

# Estimating Policy Barriers to Trade

Brendan Cooley

Political Economy Graduate Colloquium

6 December 2018

# Free and Fair?



**Donald J. Trump** ✓

@realDonaldTrump

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The United States must, at long last, be treated fairly on Trade. If we charge a country ZERO to sell their goods, and they charge us 25, 50 or even 100 percent to sell ours, it is UNFAIR and can no longer be tolerated. That is not Free or Fair Trade, it is Stupid Trade!

10:51 AM - 2 Jun 2018

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- **Fair:** Barriers that do exist affect all trade partners symmetrically

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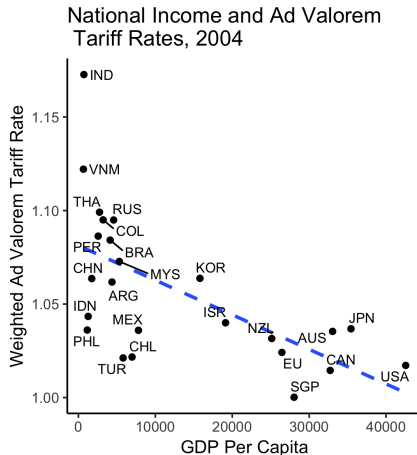
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# The Tariff System (GATT/WTO)

- **Free?** Applied tariff rates are low, ~5% on average (Baldwin 2016)
- **Fair?** WTO members (vast majority of world economy) commit to principle of non-discrimination (Most Favored Nation)



# Varieties of Barriers

## Direct

- Tariffs
- Non-Tariff Measures (NTMs)
  - Price controls, quotas, health and safety regulations, technical barriers
  - Edward D. Mansfield and Busch (1995), Lee and Swagel (1997), Gawande and Hansen (1999), Kono (2006), Rickard (2012), Maggi, Mrázová, and Neary (2018)

## Indirect (Behind-the-Border)

- Government procurement
  - Evenett and Hoekman (2004), Kono and Rickard (2014)
- Subsidies
- Excise taxes
- Regulations

**Effective Discrimination:** Target trade-disorting instruments to disproportionately affect disfavored trading partners.

- E.g. high agricultural duties by developed countries disproportionately harm developing countries

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# Approach

**Trade Costs:** Policy distortions and transportation costs to access market  $i$  in excess of those faced by firms in country  $i$

## Overview

1. Build model of international economy subject to trade costs (Eaton and Kortum 2002)
2. Derive structural relationship linking trade costs to price levels, trade flows, market shares of home producers
  - Anderson and Van Wincoop (2003), Waugh (2010), Simonovska and Waugh (2014), Sposi (2015), Waugh and Ravikumar (2016)
3. Decompose trade costs into economic (transportation costs) and political (policy barriers) components
4. Model transportation costs, combine with data on variables in (2) to separately estimate magnitude of policy barriers

$\tau_{ij} - 1 \geq 0$  - ad valorem tariff equivalent of policy barriers country  $i$  imposes on country  $j$

