Teaching material for: Search Frictions in International Goods Markets[1]

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Motivation

- Customer acquisition participates to explaining firms' heterogeneity (Arkolakis, 2010, Bernard et al, 2019)
- But is subject to various forms of frictions (Gourio & Rudanko, 2014, Allen, 2014)
- And can thus lead to misallocation

$\Rightarrow$ This paper:

How frictions in the matching of sellers and buyers in international markets affect the allocation of resources across heterogeneous producers?

What we do

- Introduce search frictions in a Ricardian model of trade
- Draw implications for the efficiency of the allocation of resources, across firms
- Use the model and firm-to-firm trade data to estimate search frictions at the product and country level
- Quantify the inefficiency implied by estimated search frictions

What we find

- Search frictions reduce trade and distort competition in favor of low productivity firms (unlike iceberg costs)
- Heterogeneity in (structurally) estimated search frictions across products and countries: higher frictions in more (geographically and culturally) distant markets and for less differentiated products
- Frictions are also larger in markets in which French firms have a comparative advantage $\Rightarrow$ magnifies the distortive impact of frictions
- Reducing search frictions in the most frictional market implies significant efficiency gains by redistributing export sales form low- to high-productivity firms

Related Literature

Information frictions and trade

- Theory: Information frictions regarding the demand curve (Allen 2014) or regarding potential suppliers (Dasgupta & Mondria, 2018). See also Chaney (2014) for purely random matching
- Empirics: Lendle et al (2016), Bernard et al (2018a), Steinwender (2018), Akerman et al (2018)

Firm-to-firm trade and two-sided heterogeneity

- Heterogeneity in the number of buyers per exporter explained by the heterogeneity of buyers in terms of...
- ... their size or productivity (Benguria 2015, Bernard et al. 2018b), their taste (Carballo et al 2018), the suppliers met (Eaton et al, 2022)

Roadmap

1. Stylized facts
2. Model
3. Structural estimation
4. Results

Roadmap

1. **Stylized facts**
2. Model
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4. Results

Data

- Firm-to-firm export data (Source: French customs)
  - Every French export transaction
  - French exporter ID, s
  - Product at the 8-digit level of the HS nomenclature, p
  - EU buyer ID, b_i (anonymized)
  - Use data for 26 EU destinations, in 2007
  - Restricted to trade flows with product information (left censoring)
- Firm-level balance-sheet information: Turnover, employment, sector of activity (Source: INSEE)

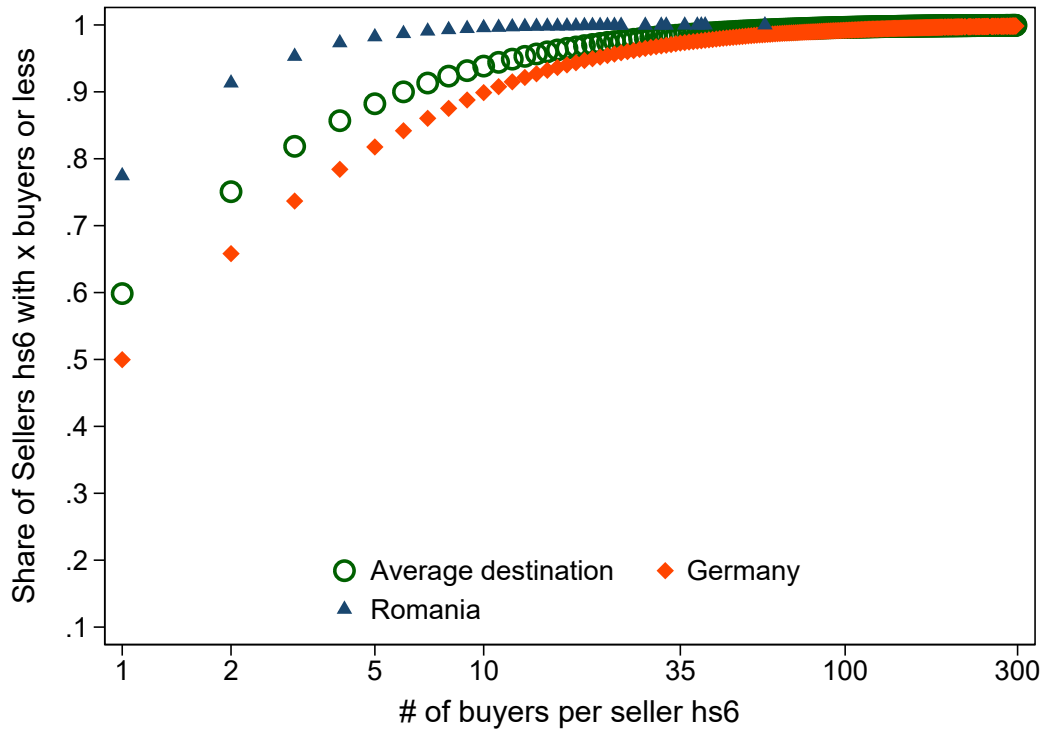
Data : French sellers and EU buyers (2007)

	Number of					
	Exporters	Importers	Pairs	Exporter-HS6	Importer-HS6	Triplets
	(1)	(2)	(3)	(4)	(5)	(6)
Overall	44,255	572,536	1,260,001	184,435	2,390,249	2,879,448
Belgium	29,468	71,271	214,070	97,415	379,490	482,960
Germany	24,641	117,935	236,536	73,735	391,424	462,759
Spain	21,633	77,592	159,636	70,410	359,825	419,895
Italy	20,123	95,864	183,238	63,494	375,681	438,393
...						
Poland	9,733	12,857	30,230	24,687	43,482	52,631
Greece	7,792	11,261	25,412	26,054	55,601	68,533
Sweden	7,682	10,198	20,391	20,212	39,315	45,462
Ireland	6,351	6,670	16,265	17,938	38,169	49,297

- Define: Seller as an exporter $\times$ product, Buyer as an importer $\times$ product
- 90% of buyers purchase a product from a single French seller

▸ Details ▸

Heterogeneity in the number of buyers per seller...



Notes: Proportion of sellers ($\times$ hs6) that serve x buyers or less in a given destination, in 2007.

