The Margins of Global Sourcing: Theory and Evidence from U.S. Firms

Pol Antràs[1] Teresa Fort [2] Felix Tintelnot[3]

[1]Harvard University

[2]Tuck School at Dartmouth

[3]University of Chicago and Princeton University (IES)

Northwestern University

April 17, 2014

Disclaimer: This work is unofficial and thus has not undergone the review accorded to official Census Bureau publications. All results have been reviewed to ensure that no confidential information is disclosed. The views expressed in the paper are those of the authors and not necessarily those of the U.S. Census Bureau.

Broad Motivation

- Firms now central to many analyses in international trade

Broad Motivation

- Firms now central to many analyses in international trade
- Selection into exporting and into importing is far from random
  - ▸ Bernard et.al. (2007), Table 8

Broad Motivation

- Firms now central to many analyses in international trade
- Selection into exporting and into importing is far from random
  ▸ Bernard et.al. (2007), Table 8
- Extensive margins account for most of the cross-country variation in U.S. exports and imports ▸ Bernard et al. (2009), Table 1

Broad Motivation

- Firms now central to many analyses in international trade
- Selection into exporting and into importing is far from random
  ▸ Bernard et.al. (2007), Table 8
- Extensive margins account for most of the cross-country variation in U.S. exports and imports ▸ Bernard et al. (2009), Table 1
- Extensive margins of exporting are much better understood than extensive margins of importing

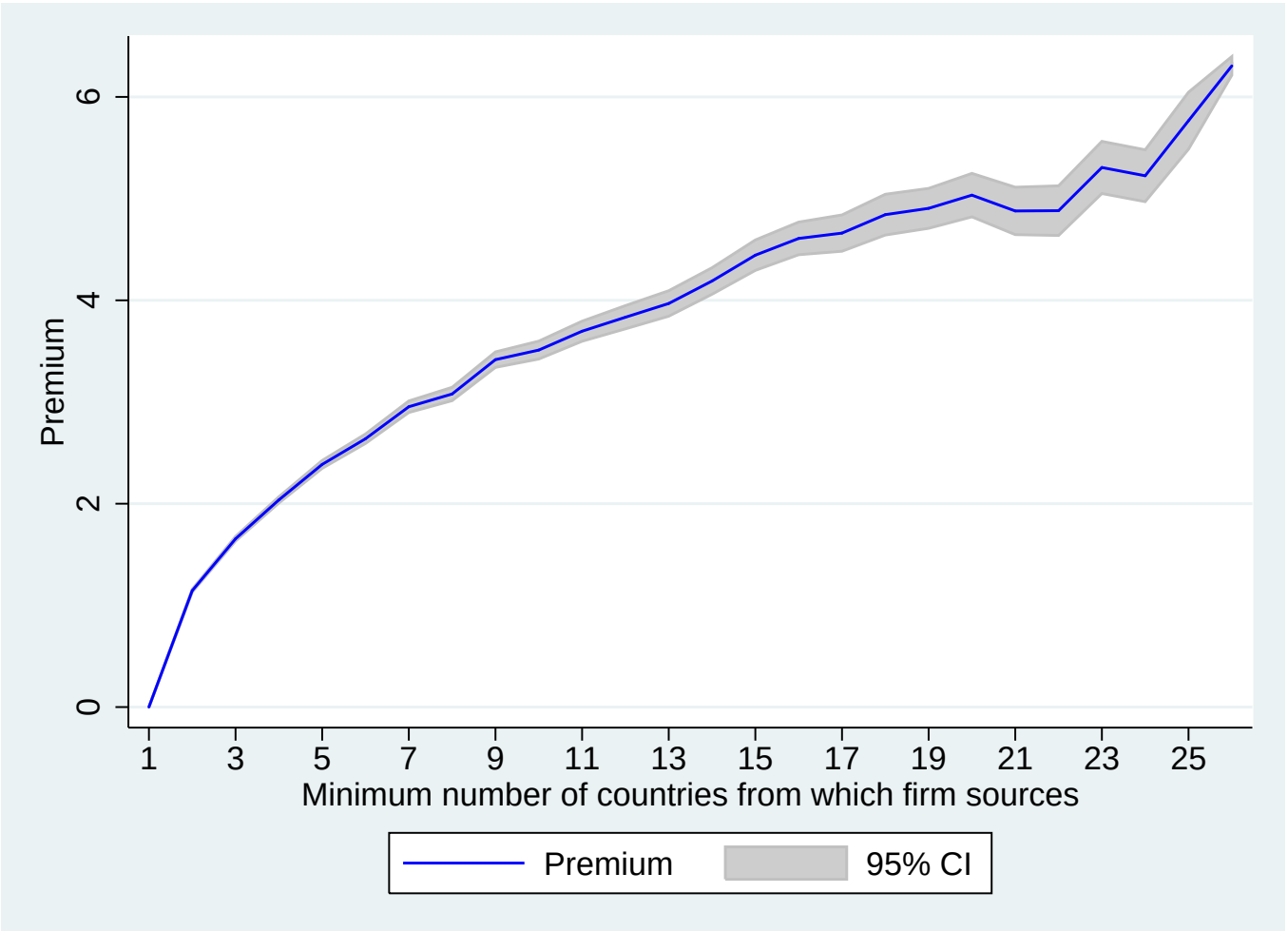
A Quick Look at the Margins

Premia for 2007 Importers

	All Firms	Non-2002 Importers
2007 Log employment	1.552***	1.269***
2007 Log sales	1.737***	1.399***
2007 Log value-added per worker	0.060***	0.039***
2002 Log employment	1.466***	1.154***
2002 Log sales	1.638***	1.270***
2002 Log value-added per worker	0.074***	0.052***

Notes: All results are from OLS regressions of the variable listed on the left on an indicator equal to one if the firm imported in 2007. The first column includes all firms. The second column is based on the subset of firms that did not import in 2002. Results with 2002 variables are based only on the subset of firms that existed in 2002. All regressions include four digit industry controls.

2007 Importer Sales Premia by Number of Source Countries



▸ Premia2002

Margin Decomposition

$$ln(M_{US,j}) = ln(N_{US,j}^{firms}) + ln(N_{US,j}^{prods}) + ln\left(\frac{O_{US,j}}{N_{US,j}^{firms} \times N_{US,j}^{prods}}\right) + ln\left(\frac{M_{US,j}}{O_{US,j}}\right)$$

Margin Decomposition

$$ln(M_{US,j}) = ln(N_{US,j}^{firms}) + ln(N_{US,j}^{prods}) + ln\left(\frac{O_{US,j}}{N_{US,j}^{firms} \times N_{US,j}^{prods}}\right) + ln\left(\frac{M_{US,j}}{O_{US,j}}\right)$$

	Log of number of importing firms	Log of number of imported products	Log of Density	Log of average import value per product per firm
	0.541***	0.535***	-0.426***	0.350***
	(0.016)	(0.015)	(0.014)	(0.018)
Adj. R^2	0.85	0.84	0.81	0.64
Observations	221	221	221	221

Notes: Each column corresponds to results from regressing the log of each margin on the log of total import values. The coefficients are a measure of the fraction of variation in aggregate import volumes across countries explained by that margin. Density represents the fraction of all possible firm-product combinations with positive import values. The estimated coefficients sum to one.

Gravity decomposition

	Log total imports	Log no. firms	Log no. products	Density	Log avg. value
Log of GDP	1.373***	0.872***	0.829***	-0.666***	0.339***
	(0.058)	(0.035)	(0.038)	(0.030)	(0.044)
Log of Distance	-1.651***	-1.057***	-1.079***	0.900***	-0.415*
	(0.294)	(0.176)	(0.191)	(0.153)	(0.222)
Common Language	0.961***	0.709***	0.501***	-0.494***	0.246
	(0.296)	(0.178)	(0.192)	(0.154)	(0.224)
Adj. R^2	0.78	0.79	0.75	0.75	0.26
Observations	176	176	176	176	176

Questions

- How does one explain the extensive margin of importing?
- Does a model of firm selection into importing yield distinct predictions for trade elasticities and welfare?
- How large are barriers to importing?
- Which country-characteristics do these barriers depend on?

Benchmark Model of Exporting

- In canonical models of exporting, firms assumed to have constant marginal costs unaffected by trade decisions
- Export entry decisions are thus analyzed independently country by country
- Firms export to country j if operating profits in that market cover the fixed cost of exporting there
- Intensive margin is simply computed based on marginal cost and export-market demand conditions

Challenges for a Model of Importing

- Importing intermediate inputs naturally affects the marginal cost of the firm
- Import entry decisions are thus interdependent across markets
- Choosing the source country for each input is complicated in a multi-country environment
  - sourcing potential of each country (a function of wages, technology and trade costs) is key
  - but complex discrete-choice problem even conditional on entry
- Intensive margin depends on the firm's sourcing costs of all inputs in all markets

This paper

- Develops a quantifiable multi-country sourcing model
  - extensive margin entry decisions are interdependent
  - more source countries increases competition between suppliers

This paper

- Develops a quantifiable multi-country sourcing model
  - extensive margin entry decisions are interdependent
  - more source countries increases competition between suppliers

- Achieves tractability by:
  - bringing Eaton-Kortum inside the firm (as in Tintelnot, 2014)
  - using monotonote comparative static techniques

This paper

- Develops a quantifiable multi-country sourcing model
  - extensive margin entry decisions are interdependent
  - more source countries increases competition between suppliers
- Achieves tractability by:
  - bringing Eaton-Kortum inside the firm (as in Tintelnot, 2014)
  - using monotonote comparative static techniques
- Estimates the sourcing potential and fixed costs of sourcing by country
  - separately identifies the two factors
  - applies iterative algorithm developed by Jia (2008)
  - role of distance and language in fixed costs
  - potential for policy-relevant counterfactuals

Related literature

- Empirical evidence on firm sourcing

  Bernard, Jensen, Redding, and Schott (2007, 2009); Bernard, Blanchard, Van Beveren, Vandebussche (2012); Fort (2014)

- Importing, firm efficiency, and markups

  Amiti and Konings (2007), Halpern, Koren, and Szeidl (2011), De Loecker, Goldberg, Khandelwal, and Pavcnik (2012), Amiti, Itskhoki, and Konings (2013)

- Multi-country sourcing

  Head, Ries, Jing (2010); Blaum, Lelarge, and Peters (2013); Bernard, Moxnes, Ulltveit-Moe (2014)

- Extended gravity and third market effects
  - Morales, Sheu, and Zahler (2014)

