Escaping Import Competition in China

Ana Cecília Fieler, Yale and NBER
Ann E. Harrison, Berkeley Haas and NBER

June 2023

Introduction

- Economists and policy makers generally agree that trade reforms improve the performance of domestic competitors in developing countries. Explanations often based on x-inefficiencies.
- Empirical evidence mostly supports this view (surveys: Tybout 2003, Shu, Steinwender 2019).
- Standard theories, based on increasing returns to scale, do not
  - Melitz (2003), Lileeva, Trefler (2010), Aw, Roberts, Tybout, Xu (2011), Bustos (2011), Bøler, Moxnes, Ulltveit-Moe (2015)

Introduction

- Economists and policy makers generally agree that trade reforms improve the performance of domestic competitors in developing countries. Explanations often based on x-inefficiencies.
- Empirical evidence mostly supports this view (surveys: Tybout 2003, Shu, Steinwender 2019).
- Standard theories, based on increasing returns to scale, do not
  - Melitz (2003), Lileeva, Trefler (2010), Aw, Roberts, Tybout, Xu (2011), Bustos (2011), Bøler, Moxnes, Ulltveit-Moe (2015)
- Our explanation: Firms escape competition by differentiating their products.
  - Examples: Xiaomi cell phones, Chery Automobiles

Introduction: This paper

- Evidence from Chinese firms during China's accession to the WTO in 2001. Import tariff cuts are associated with within-firm
  - Introduction of new goods
  - Switches to skill-intensive four-digit sectors
  - Increases in revenue productivity, especially for small firms.
- Propose and estimate a model that can account for main data patterns.
  - An extension of Atkeson, Burstein 2008 with nested CES preferences, variable markups
  - Firms can differentiate: Escape to nests with fewer competitors
  - The mechanism is a new source of gain from trade.

Literature

- Holmes and Stevens (2014): US firms that offer customized products fared better during China's export expansion. Brandt, Thun (2010, 2016) increased market segmentation in China. Porter (2008)
- Theories
  - Aghion, Griffith (2005), Aghion, Bloom, Blundell, Griffith, Howitt (2015), Akcigit, Ates, Impullitti (2018): competition comes from below
  - Agency issues within firms: Holmes, Schmitz (2010, survey) Chen, Steinwender (2019), Caliendo, Rossi-Hansberg (2012)
  - Perla, Tonetti, Waugh (2021) expected exporting profits
- Variable markup & trade: Bernard, Eaton, Jensen, Kortum (2003), Melitz, Ottaviano (2008), Eaton, Kortum, Sotelo (2012), Edmond, Midrigan, Xu (2015) Gaubert, Itskhoki (2021)
- Trade liberalization & productivity in China: Yu (2014), blueBrandt, Van Biesebroeck, Wang, Zhang (2017)
- Trade, new goods, skill: Goldberg, Pavcnik (2004, 2007), Verhoogen (2008), Goldberg, Khandelwal, Pavcnik, Topalova (2010)
- Welfare: Dixit, Stiglitz (1977), Dhingra, Morrow (2018)

The Data

The data

- Annual survey by the Chinese National Bureau
  - All SOE's
  - non-SOE's with revenue greater than 5MI yuan ($\approx 0.8 MIUS\$$)
  - years 1998-2007
  - Four-digit sectors
- We keep only manufacturing
- We drop multinationals and SOE's in most specifications
- Unbalanced panel of about 1MI observations

Empirical specification

$$y_{it} = \beta_1 \log \text{Output Tariff}_{j(i,t)t} + \gamma_1 X_{j(i,t)t} + \gamma_2 X_{i,t} + \alpha_i + \alpha_t + \varepsilon$$

