Self-Harming Trade Policy?
Protectionism and Production Networks

Alessandro Barattieri  Matteo Cacciatore

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Motivation

- In 2018, U.S. imposed new tariffs on ≈ 12% of imports and ensuing trade war sparked new debates on the effects of protectionism
  - Global supply chains hit heavily

- Protectionism on intermediate inputs not new
  - Since 1990s: temporary trade barriers (TTBs) restrict trade in intermediate inputs
  - TTBs: antidumping, countervailing duties, and safeguards

- Supply-chains considerations prominent in policy discussions
  - Protected industries vs sectors that use protected goods as inputs

- Scant systematic evidence
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What We Do

Estimate dynamic effects of protectionism through vertical production linkages

1. **Identify NAICS 4-digit trade-policy shocks** using product-level monthly data on U.S. TTBs
   - Measures “upstream protectionism” using NAICS 4-digit I-O tables

2. **Estimate employment effects** within and across industries: panel local projections

3. **Inspect the mechanism:**
   - Response of input and output prices in downstream industries
   - Stock market response in downstream industries (daily data)

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Results

1. Protected industries: small, short-lived, and mostly insignificant beneficial employment effects

2. Downstream industries: negative, persistent, and statistically-significant employment effects

3. Mechanism:
   - Intermediate-input and final producer prices increase prior to the employment decline: loss of competitiveness
   - Stock market returns decline in downstream industries (with a delay)

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Data
TTB Key Institutional Features

1. TTBs require: (i) petition by industry producers and (ii) USITC investigation

2. Regulation-induced decision lags: > 1 month to open an investigation
   - Producers must gather evidence about dumped imports (representing at least 25% of the product’s domestic production)
   - USITC’s assessment of compliance

3. Opening of an investigation publicly announced, disclosing supporting evidence
   - Focus on investigation dates to avoid anticipation effects

4. Investigations typically result in large, long-lasting, and retroactive tariffs
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TTB Data

- World Bank’s Temporary Trade Barriers Database:
  - Date of each TTB investigation
  - HS 6-digit products subject to investigation

- Construct monthly time series of products subject to a new investigation: NAICS 4-digit level (1994-2015)
  - 70 narrowly defined manufacturing sectors
  - Most detailed level at which employment, producer prices, and input-output data are available at a consistent level of aggregation
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# Top TTB Users: Descriptive Statistics

<table>
<thead>
<tr>
<th>Top TTB Users (NAICS-4 Code)</th>
<th>Episodes (Products)</th>
<th>% Success</th>
<th>Median Tariff (Duration in Months)</th>
<th>New TTBs, Average Import Share</th>
<th>New TTBs, Max Import Share</th>
<th>2007 Sectoral Imports/Output</th>
</tr>
</thead>
<tbody>
<tr>
<td>Iron, Steel and Ferro Alloy (3311)</td>
<td>60 (457)</td>
<td>82%</td>
<td>35.1% (111)</td>
<td>1.87%</td>
<td>8.89%</td>
<td>33.55%</td>
</tr>
<tr>
<td>Basic Chemical (3251)</td>
<td>44 (63)</td>
<td>75%</td>
<td>101.0% (107)</td>
<td>0.21%</td>
<td>2.26%</td>
<td>14.56%</td>
</tr>
<tr>
<td>Other Fabricated Metals (3329)</td>
<td>15 (28)</td>
<td>80%</td>
<td>57.5% (125)</td>
<td>1.53%</td>
<td>8.14%</td>
<td>37.04%</td>
</tr>
<tr>
<td>Steel Products From Purchased Steel (3312)</td>
<td>11 (33)</td>
<td>64%</td>
<td>27.9% (116)</td>
<td>11.09%</td>
<td>31.50%</td>
<td>8.61%</td>
</tr>
<tr>
<td>Resin, Rubber, Fibers (3252)</td>
<td>10 (14)</td>
<td>90%</td>
<td>24.8% (98)</td>
<td>1.04%</td>
<td>3.18%</td>
<td>14.56%</td>
</tr>
<tr>
<td>Spring and Wire Products (3326)</td>
<td>9 (11)</td>
<td>100%</td>
<td>116.3% (125)</td>
<td>7.23%</td>
<td>21.33%</td>
<td>36.49%</td>
</tr>
<tr>
<td>Agr., Constr., and Mining Machinery (3331)</td>
<td>8 (21)</td>
<td>88%</td>
<td>193.5% (115)</td>
<td>1.34%</td>
<td>4.97%</td>
<td>59.37%</td>
</tr>
<tr>
<td>Nonferrous Metal Production (3314)</td>
<td>7 (17)</td>
<td>86%</td>
<td>60.5% (102)</td>
<td>0.73%</td>
<td>2.09%</td>
<td>64.99%</td>
</tr>
</tbody>
</table>
TTBs and Production Networks (Cont.)