Model

Environment

- J countries
- Representative consumer:
  - Measure of L_j consumers / workers
  - Dixit-Stiglitz preferences, elasticity of substitution $\sigma > 1$
- Final good sector:
  - Measure N_i of firms
  - Non-tradable final output
  - Monopolistic competition
- Intermediate good sector
  - Trade cost τ_{ij} to import from country j by country i
  - Perfect competition
  - Intermediates are firm-specific

Production Technology

- Final good requires the assembly of a bundle of intermediates
- Marginal cost of final good producer, φ:

$$c_i\left(\{j(v)\}_{v=0}^{1},\varphi\right)=\frac{1}{\varphi}\left(\int_0^1\left(\tau_{ij(v)}a_{j(v)}(v,\varphi)\,w_{j(v)}\right)^{1-\rho}dv\right)^{1/(1-\rho)}$$

- Unit labor requirement $a_j(v,\varphi)$ for a given location j drawn from Fréchet distribution:

$$\Pr(a_j(v,\varphi)\leq a)=e^{-T_j a^{-\theta}},\quad \text{with } T_j>0.$$

- Fixed cost of offshoring $w_i f_{ij}$

Firm's problem

- Firm chooses:
  - Sourcing strategy $\mathcal{J}_i(\varphi) \subseteq \{1, ..., J\}$
  - Source country $j(v) \in \mathcal{J}_i(\varphi)$ for each intermediate v
  - Price of final good
- Sourcing strategy thus determines set of countries from which firm can buy inputs
- For all other countries $j \notin \mathcal{J}_i(\varphi)$, it is as if $a_j(v, \varphi) = +\infty$

Firm behavior conditional on sourcing strategy

- Share of intermediate input purchases sourced from any country j:

$$\chi_{ij}(\varphi) = \frac{T_j (\tau_{ij} w_j)^{-\theta}}{\Theta_i(\varphi)} \quad \text{if } j \in \mathcal{J}_i(\varphi)$$

- Sourcing capability:

$$\Theta_i(\varphi) \equiv \sum_{k \in \mathcal{J}_i(\varphi)} T_k (\tau_{ik} w_k)^{-\theta}$$

- Marginal cost:

$$c_i(\varphi) = \frac{1}{\varphi} (\gamma \Theta_i(\varphi))^{-1/\theta}$$

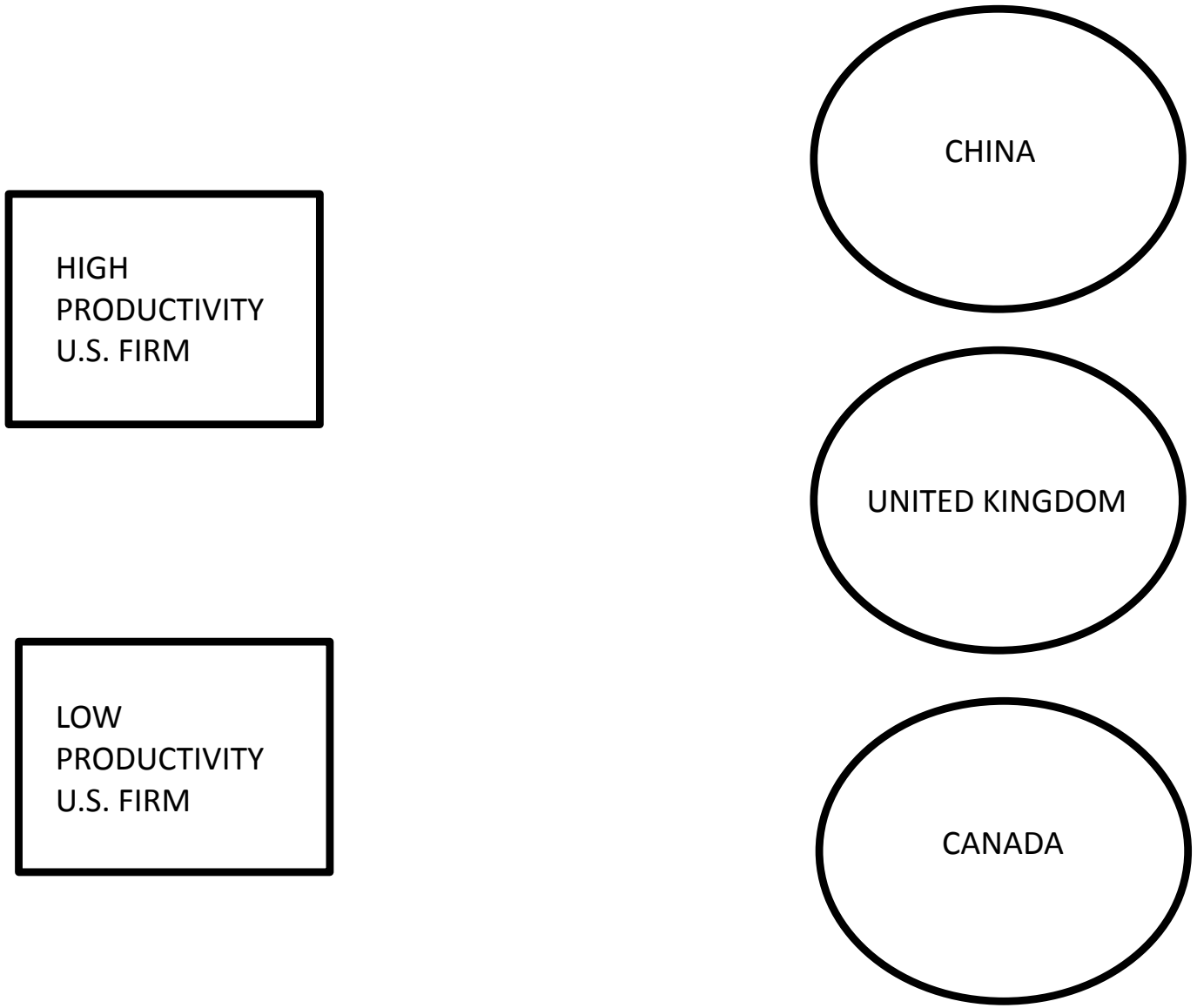
Optimal Sourcing Strategy

- Combinatorial Problem:

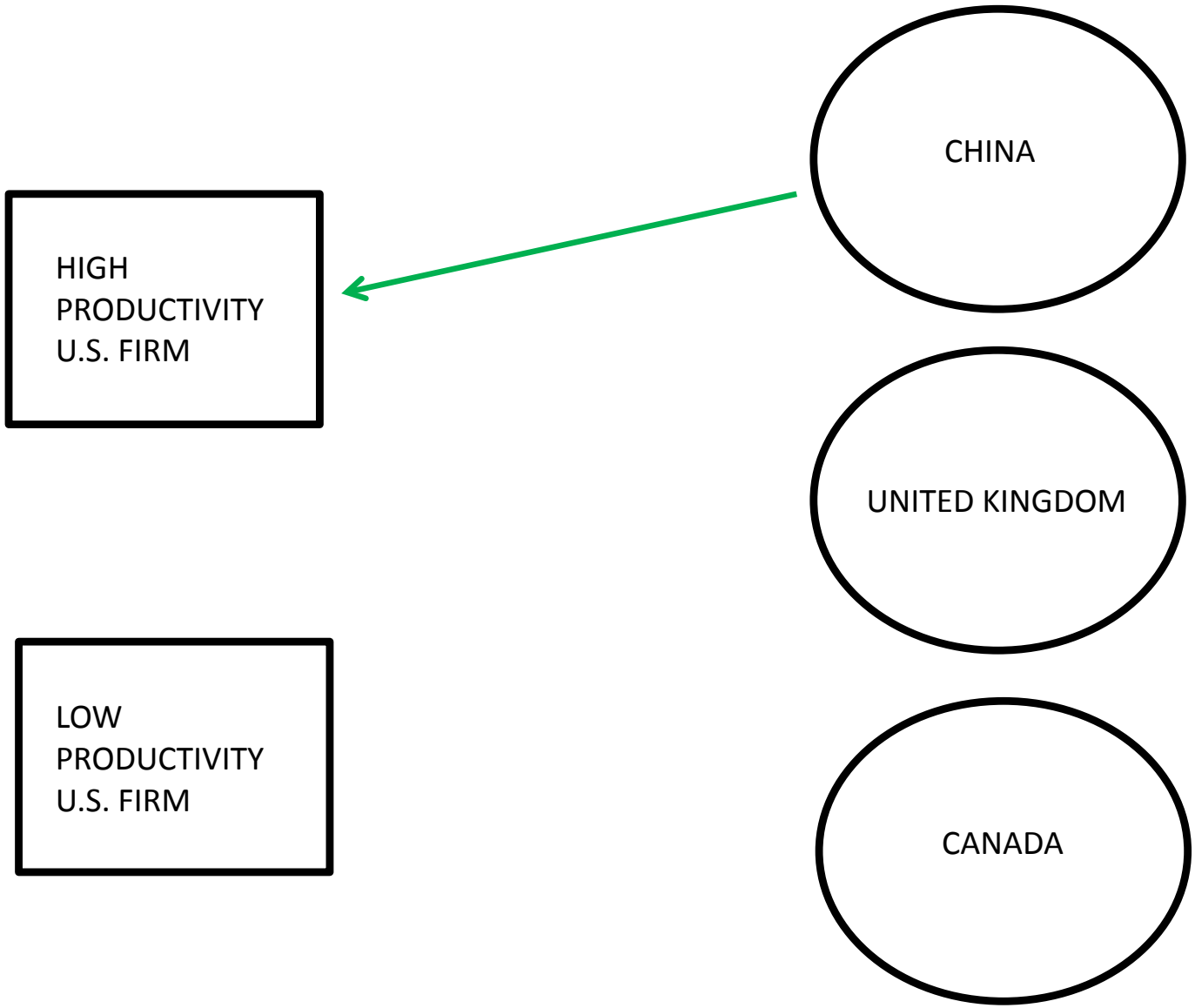
$$\max_{I_{ij} \in \{0,1\}_{j=1}^{J}} c_i(\varphi, \{I_{ij} \in \{0,1\}_{j=1}^{J}\})^{1-\sigma} B_i - w_i \sum_{j=1}^{J} I_{ij} f_{ij}$$

- Decisions interdependent across markets
- 2^N (rather than N) combinatorial problem
- Can we even ensure sales premia increasing in the number of countries?