- Firm i, time t, sector of firm i at time t is $j(i,t)$
- y: TFP, new goods, sectoral skill-intensity
- Output Tariff$_{jt}$: China imposes on sector j at time t
- Tariff IV: Initial tariffs in the firm's initial sector interacted with a post-2001 dummy (BVWZ)
- Controls: Tariffs in the sectors upstream and downstream from the firm's own; state ownership; foreign ownership upstream, downstream and in own sector; export share of sector, industrial policies at the firm-time level

dependent variable	coefficient on output tariffs	standard error	number of observations	specification
Revenue TFP, Olley-Pakes	-0.0304***	0.0027	1,037,738	OLS, all firms
Revenue TFP, FE	-0.0322***	0.0028	1,037,738	OLS, all firms
new product share	-0.000356	0.0012	1,037,738	OLS, all firms
0-1 dummy for new product	-0.000687	0.0029	1,037,738	OLS, all firms
sector rank of skill intensity	-17.82***	1.00	1,037,738	OLS, all firms
Revenue TFP, Olley-Pakes	-0.0505***	0.0169	1,037,738	IV, all firms
Revenue TFP, FE	-0.0477***	0.0184	1,037,738	IV, all firms
new product share	-0.0157**	0.0068	1,037,738	IV, all firms
0-1 dummy for new product	-0.0405**	0.0168	1,037,738	IV, all firms
sector rank of skill intensity	-26.20***	3.81	1,037,738	IV, all firms
Revenue TFP, Olley-Pakes	-0.0617***	0.016	826,072	IV, non-exporters
Revenue TFP, FE	-0.0580***	0.017	826,072	IV, non-exporters
new product share	-0.00976**	0.0045	826,072	IV, non-exporters
0-1 dummy for new product	-0.0279***	0.010	826,072	IV, non-exporters
sector rank of skill intensity	-19.27***	3.14	826,072	IV, non-exporters

Magnitude of coefficients

One standard deviation in the log of tariffs, about 0.5, is associated with:

- 2.5% increase in TFP (0.5×0.5)
- 2 pp increase in the probability of adding a new product
- Movement up the sectoral rank by 13 sectors
  - There are 450 sectors. The lowest rank is the production of packaging and bags. The highest rank is a subsector of aircraft manufacturing.
  - Common sectoral switches include:
    - from cotton and chemical fibers (1761) to textile and garments manufacturing (1810)
    - from steel rolling processing (3230) to the manufacture of metal structures (3411)
    - from non-ferrous rolling process (3351) to optical fiber and cable manufacturing (3931).

Summary of Empirical Findings

- Tariff reductions are associated with within firms
  - increases TFP
  - switches to skill-intensive sectors
  - introduction of new products
- Increases in TFP are larger for small firms.
- The effects of tariffs contradict standard trade theories of innovation and variable markups.
- Some features of new model:
  - Variable markups $\longleftrightarrow$ TFP
  - Differentiation $\longleftrightarrow$ new goods (counterfactual trade lib.)
  - No skills

A Simplified Model

Environment

- Two symmetric countries: Home, Foreign
- Households endowment of labor is $\overline{H}$
- They supply it inelastically to a perfect labor market, with $w = 1$
- Households have nested CES preferences.
- An exogenous set of heterogeneous firms, each with its own variety.

Timing

- Each firm observes its productivity z.
- It makes its discrete choice (below).
- Nature aggregates these choices and allocates them into nests.
- Firms observe their nests, set prices and quantities.
- Firms produce and sell. Payoffs are realized.

Discrete choices

- Each firm chooses among three options:
  - Exit (E)
  - Less-Differentiation (L)
  - Differentiation (D)
- Firms that exit get zero profits.
- If the firm chooses $d \in \{L, D\}$ then it pays a fixed cost f_d units of Home labor to produce.
- Its variable cost is $1/z$.
- Foreign firms pay an iceberg cost τ to sell in Home. Its productivity is z^*, and $z = z^*/\tau$ is productivity adjusted for trade costs.

Nature

- Firms' discrete choices give rise to measures of firms M_L and M_D.
- Differentiated firms get their own nests.
- The number of varieties per less-differentiated nest follows a Poisson distribution with parameter λ_L.
- The measure of L nests is exogenous $\mathcal{M}_L$ and $\lambda_L = M_L / \mathcal{M}_L$

$\Rightarrow$ Entry tightens competition in less-differentiated nests, and leads to the creation of new differentiated nests.

