

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

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24 Aug 2020
EEA Virtual Congress

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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 Selling T-shirts

2003	Australia	South Korea	Japan		
2004	Australia	South Korea		Germany	
2005	Australia		Japan	Germany	
2006	Australia			Germany	Belgium Canada

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Questions

[Micro:] How to quantify these **within-firm** changes in trade patterns?
What drives these changes?

[Macro:] Do these market changes matter for aggregate fluctuations and welfare?
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
30-40% involves simultaneously adding and dropping markets
 - (ii) are endogenous to changes in (relative) local market conditions
Exchange rates and local CPIs explain 20% of variation
 - (iii) suggest systematic changes in demand conditions in all markets
Firms dropping more markets tend to have a large drop in quantity (but little change in price) in their continuing markets

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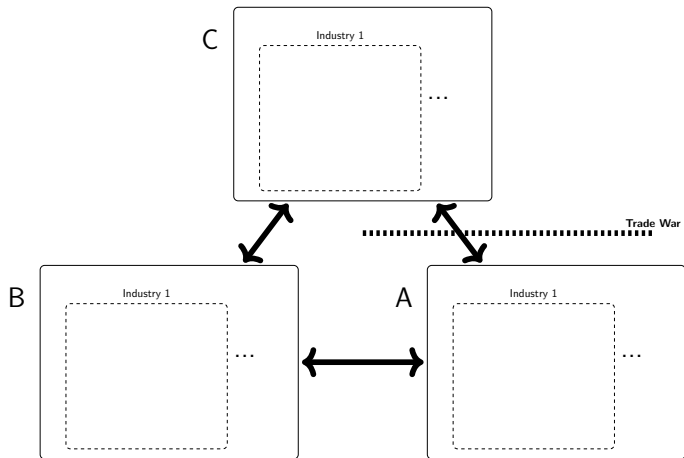
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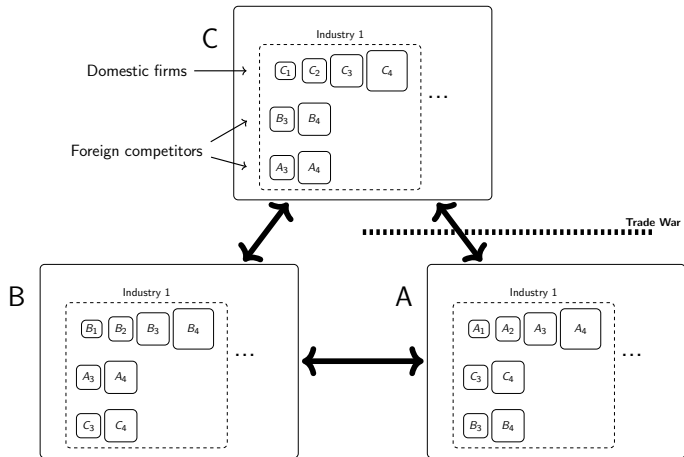
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 - (iii) suggest systematic changes in demand conditions in all markets
- ② **[A multi-country model]** to quantify the sources of these market changes and their aggregate impacts:
 - [Key elements]** variable markups + variable markets
→ systematic demand changes through multilateral competition
 - [Impact]** on shock transmission in a bilateral trade war scenario
→ the aggregate productivity increases more (10%) for the third country with endogenous market choices

Application: Bilateral Trade War (C-A)



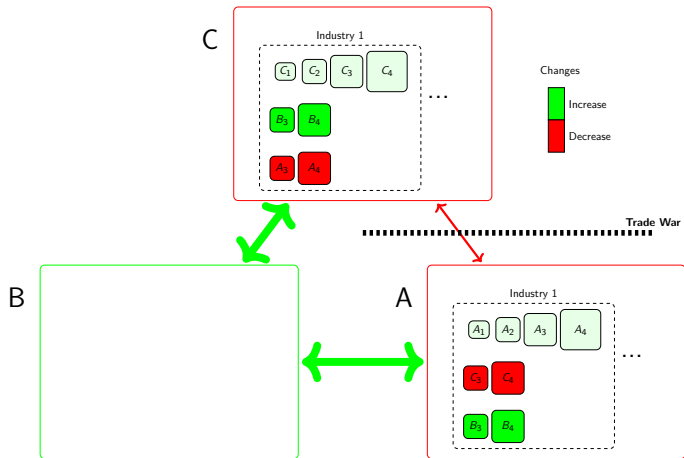
- Three countries (A, B, and C); a continuum of industries in each country
- Within each industry, there is a limited number of domestic and foreign firms competing with each other

