Two-Sided Search in International Markets

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Overview

- Firms in international markets continually search for new downstream buyers and/or upstream suppliers. Their efforts determine:
  - Who matches with whom and associated welfare, producer surplus distributions.
  - Firms' market-specific life cycle growth patterns.
  - Aggregate dynamics in response to market shocks.

- **This paper:** Develops a dynamic model of these matching processes and their implications.

- **Model features:**
  - Retailers intermediate between exporters and consumers
  - Endogenous search and matching effort on both sides of the market.
  - Many-to-many matching with heterogeneous agents.
  - Characterize stationary industry equilibria and post-shock transition paths.

Fit to customs records, the models allows us to:

- **Measure the value of international business relationships**
- **Measure international search/matching costs**, assess their role in inhibiting trade
- **Measure incidence of search/matching costs** across firm types and states.
- **Micro-found firms' life cycle growth and matching patterns in foreign markets**
- **Quantify welfare and market structure effects of three kinds of shocks**.
  - changes in the global population of sellers (the "China shock")
  - reductions in search/matching costs (the "IT shock")
  - Trump's 2018 Section 301 tariffs on Chinese apparel—in steady state and along the transition path

Some Related Literature

- **Firm dynamics with customer accumulation:** Drozd and Nosal, 2012; Gourio and Redunko, 2014; Chaney, 2014; Arkolakis, 2016; Carballo et al., 2018; Piveteau, 2021; Rodrigue and Tan, 2019; Fitzgerald et al., 2024; Eaton et al., 2025.

- **Models of firm-to-firm trade:** Rauch, 2001, Rauch and Trindade, 2002; Bernard and Moxnes, 2018; Heise, 2019; Benguiria, 2021; Bernard, et al., 2022; Dhyne et al, 2021; Monarch, 2022; Sugita et al., 2023; Alviarez et al., 2025; Eaton et al., 2025; Krolikowski and McCallum, 2021 and 2025.

- **Dynamic models of trading networks:** Chaney, 2014; Lim, 2018; Huneeus, 2019

- **Global apparel market:** Khandelwal et al. 2013; Bai et al., 2017; Cahal et al., 2023; Gereffi and Memedovic, 2003; Ha-Brookshire and Dyer, 2008; McFarlan et al., 2012; Taplan, 2014; Lu, 2016; Cavallo, 2017.

Data

- Customs transaction records, U.S. Census Bureau, 1996-2011
  - shipment values, dates, and 10-digit HS codes
  - identifiers for buyers (U.S. EIN) and foreign sellers (name and address).
    - Buyer-supplier pairs are considered to be matched during the period between their first observed shipment and their last observed shipment.
    - 12-month dormancy indicates match death.

- Annual Retail Trade Survey, U.S. Census Bureau
  - apparel retailers' revenues and variable cost components

Why U.S. Apparel?

- Retailers/wholesalers frequently update their offerings, and thus their upstream suppliers.
- Buyer-seller relationships are mostly arms-length, and mostly international. details
- Natural experiments: IT shock, Chinese reforms, Agreement on Textiles and Clothing phase-out, Section 301 tariffs