<table>
<thead>
<tr>
<th>Top TTB Users (NAICS-4)</th>
<th>NAICS-4 Output Share</th>
<th>NAICS-4 Av. Input Share Direct Req.</th>
<th>NAICS-4 Max Input Share Direct Req.</th>
<th>NAICS-4 Av. Input Share Total Req.</th>
<th>NAICS-4 Max Input Share Total Req.</th>
</tr>
</thead>
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<tr>
<td>Iron, Steel and Ferro Alloy (3311)</td>
<td>1.96%</td>
<td>2.27%</td>
<td>35.70%</td>
<td>4.79%</td>
<td>44.80%</td>
</tr>
<tr>
<td>Basic Chemical (3251)</td>
<td>4.23%</td>
<td>2.15%</td>
<td>44.72%</td>
<td>8.25%</td>
<td>84.56%</td>
</tr>
<tr>
<td>Other Fabricated Metals (3329)</td>
<td>0.59%</td>
<td>0.66%</td>
<td>3.63%</td>
<td>1.14%</td>
<td>4.77%</td>
</tr>
<tr>
<td>Steel Products From Purchased Steel (3312)</td>
<td>0.18%</td>
<td>0.42%</td>
<td>17.68%</td>
<td>0.40%</td>
<td>19.15%</td>
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<td>Resin, Rubber, Fibers (3252)</td>
<td>1.92%</td>
<td>1.69%</td>
<td>36.77%</td>
<td>3.16%</td>
<td>41.78%</td>
</tr>
<tr>
<td>Spring and Wire Products (3326)</td>
<td>0.43%</td>
<td>0.09%</td>
<td>6.85%</td>
<td>0.16%</td>
<td>7.38%</td>
</tr>
<tr>
<td>Arch., Constr. and Mining Machinery (3331)</td>
<td>1.59%</td>
<td>0.003%</td>
<td>0.255%</td>
<td>0.25%</td>
<td>1.00%</td>
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<tr>
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<td>1.10%</td>
<td>1.00%</td>
<td>18.29%</td>
<td>3.41%</td>
<td>35.59%</td>
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<tr>
<td><strong>Total</strong></td>
<td><strong>12.7%</strong></td>
<td><strong>7.96%</strong></td>
<td><strong>21.50%</strong></td>
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Baseline Measure of TTB Protection

- NAICS 4-digit shares of imports subject to new TTBs in a month:
  \[ \tau_{it} \equiv \sum_{k} \sum_{j} \omega_{ij}^{k} I_{ijt}^{k} \]

  - \( I_{ijt}^{k} = 1 \) if imports of product \( j \) from country \( k \) subject to a new investigation at time \( t \)
  
  - \( \omega_{ij}^{k} \) \equiv \text{average, bilateral, sector-}i\text{ import share for product } j \text{ from country } k \text{ in the previous-year}

\( \tau_{it} \) combines information on extensive and intensive margin

  - Single product entailing a large value of trade is more important than many products with modest trade
TTB Import Shares and Employment Growth

Iron, Steel and Ferro Alloy (3311)

Steel Products from Purchased Steel (3312)

Spring & Wire Products (3326)

Fabricated Metal Products (3329)

Figure: Share of imports affected by new TTB investigations in selected NAICS-4 industries (histograms) and employment growth (continuous line).
Identification
Strategy

- Consolidated strategy in monetary and fiscal policy literature (e.g., Romer and Romer, *AER* 2004; Auerbach and Gorodnichenko, *AER* 2013):
  - **First stage**: purge TTBs of variation endogenous to employment (past, current, and expected) $\Rightarrow$ conditional exogeneity.
  - **Second stage**: estimate panel local projections

- First stage regression: time series (benchmark) and panel (robustness)
  - Exploit regulation-induced lags in the opening of new investigations
  - Address potential forward-looking nature of protection’s demand (although TTBs address pre-existing trade injuries).
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Time-Series Approach

- Fractional response model for each industry \( i \)
  \[
  \tau_{it} \in (0, 1): \text{ restrict conditional mean}
  \]
  \[
  \tau_{it} = \frac{\exp\{\mu_{it}\}}{1 + \exp\{\mu_{it}\}} + \epsilon_{it}
  \]

