Tariff Front-Running

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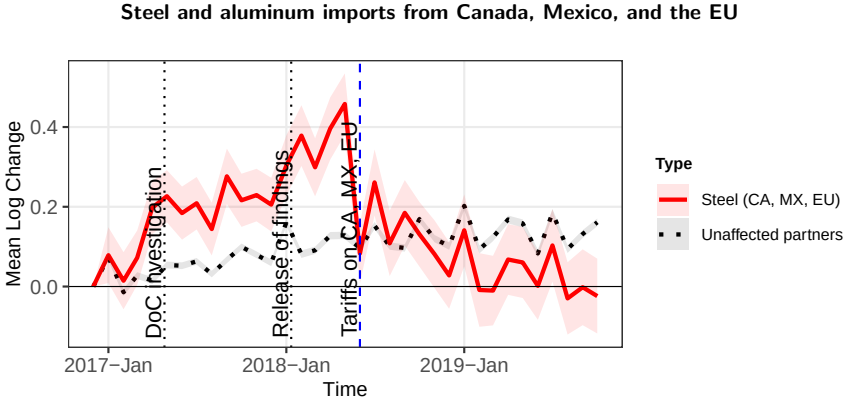
Motivation and research questions

- Trade is dynamic: firms can respond today to future changes in tariffs.
- 2018–2019 US import tariffs: a one-year gap between the start of investigations and the imposition of tariffs
- Example: steel and aluminum tariffs
  - April 2017: DOC started an investigation.
  - March and June 2018: imposition of tariffs on ROW and Canada/Mexico/EU Timeline

1. How do US importing firms respond to a future tariff?
2. How do these firm-level adjustments affect aggregate output and price dynamics?

Tariff front-running for steel and aluminum ROW



Note: average log change in imports relative to 2016 across HTS 10-digit product-country pairs.

This paper

1. How do US importing firms respond to a future tariff?
   - Data on US public firms' shipment-level imports, linked to tariffs and financials (2012–2019)
   - Local projections: dynamics before and after the tariff increase
   - ▷ Over the year before the tariff, firms **increase imports and inventories (intensive margin).**
   - ▷ They also **expand their set of product-country partners (extensive margin).**
2. How do these firm-level adjustments affect aggregate output and price dynamics?

This paper

1. How do US importing firms respond to a future tariff?

2. How do these firm-level adjustments affect aggregate output and price dynamics?

   - Dynamic trade model with **imports/inventories** and **extensive margin of trade**
   - In anticipation of tariffs, forward-looking firms expand along both intensive and extensive margins.
   - ▷ Pre-tariff: higher output and lower prices
     - Extensive-margin adjustment = additional cost draw → lower marginal cost
   - ▷ Post-tariff: year-long transition of output and prices to a new steady state
     - Intensive-margin adjustment: drawdown of inventories stockpiled ahead of the tariff
     - Full pass-through of tariffs to aggregate prices takes a year.
   - ▷ Empirical evidence: more tariff-exposed industries exhibit stronger pre- and post-tariff dynamics.

Related literature

- **US tariff wars in 2018 and 2019.** **Amiti, Redding, and Weinstein (2019, 2020); Fajgelbaum, Goldberg, Kennedy, and Khandelwal (2020); Cavallo, Gopinath, Neiman, and Tang (2021)**
  - ▷ Study firms' import choices before the tariff.
  - ▷ Role of the anticipatory response in aggregate output and prices
- **Trade-policy expectations.** Pierce and Schott (2016); Feng, Li, and Swenson (2017); Handley and Limão (2017); Steinberg (2019); Baley, Veldkamp, and Waugh (2020); Khan and Khederlarian (2021); **Alessandria, Khan, and Khederlarian (2024)**
  - ▷ Anticipatory response of imports and inventories at the firm and firm-product-country levels
  - ▷ Significant within-product, cross-country adjustment; insignificant cross-product adjustment
- **Trade-policy disruptions and global supply chains.** Grossman, Helpman, and Redding (2024); Heise, Pierce, Schaur, and Schott (2025); **Flaaen, Hortaçsu, and Tintelnot (2020)**
  - ▷ Find that firms import the tariff-affected products from new, unaffected countries before the tariff.

Data & empirical findings

Firm-level dataset for US public firms

1. Bill of Lading: shipment-level import data
   - Universe of maritime shipment data collected at US ports from 2012 to 2019
   - Description of goods, HS6 codes, quantities, import values, and country of origin
   - We grouped shipments belonging to a public firm.
2. United States International Trade Commission: tariff rates from 2015 onwards
3. Compustat: public firms' quarterly financial information such as sales, cash flows, and inventories

- Panel data of 5,776 importing firms from 2012Q1 to 2019Q4 Summary statistics
- 46% of firms in our sample faced a tariff increase.

Firms' dynamic response before and after tariff

- Analyze imports, the number of product-country partners, and inventories.
- $FTI_{i,t}$: first increase in the import-weighted tariff of the partners firm i imported from in the last four quarters Firm tariff
- Local projections (Jordà 2005) for horizon k from -6 to 6:

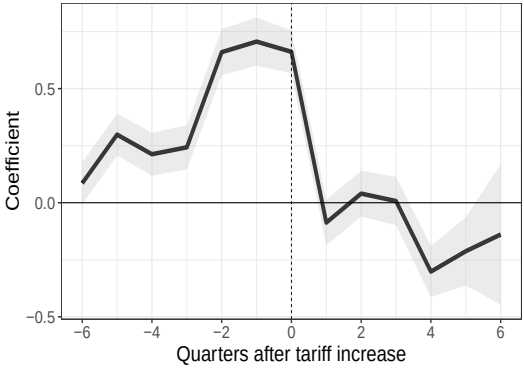
$$y_{i,t+k} = \beta_k \, \mathrm{FTI}_{i,t} + \mu_i + \mu_t + \Gamma' X_{i,t} + \epsilon_{i,t,k},$$

where μ_i and μ_t are firm and time fixed effects; and $X_{i,t}$ are firm-level controls, such as Tobin's Q, cash flow over assets, and log of sales.

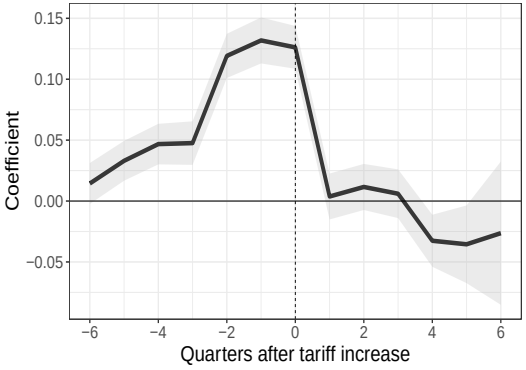
$\rightarrow$ β_k is the response of y in $t+k$ to the first tariff increase for the firm in t.

