

The Effect of Tariffs on U.S. Producer Prices: Firm-Level Evidence From the 2018–19 Trade War

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Introduction

- A central question in intl trade concerns the effect of import tariffs on domestic prices.
- Growing literature documents near-complete pass-through of 2018–19 tariffs to *import* prices. ([Amiti, Redding, & Weinstein \[2019\]](#); [Fajgelbaum et al. \[2020\]](#); [Cavallo et al. \[2021\]](#))
- About half of U.S. imports are intermediate inputs — and the 2018–19 tariffs fell mainly on them.
- This paper studies the second link:

How much do input tariffs raise domestic output prices?

This paper

- First firm-level evidence on input-tariff pass-through to U.S. producer prices
 - Novel microdata: **LFTTD** (Census imports) $\times$ **PPI** (BLS output prices)
 - For each firm-month: import portfolio (products, countries, duties paid) + output prices
 - Firm-level effective input tariffs (extending Amiti–Redding–Weinstein, 2019); Bartik IV with 2017 import shares
- Model of endogenous supplier choice, variable markups, and input–output linkages
 - Says what a *firm-level* and a *sector-level* regression each identify
 - Prices the cost of *avoiding* a tariff: what a firm loses when it drops an origin
 - Delivers aggregate producer-price responses, including a universal-tariff counterfactual

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Main findings

- Input tariffs pass through to producer prices: $\hat{\beta}^{IV} \approx 0.5\text{--}0.6$ per unit of imported-input intensity, complete within 12 months
- First stage $\approx 2/3$: effective tariffs rise by only two-thirds of the statutory shock
firms reallocate away from taxed origins
- Our model reconciles firm-level and industry-level estimates (0.5–0.6 vs. ARW's 1.87)
within an industry: *relative* cost shocks, dampened by markups and the network
across industries: the *common* shock, amplified by sourcing and the network
- *Aggregates*: China tariffs **+0.47 pp** on manufacturing PPI; universal 15% tariff **+3.3 pp**
— about **7×** as inflationary

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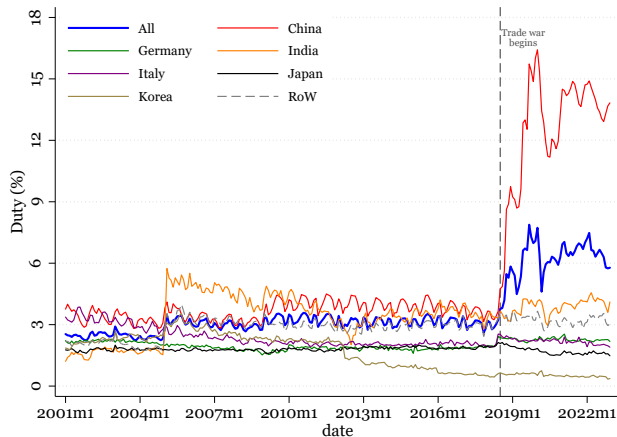
Data and Measurement

Linked LFTTD-PPI microdata at the firm level

LFTTD	Universe of U.S. import transactions (firm-HTS10-country-month). Customs value, duties paid, rate provision codes
BLS PPI	Transaction-level, quality-adjusted output prices for individual manufactured goods
CMF (2017)	Establishment-level: shipments, material costs, wage bills
LBD	Aggregates CMF establishments to firm level

- No common identifier between PPI and LFTTD $\Rightarrow$ multi-step name-matching algorithm
- Baseline sample: Jan 2017 – Dec 2019 (~ 300 k firm-product-month obs., $\sim 3,100$ firms)
- Extended: Jan 2017 – Dec 2022 (adds Phase One + COVID; ~ 550 k obs., $\sim 3,500$ firms)
- Dependent variable: 12-month log price change $\Delta_{12} \log p_{j,k,i,t}$, winsorized at 0.1%/99.9%

The 2018–19 US-China trade war



Effective duty rate $\tau_{c,t}^{\text{eff}}$ by country, monthly 2001–2022.

Computed from LFTTD as duties paid/customs value, aggregated across products within each country.

Firm-level input tariff exposure

Step 1. Effective tariff at HTS10-country-month from LFTTD:

$$\tau_{h,c,t}^{\text{eff}} = \frac{\sum_j v_{j,h,c,t}^{\text{import}} \tau_{j,h,c,t}}{\sum_j v_{j,h,c,t}^{\text{import}}}$$

where $v_{j,h,c,t}^{\text{import}}$ = import value, $\tau_{j,h,c,t}$ = firm j 's applied tariff rate.

