When Tariffs Disrupt Global Supply Chains

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Pre 2018, trade barriers notably escalated

- MFN tariffs in G20 countries 70-75% higher on final goods than on intermediates (Bown and Crowley, 2018)
- We calculate: US average applied tariffs 2010-2017 on consumption goods more than 4x as high as on intermediates
- Wtd-average applied tariff on intermediate goods only 0.9% in 2017

History changes course: Trump tariffs hit supply chains
By September 2018, 82% of intermediates from China covered by increased tariffs, but only 29% of consumer goods (Bown)
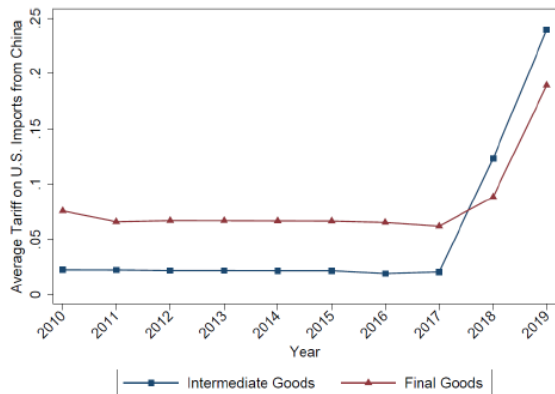
Supply Chain Disruption?

- Anecdotes from the business press
  - Shift from China to Vietnam, Thailand, Indonesia, Malaysia, etc.
  - Variety of industries: electronics, furniture, hand luggage, auto parts ...
  - Variety of firms: Samsonite, Cisco Systems, Macy's, Ingersoll-Rand ...

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- Diff-in-Diff Evidence of Supply Chain Disruption (à la Amiti et al.)
  - Monthly customs data for imports of intermediate goods at HTS10-country-of-origin level, January 2016 - October 2019

	Imports from China (1)	Imports from 13 LCCs (2)
Log Difference in Tariffs	-1.609**	0.441*
	(0.212)	(0.224)
R Squared	0.85	0.84
Obs	110132	110132

Goals of Paper

- Develop model of trade in intermediate inputs, capturing many of the defining features of relational supply chains (c.f. WDR, 2020):
  - Made possible by fragmentation of production processes
  - Impose non-trivial search costs
  - Require matching of compatible partners
  - Often governed by incomplete contracts with frequent renegotiation
  - Typically observe many durable relationships ("stickiness")

- Neglect: relationship specific investments (Ornelas and Turner, Antràs and Staiger)

- Study effects of unanticipated tariff shocks on organization of supply chains, prices, and welfare

Foreign Sourcing with Search and Bargaining
Model Outline

- **Two sectors**
  - Homogeneous good, produced competitively with CRS
  - Differentiated products, monopolistic competition, relational supply chains
  - Quasi-linear preferences with CES across varieties

- **Technology for differentiated products**
  - Combines labor and composite intermediate good, Cobb Douglas
  - Composite requires continuum of inputs in fixed proportions
  - Inputs imported from cheapest source, or produced at home

- **Search and Bargaining**
  - A final producer pays to search for supplier of each input
  - Each supplier has match-specific productivity
  - Buyer can negotiate a short-term contract or resume search

- **Long-run Equilibrium**: Zero profits in anticipation of free trade

Search

- Symmetry across firms and inputs: All producers initially search in minimum wage country A
- At cost F, take draw from $G(\cdot)$ for input ω
  - Learn inverse match productivity a: can produce ω at unit cost wa
  - Negotiate short-term contract or pay F again and take another draw
- For simplicity: Assume no time between draws
- Optimal strategy: Reservation stopping rule $\bar{a}$ for each input
- Search cost: $S(\bar{a}) = F + [1 - G(\bar{a})] S(\bar{a}) \Rightarrow$

$$S(\bar{a}) = \frac{F}{G(\bar{a})}$$

Bargaining

- Nash bargaining over per-unit price, with weights β and $1 - \beta$
- "Nash-in-Nash": bargain separately with suppliers, take m as given
- Outside options:
  - For buyer: Resume search, find alternative supplier with expected price $\mu_\rho(\bar{a})$ at expected flow cost $f / G(\bar{a})$
  - For supplier: Zero

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- **Total cost** of m units of intermediates (including search cost):

$$C(m) = w\mu_a(\bar{a})m + \frac{f}{\beta G(\bar{a})}$$

- **Perceived marginal cost**:
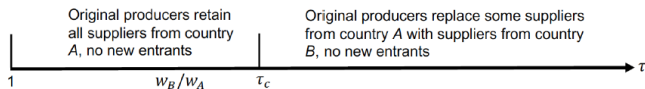
$$\phi = w\mu_a(\bar{a}) \Rightarrow MC < AC$$
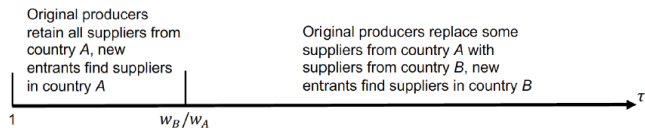
Free-Trade Equilibrium