Nested CES Demand

- Notation: $i \in n$ indicates that firm i is in nest n.
- The demand for a variety with price p in nest n is

$$q(p, n) = \overline{P}^{\eta-1} P_n^{\sigma-\eta} p^{-\sigma} y$$

- where

$$P_n = \left[\sum_{i \in n} p_i^{1-\sigma} \right]^{\frac{1}{1-\sigma}}$$

$$\overline{P} = \left[\int_{\mathcal{M}} P_n^{1-\eta} dn \right]^{\frac{1}{1-\eta}}$$

- y is total spending, p_i is the price of variety i and $\mathcal{M} = \mathcal{M}_L \cup \mathcal{M}_D$
- Assume $\sigma > \eta > 1$.

Cournot equilibrium

- A firm chooses quantity, given the quantities of other firms.
- Following Atkeson, Burstein (2008), its price is $p = \epsilon/[(\epsilon - 1)z]$:

$$\epsilon = \left[\frac{1}{\sigma}(1 - s) + \frac{1}{\eta}s\right]^{-1},$$

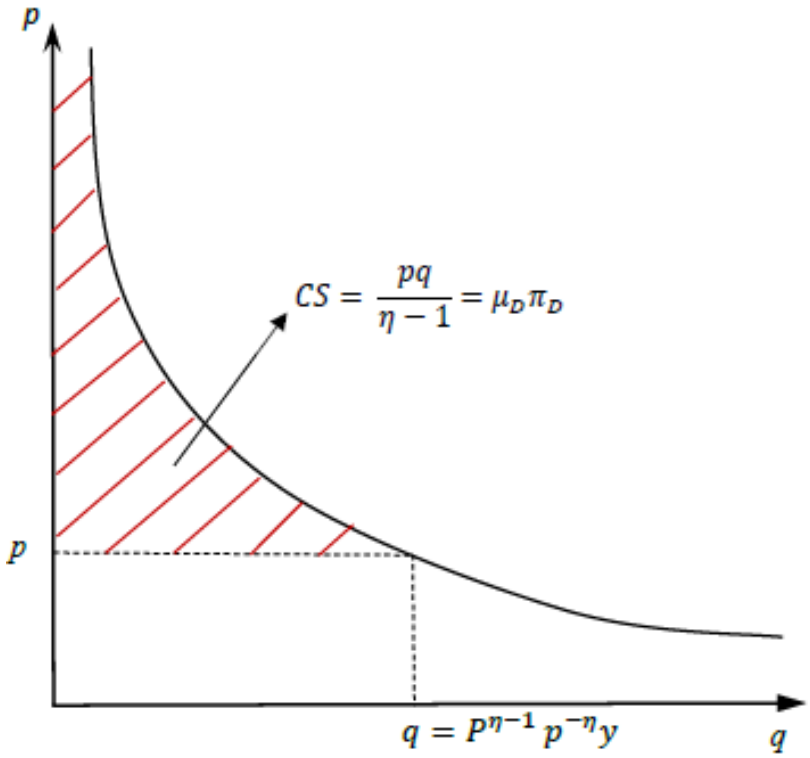
$$s = \left(\frac{p}{P_n}\right)^{1-\sigma}$$

- The vector of prices and profits and the nest price indices are all implicit functions of the vector of productivity.
- Differentiated firms have $\epsilon = \eta$ and profits $(z\overline{P}/\mu)^{\eta-1}y$ where $\mu = \eta/(\eta - 1)$

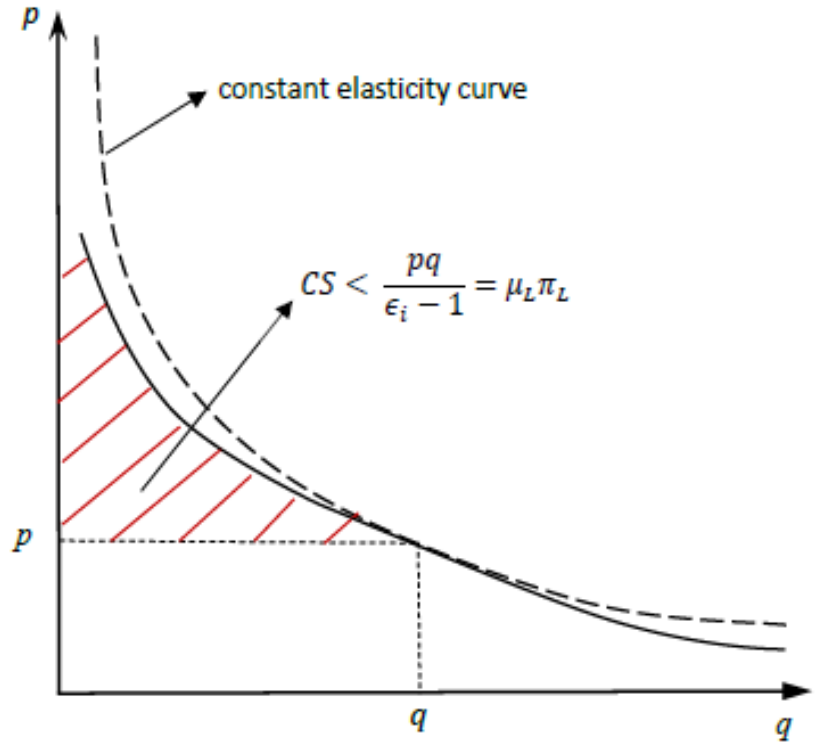
Equilibrium (in words)

