The Economic Effects of Trade Policy Uncertainty

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The End of Free Trade?

U.S. Import Tariffs as % Share of Total Imports of Goods

Implemented 2018 Tariffs

Tariffs Under Consideration

Forward to Model
Our Contribution

We study effects of trade policy uncertainty (TPU) on U.S. economy

1. **Measurement**: We construct 3 TPU measures based on firm-level and aggregate data

2. **Quantification**: We provide firm-level and aggregate evidence that higher TPU reduced U.S. investment by about 1.5 percent in 2018

3. **Transmission**: We use an open-economy DSGE model to highlight how risk and uncertainty about trade policy affect economic activity
Firm-Level TPU
Measuring Firm-Level TPU: Data

We construct firm-level measures of TPU from earnings call transcripts for publicly listed companies (see also Hassan et al., 2017)

Each earnings call follows a common two-part format:

1. Performance review of the last quarter
2. Q&A sessions with investors and analysts.
   - They contain information about risks faced by firm

Measuring Firm-Level TPU: Textual Analysis

We proceed in two steps:

1. Search the earnings call transcripts for trade policy ($TP$) terms
   - E.g., *tariff*, *import dut*, *import barrier*, *trade polic*
   - Frequency of $TP$ matches indicates the intensity of trade policy discussions in a conference call

2. Search for uncertainty ($U$) terms in close proximity to $TP$ terms
   - E.g., *risk*, *threat*, *tension*, *uncertain*
   - Must appear within 10 words

$$TPU = \text{Number of joint instances of } TP \text{ and Uncertainty (normalized by number of words in the call)}$$
Examples of TP and TPU

TP:
Goodyear Tire & Rubber - 2013Q3

“You will note for the fourth quarter, however, that North America will be down year over year, again reflecting the aberration of a year ago, when fourth-quarter dealer orders for low-end tires were high post expiration of Chinese tire tariffs.”

TPU:
Levi & Strauss Co. - 2018Q1

“The biggest uncertainty I think we’re facing. There are really two, and I don’t know if I want to rank them, but one is the uncertainty around trade and tariffs. That could have significant short-term impact.”
Variation Across Industries and Time

Note: Share of firms in the industry mentioning TPU in their earnings calls

Comparison with Hassan et al. (2019)
Quantifying the Effects of Firm-Level TPU on Investment

- We use Compustat balance-sheet data over 2015Q1-2018Q4
- (Cumulative) Investment constructed from fixed assets $k_{i,t}$ as:
  $$\log k_{i,t+h} - \log k_{i,t-1}, \text{ where } h \geq 0$$

- We estimate, for $h = 0, 1, 2, 3, 4$:
  $$\log k_{i,t+h} - \log k_{i,t-1} = \alpha_i + \alpha_t + \beta_h TPU_{i,t} + \Gamma' X_{i,t} + \varepsilon_{i,t}$$
  - $\alpha_i$ and $\alpha_t$: firm and time fixed effects
  - $X_{i,t}$: Tobin’s q, cash-flow, openness, $\log k_{i,t-1} - \log k_{i,t-2}$, $TPU_{i,t-1}$
  - $\beta_h$: response of $\log k$ in $t+h$ to change in TPU in quarter $t$

- We restrict sample to firms in manufacturing, agriculture and mining
Firm-Level Response to High TPU

Cumulative response of log assets after increase in $TPU$ Cross-Section in 2018
Local Projections: Robustness

1. Trade Policy without Uncertainty

2. Without Controls

3. Include Non-manufacturing Firms

4. Sample 2005-2018
Our estimates imply that the 2018 increase in TPU reduced U.S. investment by 1 percent through direct firm-level effects:

\[
\left(-\frac{2.5}{100}\right) \times \left(\frac{10}{100}\right) \times \left(\frac{43}{100}\right) \times \frac{\$24\text{ tn}}{\$2.8\text{ tn}} \approx -1\%
\]

Note: Calculation ignores indirect effects through general equilibrium channels.
Aggregate TPU
Measuring Aggregate TPU

1. News-Based Using Textual Analysis (Baker et al., 2016)
   - We search for TPU words in newspaper articles
   - Hence, this index captures TPU as perceived by press
News-Based TPU

Index = 100 when share of articles mentioning TPU is 1 percent

Comparison with Baker et al. (2016)
News-Based vs. Earnings Calls Based TPU
Measuring Aggregate TPU

1. News-Based Using Textual Analysis *(Baker et al., 2016)*
   - We search for TPU words in newspaper articles
   - Hence, this index captures TPU as perceived by press

2. Stochastic Volatility Using Tariff Data *(Fernandez-Villaverde et al., 2015)*
   - We estimate the process:
     \[
     \tau_t = (1 - \rho_\tau) \mu_\tau + \rho_\tau \tau_{t-1} + \exp(\sigma_t) \varepsilon_t, \quad \varepsilon_t \sim N(0, 1)
     \]
     \[
     \sigma_t = (1 - \rho_\sigma) \sigma + \rho_\sigma \sigma_{t-1} + \eta u_t, \quad u_t \sim N(0, 1)
     \]
   - \(u_t\) affects spread of values for tariffs (i.e. tariff volatility shock)
Filtered series of tariff volatility. Shaded area: 68-percent credible sets.