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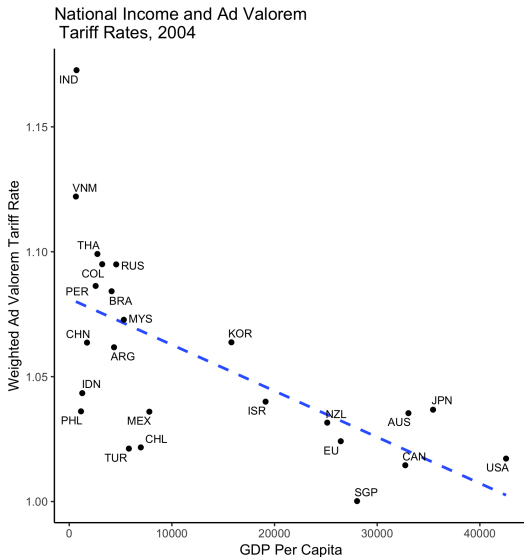
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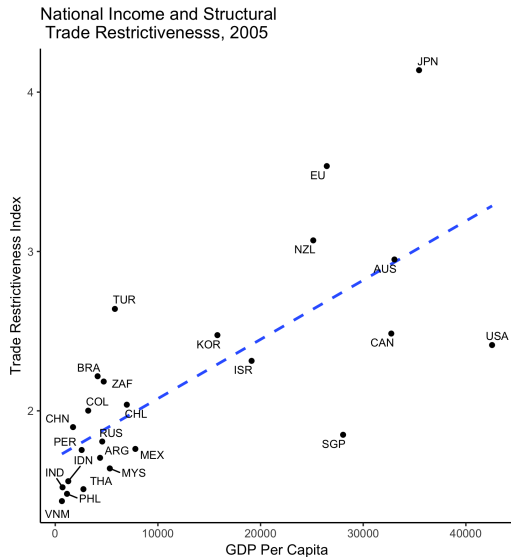
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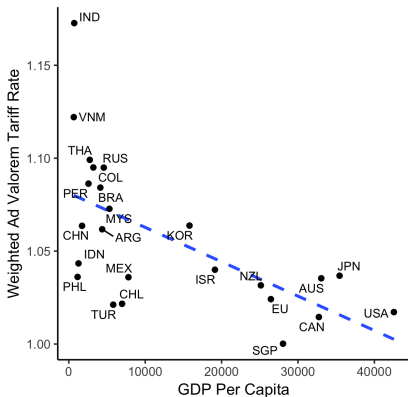


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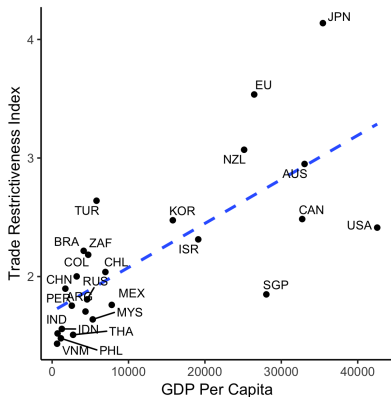


# Bottom Line

National Income and Ad Valorem  
Tariff Rates, 2004



National Income and Structural  
Trade Restrictiveness, 2005



# Model

# Model Intuition

- $N$  countries  $i \in \{1, \dots, N\}$  with representative consumers
  - Value C-D mixture of tradable goods and nontradable services
  - Earn wage  $w_i$  for every unit of labor endowment  $L_i$  supplied
- Competitive economy, stochastic technology
  - Production requires labor and bundle of intermediate inputs

## Structural Relationship

$$d_{ij} = \left( \frac{\lambda_{ij}}{\lambda_{jj}} \right)^{-\frac{1}{\theta}} \frac{P_i}{P_j} \quad (1)$$

- $d_{ij}$  - trade costs
- $\lambda_{ij}$  - share of  $j$ 's producers in  $i$ 's market for tradables
- $\lambda_{jj}$  - share of  $j$ 's producers in home market for tradables
- $P_i$  - price level of tradables
- $\theta$  - trade elasticity

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# Consumption

## Consumer's Problem

$$\begin{aligned} \max \quad & Q_i^{\alpha_i} S_i^{1-\alpha_i} \\ \text{subject to} \quad & P_i Q_i + P_i^s S_i \leq w_i L_i \end{aligned} \quad (2)$$

## CES Preferences over Tradable Varieties

$$Q_i = \left( \int_{[0,1]} q_i(\omega)^{\frac{\sigma-1}{\sigma}} d\omega \right)^{\frac{\sigma}{\sigma-1}} \quad (3)$$

## Tradable Price Index

$$P_i = \left( \int_{[0,1]} p_i(\omega)^{1-\sigma} \right)^{\frac{1}{1-\sigma}} \quad (4)$$