Pre-tariff increase in imports and the count of partners

(a) Imports: asinh $\left(\text{import}_{i,t+k}\right)$



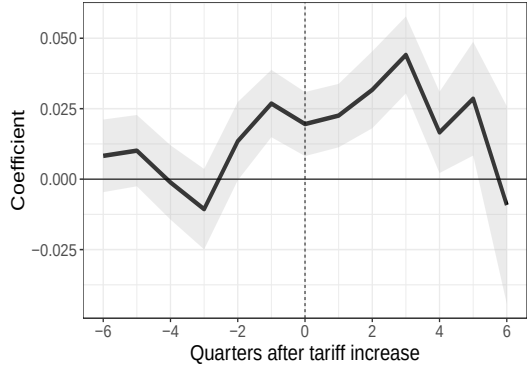
(b) Count of partners: asinh$(|C_{i,t+k}|)$



asinh(y) Log() Continuous measure of tariff shock $TI_{i,t}$ Existing set Firm size

Concurrent increase in inventories

(c) Inventories: $\log(\text{inventory}_{i,t+k})$



Which partners do firms turn to?

- Example: suppose a small **DC motor (HS6: 850131) from China** faces a tariff increase.
- Firms can adjust, intensively and extensively, toward four types of partners:

	Affected country (China)	**Unaffected country** (Vietnam)
Affected product (DC motors, 850131)	**AA**	**AU**
Unaffected product (AC motors, 850140)	**UA**	**UU**

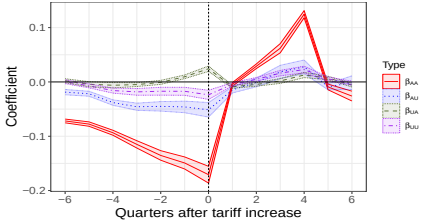
- For k from -6 to 6, estimate

$$y_{i,h,c,t+k} = \beta_{AA,k}\, AA_{i,h,c,t} + \beta_{AU,k}\, AU_{i,h,c,t} + \beta_{UA,k}\, UA_{i,h,c,t} + \beta_{UU,k}\, UU_{i,h,c,t} + \mu_i + \mu_h + \mu_c + \mu_t + \Gamma' X_{i,t} + \epsilon_{i,h,c,t,k}.$$

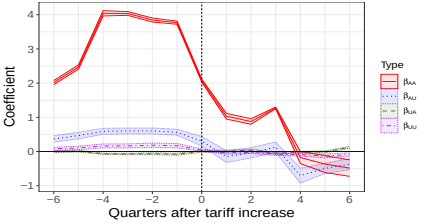
Extensive and intensive margins of adjustment

- Extensive margin
  - Dropping a partner: imported a product-country in $t-5$ but did not import for the next four quarters.
    Adding a partner
- Intensive margin: asinh(import) at the firm-product-country level

(a) Probability of dropping



(b) Imports



- Red-solid: AA (DC Motor, China); Blue-dotted: AU (DC Motor, Vietnam) Existing imports Magnitude of adjustments

▷ Prior to the tariff, firms extensively and intensively turn to AA and AU partners.

⇒ Significant within-product and insignificant cross-product adjustments

Model

Environment

Partial equilibrium: a unit continuum of monopolistically competitive final-good firms, each with two managers.

(i) Inventory manager: Alessandria, Kaboski, and Midrigan (2010)

- Decides on the **production level** under **stochastic demand** from consumers.
- **Demands an input from the import manager.**
- The input arrives with **a one-period delivery lag**.
- Stores inputs as **costly inventories**.
- Maximizes the present discounted value of **profits**.
- Takes into account the **future tariff-inclusive price of inputs**.

(ii) Import manager: Antras, Fort, and Tintelnot (2017); Blaum, Lelarge, and Peters (2018)

- **Fulfills the input order from the inventory manager.**
- Imports foreign varieties subject to **tariffs** and CES-aggregates them into the input.
- **Minimizes the average cost** of the input.
- **Extensive margin:** chooses the set of countries to import from.
- Adding a country: trade-off between **higher fixed costs** and **lower marginal costs**

Import manager: static problem Details

- Eaton and Kortum (2002) + extensive-margin choice of sourcing countries
- Foreign country j produces variety $\upsilon \in [0,1]$ with unit labor requirements $a_j(\upsilon)$ drawn from a Fréchet distribution, where $\Pr(a_j(\upsilon) \geq a) = e^{-T_j a^\theta}$.
- Tariffs are country-specific: $\tau_j \geq 1$.
- Import manager chooses the country-partner set $\mathcal{J}$ to minimize the cost of input n, which is a CES aggregate of varieties:

$$p(n, \bar{\tau})\, n = \min_{\mathcal{J}} \left[c(\mathcal{J})\, n + w\, |\mathcal{J}|\, f \right],$$
$$\text{s.t. } c(\mathcal{J}) = \left(\gamma \sum_{j \in \mathcal{J}} T_j \left(\tau_j\, w_j \right)^{-\theta} \right)^{-1/\theta}.$$

- Trade-off of adding a country: **higher fixed cost** vs. **lower marginal cost** (additional cost draw for varieties)
- Proposition: A higher input demand expands the optimal country-partner set and lowers the marginal cost: If $n_{\text{low}} < n_{\text{high}}$, then $\mathcal{J}(n_{\text{low}}) \subset \mathcal{J}(n_{\text{high}})$, and $c\left(\mathcal{J}(n_{\text{low}})\right) \geq c\left(\mathcal{J}(n_{\text{high}})\right)$. Details

Inventory manager: dynamic problem

$$V(s,\ \nu,\ p(n,\bar{\tau})) = \max_{\{p^f,\ x,\ n,\ s'\}} \left\{ p^f\ y^f\ -\ p(n,\bar{\tau})\ n\ +\ \beta\ \mathbb{E}_{\nu'}\Big[V(s',\ \nu',\ p(n',\bar{\tau}))\Big]\right\}$$

$$\begin{aligned}
\text{s.t.} \quad y^f\ &= \nu\ \left(p^f\right)^{-\epsilon}; && \text{CES demand}\\
y^f\ &= x; && \text{linear production}\\
x\ &\leq\ s; && \text{stock-out constraint } (\lambda)\\
s'\ &= (1-\delta)\,(s\ -\ x\ +\ n). && \text{law of motion for inventory}
\end{aligned}$$

- Final good price, if a firm is sourcing from k countries:

$$p^f = \underbrace{\frac{\epsilon}{\epsilon-1}}_{\text{markup}} \Big(\underbrace{c_k}_{\text{marginal cost}} + \underbrace{\lambda}_{x\leq s} \Big).$$

  Tariff pass-through to the marginal cost is immediate, but the price also depends on whether a stock-out happens.

