tariffs and TRQs not fully phased out
       - No cuts



# General Equilibrium

## Scenario Analysis: CPTPP tariffs

1. Reduce product-specific bilateral trade cost estimates in the amount of tariff cut
2. Re-solve model for new equilibrium

## Two Scenarios

CPTPP - Tariff cuts among CPTPP countries

CPTPP+U.S.- U.S. gains access equivalent to CPTPP and offers full access to CPTPP countries



# Scenario Analysis: CPTPP

| Exporter | % Change in primary ag. exports value to CPTPP countries and U.S. |
|---|---|
| Australia | 2.29 |
| Canada | 2.37 |
| Chile | 2.17 |
| Japan | 1.94 |
| Malaysia | 1.73 |
| Mexico | 1.97 |
| New Zealand | 0.05 |
| Peru | 1.16 |
| Vietnam | 1.61 |
| United States | 0.27 |

- Rise in Trans-Pacific regional trade
  - Direct effects of higher tariffs
  - Indirect effects of lower real incomes, higher costs of production



# Scenario Analysis: CPTPP+U.S.

| Exporter | **Ratio: CPTPP/CPTPP+U.S.** % Change in primary ag. exports value to CPTPP countries and U.S. |
|---|---|
| Australia | 0.905 |
| Canada | 0.949 |
| Chile | 0.790 |
| Japan | 0.994 |
| Malaysia | 1.002 |
| Mexico | 0.631 |
| New Zealand | 1.381 |
| Peru | 1.133 |
| Vietnam | 0.999 |
| United States | 1.322 |

- U.S. gains roughly 1/3 larger for U.S. from CPTPP access



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- Relatively larger gains reflect value of U.S. market access



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- Relatively smaller gains imply U.S. is close competitor in CPTPP markets



# Conclusion

- Trans-Pacific integration offers a substantial opportunity for increased trade in primary agriculture
- Advantages of SH model
  - Captures variation in the impact on trade patterns when integration proceeds with vs. without the U.S.
    - Closer competitors have relatively smaller gains in export value when U.S. participates
  - Can incorporate product level policy change in a single-equation, sector-level model



# Limitations of this analysis

- Model calibrated with 2006 data does not capture
  - Changes in relative productivity (Brazil)
  - Changes in relative bilateral trade costs (PTAs)
  - Changes in demand (China)
- Tariff changes limited to primary agricultural products
- Paper will be updated with newly available data source: USITC gravity datast