The Mutable Geography of Firms' International Trade: Evidence and Macroeconomic Implications

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FIND, Aarhus

Introduction

- International trade is dominated by firms selling to multiple destinations
  - → e.g., multi-destination exporters account for 75% transactions and 95% trade values of China's exports.

- Conventional wisdom: stable market structure
  - → i.e., once a firm starts exporting to a market, it keeps selling there

- Empirically: the set of destinations changes frequently for a multi-destination exporter:

Trade Pattern of a Chinese Exporter (ID 3107930188)
Selling T-shirts (HS 61091000)

2003	Australia	South Korea	Japan		
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2005	Australia		Japan	Germany	
2006	Australia			Germany	Belgium Canada

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2005	Australia		Japan	Germany		
2006	Australia			Germany	Belgium	Canada

Questions

[Micro:] What are the drivers of these **within**-**firm** changes in trade patterns? How are these market changes related to firms' price and quantity adjustments across markets?

[Macro:] Are these market changes important for aggregate fluctuations and welfare?
- → How do these market changes affect the global transmission of shocks?
- → How do they impact our analysis of recent bilateral events?
  e.g., US-China trade war

This Paper

1. **[Empirical] new facts** on firm (and firm-product) level market changes based on two customs databases (China 2000-2006 and UK 2010-2016). These within-firm market changes:
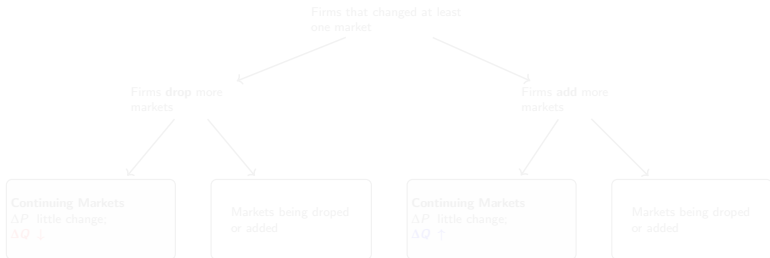
   (i) involve substantial market switching

   $\rightarrow$ 30-40% involves simultaneously adding **and** dropping markets

   (ii) are endogenous to changes in (relative) local market conditions

   $\rightarrow$ exchange rates and local CPIs explain 20% of variation

   (iii) suggest systematic changes in demand conditions in all markets

   $\rightarrow$ more markets are dropped (**than** added) $\Rightarrow$ big drop in quantity but little change in price in those unchanged (continuing) markets

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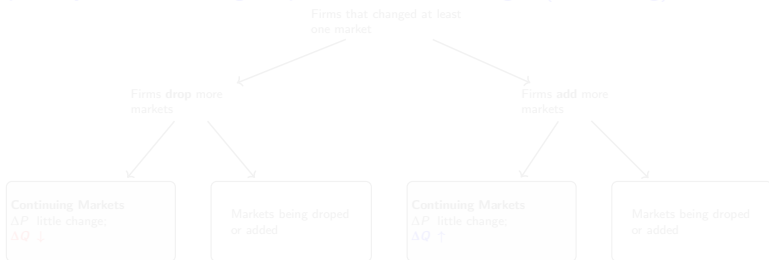
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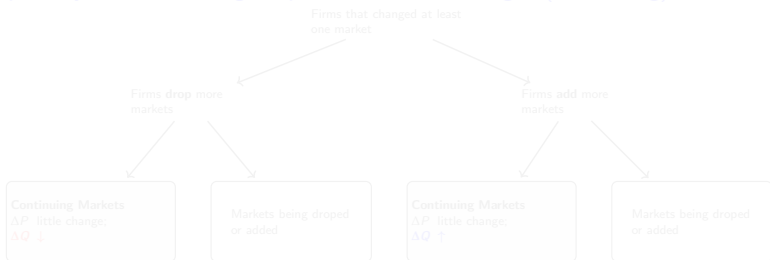
Firms that changed at least one market

Firms **drop** more markets

Firms **add** more markets

Continuing Markets
ΔP little change
ΔQ ↓

Markets being dropped or added

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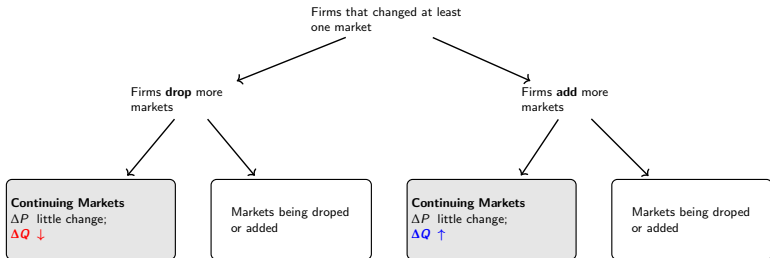**❶ [Empirical] new facts** on firm (and firm-product) level market changes based on two customs databases (China 2000-2006 and UK 2010-2016). These within-firm market changes:

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❷ [A multi-country model] to quantify the sources of these market changes and their aggregate impacts:

  [Key elements] variable markups + variable markets

  [Impact] on shock transmission in a bilateral trade war scenario
  $\rightarrow$ the aggregate productivity increases more (10%) for the third country with endogenous market choices

Application: Bilateral Trade War (C-A)
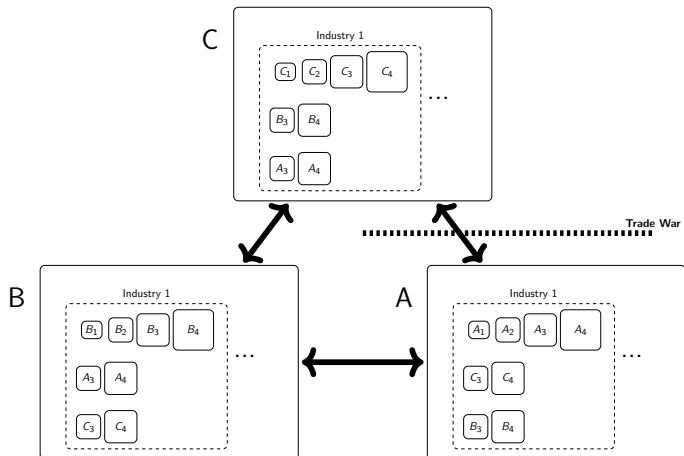
- Three countries (A, B, and C); a continuum of industries in each country
- Within each industry, there is a limited number of domestic and foreign firms competing with each other

Application: Bilateral Trade War (C-A)
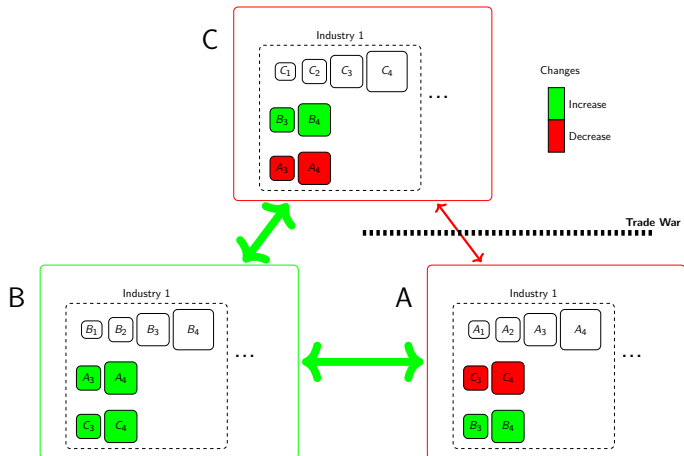
- Aggregate productivities of warring countries A and C decrease
- Aggregate productivity of the third country B increases