- Aggregate output and prices (firms indexed by $\omega \in [0,1]$):

$$Y = \left(\int_0^1 \nu_\omega^{\frac{1}{\epsilon}}\ \left(y_\omega^f\right)^{\frac{\epsilon-1}{\epsilon}}\ d\omega \right)^{\frac{\epsilon}{\epsilon-1}}, \qquad P = \left(\int_0^1 \nu_\omega\ \left(p_\omega^f\right)^{1-\epsilon}\ d\omega \right)^{\frac{1}{1-\epsilon}}.$$

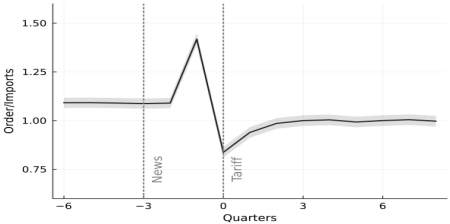
Aggregate effects of tariff front-running

Anticipated increase in tariffs Calibration

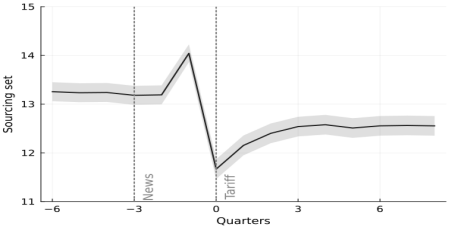
- Firms have perfect foresight, and tariffs increase with certainty.
- Country-specific tariffs change according to data (China: 15 pp, import-weighted change: 3 pp). Values
- Timeline
  1. Firms start in a low-tariff steady state.
  2. News: at $t = -3$, they learn that tariffs will increase at $t = 0$.
  3. Tariff: at $t = 0$, the tariffs increase.
- Evaluate the transition.

Average of firm-level variables

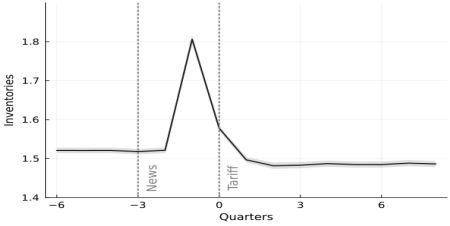
(a) Orders/imports



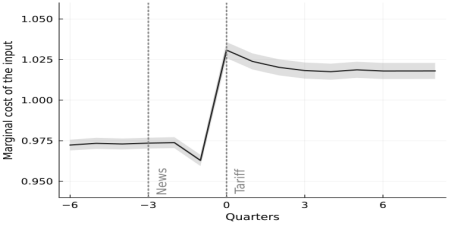
(b) Number of country partners



(c) Inventories



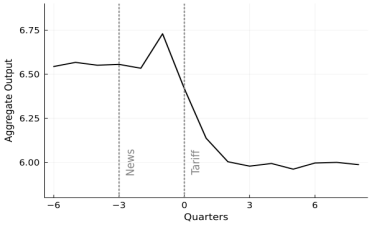
(d) Marginal cost of the input



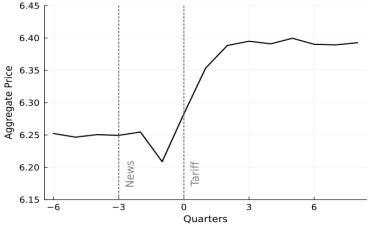
- **High vs. low-tariff steady state:** imports 8% ↓, the number of country partners 0.7 ↓, inventories 2% ↓, MC 5% ↑.
- **Pre-tariff:** imports 30% ↑, country partners 0.8 ↑, inventories 19% ↑; the larger sourcing set lowers MC 1% ↓. Untargeted moments
- **Post-tariff:** imports and the number of partners undershoot ⇒ MC overshoots; inventories converge in 3–4 quarters.

Aggregate effects of tariff front-running

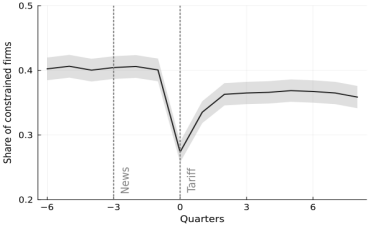
(a) Aggregate output, Y



(b) Aggregate prices, P



(c) Share of stock-out firms



- **High vs. low-tariff steady state:** Y 9.1% ↓, P 2.4% ↑.
- **Pre-tariff:** MC ↓ ⇒ Y 2.0% ↑, P 0.7% ↓.
- **Post-tariff:** anticipatory response allows for a **year-long smooth transition** to the new steady state.
- Despite immediate pass-through of tariffs to MC (4.7% ↑), P rises by less (2.4% ↑) and transitions smoothly: the falling share of stock-out firms keeps prices low.

Additional results

- Tariff front-running in aggregate import data: steel-and-aluminum and China tariff waves. Details
  - **Unrealized shock:** China List 3's 10% $\rightarrow$ 25% escalation, scheduled for January 2019, was delayed to May 2019; imports were stockpiled just ahead of January.
- Anticipated vs. unanticipated tariff: stockpiled inventories pre-tariff yield a smoother transition post-tariff in the anticipated case. Details
- Model without the extensive margin vs. baseline: due to the anticipatory extensive-margin expansion, higher output and lower prices pre-tariff Details
- Cross-industry validation: more tariff-exposed industries exhibit stronger pre- and post-tariff dynamics. Details
- Trade elasticity: short- and long-run trade (tariff) elasticities are twice as large when the tariff is anticipated as when it is unanticipated. Details

Conclusion

- Examine US firms' responses to future tariff increases and their macroeconomic implications.
- ▷ Find significant **tariff front-running** along intensive (imports/inventories) and extensive (set of partners) margins, which begins a year before the tariff.
- ▷ Develop a dynamic trade model where forward-looking firms decide on both margins.
- ▷ Pre-tariff dynamics: higher output and lower prices due to the extensive margin
- ▷ Post-tariff dynamics: a year-long transition of output and prices due to the intensive margin (stockpiled inventories)

Thank you!

I would love to hear your thoughts and suggestions!

Feel free to email me at sangmin.lee@moore.sc.edu.

Additional result: tariff front-running in aggregate data

Timeline of tariffs on steel, aluminum, and China

Return (intro) Return (additional)

Event	Date	Description	Source	Products or Countries[b]	Value ($B)[c]
(a) Section 232: national security (steel and aluminum)					
Investigation	Apr 19 & 26, 2017	DoC initiates investigation.	82 FR 19205	Steel, Alum.	–
Report	Jan 11, 2018	DoC reports findings.	DoC report	–	–
Announcement	Mar 1, 2018	Intent to impose global tariffs.	White House	All	–
Effective Date (I)	Mar 23, 2018	25% (Steel) / 10% (Alum.)	83 FR 11625	ROW[a]	18
Effective Date (II)	Jun 1, 2018	Expiration of exemptions	Proclamation 9759	Can, Mex, EU	22
(b) Section 301: technology transfer (China)					
Investigation	Aug 18, 2017	USTR initiates investigation.	82 FR 40213	–	–
Determination	Mar 22, 2018	President concurs with USTR.	83 FR 13099	–	–
List 1 Effective	Jul 6, 2018	25% tariff	83 FR 28710	Industrial Machinery	33
List 2 Effective	Aug 23, 2018	25% tariff	83 FR 40823	Chemicals	13
List 3 Effective	Sep 24, 2018	10% tariff	83 FR 47974	Consumer Products	188
List 3 Escalate	May 10, 2019	Rate raised to 25%	84 FR 20456	–	–
List 4A Effective	Sep 1, 2019	15% tariff	84 FR 43304	Apparel, Footwear, TVs	99
Phase One Deal	Dec 13, 2019	List 4B suspended*	84 FR 69447	Cell Phones, Laptops	–

Notes: "DoC" refers to the Department of Commerce. "USTR" refers to the United States Trade Representative. "FR" refers to the Federal Register.