Aggregate Trends

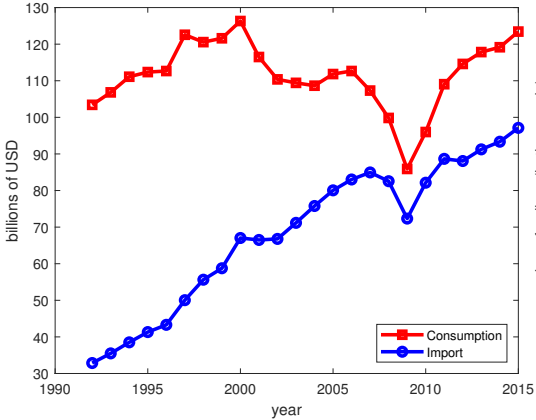


Figure: U.S. apparel consumption/imports

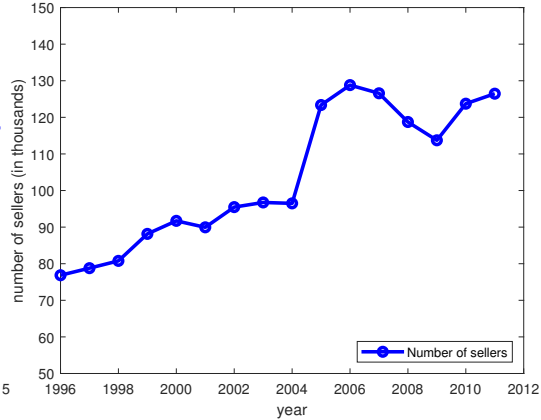


Figure: Number of suppliers, 1996-2011

Major Sources of Sellers: The Rise of China and ROA

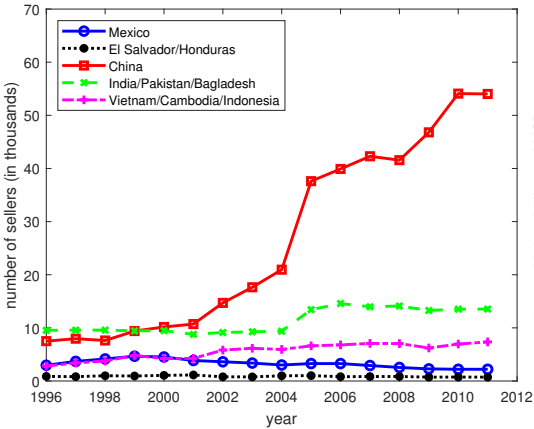


Figure: Number of sellers by country, 1996-2011

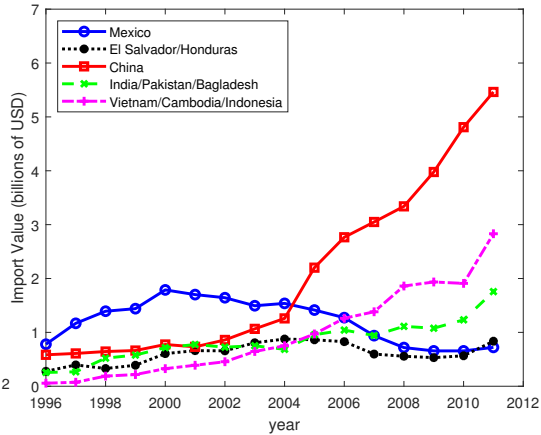


Figure: Value of imports by country, 1996-2011

Note: Exports per firm are lower in China and India than in other exporting countries.

Table: Year-to-year transition rates: buyers per seller*

year t, year t+1	0	1	2	3	4	5	6	7	8	9	≥10
1	0.65	0.27	0.05	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2	0.32	0.31	0.21	0.09	0.03	0.02	0.01	0.00	0.00	0.00	0.00
3	0.19	0.22	0.23	0.17	0.09	0.05	0.02	0.01	0.01	0.00	0.01
4	0.13	0.15	0.18	0.18	0.14	0.09	0.05	0.03	0.02	0.01	0.02
5	0.10	0.10	0.13	0.16	0.16	0.12	0.08	0.05	0.03	0.02	0.04
6	0.08	0.07	0.10	0.13	0.14	0.13	0.11	0.08	0.05	0.03	0.07
7	0.07	0.06	0.08	0.09	0.12	0.13	0.12	0.10	0.07	0.05	0.11
8	0.07	0.05	0.05	0.07	0.10	0.11	0.11	0.11	0.09	0.07	0.16
9	0.06	0.05	0.05	0.06	0.08	0.09	0.10	0.10	0.10	0.08	0.24
≥10	0.05	0.03	0.03	0.03	0.04	0.04	0.05	0.05	0.06	0.06	0.56

Based on monthly U.S. Customs records, 1996-2011. Figures are cross-year averages of annual transition rates during the sample period.

Table: Year-to-year transition rates: sellers per buyer*

year t, year t+1	0	1	2	3	4	5	6	7	8	9	≥10
1	0.58	0.26	0.09	0.04	0.02	0.01	0.01	0.00	0.00	0.00	0.01
2	0.34	0.24	0.19	0.10	0.05	0.03	0.02	0.01	0.01	0.00	0.02
3	0.25	0.16	0.18	0.14	0.09	0.06	0.03	0.02	0.02	0.01	0.03
4	0.21	0.11	0.14	0.14	0.13	0.08	0.06	0.04	0.03	0.02	0.06
5	0.19	0.07	0.10	0.12	0.12	0.11	0.07	0.06	0.04	0.03	0.09
6	0.17	0.06	0.08	0.09	0.11	0.11	0.09	0.07	0.05	0.04	0.13
7	0.16	0.05	0.05	0.07	0.09	0.10	0.09	0.09	0.06	0.06	0.19
8	0.15	0.04	0.05	0.06	0.07	0.08	0.08	0.08	0.07	0.06	0.25
9	0.15	0.03	0.03	0.04	0.06	0.07	0.08	0.08	0.07	0.07	0.32
≥10	0.12	0.01	0.01	0.01	0.02	0.02	0.02	0.02	0.03	0.03	0.71

Downward shocks are common; even buyers with 5-7 suppliers have 15-20% odds of going to zero suppliers next year.

