Elasticities of Related-party Trade

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Introduction

Motivation

- MNEs trade: home Multinationals (MNE) export or import from foreign affiliates $\implies$ channels of engaging in Global value chain
  - Further decomposed into the "related-party" versus "arms-length."
- Firm's sourcing problem: import decisions are known to be shaped by the existence industry-specific sunk costs and trade shocks.
- Both, separately, are studied extensively by firm dynamics contexts.
- But little is known about their combination: **MNEs' related-party imports under tariff shocks?**

Research Question

- How do Multinationals (MNEs) respond differently to short-run tariff shocks?

Motivation (Cont'd)

- **Why should we care?**
  1. The majority investigate MNEs' productivity and export patterns but *rarely* look into their import decisions and intensive margins.
  2. Two *opposite* forces for MNEs' import demand upon trade shocks:
     - **(−)** : potential negative effect by higher trade costs and/or trade diversion
     - **(+)** : potential compensating effect by intrafirm rigidity (e.g. contracts) and/or adjustment costs

- Yet, the effects are not quite clear at this moment

- A puzzle of MNEs' trade patterns and import demand rigidities under trade shocks!

Contribution

- **How?** It turns out the puzzle is tractable via exploring **related-party import elasticity** (σ).

- Exogeneous Tariff shock: the 2017-18 Trump tariffs (1^{st} wave: Jan 2018)

- The **contributions** are threefold:
  ① **(Channel).** Refine the short-run shock responses "trade elasticity" by related-party channel (σ_{MNE}) and arms-length channel (σ_{NMNE}).

  ② **(Related-party).** Estimated $\sigma_{MNE} \in [-1.578, -1.955]$ and are *more elastic* than NMNEs' ($|\sigma_{NMNE}| < |\sigma_{MNE}|$).

  ③ **(Implication).** MNE importers are *more responsive* to $\Delta\boldsymbol{\tau}$ under complete pass-through than NMNE. May reflect the "profit-shifting" process.

Literature Review

- **Key literatures**: Amiti et al. (2019) (Trump 2017-18 tariffs, elasticity and welfare) & Cox (2023) (Bush 2003-04 Steel tariffs shocks and persistent response)
- This related-party elasticity exercise finds the connection between the above two studies. (Heterog. Rp share $\overset{?}{\rightarrow}$ Heterog. responses)
- Several more studies for empirical & theoretical guidance:
  - ⊛ **Elasticity & Welfare**: Fajgelbaum et al. (2020) (Comprehensive study of the Trump tariffs), Alvarez and Lucas (2007)
  - ⊛ **MNEs & Intrafirm**: Ramondo et al. (2016), Bernard et al. (2006), Ruhl (2015) (intrafirm measurement), Costinot and Rodríguez-Clare (2014) (Structural trade theory), Antràs et al. (2017) (Structural MNEs)
  - ⊛ **Intl Finance**: Engel and Wang (2011) (Durable vs nondurable)

Empirical Framework

Classification and Aggregation

- Two main systems of classification code:
  - Harmonized Tariff Schedule (HTS)
  - North American Industry Classification System (NAICS)
- Define some **levels of aggregation** throughout this MNE elasticities exercise:
  - Sector level: NAICS4
  - Industry level: NAICS6
  - Commodity level: HS10[1]
- In addition, tariff policies vary at HS8 level

[1] In literature, there is a standard crosswalk between HTS10 and NAICS6– the Pierce and Schott (2012) concordance.

Data

Two datasets are used for estimations of related-party elasticities:

- Amiti et al. (2019)
  - Monthly data on U.S. imports and tariff change from January 2017 to December 2018. Prices are *before-duty* unit values.
  - Coded at (HTS10 $\times$ Country $\times$ Month) level; matched with NAICS6.
- Related Party Time Series Data
  - Publicly available annual records of bilateral total imports, exports, related-party trade imports, and related-party trade exports.
  - Coded at (NAICS6 $\times$ Country $\times$ Year) level.
  - "α_r": I calculate "Share of related-party Imports":[2]

$$\%RelatedParty := \frac{v_{ijt}^{r}}{v_{ijt}} = \frac{v_{ijt}^{r}}{v_{ijt}^{r} + v_{ijt}^{a}} \equiv \alpha_r \tag{1}$$

[2] In Table 1 summary statistics I did not multiply it by 100. Also see Antràs and Yeaple (2014) Section 7 Table (2.5). Here I restrict imports to be decomposed into **related-party** and arms-length parts.