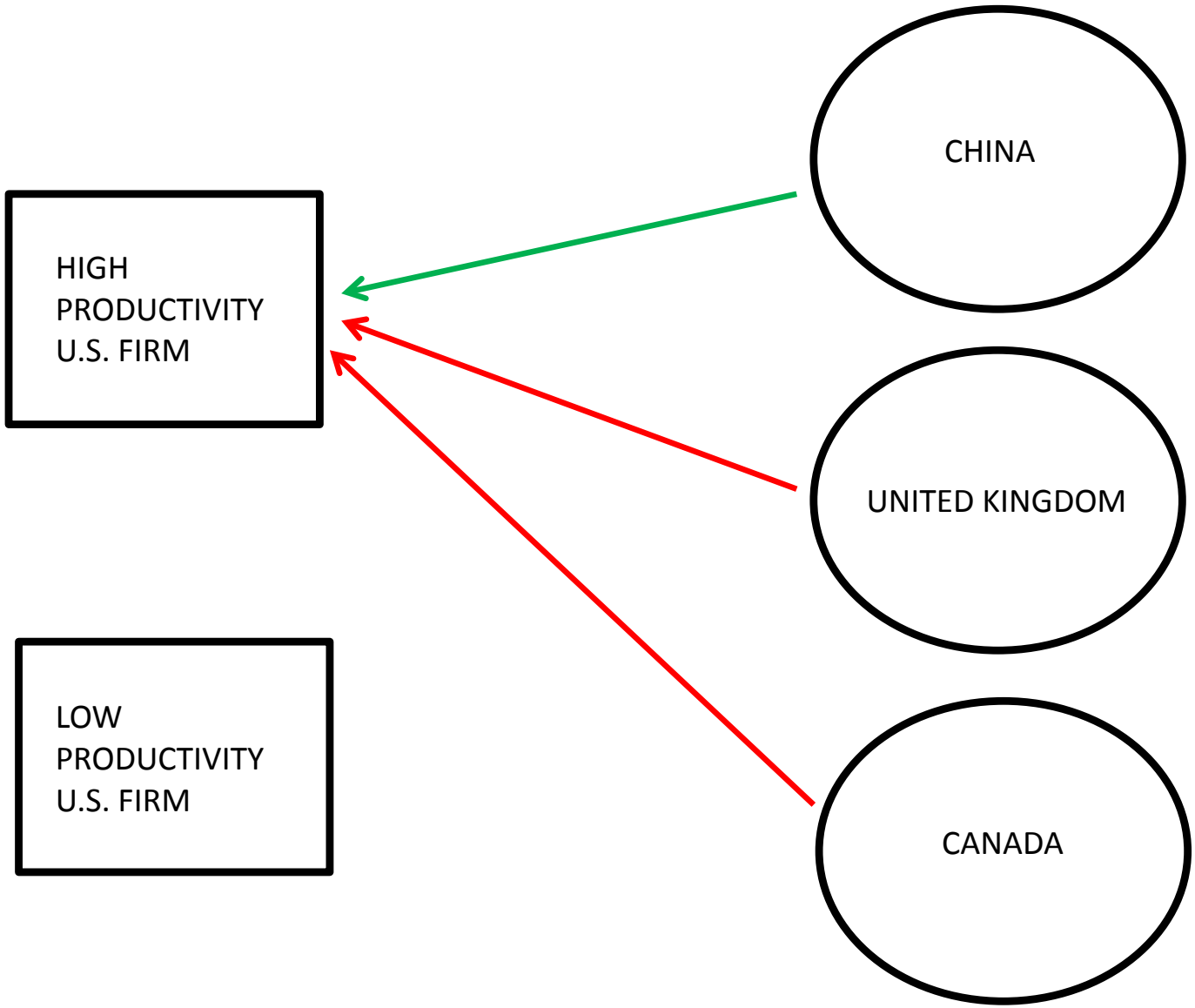
Example


HIGH
PRODUCTIVITY
U.S. FIRM
LOW
PRODUCTIVITY
U.S. FIRM
CHINA
UNITED KINGDOM
CANADA

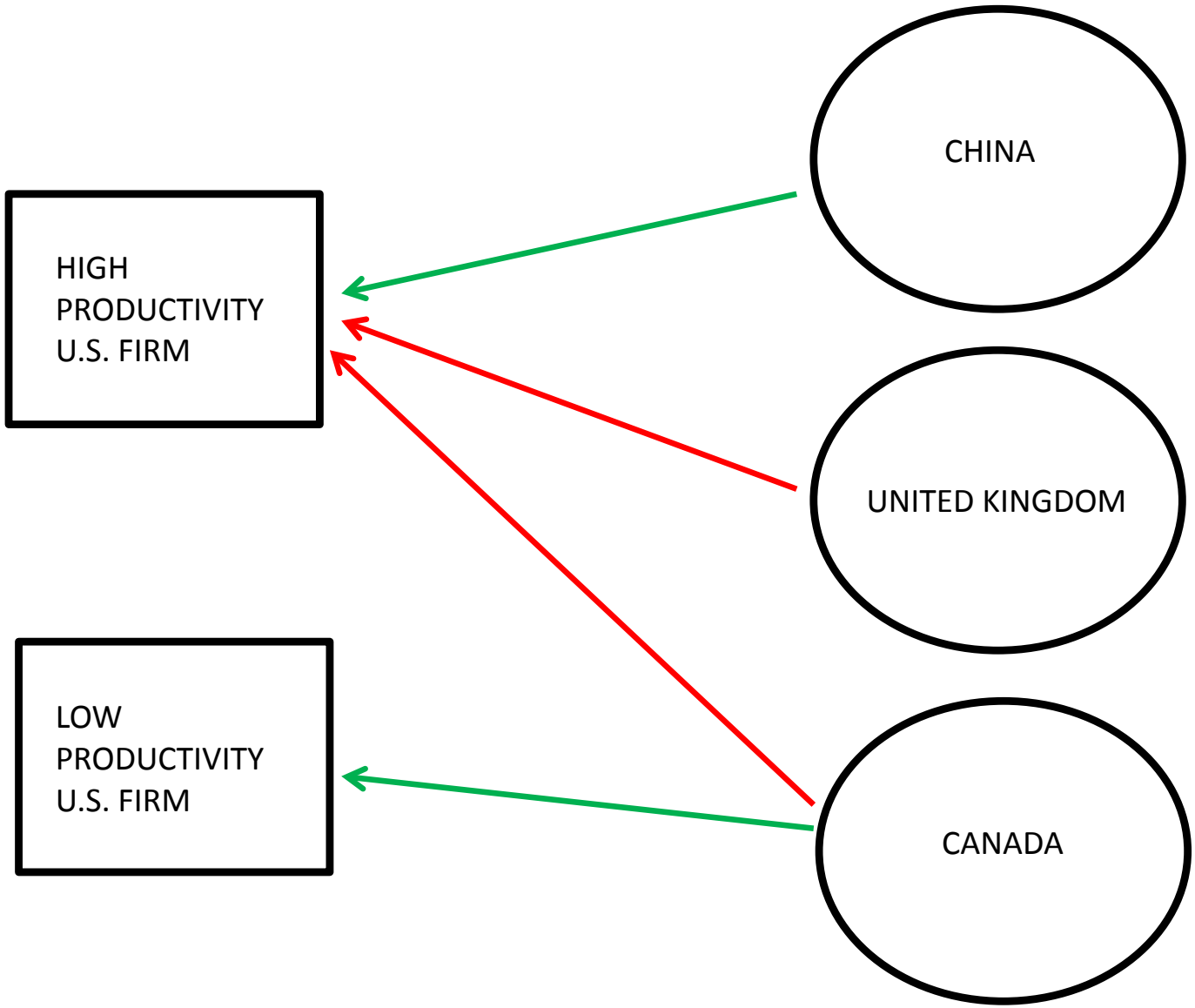
Example


CHINA
HIGH PRODUCTIVITY U.S. FIRM
UNITED KINGDOM
LOW PRODUCTIVITY U.S. FIRM
CANADA

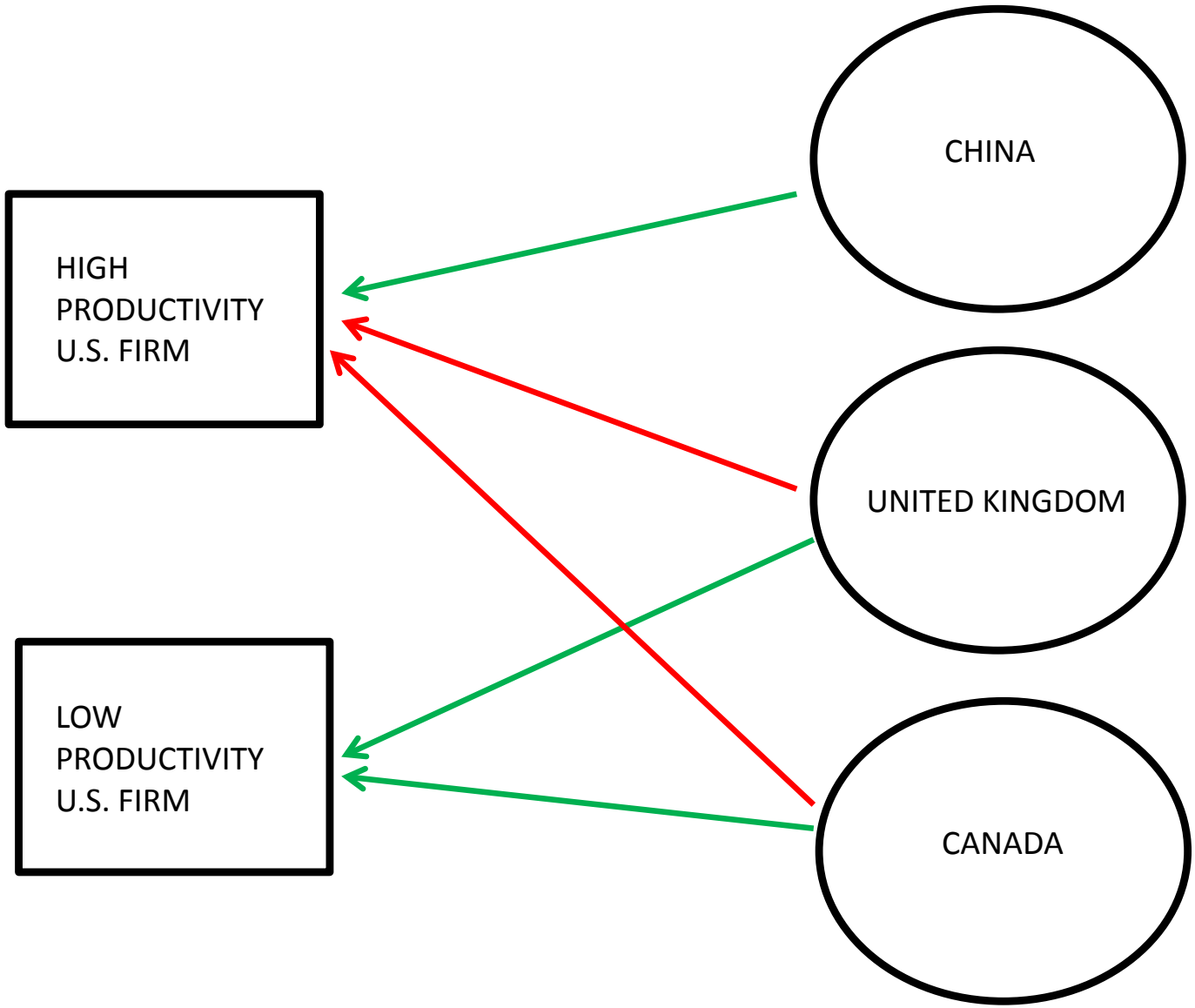
Example


CHINA
HIGH PRODUCTIVITY U.S. FIRM
UNITED KINGDOM
LOW PRODUCTIVITY U.S. FIRM
CANADA

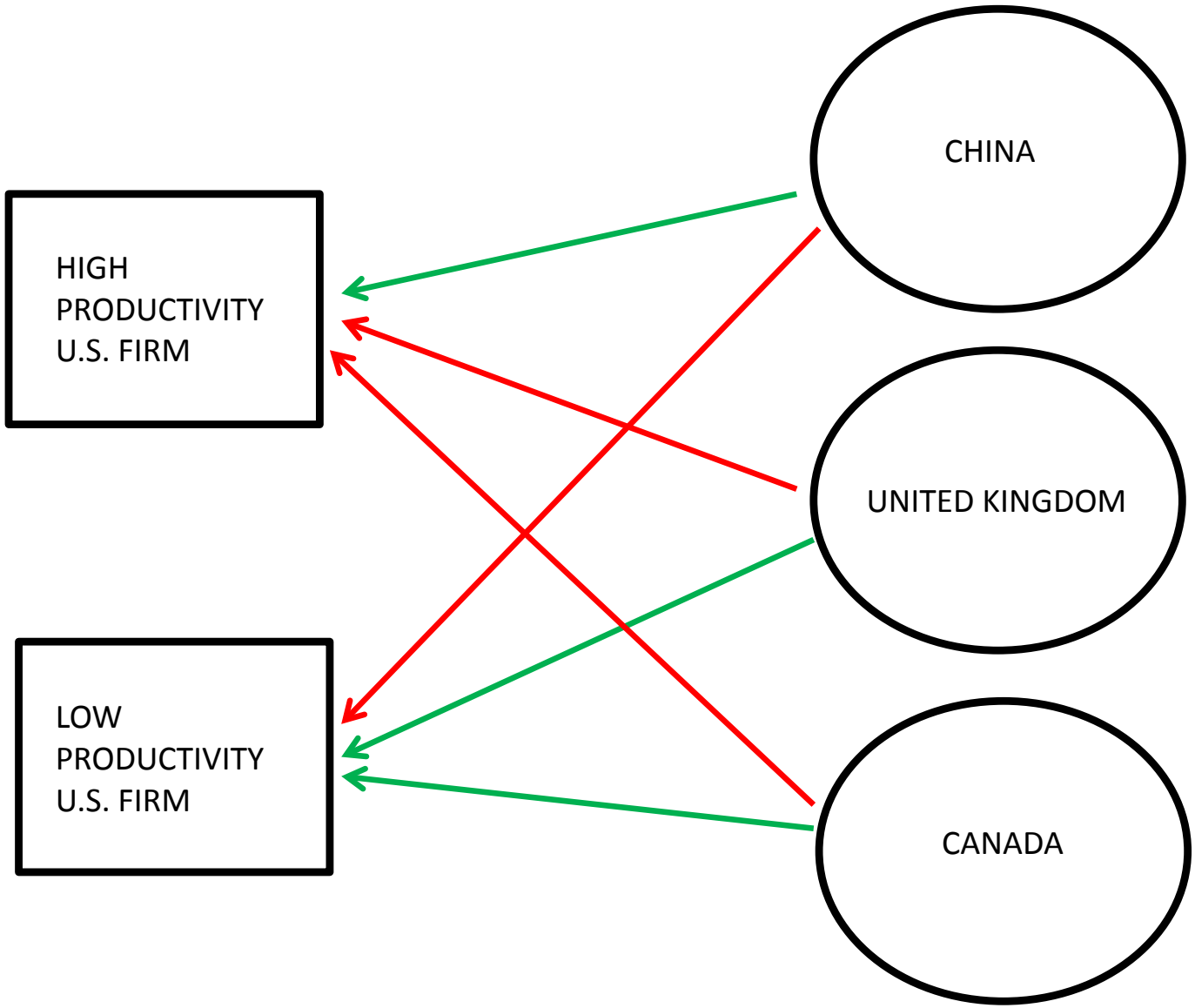
Example


CHINA
HIGH PRODUCTIVITY U.S. FIRM
UNITED KINGDOM
LOW PRODUCTIVITY U.S. FIRM
CANADA

Example


CHINA
HIGH PRODUCTIVITY U.S. FIRM
UNITED KINGDOM
LOW PRODUCTIVITY U.S. FIRM
CANADA

Example


CHINA
HIGH PRODUCTIVITY U.S. FIRM
UNITED KINGDOM
LOW PRODUCTIVITY U.S. FIRM
CANADA

Optimal Sourcing Strategy

- With cost function plugged in:

$$\max_{I_{ij}\in\{0,1\}_{j=1}^{J}} \varphi^{\sigma-1}\left(\gamma\sum_{j=1}^{J} I_{ij}T_j\left(\tau_{ij}w_j\right)^{-\theta}\right)^{(\sigma-1)/\theta} B_i - w_i\sum_{j=1}^{J} I_{ij}f_{ij}$$

- Complements case: $\frac{\sigma-1}{\theta} > 1$
- Substitutes case: $\frac{\sigma-1}{\theta} < 1$

Core Efficiency and Sourcing Capability

- Proposition: The solution $I_{ij}(\varphi) \in \{0,1\}_{j=1}^{J}$ to the optimal sourcing problem is such that a firm's sourcing capability $\Theta_i(\varphi) = \sum_{j=1}^{J} I_{ij}(\varphi) T_j (\tau_{ij} w_j)^{-\theta}$ is nondecreasing in φ .
- Implications for size distribution of firms

Hierarchies in the complements case

- Proposition: Whenever $(\sigma - 1)/\theta > 1$, the solution $I_{ij}(\varphi) \in \{0,1\}_{j=1}^{J}$ to the optimal sourcing problem is such that $\mathcal{J}_i(\varphi_L) \subseteq \mathcal{J}_i(\varphi_H)$ for $\varphi_H \geq \varphi_L$, where $\mathcal{J}_i(\varphi) = \{j : I_{ij}(\varphi) = 1\}$.

Brief Discussion of Assumptions

- Model has many moving pieces
- Q1: Are extensive margin interdependencies all that relevant?
- Q2: Wouldn't it be simpler to have a single-input model?
- Q3: Wouldn't it be simpler to adopt an Armington model?

Suggestive Evidence for Interdependencies

- Adopt identification strategy similar to Autor et al. (2013)