## Expenditure on Tradables

$$E_i^q = \alpha_i I_i + D_i = P_i Q_i^*$$

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# Production

## Costs

$$c_i = w_i^{1-\beta} P_i^\beta \quad (5)$$

- $w_i$  - cost of labor
- $P_i$  - cost of composite intermediate good
  - equivalent to composite consumption good

$$E_i^x = \beta X_i$$

## Local Prices

$$p_{ii}(\omega) = \frac{c_i}{z_i(\omega)} \quad (6)$$

## Technology (Frechet)

$$F_i(z) = \Pr \{z_i(\omega) \leq z\} = \exp \{-T_i z^{-\theta}\} \quad (7)$$

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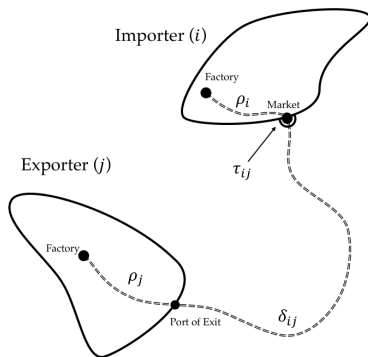
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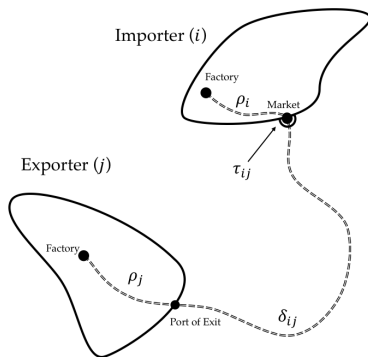
$$p_{ji}(\omega) = d_{ji} p_{ii}(\omega)$$

$$d_{ij} = \rho_j \delta_{ij} \tau_{ij} \quad (8)$$

-  $\tau_{ij} = 1 \implies$  no policy distortion -  
 $\tau_{jj} = \delta_{jj} = 1$

$$p_i^*(\omega) = \min_{j \in \{1, \dots, N\}} \{p_{ij}\}$$

# Trade Costs



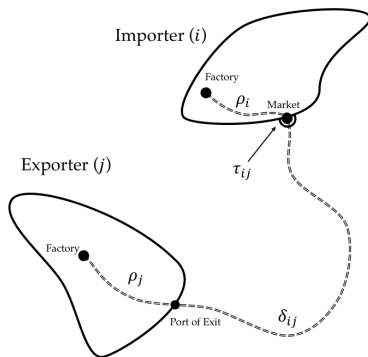
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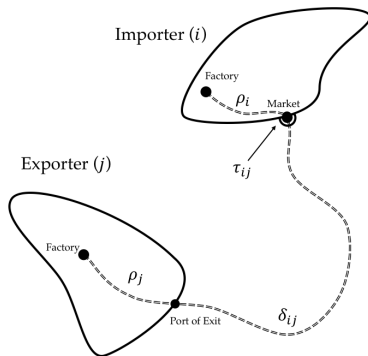
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# Equilibrium

## Total Expenditure on Tradables

$$X_i = \underbrace{E_i^q + E_i^x}_{E_i} - D_i \quad (9)$$

## Trade Shares

$$\Omega_{ij}^* = \left\{ \omega \in [0, 1] \mid p_{ij}(\omega) \leq \min_{k \neq j} \{p_{ik}\} \right\}$$
$$\lambda_{ij}(\mathbf{w}) = \frac{1}{E_i} \int_{\Omega_{ij}^*} p_{ij}(\omega) q_i(p_{ij}(\omega)) d\omega \quad (10)$$

## Market Clearing

$$X_i = \sum_{j=1}^N \lambda_{ji}(\mathbf{w}) E_j \quad (11)$$

**Definition:** An *international equilibrium* is a vector of wages  $\mathbf{w}$  such that Equations 9, 10, and 11 hold for all  $i \in \{1, \dots, N\}$ .

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# Isolating Policy Barriers (I)

## Trade Shares (w/ Frechet)

$$\begin{aligned}\lambda_{ij}(\mathbf{w}) &= \frac{T_j \left( d_{ij} w_j^{1-\beta} P_j^\beta \right)^{-\theta}}{\sum_j T_j \left( d_{ij} w_j^{1-\beta} P_j^\beta \right)^{-\theta}} \\ &= \frac{T_j \left( \underbrace{\rho_j \delta_{ij} \tau_{ij}}_{d_{ij}} w_j^{1-\beta} P_j^\beta \right)^{-\theta}}{\frac{1}{\gamma} P_i^{-\theta}}\end{aligned}$$