Proof of Concept

- I have not yet shown but taken advantage of relating **share of related-party imports** to **MNE concentration** already.
- **Assumption. (Data)** By reordering, the MNE concentration $m \in \mathbb{R}_+$ has $\sup m = \mathcal{M},\ \mathbb{E}|\mathcal{M}| < \infty$ (finite), $\mathcal{M} \neq 0$, in data.
- **Proposition.** *The MNE concentration $m \in [0, \mathcal{M}]$ is order isomorphic to the share of related-party trade $\alpha_r \in [0, 1]$.*
    - *Proof. See Appendix A.1.* $\square$
- **Remark.** Use the share of related-party imports to help proxy trade elasticities of Multinationals (i.e., shock responses).

Defining MNE

By **Proposition**, I don't know MNE concentration but can instead examine the share of related-party imports α_r:

① WLOG, assume all firms source intermediate goods only

② **(MNE).** Firms source $\alpha_r \in [0, 1]$ share of goods from their foreign affiliates/related parties.

- ($\alpha_r = 1$) *All* imports are related-party $\longrightarrow$ MNE (✓)
- ($\alpha_r \in (0, 1)$) *Some* imports are related-party $\longrightarrow$ MNE (✓)
- ($\alpha_r = 0$) *None* of imported goods are related-party $\longrightarrow$ NMNE

Remark. A firm is MNE if and only if $\alpha_r \in (0, 1]$.[3]
Remark. Since MNEs have $\alpha_r > 0$, I define $\tilde{\alpha}_r^+ \equiv \text{median}(\alpha_r; \alpha_r > 0)$.

[3] This definition of MNE is second-best since no firm-level data.

Baseline Estimation

Baseline Estimation

- Building on Amiti et al. (2019) and Fajgelbaum et al. (2020), I first consider the reduced form:

$$\underbrace{\Delta \ln q_{ijt}}_{\%\Delta \text{quantities}} = \sigma \underbrace{\Delta \ln (1 + \tau_{ijt})}_{\%\Delta \text{tariffs}} + \mu_j + \zeta_{it} + \xi_{ijt}, \tag{2}$$

where i: import origins, j: commodity/sector, and t: time.

  - μ_j: commodity (HS10) fixed effect
  - ζ_{it}: country $\times$ time fixed effect
  - ξ_{ijt}: unobserved Supply/Demand shocks
  - Clustered-robust standard errors at HS8

Threats to Identification

- Revisit Equation (2):

$$\underbrace{\Delta \ln q_{ijt}}_{\equiv \Delta \mathbf{q}} = \sigma \underbrace{\Delta \ln \left(1 + \tau_{ijt}\right)}_{\equiv \Delta \boldsymbol{\tau}} + \mu_j + \zeta_{it} + \xi_{ijt},$$

- **Empirical assumptions**:
  ① Idiosyncratic errors: The Trump tariffs ($\Delta \boldsymbol{\tau}$) were *unanticipated* (exogeneous) and uncorrelated to unobserved $\boldsymbol{\xi}$.[4]
  ② Complete pass-through: No impact of tariffs to before-duty prices.

- Potential Threats/Limitations:[5]
  - Simultaneity $\longrightarrow$ instrument duty-inclusive prices by $\Delta \boldsymbol{\tau}$ (structural; also need foreign exports)
  - Tariff Anticipation $\longrightarrow$ ① is a *strong* assumption
  - Complete tariff pass-through $\longrightarrow$ supportive evidence in Table 2

[4] Also see discussion in Amiti et al. (2019), Fajgelbaum et al. (2020), Cox (2023)
[5] Also see discussion in Fajgelbaum et al. (2020) Section III.C.5.