Dependent variable is Ln US Imports at ISIC 3-digit sector, 1990-2006

	OLS	IV	First Stage
Ln US Imp from China	0.138***	0.426***	
	(0.028)	(0.122)	
Ln Chinese EU share			0.343***
			(0.120)
Industry Fixed Effects	yes	yes	yes
Country by Year Fixed Effects	yes	yes	yes
Adj. R^2	0.69	0.69	0.91
N	52,039	52,039	52,039

Notes: IV regression uses the log of China's export share to EU countries as an instrument.

▸ Firm-Level Test

The need to model multiple inputs

Table: Count of distinct HS10 products imported by a firm

Mean	Std. Dev.	25th Ptile	Median	95th Ptile
11.91	48.89	1	3	41

- Although extreme, the continuum assumption will help a lot

Why depart from Armington?

- Number of countries per HS10 products imported by a firm

	Firm Level		
	Mean	Median	Max
Mean	1.11	1.00	1.61
Median	1.03	1.00	1.00
95%tile	1.78	1.00	4.00

- Not much evidence of differentiation by country of origin

Aggregation and General Equilibrium

- Equilibrium is characterized by:
  - Fixed point for the market potential, B_i
  - Free entry condition
  - Labor market clearing
- Given a positive wage vector, solution for B_i and N_i is unique
  - e.g., if outside sector of the economy pins down relative wages

Gravity - low fixed cost of offshoring

- Special case 1: Very low fixed cost of offshoring

$$M_{ij} = \frac{(\sigma - 1)}{\sigma} \tau_{ij}^{-\theta} \frac{w_i L_i}{\Theta_i} \frac{w_j L_j}{\sum_k \tau_{kj}^{-\theta} \frac{w_k L_k}{\Theta_k}}$$

- Familiar from Eaton and Kortum (2002)
- Trade elasticity is given by θ

Gravity - general case

- General case

$$M_{ij} = \frac{(\sigma - 1)}{\sigma} \tau_{ij}^{-\theta} \Lambda_{ij} \frac{w_i L_i}{P_i^{1-\sigma}/N_i} \frac{w_j L_j}{\sum_k \tau_{kj}^{-\theta} \Lambda_{kj} \frac{w_k L_k}{P_j^{1-\sigma}/N_j}}$$

  where

$$\Lambda_{ij} = \int_{\tilde{\varphi}_{ij}}^{\infty} I_{ij}(\varphi) \left(\Theta_i(\varphi)\right)^{(\sigma-1-\theta)/\theta} \varphi^{\sigma-1} dG_i(\varphi),$$

- Λ_{ij} yields
  - Extensive margin effect at the *firm-level* in addition to the *product-level*
  - Third market effects