[a] "ROW" (Rest of World) includes countries not granted exemptions. South Korea, Brazil, and Argentina accepted quotas in lieu of tariffs.

[b] This column denotes the products or countries mainly targeted by each event.

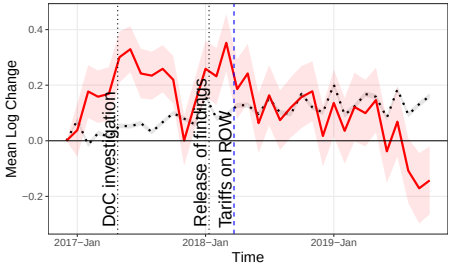
[c] Values represent the 2017 annual import volume from the affected partners (in billions of USD), based on authors' calculation using the Census data.

* List 4B was scheduled to go into effect on Dec 15, 2019, covering roughly $160 billion in imports, but was suspended indefinitely following the Phase One trade agreement.

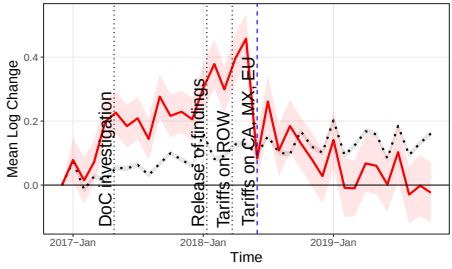
Aggregate import dynamics of steel and aluminum

Return (Intro) Return (additional)

(a) Rest of the world (Mar 2018 tariff)



(b) Canada, Mexico, and EU (Jun 2018 tariff)

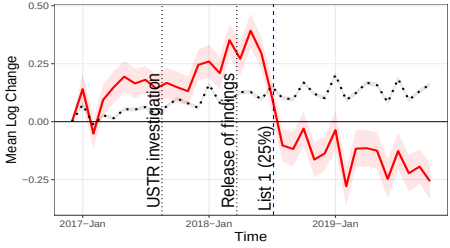


Note: average log change in imports relative to 2016 across HTS 10-digit product-country pairs

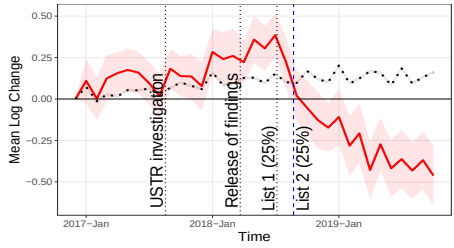
Aggregate import dynamics: China

Return (Intro) Return (additional)

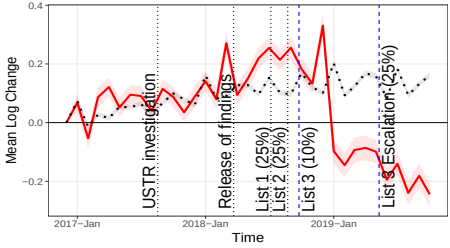
(a) List 1 products



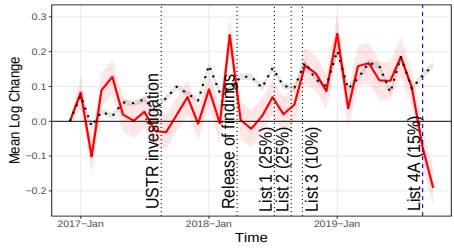
(b) List 2 products



(c) List 3 products



(d) List 4A products

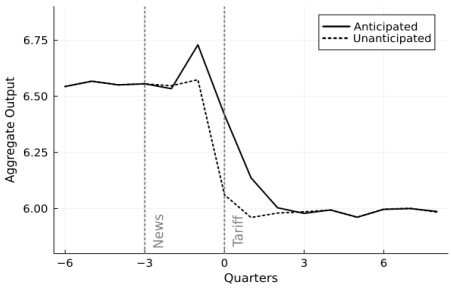


Additional result: anticipated vs. unanticipated tariff

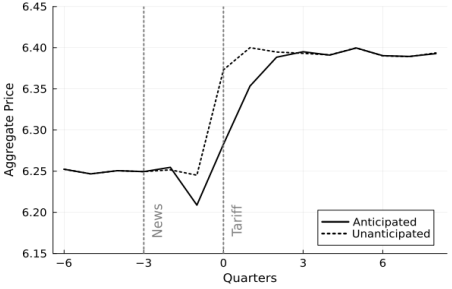
Gains from anticipation: smoother transition of aggregates

Return (additional)

(a) Aggregate output



(b) Aggregate prices



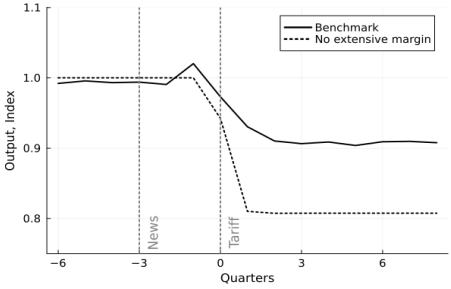
- Unanticipated: firms learn about the tariffs when they are implemented.
  - ▷ Anticipatory response allows for a longer and smoother transition of aggregate output and prices.
  - ▷ Note: even when tariffs are unanticipated, there exists a gradual transition: the new high-tariff steady state requires lower inventories, so firms can draw down the excess.

Additional result: model without the extensive margin vs. baseline

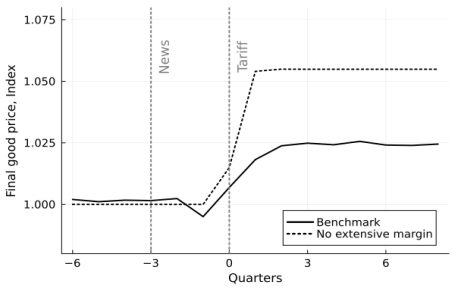
Role of the extensive margin: pre-tariff aggregate dynamics

Return (additional)

(a) Aggregate output



(b) Aggregate prices



- **No-extensive-margin model**
  - ▷ Firms can only source from one country, which implies a constant marginal cost.
  - ▷ Calibrate such that aggregate prices in both economies are the same at the initial steady state.
  - ▷ Firms' anticipatory response does not affect the pre-tariff aggregate output and price dynamics.