Estimation Strategy

- Ideally, I should run two OLS & get $\boldsymbol{\sigma}$ (split related-party vs arms-length)
- **Problem.** The related-party trade data is at *industry-level* aggregation, not as *commodity-level* as in Amiti et al. (2019) data (i.e., $\boldsymbol{\sigma}$ is not right).
- This paper proceeds with this alternative specification:[6]

$$\Delta \ln q_{ijt} = \underbrace{\phi_B \Delta \ln (1+\tau_{ijt})}_{\text{standalone}} + \underbrace{\phi_{MNE} \Delta \ln (1+\tau_{ijt}) \times \% RelatedParty}_{\text{diff. effect of related-party(MNE)}} + \mathbf{e}, \qquad (3)$$

where $\mathbf{e} = \mu_j + \zeta_{it} + \xi_{ijt}$.

[6] Also see Draft Section 3.2 **Strategy (A2)**.

Elasticities for Non/Multinationals

Denote $\Delta\mathbf{q} \equiv \Delta \ln q_{ijt}$, $\Delta\boldsymbol{\tau} \equiv \Delta \ln(1+\tau_{ijt})$, $\alpha_r \equiv \%\textit{RelatedParty}$ and rewrite Equation (3) as:

$$\Delta\mathbf{q} = \phi_B \Delta\boldsymbol{\tau} + \phi_{MNE}\Delta\boldsymbol{\tau} \cdot \alpha_r + \mu_j + \zeta_{it} + \xi_{ijt} \tag{4}$$

Under the empirical assumptions on $\Delta\boldsymbol{\tau}, \alpha_r$ and $\boldsymbol{\xi}$, I obtain the stacked CEF:[7]

$$\begin{aligned}
\mathbb{E}[\Delta\mathbf{q}|\Delta\boldsymbol{\tau}, \alpha_r] &= (\phi_B + \phi_{MNE} \cdot \alpha_r)\Delta\boldsymbol{\tau} && (5)\\
&= \underbrace{\begin{pmatrix} 1 & 0 \\ 1 & \alpha_r \end{pmatrix}}_{\equiv \boldsymbol{\alpha}} \underbrace{\begin{pmatrix} \phi_B \\ \phi_{MNE} \end{pmatrix}}_{\equiv \boldsymbol{\phi}} \Delta\boldsymbol{\tau} && (6)\\
&\equiv \boldsymbol{\sigma}(\boldsymbol{\phi}; \boldsymbol{\alpha})\Delta\boldsymbol{\tau}, && (7)
\end{aligned}$$

where $\boldsymbol{\sigma}(\boldsymbol{\phi}; \boldsymbol{\alpha})$ is the elasticities function given $\boldsymbol{\phi}$ and $\boldsymbol{\alpha}$,

[7] Also see Appendix A.2 for derivation.

Elasticities for Non/Multinationals (Cont'd)

- Let's focus on $\alpha_r \in (0,1]$ (in particular $\tilde{\alpha}_r^+$) and the CEF:

$$\mathbb{E}[\Delta \mathbf{q} | \Delta \boldsymbol{\tau}, \boldsymbol{\alpha}] = \boldsymbol{\sigma}(\phi; \boldsymbol{\alpha}) \Delta \boldsymbol{\tau} \tag{8}$$

$\implies$ Fixed $\boldsymbol{\alpha}$ (p.d.; invertible), I have 2 unknowns (ϕ's) with 2 equations
$\implies$ ϕ identified via OLS $\implies$ can calculate $\boldsymbol{\sigma}(\phi; \boldsymbol{\alpha})$!

- Thus, the final step is to recover **elasticities $\boldsymbol{\sigma}(\phi; \boldsymbol{\alpha})$**:

$$\boldsymbol{\sigma}(\phi; \boldsymbol{\alpha}) = \begin{cases} \sigma_{NMNE} = \phi_B \\ \sigma_{MNE} = \phi_B + \phi_{MNE} \cdot \tilde{\alpha}_r^+ \end{cases} \tag{9}$$

⊛ Interpretation: a proxy of trade elasticity of a median MNE
⊛ MCS: $\boldsymbol{\sigma}(\phi; \boldsymbol{\alpha})$ is increasing (in abs value) in α_r.[8]

[8] Also see Appendix A.4. Monotone Comparative Statics.