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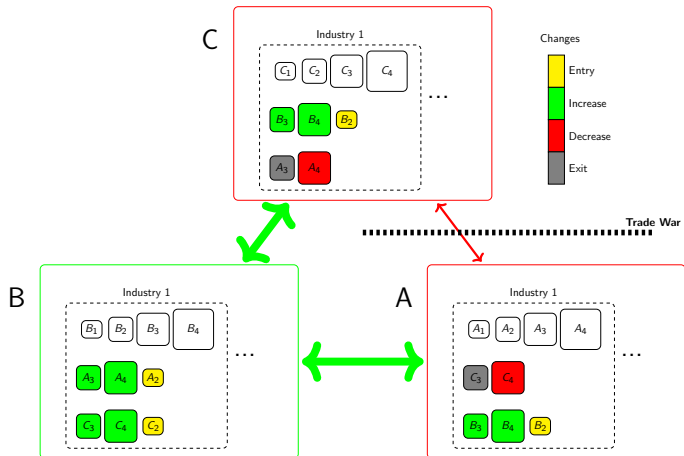
The effects of endogenous market choices (in relative terms):

  (i) the aggregate productivities of A and C fall by more (-1%)

  (ii) the aggregate productivity of B increases by more (10%)

Contribution to the Literature

❶ Pricing-to-market and international shock transmissions:

e.g., Dornbush (1987); Corsetti and Dedola (2005); Atkeson and Burstein (2008); Amiti, Itskhoki and Konings (2012, 2018), Chatterjee, Dix-Carneiro and Vichyanond (2013); Fitzgerald and Haller (2014, 2018); Auer and Schoenle (2016); Corsetti, Crowley, Han and Song (WP2019)

This paper → firms actively adjust their set of destination markets due to large fluctuations in destination-specific residual demand

❷ Margins of trade and export dynamics:

e.g., Eaton, Kortum and Kramarz (2004); Chaney (2008, 2014); Bernard, Redding and Schott (2010); Albornoz, Pardo, Corcos, and Ornelas (2012); Békés and Muraközy (2012); Fitzgerald, Haller and Yedid-Levi (2017); Ciliberto and Jäkel (2017); Ruhl and Willis (2018); Geishecker, Schröder and Sørensen (2019); Macedoni and Xu (2020);

→ new measures to quantify within-firm market changes:
(i) endogenous to local market conditions;
(ii) suggest systematic demand changes in all markets

❸ Trade, markups and welfare:

e.g., Edmond, Midrigan and Xu (2015); Feenstra and Weinstein (2017); Arkolakis, Costinot, Donaldson and Rodriguez-Clare (2018)

→ study the effect of market changes on competition and welfare in a multi-country framework

Roadmap

1 Empirical Results
  - $\rightarrow$ New measures of within-firm market changes
  - $\rightarrow$ Market changes and relative market conditions
  - $\rightarrow$ Market changes and intensive margin adjustments in continuing markets

2 Multi-country General Equilibrium Model
  - $\rightarrow$ Featuring variable markups and variable markets

3 Aggregate Implications
  - $\rightarrow$ Application: bilateral "trade war"

4 Conclusions

Measures of Variable Markets

Consider a firm selling a product to countries A, B, C, D over 4 time periods:

					Trade Pattern	Activity	M. Changes/ Markets	Drops/ Changes
$t = 1$	A	B			A-B	–	–	–
$t = 2$	A		C		A-C	Churn	2/2	1/2
$t = 3$	A		C	D	A-C-D	Add	1/3	0/1
$t = 4$	A		C		A-C	Drop	1/2	1/1

Note: Add $\Leftrightarrow$ drops/changes $= 0$;   Churn $\Leftrightarrow$ $0 <$ drops/change < 1;   Drop $\Leftrightarrow$ drops/change $= 1$

Corresponding value measures:

$$\text{Market Changes/Markets in period 2} \ = \frac{V_{B,1} + V_{C,2}}{V_{A,2} + V_{C,2}}$$

$$\text{Drops/Changes in period 2} \ = \frac{V_{B,1}}{V_{B,1} + V_{C,2}}$$

e.g. $V_{B,1}$ refers to the trade value at firm-product level to country B in period 1.

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Data

1. Chinese Customs Data, 2000-2006

	Products (HS8)	Exporters	Observations	Value (billion US$)
All	7,620	183,993	18,676,554	2,917

2. UK Customs Data, 2010-2016 (HMRC administrative datasets)

	Products (CN8)	Exporters	Observations	Value (billion £)
All	10,457	165,798	16,357,110	1,987
Non-EU	10,032	159,328	6,772,946	990
EU*	10,249	35,751	9,584,164	997

- An observation is a firm-product-destination-year quartet.

Note: * UK-EU transactions are available only for firms whose trade value exceeds £250,000 in a given calendar year; these firms account for 96-98% of total trade values.

Within-Firm Market Changes

A typical exporter changes more than half of its markets on a year-to-year basis

Markets Changes/ Markets (Count Measure, Median)

	All Firms	Large Firms
Chinese Exporters, 2000-2006		
Firm-product (8-digit) level	0.70	0.67
Firm-industry (2-digit) level	0.60	0.52
Firm level	0.57	0.50
British Exporters, 2010-2016		
Firm-product (8-digit) level	0.50	0.50
Firm-industry (2-digit) level	0.50	0.40
Firm level	0.62	0.38

Value Measure   Breakdown by Firm and Product Types   Deviation from Common Trade Pattern

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Drop-to-Change Ratio and Market Churning

Statistics from Firm-product Level Trade Patterns (Median)

	All Firms	Large Firms
Chinese Exporters, 2000-2006		
Markets Drop/ Market Changes (Count Measure)	0.50	0.50
Markets Drop/ Market Changes (Value Measure)	0.41	0.35
Probability of Churn	0.26	0.33
British Exporters, 2010-2016		
Markets Drop/ Market Changes (Count Measure)	0.50	0.50
Markets Drop/ Market Changes (Value Measure)	0.48	0.46
Probability of Churn	0.32	0.45

- Drop-to-change (DC) ratio is a directional measure of market changes
  - → Market adds and drops can be analysed jointly

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   - → New measures of within-firm market changes
   - → **Market changes and relative market conditions**
   - → **Market changes and intensive margin adjustments in continuing markets**

Market Changes and Local Market Conditions

Constructing firm(-product) level measures of changes in local market conditions (focusing on those changed markets)

					Continuing Markets	Changed Markets	Changes in Relative Exchange Rates
$t = 1$	A	B			–	–	–
$t = 2$	A		C		A	B, C	$log(e_{C,2}/e_{C,1}) - log(e_{B,2}/e_{B,1})$
$t = 3$	A		C	D	A, C	D	$log(e_{D,3}/e_{D,2})$
$t = 4$	A		C		A, C	D	$-log(e_{D,4}/e_{D,3})$

Note: Circled cells mark the variation used to construct relative exchange rates.