▸ Firm ▸

More than 80% of the variance in the data comes from the heterogeneity across firms within a product and destination

Gravity and the buyer margin of trade

	Dependent Variable (all in log)						
	Product-level				Firm-level		
	Value of Exports	# Sellers	# Buyers per Seller	Mean export per Buyer-seller	Value of Exports	# Buyers	Exports per Buyer
	(1)	(2)	(3)	(4)	(5)	(6)	(7)
log Distance	-0.972***	-0.413***	-0.262***	-0.298***	-0.284***	-0.183***	-0.101**
	(0.0734)	(0.0345)	(0.0263)	(0.0466)	(0.0606)	(0.0283)	(0.0502)
log Import Demand	0.845***	0.269***	0.154***	0.422***	0.459***	0.203***	0.256***
	(0.0147)	(0.00687)	(0.00514)	(0.00909)	(0.0110)	(0.00794)	(0.00930)
log GDP per Capita	0.119***	0.0932***	0.0615***	-0.0357	-0.0190	-0.0313**	0.0123
	(0.0326)	(0.0153)	(0.0105)	(0.0234)	(0.0262)	(0.0159)	(0.0177)
Proba Common Language	1.084***	1.492***	0.389***	-0.796***	1.056***	0.752***	0.304**
	(0.315)	(0.146)	(0.107)	(0.173)	(0.176)	(0.0920)	(0.125)
Observations	63,096	63,096	63,096	63,096	621,816	621,816	621,816
R-squared	0.633	0.774	0.412	0.584	0.685	0.428	0.717
Fixed effects	Product	Product	Product	Product	Firm	Firm	Firm

Notes: Standard errors clustered at the country level in parentheses with ***, ** and * respectively denoting significance at the 1, 5 and 10% levels.

Roadmap

1. Stylized facts
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Model : Mechanism

We embed search frictions into a Ricardian model of trade

1. Ex-ante homogeneous buyers meet with a random number of heterogeneous producers of a perfectly substitutable good

2. Conditional on their random draw, they choose to interact with the lowest-cost supplier

Simplifying assumptions

- Partial equilibrium

- Marginal cost pricing (See Fontaine et al, 2022, for more sophisticated price dynamics)

Supply Side

- N countries, $i, j = 1...N$
- S_j sellers of the same perfectly substitutable variety (Eaton et al, 2012)
- CRS technology involving an input bundle which price c_j is exogenous
- Pareto distribution of sellers' productivity with parameter θ and support $[z_{min}, +\infty]$

$\Rightarrow$ # firms with productivity above $z \sim$ Poisson$(T_j z^{-\theta})$

- Iceberg trade costs d_{ij}

Supply Side (ii)

$\Rightarrow$ **Marginal cost** of serving market i: $\dfrac{d_{ij} w_j}{z_{s_j}}$

$\Rightarrow$ **# firms from j serving country i at a cost $\leq p$ is distributed Poisson with parameter**

$$\mu_{ij}(p) = T_j \left(\frac{d_{ij} w_j}{p} \right)^{-\theta}$$

$$\Rightarrow \quad \mu_i(p) = p^{\theta} \sum_{j=1}^{N} T_j (d_{ij} w_j)^{-\theta} = p^{\theta} \Upsilon_i$$

Υ_i : "Multilateral resistance" in country i in EK (2002)

Demand Side

- B_i ex-ante homogeneous buyers in country i, iso-elastic demand function

- Perfect substitution between varieties $\Rightarrow$ Buyer purchases the good to the lowest cost supplier met ▸ Many-to-one

$$p_{b_i} = \arg\min \left\{ \frac{w_j d_{ij}}{z_{s_j}}; s_j \in \Omega_{b_i}; \forall j = 1, ...N \right\}$$

- Given λ_{ij} the probability of a supplier from j to meet with a buyer from i, # of sellers met $\sim$ Poisson$(\sum_j \lambda_{ij} T_j z_{min}^{-\theta})$

- λ_{ij} is an **inverse measure of bilateral frictions**, which we estimate for each product and each destination of French exports ($\lambda_{ij} \to 1 \to \approx$ EK)

Meeting process

- # sellers met with a cost $\leq p \sim$ Poisson $\left(\sum_{j=1}^{N} \lambda_{ij} \mu_{ij}(p) \right)$
- Minimum cost drawn distributed Weibull:

$$G_i(p) = 1 - e^{-p^\theta \Upsilon_i \kappa_i}$$

$$\textit{with} \quad \kappa_i = \frac{\sum_j \lambda_{ij} T_j (d_{ij} w_j)^{-\theta}}{\sum_j T_j (d_{ij} w_j)^{-\theta}} < 1$$

$\Rightarrow$ Expected prices are inflated by search frictions as buyers fail to identify the lowest cost supplier

$\Rightarrow$ Size of the distorsion depends on correlation between λ_{ij} and $T_j (d_{ij} c_j)^{-\theta}$

Product-level trade

- Share of country j in i's consumption = Probability for a buyer b_i to choose a supplier from j:

$$\begin{aligned}\pi_{ij} &= \mathbb{E}\left[\mathbb{1}_{b_i j}^{(1)}\right] \\ &= \underbrace{\frac{T_j(d_{ij}w_j)^{-\theta}}{\Upsilon_i}}_{EK(2002)} \frac{\lambda_{ij}}{\kappa_i}\end{aligned}$$

  which is increasing in λ_{ij}:

$$\frac{d\ln \pi_{ij}}{d\lambda_{ij}} = \frac{1-\pi_{ij}}{\lambda_{ij}} > 0$$

- Consistent with the argument in Rauch (1999) that search frictions contribute to reducing trade bw (physically and culturally) distant countries ▸ Gravity

Firm-level trade

- Probability that a seller s_j ends up serving a buyer b_i:

$$\begin{aligned}\rho_{ij}(z_{s_j}) &= \mathbb{P}\left(s_j \in \Omega_{b_i}\right)\mathbb{P}\left(s_j : \min\left\{\frac{w_k d_{ik}}{z_{s'_k}}; s'_k \in \Omega_{b_i}\right\} = \frac{w_j d_{ij}}{z_{s_j}}\right) \\ &= \lambda_{ij} e^{-\left(w_j d_{ij}\right)^{\theta} z_{s_j}^{-\theta} \Upsilon_i \kappa_i} \qquad (1)\end{aligned}$$

$\Rightarrow$ Increasing in the seller's productivity

Firm-level trade: proposition 1

The impact of search frictions varies along the distribution of productivities, with high-productivity firms benefiting more, in terms of export performances, from a reduction in search frictions:

$$\frac{\partial \ln \rho_{ij}(z)}{\partial \lambda_{ij}} = \underbrace{\frac{\partial \ln \lambda_{ij}}{\partial \lambda_{ij}}}_{\text{Visibility channel}} - \underbrace{\frac{\partial \left(w_j d_{ij}\right)^{\theta} z^{-\theta} \kappa_i \Upsilon_i}{\partial \lambda_{ij}}}_{\text{Competition channel}} = \frac{1}{\lambda_{ij}} - z^{-\theta} T_j \tag{2}$$

and

$$\frac{\partial^2 \ln \rho_{ij}(z)}{\partial \lambda_{ij} \partial z} > 0$$

Firm-level trade: proposition 1 (ii)

High-productivity firms always benefit from a reduction in frictions (an increase in the meeting probability λ_{ij}):

$$\lim_{z \to +\infty} \frac{\partial \ln \rho_{ij}(z)}{\partial \lambda_{ij}} = \frac{1}{\lambda_{ij}} > 0.$$

For low-enough search frictions, an increase in λ_{ij} instead has a negative impact on firms at the bottom of the distribution; that is,

$$\frac{\partial \ln \rho_{ij}(\underline{z})}{\partial \lambda_{ij}} < 0 \quad \text{if} \quad \lambda_{ij} > \frac{1}{T_j \underline{z}^{-\theta}}, \tag{3}$$

where $\rho_{ij}(\underline{z})$ is the export probability in i of a firm from j with productivity $\underline{z}$.