Wrap-up: Estimation Strategy

Table 1: Summary of Estimation Strategy

Notations	Concept	Known?
$\Delta \mathbf{q} \equiv \Delta \ln q_{ijt}$	12-month log changes of import quantities	✓
$\Delta \boldsymbol{\tau} \equiv \Delta \ln (1 + \tau_{ijt})$	12-month log changes of tariffs	✓
$\Delta \mathbf{p} \equiv \Delta \ln p_{ijt}$	12-month log changes of before-duty import prices	✓
m	MNE concentration $m \in [0, \mathcal{M}]$	No, but $\cong \alpha_r$
α_r	Share of Related-party Imports $\alpha_r \in [0, 1]$	✓
$\tilde{\alpha}_r^+$	Median of non-zero Share of Related-party Imports	0.299
ϕ_B	Standalone effect of tariff changes on import quantities	Est. by OLS
ϕ_{MNE}	Differential effect of tariff changes $\times \alpha_r$ on import quantities	Est. by OLS
Parameters of Interest		
σ_{NMNE}	Trade elasticities of Non-multinationals (calculated by $\boldsymbol{\sigma}(\phi; 0)$)	ϕ_B
σ_{MNE}	Trade elasticities of Multinationals (calculated by $\boldsymbol{\sigma}(\phi; \tilde{\alpha}_r^+)$)	$\phi_B + \phi_{MNE} \cdot \tilde{\alpha}_r^+$

Note: See Appendix B.2 and B.3 for a case study of steel-specific. Also see Draft for more details.

Estimation Results: General

Table 2: Impact of the Trump tariffs, Related-party (Partial)

	log–diff *Before-duty Prices*		*log–diff* *Import Quantities*		
	$\Delta \ln p_{ijt}$		$\Delta \ln q_{ijt}$		
	(1)	(2)	(3)	(4)	(5)
$\Delta \ln(1+\tau_{ijt})$	-0.012	-0.057	-1.802***	-0.854*	-1.551***
	(0.023)	(0.038)	(0.327)	(0.499)	(0.413)
$\Delta \ln(1+\tau_{ijt}) \times \%RelatedParty$		0.113		-2.422**	
		(0.069)		(0.965)	
$\Delta \ln(1+\tau_{ijt}) \times \mathbb{1}HighRelatedParty$					-0.404
					(0.428)
σ_{NMNE}			-1.802	-0.854	-1.551
σ_{MNE}			-1.802	-1.578	-1.955
N	1,647,617	1,641,326	2,473,895	2,464,296	2,473,895

Note: Clustered SE at HS8 level, with Commodity & Country × Time FE. Also see Appendix B.1 for more details.

Conclusion

Motivation. How do firms with different share of related-party imports respond differently to short-run tariff shock?

Contribution. Refine the short-run shock responses "elasticity" by related-party channel (σ_{MNE}) and arms-length channels (σ_{NMNE}). Focus on point estimates.

(Related-party elasticity). Import demand of MNE (related-party) is more *elastic* than NMNEs' ($|\sigma_{NMNE}| < |\sigma_{MNE}|$), monotonically increasing in α_r.

(Implications). MNE importers are *more responsive* to $\Delta\tau$ under complete tariff pass-through (fixed foreign supply).

① **Why?** May reflect "profit–shifting," better ability to switch sourcing origins

② Built on ①, profit-shifting is increasing in α_r

③ The "more responsive" drop of MNE imports $\longrightarrow$ profit–shifting process to alternative origins?

Limitations and Future Directions

- Push forward on the **policy implications**
  - MNE: what clusters are really reducing the imports?
  - PM: What's the efficiency/goal of tariff policy if MNE can do profit-shifting? What about home production?