- \( \mu_{it} \equiv \delta_i + \sum_{\kappa=1}^{p_L} \phi^k_{L_i} \Delta L_{it-\kappa} + \sum_{\kappa=1}^{p_{LDI}} \phi^k_{L_{DI_i}} \Delta L_{DI_{it-\kappa}} \)
  \[
  + \sum_{\kappa=1}^{p_{MB}} \phi^k_{MB_i} MB_{it-\kappa} + \sum_{\kappa=1}^{p_{MB_{DI}}} \phi^k_{MB_{DI_i}} MB_{DI_{it-\kappa}} + \sum_{\kappa=1}^{p_x} \kappa x_{t-\kappa}, \quad (1)
  \]

- \( \Delta L_{it-\kappa} \): employment growth (\( \Delta L_{DI_{it-\kappa}} \) in downstream industries)
- \( MB_{it-\kappa} \): median market-to-book ratio, using firm-level data (\( MB_{DI_{it-\kappa}} \) in downstream industries)
- \( x_{t-\kappa} \): \( \Delta \) real exchange rate, expected \( \Delta IP \) (median SPF)
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  \[ + \sum_{\kappa=1}^{p_{MB}} \phi_{MB}^\kappa MB_{it-\kappa} + \sum_{\kappa=1}^{p_{MBDII}} \phi_{MBDII}^\kappa MB_{it-\kappa} + \sum_{\kappa=1}^{p_x} \phi_x^\kappa x_{t-\kappa} \]

  \[ (1) \]

- $\Delta L_{it-\kappa}$: employment growth ($\Delta L_{it-\kappa}^{DII}$ in downstream industries)
- $MB_{it-\kappa}$: median market-to-book ratio, using firm-level data ($MB_{it-\kappa}^{DII}$ in downstream industries)
- $x_{t-\kappa}$: $\Delta$ real exchange rate, expected $\Delta IP$ (median SPF)
Market-to-Book Ratio

- Benchmark firm-level measure of expected returns from finance literature (Compustat/CRSP):
  \[ MB_{ijt} \equiv \frac{E_{jit}}{V_{jit}} \]

  - \( E_{jit} \equiv \) equity market value for firm \( i \) (outstanding shares \( \times \) price)
  - \( V_{jit} \equiv \) accounting value (from company's balance sheet)
  - \( MB_{ijt} > 1 \): positive expected returns
  - \( MB_{it} \equiv \text{mdn}(MB_{ijt}) \)

- \( MB_{it} \) contains information about petitioners' expected profitability
  - Petitioner-specific market-to-book ratio for largest TTB user:
    \[ \text{corr}(MB_{3311,t}, MB_{3311,t}^P) = 0.95 \]

- \( MB_{it} \) has forecasting power for industry employment growth (Granger causality)
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Predicted vs Actual TTB Import Shares

Figure: Share of imports affected by new TTB investigations in selected NAICS-4 industries (light histograms) and predicted values from the fractional-response model (dark histograms).
Measuring Upstream Protectionism

- Combine identified structural shocks with information from I-O matrices

- Compute exposure to upstream protectionism as weighted average of shocks across industries:
  \[ \hat{\varepsilon}_{i,t}^{I/O} \equiv \sum_{j \neq i} \theta_{ij} \hat{\varepsilon}_{j,t} \]

  - Fixed weights \( \theta_{ij} \equiv \) contribution of industry \( j \) to output of industry \( i \)
  - Total-requirements input-output table in year 2007 (both direct and indirect contributions)
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Local Projections
Local Projections

- Estimate employment response using local projections (Jorda, 2005)

- $h$-step ahead predictive panel regressions:

$$\Delta L_{it+h} = \nu_{ih} + \gamma_h \hat{\epsilon}_{it} + \psi_{t+h} + \epsilon_{it+h}$$

$$\Delta L_{it+h} = \nu_{ih} + \gamma_{h}^{lO} \hat{\epsilon}_{it}^{lO} + \psi_{t+h} + \epsilon_{it+h}$$

- $\Delta L_{it+h} \equiv \log L_{it+h} - \log L_{it-1}$: cumulative employment difference
- $\nu_{ih}$ and $\psi_{t+h}$: industry and time fixed effects
Employment Response (Time Series Identification)

- 1% increase in the share of imports subject to new TTBs
Understanding Magnitudes

- Map TTB shocks in a corresponding sectoral uniform-tariff variation $\tau_{it}$

- Compute elasticity of $\tau_{it}$ to the share of imports subject to new TTBs:
  \[ \Delta \tau_{it} = 1\% \implies \Delta \bar{\tau}_{it} = 1.02\% \]
Mechanisms and Quantitative Implications
Inspecting the Mechanism

- **Loss of competitiveness**: candidate explanation for downstream employment decline
  - Downstream producers cannot quickly replace inputs subject to TTBs → pay higher price
  - Producers switch to potentially less-efficient domestic suppliers → pay higher price

- **Test the mechanism**:
  - Response of intermediate-input and final-producer prices in downstream industries (also prices in protected industries)
  - Response of downstream-industries excess stock returns following TTB investigations (daily data)
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Inspecting the Mechanism (Cont.)