## In Differences

$$\frac{\lambda_{ij}}{\lambda_{jj}} = \left( \underbrace{\delta_{ij} \tau_{ij} \frac{P_j}{P_i}}_{\text{observables}} \right)^{-\theta}$$

# Isolating Policy Barriers (I)

## Trade Shares (w/ Frechet)

$$\begin{aligned}\lambda_{ij}(\mathbf{w}) &= \frac{T_j \left( d_{ij} w_j^{1-\beta} P_j^\beta \right)^{-\theta}}{\sum_j T_j \left( d_{ij} w_j^{1-\beta} P_j^\beta \right)^{-\theta}} \\ &= \frac{T_j \left( \underbrace{\rho_j \delta_{ij} \tau_{ij}}_{d_{ij}} w_j^{1-\beta} P_j^\beta \right)^{-\theta}}{\frac{1}{\gamma} P_i^{-\theta}}\end{aligned}$$

## In Differences

$$\frac{\lambda_{ij}}{\lambda_{jj}} = \left( \underbrace{\delta_{ij} \tau_{ij} \frac{P_j}{P_i}}_{\text{observables}} \right)^{-\theta}$$

## Isolating Policy Barriers (II)

$$\tau_{ij} = \left( \frac{\lambda_{ij}}{\lambda_{jj}} \right)^{-\frac{1}{\theta}} \frac{P_i}{P_j} \underbrace{\frac{1}{\delta_{ij}}}_{\text{freight cost correction}} \quad (12)$$

# Calibration

# Prices (I)

## Data

- International Comparison Program (World Bank)
- $M$  tradable expenditure categories  $m \in \{1, \dots, M\}$  Empirical Categories

$$P_i = \sum_{m=1}^M e_i^m P_i^m$$

## Expenditure on Tradables

$$\alpha_i = \frac{1}{I_i} \sum_{m=1}^M e_i^m$$

$$E_i = \underbrace{I_i + \beta X_i}_{\text{gross consumption}} - \underbrace{(1 - \alpha_i) I_i}_{\text{services exp.}}$$

## Home Expenditure

$$\lambda_{jj} = E_j \left( 1 - \sum_{i \neq j} \lambda_{ji} \right)$$

# Prices (I)

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- International Comparison Program (World Bank)
- $M$  tradable expenditure categories  $m \in \{1, \dots, M\}$  Empirical Categories

$$P_i = \sum_{m=1}^M e_i^m P_i^m$$

## Expenditure on Tradables

$$\alpha_i = \frac{1}{l_i} \sum_{m=1}^M e_i^m$$

$$E_i = \underbrace{l_i + \beta X_i}_{\text{gross consumption}} - \underbrace{(1 - \alpha_i)l_i}_{\text{services exp.}}$$

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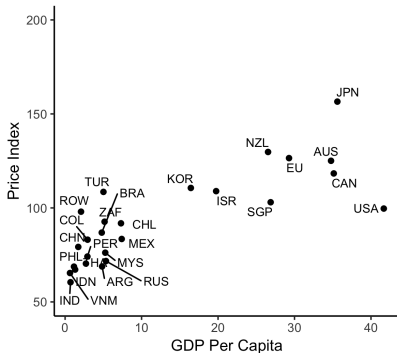
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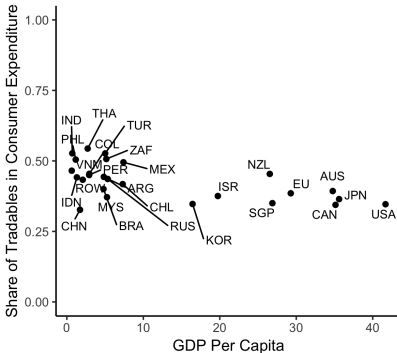
$$\lambda_{jj} = E_j \left( 1 - \sum_{i \neq j} \lambda_{ji} \right)$$

# Prices (II)

Price Indices and Per Capita National Income, 2005



Tradable Shares and Per Capita National Income, 2005





# Freight Costs (I)

$$\delta_{ij} : \mathbf{Z}_{ij} \rightarrow \hat{\delta}_{ij}$$

## Data

- Transportation Mode Shares
  - United States, Japan, European Union, Brazil
- Freight Costs
  - United States Census Bureau
  - OECD Maritime Transport Costs
- Geographic Covariates ( $\mathbf{Z}_{ij}$ )
  - Sea Distance
  - Population-weighted great circle distance
  - Island indicators
  - Contiguity