- Investigate the MNE sourcing dynamics
  - Modeling $\pi-$ max MNEs
  - Uncertainty affects imports diversion or intermediates prod reshoring?
  - # of origins; up/downstreams; labor/capital-intensive industry

- Refine the intrafirm measurements (connect to Ruhl (2015))
  - This paper is an attempt to proxy MNEs without firm-level data.

- Add more years of data to see shock responses (connect to Cox (2023))

- Construct structural parameters (connect to Fajgelbaum et al. (2020))

References

Alvarez, F., & Lucas, R. E. (2007).**General equilibrium analysis of the eaton–kortum model of international trade.** *Journal of Monetary Economics*, *54*(6), 1726–1768. https://doi.org/10.1016/j.jmoneco.2006.07.006

Amiti, M., Redding, S. J., & Weinstein, D. E. (2019).**The impact of the 2018 tariffs on prices and welfare.** *Journal of Economic Perspectives*, *33*(4), 187–210. https://doi.org/10.1257/jep.33.4.187

Antràs, P., Fort, T. C., & Tintelnot, F. (2017).**The margins of global sourcing: Theory and evidence from us firms.** *American Economic Review*, *107*(9), 2514–64. https://doi.org/10.1257/aer.20141685

Antràs, P., & Yeaple, S. R. (2014). **Chapter 2 - multinational firms and the structure of international trade.** In G. Gopinath, E. Helpman, & K. Rogoff (Eds.), *Handbook of international economics* (pp. 55–130, Vol. 4). Elsevier. https://doi.org/10.1016/B978-0-444-54314-1.00002-1

Bernard, A. B., Jensen, J. B., & Schott, P. K. (2006, August). **Transfer pricing by u.s.-based multinational firms (Working Paper No. 12493).** National Bureau of Economic Research. https://doi.org/10.3386/w12493

Costinot, A., & Rodríguez-Clare, A. (2014). **Chapter 4 - trade theory with numbers: Quantifying the consequences of globalization.** In G. Gopinath, E. Helpman, & K. Rogoff (Eds.), *Handbook of international economics* (pp. 197–261, Vol. 4). Elsevier. https://doi.org/10.1016/B978-0-444-54314-1.00004-5

Cox, L. (2023, February). **The long-term impact of steel tariffs on u.s. manufacturing (Working Paper).**

Engel, C., & Wang, J. (2011).**International trade in durable goods: Understanding volatility, cyclicality, and elasticities.** *Journal of International Economics*, *83*(1), 37–52. https://doi.org/10.1016/j.jinteco.2010.08.007

Fajgelbaum, P. D., Goldberg, P. K., Kennedy, P. J., & Khandelwal, A. K. (2020).**The return to protectionism.** *The Quarterly Journal of Economics*, *135*(1), 1–55. https://doi.org/10.1093/qje/qjz036

Pierce, J. R., & Schott, P. K. (2012). **A concordance between ten-digit U.S. Harmonized System codes and SIC/NAICS product classes and industries (tech. rep. No. 2012-15).** Board of Governors of the Federal Reserve System (U.S.)

Ramondo, N., Rappoport, V., & Ruhl, K. J. (2016).**Intrafirm trade and vertical fragmentation in u.s. multinational corporations.** *Journal of International Economics*, *98*, 51–59. https://doi.org/10.1016/j.jinteco.2015.08.002

Ruhl, K. J. (2015).**How well is us intrafirm trade measured?** *American Economic Review*, *105*(5), 524–29. https://doi.org/10.1257/aer.p20151045

Appendix A: Empirical Framework

Appendix A.1 Proof of Concept

Proposition. *The MNE concentration $m \in [0, \mathcal{M}]$ is order isomorphic to the share of related-party trade $\alpha_r \in [0, 1]$.*

Proof.