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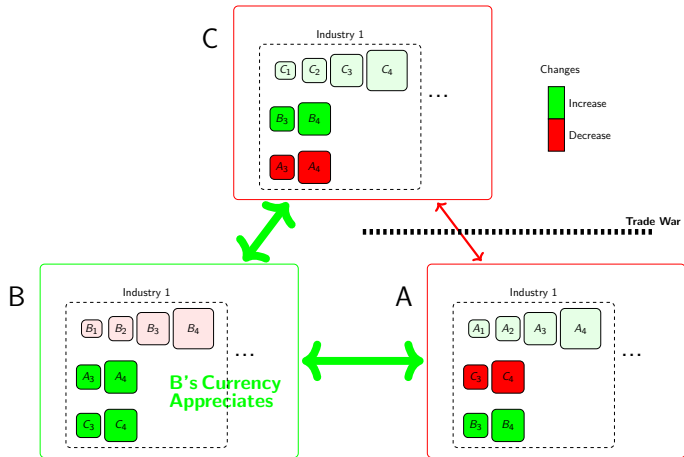
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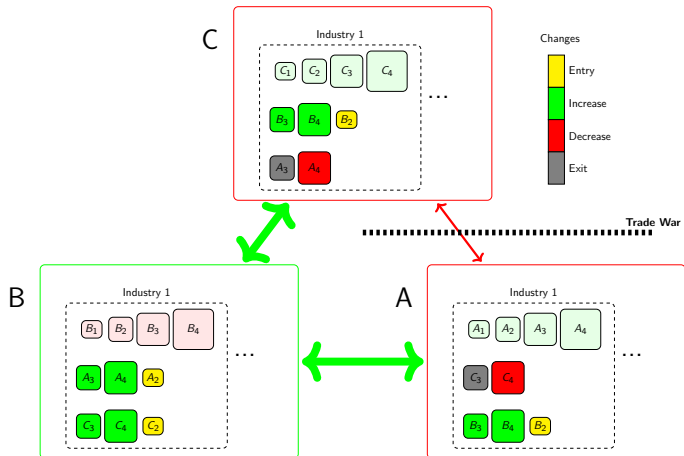
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Application: Bilateral Trade War (C-A)



- Aggregate productivities of warring countries A and C decrease
- Aggregate productivity of the third country B increases

Application: Bilateral Trade War (C-A)



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

- the aggregate productivities of A and C fall by more (-1%)
- the aggregate productivity of B increases by more (10%)

Contribution to the Literature

① 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

② Margins of trade and export dynamics:

e.g., Eaton, Kortum and Kramarz (2004); Chaney (2008, 2014); Bernard, Redding and Schott (2010); Alborno, 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

③ 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

- 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
- Aggregate implications: application to the bilateral “trade war”

③ Conclusions

New Measures of Market Changes

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	Add	1/3	0/1
$t = 4$	A		C		Drop	1/2	1/1

⇒ M. Changes/Markets captures the **magnitude** of market changes

⇒ Drops/Changes captures the **direction** of market changes

e.g. drops/changes = 0 ⇔ Add; 0 < drops/changes < 1 ⇔ Churn; drops/changes = 1 ⇔ Drop

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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Within-Firm Market Changes

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

Market Changes/ Markets (Count Measure, Median)

	All Firms	Large Firms
<i>Chinese Exporters, 2000-2006</i>		
Firm-product (8-digit) level	0.70	0.67
Firm-industry (2-digit) level	0.60	0.52
Firm level	0.57	0.50
<i>British Exporters, 2010-2016</i>		
Firm-product (8-digit) level	0.50	0.50
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Data

Value Measure

Breakdown by Firm and Product Types

Deviation from Common Trade Pattern

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Drop-to-Change Ratio and Market Switching

Equal probability of drops and adds and 1/3 of these changes involve market switching

Statistics from Firm-product Level Trade Patterns (Median)

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

Are these market changes driven by systematic changes (matter for aggregate fluctuations and welfare) or purely idiosyncratic shocks (aggregate to zero)?