- Given strategies, we can get
  - the distribution of productivities conditional on strategies
  - the distribution of firms into nests
  - expected profits conditional on choices L and D as functions of z_d
  - Aggregate variables $\overline{P}$, y
- An equilibrium is a set of strategies that maximize profits.
- An equilibrium exists under conditions similar to Melitz (2003).

Welfare



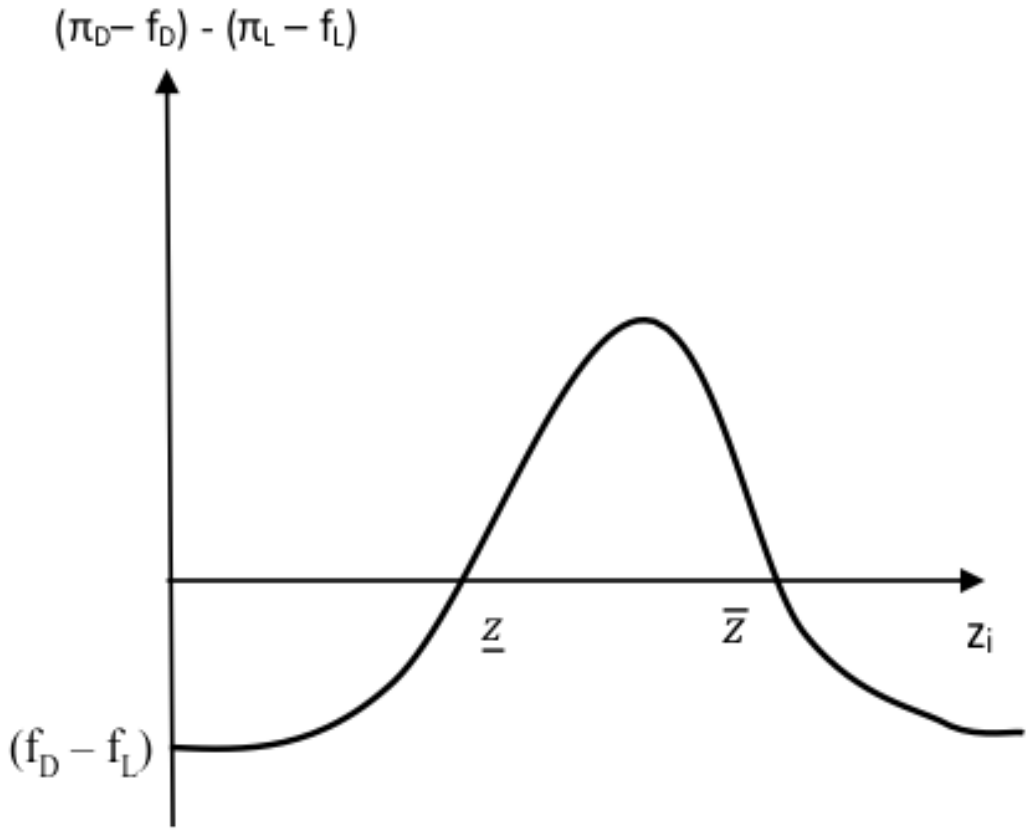
monopolist in nest



less-differentiated firm

The planner values differentiated firms more than the market.

Gains from trade & productivity



The gain from differentiation is $\cap$ shaped because very productive firms are almost monopolists in their nests.