We need to show there exists an affine transformation from m onto α_r and check if the ordering is preserved. By **Assumption** and Heine-Borel Theorem, $[0, \mathcal{M}] \subseteq \mathbb{R}$ is compact. So, any continuous function defined on $[0, \mathcal{M}]$ attains its min/max values. Consider the simplest possible affine transformation $\alpha_r = \varphi(m) = \frac{1}{\mathcal{M}} m, \; m \in [0, \mathcal{M}]$. Note that:

① The support of α: $\frac{1}{\mathcal{M}} m \in [0, 1]$ for all $m \in [0, \mathcal{M}]$ (✓)

② Bijection: automatically true since $\varphi(\cdot)$ is a linear function (✓)

③ Ordering: take $m_1 \leq m_2, m_1, m_2 \in [0, \mathcal{M}]$. Since $\mathcal{M} \neq 0$ and $\frac{1}{\mathcal{M}} > 0$, we have $\alpha_{r,1} = \frac{1}{\mathcal{M}} m_1 \leq \frac{1}{\mathcal{M}} m_2 = \alpha_{r,2}$ (✓)

We conclude that $\alpha_r = \varphi(m)$ is one affine transformation that preserves order-isomorphic property from m to α_r. □

Appendix A.2 Elasticities for Non/Multinationals

Denote $\Delta\mathbf{q} \equiv \Delta \ln q_{ijt}$, $\Delta\boldsymbol{\tau} \equiv \Delta \ln (1 + \tau_{ijt})$, $\alpha_r \equiv \% \mathit{RelatedParty}$. Then, Equation (3) becomes:

$$\Delta\mathbf{q} = \phi_B \Delta\boldsymbol{\tau} + \phi_{MNE} \Delta\boldsymbol{\tau} \cdot \alpha_r + \mu_j + \zeta_{it} + \xi_{ijt} \tag{10}$$

Under our empirical assumptions on $\Delta\boldsymbol{\tau}, \alpha_r$ and $\boldsymbol{\xi}$, we obtain the CEF:

$$\begin{aligned}
\mathbb{E}[\Delta\mathbf{q}|\Delta\boldsymbol{\tau}, \alpha_r] &= \mathbb{E}\left[\phi_B \Delta\boldsymbol{\tau} + \phi_{MNE} \Delta\boldsymbol{\tau} \cdot \alpha_r + \mu_j + \zeta_{it} + \xi_{ijt} | \Delta\boldsymbol{\tau}, \alpha_r\right] & (11)\\
&= \mathbb{E}\left[\phi_B \Delta\boldsymbol{\tau} + \phi_{MNE} \Delta\boldsymbol{\tau} \cdot \alpha_r | \Delta\boldsymbol{\tau}\right] + \mathbb{E}[\xi_{ijt} | \Delta\boldsymbol{\tau}, \alpha_r] & (12)\\
&= \mathbb{E}\left[(\phi_B + \phi_{MNE} \cdot \alpha_r)\Delta\boldsymbol{\tau} | \Delta\boldsymbol{\tau}, \alpha_r\right] + 0 & (13)\\
&= \mathbb{E}\left[(\phi_B + \phi_{MNE} \cdot \alpha_r)\Delta\boldsymbol{\tau} | \Delta\boldsymbol{\tau}, \alpha_r\right] & (14)\\
&= (\phi_B + \phi_{MNE} \cdot \alpha_r)\Delta\boldsymbol{\tau} & (15)\\
&= \underbrace{\begin{pmatrix} 1 & 0 \\ 1 & \alpha_r \end{pmatrix}}_{\equiv \boldsymbol{\alpha}} \underbrace{\begin{pmatrix} \phi_B \\ \phi_{MNE} \end{pmatrix}}_{\equiv \boldsymbol{\phi}} \Delta\boldsymbol{\tau} \longleftarrow \text{stack 2 eqns with boundary cond.} & (16)\\
&\equiv \boldsymbol{\sigma}(\boldsymbol{\phi}; \boldsymbol{\alpha})\Delta\boldsymbol{\tau} & (17)
\end{aligned}$$

Appendix A.3 Summary Statistics (Full)