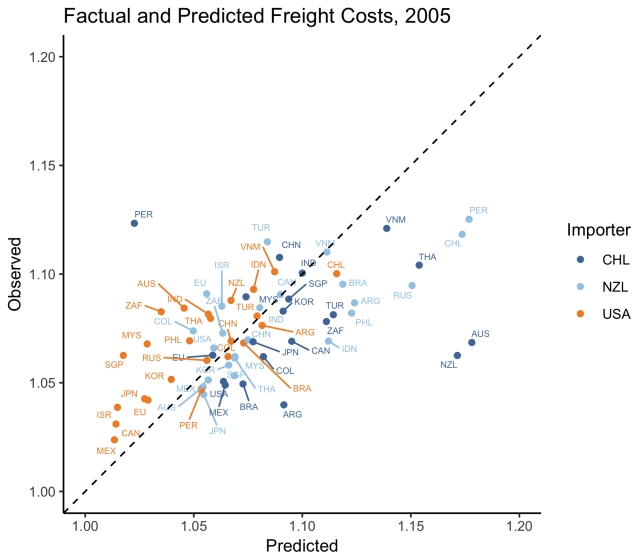
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# Freight Costs (II)



# Isolating Policy Barriers (Again)

$$\tau_{ij} = \left( \frac{\lambda_{ij}}{\lambda_{jj}} \right)^{-\frac{1}{\theta}} \frac{P_i}{P_j} \underbrace{\frac{1}{\delta_{ij}(\mathbf{Z}_{ij})}}_{\text{freight cost correction}} \quad (13)$$

- 25 countries, representing 91 percent of world GDP.
  - Rest of World as aggregate outside economy
- $\theta = 5$

## Isolating Policy Barriers (Again)

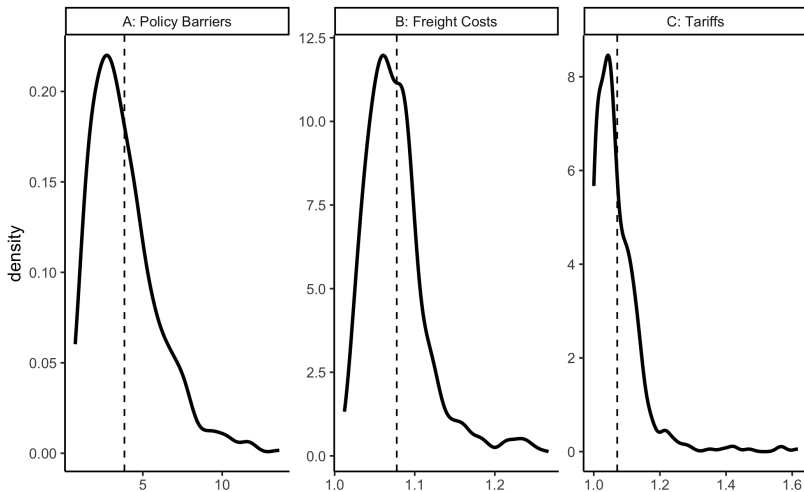
$$\tau_{ij} = \left( \frac{\lambda_{ij}}{\lambda_{jj}} \right)^{-\frac{1}{\theta}} \frac{P_i}{P_j} \underbrace{\frac{1}{\delta_{ij}(\mathbf{Z}_{ij})}}_{\text{freight cost correction}} \quad (13)$$