Regressing drop-to-change (DC) ratio on the constructed measures

$$DC_{f,i,t} = \beta_e \tilde{e}_{f,i,t} + \beta_P \tilde{P}_{f,i,t} + \delta_{f,i} + \delta_t + \epsilon_{f,i,t}$$

where $DC_{f,i,t}$ is drop-to-change ratio; $\tilde{e}_{f,i,t}$ is relative exchange rates; $\tilde{P}_{f,i,t}$ is relative local CPI rate; $\delta_{f,i}$ and δ_t are firm-product and time fixed effects respectively. $f, i, t =$ firm, product, time.

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$t = 2$	A	$\square$	$\boxed{C}$	$\square$	A	B, C	$log(e_{C,2}/e_{C,1}) - log(e_{B,2}/e_{B,1})$
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Market Changes and Local Market Conditions

Regressing drop-to-change (DC) ratio on changes in local market conditions
(results from Chinese exporters, 2000-2006)

	Exchange Rate	Destination CPI	Within R^2	Observations
Count Measure				
Firm-product (8-digit) level	-0.22***	-0.81***	0.23	1,791,353
Firm-industry (2-digit) level	-0.14***	-0.59***	0.21	875,096
Firm level	-0.12***	-0.45***	0.20	301,455
Trade Value Measure				
Firm-product (8-digit) level	-0.21***	-0.83***	0.17	1,791,353
Firm-industry (2-digit) level	-0.14***	-0.61***	0.16	875,095
Firm level	-0.11***	-0.46***	0.16	301,455

Data source: Chinese Customs Database, 2000-2006
Note: The statistical significance is calculated based on robust standard errors with ***, **, * representing statistical significance at 1%, 5%, 10% respectively. Firm-product and year fixed effects are added for firm-product and firm-industry specifications. Firm and year fixed effects are added for firm level specifications.

UK Results

Market Changes, Prices and Quantities

How are firms' price and quantity changes in those continuing markets related to their drop-to-change ratio?

					Changes in the Unit Value of Continuing Markets	Drops/Changes
$t = 1$	A	B			.	.
$t = 2$	A		C		$p_{A,2} - p_{A,1}$	1/2
$t = 3$	A		C	D	$p_{AC,3} - p_{AC,2}$	0/1
$t = 4$	A		C		$p_{AC,4} - p_{AC,3}$	1/1

Constructing Price Changes for Continuing Markets

Price and Quantity Changes in Continuing Markets

Price and Quantity Elasticities to Drop-Change Ratio in Continuing Markets

	Unit Value	Mean Quantity	Observations
Chinese Exporters, 2000-2006			
Firm-product level	0.01***[†]	-0.65***	1,244,580
Firm-industry level	0.03***[†]	-0.73***	731,199
Firm level	0.05***[†]	-0.73***	281,564
British Exporters, 2010-2016			
Firm-product level	0.00[†]	-0.51***	1,149,821
Firm-industry level	0.01**[†]	-0.39***	488,877
Firm level	0.02*[†]	-0.25***	230,634

Note: Each cell represents an estimate from a separate estimation equation.
[†] indicates the significance of the estimate is sensitive to alternative samples.
Firm(-product/industry) and year fixed effects are included. `Results for All Markets`

- Little change in price but large drop in quantity

  ⇒ **firms dropping more markets also reduce sales in continuing markets because of common negative demand shocks.**

Roadmap

① Empirical Results
- $\rightarrow$ New measures of within-firm market changes
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② **Multi-country General Equilibrium Model**
- $\rightarrow$ **Featuring variable markups and variable markets**

③ Aggregate Implications
- $\rightarrow$ Application: bilateral "trade war"

④ Conclusions

A Multi-country General Equilibrium Model with Variable Markups and Variable Markets

Key Elements:

1. **Variable Markets**
   - $H > 2$ countries in the world
   - Firms making entry decisions for each country separately in each period

2. **Variable Markups**
   - demand competition by local and international producers of substitutable goods (Atkeson and Burstein 2008; Midrigan, Edmond and Xu 2015)
   - local cost component: the need for local production and retail distribution (e.g., Corsetti and Dedola 2005)

Production of Final and Intermediate Goods

Final consumption and the price of final good are:

$$C_{d,t} \equiv \left[\int_0^1 (C_{i,d,t})^{\frac{\eta-1}{\eta}} di \right]^{\frac{\eta}{\eta-1}}, \quad P_{d,t} \equiv \left[\int_0^1 (P_{i,d,t})^{1-\eta} di \right]^{\frac{1}{1-\eta}}$$

Industry level consumption and the price of intermediate good are:

$$C_{i,d,t} = \left[\sum_f \sum_o (\alpha_{f,i,o,d,t})^{\frac{1}{\rho}} (q_{f,i,o,d,t})^{\frac{\rho-1}{\rho}} \phi_{f,i,o,d,t} \right]^{\frac{\rho}{\rho-1}},$$

$$P_{i,d,t} = \left[\sum_f \sum_o \alpha_{f,i,o,d,t} (p_{f,i,o,d,t})^{1-\rho} \phi_{f,i,o,d,t} \right]^{\frac{1}{1-\rho}}$$

- subscripts: f firm, i industry, o origin, d destination, t time
- $1 < \eta$ (cross-industry elasticity of substitution) $< \rho$ (within-industry elasticity of substitution)
- α preference shifter
- q and p are firm-level price and quantity respectively
- $\phi_{f,i,o,d,t} \in \{0,1\}$ indicates whether firm f in industry i from origin o sells to destination d at t
- all prices denominated in the destination currency

Price and Export Decisions

Firms compete by simultaneously choosing:

❶ whether to enter a market, indicated by $\phi_{f,i,o,d,t}$

❷ and if enter, the price $p_{f,i,o,d,t}$ internalizing

    (i) impact on the industry level price index $P_{i,d,t}$ and

    (ii) the wedge $\chi_{f,i,o,d,t}$ between producer and consumer prices

$$\pi_{f,i,o,d,t} = \max_{p_{f,i,o,d,t},\phi_{f,i,o,d,t}} \left[q_{f,i,o,d,t}(\mu^b_{f,i,o,d,t} - 1)mc_{f,i,o,t} - W_{o,t}F_x \right] \phi_{f,i,o,d,t}$$

subject to

$$q_{f,i,o,d,t} = \alpha_{f,i,o,d,t} \left(\frac{p_{f,i,o,d,t}}{P_{i,d,t}} \right)^{-\rho} \left(\frac{P_{i,d,t}}{P_{d,t}} \right)^{-\eta} C_{d,t}$$

$$\mu^b_{f,i,o,d,t} = \frac{(p_{f,i,o,d,t} - \chi_{f,i,o,d,t})e_{o,d,t}}{\tau_{o,d} \, mc_{f,i,o,t}}$$

μ^b denotes producer's markup denominated in home currency

$mc_{f,i,o,t}$ marginal cost of firm f from industry i and origin o at time t

$e_{o,d,t}$ bilateral exchange rate; defined as units of currency o per unit of currency d at time t

$\tau_{o,d}$ bilateral trade cost (including tariff)

F_x fixed cost of export; $W_{o,t}$ nominal wage in origin o at time t

Variable Markets and Profit Heterogeneity

Probability of Market Change

$$= Pr(\pi_{k,i,o,d,t+1} < 0 \bigcap \pi_{k,i,o,d,t} > 0) + Pr(\pi_{k,i,o,d,t+1} > 0 \bigcap \pi_{k,i,o,d,t} < 0)$$