- 1 Drop-to-change ratio and local market conditions
- 2 Linking extensive margin with intensive margins: systematic demand changes

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To what extent, are these market changes explained by fluctuations in local market conditions?

Step 1: 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	A, C	D	$\log(e_{D,3}/e_{D,2})$
$t = 4$	A		 	A, C	D	$-\log(e_{D,4}/e_{D,3})$

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

Step 2: 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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To what extent, are these market changes explained by fluctuations in 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
<u>Count Measure</u>				
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
<u>Trade Value Measure</u>				
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: Firm(-product/industry) and year fixed effects are added in all specifications.

UK Results

Linking Extensive and Intensive Margins

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

Linking Extensive and Intensive Margins

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

	Unit Value	Mean Quantity	Observations
<i>Chinese Exporters, 2000-2006</i>			
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
<i>British Exporters, 2010-2016</i>			
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

Firms dropping more markets reduce sales in continuing markets
(with little change in price)

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

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
- Aggregate implications: application to the bilateral “trade war”

③ Conclusions

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

Key Elements:

① Variable Markets

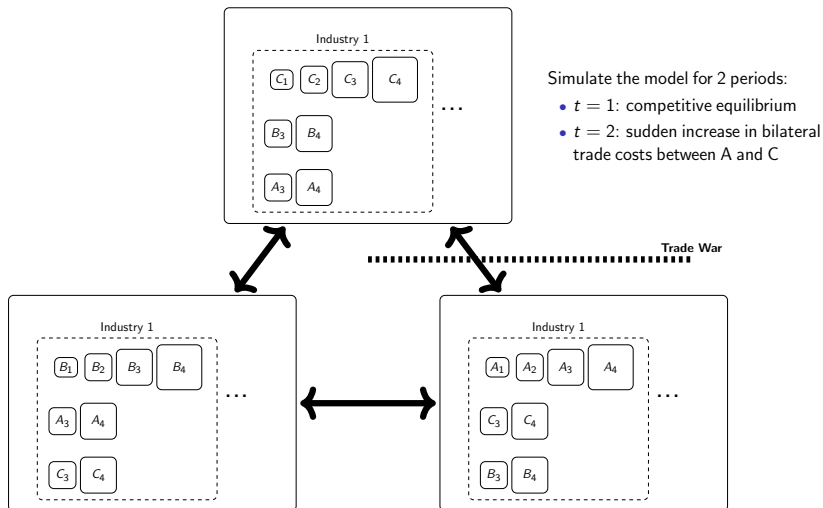
- $H > 2$ countries in the world
- Firms making entry decisions for each country separately in each period

② Variable Markups

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

Key Extension: Firms compete by *simultaneously* choosing their optimal markets and markups in a multi-country framework.

Application: Bilateral Trade War



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

Calibration

Key Moments

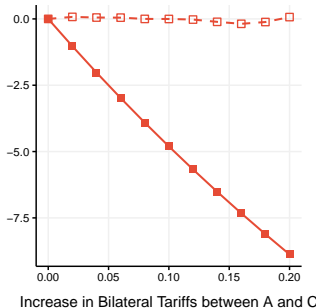
Additional Model Moments

The Effect of Local Cost Component

Trade War A-C: Markups

The effect of market changes on markup distribution

Mean Markups of Exporters from Country C to A (Percentage Change)



□: Variable Markets Version

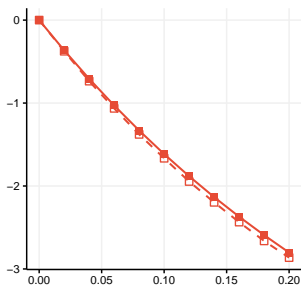
■: Fixed Markets Version (same set of firms in each market in both periods)