Additional result: cross-industry empirics for model validation

Cross-industry variation in tariffs and imports: specification

Return (additional)

- Aggregate output and price data
  - ▷ Tariff exposure$_{j,t}$: share of firms in NAICS industry j that faced an increase in tariffs
  - ▷ Tariff increase$_{j,t}$: average magnitude of the tariff increase (MS_i) across firms in NAICS industry j MS_i
  - ▷ IPI$_{j,t}$: aggregate output from the Industrial Production Index
  - ▷ PPI$_{j,t}$: aggregate prices from the Producer Price Index

- Compare the average growth rates across periods.
  - (i) **Initial**: low-tariff steady state (January 2016 to July 2017)
  - (ii) **Pre-tariff:** after the investigation into China's trade practices (August 2017 to August 2018)
  - (iii) **Post-tariff:** after the implementation of higher tariffs (September 2018 to December 2020)

- Correlate the tariff measures with the difference in growth rates across industries.

$$\log(y_{j,t}/y_{j,t-1}) = \beta_0 + \beta \text{ tariff measure}_{j,t} + \epsilon_{j,t}.$$

Cross-industry variation in tariffs and imports: results

Return (additional)

Panel A. Output		Tariff exposure$_{j,t}$	Tariff increase$_{j,t}$
(1)	$\log(IPI_{j,pre-\tau}/IPI_{j,\text{initial}})$	0.044	0.496
		(0.029)	(0.281)
(2)	$\log(IPI_{j,post-\tau}/IPI_{j,pre-\tau})$	−0.052	−0.530
		(0.025)	(0.245)
	Observations	128	128
Panel B. Prices			
(3)	$\log(PPI_{j,pre-\tau}/PPI_{j,\text{initial}})$	−0.025	−0.157
		(0.008)	(0.061)
(4)	$\log(PPI_{j,post-\tau}/PPI_{j,pre-\tau})$	0.011	0.113
		(0.008)	(0.063)
	Observations	257	257

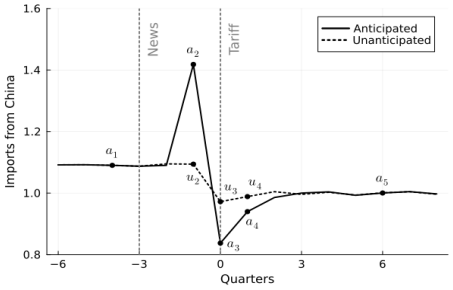
- Output of more tariff-exposed industries grows more pre-tariff and less post-tariff.
- Prices of more tariff-exposed industries rise less pre-tariff and more post-tariff.

Additional result: trade elasticity

Anticipatory response overstates the trade (tariff) elasticity.

Return (additional)

Response of imports from China



Time-varying trade elasticity, ϵ^h

$$\epsilon^h = \frac{\log(x_{t+h}) - \log(x_{\tilde{t}-1})}{\log(\tau_{t+h}) - \log(\tau_{\tilde{t}-1})}$$

Time	Anticipated tariff	News	Unanticipated tariff
$h = 0$	−5.7 (a2 → a3)	−3.8 (a1 → a3)	−2.7 (u2 → u3)
$h = 1$	−4.8 (a2 → a4)	−2.9 (a1 → a4)	−2.6 (u2 → u4)
Long Run	−4.4 (a2 → a5)	−2.4 (a1 → a5)	−2.4 (u2 → a5)

$(x \to y)$: points on the figure used to compute elasticity

- Compute the elasticity considering only imports from China; t = tariff period, $\tilde{t}$ = *reference period*.
- Two issues: (i) pre-tariff, firms increase their imports; and (ii) post-tariff, firms use inventories for production, which leads imports to dip below their new steady-state level.

▷ $\tilde{t}$ = **tariff**: the pre-tariff surge (i) inflates the reference (a_2 vs. u_2), overstating both the short- and long-run elasticities.

▷ $\tilde{t}$ = **news**: reference a_1 avoids (i), but the deeper post-tariff dip (a_3, a_4) from (ii) still overstates the short-run elasticity.

Appendix: data and empirics

Summary statistics

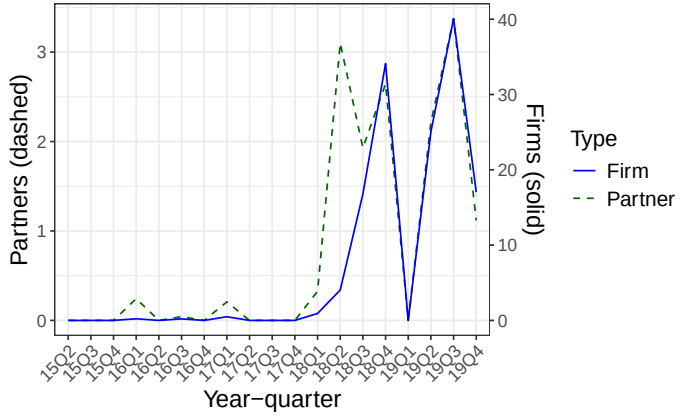
Return (dataset)

	Mean	Stdev	P10	P25	P50	P75	P90
(a) All firm-quarters (N = 154,783)							
Sales ($ millions)	1,401	5,459	1	15	133	669	2,710
Inventories ($ millions)	980	11,010	0	0	17	187	934
(b) Importing firms (N = 5,776)							
Importing quarters (count)	18	12	1	5	20	32	32
Importing products (count)	83	171	1	4	19	81	230
Importing countries (count)	13	16	1	2	6	17	34
(c) Importing firm-quarters (N = 104,908)							
Importing products (count)	19	40	1	2	6	18	49
Importing countries (count)	6	7	1	1	3	7	14
(d) Importing firm-quarter-products (N = 1,996,187)							
Imports ($ thousand)	3,253	116,589	2	11	57	299	1,602
Importing countries (count)	1	1	1	1	1	1	2
(e) Importing firm-quarter-countries (N = 595,113)							
Imports ($ thousand)	10,912	161,728	6	27	162	1,230	7,637
Importing products (count)	4	13	1	1	2	4	9
(f) Importing firm-quarter-product-countries (N = 2,677,379)							
Imports ($ thousand)	2,426	69,088	2	10	50	250	1,301

Lumpiness of trade and tariff dynamics Return (dataset)

- Panel data of 5,776 public importing firms from 2012Q1 to 2019Q4
  - ▷ Lumpiness of trade: the median firm imports in 20 of the 32 quarters.
  - ▷ Tariff exposure in our data

Share of partners (product-country) and firms with tariff increase



Tariff increases in earlier periods Return (dataset) Return (firm-level tariff)

- 2017Q1: HS 2012 $\rightarrow$ HS 2017
  - If we set the cutoff to 0, we get spurious tariff-increase observations.
  - For example, 45% of product-countries experienced a "tariff increase" given the 0 cutoff.
- 2016Q1: tariff increase events (though not as broad as those in 2018 and 2019)
  - Expiration of temporary duty suspensions on commodities (such as dairy, sugar, and processed foods)
  - Changes in preferential programs like the Generalized System of Preferences (GSP) that raised applied tariffs on textiles, footwear, and other imports

Increase in a firm's tariffs

Return (firm-level analysis)

- Lumpiness of trade: the median firm imports in 20 of the 32 quarters.
- Consider the *existing* set of partners:

$$E_{i,t} \equiv \bigcup_{k=-4,\ldots,-1} C_{i,t+k},$$

where $C_{i,t+k}$ is the set of *current* product-countries the firm imports from in $t+k$.

- Tariff increase for a firm: $TI_{i,t} = 1$, if $\hat{\tau}_{i,t} > 0.01$ Why 0.01 cutoff?

$$\hat{\tau}_{i,t} \equiv \frac{\sum_{(h,c)\in E_{i,t}} v_{i,h,c,t} \left(\tau_{h,c,t} - \tau_{h,c,t-1}\right)}{\sum_{(h,c)\in E_{i,t}} v_{i,h,c,t}},$$

where i denotes a firm, h an HS6 product, c a country, and $v_{i,h,c,t}$ imports from $t-4$ through $t-1$.