Drop to Change Ratio

$$= \frac{Pr(\pi_{k,i,o,d,t+1} < 0 \bigcap \pi_{k,i,o,d,t} > 0)}{Pr(\pi_{k,i,o,d,t+1} < 0 \bigcap \pi_{k,i,o,d,t} > 0) + Pr(\pi_{k,i,o,d,t+1} > 0 \bigcap \pi_{k,i,o,d,t} < 0)}$$

where

$$Pr(\pi_{k,i,o,d,t+1} < 0 \bigcap \pi_{k,i,o,d,t} > 0)$$
$$= Pr((1 + \hat{\pi}_{k,i,o,d,t})\pi_{k,i,o,d,t} < 0 | \pi_{k,i,o,d,t} > 0) Pr(\pi_{k,i,o,d,t} > 0)$$

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Drop to Change Ratio

$$= \frac{Pr(\pi_{k,i,o,d,t+1} < 0 \bigcap \pi_{k,i,o,d,t} > 0)}{Pr(\pi_{k,i,o,d,t+1} < 0 \bigcap \pi_{k,i,o,d,t} > 0) + Pr(\pi_{k,i,o,d,t+1} > 0 \bigcap \pi_{k,i,o,d,t} < 0)}$$

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$$= Pr((1 + \hat{\pi}_{k,i,o,d,t})\pi_{k,i,o,d,t} < 0 | \pi_{k,i,o,d,t} > 0) Pr(\pi_{k,i,o,d,t} > 0)$$

Variable Markets and Profit Heterogeneity

Probability of Market Change

$$= Pr(\pi_{k,i,o,d,t+1} < 0 \bigcap \pi_{k,i,o,d,t} > 0) + Pr(\pi_{k,i,o,d,t+1} > 0 \bigcap \pi_{k,i,o,d,t} < 0)$$

Drop to Change Ratio

$$= \frac{Pr(\pi_{k,i,o,d,t+1} < 0 \bigcap \pi_{k,i,o,d,t} > 0)}{Pr(\pi_{k,i,o,d,t+1} < 0 \bigcap \pi_{k,i,o,d,t} > 0) + Pr(\pi_{k,i,o,d,t+1} > 0 \bigcap \pi_{k,i,o,d,t} < 0)}$$

where

$$Pr(\pi_{k,i,o,d,t+1} < 0 \bigcap \pi_{k,i,o,d,t} > 0)$$
$$= Pr((1 + \widehat{\pi}_{k,i,o,d,t})\pi_{k,i,o,d,t} < 0 | \pi_{k,i,o,d,t} > 0) Pr(\pi_{k,i,o,d,t} > 0)$$

Variable Markets and Profit Heterogeneity II

Changes in potential profit $\widehat{\pi}^*_{k,i,o,d,t}$ is given by:

$$
\begin{aligned}
\widehat{\pi}^*_{k,i,o,d,t} \propto\ & \underbrace{\widehat{\alpha}_{k,i,o,d,t}}_{\text{taste}} - [\varepsilon_{k,i,o,d,t}(1 - dm_{k,i,o,d,t}) - 1]\underbrace{\widehat{mc}_{k,i,o,t}}_{\text{marginal cost}} \\
& - \varepsilon_{k,i,o,d,t} dm_{k,i,o,d,t} \underbrace{\widehat{\chi}_{k,i,o,d,t}}_{\text{retail cost}} \\
& - \frac{\rho - \eta}{\rho - 1} \underbrace{\widehat{CE}_{k,i,o,d,t}}_{\text{competitors' effect}} \\
& + \underbrace{\varepsilon_{k,i,o,d,t}(1 - dm_{k,i,o,d,t})\widehat{e}_{o,d,t} + \eta \widehat{P}_{d,t} + \widehat{C}_{d,t}}_{\text{local market conditions}}
\end{aligned}
$$

Channels of variable markups:

(Competition) $\varepsilon_{k,i,o,d,t} = \rho(1 - ms_{k,i,o,d,t}) + \eta\, ms_{k,i,o,d,t}$

(Local cost) $dm_{k,i,o,d,t} = \frac{\chi_{k,i,o,d,t}}{p^{border}_{k,i,o,d,t} + \chi_{k,i,o,d,t}}$

Competitors' Effect

$$\widehat{CE}_{k,i,o,d,t} \approx \underbrace{\sum_{o'}\sum_{f \neq k} \phi_{f,i,o',d,t+1}\phi_{f,i,o',d,t}ms_{f,i,o',d,t}(1-\rho)\widehat{p}_{f,i,o',d,t}}_{\text{impact of continuing firms}}$$

$$+ \underbrace{\sum_{o'}\sum_{f \neq k} \phi_{f,i,o',d,t+1}(1-\phi_{f,i,o',d,t})ms_{f,i,o',d,t+1}}_{\text{impact of entrants}}$$

$$- \underbrace{\sum_{o'}\sum_{f \neq k} (1-\phi_{f,i,o',d,t+1})\phi_{f,i,o',d,t}ms_{f,i,o',d,t}}_{\text{impact of exitors}}$$

where

$$\widehat{p}_{f,i,o',d,t} = (1-\omega_{f,i,o',d,t})(\widehat{mc}_{f,i,o',t} - \widehat{e}_{o',d,t})$$
$$+ \omega_{f,i,o',d,t}\widehat{\chi}_{f,i,o',d,t} + \kappa_{f,i,o',d,t}\widehat{ms}_{f,i,o',d,t}$$

$\omega(mc, \chi, e)$: cost share of local component

$\kappa(ms, \eta, \rho)$: price elasticity w.r.t. market share

Multilateral Competition Effect

Market Changes / Markets — plotted against Number of Countries

Median Profit of Exporters — plotted against Number of Countries
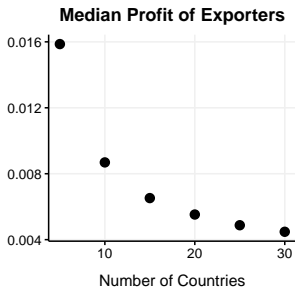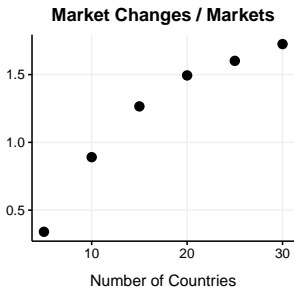
- Multilateral competition flattens the distribution of profits, making exporters more sensitive to shocks
- Entry and exit of foreign firms have a larger impact on others' residual demand

Equilibrium

Production:

$$mc_{f,i,o,t} = \frac{W_{o,t}}{\Omega_{f,i,o,t}}, \quad mc_{N,d,t} = \frac{W_{d,t}}{\Omega_{N,d,t}}$$

Goods market clearing:

$$C_{d,t} = Y_{d,t}$$

$$\sum_d q_{f,i,o,d,t} = \Omega_{f,i,o,t} l_{f,i,o,t}$$

$$q_{N,d,t} = \sum_i \sum_o \sum_f q_{f,i,o,d,t} \frac{\chi_{f,i,o,d,t}}{P_{N,d,t}} = \Omega_{N,d,t} L_{N,d,t}$$

Labor market clearing:

$$\sum_i \sum_f l_{f,i,o,t} + L_{N,o,t} + \sum_i \sum_{d \neq o} \sum_f \phi_{f,i,o,d,t} F_x + \sum_i \sum_f \phi_{f,i,o,o,t} F_h = L_{o,t} = 1$$