Gravity - knife edge case

- Special case 2: $(\sigma - 1)/\theta = 1$ and core efficiency Pareto

$$M_{ij} = \frac{(\sigma - 1)}{\sigma} \tau_{ij}^{-\kappa} f_{ij}^{1-\kappa/(\sigma-1)} \Psi_i \frac{w_i L_i}{P_i^{-\kappa}} \frac{w_j L_j}{\sum_k \tau_{kj}^{-\kappa} f_{kj}^{1-\kappa/(\sigma-1)} \Psi_k \frac{w_k L_k}{P_k^{-\kappa}}},$$

- Trade elasticity as in Chaney (2008)
- Extensive margin effect
- No third market effects

Welfare

- General case with core productivity distributed Pareto

$$\frac{w_i}{P_i} = \frac{\sigma-1}{\sigma}\left(\frac{\gamma T_i}{\chi_{ii}^{agg}}\right)^{1/\theta}\left(\frac{(\sigma-1)L_i}{\sigma\kappa f_e}\right)^{1/(\sigma-1)} \times\left(\frac{\left(\int_{\tilde{\varphi}_{ii}}^{\infty} I_{ii}(\varphi)\Theta_i(\varphi)^{(\sigma-1)/\theta-1}\varphi^{\sigma-1}dG_i(\varphi)\right)^{(\sigma-1)/\theta}}{\left(\int_{\tilde{\varphi}_{i\vartheta(i)}}^{\infty}(\Theta_i(\varphi))^{(\sigma-1)/\theta}\varphi^{\sigma-1}dG_i(\varphi)\right)^{(\sigma-1)/\theta-1}}\right)^{1/(\sigma-1)}$$

- ACR welfare formula does not appear to apply (except when $(\sigma-1)/\theta = 1$ or $f_{ij} \to 0$)

Extensions - tradable final good

- Firm behavior conditional on a sourcing strategy is analogous

$$\max_{\substack{I_{ij}^M \in \{0,1\}_{j=1}^J \\ I_{ik}^X \in \{0,1\}_{k=1}^J}} = \varphi^{(\sigma-1)} \left(\gamma \sum_{j=1}^{J} I_{ij}^M T_j \left(\tau_{ij} w_j \right)^{-\theta} \right)^{(\sigma-1)/\theta} \sum_{k=1}^{J} I_{ik}^X \left(\tau_{ik}^X \right)^{1-\sigma} B_k$$
$$- w_i \sum_{j=1}^{J} I_{ij}^M f_{ij} - w_i \sum_{k=1}^{J} I_{ik}^X f_{ij}^X ,$$

- Profit function features increasing differences in any pair of importing and exporting countries
- In the complements case, increasing differences in all importing and exporting choices
- In such a case, reductions in the trade cost of final goods also lead to an increase in importing

Empirical Evidence

Data

- 2007 data from the U.S. Census Bureau
  - Economic Censuses
  - Import transactions data
- Sample is all manufacturing firms (around 250,000 firms)
  - Include firms with non-manufacturing activity
  - 23% of employment and 38% of sales
  - 65% of (non-mining) imports
  - A quarter of these firms imports

Data

- Limit analysis to countries with 200+ U.S. importers
  - 64 countries and the U.S.
- Country-level data
  - Distance and language from CEPII
  - Wages from ILO database
  - R&D from WDI database
  - Tariffs from WITS
  - Physical and human capital from Penn Word Tables, Barro and Lee

Measuring Input Shares

- $Inputs^n = Sales^n - ValueAdded^n + ProductionWorkerWages^n$
  - Manufacturing and wholesale coverage
  - Highly correlated with traditional input measures for manufacturing
- $\chi_{ij}^n = M_j^n / Inputs^n$
  - Use imports from j to measure inputs sourced from j
  - Domestic sourcing is the residual
  - Imports are zero if country is not in the firm's sourcing strategy

Top 10 Countries Source Countries

	Rank by: Firms	Rank by: Value	Number of Firms	Value of Imports
Canada	1	1	37,800	145,700
China	2	3	21,400	121,980
Germany	3	5	13,000	62,930
United Kingdom	4	6	11,500	30,750
Taiwan	5	11	10,500	16,630
Italy	6	13	8,500	13,230
Japan	7	4	8,000	112,250
Mexico	8	2	7,800	125,960
France	9	9	6,100	22,980
Korea, South	10	10	5,600	20,390

Estimation

Step 1: Estimation of countries' sourcing potential

- Define $\xi_j = T_j \left(\tau_{ij} w_j\right)^{-\theta}$ and normalize $\xi_i = 1$.
- Rearranging $\chi_{ij}(\varphi) = \frac{T_j (\tau_{ij} w_j)^{-\theta}}{\Theta_i(\varphi)}$ if $j \in \mathcal{J}_i(\varphi)$ leads to
- Linear equation: $\log \chi_{ij}^n - \log \chi_{ii}^n = \log \xi_j + \log \epsilon_j^n$
- ϵ_j^n is a firm-country-specific shock
  - observed by firm after paying the fixed cost

Estimation of countries' sourcing potential

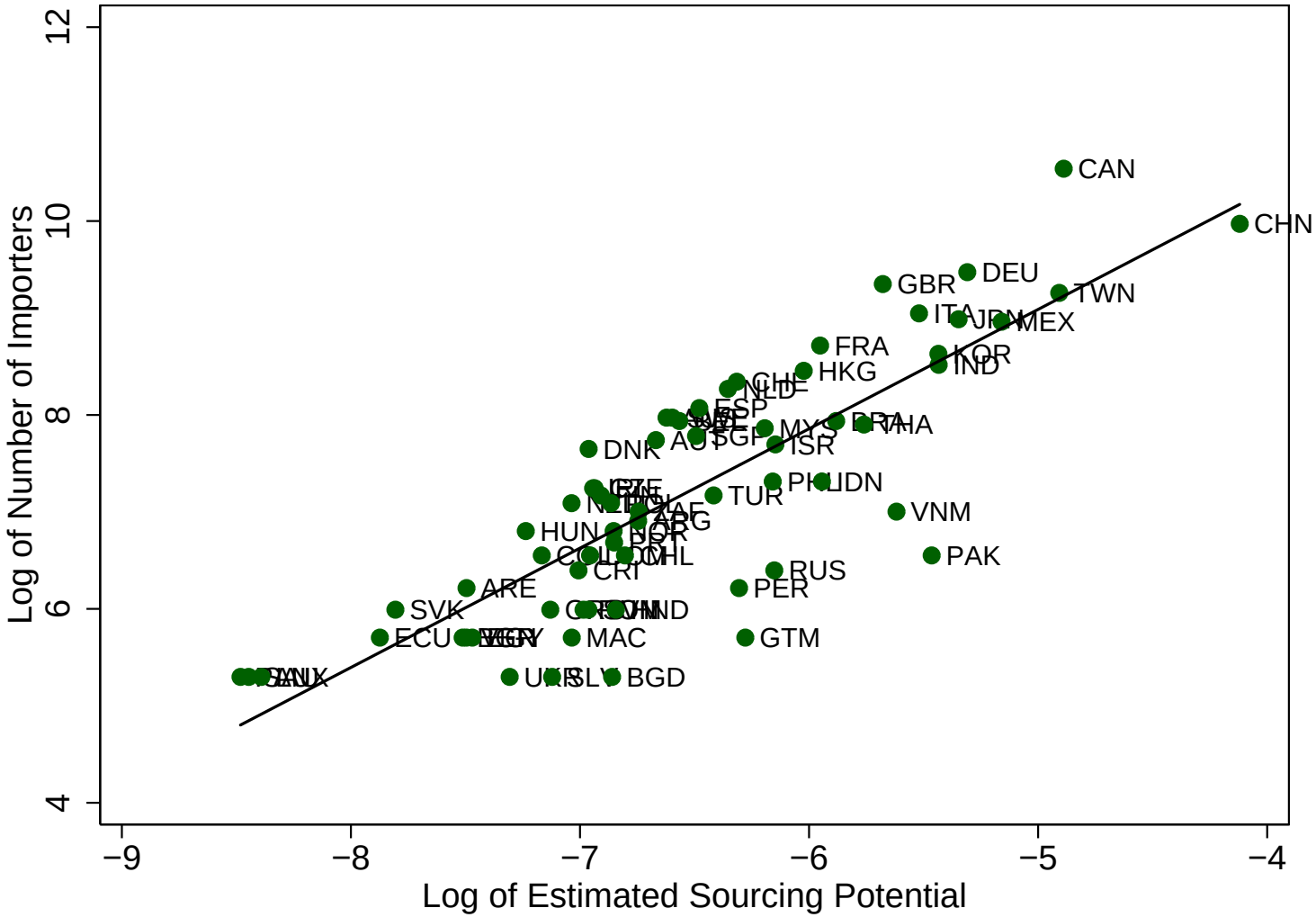
- Estimate via OLS

$$\log \chi_{ij}^n - \log \chi_{ii}^n = \log \xi_j + \log \epsilon_j^n$$

- Summary statistics for sourcing appeal estimation

Number of observations	200,000
Number of importing firms	64,600
Mean Squared Error	2.64
Range of foreign $\log \xi_j$	- 4.12 to -8.42
Sum of foreign ξ_j	0.137

Sourcing potential versus number of firms



▸ Aggregate Imports

Step 2: Estimation of elasticity of demand and dispersion of productivities

- Estimate elasticity of demand using model's predicted mark-up
  - Median manufacturing firm's mark-up is 1.35
  - Implies $\sigma = 3.85$
- Project $\hat{\xi}_j = T_j \widehat{(\tau_{ij} w_j)^{-\theta}}$ on country variables
  - Distance and common language
  - R&D stock, capital per worker, control of corruption
  - Tariffs and wages

$$\begin{aligned}\log \xi_j =& \beta_r \log \text{R\&D}_j + \beta_k \log \text{capital}_j + \beta_C \text{control corruption}_j \\ & - \theta \left(\log w_j + \log(1 + \text{tariff}_{ij})\right) \\ & - \theta \left(\log \beta_c + \beta_d \log \text{distance}_{ij} + \text{language}_{ij} \log \beta_l\right) + \iota_j\end{aligned}$$