Table: Degree Distributions by Partner Counts, 2011

x	Frac. buyer with at most x sellers	Frac. seller with at most x buyers
1	0.407	0.798
2	0.554	0.951
3	0.645	0.970
4	0.709	0.980
5	0.743	0.987
6	0.780	0.991
7	0.808	0.993
8	0.823	0.995
9	0.837	0.996
10	0.855	0.997

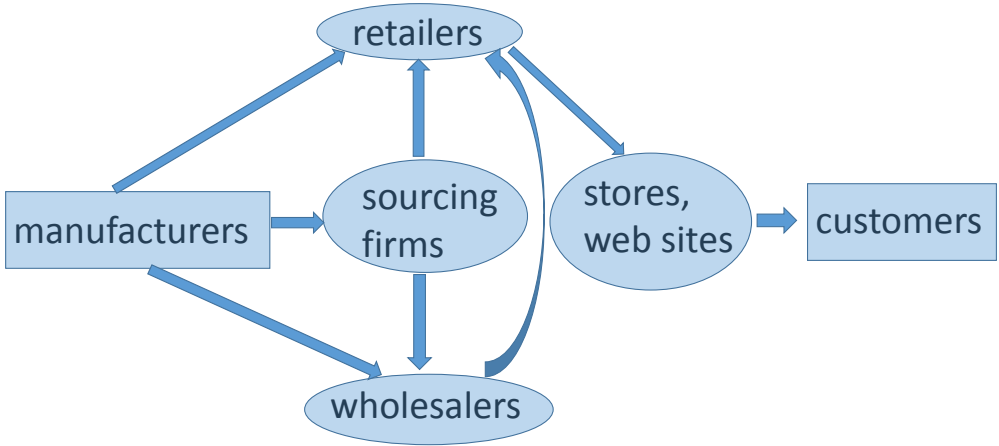
- Fat tail, nearly Pareto shape
- Heavy concentration at of small businesses
- Sellers more common than buyers

Table: Buyers' imports per supplier and within-buyer supplier shares

No. suppliers	mean log imports	Supplier shares in buyer purchases, ordered by supplier size									
		1^{st}	2^{nd}	3^{rd}	4^{th}	5^{th}	6^{th}	7^{th}	8^{th}	9^{th}	10^{th}
1	0.000	1.000	0	0	0	0	0	0	0	0	0
2	1.134	0.771	0.229	0	0	0	0	0	0	0	0
3	1.604	0.668	0.240	0.092	0	0	0	0	0	0	0
4	1.764	0.608	0.232	0.111	0.049	0	0	0	0	0	0
5	1.904	0.544	0.231	0.126	0.067	0032	0	0	0	0	0
6	2.054	0.540	0.218	0.115	0.070	0.039	0.019	0	0	0	0
7	2.214	0.502	0.214	0.123	0.074	0.045	0.027	0.019	0	0	0
8	2.094	0.460	0.212	0.125	0.080	0.054	0.035	0.023	0.011	0	0
9	2.364	0.451	0.201	0.121	0.083	0.055	0.038	0.026	0.017	0.017	0
10	2.324	0.420	0.197	0.125	0.084	0.060	0.042	0.029	0.021	0.013	0.007

Figures in column 2: Average log imports per supplier of buyers with n suppliers. They are expressed net of the mean log imports per supplier for buyers with a single supplier.
Figures in columns 3-12: the n^{th} row give the average within-buyer share of the m^{th} largest supplier among buyers with n suppliers, $m \in \{1, 2, ..., n\}$.

Industry Structure



Economic Agents along the Supply Chain

- Sellers: manufacturers abroad (almost all in the global South)
- Buyers: a combination of general merchandise retailers or wholesalers
  - General merchandise retailer: Walmart, Target, Macy's, etc.
  - Designer firms: Ralph Lauren, Gap, etc. – sell directly to consumers and/or via general merchandise stores (however, rarely price discriminate)
  - Sourcing firms: Gulati Group, Apparel Sourcing Group, Li&Fung, etc. (which don't play a major role in this industry).
- Consumers: purchase apparel products from brick-and-mortar stores or websites.

Product Market at a Point in Time

- Final consumers in U.S. market spend a (time-invariant) flow amount E on apparel.
- Continuum of buyers (retailers/importers) indexed by $y \in Y$, each offering a discrete set of varieties, with one upstream seller (producer/exporter) $x \in J_y$ per variety.
- Nested CES utility function ▸ details implies retail market demand for each store y and each product x offered at store y are

$$Q_y = \frac{E}{P_y} \cdot \frac{\left(\frac{P_y}{\mu_y}\right)^{1-\eta}}{P^{1-\eta}}, \qquad q_{xy} = \frac{P_y Q_y}{p_{xy}} \frac{\left(\frac{p_{xy}}{\xi_x}\right)^{1-\alpha}}{P_y^{1-\alpha}}$$

where $P_y = \left[\sum_{x \in J_y} \left(\frac{p_{xy}}{\xi_x}\right)^{1-\alpha}\right]^{\frac{1}{1-\alpha}}$ and $P = \left[\int_y \left(\frac{P_y}{\mu_y}\right)^{1-\eta}\right]^{\frac{1}{1-\eta}}$.