Allowing firms to reallocate brings in two additional effects:

- (i) selection effect: only very productive firms keep exporting to A (+)
(these firms are larger and charge higher markups)
- (ii) competition effect: different markup adjustments as
 - (+) less competition due to exits of less productive exporters from C to A
 - (-) more competition due to entrants of exporters from B to A

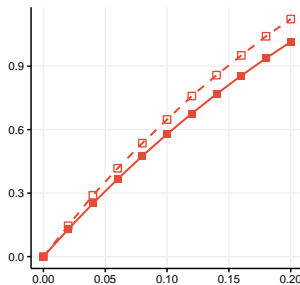
Trade War A-C: Aggregate Productivity

Two Warring Countries C (or A)



Increase in Bilateral Tariffs between A and C

The Third Country B



Increase in Bilateral Tariffs between A and C

Percentage Differences in Responses between Fixed Markets and Variable Markets

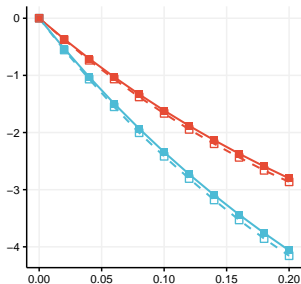
Model	Aggregate Productivity C (or A)	Aggregate Productivity B
Benchmark	1-2% more	10-13% more

□: Variable Markets Version

■: Fixed Markets Version

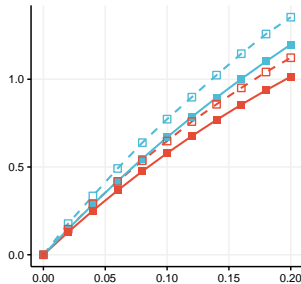
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Increase in Bilateral Tariffs between A and C

The Third Country B



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

Red: Variable Markups (Oligopolistic Competition + Local Cost Component)

Cyan: Variable Markups (Oligopolistic Competition Only)

□: Variable Markets Version

■: Fixed Markets Version

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
 - interdependence between variable markups and variable markets
 - the third country benefits more from the bilateral trade war under variable markets

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

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.

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Within Firm Market Changes involve Non-trivial Trade Values

Market Changes/ Markets (**Value Measure, Median**)

	All Firms	Large Firms
<i>Chinese Exporters, 2000-2006</i>		
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

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

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

	Mean	Median	Distribution (Percentile)				Obs.
			1st	25th	75th	99th	
<hr/>							
<u>8-digit level deviation from</u>							
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
<hr/>							
<u>2-digit level deviation from</u>							
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.

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

	Exchange Rate	Destination CPI	Within R^2	Observations
<u>Count Measure</u>				
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
<u>Value Measure</u>				
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.

Long distance markets are more likely to be dropped

Mean Distance to Drop-Change Ratio (China Results)

	Mean Distance	Within R^2	Observations
<u>Count Measure</u>			
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
<u>Trade Value Measure</u>			
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

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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.

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	$P_{ACD,3} - P_{AC,2}$	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
<i>Chinese Exporters</i>				
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
<i>British Exporters</i>				
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;
(\Rightarrow **markets with a lower price are more likely to be dropped**)
- 2 less units being sold per market if more markets are dropped

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		1/3
$t = 4$	A		C	A-C		0

Statistics Based on Chinese Exporters, 2000-2006:

	Mean	Median	Distribution (Percentile)				Obs.
			1st	25th	75th	99th	
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

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

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

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

Variable Markets and Profit Heterogeneity

Probability of Market Change

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

Drop to Change Ratio

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

where

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

Variable Markets and Profit Heterogeneity

Probability of Market Change

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

Drop to Change Ratio

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

where

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

Variable Markets and Profit Heterogeneity

Probability of Market Change

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

Drop to Change Ratio

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

where

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

Variable Markets and Profit Heterogeneity

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

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

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) $dm_{k,i,o,d,t} = \frac{\chi_{k,i,o,d,t}}{p_{k,i,o,d,t}^{border} + \chi_{k,i,o,d,t}}$

Competitors' Effect

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

where

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

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

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

Price and Export Decisions

Firms compete by simultaneously choosing:

- ① whether to enter a market, indicated by $\phi_{f,i,o,d,t}$
- ② and if enter, the price $p_{f,i,o,d,t}$ internalizing two markup channels:
 - (i) impact on competition and the industry level price index $P_{i,d,t}$ and
 - (ii) the wedge $\chi_{f,i,o,d,t}$ between producer and consumer prices

$$\pi_{f,i,o,d,t} = \max_{p_{f,i,o,d,t}, \phi_{f,i,o,d,t}} \left[q_{f,i,o,d,t} (\mu_{f,i,o,d,t}^b - 1) m c_{f,i,o,t} - W_{o,t} F_x \right] \phi_{f,i,o,d,t}$$

subject to

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

$$\mu_{f,i,o,d,t}^b = \frac{(p_{f,i,o,d,t} - \chi_{f,i,o,d,t}) e_{o,d,t}}{\tau_{o,d} m c_{f,i,o,t}}$$

subscripts f, i, o, d, t = firm, industry, origin, destination, time

q quantity; μ^b producer's markup denominated in home currency;

$m c_{f,i,o,t}$ marginal cost; α preference shifter; $\tau_{o,d}$ bilateral trade cost (including tariff)

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

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

Key Moments

Work in Progress

	Data	3-Country Model
Extensive margin		
Market 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

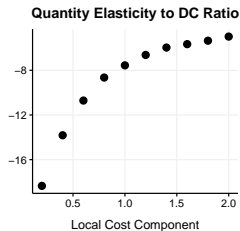
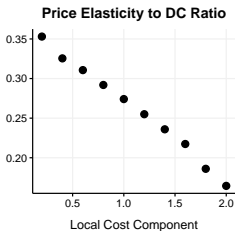
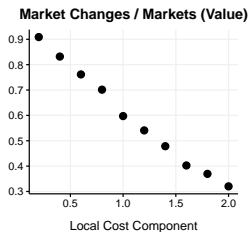
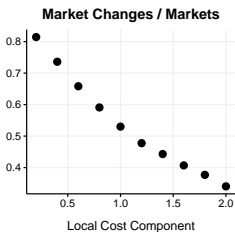
Parameter	Value
<i>Varies to match moments</i>	
Cross-industry elasticity of substitution, η	1.3
Within-industry elasticity of substitution, ρ	7.5
Fixed cost of export operations	0.2
Measure of local component, χ	2.0
Size of taste shocks μ_α ($\hat{\alpha} \sim \text{lognormal}(-\mu_\alpha, 2\mu_\alpha)$)	0.5
Size of productivity shocks μ_Ω ($\hat{\Omega} \sim \text{lognormal}(-\mu_\Omega, 2\mu_\Omega)$)	0.1
<i>Fixed: taken from Edmond, Midrigan and Xu (2015) to match firm and sector distributions</i>	
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

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	-	-

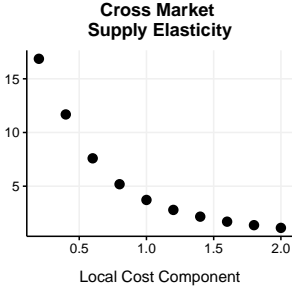
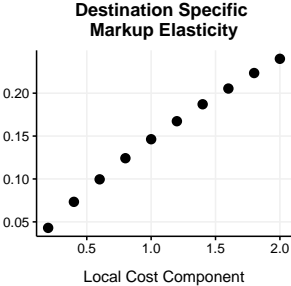
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Increasing in Local Cost Component