Firm-level trade: corollary

- Corollary: High-productivity firms' export premium:

$$\begin{aligned} \ln \frac{\rho_{ij}(z^H)}{\rho_{ij}(z^L)} &= (w_j d_{ij})^{\theta} \Upsilon_i \kappa_i \left((z^L)^{-\theta} - (z^H)^{-\theta} \right) \\ &= \frac{\lambda_{ij}}{\pi_{ij}} T_j \underline{z}^{-\theta} \left[\left(\frac{z^L}{\underline{z}} \right)^{-\theta} - \left(\frac{z^H}{\underline{z}} \right)^{-\theta} \right] \end{aligned} \tag{4}$$

  - Positive: High-productivity firms are more likely to export / export more conditional on exporting
  - Increasing in κ_i: More distortive search frictions reduce the competitive advantage of high-productivity sellers

▸ Robustness

Discussion

- Extension to general equilibrium not expected to change proposition 1, because change in wages induced by GE effects impact all firms symmetrically
- Assumption of price posting might be relaxed as shown in Fontaine, Martin, Mejean (2022)
- Proposition 1 still holds if one relaxes the assumption that meeting probability does not vary with size
- The distortive effect of search frictions is hard to reproduce in alternative models featuring two-sided heterogeneity, penetration costs or heterogeneous buyers

Roadmap

1. Stylized facts
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3. **Structural estimation**
4. Results

Intuition for the identification of λ_{ij}

- Distortive impact of frictions used to identify λ_{ij} *separately from* d_{ij}
- Export premium of high-productivity firms dampened in high frictional markets but strengthened by high iceberg costs
- Continues to be true in a less restrictive version of the model where $\partial \lambda_{ij} / \partial z_{s_j} > 0$
- Heterogeneity in export performances across firms within a market is thus a good candidate to identify search frictions

Moment choice

- Define $h_i^k(M)$ the expected number of French exporters serving M buyers in destination i, product k:

$$h_i^k(M) = \frac{\pi_i^k}{\lambda_i^k} \frac{1}{M} I_{\lambda_i^k}(M, B_i^k - M + 1)$$

  where $I_{\lambda_i^k}()$ is the regularized incomplete beta function and B_i^k the number of buyers of product k in country i

- Difficulty is to estimate frictions, separately from other impediments to trade

- Choose a moment which is not correlated with distance
  - Excludes using $h_i^k(M)$
  - Excludes using $h_i^k(M)/h_i^k(1)$
  - Use the variance of $h_i^k(M)/h_i^k(1)$, over M

- Variance of $h_i^k(M)/h_i^k(1)$ is related to the curvature of the distribution of sellers' degree and is positively correlated with λ_i^k ▸ Graph

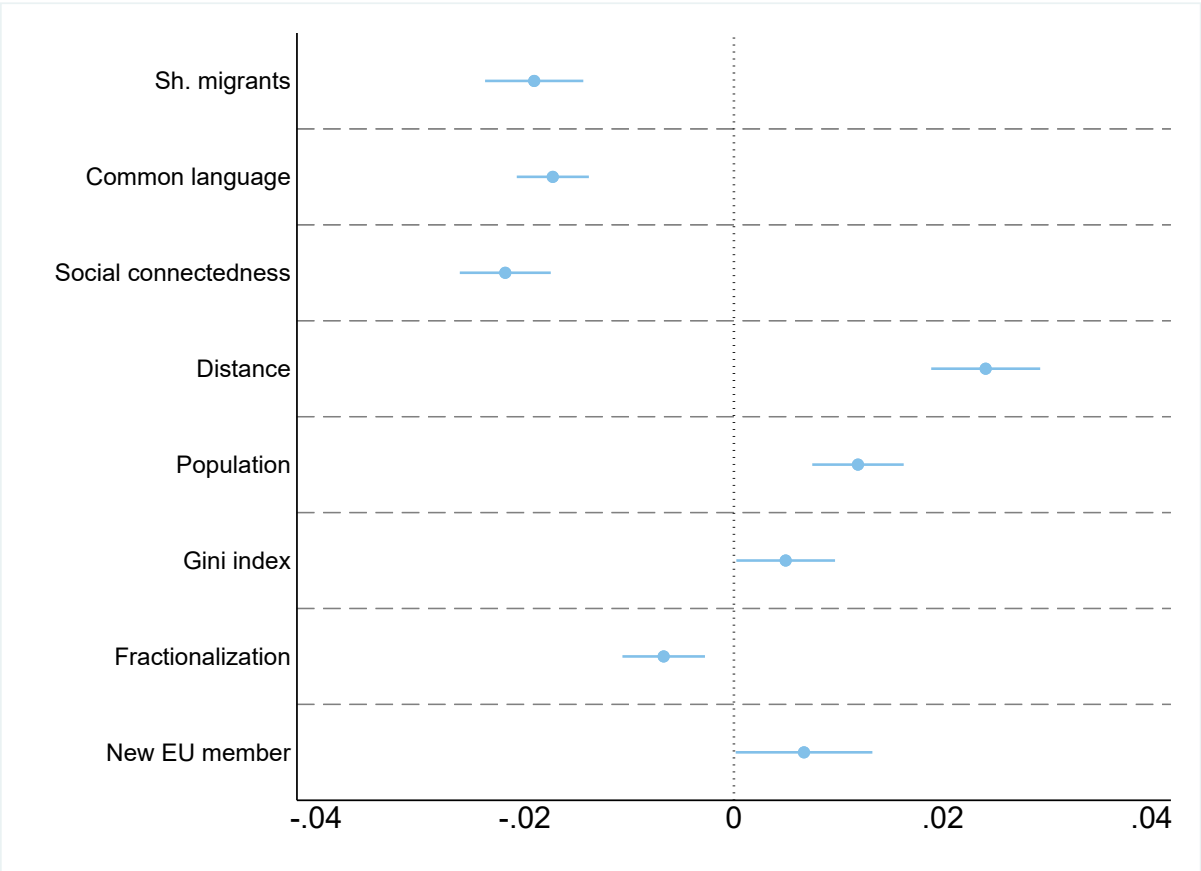
Estimation details

- Estimated using Asymptotic Least Squares
  - with 3 values for M
  - $M = \{2, 3-4, 5+\}$ or $M = \{2, 3, 4+\}$ or $M = \{2-3, 4-5, 6+\}$ to maximize sample coverage
  - for 15 countries and up to 1,231 hs6 products per country
- B_i^k recovered from information on the number of French exporters to the destination (Customs data) and the market share of French products (BACI + WIOD) ($B_i^k = B_{iF}^k / \pi_{iF}^k$)
- Compute estimated standard errors using the optimal matrix of weights and a measure of the number of potential suppliers in France recovered from INSEE data