Balance of trade determines the bilateral exchange rates; for $o \neq d$,

$$\sum_i \sum_f (p_{f,i,d,o,t} - \chi_{f,i,o,d,t}) q_{f,i,d,o,t} = \sum_i \sum_f (p_{f,i,d,o,t} - \chi_{f,i,o,d,t}) q_{f,i,o,d,t} * e_{o,d,t}$$

Key Moments

Work in Progress

	Data	3-Country Model
Extensive margin		
Markets Changes / Markets (median)	0.60	0.94
Drop-to-Change Ratio (median)	0.50	0.50
Intensive margin		
Destination Specific Markup Elasticity[†]	0.07	0.14
Cross Market Supply Elasticity[†]	4.09	1.67
Linking intensive and extensive margins		
Price Elasticity to Drop-to-Change Ratio (All Markets)	0.15	0.19
Quantity Elasticity to Drop-to-Change Ratio (All Markets)	-2.49	-2.95

Calibrated based on Edmond, Midrigan and Xu (2015)
† Estimates from Corsetti, Crowley, Han, and Song (2019)

Calibration   Additional Model Moments   The Effect of Local Cost Component

Roadmap

1 Empirical Results
  → New measures of within-firm market changes
  → Market changes and relative market conditions
  → Market changes and intensive margin adjustments in continuing markets

2 Multi-country General Equilibrium Model
  → Featuring variable markups and variable markets

3 Aggregate Implications
  → **Application: bilateral "trade war"**

4 Conclusions

Application: Bilateral Trade War
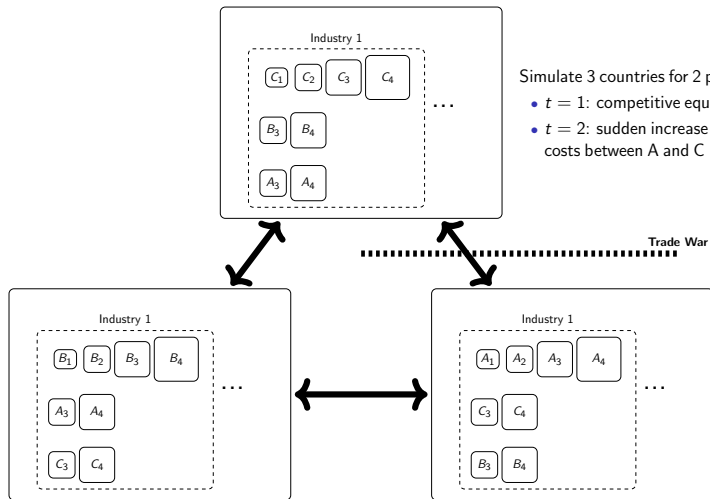
Simulate 3 countries for 2 periods:
- $t = 1$: competitive equilibrium
- $t = 2$: sudden increase in bilateral trade costs between A and C

Study percentage changes of variables from period 1 to 2, i.e., $\widehat{x} = \frac{x_2 - x_1}{x_1} * 100$

Trade War A-C: Extensive Margin

Trade destruction: Number of exporters from C to A decreases
Trade deflection: Number of exporters from C to B increases

Number of Exporters C to A
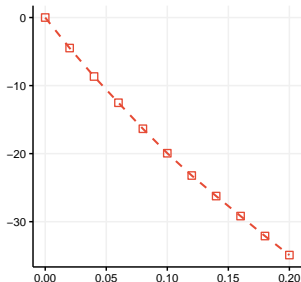
Increase in Bilateral Tariffs between A and C

Number of Exporters C to B
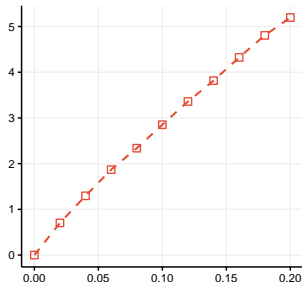
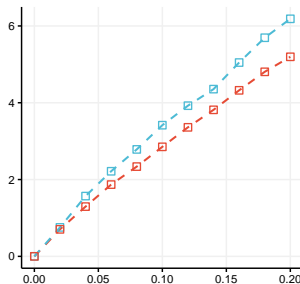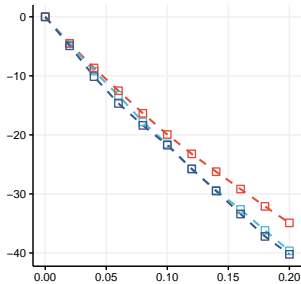Increase in Bilateral Tariffs between A and C

Trade War A-C: Trade Deflection

**In equilibrium, country B's currency appreciate,
making products from C (and A) cheaper in B.**

Bilateral Exchange Rates B to C
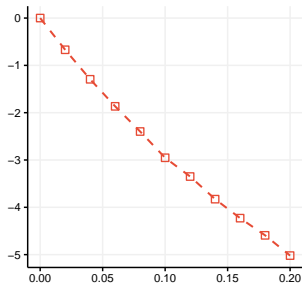
Increase in Bilateral Tariffs between A and C

Number of Exporters C to B
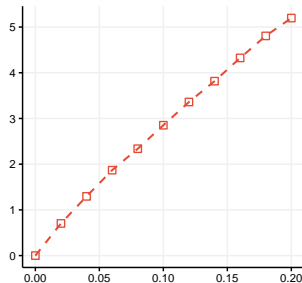
Increase in Bilateral Tariffs between A and C

Trade War A-C: Extensive Margin

The existence of local cost component reduces extensive margin responses

Number of Exporters C to A
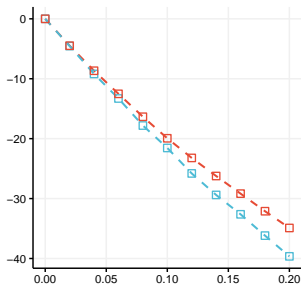
Increase in Bilateral Tariffs between A and C

Number of Exporters C to B

Increase in Bilateral Tariffs between A and C

Red: Variable Markups (Oligopolistic Competition + Local Cost Component)
Cyan: Variable Markups (Oligopolistic Competition Only)
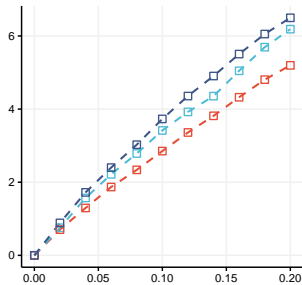
Trade War A-C: Extensive Margin

Comparing to the model with constant markups, incorporating oligopolistic competition slightly reduces the magnitude of extensive margin adjustments.