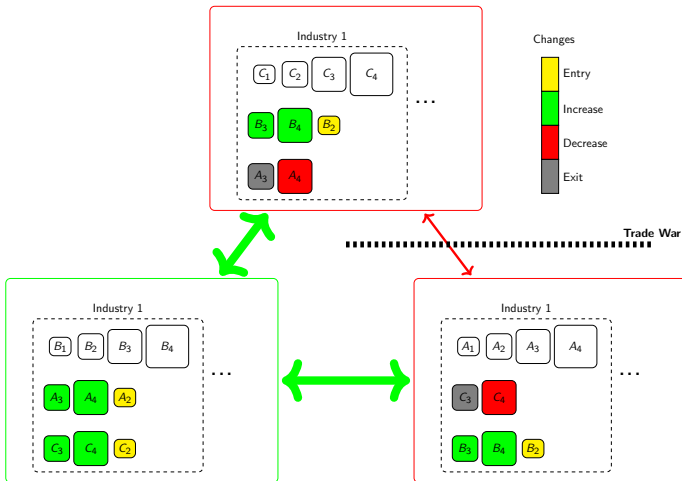
- The existence of local cost component reduces the magnitude of market changes but improves the fits of price and quantity elasticities

Local Component Helps to Match Intensive Margins



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Overview: Bilateral Trade War A-C



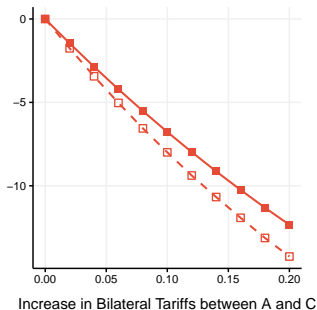
Next:

- 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.

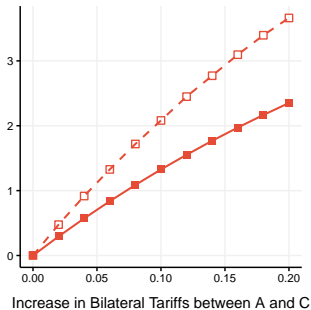
Trade War A-C: Imports

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

Country C (or A): Changes in Import Share



Country B: Changes in Import Share



Empty Square: Variable Markets; Solid Square: Fixed Markets

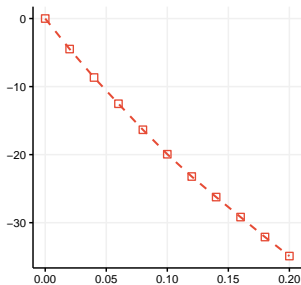
Red: Variable Markups (Oligopolistic Competition + Local Cost Component)

Trade War A-C: Extensive Margin

Trade destruction: Number of exporters from C to A decreases

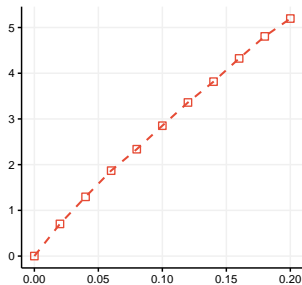
Trade deflection: Number of exporters from C to B increases

Number of Exporters C to A



Increase in Bilateral Tariffs between A and C

Number of Exporters C to B

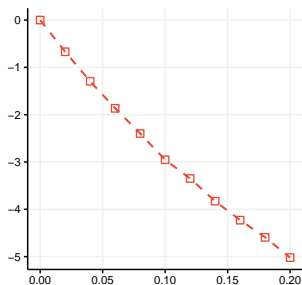


Increase in Bilateral Tariffs between A and C

Trade War A-C: Trade Deflection

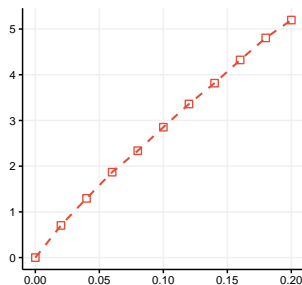
In equilibrium, country B's currency appreciate, making products from C (and A) cheaper in B.

Bilateral Exchange Rates B to C



Increase in Bilateral Tariffs between A and C

Number of Exporters C to B

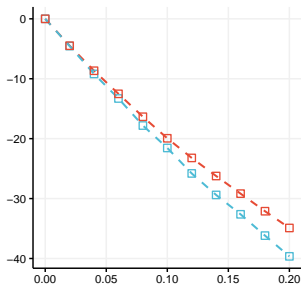


Increase in Bilateral Tariffs between A and C

Trade War A-C: Extensive Margin

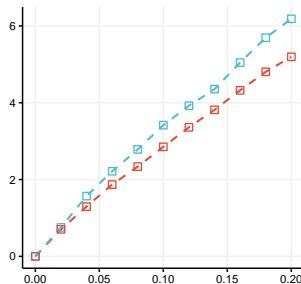
The existence of local cost component reduces extensive margin responses