Markup, Differentiation & Trade

- Trade has an ambiguous effect on differentiation:
  - It tightens competition in L nests $\Rightarrow \uparrow$ differentiation
  - It decreases the profit shifter $\overline{P}^{\eta-1}y \Rightarrow \downarrow$ differentiation if f_D is high
- Trade has an ambiguous effect on markups:
  - It decreases the markup of firms that stay in L
  - It increases the markup of firms that differentiate

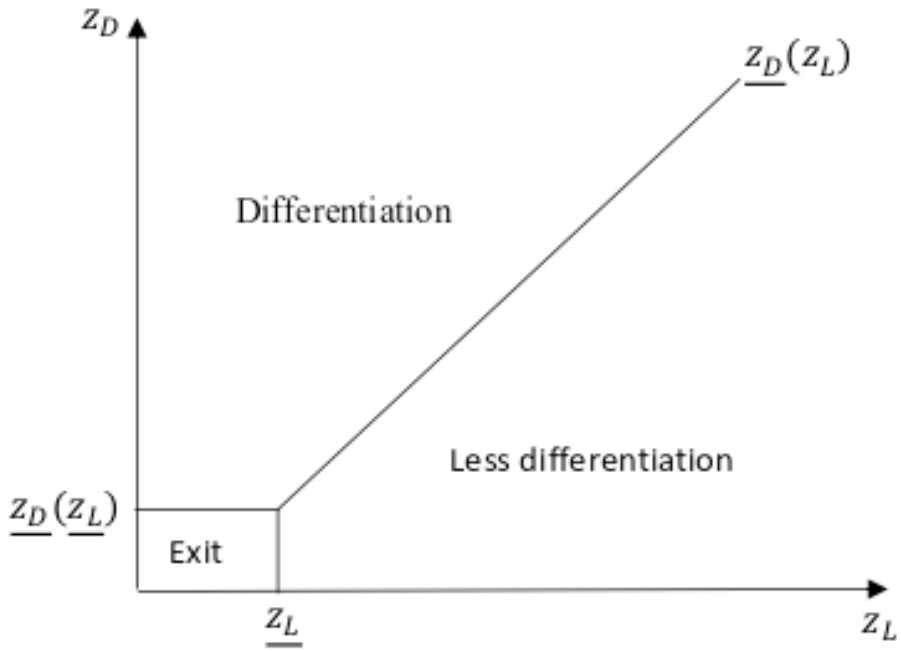
Markup, Differentiation & Trade

- Trade has an ambiguous effect on differentiation:
  - It tightens competition in L nests $\Rightarrow \uparrow$ differentiation
  - It decreases the profit shifter $\overline{P}^{\eta-1}y \Rightarrow \downarrow$ differentiation if f_D is high
- Trade has an ambiguous effect on markups:
  - It decreases the markup of firms that stay in L
  - It increases the markup of firms that differentiate
- Estimation: Does trade increase differentiation? Can it match the increases in TFP in the data? How large are the gains from trade relative to a model without the differentiation option?

Estimation

Quantitative Model

- In the quantitative model, firm i gets a productivity pair (z_{iL}, z_{iD})
- We match moments from the joint distribution of sales and TFP. In the data, many small firms have high TFP.
- Equilibrium strategy takes the following form:



Parametrization

- Normalize endowment so that $\overline{P}^{\eta-1} y = 1$.
- $(z_L, z_D) \sim$ bivariate log-normal with parameters $\nu_L = 0$, ν_D, v_L, v_D, and correlation $\rho = 0$
- Foreign firms have this same distribution adjusted for trade cost. Normalize the total mass of firms to 1 and the mass of Foreign firms to 0.14 to correspond to import penetration in 1998.
- Set $f_L = 0.006$ so that about 1% of firms exit
- We estimate 8 parameters: $\eta, \sigma, \nu_D, v_L, v_D, \lambda_L, \lambda_D, f_D$
- Method of simulated moments: 11 moments from 1998 cross section on the joint distribution of sales and revenue TFP (log markup in model)
- Simulation: 1.3 MI firm outcomes in nests of sizes 1, ..., 4