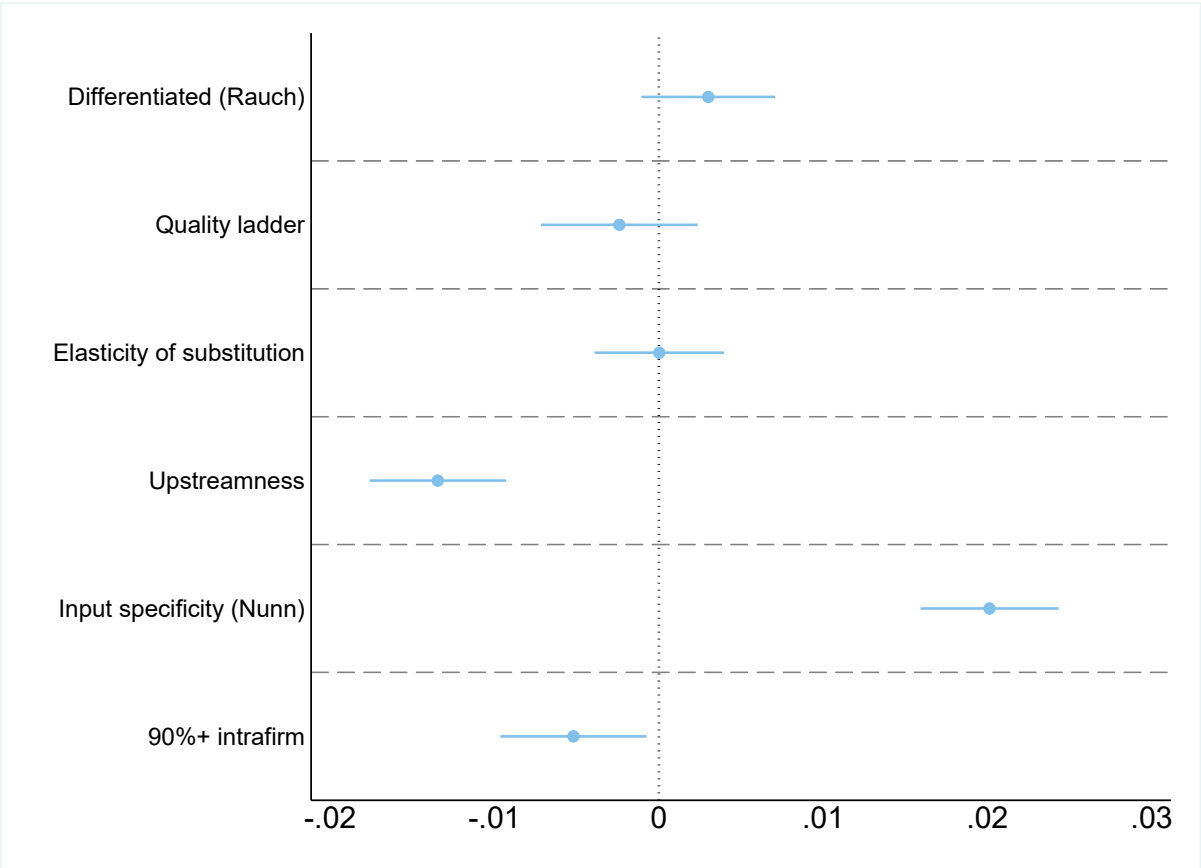
Summary statistics on estimated coefficients

	Meeting Probability λ_i^k (en %)	Probability of Meeting 0 Buyer $(1-\lambda_i^k)^{B_i^k}$ (en %)	Number of Buyers B_i^k
Mean	1.05	12.19	6159
Percentile 10	0.01	0.00	296
Percentile 25	0.08	0.00	715
Percentile 50	0.35	0.03	1,946
Percentile 75	1.07	4.39	5,677
Percentile 90	2.48	56.56	15,399
# Observations	13,253	13,253	13,253

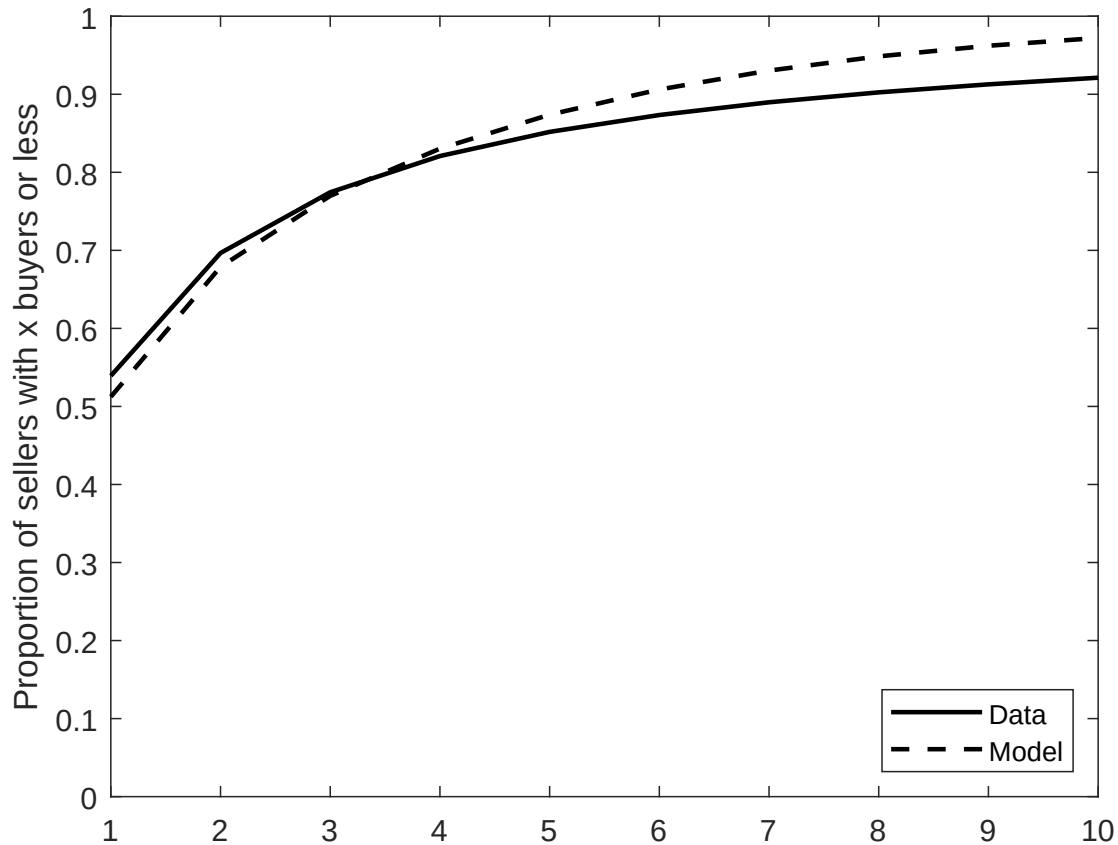
Country-specific correlates of bilateral frictions