Step 2b: Estimation of dispersion of productivities

	$\log \xi$			log aggregate import		
	OLS	IV	IVl	OLS	IV	IV
log(1+tariff) + log wage	-0.471	-1.785	-1.083	-0.516	-4.763	-2.399
	(0.175)	(0.651)	(0.320)	(0.389)	(1.824)	(0.788)
log distance	-0.326	-0.730	-0.514	-1.025	-2.329	-1.614
	(0.182)	(0.311)	(0.217)	(0.404)	(0.870)	(0.534)
common language	0.291	0.199	0.434	0.489	0.189	0.965
	(0.209)	(0.288)	(0.219)	(0.463)	(0.806)	(0.539)
log R&D	0.372	0.490	0.445	0.668	1.052	0.859
	(0.0500)	(0.0875)	(0.0556)	(0.111)	(0.245)	(0.137)
log KL	-0.158	0.506	0.415	-0.266	1.879	1.528
	(0.170)	(0.384)	(0.291)	(0.378)	(1.076)	(0.717)
Control of corruption	0.117	0.626		0.323	1.966	
	(0.147)	(0.308)		(0.327)	(0.864)	
Constant	-7.034	-11.44	-9.925	6.282	-7.969	-2.680
	(0.852)	(2.340)	(1.523)	(1.891)	(6.556)	(3.752)
Observations	57	57	58	57	57	58

Step 2b: Estimation of dispersion of productivities

	$\log \xi$			log aggregate import		
	OLS	IV	IVl	OLS	IV	IV
log(1+tariff) + log wage	-0.471	-1.785	-1.083	-0.516	-4.763	-2.399
	(0.175)	(0.651)	(0.320)	(0.389)	(1.824)	(0.788)
log distance	-0.326	-0.730	-0.514	-1.025	-2.329	-1.614
	(0.182)	(0.311)	(0.217)	(0.404)	(0.870)	(0.534)
common language	0.291	0.199	0.434	0.489	0.189	0.965
	(0.209)	(0.288)	(0.219)	(0.463)	(0.806)	(0.539)
log R&D	0.372	0.490	0.445	0.668	1.052	0.859
	(0.0500)	(0.0875)	(0.0556)	(0.111)	(0.245)	(0.137)
log KL	-0.158	0.506	0.415	-0.266	1.879	1.528
	(0.170)	(0.384)	(0.291)	(0.378)	(1.076)	(0.717)
Control of corruption	0.117	0.626		0.323	1.966	
	(0.147)	(0.308)		(0.327)	(0.864)	
Constant	-7.034	-11.44	-9.925	6.282	-7.969	-2.680
	(0.852)	(2.340)	(1.523)	(1.891)	(6.556)	(3.752)
Observations	57	57	58	57	57	58

Step 2b: Estimation of dispersion of productivities

	$\log \xi$			log aggregate import		
	OLS	IV	IVl	OLS	IV	IV
log(1+tariff) + log wage	-0.471	-1.785	-1.083	-0.516	-4.763	-2.399
	(0.175)	(0.651)	(0.320)	(0.389)	(1.824)	(0.788)
log distance	-0.326	-0.730	-0.514	-1.025	-2.329	-1.614
	(0.182)	(0.311)	(0.217)	(0.404)	(0.870)	(0.534)
common language	0.291	0.199	0.434	0.489	0.189	0.965
	(0.209)	(0.288)	(0.219)	(0.463)	(0.806)	(0.539)
log R&D	0.372	0.490	0.445	0.668	1.052	0.859
	(0.0500)	(0.0875)	(0.0556)	(0.111)	(0.245)	(0.137)
log KL	-0.158	0.506	0.415	-0.266	1.879	1.528
	(0.170)	(0.384)	(0.291)	(0.378)	(1.076)	(0.717)
Control of corruption	0.117	0.626		0.323	1.966	
	(0.147)	(0.308)		(0.327)	(0.864)	
Constant	-7.034	-11.44	-9.925	6.282	-7.969	-2.680
	(0.852)	(2.340)	(1.523)	(1.891)	(6.556)	(3.752)
Observations	57	57	58	57	57	58

Implications of first two steps

- Baseline estimates imply that a firm that sources from all countries
  - 7 percent lower input costs relative to pure domestic sourcing
  - Translates into 22 percent larger sales
- Lower θ estimate (IV without corruption measure, $\theta = 1.08$)
  - 11 percent lower costs relative to pure domestic sourcing
  - 40 percent larger sales
- Robust result: $\frac{\sigma-1}{\theta} > 1$
  - Complements case from model
  - Increasing differences of the profit function in the sourcing strategy

Step 3: Estimation of fixed cost of sourcing

- Firm heterogeneity: φ, f_{ij}^n, ϵ_j^n
- Rational expectations about ϵ_j^n (log-normal)
- Large discrete choice problem: 2^{65} or about 10^{19} possible choices
- Build on algorithm in Jia (2008)
- Estimate fixed cost and other distributional parameters via Simulated Method of Moments

Marginal benefit of country j

- Expected profits of a sourcing strategy $\mathcal{J}$ for a firm
  - given productivity φ and fixed cost f_{ij}^n

$$\Pi\left(\mathcal{J},\varphi,f_{ij}^n\right)=\varphi^{\sigma-1}BE_\epsilon\left(\left(\gamma\Theta_i\left(\mathcal{J},\epsilon\right)\right)^{(\sigma-1)/\theta}\right)-\sum_{j\in\mathcal{J}}f_{ij}^n,$$

- Expected marginal benefit of adding country j given φ and $\mathcal{J}$

$$\varphi^{\sigma-1}\gamma^{(\sigma-1)/\theta}BE_\epsilon\left(\left(\Theta_i\left(\mathcal{J},\epsilon\right)\right)^{(\sigma-1)/\theta}-\left(\Theta_i\left(\mathcal{J}\setminus j,\epsilon\right)\right)^{(\sigma-1)/\theta}\right)-f_{ij}^n$$

Algorithm

- Define mapping $V : \{0,1\}^N \to \{0,1\}^N$
  - $V_j(\mathcal{J}) = 1$ if marginal benefit of j given $\mathcal{J}$ is positive
- Increasing differences in profit function yield increasing mapping function
- Start from set $\mathcal{J}^0$ and use iterative application of V-operator to obtain lower bound for sourcing strategy
- Start from set $\mathcal{J}^1$ and use iterative application of V-operator to obtain upper bound for sourcing strategy
- If bounds do not overlap, evaluate all combinations between them

Parameters

- f_{ij}^n distributed log-normal
  - Scale parameter: $\log \beta_c^f + \beta_d^f \log \text{distance}_{ij} + \log \beta_l^f \text{language}_{ij}$
  - Dispersion parameter β_{disp}^f
  - Assume draws rank-correlated across countries
- No domestic fixed cost of sourcing
- $\delta = \left[B, \kappa, \beta_c^f, \beta_d^f, \beta_l^f, \beta_{\text{disp}}^f\right]$
- Simulate 50,000 firms

Moments

1. The share of importing firms

2. The share of firms that sources from each country

3. The share of firms in each input quantile for each country
   - Quantiles defined by the qth percentile of inputs in data
   - Where $q = (25, 50, 90)$

▸ Percentiles

Simulated Method of Moments

- Differences between moments and simulated moments

$$\hat{y}(\delta) = m - \hat{m}(\delta) = \begin{bmatrix} m_1 - \hat{m}_1(\delta) \\ m_2 - \hat{m}_2(\delta) \\ m_3 - \hat{m}_3(\delta) \end{bmatrix}$$

- Select model parameters that minimize:

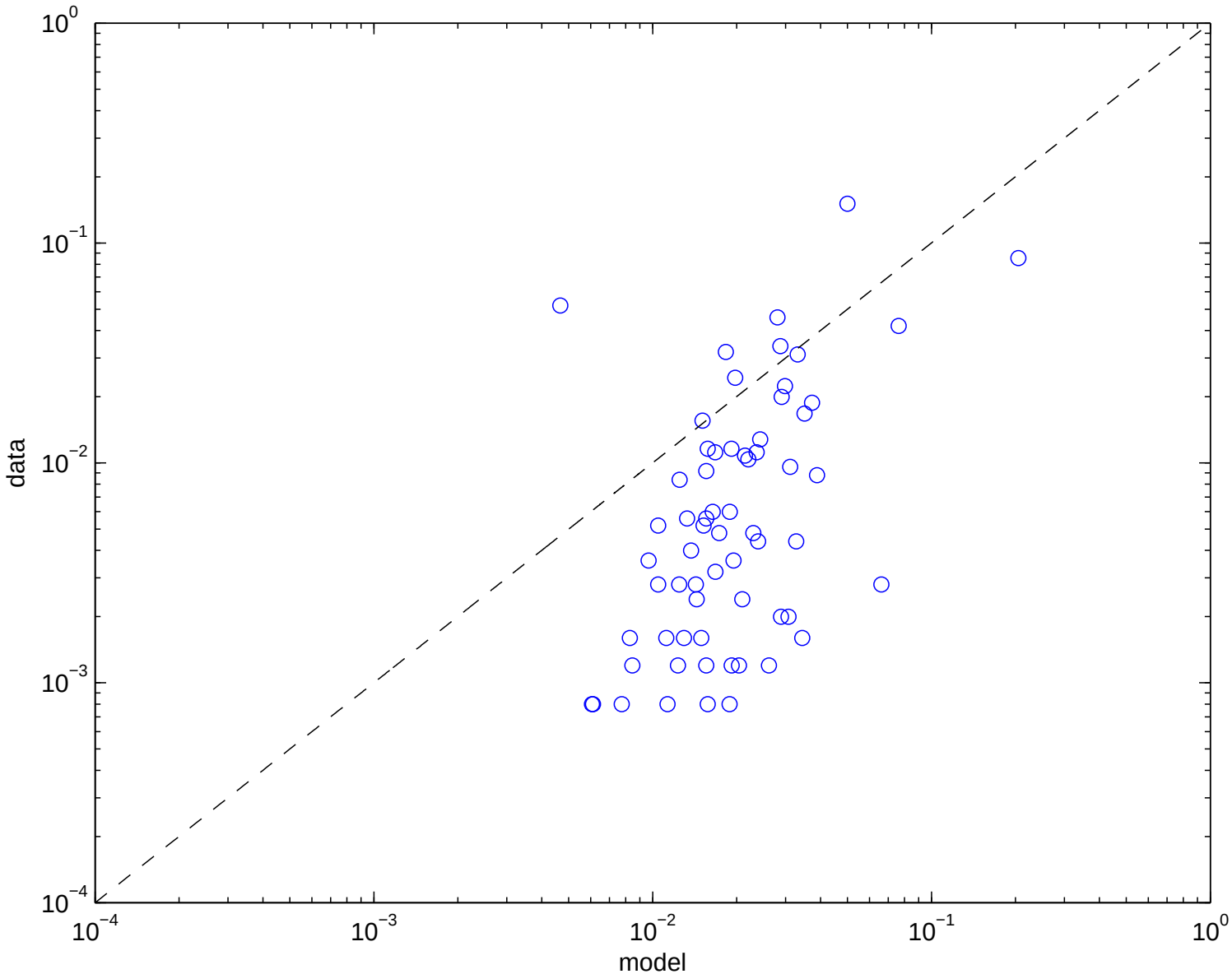
$$\hat{\delta} = \arg\min_{\delta} \left[\hat{y}(\delta)\right]^{\top} \mathbf{W} \left[\hat{y}(\delta)\right]$$