Step 2. Aggregate to firm-month using rolling 12-month import shares:

$$\Delta \log(1 + \tau_{j,t}^{\text{input,eff}}) = \sum_{(h,c)} \omega_{(h,c) \rightarrow j,t}^{(12m)} \log(1 + \tau_{h,c,t}^{\text{eff}}) - \sum_{(h,c)} \omega_{(h,c) \rightarrow j,t-12}^{(12m)} \log(1 + \tau_{h,c,t-12}^{\text{eff}})$$

- Captures within-industry heterogeneity in sourcing patterns
- Uses contemporaneous LFTTD weights, not outdated BEA I-O tables

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Endogeneity problem

- Firm-level effective tariff uses *contemporaneous* import weights $\omega_{(h,c) \rightarrow j,t}^{(12m)}$
- Firms **substitute away** from tariffed inputs:
 - Shift toward domestic varieties and toward untaxed origins (intensive margin)
 - Drop an origin; switch to another or stop importing (extensive margin)
- Two reasons OLS is biased toward zero:
 - firms that drop a taxed origin raise prices with little measured tariff
 - the rolling import weights also shift for reasons unrelated to the tariffs

⇒ Instrument with **pre-war import shares** × **statutory rates**

Bartik IV: pre-trade-war import shares $\times$ *de jure* tariff changes

$$\Delta \log(1 + \tau_{j,t}^{IV, \text{dejure}}) = \sum_{(h,c)} \underbrace{\frac{v_{(h,c) \rightarrow j}^{(2017)}}{\sum_{(h',c')} v_{(h',c') \rightarrow j}^{(2017)}}}_{\text{"Share": 2017 import portfolio}} \cdot \underbrace{\Delta \log(1 + \tau_{h,c,t}^{\text{dejure}})}_{\text{"Shift": policy-set tariff change}}$$

- **Relevance:** 2017 portfolios predict contemporaneous effective tariff.
First-stage coeff. 0.65–0.74; *F*-stat 229–874.
- **Exogeneity:** 2017 portfolios pre-date the trade war (first Section 301 list: June 2018);
de jure rates measured as max observed rate by HTS10-country.

De facto IV (using actual duties paid) gives near-identical second-stage estimates.

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Exposure: imported-input intensity

Industry exposure measures from firm-level 2017 CMF, LBD, and LFTTD data:

$$\text{Import share: } IS_i = \frac{\text{imports}_i}{\text{imports}_i + \text{sales}_i - \text{exports}_i}$$

$$\text{Imported-input intensity: } III_i = IS_i \times \frac{\text{material cost}_i}{\text{material cost}_i + \text{wage bill}_i}$$

	Mean	P25	P50	P75
Δ_{12} input tariff (pp)	0.46	-0.15	0.00	0.45
Δ_{12} output tariff (pp)	0.54	-0.02	0.01	0.53
Import share, IS_i (%)	30.0	8.4	23.6	45.0
Imported-input intensity, III_i (%)	20.6	6.6	17.3	31.5

- Tariff changes are right-skewed: median firm sees ≈ 0 , the right tail carries the shock

Preferred empirical specification:

$$\Delta \log p_{j,k,i,t} = \beta [III_i \cdot \Delta \log(1 + \tau_{j,t}^{\text{input,eff}})] + \eta_j + \delta_{i,t} + \varepsilon_{j,k,i,t}$$

j, k, i, t	firm j , product k , NAICS6 industry i , month t
$\tau_{j,t}^{\text{input,eff}}$	firm j 's effective input tariff (12-m rolling import-share weights)
III_i	industry imported-input intensity (CMF $\times$ LBD $\times$ LFTTD)
η_j	firm FE: market power, product mix, import dependence
$\delta_{i,t}$	industry $\times$ month FE: output-tariff (competition) channel and other industry shocks

- Estimator: OLS and 2SLS (Bartik IV); SE clustered at firm level
- Identification: firms in the same industry-month with different import portfolios

Results

Pass-through estimates

Results

	Spec without <i>///</i>		Spec with <i>///</i>	
	OLS	IV	OLS	IV
Pass-through coeff.	0.135 (0.026)	0.203 (0.035)	0.349 (0.106)	0.577 (0.143)
First stage	0.738		0.669	
Sample	2017–2019; ~300k obs.; ~3,100 firms			
Fixed effects	firm + month (with industry × month: IV 0.144 and 0.579)			