- Intermediate-input price index $P_{it}^l$:

$$P_{it}^l \equiv \sum_{j \neq i} \theta_{ij} P_{jt}$$

- $P_{jt} \equiv$ Producer Price Index (NAICS 4-digit, available from 2004)

- Median daily returns using firm-level stock price data from CRSP:

$$R_{id} = \frac{(P_{id} - P_{id-1})}{P_{id-1}}$$

- Local projections:

$$\Delta P_{it+h}^l = v_{ih} + \pi_h^l \hat{\epsilon}_{it}^l + \sum_{s=1}^{p} \phi_{sh} \Delta P_{it-s}^l + \psi_{t+h} + \epsilon_{it+h},$$

$$\Delta P_{it+h} = v_{ih} + \pi_h \hat{\epsilon}_{it}^l + \sum_{s=1}^{p} \phi_{sh} \Delta P_{it-s} + \psi_{t+h} + \epsilon_{it+h},$$

$$\Delta R_{id+h} = v_{ih} + \rho_h \hat{\epsilon}_{id}^l + \rho_h \Delta R_{d+h}^m + \epsilon_{id+h}.$$
Inspecting the Mechanism (Cont.)

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- $P_{jt} \equiv$ Producer Price Index (NAICS 4-digit, available from 2004)

- Median daily returns using firm-level stock price data from CRSP:
  
  $$R_{id} = \frac{(P_{id} - P_{id-1})}{P_{id-1}}$$

- Local projections:
  
  $$\Delta P_{it+h}^l = \nu_{ih} + \pi_t^l \hat{e}_{it}^O + \sum_{s=1}^{p} \phi_{sh} \Delta P_{it-s}^l + \psi_{t+h} + \epsilon_{it+h},$$

  $$\Delta P_{it+h} = \nu_{ih} + \pi_t^O \hat{e}_{it}^O + \sum_{s=1}^{p} \phi_{sh} \Delta P_{it-s} + \psi_{t+h} + \epsilon_{it+h},$$

  $$\Delta R_{id+h} = \nu_{ih} + \rho_{h}^O \hat{e}_{id}^O + \rho_{h} \Delta R_{d+h}^m + \epsilon_{id+h}.$$
Aggregate Effects

1. **Manufacturing employment loss after 12 months**, including potential spillovers across industries:
   - Largest TTB episode (Steel sector, August 2015): 0.34% (0.24% without spillovers)
   - Average TTB shocks: 0.15% (0.11% without spillovers)

2. **Aggregate employment loss after 12 months**:
   - Largest TTB episode (Steel sector, August 2015): 0.29%
   - Average shocks in TTB episodes: 0.034%
Aggregate Effects

1. Manufacturing employment loss after 12 months, including potential spillovers across industries:
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2. Aggregate employment loss after 12 months:
   - Largest TTB episode (Steel sector, August 2015): 0.29%
   - Average shocks in TTB episodes: 0.034%
Conclusion

- Estimate dynamic effects of protectionism:
  - Small, short-lived, and mostly insignificant effects in protected industries
  - Long-lasting and significant negative effects in downstream industries

- Loss of competitiveness and lower profitability contribute to downstream employment losses
  - Higher intermediate-input and final producer prices
  - Decline in daily downstream-industries stock returns

- TTBs have small aggregate employment effects on average, but effects can be sizeable in large TTB episodes
Appendix
Literature

- Effects of 2018 trade war on U.S. prices, imports, and welfare
  - Amiti Redding Weinstein (2020); Fajgelbaum, Goldberg, Kennedy, Khandelwal (2020), Flaen and Pierce (2019)

- Trade policy and vertical production linkages
  - Conconi, Garcia-Santana, Puccio and Venturini (2018); Blanchard, Bown and Johnson (2018), Bown et al (2020)