Number of Exporters C to A

Increase in Bilateral Tariffs between A and C

Number of Exporters C to B

Increase in Bilateral Tariffs between A and C

Red: Variable Markups (Oligopolistic Competition + Local Cost Component)
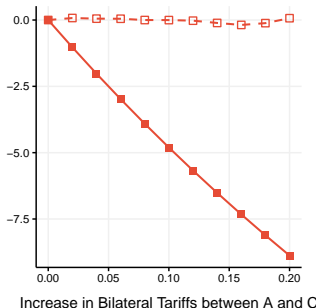Cyan: Variable Markups (Oligopolistic Competition Only)
Dark Blue: Constant Markups

Trade War A-C: Markups

The effect of market changes on markup distribution

Mean Markups of Exporters from Country C to A

Increase in Bilateral Tariffs between A and C

Allowing firms to reallocate brings in two additional effects:

(i) selection effect: only very productive firms exports to A
(these firms are larger and charge higher markups)

(ii) competition effect: different markup adjustments as

    (a) less competition due to exits of less productive exporters from C to A

    (b) more competition due to entrants of exporters from B to A

Empty Square: Variable Markets;
Solid Square: Fixed Markets (same set of firms in each market in both periods)
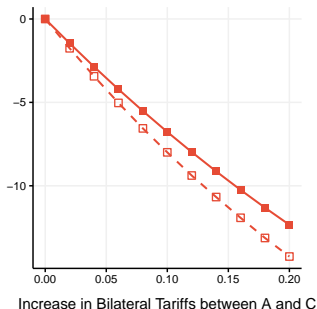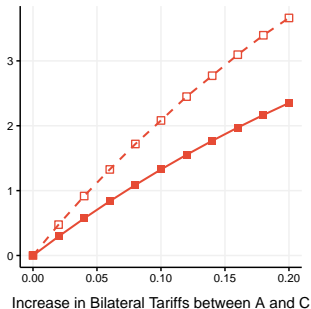Red: Variable Markups (Oligopolistic Competition + Local Cost Component)

Trade War A-C: Imports

The two warring countries import less;
The third country (B) imports more

Country C (or A): Changes in Import Share

Increase in Bilateral Tariffs between A and C

Country B: Changes in Import Share

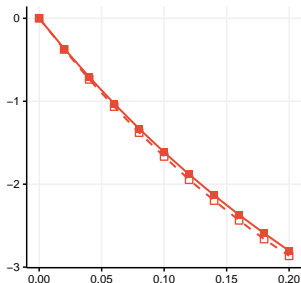Increase in Bilateral Tariffs between A and C

Empty Square: Variable Markets; **Solid Square: Fixed Markets**
Red: Variable Markups (Oligopolistic Competition + Local Cost Component)

Trade War A-C: Aggregate Productivity

Two Warring Countries C (or A)

The Third Country B

Increase in Bilateral Tariffs between A and C

Increase in Bilateral Tariffs between A and C

Percentage Differences in Responses between Fixed Markets and Variable Markets		
Model	Aggregate Productivity C (or A)	Aggregate Productivity B
Benchmark	1-2% more	10-13% more

Empty Square: Variable Markets; **Solid Square: Fixed Markets**
Red: Variable Markups (Oligopolistic Competition + Local Cost Component)

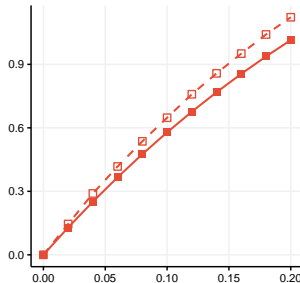# Trade War A-C: Aggregate Productivity

Two Warring Countries C (or A)

The Third Country B

Increase in Bilateral Tariffs between A and C

Increase in Bilateral Tariffs between A and C

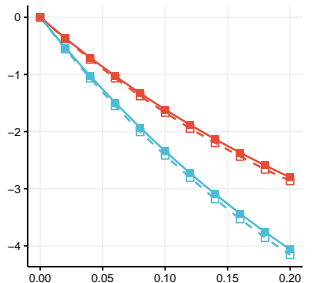| Percentage Differences in Responses between Fixed Markets and Variable Markets		
Model	Aggregate Productivity C (or A)	Aggregate Productivity B
Benchmark	1-2% more	10-13% more
No Local Cost	2-3% more	5-9% more

Empty Square: Variable Markets; **Solid Square: Fixed Markets**
Red: Variable Markups (Oligopolistic Competition + Local Cost Component)
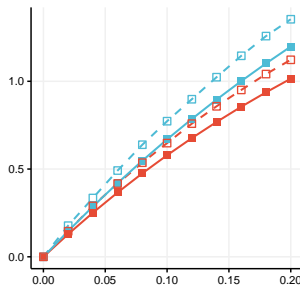Cyan: Variable Markups (Oligopolistic Competition Only)

Conclusions

- Empirically, I document **within-firm** market changes:
  - (i) involve substantial switching;
  - (ii) are endogenous to relative market conditions;
  - (iii) suggest systematic changes in demand conditions in all markets

- Theoretically, I build a multi-country GE model
  - $\rightarrow$ interdependence between variable markups and variable markets
  - $\rightarrow$ the third country benefits more from the bilateral trade war under variable markets

$\Rightarrow$ a step towards building a realistic multi-country framework that captures key features of intensive and extensive adjustments **across** markets

Within Firm Market Changes involve Non-trivial Trade Values

Markets Changes/ Markets (Value Measure, Median)

	All Firms	Large Firms
Chinese Exporters, 2000-2006		
Firm-product (8-digit) level	0.25	0.13
Firm-industry (2-digit) level	0.14	0.07
Firm level	0.09	0.05

Aggregate Level (Chinese Exporters)

	Sum of Sales of Those Changed Markets / Total Sales
Firm-product (8-digit) level	**0.19**
Firm-industry (2-digit) level	**0.12**
Firm level	**0.10**

Go Back

Breakdown by Firm and Product Types (Median, China Results)

	Market Changes / Markets	
	Count Measure	Value Measure
By Form of Commerce		
— General Trade	0.83	0.40
— Processing Trade	0.40	0.01
— Mixture	0.00	0.00
By Rauch Classification		
— Differentiated Products	0.75	0.29
— Reference Priced	0.50	0.10
— Organised Exchange	0.41	0.03
By Firm Ownership		
— State-owned Enterprises	1.00	0.47
— Private Enterprises	0.80	0.39
— Foreign Invested Enterprises	0.40	0.01

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Deviation from the Common Trade Pattern (CTP)
(Based on UK to Non-EU exports)

| | Mean | Median | Distribution (Percentile) | | | | Obs. |
			1st	25th	75th	99th	
8-digit level deviation from							
product-time CTP	1.34	1.50	0.00	0.67	2.00	2.00	2,118,190
firm-product CTP	0.70	0.00	0.00	0.00	1.25	4.00	2,118,190
2-digit level deviation from							
product-time CTP	1.28	1.33	0.00	0.80	2.00	2.00	795,062
firm-product CTP	0.67	0.24	0.00	0.00	1.00	4.00	795,062

Note: This table presents measures of deviations from the common trade pattern. Two deviation measures are constructed, the deviation from the product-time common trade pattern and the deviation from the firm-product common trade pattern. Note that the deviation is normalized by the number of markets traded to facilitate the comparison across firms. Statistics are calculated based on non-EU exports of British firms during 2010-2016. Source: Calculations based on HMRC administrative datasets.