Product-specific correlates of bilateral frictions



Model fit: Distribution of sellers' degrees



▸ More

Model's predictions: Impact on trade shares

	(1)	(2)	(3)	(4)	(5)
	Dep. Variable: log of product-level exports				
log Distance	-0.928***	-0.916***	-0.701***	-0.466***	-0.284***
	(0.0849)	(0.0835)	(0.103)	(0.0828)	(0.0856)
log Import demand	0.736***	0.737***	0.774***	0.837***	0.842***
	(0.0217)	(0.0217)	(0.0238)	(0.0217)	(0.0213)
log GDP per capita	-0.427***	-0.425***	-0.404***	-0.380***	-0.453***
	(0.0638)	(0.0636)	(0.0624)	(0.0529)	(0.0569)
Proba no match		-0.185***	-0.180***	-0.148***	-0.167***
		(0.0490)	(0.0484)	(0.0460)	(0.0448)
Common language			0.802***		
			(0.298)		
Social connectedness				0.268***	
				(0.0281)	
Share migrants					0.272***
					(0.0227)
Observations	12,802	12,802	12,802	12,802	12,802
R-squared	0.794	0.794	0.795	0.801	0.807

Notes: Robust standard errors, clustered at the country level, in parentheses with ***, ** and * respectively denoting significance at the 1, 5 and 10% levels.

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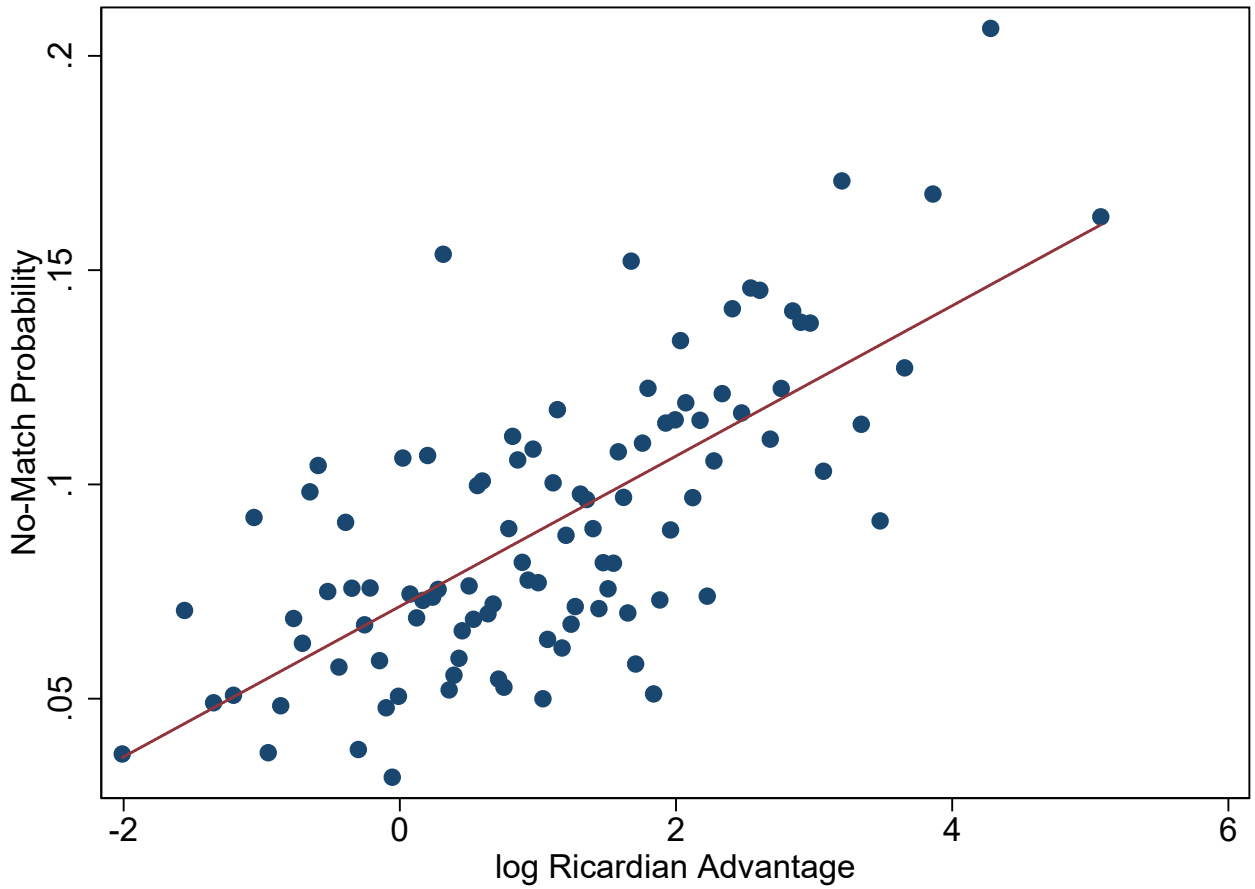
Search frictions and Ricardian comparative advantage

- Model: Distortive effect of search frictions depends on their correlation with Ricardian CA
- Estimate "revealed" CA using a model-consistent gravity equation (Costinot et al, 2012) ▸ Details
- Correlate with estimated frictions

Search frictions and Ricardian comparative advantage



Notes: The graph is a binned scatter plot of the log of revealed comparative advantages measured for each hs6 product, against the mean value of no-match probability (averaged across destinations).