- Effects of protectionism on aggregate outcomes
  - Barattieri, Cacciatore, Ghironi (2021); Furceri. Swarnali, Ostry, and Rose (2018)

- Long-run productivity effects of trade liberalization
  - Amity and Konings (2007); Goldberg, Kumar, Pavcnik, and Topalova (2018)
TTBs and Production Networks

U.S. Production Network (2007)
Panel Approach

- Alternative strategy: exploit panel dimension of the data
  - Industry and time fixed effects
  - Remove (constant) unobserved industry heterogeneity and common shocks

Panel regression:

\[
\tau_{it} = \alpha_i + \sum_{\kappa=1}^{p_L} \phi_L^\kappa \Delta L_{it-\kappa} + \sum_{\kappa=1}^{p_{LDI}} \phi_{LDI}^\kappa \Delta L_{it-\kappa}^{DI}
\]

\[
+ \sum_{\kappa=1}^{p_{MB}} \phi_{MB}^\kappa MB_{it-\kappa} + \sum_{\kappa=1}^{p_{MBD}} \phi_{MBD}^\kappa MB_{it-\kappa}^{DI} + \eta_t + \varepsilon_{it},
\]

- Fixed effects (potentially) remove variation in \(\tau_{it}\) unrelated to employment outcomes (which we would like to keep)
Interpreting TTB Shocks

- Identified TTB shocks are conditionally exogenous to employment dynamics in protected and downstream sectors

- Trade and antitrust literature offer explanation for TTB remaining variation ($\hat{\epsilon}_{it}$):
  - Political pressure (lobbying): affect domestic market structure and exports (“tit-for-tat” strategies)
  - Prevention of foreign predatory pricing
  - Retaliation against foreign protectionism
  - Strategies to coordinate and support collusive behavior
Robustness

- Additional outcome variables
  - Bilateral imports
  - Custom unit values
  - Profits (upstream and downstream industries)

- Abnormal stock market returns
Panel A: Imports Subject to New TTBs

Panel B: Imports Not Subject to New TTBs
Customs Unit Values in Protected Industries

Percentage Points

Months
Downstream Industries Profits

Percentage Points vs. Quarters

Quarters:
0  2  4  6  8

Percentage Points:
-3  -2  -1  0  1
Robustness (Cont.)

- Probit model in the first-stage ($\hat{e}_{it}$)
  - Potential measurement error in $\tau_{it}$ due to the use of lagged imports

- Alternative measure of industry-level expectations
  - Price-to-earnings ratio

- Different upstream-protectionism measures ($\hat{e}^{IO}_{it}$)
  - Sectoral shocks as a fraction of total imports

\[
\hat{e}^{IO}_{it} = \sum_{j \neq i} \theta_{ij} s_j \hat{e}_{jt},
\]

where $s_j$ ≡ previous-year import share of sector $j$ relative to total imports

- Only successful investigations
Employment Response to Protectionism

Panel A: Probit Model in the First Stage

Panel B: Price-to-Earnings in the First Stage

Panel C: Upstream Protectionism Shocks using Import Weights

Panel D: Only Successful Initiatives

Figure: Impulse responses following a protectionism shock.
Robustness (Cont.)

- Additional industry-level controls in the first-stage regression
  - Hourly earnings
  - Imports
  - Sales
  - Industry-specific commodity prices

- Alternative measure of protectionism:
  - Variation in TTB uniform-tariff equivalent (rather than share of imports subject to TTBs)

- Alternative measure of upstream protectionism
  - Sectoral weights consider upstream industries’ average openness:
    \[ \hat{\varepsilon}_{it}^{IO} = \sum_{j \neq i} \theta_{ij} \tilde{s}_j \hat{\varepsilon}_{jt}, \]
    where \( \tilde{s}_j \equiv \) average share of imports relative to output

- Include global safeguards
Employment Response to Protectionism

Panel A: Hourly Earnings in the First Stage

Panel B: Imports in the First Stage

Panel C: Quarterly Sales in the First Stage

Panel D: Commodity Prices in the First Stage
Employment Response to Protectionism

Panel A: Protectionism Measured by TTB Uniform Tariff Change

Protected Industries

Downstream Industries

Panel B: Upstream Protectionism Shock using Import/Output Weights

Protected Industries

Downstream Industries

Panel C: TTBs Including Global Safeguards

Protected Industries

Downstream Industries

Figure: Impulse responses following a protectionism shock.

Panel A: First-stage regression includes hourly earnings.

Panel B: First-stage regression includes imports.

Panel C: First-stage regression includes sales.

Panel D: First-stage regression includes commodity prices.