- Optimal search trade-off:

$$\bar{a} = \arg\min_a \, mw\mu_a\left(a\right) + \frac{f}{\beta G\left(a\right)}$$

- $\bar{a}$ is decreasing in mw:
    - greater stake in search outcome $\Rightarrow$ more intensive search
- Start tariff analysis from this equilibrium
    - Ad valorem tariff t on imports from country A, $\tau \equiv 1 + t$
    - Unanticipated: n pre-determined in expectation of $\tau = 1$

Sourcing Patterns

Original producers retain
all suppliers from country
A, no new entrants

Original producers replace some suppliers
from country A with suppliers from country
B, no new entrants

1 w_B/w_A τ_c τ

Elastic demand: $\varepsilon > 1$

Original producers
retain all suppliers from
country A, new
entrants find suppliers
in country A

Original producers replace some
suppliers from country A with
suppliers from country B, new
entrants find suppliers in country B

1 w_B/w_A τ

Inelastic demand: $\varepsilon < 1$

- Small tariff: $\tau < w_B/w_A$

Renegotiation in Enduring Relationships (Small Tariff)

- Start with "small tariff": $\tau < w_B / w_A$
  - Actual and threatened searches remain in A

- Renegotiated price:
  - $\rho \downarrow$ if credible threat of more intensive search
  - $\rho \uparrow$ if threatend search is less discerning

- Optimal choice of $\bar{a}$: decreasing in $\tau m(\tau)$
  - Input prices rise iff $\bar{a}(\tau) > \bar{a}$
  - Input prices rise iff $\tau m(\tau) < m$ (smaller stake)
  - $\tau m(\tau) < m$ iff $\varepsilon > 1$

- These are TOT effects of tariff due to shared surplus

Replacing Unproductive Suppliers (Small Tariff)

- Producers might choose to terminate some relationships and recommence search for these inputs
- When, if ever, do firms replace some of their initial suppliers?
  - If $\varepsilon > 1$, $\bar{a}(\tau) > \bar{a} \Rightarrow$ no replacement of any suppliers by original producers
  - If $\varepsilon < 1$, $\bar{a}(\tau) < \bar{a}$ at original n
    - But profitability rises, because direct effect of input tariff offset by favorable effect on competition through $P \uparrow$
    - Tariff induces entry: $n \uparrow$
    - Entry reduces stake in search by original producers; entry continues until $\tau m^{\tau} = m(1)$
    - In equilibrium, $\bar{a}(\tau) = \bar{a}(1) \Rightarrow$ no replacement of any suppliers by original producers

Welfare Effects of Small Tariffs: Elastic Demand

- No new searches, no entry, so no new capital costs
- Tariff payments by firm accrue as tariff revenue
- So

$$V\left(\tau\right) = U\left(X^{\tau}\right) - n\rho^{\tau}m^{\tau} - n\ell^{\tau}$$

- Differentiating:

$$\frac{1}{n}\frac{dV^{\tau}}{d\tau} = \left(\frac{\sigma}{\sigma - 1} - 1\right)\frac{d\ell^{\tau}}{d\tau} + \left(\frac{\sigma}{\sigma - 1}\phi^{\tau} - \rho^{\tau}\right)\frac{dm^{\tau}}{d\tau} - m^{\tau}\frac{d\rho^{\tau}}{d\tau}$$

- Labor demand declines, m declines, terms of trade deteriorate
- Possibility of welfare enhancing tariff due to middle term ($\phi^{\tau} < \rho^{\tau}$), but plausible parameter values suggest not.

Larger Tariffs

- Suppose $w_B < \tau w_A$
  - Country B could be foreign country exempt from tariff (e.g., Vietnam)
  - Country B could be the home country
- New searches (if any) and threatened searches take place in B
- Renegotiation with original suppliers: Suppliers share burden of tariff!
  - Consistent with Amiti et al. (2020)
  - Partial Effect: TOT improve!
- Reorganization of supply chains:
  - With $\varepsilon > 1$
    - $\tau < \tau_c \Rightarrow$ no replacement (room to bargain)
    - $\tau > \tau_c \Rightarrow$ replace range of least productive suppliers
  - With $\varepsilon < 1$, replace range of least productive suppliers
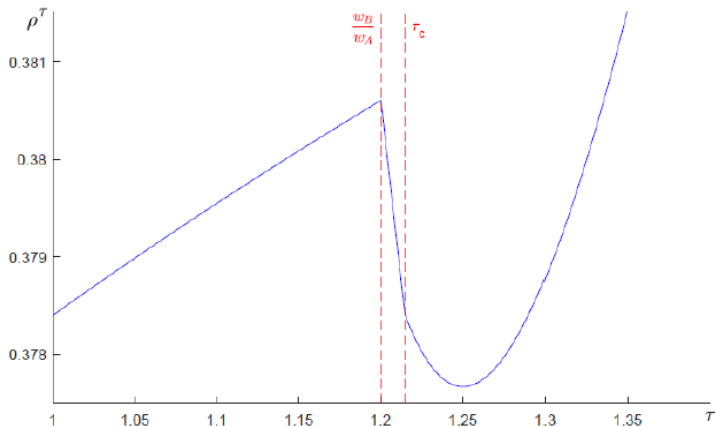 - Replacement $\Rightarrow$ Vinerian trade diversion, harms TOT