Heterogenous impact of search frictions on export performances

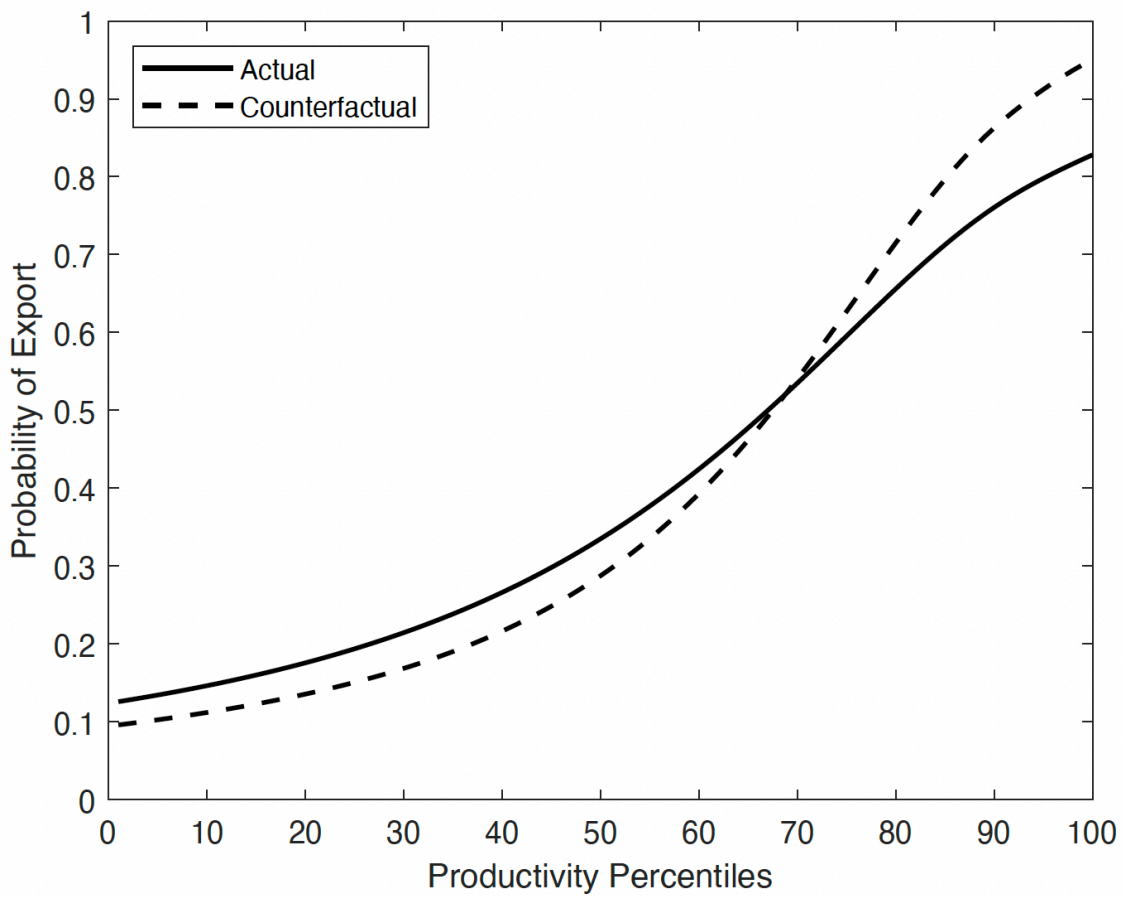
	Dep.Var.: ln firm-level bilateral exports					
	(1)	(2)	(3)	(4)	(5)	(6)
ln Domestic Sales	0.211***	0.218***				
	(.011)	(.011)				
- × Proba No match		-0.047***				
		(.011)				
𝟙 Top Quartile Sectoral Sales			0.400***			
			(.032)			
- × Proba No match			-0.121**			
			(.056)			
ln L Productivity				0.279***	0.285***	
				(.022)	(.023)	
- × Proba No match					-0.044*	
					(.026)	
𝟙 Top Quartile Sectoral L Prod.						0.299***
						(.038)
- × Proba No match						-0.119***
						(.042)
Observations	470,807	470,807	470,807	470,807	470,807	470,807
R-squared	0.230	0.231	0.213	0.216	0.216	0.213
Fixed effects	Product -Country	Product -Country	Product -Country	Product -Country	Product -Country	Product -Country

Counterfactual drop in frictions

1. Counterfactual: multiply all parameters by the ratio of frictions at the first and second quartiles

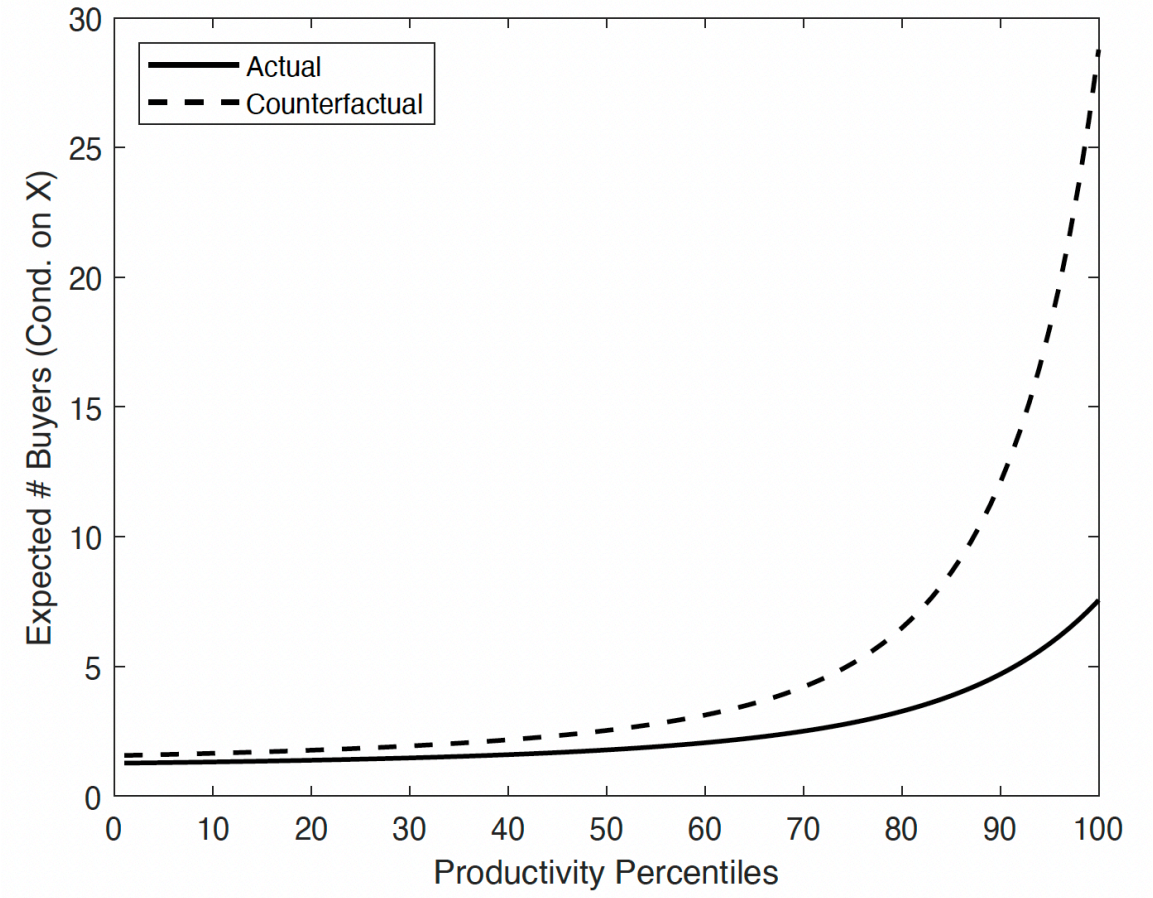
2. Compute the impact on:
   - The mean level of trade between France and Greece: A 1.1pp increase in market shares, in the median product market (max = 14pp)
   - The relative export performances of individual firms