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

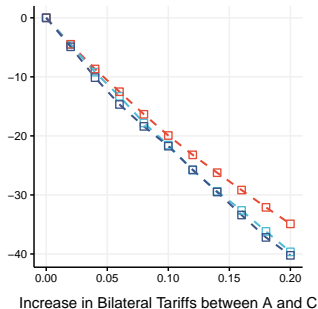
Red: Variable Markups (Oligopolistic Competition + Local Cost Component)

Cyan: Variable Markups (Oligopolistic Competition Only)

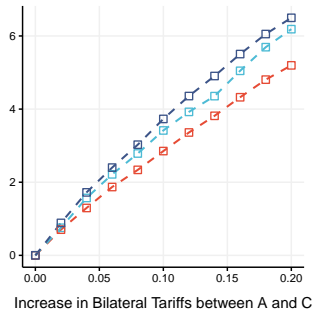
Trade War A-C: Extensive Margin

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

Number of Exporters C to A



Number of Exporters C to B



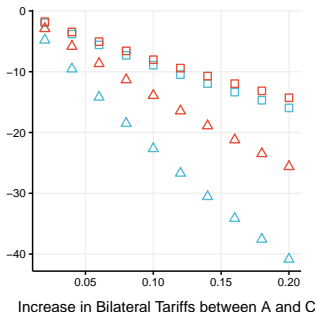
Red: Variable Markups (Oligopolistic Competition + Local Cost Component)
Cyan: Variable Markups (Oligopolistic Competition Only)
Dark Blue: Constant Markups

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



Empty Square: Three-Country Models (with Variable Markets);

Empty Triangle: Two-Country Models (with Variable Markets)

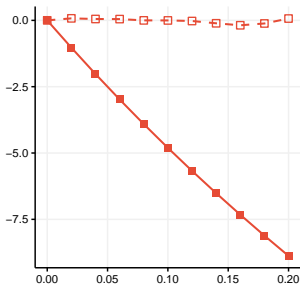
Red: Variable Markups (Oligopolistic Competition + Local Cost Component)

Cyan: Variable Markups (Oligopolistic Competition Only)

Trade War A-C: Quantity Responses

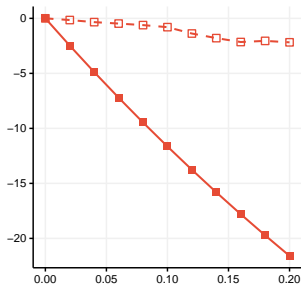
- (i) Market changes reduce quantity responses
- (ii) Markup adjustments further dampen quantity responses

Mean Markups of Exporters
from Country C to A



Increase in Bilateral Tariffs between A and C

Mean Quantity of Exporters
from Country C to A



Increase in Bilateral Tariffs between A and C

Empty Square: Variable Markets; Solid Square: Fixed Markets

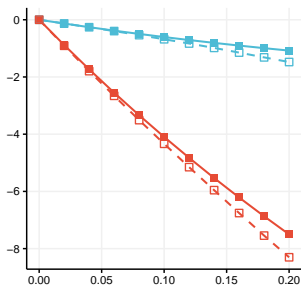
Red: Variable Markups (Oligopolistic Competition + Local Cost Component)

Trade War A-C: Relative Markups and Quantities

For exporters of C:

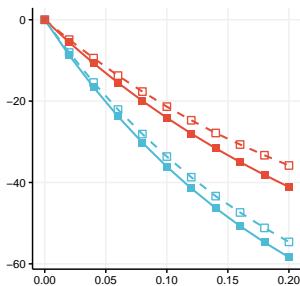
- Markup in A is relatively lower compared to B; the difference is larger with variable markets
- Relative quantity decreases in all models; the decrease is smaller with variable markups and variable markets

Exporters of C: Markup in A relative to B



Increase in Bilateral Tariffs between A and C

Exporters of C: Quantity in A relative to B



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)