- Per unit of imported-input intensity, IV pass-through of **0.58**
- First stage **well below one**: firms reallocate
- IV exceeds OLS by 65%: as expected from reallocation and measurement error

Magnitudes

- $\hat{\beta}^{IV} = 0.58$ per unit of imported-input intensity (III)
- Suppose a China-specific tariff increase of 15 pp:
 - For a typical importer ($III = 0.20$, China share 0.17):

$$\begin{aligned}\Delta \log p_j &= \hat{\beta}^{IV} \cdot III_i \cdot s_{j, \text{China}} \cdot \Delta \log(1 + \tau_{\text{China}}) \\ &= 0.58 \times 0.20 \times 0.17 \times \log(1.15) \approx \mathbf{0.28 \text{ pp}}\end{aligned}$$

- For a firm fully exposed to China ($III = 1$, all China):

$$\Delta \log p_j = 0.58 \times 1 \times 1 \times \log(1.15) \approx \mathbf{8.1 \text{ pp}}$$

- Pass-through is essentially complete within 12 months

Specification	$\hat{\beta}^{IV}$ (s.e.)
Baseline (de jure, 2017–19, unweighted)	0.577 (0.143)
De facto IV	0.600 (0.145)
24-month horizon	0.624 (0.152)
Industry $\times$ month FE	0.579 (0.149)
BLS-importance weighted	0.531 (0.141)
Extended sample (2017–2022, incl. COVID)	0.556 (0.154)

- All estimates in **0.49–0.63**
- Stable across IV construction (de jure vs. de facto), FE structure, weighting
- 12- vs. 24-month indistinguishable: **pass-through complete within 12 months**
- Weighted < unweighted throughout: larger firms pass through less

Four empirical facts, one model

- 1 **Firms reallocate.** First stage=**0.65**: duty bills rose by two-thirds of the statutory shock — mostly because firms shifted away from taxed inputs
- 2 **Within an industry, pass-through is below one.** IV=**0.58**
- 3 **Larger firms pass through less.** Size-weighted IV 0.49 vs. 0.58 unweighted; weighted is lower in every specification
- 4 **Across industries, pass-through is above one.** Amiti-Redding-Weinstein (2019): **1.87**

$$\Delta_{12} \ln PPI_{i,t} = \underset{(0.70)}{1.87} III_i \Delta \ln(1 + \tau_{i,t}^{\text{input}}) + \underset{(0.20)}{0.40} IS_i \Delta \ln(1 + \tau_{i,t}^{\text{output}}) + \alpha_i + \delta_t$$

One model, four facts: sourcing choice (1, 4); variable markups (2, 3); the input–output network (2, 4)

Model

Sourcing, markups, and the input–output network

A model with endogenous sourcing

Builds on Halpern–Koren–Szeidl (2015), Antràs–Fort–Tintelnot (2017), Amiti–Itskhoki–Konings (2019), and Caliendo–Parro (2015)

- CES between domestic and imported inputs, and among origins (*intensive margin*)
- Firms choose origins at a fixed cost per origin, random across firms (*extensive margin*)
- Cournot competition within industries; input–output network across industries

What the model delivers:

- Separates duties paid from costs borne
- Shows why firm- and industry-level regressions identify different objects
 - Relative shocks are dampened by markups.
 - Common shocks propagate through the network and sourcing.
- Quantifies the aggregate impact on producer prices

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Setup: marginal cost depends on a portfolio of origins

Technology. $Y_f = A_f X_f^{\phi_s} L_f^{1-\phi_s}$. Intermediates X_f are CES in domestic and imported inputs

$$X_f = \left(a_D^{\frac{1}{1+\zeta}} Z_f^{\frac{\zeta}{1+\zeta}} + a_M^{\frac{1}{1+\zeta}} M_f^{\frac{\zeta}{1+\zeta}} \right)^{\frac{1+\zeta}{\zeta}}, \quad M_f = \left(\sum_{c \in \mathbf{J}_f} \xi_c^{\frac{1}{1+\eta}} M_{f,c}^{\frac{\eta}{1+\eta}} \right)^{\frac{1+\eta}{\eta}}.$$

Sourcing capability, $\Xi_f = \sum_{c \in \mathbf{J}_f} \tilde{\xi}_c$ with $\tilde{\xi}_c \equiv \xi_c (p_c^M)^{-\eta}$, lowers marginal cost:

$$MC_f = \frac{C_s^*}{A_f} \mathbf{B}(\Xi_f)^{-\phi_s}, \quad \mathbf{B}(\Xi) \equiv \left(1 + \frac{a_M}{a_D} p_{D,s}^\zeta \Xi^{\zeta/\eta} \right)^{1/\zeta}.$$

Imported input intensity is $III_f = \phi_s \alpha_f$, where $\alpha_f = 1 - \mathbf{B}(\Xi_f)^{-\zeta}$ is the import share.