Counterfactual: Export probabilities



Notes: Export probability along the productivity distribution in the data and the counterfactual.

Counterfactual: Expected number of buyers



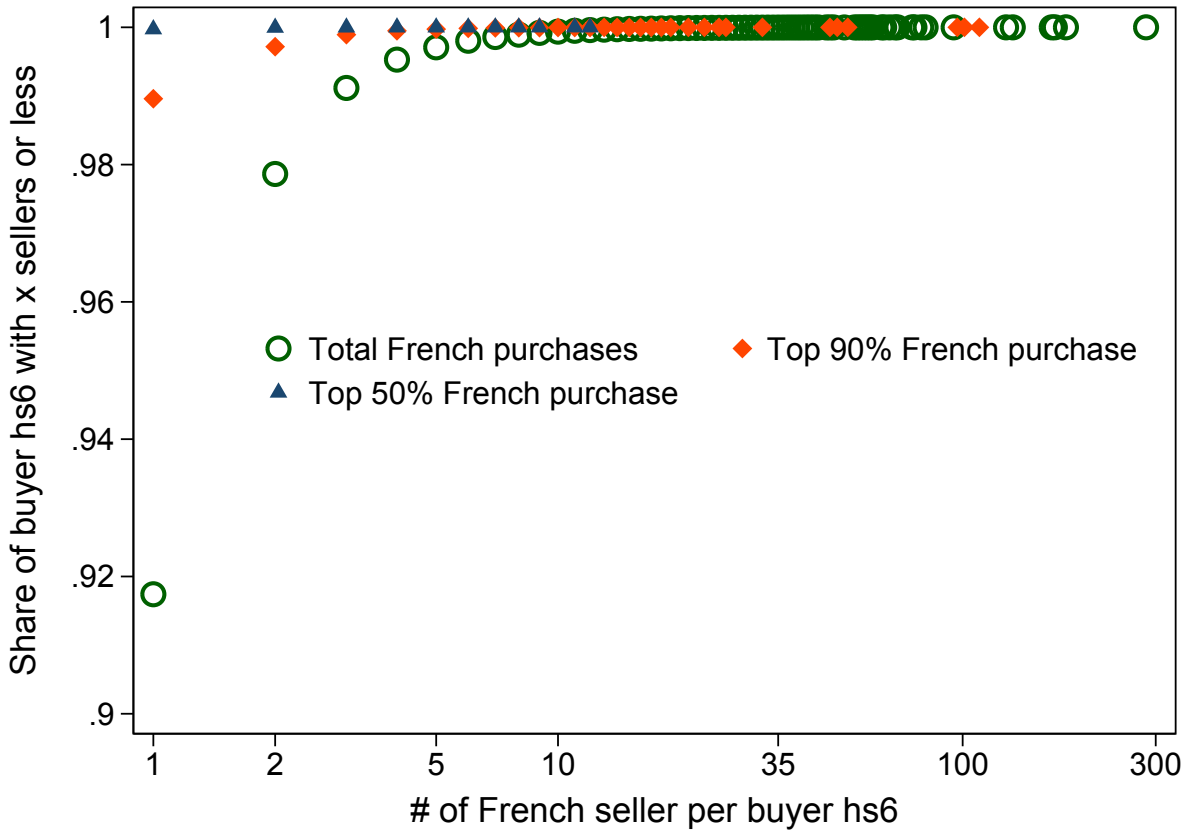
Counterfactual: Quantitative results

- Reallocation from low- to high-productivity firms induces a 5% to 10% increase in average productivity
- Comparison:
  - Reduction in iceberg costs that delivers the same change in market shares
  - Benefits, in relative terms, low-productivity firms
  - Mean productivity of exporters decreases by 8-13%

Conclusion

- Search frictions
  - contribute to reducing trade between countries
  - are not isomorphic to other trade barriers
  - affect the allocative efficiency, especially in markets where France has a comparative advantage
- Policy consequences: Reducing search frictions can have a large impact
  - on the volume of trade
  - on the efficiency of the selection process