- First tariff increase for a firm: $FTI_{i,t} = 1$ for the first period where $TI_{i,t} = 1$.

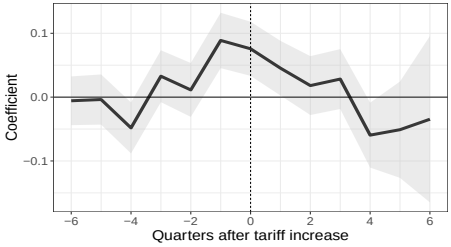
$\text{asinh}(y)$ Return (imports and partners)

- Only 57% of firm-quarters import; $\log(y)$ drops many observations and, hence, useful variation.
- Inverse hyperbolic sine: $\text{asinh}(y) \equiv \log(y + \sqrt{y^2 + 1})$.
  - Well-defined at zero
  - For small y, $\text{asinh}(y) \approx y$; for large y, $\text{asinh}(y) \approx \log(2y)$.
- Scaling issues: changing a in $\text{asinh}(ay)$ can provide arbitrary quantitative results (Chen and Roth 2024).
  $\rightarrow$ We also study the intensive and extensive margins separately.

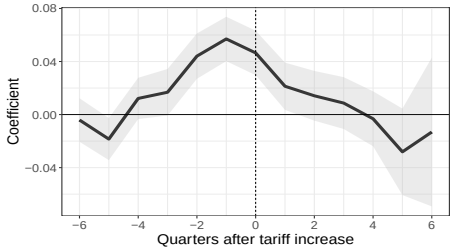
Robustness: log instead of asinh

Return (imports and partners)

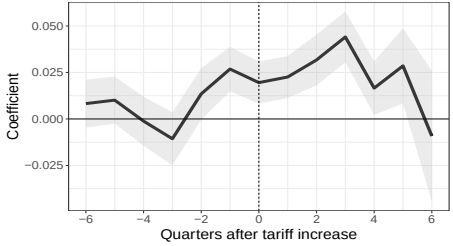
(a) Imports: $\log\left(\text{import}_{i,t+k}\right)$



(b) Number of partners: $\log(|C_{i,t+k}|)$



(c) Inventories: $\log(\text{inventory}_{i,t+k})$



Robustness: continuous measure of tariff shock

Return (imports and partners) Return (cross-industry)

- Magnitude of tariff shock for a firm:

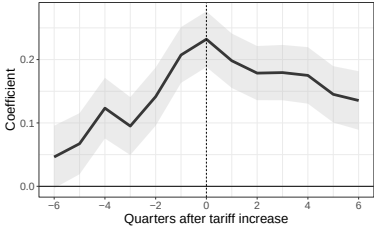
$$MS_i \equiv \max_{t'} \left\{ \log \left(\frac{1+\tilde{\tau}_{i,t'}}{1+\tilde{\tau}_{i,t_{i,pre}}} \right) \right\}, \text{ where } t_{i,pre} = (t-1), \text{ for } t \text{ such that } FTI_{i,t} = 1.$$

- Independent variable: $FTI_{i,t} \rightarrow FTI_{i,t} MS_i$
- Why maximum? Before the tariff increase, tariffs were stable, and we are studying the pre-trend.

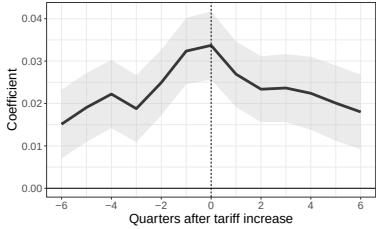
Robustness: continuous measure of tariff shock

Return (imports and partners)

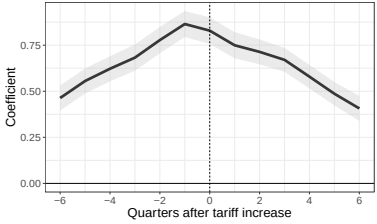
(a) Imports: asinh $\left(\text{import}_{i,t+k}\right)$



(b) Count of partners: asinh$(|C_{i,t+k}|)$

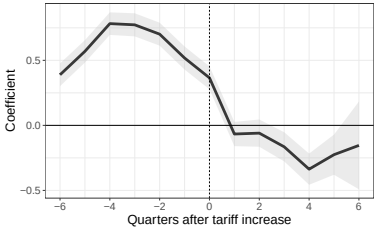


(c) Inventories: asinh$(\text{inventory}_{i,t+k})$

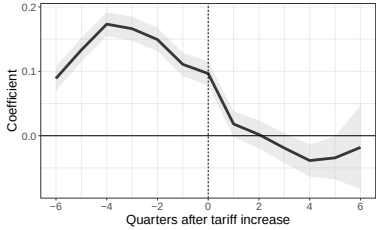


Robustness: $TI_{i,t}$ instead of $FTI_{i,t}$ Return (imports and partners)

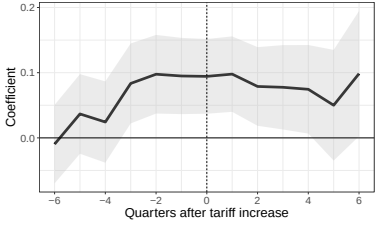
(a) Imports: asinh $(\text{import}_{i,t+k})$



(b) Count of partners: asinh$(|C_{i,t+k}|)$



(c) Inventories: asinh$(\text{inventory}_{i,t+k})$

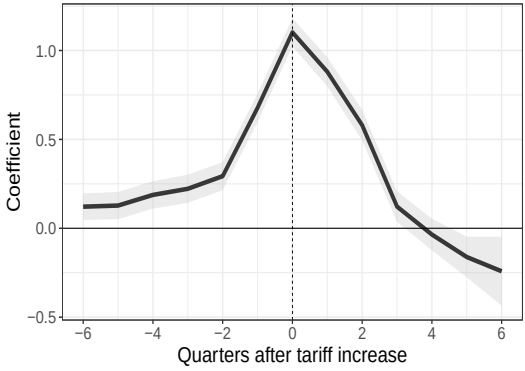


Robustness: existing import and partner set

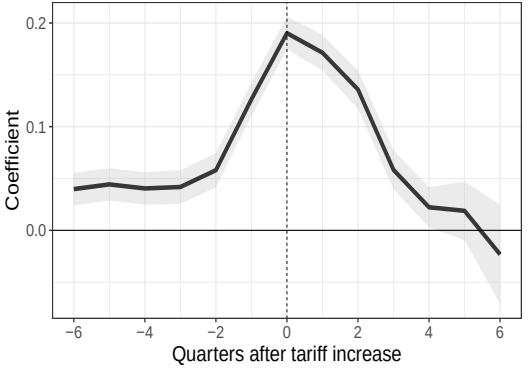
Return (imports and partners)

- "Existing" set $E_{i,t}$: product-countries the firm imported from over the past four quarters ($t-4$ through $t-1$).