Effect of Tariffs on TOT

Elastic Demand

$\sigma = 5, \theta = 4, \varepsilon = 1.5, \alpha = \beta = 0.5$
$w_A = 0.5, w_B = 0.6$

Welfare Effects of Tariffs
Elastic Demand, B is Foreign Country

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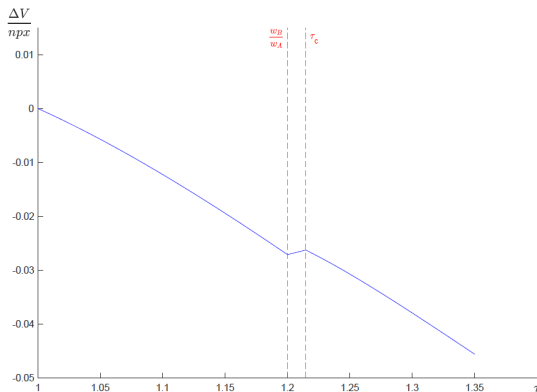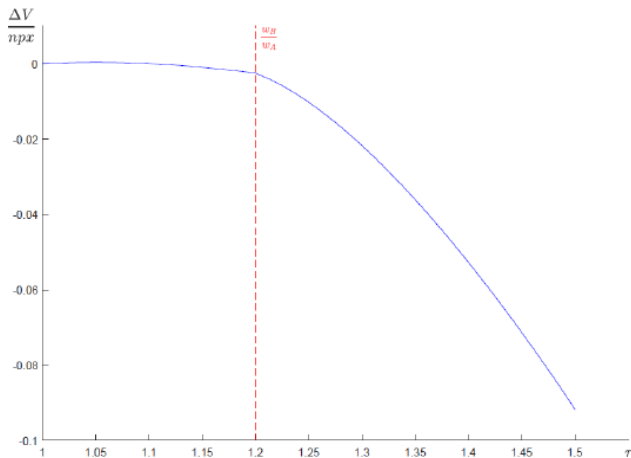$w_A = 0.5, w_B = 0.6$

Figure: Welfare Effects of Unanticipated Tariffs: Elastic Demand

Welfare Effects of Tariffs
Inelastic Demand, B is Foreign Country

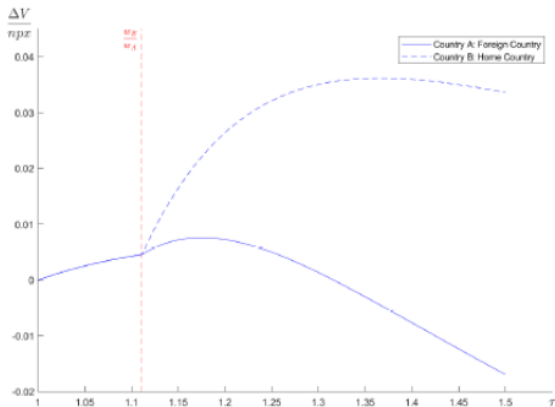$\sigma = 5, \theta = 4, \varepsilon = 0.5, \alpha = \beta = 0.5$
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Welfare Effects of Tariffs
Inelastic Demand, Weak Bargaining Position

$\sigma = 5, \theta = 4, \varepsilon = 0.3, \alpha = \beta = 0.3$
$w_A = 0.9, w_B = 1$

Conclusions

- New mechanisms for tariffs to affect prices and welfare:
  - Price negotiations conducted in shadow of renewed search. Input prices rise (fall) if incentive for search reduced (intensified)
  - Bargaining drives a wedge between marginal cost of inputs as perceived by final-good producers and their true social cost — due to independent bargaining with myriad suppliers
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- Elements missing from analysis:
  - Heterogeneous suppliers with comparative advantage in different inputs – which could explain multi-country sourcing
  - Time for search: slow adjustment (major complication)
  - Investment in customization of inputs that generates hold-up problems, as in Ornelas and Turner (2008) and Antràs and Staiger (2012)