Table 3: SUMMARY STATISTICS, RELATED-PARTY TRADE (FULL)

	mean	sd	min	p25	p75	max
Total Imports	81.70	906.41	0.00	0.03	7.60	78398.92
Related-party Imports	40.47	601.18	0.00	0.00	1.28	48329.58
Non related-party Imports	41.23	485.62	0.00	0.02	4.31	59038.40
$\mathbb{1}\{$Related-party Imports$\}_t$	0.61	0.49	0.00	0.00	1.00	1.00
% RelatedParty	0.25	0.33	0.00	0.00	0.45	1.00
Total Trade Balance	-44.68	875.44	-77986.20	-1.62	1.84	27524.11
Related-party Trade Balance	-27.50	552.13	-48329.58	-0.27	0.05	9460.98
Non related-party Trade Balance	-17.83	499.37	-58686.64	-0.59	1.98	22232.32
$\mathbb{1}\{$Related-party Trade Balance$\}_t$	0.42	0.49	0.00	0.00	1.00	1.00
			Obs = 58988			
Lagged status						
$\mathbb{1}\{$Related-party Imports$\}_{t-1}$	0.65	0.48	0.00	0.00	1.00	1.00
$\mathbb{1}\{$Related-party Trade Balance$\}_{t-1}$	0.44	0.50	0.00	0.00	1.00	1.00
			Obs = 52956			

Note: The data is obtained from the Related Party Time Series, with a sample period 2017-2018. Units in million.

Appendix A.4 MCS of Elasticity function

Definition. (Single-crossing) $f : \mathbb{R}^2 \to \mathbb{R}$ satisfies single-crossing (SC) if $\forall x' > x, t' > t \in T$, we have $f(x'; t) - f(x; t) > 0 \implies f(x'; t') - f(x; t') > 0$ and the "$\geq$" version.

Proposition. $\boldsymbol{\sigma}(\phi; \boldsymbol{\alpha}) : \mathbb{R}^2 \to \mathbb{R}$ satisfies SC in absolute values.

Proof.
I show strict version. Since ϕ_B is a common term, let's focus on ϕ_{MNE}. Take $\phi_{MNE,1} < \phi_{MNE,2}$ (in abs value) and $\boldsymbol{\alpha}_1 \ll \boldsymbol{\alpha}_2$. We have:

$$\begin{aligned} 0 < \boldsymbol{\sigma}(\phi_{MNE,2}; \boldsymbol{\alpha}_1) - \boldsymbol{\sigma}(\phi_{MNE,1}; \boldsymbol{\alpha}_1) &= (\phi_B + (\phi_{MNE,2} - \phi_{MNE,1}) \cdot \alpha_{r,1}) \\ &< (\phi_B + (\phi_{MNE,2} - \phi_{MNE,1}) \cdot \alpha_{r,2}) \\ &= \boldsymbol{\sigma}(\phi_{MNE,2}; \boldsymbol{\alpha}_2) - \boldsymbol{\sigma}(\phi_{MNE,1}; \boldsymbol{\alpha}_2) \end{aligned}$$

□

Proposition. $\boldsymbol{\sigma}(\phi; \boldsymbol{\alpha}) : \mathbb{R}^2 \to \mathbb{R}$ is increasing in α_r in SSO in absolute value.

Proof.
Apply Milgrom-Shannon Thm to $|\boldsymbol{\sigma}(\phi; \boldsymbol{\alpha})|$ and note $|\boldsymbol{\sigma}|$ is OLS maximizer. □

Appendix B: Estimation

Appendix B.1 Table 2 (Full)

Table 4: IMPACT OF THE TRUMP TARIFFS, RELATED-PARTY (FULL)

	log–diff *Foreign Exporter Prices*		*log–diff* *Import Quantities*			*log–diff* *Import Values*	
	$\Delta \ln p_{ijt}$		$\Delta \ln q_{ijt}$			$\Delta \ln (p_{ijt} \times q_{ijt})$	
	(1)	(2)	(3)	(4)	(5)	(6)	(7)
$\Delta \ln(1 + \tau_{ijt})$	-0.012	-0.057	-1.802***	-0.854*	-1.551***	-1.597***	0.164
	(0.023)	(0.038)	(0.327)	(0.499)	(0.413)	(0.340)	(0.549)
$\Delta \ln(1 + \tau_{ijt}) \times$ *%RelatedParty*		0.113		-2.422**			-4.430***
		(0.069)		(0.965)			(1.146)
$\Delta \ln(1 + \tau_{ijt}) \times \mathbb{1}$*HighRelatedParty*					-0.404		
					(0.428)		
σ for Non-MNE			-1.802***	-0.854*	-1.551***		
			(0.327)	(0.499)	(0.413)		
σ for MNE			-1.802***	-1.578***	-1.955***		
			(0.327)	(0.341)	(0.370)		
Commodity FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Country $\times$ Time FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes
N	1,647,617	1,641,326	2,473,895	2,464,296	2,473,895	2,473,895	2,464,296