(a) Existing imports: asinh $\left(\text{import}^{E}_{i,t+k}\right)$



(b) Count of existing partners: asinh($|E_{i,t+k}|$)



Heterogeneity across firm sizes: specification

Return (imports and partners)

- Assign firms to terciles (small, medium, large) by average quarterly sales.

  Even the "small" tercile is large relative to the universe of US firms, since the sample consists of Compustat firms.

- Estimate the regression with tercile interactions:

$$y_{i,t+k} = \sum_{g \in \{S,M,L\}} \beta_k^g \, D_i^g \, \text{FTI}_{i,t} + \mu_i + \mu_t + \Gamma' X_{i,t} + \epsilon_{i,t,k},$$

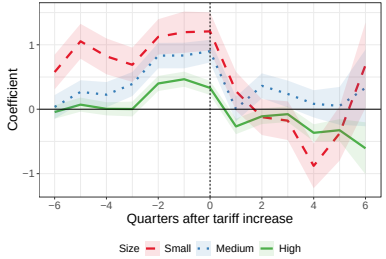
  where dummy D_i^g indicates firm i's tercile group.

$\rightarrow$ β_k^g measures the response of group g firms at horizon k.

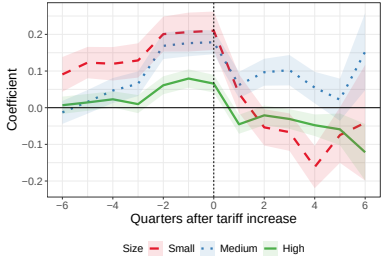
Heterogeneity across firm sizes: results

Return (imports and partners)

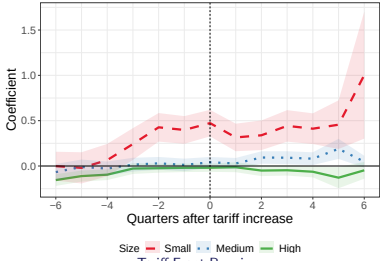
(a) Imports: asinh $\left(\text{import}_{i,t+k}\right)$



(b) Number of partners: asinh($|C_{i,t+k}|$)



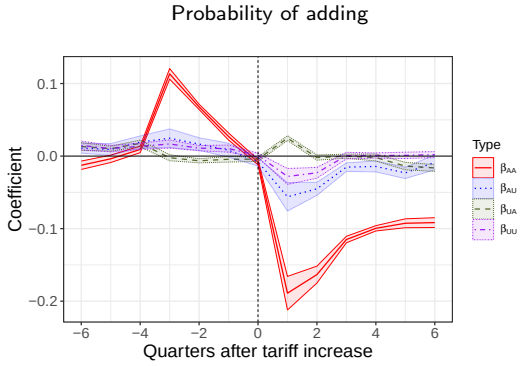
(c) Inventories: asinh($\text{inventory}_{i,t+k}$)



Extensive margin: adding a partner

Return (margins of adjustment)

- Adding a partner: imported a product-country in $t-1$ but did not import for the previous four quarters.

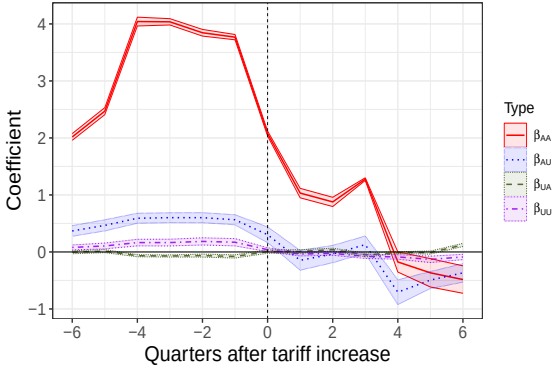


▷ The probability of adding AA and AU partners rises before the tariff and falls afterwards — the mirror image of dropping.

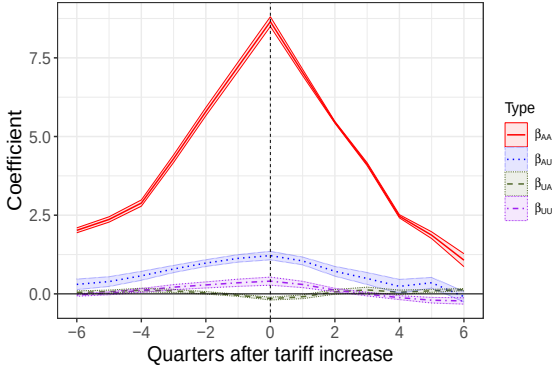
Intensive margin: current and existing imports

Return (margins of adjustment)

(a) Current imports: asinh($\text{import}_{i,h,c,t+k}$)



(b) Existing imports: asinh $\left(\sum_{j=k-4}^{k-1} \text{import}_{i,h,c,t+j}\right)$



Magnitude of import adjustments: setup

Return (margins of adjustment)

- Event time t: the first quarter in which one of firm i's country partners for product h faces a tariff increase.
- Decompose the firm's sourcing countries for product h around t.
- Empirics: $t-2$ and $t-1$ are when the anticipatory adjustments are the most active.
- Pre-adjustment country set: $PA_{i,h,t} \equiv \bigcup_{k=-6,\ldots,-3} \tilde{C}_{i,h,t+k}$.
- Adjustment-period country set: $DA_{i,h,t} \equiv \bigcup_{k=-2,-1} \tilde{C}_{i,h,t+k}$.
- Classify each country c into four types:
  - ▷ Continuing: $c \in PA \cap DA$.
  - ▷ Added: $c \in DA \setminus PA$.
  - ▷ Dropped: $c \in PA \setminus DA$.
  - ▷ Neither: $c \notin PA \cup DA$.
- Within each type, distinguish between *tariff-affected* and *unaffected* countries; the Added-Unaffected group reflects the within-product cross-country substitution (β_{AU}).

Magnitude of import adjustments: results

Return (margins of adjustment)

- For each firm-product-group (i, h, G) with event time t:

$$(\text{Country-group import share})_{i,h,G} \equiv \frac{\sum_{c \in G} \left(\sum_{s \in \{t-2, t-1\}} x_{i,h,c,s} \right) / 2}{\sum_{c \in PA_{i,h,t}} \left(\sum_{s \in \{t-6, \ldots, t-3\}} x_{i,h,c,s} \right) / 4}.$$

Average quarterly imports from group G at $[t-2, t-1]$ relative to firm-product (i, h)'s pre-adjustment average.

Country-group import shares by partner type (%)

Type	Tariff at t	Nobs.	Q1	Q2 (Median)	Q3
Added	Affected	33,883	12.3	89.8	624.8
	Unaffected	9,418	1.9	**15.0**	114.9
Continuing	Affected	27,340	30.5	95.4	249.0
	Unaffected	10,404	11.6	48.2	126.0

▷ Added-Unaffected: median is 15.0% of pre-adjustment imports—quantitatively smaller than other groups, but still significant; new country partners play a supplementary sourcing role.