Prices, Flow Profits and Transfers

- To provide product x to the customers of buyer (retailer/importer) y, the buyer and seller (supplier/producer/exporter) incur a combined unit cost c_x.
- Buyers bargain with their suppliers over retail prices p_{xy} and transfers τ_{xy} $\forall x \in J_y$.
- Under ▸ Assumptions 1-5, Theorem 2A of de Fontenay and Gans (2014) holds. Therefore **prices are bilaterally efficient**:

$$q_{xy} + \sum_{x' \in J_y} \frac{\partial q_{x'y}}{\partial p_{xy}} (p_{x'y} - c_{x'}) = 0, \forall x \in J_y$$

and **transfers are "fair"**. That is, for all $x \in J_y$:

$$\tau_{xy}(J_y) = \frac{1}{2} \left[\underbrace{\pi^T(J_y) - \pi^T(J_y \backslash x)}_{x\text{'s contribution to total surplus}} - \underbrace{\sum_{x' \in J_y \backslash x} \left(\tau_{x'y}(J_y) - \tau_{x'y}(J_y \backslash x) \right)}_{\text{impact of } x \text{ on other supplier transfers}} \right]$$

where $\pi_y^T(J_y) = \sum_{x \in J_y} (p_{xy} - c_x) q_{xy}$.

Match Creation and Destruction

- **Search is undirected** and matching is random.
- **Search costs** The cost of searching at effort level σ is:

$$k^A\left(\sigma, n^A\right) = \frac{k_0\left(\sigma\right)^2}{\left(n^A+1\right)^{\gamma^A}}, \quad A \in \{B, S\},$$

where n^B and n^S are the number of suppliers connected to the buyer, $\|J\|$, and the number buyers connected to the seller, respectively.

- **Optimal search** Each type of agent continually adjusts its search intensity to maximize its expected presented value, given its current portfolio of matches. details

Dynamics

- **Discretization:** There are a discrete number of buyer types (μ_i's) and seller types (ξ_j's) with exogenous measures M_i^B's and M_j^S's, respectively.
- For any particular type, the distribution of connected agents across states evolves endogenously ("state:" portfolio of connected business partners).
- **Match arrivals** Search efforts σ on both sides of the market jointly determine the arrival hazard of a new match of each type for each type of agent in each state.
- **Match deaths**: Relationships terminate with exogenous hazard, δ. They also end with the exogenous exit of the buyer or seller from the export market. The hazard rates of buyer and seller exits are δ^B and δ^S, respectively.
- **Equations of motion** Arrival and death hazards determine evolution of measures of buyers and sellers of each type in each state. details
- **Entry/exit** Firms with no business partners are dubbed "inactive," but they too search and may re-enter.

Empirical Parametrization

- Assume 2 types of sellers, with $\Delta = \xi_2 - \xi_1$ and $\omega = M_2^S / M^S$.
- Assume 30 types of buyers, with $\ln \mu \sim N(0, \sigma^2_{\ln \mu})$, discretized.
- Fix $\rho = 0.05$ and $\delta = \delta^{observed} - \delta^B - \delta^S = 0.774 - 0.07 - 0.15 = 0.554$.
- Take within-store, cross-product elasticity of substitution from Hottman et al. (2016): $\alpha = 4.35$
- Estimate $(\kappa_0, \gamma^B, \gamma^S, M^S, \omega, \Delta, \sigma^2_{\ln \mu}, \eta)$ using generalized method of moments with efficient weighting matrix.