Note: * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$. The elasticities of MNE in Column 3–5 are recovered by the median = 0.299 for all non-zero share of related-party imports, and their point estimates are reported. Standard errors in parentheses are clustered at the HTS8 level, respecting that tariff variations for some commodities only happened at the HTS8 aggregation. Also see Draft for more details.

Table 5: Related-party Trade Elasticity, Steel Industry (Full)

	log–diff Import Quantities							
	General: $\Delta \ln q_{ijt}$				Steel Industry: $\Delta \ln q_{ijt}^{steel}$			
	Reduced form		Structural		Reduced form		Structural	
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
$\Delta \ln(1+\tau_{ijt})$	-1.802***	-0.854*			-2.509**	0.192		
	(0.327)	(0.499)			(1.100)	(1.694)		
$\Delta \ln(1+\tau_{ijt}) \times$ %*RelatedParty*		-2.422**				-6.368*		
		(0.965)				(3.518)		
$\Delta \ln(\tilde{p}_{ijt})$			-11.234***	-9.787***			-65.735**	-66.186**
			(2.038)	(2.884)			(28.809)	(29.077)
			[54.92]	[31.93]			[1.54]	[0.92]
$\Delta \ln(\tilde{p}_{ijt}) \times$ %*RelatedParty*				-2.501				-13.139
				(3.543)				(9.363)
				[38.44]				[40.57]
σ for Non-MNE	-1.802***	-0.854*	-11.234***	-9.787***	-2.509**	0.192	-65.735**	-66.186**
	(0.327)	(0.499)	(2.038)	(2.884)	(1.100)	(1.694)	(28.809)	(29.077)
σ for MNE	-1.802***	-1.578***	-11.234***	-10.535***	-2.509**	-3.119***	-65.735**	-73.018**
	(0.327)	(0.341)	(2.038)	(2.200)	(1.100)	(1.199)	(28.809)	(29.348)
Commodity FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Country × Time FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
N	2,473,895	2,464,296	2,473,895	2,464,296	73,295	73,295	73,295	73,295

Note: * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$. Column 3–4 and 7–8 follow Fajgelbaum et al. (2020) to estimate the structural trade elasticity for MNEs (unit values instrumented by tariff changes). The first-stage F statistics are reported in square brackets. The elasticities of MNEs in Column 1–4 are recovered by $\text{med}(\alpha_+) = 0.299$. The elasticities of MNE in Column 5–8 are recovered by the steel-specific $\text{med}^{steel}(\alpha_+) = 0.520$. Standard errors in parentheses at the HTS8 level. Also see Draft for more details.

Appendix B.3 Summary of Preliminary results

- **(Related-party).** I found that demand of related-party (MNE) imports is more *elastic* than NMNEs' ($|\sigma_{NMNE}| < |\sigma_{MNE}|$).
- **(Welfare implication).** Under complete pass-through, domestic importers bear entire tariff burdens. Holding foreign supply fixed, MNE importers suffer *less* tariff incidence (more responsive to $\Delta\boldsymbol{\tau}$) among importers.
- **(Case: Steel manufacturing).** Steel import demand is estimated to be more *elastic* than general imports ($|\sigma| < \left|\sigma^{steel}\right|$).
  - Within industry, related-party imports are the main drivers of its industry-level elasticity.
  - MNE imports estimated to be more *elastic* than the NMNE counterparts ($\left|\sigma^{steel}_{NMNE}\right| < \left|\sigma^{steel}_{MNE}\right|$).