Appendix: model and counterfactual

Import manager: static problem

Return (importer)

(i) Demands a unit continuum of varieties v to produce the input:

$$y = \left[\int_0^1 x(v)^{\frac{\rho-1}{\rho}} \, dv \right]^{\frac{\rho}{\rho-1}}.$$

(ii) Each variety v can be sourced from J potential countries.

- Variety v in country j is produced by competitive suppliers with unit labor requirements $a_j(v)$.
- The manager can procure variety v from a supplier in country j at cost $\tau_j \, a_j(v) \, w_j$.
- Given the optimal set of partners $\mathcal{J}$, the cost of purchasing v is

$$z(v, \mathcal{J}) = \min_{j \in \mathcal{J}} \{ \tau_j \, a_j(v) \, w_j \}.$$

(iii) Chooses $\mathcal{J} = \{j \in J : I_j = 1\}$ to minimize costs of sourcing input demand n given fixed costs $\{f_j\}_{j \in J}$.

$$\min_{\{x(v)\}_v, \, \{I_j \in \{0,1\}\}_j} \int_0^1 z(v, \mathcal{J}) \, x(v) \, dv \; + \; w \sum_{j=1}^{J} I_j \, f_j, \quad \text{s.t. } y \geq n.$$

Import manager: propositions Return (importer)

Assumption Fixed costs of importing are common across countries: $f_j = f$ for all $j \in J$.
(Blaum, Lelarge, and Peters 2018)

Proposition 1. The solution $\mathcal{J}$ is such that

(i) Countries are added to the optimal sourcing set according to their sourcing potential:
If $k \in \mathcal{J}(n)$ and $T_k \left(\tau_k\, w_k\right)^{-\theta} \leq T_j \left(\tau_j\, w_j\right)^{-\theta}$, then $j \in \mathcal{J}(n)$.

(ii) A higher input demand expands the optimal sourcing set, which lowers the marginal cost:
If $n_{\text{low}} < n_{\text{high}}$, then $\mathcal{J}(n_{\text{low}}) \subset \mathcal{J}(n_{\text{high}})$, and $c\left(\mathcal{J}(n_{\text{low}})\right) \geq c\left(\mathcal{J}(n_{\text{high}})\right)$.

Proposition 2. Let $\{j_1, j_2, ..., j_J\}$ denote the ranking of countries, $\{n_1, n_2, ..., n_J\}$ the associated demand thresholds for a country to be added to the optimal sourcing set, and $\{c_1, c_2, ..., c_J\}$ the marginal cost for each threshold. Then,

$$\frac{\partial(p(n)\, n)}{\partial\, n} = c_k \quad \text{if } n \in [n_k, n_{k+1}).$$

Calibration

Return (anticipated tariff) Untargeted moments

Predetermined parameters

Parameter		Value	Comment
Elasticity of sub, y^f	ϵ	4	33% markup
Elasticity of sub, v	ρ	2	Antras, Fort, Tintelnot (2017)
Variability of productivities	θ	1.789	Antras, Fort, Tintelnot (2017)
Wages	w_j	1	Normalize to one
Countries	J	17	Sourcing countries, 75th percentile
Discount rate	β	$0.96^{1/4}$	4% annual interest rate
Storage costs	δ	0.05	20% annual rate (Richardson 1995)

Calibrated parameters (target: moments in 2015)

Parameter		Value	Moment	Data	Model
Fréchet technology	$\{T_j\}$	Next page	Import shares in 2015 for the top 17 sourcing countries		
Fixed cost of importing	f	0.005	Average number of sourcing countries, 2015	13.0	13.2
Variance of demand	σ_ν	0.78	Inventories over sales, 2015	2.1	2.2
			Demand shocks: $\log(\nu) \sim N(1, \sigma_\nu)$		

Tariffs

Parameter			Moment
Tariff increase	$\Delta\, \tau_j$	Next page	Increase in average import tariffs: 2015–2019

Calibrated parameters

Return (anticipated tariff)

Parameter		Value	Data	Model
			Mean sourcing countries, 2015	
Fixed cost of importing	f	0.005	13.0	13.2
			Mean inventories to sales, 2015	
Variance of demand	σ_ν	0.78	2.1	2.2
Technology parameter	$\{T_j\}$		Import shares, 2015	
1 China		0.82	21.5%	22.4%
2 Rest of the world		0.74	19.5%	20.3%
3 Mexico		0.51	13.2%	14.1%
4 Canada		0.51	13.2%	14.1%
5 Japan		0.27	5.8%	6.6%
6 Germany		0.26	5.6%	6.2%
7 South Korea		0.15	3.2%	2.4%
8 U.K.		0.12	2.6%	2.0%
9 France		0.10	2.1%	1.6%
10 India		0.09	2.0%	1.5%
11 Italy		0.09	2.0%	1.5%
12 Taiwan		0.08	1.8%	1.4%
13 Ireland		0.08	1.7%	1.3%
14 Vietnam		0.08	1.7%	1.3%
15 Malaysia		0.07	1.5%	1.2%
16 Switzerland		0.06	1.4%	1.1%
17 Thailand		0.06	1.3%	1.0%

Increase in tariffs

Return (anticipated tariff)

Increase in tariffs (percentage points)

Country		$\Delta_{2019-2015}\ \tau_{c,t}$
1	China	15.05
2	Rest of the world	0.00
3	Mexico	0.21
4	Canada	0.32
5	Japan	0.18
6	Germany	0.13
7	South Korea	0.00
8	U.K.	0.00
9	France	0.10
10	India	0.12
11	Italy	0.14
12	Taiwan	0.25
13	Ireland	0.00
14	Vietnam	0.00
15	Malaysia	1.70
16	Switzerland	0.07
17	Thailand	0.81

$\tau_{c,t} \equiv \frac{\sum_{i,h} x_{i,h,c,t}\ \tau_{h,c,t}}{\sum_{i,h} x_{i,h,c,t}}$, where x denotes firm i's imports of product h from country c.

Untargeted moments

Return (firm-level results) Return (calibration)

Import shares in 2019

		Data	Model	Diff. (pp)
1	China	18.1%	19.1%	-1.0
2	Rest of the world	19.3%	21.6%	-2.3
3	Mexico	14.3%	15.0%	-0.8
4	Canada	12.8%	15.0%	-2.2
5	Japan	5.8%	7.1%	-1.3
6	Germany	5.1%	6.7%	-1.6
7	South Korea	3.1%	2.3%	0.8
8	U.K.	2.5%	1.9%	0.7
9	France	2.3%	1.5%	0.8
10	India	2.3%	1.4%	0.9
11	Italy	2.3%	1.4%	0.9
12	Taiwan	2.2%	1.3%	0.9
13	Ireland	2.5%	1.3%	1.2
14	Vietnam	2.7%	1.2%	1.4
15	Malaysia	1.6%	1.1%	0.6
16	Switzerland	1.8%	1.0%	0.8
17	Thailand	1.3%	0.9%	0.4

- Pre-tariff firm-level response at $t = -1$
  - ▷ **Data** (log specification): imports 8.7% ↑, inventories 2.7% ↑, partners 0.7 ↑ (0.057*13).
  - ▷ **Model**: imports 30% ↑, inventories 18% ↑, partners 0.8 ↑.