Parameter Estimates

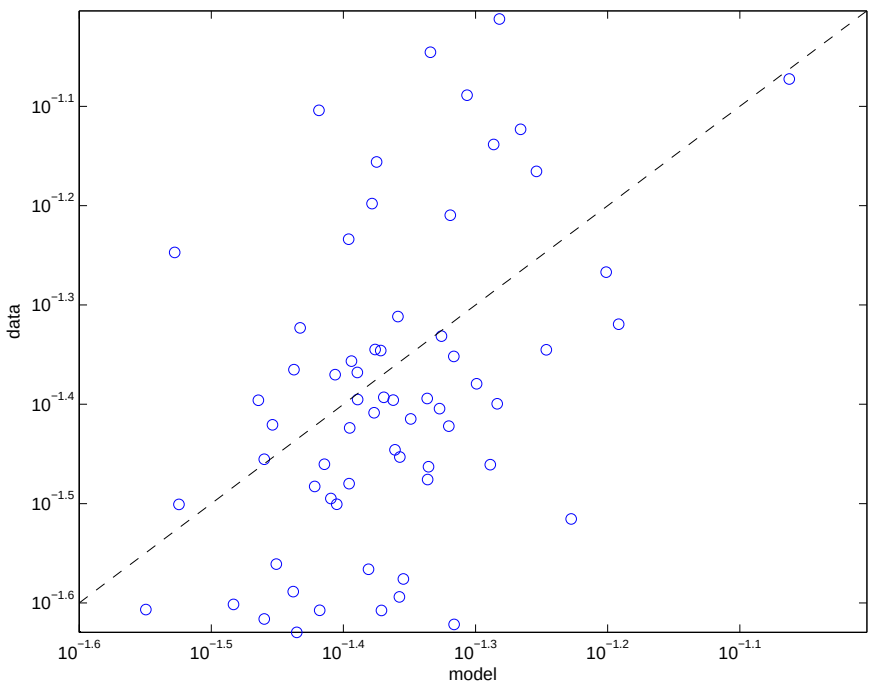
B	0.0001
κ	1.5773
β_c^f	0.0592
β_d^f	0.0027
β_l^f	0.7134
β_{disp}^f	2.2022

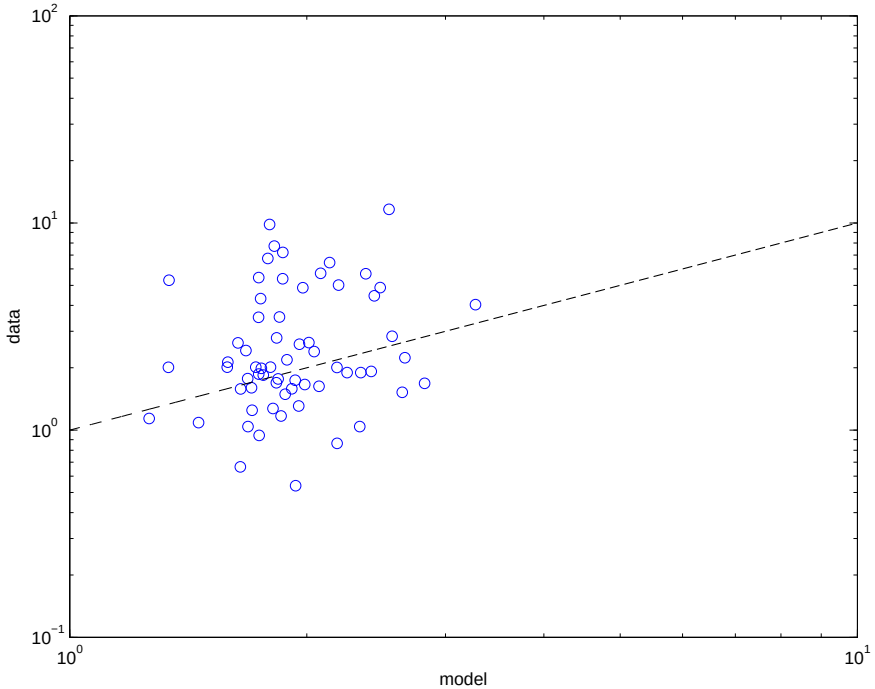
- Fixed costs 30 percent lower if common language
- Median fixed cost estimates range from 40,000 to 60,000 USD

Share of importers by country



Median and 90th percentile imports





Conclusion

- Main contributions:
  - Systematic selection is a key factor in aggregate imports
  - New framework to analyze interdependencies in firms' sourcing strategies
  - Identify country fixed costs versus sourcing potential
- Extensions / future applications:
  - Counterfactuals and welfare analysis
  - Techniques could be used to study interdependencies in exporting

Back-up

Bernard e.a. (2009), Table 1

Table 1: OLS Regression Decomposition of U.S. Exports and Imports Across Trading Partners, 2003

	Exports				Imports			
Margin	Full Sample	RP	AL	Large Countries	Full Sample	RP	AL	Large Countries
Firms	0.694	0.591	0.711	0.701	0.580	0.475	0.619	0.632
	(0.016)	(0.017)	(0.017)	(0.028)	(0.016)	(0.015)	(0.017)	(0.045)
Products	0.588	0.598	0.605	0.490	0.543	0.511	0.577	0.531
	(0.015)	(0.017)	(0.016)	(0.031)	(0.016)	(0.016)	(0.018)	(0.031)
Density	-0.508	-0.500	-0.527	-0.405	-0.441	-0.398	-0.476	-0.455
	(0.015)	(0.016)	(0.015)	(0.037)	(0.013)	(0.013)	(0.015)	(0.035)
Intensive	0.226	0.311	0.211	0.214	0.318	0.412	0.279	0.292
	(0.017)	(0.018)	(0.017)	(0.024)	(0.018)	(0.018)	(0.020)	(0.046)
Countries	231	207	231	22	227	214	224	22

Notes: Table reports 2003 OLS decomposition of variation in U.S. exports and imports across trading partners along four margins: the unique number of firms exporting to that destination, the unique number of products exported to that destination, the density of trade to that destination (observations divided by firms times products) and the intensive margin of average value per observation. Each cell reports the result of a different regression, i.e., each cell reports the coefficient and standard error on the logarithm of export or import value as noted in the text. First column is for the full sample, second and third are restricted to related-party and arm's-length trade, respectively, and fourth and fifth columns are restricted to OECD countries and the trade of the largest ten percent of firms, respectively.

▸ BACK

Bernard e.a. (2007), Table 8

Table 8

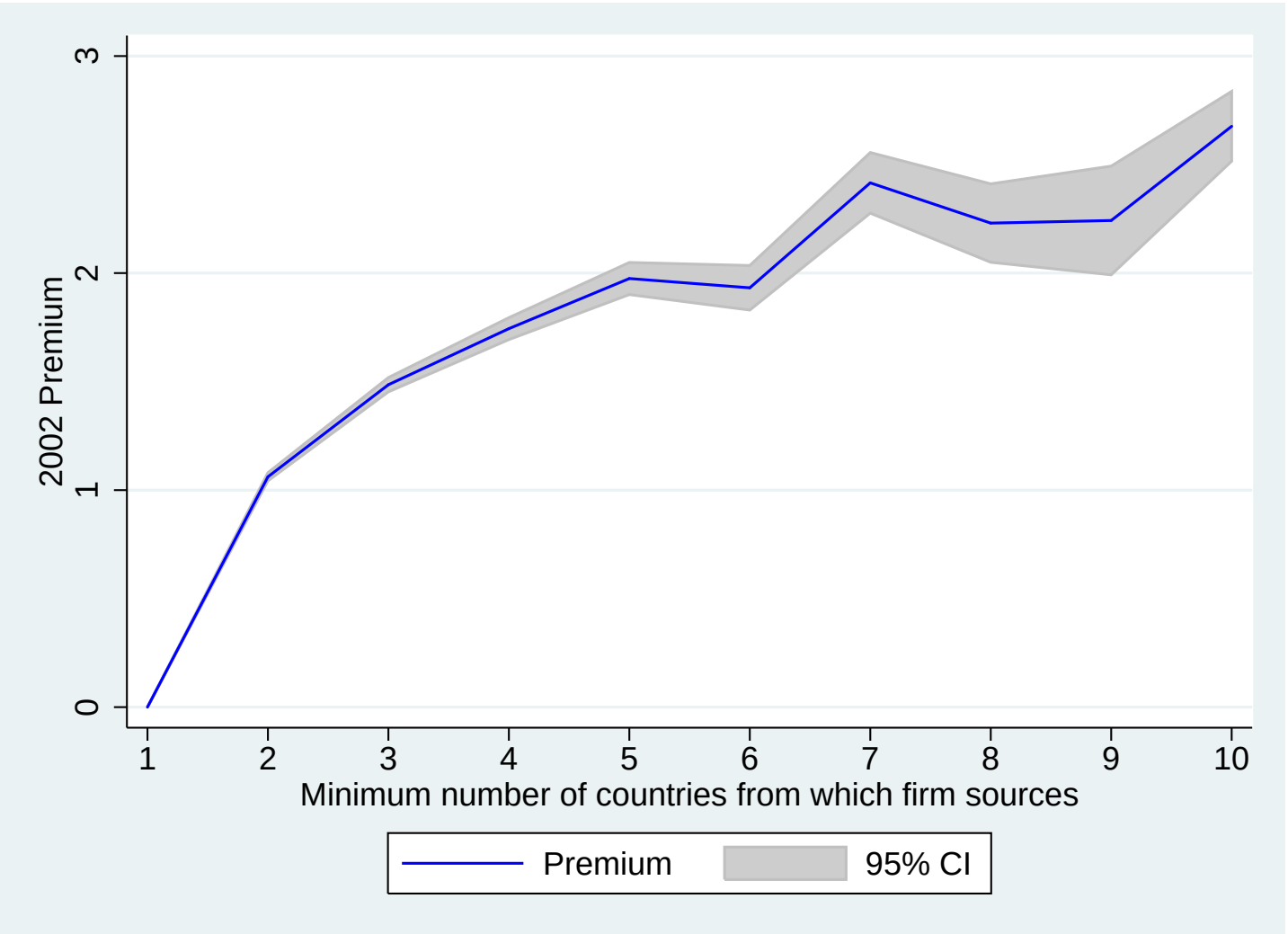
Trading Premia in U.S. Manufacturing, 1997

	(1) Exporter premia	(2) Importer premia	(3) Exporter & importer premia
Log employment	1.50	1.40	1.75
Log shipments	0.29	0.26	0.31
Log value-added per worker	0.23	0.23	0.25
Log TFP	0.07	0.12	0.07
Log wage	0.29	0.23	0.33
Log capital per worker	0.17	0.13	0.20
Log skill per worker	0.04	0.06	0.03

Sources: Data are for 1997 and are for firms that appear in both the U.S. Census of Manufacturers and the Linked-Longitudinal Firm Trade Transaction Database (LFTTD).
Notes: All results are from bivariate ordinary least squares regressions of the firm characteristic listed on the left on a dummy variable noted at the top of each column as well as industry fixed effects and firm employment as additional controls. Employment regressions omit firm employment as a covariate. Total factor productivity (TFP) is computed as in Caves, Christensen, and Diewert (1982).