Model Identification

- Sets of targeted moments (see earlier slides):
  1. partner count transition matrices
  2. partner count frequency distributions
  3. cross-buyer sales distribution
  4. within-buyer seller sales shares
  5. variable cost to total revenue ratio, U.S. apparel retailers (from Annual Retail Trade Survey, U.S. Census Bureau)

- Main sources of parameter identification
  - **search cost function** (κ_0, γ^B, γ^S): moment sets 1 and 2
  - **measure of potential sellers per buyer** (M^S): moment sets 1 and 2
  - **seller type distribution** (ω, Δ): moment sets 1, 2 and 4
  - **buyer type distribution** ($\sigma^2_{ln\mu}$): moment sets 2 and 3
  - **cross-buyer substitution elasticity** (η): moment 5

Model Fit: Predicted and Data-based Statistics

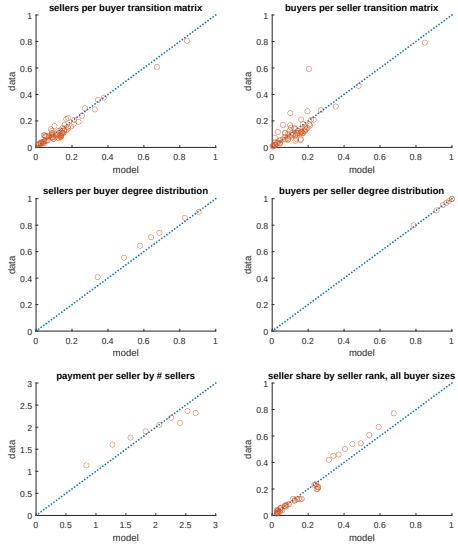
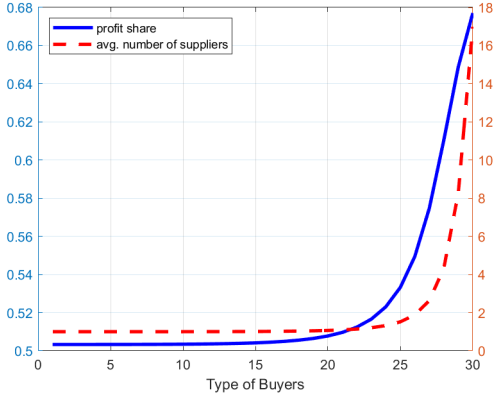


Table: Cost and Distributional Parameters*

	estimate	std. error
k_0	0.009	0.003
γ^B	0.320	0.041
γ^S	0.230	0.046
ω	0.030	0.002
Δ	0.454	0.006
M^S	4.203	0.728
η	2.432	0.728
$\sigma^2_{\ln \mu}$	7.428	2.508
objective function	10,461.73	

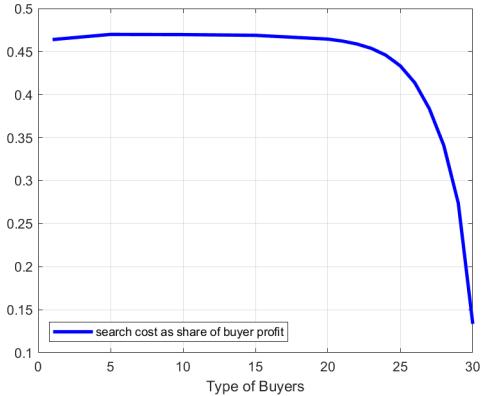
*GMM estimates of $\hat{\Lambda}$ using efficient weighting matrix.

Figure: Buyer Share of Gross Profit



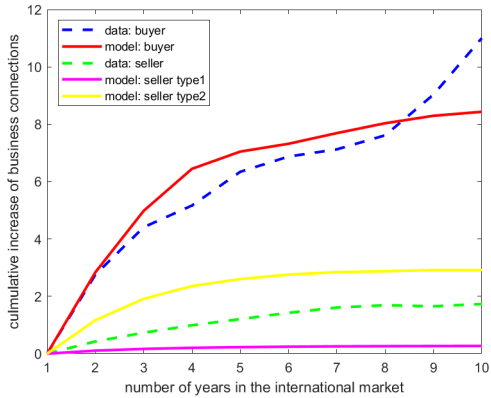
- High-μ buyers have more incentives to build large client portfolios.
- Buyers with large portfolios have more bargaining power.

Figure: Search Cost Share of Gross Profit, Buyers



- High-μ buyers spend a smaller share of profits on search because they:
  - earn more profits per match
  - enjoy search cost scale economies

Figure: Number of clients by years in market (Steady State)



- Buyers' growth trajectory captured by model
- Sellers' high-type and low-type trajectories bracket observed trajectories (but weighted average too low).

Experiments

- What combination of lower search costs (to proxy the spread of IT) and greater access to the U.S. market for low-ξ suppliers (to proxy ATC phaseout and Chinese reforms) details allow the model to approximate observed market developments?
  - How do these shocks change the structure of the U.S. apparel market and what are their welfare implications?
  - Assume κ_0 remained stable after 2004; M_S and ω changed only in 2005.
- Through the lens of our model, what were the effects of the 2018 Trump tariffs on the U.S. apparel market?