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# Results

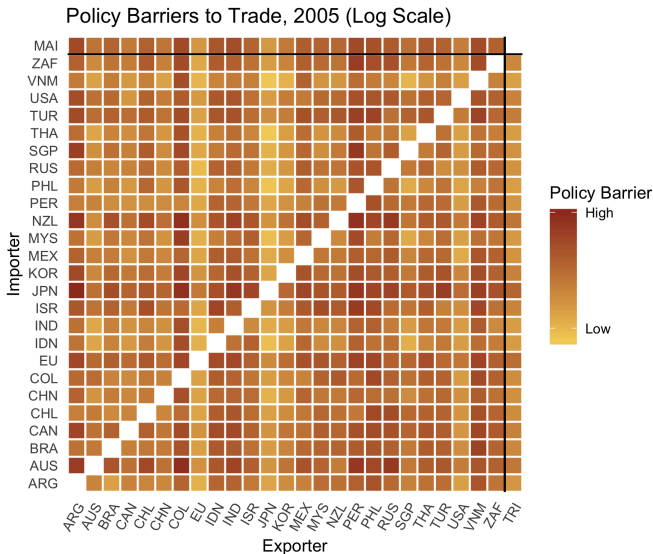
# Magnitude of Policy Barriers

- **Free?** Average policy barrier equivalent to 284 percent import tariff ( $\tau = 3.84$ )



# Distribution of Policy Barriers

- **Fair?** Within-country standard deviation of  $\tau_{ij}$  is 1.72





# Trade Restrictiveness and Market Access (I)

## Trade Restrictiveness Index

$$TRI_i = \frac{1}{\sum_{j \neq i} E_j} \sum_{j \neq i} \tau_{ij} E_j \quad (14)$$

## Market Access Index

$$MAI_j = \frac{1}{\sum_{i \neq j} E_i} \sum_{i \neq j} \tau_{ij} E_i \quad (15)$$

# Trade Restrictiveness and Market Access (I)

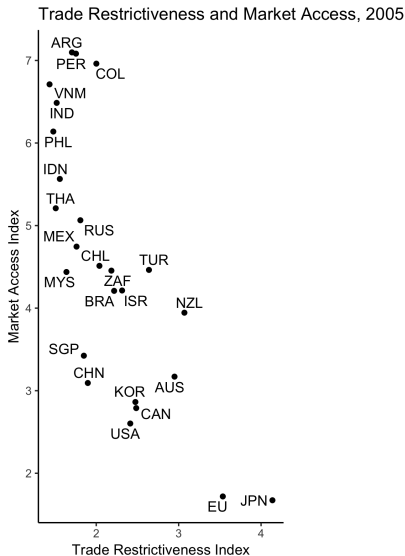
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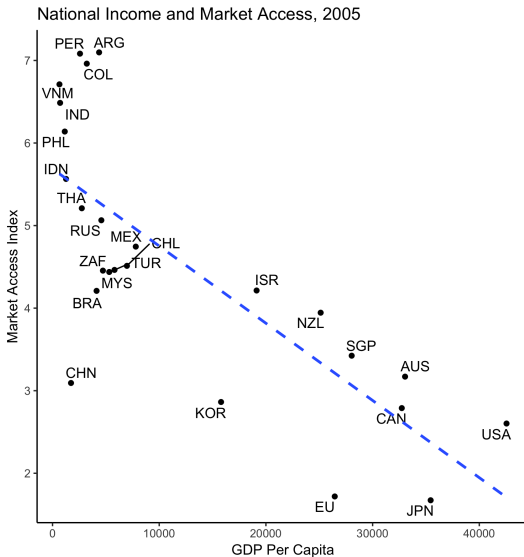
## Market Access Index

$$MAI_j = \frac{1}{\sum_{i \neq j} E_i} \sum_{i \neq j} \tau_{ij} E_i \quad (15)$$