A tariff at a fixed set of origins ($\hat{\tau}_f \equiv \sum_{c \in \mathbf{J}_f} s_{f,c} \hat{\tau}_c$, $s_{f,c} = \tilde{\xi}_c / \Xi_f$):

$$d \ln MC_f = \underbrace{III_f \hat{\tau}_f}_{\text{tariff}} + (\phi_s - III_f) d \ln p_{D,s}$$

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Setup: firms choose origins in a pecking order

A fixed cost per origin. Firm f chooses J_f to minimize $TVC_f(J) + |J| \varepsilon_f C_F$, with $\varepsilon_f \sim F(\cdot)$ a firm-specific draw. Origins are ranked by sourcing potential $\tilde{\xi}_c$, and the k -th is worth its fixed cost iff

$$\varepsilon_f \leq \varepsilon_f^{(k)} \equiv \frac{TVC(\Xi_{k-1}) - TVC(\Xi_k)}{C_F}.$$

A pecking order. Sourcing sets are nested with decreasing cutoffs:



Prop. 1 (two margins). With $F_k \equiv F(\varepsilon_f^{(k)})$, the share of firms using at least k origins,

$$\begin{aligned} d\mathbb{E}[MC_f] &= \underbrace{\sum_k (F_k - F_{k+1}) dMC_f^{(k)}}_{\mathcal{I}: \text{intensive}} + \underbrace{\sum_k MC_f^{(k)} (dF_k - dF_{k+1})}_{\mathcal{E}: \text{extensive}} \\ &= (1 + q)\mathcal{I}, \quad \text{if } F(x) = (x/\bar{\varepsilon})^q. \end{aligned}$$

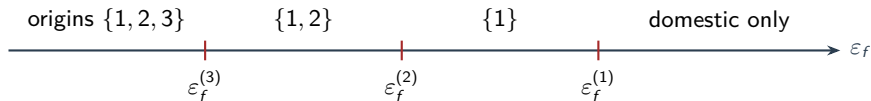
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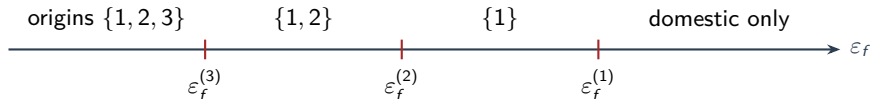
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Variable markups with endogenous sourcing

Demand and competition (AB2008; AIK2019): nested CES, θ across industries, $\rho > \theta$ within;
Cournot: $1/\sigma_f = \varsigma_f/\theta + (1 - \varsigma_f)/\rho$, so the markup $\mu_s(\varsigma_f)$ rises with market share.

Prop. 2 (markups and sourcing). Price, output, and the sourcing set are chosen jointly:

$$\ln P_f = \ln MC_f^{(k_f)} + \ln \mu_s(\varsigma_f), \quad k_f = k(\varepsilon_f, Q_f)$$

- AIK's fixed point **plus the extensive margin**: the sourcing set depends on output, output on the price, and the price on the sourcing set

Prop. 3 (pass-through).

$$d \ln P_f - d \ln P_s = \psi_f (d \ln MC_f - d \ln P_s), \quad d \ln P_s = \mathbb{E}_\varsigma[d \ln MC_f] + \frac{\text{Cov}_\varsigma(\psi_f, d \ln MC_f)}{\mathbb{E}_\varsigma[\psi_f]}$$

- Relative shock**: loses share, trims its markup: $\psi_f < 1$, least for large firms (facts 2, 3)
- Common shock**: shares and markups stay put, and the index rises one for one (fact 4)

Variable markups with endogenous sourcing

Demand and competition (AB2008; AIK2019): nested CES, θ across industries, $\rho > \theta$ within; Cournot: $1/\sigma_f = \varsigma_f/\theta + (1 - \varsigma_f)/\rho$, so the markup $\mu_s(\varsigma_f)$ rises with market share.