Parameter Estimates

Parameter description		estimate	std. error
elasticity of substitution between nests	η	1.59	0.01
elasticity of substitution varieties within nests	σ	8.76	0.20
mean log z_D	ν_D	-1.87	0.04
variance log z_L	v_L	0.18	0.01
variance log z_D	v_D	0.20	0.028
Poisson par. # of firms in L nests	λ_L	12.91	0.35
Poisson par. # of firms in D nests	λ_D	7.53	0.32
Fixed costs of choice D	f_D	0.0058	0.0002

- η, σ in line with previous calibrations of AB model and with estimates of elasticity of demand
- Avg. number of firms is 3.5 for L nests and 3.1 for D nests
- Differentiated firms are smaller (as in Holmes and Stevens 2014)

Model Fit

	data	model	model with only L firms
Distribution of log sales			
std deviation	1.22	1.24	0.32
90/10 ratio	2.97	2.96	1.01
Distribution of revenue TFP			
10^{th} percentile	-0.28	-0.21	-0.20
25^{th} percentile	-0.14	-0.16	-0.20
50^{th} percentile	-0.003	-0.05	-0.11
75^{th} percentile	0.14	0.10	0.07
90^{th} percentile	0.29	0.27	0.29
Mean R-TFP by quartile of sales			
Q1	-0.20	-0.19	-0.17
Q2	-0.05	-0.06	-0.14
Q3	0.05	0.04	-0.09
Q4 (largest)	0.20	0.21	0.41

The identification of D firms relative to L is similar to latent types in labor.

Counterfactual: ↑ imports from 14% to 28%

	data (1)	no differentiation (2)	few firms at margin (3)	small firms at margin of diff. (4)	more firms at margin of diff. (5)
		$z_{iL} = 0$			
correlation $\log z_{iL}$, $\log z_{iD}$		or $z_{iD} = 0$	0	0.63	0.86
Panel A: Changes TFP (data) and in log markups (model), surviving firms					
mean	0.032	-0.042	-0.014	0.015	0.010
by initial quartile of sales ↓					
1	0.021	-0.005	0.007	0.016	0.005
2	0.018	-0.018	0.003	0.022	0.011
3	0.006	-0.041	-0.005	0.028	0.026
4	0.008	-0.094	-0.058	-0.007	-0.001
Panel B: Introduction of new goods (data) and shifts from L to D (model)					
mean	0.026	-	0.074	0.143	0.131
by initial quartile of sales ↓					
1	0.033	-	0.156	0.236	0.210
2	0.022	-	0.077	0.182	0.136
3	0.019	-	0.046	0.121	0.105
4	0.017	-	0.016	0.032	0.073
Panel C:					
exit	0.041	0.066	0.029	0.000	0.000
welfare: $(y_1/\overline{P}_1) \times (\overline{P}_0/y_0) - 1$		0.084	0.144	0.205	0.205
Aggregate markup: μ_1 - μ_0		-0.043	-0.025	-0.001	0.005

Conclusion

- During the Chinese WTO accession, tariff cuts are associated with increases in TFP and innovation, as measured by introduction of new goods, and shifts to more skill-intensive activities.
- We have proposed a model that allows firms to escape import competition by moving to new market segments with fewer competitors.
- A counterfactual trade liberalization in the model can quantitatively account for the introduction of new goods in the data and predicts decreases in TFP that are much smaller than the alternative model with no innovation.

TFP-R

- For TFP, we estimate separately for each two-digit sector:

$$\log X_{it} = \alpha_{0j(i,t)} + \alpha_{Lj(i,t)} \log L_{it} + \alpha_{Mj(i,t)} \log M_{it} + \alpha_{Kj(i,t)} \log K_{it} + \mu_{it}$$

- X is revenue, L is labor, K is value of capital, M is spending material inputs, and α_{0j}, α_{Lj}, α_{Kj} and α_{Mj} are sector-specific parameters.
- We estimate α's following Olley-Pakes (1996), with OLS and time fixed effects, and following Ackerberg et al (2015)
- The estimated TFP_{it} is the predicted value of

$$\log X_{it} - \hat{\alpha}_{Lj(i,t)} \log L_{it} - \hat{\alpha}_{Mj(i,t)} \log M_{it} - \hat{\alpha}_{Kj(i,t)} \log K_{it}$$

main