# Trade Restrictiveness and Market Access (II)



# Market Access Barriers



## Correlates of Policy Barriers

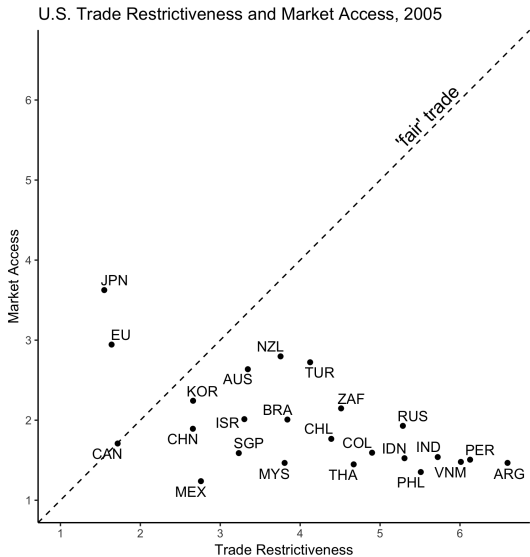
	<i>Dependent variable:</i>
	Structural Policy Barrier
Tariffs	2.886*** (0.875)
PTAs	-0.706*** (0.133)
Core NTM	-0.285 (0.440)
Health/Safety NTM	-0.160 (0.351)
Other NTM	-0.241 (0.691)
Importer Fixed Effects	✓
Exporter Fixed Effects	✓
Observations	506
R <sup>2</sup>	0.781

Note:

\*p<0.1; \*\*p<0.05; \*\*\*p<0.01

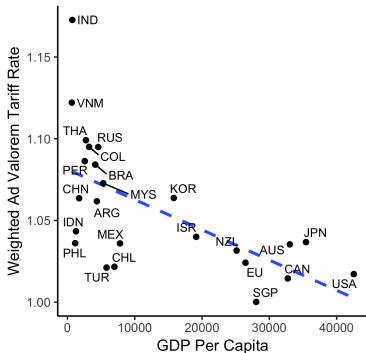


# U.S. Barriers and Market Access

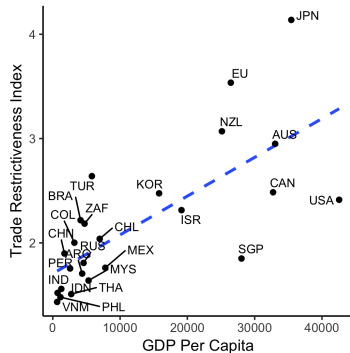


# Measurement Matters

National Income and Ad Valorem  
Tariff Rates, 2004



National Income and Structural  
Trade Restrictiveness, 2005





# Conclusion

## State Capacity and Protectionism

- Tariffs as “second-best” solution to revenue-raising problem facing low-capacity governments
  - Acemoglu (2005), Rodrik (2008), and Queralt (2015)
- Developing (more autocratic) world not necessarily more “welfare-conscious” than developed counterparts
  - Milner and Kubota (2005), Gawande, Krishna, and Olarreaga (2009); Gawande, Krishna, and Olarreaga (2015)

## Development and Trade Discrimination

- Growth causally linked to market access conditions abroad (Romalis 2007)
- Lack of market access by developing countries may hinder development prospects
  - Redding and Venables (2004), Romalis (2007), Waugh (2010)

*International trading system neither free nor fair – and developing world bears brunt of inequality*

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# Freight Cost Model

- Products  $m \in \{1, \dots, M\}$
- Transportation modes  $k \in \{1, \dots, K\}$
- $\zeta_{ij}^{mk}$  share of product  $m$  transported by mode  $k$

## Mode and Cost Functions

$$g : \{\mathbf{Z}_{ij}, d^m\} \rightarrow \delta_{ij}^{mk}$$

$$h : \{\mathbf{Z}_{ij}, d^m\} \rightarrow \zeta_{ij}^{mk}$$

## Aggregate Freight Costs

$$\hat{\delta}_{ij}(\mathbf{Z}_{ij}, \mathbf{d}_{ij}) = \frac{1}{X_{ij}} \sum_{m=1}^M x_{ij}^m \sum_{k=1}^K g(\mathbf{Z}_{ij}, d^m) h(\mathbf{Z}_{ij}, d^m)$$

# Tradable Expenditure Categories

Expenditure Category	Tradable?
Food and non-alcoholic beverages	✓
Alcoholic beverages and tobacco	✓
Clothing and footwear	✓
Housing, water, electricity, gas and other fuels	
Furnishings, household equipment and household maintenance	✓
Health	
Transport	✓
Communication	✓
Recreation and culture	✓
Education	
Restaurants and hotels	
Miscellaneous goods and services	
Net purchases from abroad	
Collective consumption expenditure by government	
Machinery and equipment	✓
Construction	
Other products	
Changes in inventories and valuables	
Balance of exports and imports	