China Results

DC Ratio to Changes in Relative Market Conditions
(Based on UK to Non-EU exports)

	Exchange Rate	Destination CPI	Within R^2	Observations
Count Measure				
Firm-product (8-digit) level	-0.12***	-1.06***	0.20	805,626
Firm-sector (2-digit) level	-0.11***	-0.97***	0.19	405,255
Firm-level	-0.09***	-0.92***	0.19	259,026
Value Measure				
Firm-product (8-digit) level	-0.12***	-1.07***	0.15	805,626
Firm-sector (2-digit) level	-0.10***	-0.99***	0.14	405,255
Firm level	-0.09***	-0.93***	0.14	259,026

Note: This table shows estimates from regressing drop-change ratio on augmented exchange rates and destination CPI measures. The upper panel shows results using non-weighted drop-change ratio as the dependent variable and the bottom panels shows results using trade-weighted drop-change ratio as the dependent variable. The subsections of the first column indicate the level of disaggregation at which the trade pattern measures are constructed. Firm-product and year fixed effects are added for firm-product and firm-sector specifications. Firm and year fixed effects are added for firm level specifications. The statistical significance is calculated based on robust standard errors with ***, **, * representing statistical significance at 1%, 5%, 10% respectively. Source: Calculations based on HMRC administrative datasets, non-EU exports, 2010-2016.

China Results

Long distance markets are more likely to be dropped

Mean Distance to Drop-Change Ratio (China Results)

	Mean Distance	Within R^2	Observations
Count Measure			
8-digit	-0.16***	0.01	1,791,353
2-digit	-0.13***	0.01	875,096
Firm-level	-0.20***	0.04	301,455
Trade Value Measure			
8-digit	-0.13***	0.01	1,791,353
2-digit	-0.13***	0.01	875,095
Firm-level	-0.15***	0.03	301,455

Go Back

Mean Distance to DC Ratio
(Based on UK to Non-EU exports)

	Mean Distance	Within R^2	Observations
<u>Count Measure</u>			
Firm-product (8-digit) level	-0.21***	0.01	805,626
Firm-sector (2-digit) level	-0.10***	0.00	405,255
Firm level	-0.20***	0.02	259,026
<u>Value Measure</u>			
Firm-product (8-digit) level	-0.16***	0.01	805,626
Firm-sector (2-digit) level	-0.11***	0.00	405,255
Firm level	-0.15***	0.01	259,026

Note: This table shows estimates from regressing changes in average distance of trading markets on the DC ratio. The upper panel shows results using non-weighted drop-change ratio as the dependent variable and the bottom panels shows results using trade weighted drop-change ratio as the dependent variable. The subsections of the first column indicate the level of disaggregation at which the trade pattern measures are constructed. Firm-product and year fixed effects are added for firm-product and firm-sector specifications. Firm and year fixed effects are added for firm level specifications. The statistical significance is calculated based on robust standard errors with ***, **, * representing statistical significance at 1%, 5%, 10% respectively. Source: Calculations based on HMRC administrative datasets, non-EU exports, 2010-2016.

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Price and Quantity Changes in All Markets

					Changes in Unit Value	**Drops/Changes**
$t = 1$	A	B			.	.
$t = 2$	A		C		$p_{AC,2} - p_{AB,1}$	$1/2$
$t = 3$	A		C	D	$p_{ACD,3} - p_{AC,2}$	$0/1$
$t = 4$	A		C		$p_{AC,4} - p_{ACD,3}$	$1/1$

Constructing Price Changes Based on **All** Markets

Price and Quantity Changes in All Markets

Price and Quantity Elasticities to Drop-Change Ratio

	Unit Value	Mean Quantity	Total Quantity	Observations
Chinese Exporters				
Firm-product level	0.08***	-0.52***	-2.49***	1,788,094
Firm-industry level	0.15***	-0.57***	-2.49***	873,994
Firm level	0.16***	-0.06***	-1.82***	314,537
British Exporters				
Firm-product level	0.07***	-0.38***	-2.04***	1,529,152
Firm-industry level	0.15***	-0.31***	-1.89***	596,355
Firm level	0.31***	-0.24***	-1.84***	280,362

Note: Each cell represents an estimate from a separate estimation equation.
Firm(-product/industry) and year fixed effects are included.

Conditional on a market change,

1. the price is higher if more markets are dropped;
   (⇒ **markets with a lower price are more likely to be dropped**)
2. less units being sold per market if more markets are dropped

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Measures Based on Deviation from the **Common Trade Pattern within Firm**

					Common Trade Pattern	Deviation	N. of Deviations/ Markets
$t = 1$	A	B			A-C	B $-C$	2/2
$t = 2$	A		C		A-C		0
$t = 3$	A		C	D	A-C	D	1/3
$t = 4$	A		C		A-C		0

Statistics Based on Chinese Exporters, 2000-2006:

			Distribution (Percentile)				
	Mean	Median	1st	25th	75th	99th	Obs.
8-digit level deviation from the CTP within firm	0.64	0.00	0.00	0.00	1.00	5.00	6,042,761
2-digit level deviation from the CTP within firm	0.71	0.00	0.00	0.00	1.00	7.00	1,927,599

UK Results　Back Firm Product Level　Back Firm Level

Measures Based on Deviation from the **Common Trade Pattern across Firms**

					Common Trade Pattern	Deviation	N. of Deviations/ Markets
$t=1$	A	B			A	B	1/2
$t=2$	A		C		A-C		0
$t=3$	A		C	D	A-C	D	1/3
$t=4$	A		C		A	C	1/2

Statistics Based on Chinese Exporters, 2000-2006:

	Mean	Median	Distribution (Percentile)				Obs.
			1st	25th	75th	99th	
8-digit level deviation from							
the CTP across firms	1.28	1.50	0.00	0.75	2.00	2.00	6,042,761
the CTP within firm	0.64	0.00	0.00	0.00	1.00	5.00	6,042,761
2-digit level deviation from							
the CTP across firms	1.23	1.25	0.00	0.83	2.00	2.00	1,927,599
the CTP within firm	0.71	0.00	0.00	0.00	1.00	7.00	1,927,599

UK Results   Back Firm Product Level   Back Firm Level

Markups and Quantities

markup:
$$\widehat{\mu}^{b*} = \frac{1}{1-dm} \left\{ \begin{array}{l} (1-\lambda)\kappa(1-ms)\widehat{\alpha} \\ -(1-\lambda)\kappa\widehat{CE} \\ +[(1-\lambda)\omega - dm]\widehat{\chi} \\ + [1 - (1-\lambda)(1-\omega) - dm]\,(\widehat{e} - \widehat{mc}) \end{array} \right\}$$

quantity:
$$\widehat{q} = \widehat{\alpha} - \varepsilon\widehat{p} - \frac{\rho - \eta}{\rho - 1}\widehat{CE} + \eta\widehat{P} + \widehat{C}$$

Subscripts are omitted for simplicity

$\lambda(ms, \rho, \eta)$ captures the degree of competition among firms

$\kappa(ms, \eta, \rho)$: price elasticity w.r.t. market share

$\omega(mc, \chi, e)$: cost share of distribution

dm: distribution margin

ρ: within industry elasticity of substitution

η: cross industry elasticity of substitution

Calibration

Parameter	Value
Varies to match moments	
Cross-industry elasticity of substitution, η	1.3
Within-industry elasticity of substitution, ρ	7.5
Fixed cost of export operations	0.2
Measure of local component, χ	2.0
Size of taste shocks μ_α ($\widehat{\alpha} \sim lognormal(-\mu_\alpha, 2\mu_\alpha)$)	0.5
Size of productivity shocks μ_Ω ($\widehat{\Omega} \sim lognormal(-\mu_\Omega, 2\mu_\Omega)$)	0.1
Fixed: taken from Edmond, Midrigan and Xu (2015) to match firm and sector distributions	
Pareto shape parameter, idiosyncratic productivity	4.58
Pareto shape parameter, sector productivity	0.51
Kendall correlation for Gumbel copula	0.94
Fixed cost of domestic operations	0.004
Tariff rate	0.129