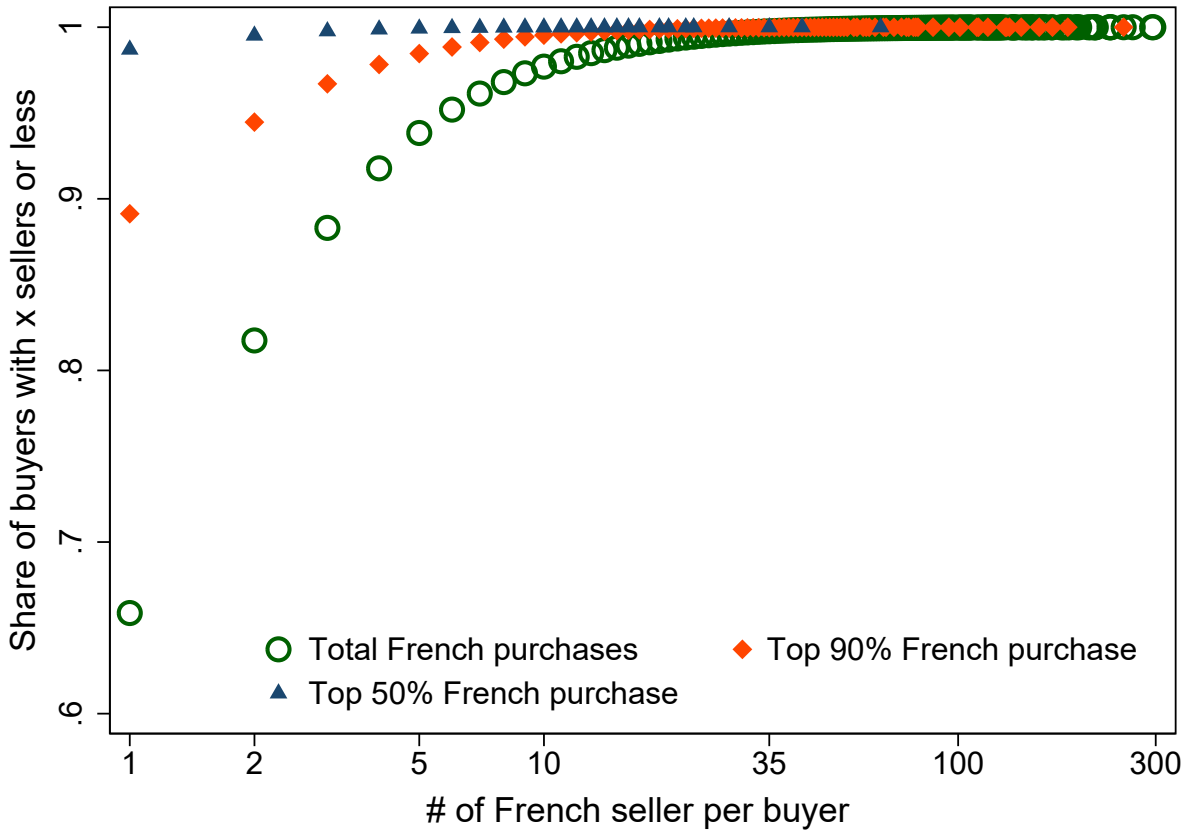
Figure: Distribution of buyers' degree



Notes: Proportion of buyers that serve x sellers or less in a given destination, in 2007. A buyer is defined as a buyer-HS6 product pair.

Back

Figure: Distribution of buyers' degree, without conditioning on products



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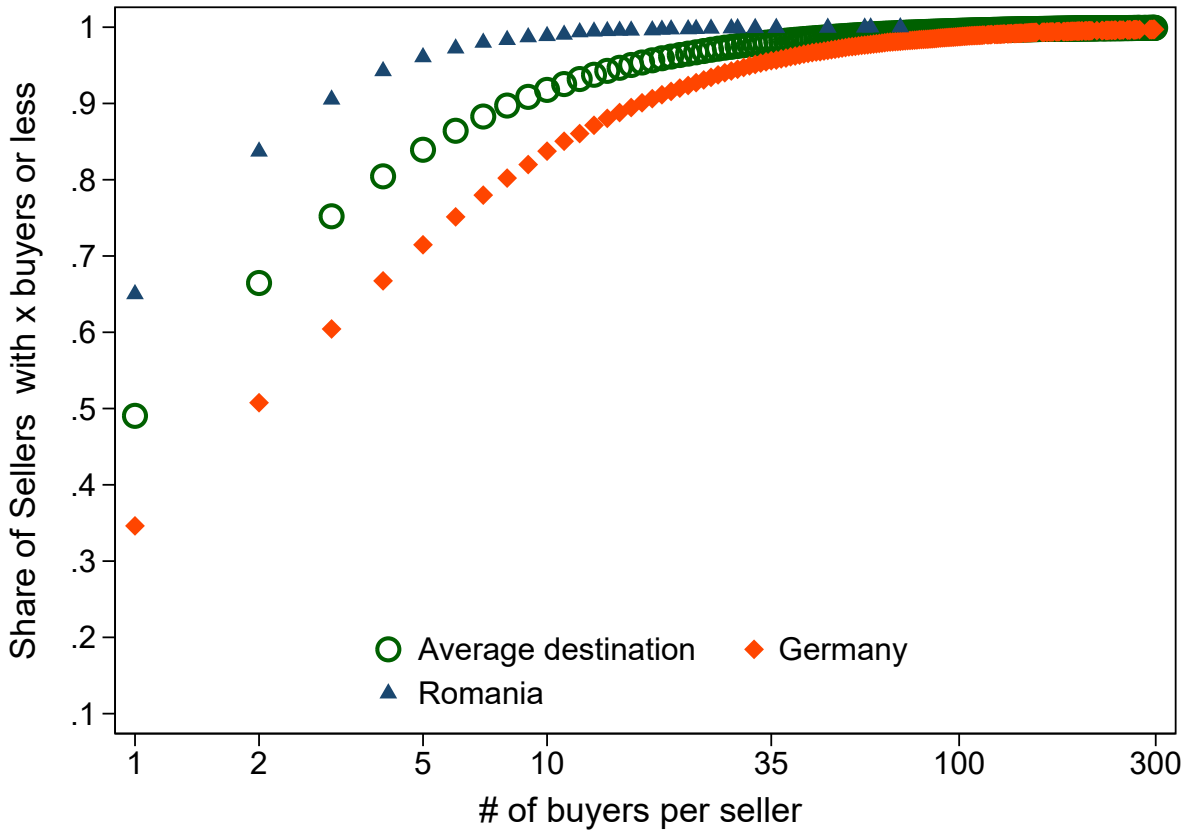
Back

Figure: Distribution of sellers' degree, without conditioning on products



Notes: Proportion of firms that serve x buyers or less in a given destination, in 2007.

▸ Seller

Model fit: Share of sellers with 1 buyer

	Dep.Var.: Empirical share of one buyer		
	(1)	(2)	(3)
Predicted share	0.289***	0.267***	0.172***
	(.005)	(.005)	(.005)
Constant	.390***		
	(.003)		
# obs	13,253	13,253	13,253
Fixed Effects	No	Country	Country Product
R-squared	.172	.250	.563

Notes: The predicted share of sellers with one buyer is calculated as $h_{ij}(1)/\sum_{M=1}^{B_i} h_{ij}(M)$. Robust standard errors in parentheses with *** denoting significance at the 1% level.

▸ Back

Estimating revealed comparative advantage

- In the model

$$\ln \pi_{ijk} = \ln T_{jk} c_{jk}^{-\theta} - \ln \Upsilon_{ik} \kappa_{ik} + \ln \lambda_{ijk} d_{ijk}^{-\theta}$$

- Estimated using multilateral trade data (BACI) and a two-way fixed effect estimator

- Origin country fixed effects capture the impact of technological comparative advantages (+ any common component of search and iceberg frictions)

▸ Back