Table: Counterfactuals: ATC phaseout and IT shock

		Before policy and IT shocks: 1996 (low M^S, high κ_0)	Before policy shocks, after IT shock: 2004 (low M^S, baseline κ_0)	After policy and IT shocks: 2011 (baseline M^S and κ_0)
		(1)	(2)	(3)
1.	measure, active low-ξ suppliers	0.446	26.4%	69.3%
2.	measure, active high-ξ suppliers	0.106	6.5%	2.3%
3.	measure, active buyers	0.188	19.9%	17.0%
4.	total profit, low-ξ suppliers	0.022	0.1%	35.4%
5.	total profit, high-ξ suppliers	0.120	-1.7%	-9.8%
6.	total profit, buyers	0.269	0.7%	1.4%
7.	total search costs, low-ξ suppliers	0.009	0.5%	35.4%
8.	total search costs, high-ξ suppliers	0.057	4.6%	-6.0%
9.	total search costs, buyers	0.045	-17.3%	-2.8%
10.	number of suppliers per buyer	1.653	12.9%	20.9%
11.	high-ξ suppliers per buyer	0.614	13.2%	-11.7%
12.	consumer welfare	1.000	9.0%	7.3%

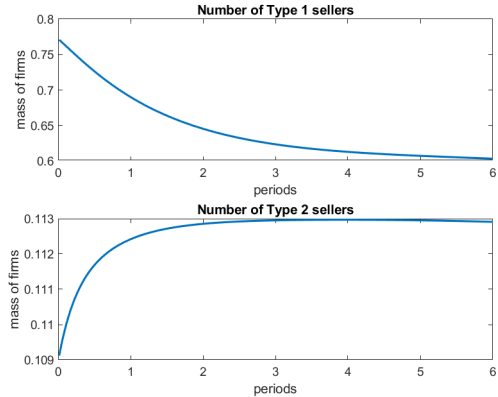
*Figures in columns 2 and 3 are percentage deviations from column 1. Column 1 figures reflect several normalizations. First, measures of active buyers and suppliers are expressed as shares of the population of potential buyers. Second, surpluses, profits, and search costs are expressed as shares of total consumer expenditures. Finally, baseline consumer welfare is normalized to unity.

Table: Steady State Effects of Trump's Section 301 Tariff

		Long run responses to tariff
1.	measure, active low-ξ suppliers	-22.4%
2.	measure, active high-ξ suppliers	3.4%
3.	measure, active buyers	1.6%
4.	total profit, low-ξ suppliers	-52.5%
5.	total profit, high-ξ suppliers	18.3%
6.	total profit, buyers	-2.2%
7.	number of suppliers per buyer	-7.6%
8.	high-ξ suppliers per buyer	28.1%
9.	consumer welfare	-1.0%

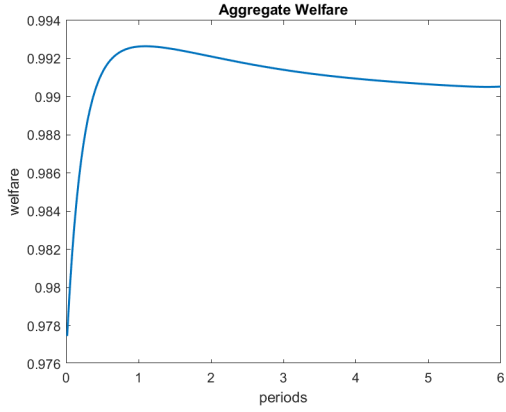
This experiment treat the 2018 Trump tariffs as a permanent 15% tariff on low-quality imports.

Figure: Seller transition dynamics: 2018 Trump tariffs



- Entry by high-type sellers offsets exit of low-type sellers, especially in the first 1.5 years.
- Transition is complete after about 5 years.

Figure: Consumer welfare transition dynamics: 2018 Trump tariffs



- Initial drop in welfare due to higher import prices for low-quality goods.
- Adjustments in quality of imports partly offset welfare loss after first year.

Summary

- Model captures key cross-sectional and time-series features of business-to-business relationships between foreign exporters and U.S. buyers.
- Some implications:
  - Buyers and suppliers adjust their search intensity over their life cycles, both because their market visibility changes and because buyers face diminishing returns to adding business partners.
  - Reductions in search costs due to technological progress can induce substantial entry on both sides of the market, increasing consumer welfare while shifting rents away from buyers and suppliers.
  - Increasing the set of potential suppliers with access to the downstream market need not be welfare improving.