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Additional Model Moments

	3 countries	2 countries	1 country
Fraction exporters (A to B)	0.169	0.194	-
Fraction exporters (A to C)	0.170	-	-
Firms of A: Home markup relative to B (median)	1.089	1.085	-
Firms of A: Home markup relative to C (median)	1.090	-	-
Exporters of A: Markup in B relative to C (median)	1.000	-	-
Firms of A: Home quantity relative to B (median)	1.289	1.355	-
Firms of A: Home quantity relative to C (median)	1.297	-	-
Exporters of A: Quantity in B relative to C (median)	1.000	-	-
Markup of domestic firms (median)	1.260	1.246	1.348
Markup of 1-country exporters (median)	2.375	2.307	-
Markup of 2-country exporters (median)	3.883	-	-
Distribution margin of domestic firms (median)	0.153	0.148	0.098
Exporters of A: Distribution margin in B (median)	0.596	0.568	-
Exporters of A: Distribution margin in C (median)	0.597	-	-

Go Back

Increasing in Local Cost Component

Market Changes / Markets

Local Cost Component

Market Changes / Markets (Value)

Local Cost Component

**Price Elasticity to DC Ratio**

Local Cost Component

**Quantity Elasticity to DC Ratio**

Local Cost Component
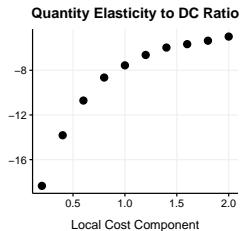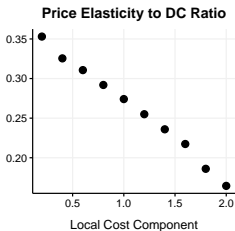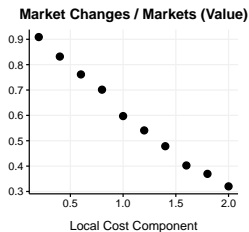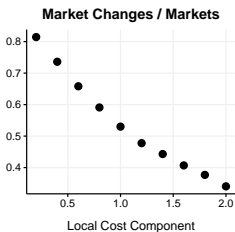
- The existence of local cost component reduces the magnitude of market changes but improves the fits of price and quantity elasticities

Local Component Helps to Match Intensive Margins

Destination Specific Markup Elasticity

Cross Market Supply Elasticity

Local Cost Component
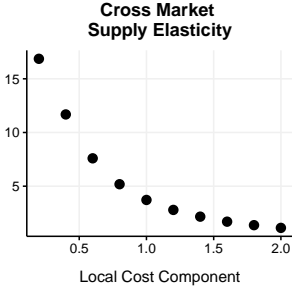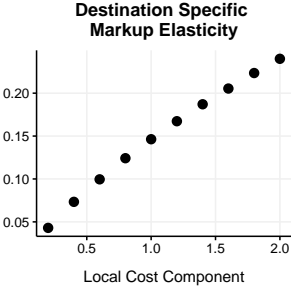
Go Back

Overview: Bilateral Trade War A-C
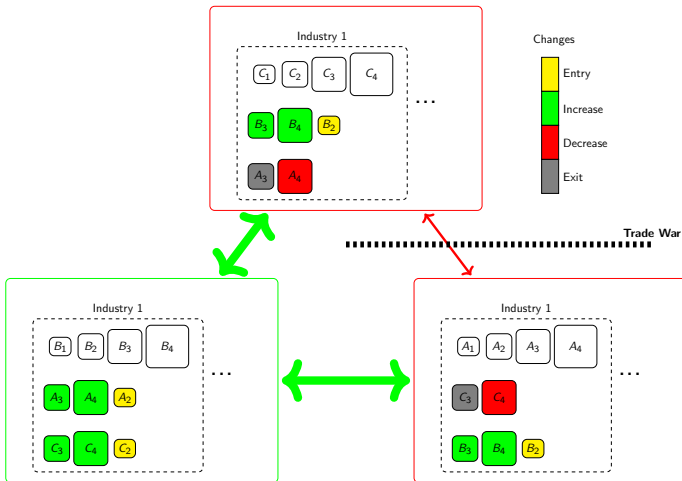
Next:
- The effects of oligopolistic competition and local cost component on market changes.
- The effects of market changes on the distribution of markups, imports and aggregate productivity.

Trade War A-C: Imports

Two versus Three-Country Models
Adding the third country significantly reduce the effect of the trade war

Country C: Changes in Import Share

Increase in Bilateral Tariffs between A and C
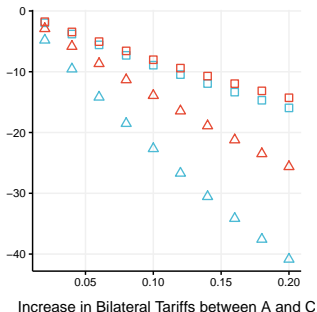
Empty Square: Three-Country Models (with Variable Markets);
Empty Triangle: Two-Country Models (with Variable Markets)
Red: Variable Markups (Oligopolistic Competition + Local Cost Component)
Cyan: Variable Markups (Oligopolistic Competition Only)

Trade War A-C: Quantity Responses

(i) Market changes reduce quantity responses
(ii) Markup adjustments further dampen quantity responses

Mean Markups of Exporters from Country C to A
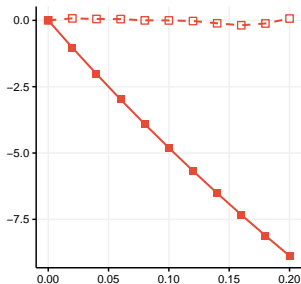
Mean Quantity of Exporters from Country C to A
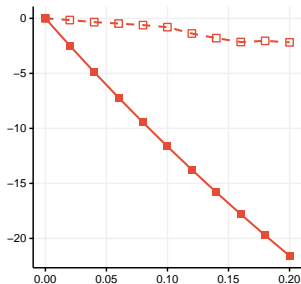
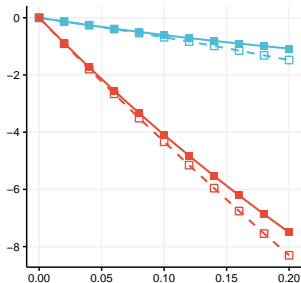**Empty Square: Variable Markets**; **Solid Square: Fixed Markets**
Red: Variable Markups (Oligopolistic Competition + Local Cost Component)

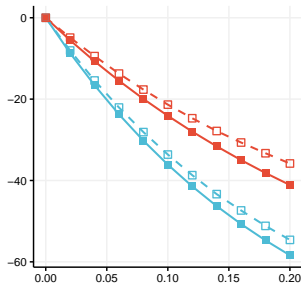# Trade War A-C: Relative Markups and Quantities

For exporters of C:

- Markup in A is relatively lower compared to B; the difference is larger with variable markets
- Relative quantity decreases in all models; the decrease is smaller with variable markups and variable markets

Exporters of C: Markup in A relative to B

Exporters of C: Quantity in A relative to B

Increase in Bilateral Tariffs between A and C

Increase in Bilateral Tariffs between A and C

Empty Square: Variable Markets; **Solid Square: Fixed Markets**
Red: Variable Markups (Oligopolistic Competition + Local Cost Component)
Cyan: Variable Markups (Oligopolistic Competition Only)