▸ BACK

2002 Sales Premia for 2002 non-importers



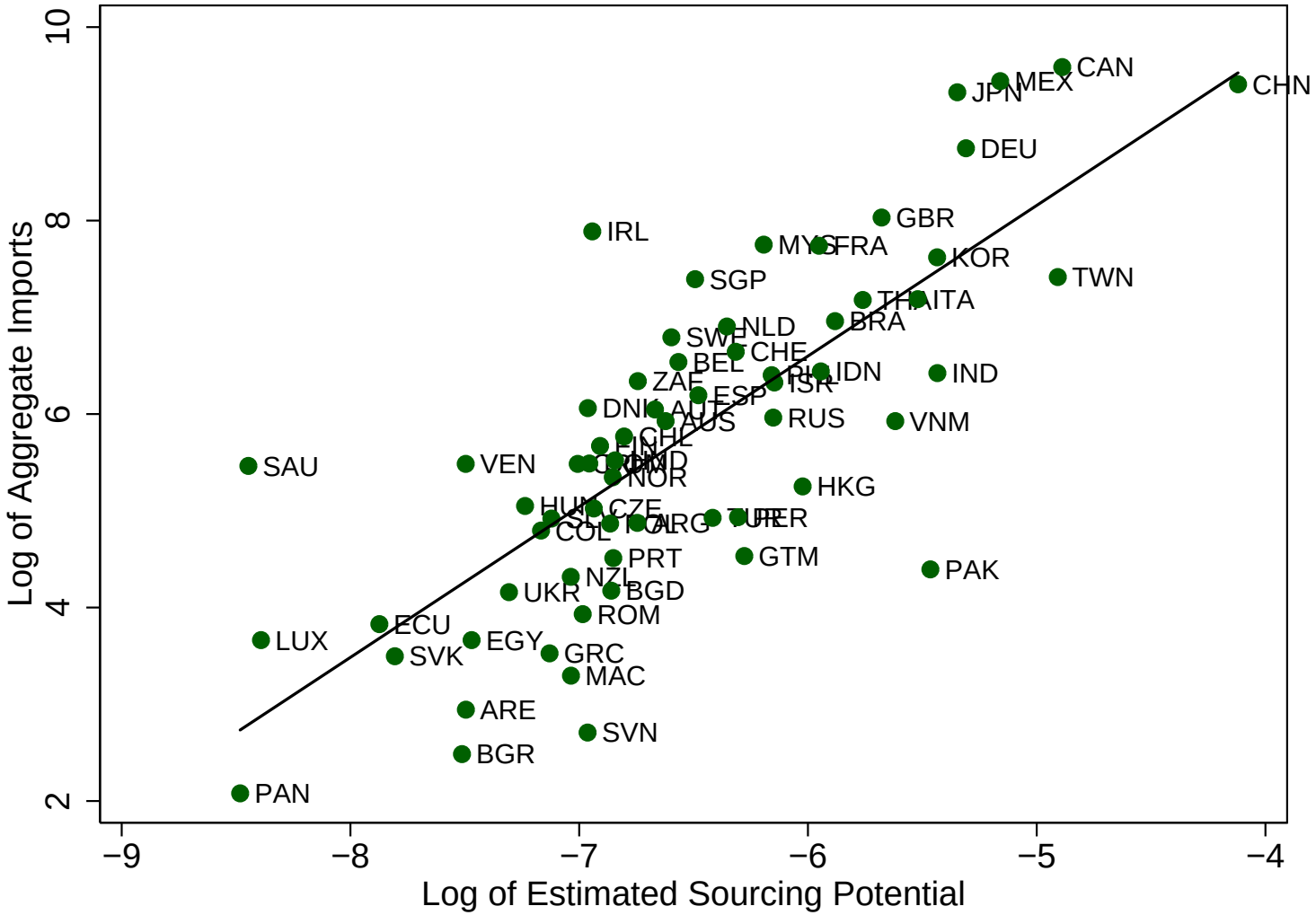
▸ BACK

Firm-level instrument

- Ideally, want the importance of each product in firm production
  - Use HS-IO tables and firm industry to get product weights?
  - Firm-specific if firms span multiple industries or switch over time
  - Works for all firms
- Alternative strategy for importers
  - Use import product share in pre-sample
  - Firm-specific, time invariant share
  - Time variation comes from China product-level shocks
- Similar product-level test
  - Effect of shock to product k on sourcing strategy
  - Sample is all firms already importing a product (not from China)
  - $Pr(y_{ijkt}|X_{ijt} = 1) = M_{i,China,t-1} + Sales_{it} + Controls$
  - Where $y_{ijkt} = 1$ if firm switches its import of product k to China
  - Also assess how this change affects other sourcing decisions

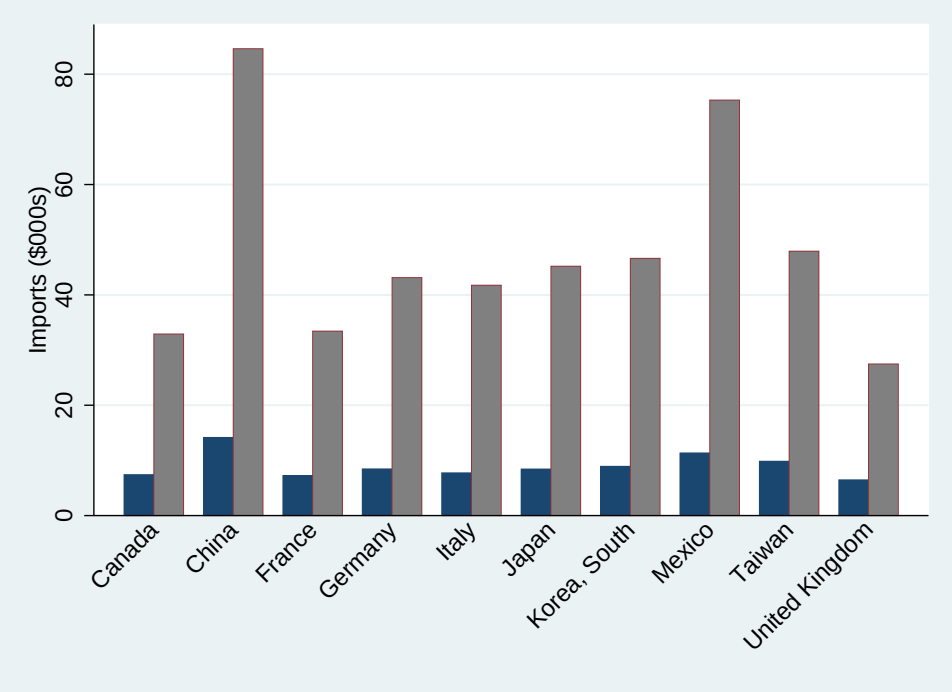
▸ BACK

Sourcing potential versus aggregate imports

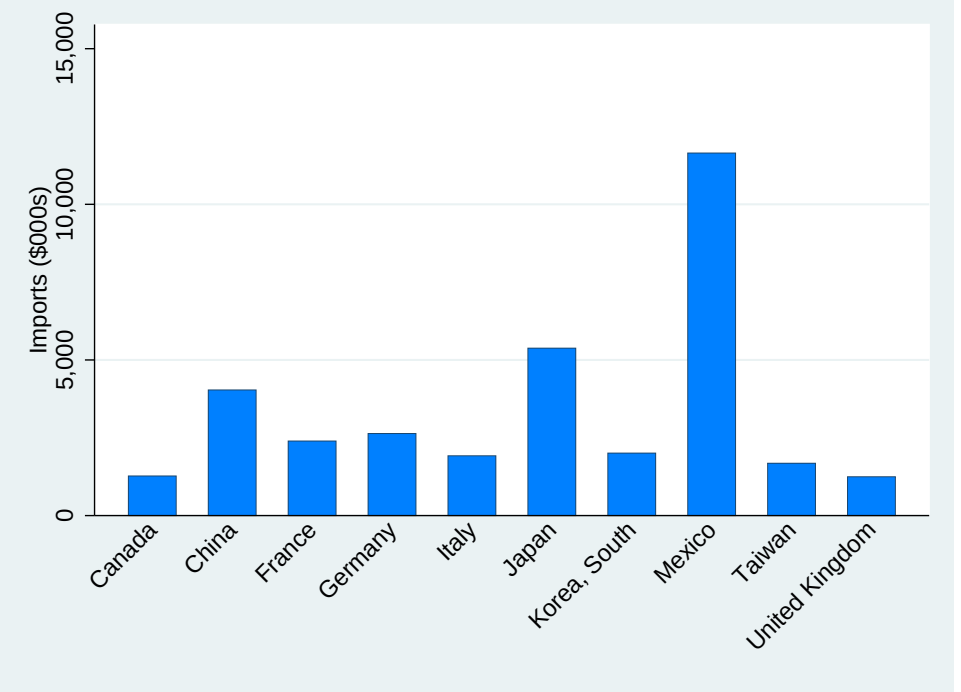


BACK

Import Percentiles by Country



(a) 25th and 50th



(b) 90th

▸ BACK