Number of Buyers: Mostly Arms-length Trade

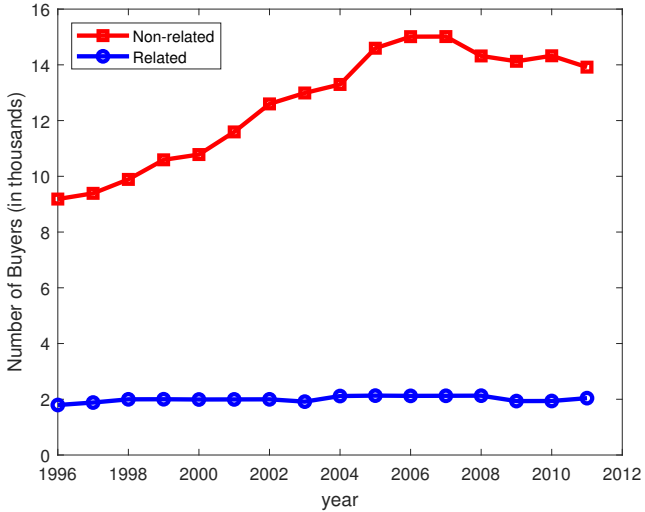


Figure: Number of buyers, related party versus arm's length trade

Utility function

- Continuum of buyers (retailers/importers) indexed by $y \in Y$, each offering a discrete set of varieties, with one seller (producer/exporter) $x \in J_y$ per variety.
- Representative consumer utility:

$$U = \left[\int_{y \in Y} (\mu_y Q_y)^{\frac{\eta-1}{\eta}} \right]^{\frac{\eta}{\eta-1}},$$

where Q_y measures consumption of the set of products, J_y, offered at store y,

$$Q_y = \left[\sum_{x \in J_y} (\xi_x q_{xy})^{\frac{\alpha-1}{\alpha}} \right]^{\frac{\alpha}{\alpha-1}},$$

and μ_y and ξ_x are exogenous parameters that measure the inherent appeal or quality of retailer y and product x, respectively.

Bargaining game assumptions

No commitment: The buyer and her suppliers cannot commit to a long-term transfer schedule. They renegotiate whenever the buyer's portfolio of suppliers changes.

Bilateral bargaining:The buyer uses delegates to bargain bilaterally and simultaneously with each of her connected sellers. Each bargaining session follows the protocol described by Binmore, et al. (1986).

Private information: The history of each bilateral bargaining session between a supplier and a delegate is privately observed by the two parties involved.

Passive beliefs: When an agent (seller or delegate) receives an offer that is different from the equilibrium outcome, or an unexpected rejection, she does not revise her belief about bargaining sessions she does not observe.

Limited contract space: Suppliers cannot condition transfers on the buyer's search effort or portfolio history.

Optimal Buyer Search

Let θ^B be the probability that a unit of buyer search effort yields a match, and let υ_k^S be the probability that it is with a type-k seller (both objects will be discussed later). The flow value of a type-i buyer currently in state $\mathbf{s}$ is then:

$$\begin{aligned}(\rho+\delta^B)V_i^B(\mathbf{s}) &= \pi_i^T(\mathbf{s})-\sum_{k=1}^{J}s_k\tau_{ki}(\mathbf{s})-k_s^B(\sigma_i^B(\mathbf{s}))+\sigma_i^B(\mathbf{s})\theta^B\sum_{k=1}^{J}\upsilon_k^S\left[V_i^B(\mathbf{s}+\mathbf{1}_k)-V_i^B(\mathbf{s})\right]\\ &\quad+(\delta+\delta^S)\sum_{k=1}^{J}s_k\left[V_i^B(\mathbf{s}-\mathbf{1}_k)-V_i^B(\mathbf{s})\right]\end{aligned}$$

The optimal search policy for type-i buyers with a set of $\mathbf{s}$ sellers, $\sigma_i^B(\mathbf{s})$, therefore satisfies

$$\frac{\partial k^B\left(\sigma_i^B,\mathbf{s}\right)}{\partial\sigma_i^B}=\theta^B\sum_{k=1}^{J}\upsilon_k^S\left[V_i^B(\mathbf{s}+\mathbf{1}_k)-V_i^B(\mathbf{s})\right].$$

Optimal Seller Search

Similarly, the value to a type-j seller of being matched with a type-i buyer in state $\mathbf{s}$ is:

$$\begin{aligned}(\rho+\delta^B+\delta+\delta^S)V_{ji}^S(\mathbf{s}) &= \tau_{ji}(\mathbf{s})+\sigma_i^B(\mathbf{s})\theta^B\sum_{k=1}^{J}\upsilon_k^S\left[V_{ji}^S(\mathbf{s}+\mathbf{1}_k)-V_{ji}^S(\mathbf{s})\right]\\ &\quad+(\delta+\delta^S)\sum_{k=1}^{K}(s_k-\mathbf{1}_{k=j})\left[V_{ji}^S(\mathbf{s}-\mathbf{1}_k)-V_{ji}^S(\mathbf{s})\right]\end{aligned}$$