Prop. 2 (markups and sourcing). Price, output, and the sourcing set are chosen jointly:

$$\ln P_f = \ln MC_f^{(k_f)} + \ln \mu_s(\varsigma_f), \quad k_f = k(\varepsilon_f, Q_f)$$

- AIK's fixed point **plus the extensive margin**: the sourcing set depends on output, output on the price, and the price on the sourcing set

Prop. 3 (pass-through).

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What the two regressions identify

1. Roundabout production (Caliendo–Parro 2015). Domestic inputs are a Cobb–Douglas bundle of other industries' output, with use-table weights $\omega_{s,s'}$:

$$Z_f = \prod_{s'} Z_{f,s'}^{\omega_{s,s'}} \quad \Rightarrow \quad \Delta \ln p_{D,s} = \sum_{s'} \omega_{s,s'} \Delta \ln P_{s'}$$

2. Within industries:

$$\beta^{\text{firm}} = \sum_s w_s \underbrace{\psi_s}_{\text{markup}} \Theta_s, \quad \Theta_s = 1 - \underbrace{\gamma_s}_{\text{network}} \quad (\text{Prop. 6})$$

3. Across industries:

$$\mathbb{E}[\Delta \ln \mathbf{P}] = \nu \left[I - \Phi \text{diag}(1 - \nu \bar{\alpha}_s) \Omega \right]^{-1} \Lambda^\tau \quad \Rightarrow \quad \beta^{\text{sec}} = \underbrace{\nu}_{\text{sourcing}} \left(1 + \underbrace{A_\nu}_{\text{network}} \right) \quad (\text{Props. 5, 7})$$

Markups enter β^{firm} but not β^{sec} ; the network raises β^{sec} and lowers β^{firm} ; sourcing raises β^{sec} .

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Quantification

Calibrated without price data

Within industries: network and markups pull β^{firm} below one

- **Network**, $1 - \gamma_s$. A heavier importer buys fewer domestic inputs, whose price also rises: its cost rises by the tariff *net of* that increase.
- **Markups**, ψ_s . A firm whose cost rises relative to its rivals loses share and cuts its markup.

	Within industry	Across industries
Complete pass-through, fixed sourcing sets	1.00	1.00
+ network	0.905	1.33
+ variable markups	0.75	1.29
+ sourcing, $q = 0.5\text{--}1.15$	0.64–0.79	1.44–1.94
Estimate	0.38–0.65	1.87

Gap shares: markups 24–56%, network 27%, sourcing 20–23%.

Across industries: network and sourcing push β^{sec} above one

- **Markups wash out.** A common shock leaves shares and markups unchanged.
- **Network,** $1 + A_\nu$. Industry prices also carry dearer domestic inputs, which rise more in the industries that are more exposed directly ($A_\nu = 0.33$).
- **Sourcing,** $\nu = 1 + q$. The firms that drop a taxed origin also bear its cost.

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Estimate	0.38–0.65	1.87

Gap shares: network 38%, sourcing 53–75%.

Aggregates: the tariff bill understates the PPI response

- **Network, level** m_s . Each industry's tariff bill is scaled up by its multiplier $m_s \geq 1$:
$$\Delta \ln P^{PPI} = \sum_s \vartheta_s m_s \Lambda_s^\tau$$
- **Markups barely matter.** Common shocks pass through one for one.
- **Sourcing, $\nu = 1 + q$.** It multiplies the direct effect and dampens each round of propagation.

Manufacturing PPI (pp)		
	China	Universal 15%
Tariff bill, pre-tariff import shares	0.267	1.642
+ network	0.438	2.975
+ variable markups	0.426	2.901
+ sourcing, $q = 0.5-1.15$	0.470-0.562	3.346-4.001

A universal tariff is about seven times as inflationary: no untaxed origin to switch to, and every domestic supplier's price rises at once.

Conclusion

Input tariffs pass through to producer prices at 0.5–0.6 per unit of imported-input intensity, complete within 12 months

Firms reallocate away from taxed origins — first stage $\approx 2/3$

Firm-level and sector-level regressions identify different objects. Within industry: relative shocks dampened by markups. Across industries: the common component, amplified by the network and sourcing.

A universal tariff is $\approx 7\times$ as inflationary as the China tariffs (+3.3 pp vs. +0.47 pp): the escape valve closes and every supplier's price rises at once

Thank you. Comments welcome.