Let $\upsilon_i^B(\mathbf{s})$ be the probability that the next match will be with a type-i buyer in state $\mathbf{s}$. The *ex-ante* expected value of a new business relationship for a type-j seller is then:

$$V_j^S=\sum_i\sum_{\mathbf{s}\in\mathbb{S}}\upsilon_i^B(\mathbf{s})V_{ji}^S(\mathbf{s}).$$

So the optimal search intensity for any seller with a total of b active buyers satisfies:

$$\frac{\partial k^S\left(\sigma^S,\mathbf{b}\right)}{\partial\sigma^S}=\theta^S V_j^S.$$

We assume that the sellers have no capacity constraint in production.

Equations of Motion

- Evolution of the measure of buyers of type i in state $\mathbf{s}$, with $n^S > 0$:

$$\begin{aligned}\dot{M}_i^B(\mathbf{s}) &= \sum_j \left[\sigma_i^B(\mathbf{s}-\mathbf{1}_j)\theta^B \upsilon_j^S M_i^B(\mathbf{s}-\mathbf{1}_j) + \delta(s_j+1)M_i^B(\mathbf{s}+\mathbf{1}_j)\right] \\ &\quad - \left[\sigma_i^B(\mathbf{s})\theta^B M_i^B(\mathbf{s}) + (\delta n^B(\mathbf{s}) + \delta^B)M_i^B(\mathbf{s})\right],\end{aligned}$$

$\mathbf{s} \in \mathbb{S}; i = 1, ..., I.$

- Evolutions of the measure of buyers of type i with $n^S = 0$ sellers:

$$\dot{M}_i^B(\mathbf{0}) = \delta^B \sum_{n^B(\mathbf{s})\neq 0} M_i^B(\mathbf{s}) + \delta \sum_j M_i^B(\mathbf{1}_j) - \sigma_i^B(\mathbf{0})\theta^B M_i^B(\mathbf{0})$$

- Measure of sellers of type j, $M_j^S(\mathbf{b})$ follows similar equations of motions.

Aggregates: buyer side

- Measure $M_i^B(\mathbf{s})$ buyers of type i with $\mathbf{s}$ sellers. Exogenous buyer measures:

$$\sum_{\mathbf{s}\subset\mathbb{S}} M_i^B(\mathbf{s}) = M_i^B, \quad M^B = \sum_i M_i^B = 1$$

  Note: $\mathbf{s} = \mathbf{0}$ is in $\mathbb{S}$, so M^B includes buyers with no active matches.

- Total "visibility" of type-i buyers with $\mathbf{s}$ sellers :

$$H_i^B(\mathbf{s}) = \sigma_i^B(\mathbf{s}) M_i^B(\mathbf{s})$$

- Measure of overall visibility of buyers:

$$H^B = \sum_i \sum_{\mathbf{s}} H_i^B(\mathbf{s})$$

Aggregates: seller side

- Seller side of market similar to buyer side. Visibility measures:

$$H_j^S(\mathbf{b}) = \sigma_j^S(\mathbf{b}) M_j^S(\mathbf{b})$$

$$H^S = \sum_j \sum_{\mathbf{b}} H_j^S(\mathbf{b})$$

- Exogenous measure of total number of sellers:

$$M^S = \sum_j \sum_{\mathbf{b}} M_j^S(\mathbf{b})$$

Aggregates: market tightness

- Measure of matches:

$$X = H^B[1 - (1 - \frac{1}{H^B})^{H^S}] \approx H^B[1 - e^{-H^S/H^B}]$$

  - matching technology satisfied general properties and CRS
  - availability of sellers to buyers: $\theta^B = X/H^B$; buyers to sellers: $\theta^S = X/H^S$

- Share of matches involving type i buyers of $\mathbf{s}$ sellers:

$$\frac{H_i^B(\mathbf{s})}{H^B} \equiv \upsilon_i^B(\mathbf{s})$$

- Share of matches involving type j sellers:

$$\frac{\sum_{\mathbf{b}} H_j^S(\mathbf{b})}{H^S} \equiv \theta_j^B$$

The ATC Phaseout and Chinese reforms

- The Uruguay Round's 1995 Agreement on Textiles and Clothing (ATC) mandated the phaseout of import quotas
- The U.S quotas were relaxed in four phases (1995, 1998, 2002, 2005).
- Chinese firms' access to U.S. markets:
  - WTO accession in 2002 removed the first three phases of quotas
  - The MFA was completely phased out in 2005
  - China began allowing small private firms to engage directly with foreign buyers in 2004 (Bai et al., 2017).