Comparison with news-based TPU
Quantifying the Effects of Aggregate TPU

- Estimation of VAR
- Baseline specification and ordering:
  1. News-Based TPU
  2. Real business fixed investment per capita
- Alternative specifications (see paper):
  - Tariff volatility TPU:
  - Additional controls: tariff rate, real GDP per capita, JLN uncertainty, exchange rate, tax rate on capital income.
- Sample: 1960Q1-2018Q4
- Consider IRFs to 2-standard deviation shock

Correlation with other shocks
Aggregate Effects: Baseline VAR

News-Based TPU Index

Private Investment

Quarters

Quarters

SV TPU

Larger VAR
Taking Stock of the Empirical Evidence

- 2018 Increase in Firm-Level TPU
  → K of manufacturing firms drops 2.5 percent after 1 year
  → $\approx$ 1 percent decline ($25$ bn) in aggregate U.S. fixed investment.

- 2 standard deviations increase in aggregate TPU
  (comparable to recent developments)
  → $\approx$ 2 percent decline in U.S. investment.
TPU Transmission: DSGE Model
Framework

- Medium-scale DSGE model featuring:
  - Two countries specializing in production of traded intermediate inputs
  - Armington CES aggregator for traded intermediate inputs
  - Sticky prices and wages
  - Investment adjustment costs
  - Entry into and exit from export market (as in Alessandria and Choi, 2007)

- Goal: Trace out aggregate GE effects and firm-level effects of an increase in TPU.

- Assumption: Tariffs are perfectly correlated across countries (full retaliation).
Effects of Tariffs

- Tariffs increase the relative price of imported goods → consumers switch towards domestic varieties
  
- Tariffs induce supply-side distortions: They act like taxes on K and L
  
- Tariffs reduce the value of exporting → mass of exporters shrinks and aggregate productivity declines
Experiment: An Increase in TPU

- We isolate two effects of an increase in TPU
  - Rise in expected tariffs (first moment)
  - Mean-preserving increase in the volatility of future tariffs (second moment)

- Tariffs follow a SV process with news:

\[
\tau_t^m = (1 - \rho_\tau) \mu_\tau + \rho_\tau \tau_{t-1}^m + \exp(\sigma_{t-1}^m) \varepsilon_t^\tau + \varepsilon_{t-1}^N
\]

\[
\sigma_t^m = (1 - \rho_{\sigma^m}) \sigma^m + \rho_{\sigma^m} \sigma_{t-1}^m + \eta u_t
\]

where \( \{\varepsilon_t^N\}_{t=0}^T \) is a news shock about the level of future tariffs

- We calibrate the parameters of this SV process using the empirical estimates
Experiment: Calibration of the Shocks

1. Time 0: Agents learn that there is probability $p_0 = \frac{1}{2}$ that tariffs increase from $\tau^{SS} = 0.02$ to $\tau^{HIGH} = 0.08$

\[
\varepsilon_0^N = p_0 \cdot 0.08 + (1 - p_0) \cdot 0.02 = 0.03
\]

\[
\sigma_0^m = \sigma^m (p_0) = \log (0.03)
\]

where $\sigma^m (p)$ satisfies $\exp (\sigma^m) = \Delta \tau^m \sqrt{p (1 - p)}$

2. From $t = 1, \ldots, T$ no change in tariffs occurs i.e. $\tau_t^m = \tau^{SS}$ but uncertainty about tariffs persists:
   - As agents observe no increase in tariffs they update $p_t$ so that $\sigma^m (p_t) = \sigma_t^m$ follows SV law of motion (2)
   - Expectation of tariffs adjust accordingly: $\varepsilon_t^N = p_t \cdot 0.08 + (1 - p_t) \cdot 0.02$
Model Experiment: Results

- **Tariffs**
  - Expected and Realized

- **Standard Dev. Tariffs**

- **Investment**

- **Consumption**

- **GDP**

- **Exports**

- **Interest Rate**

- **Marginal Cost**

- **Mass of Exporters**

- **Capital Differential**

- **Prob. Entry**

- **Prob. Stay Exporter**

Legend:
- Black line: News and Uncertainty
- Blue line: News
- Red line: Uncertainty

Robustness I & II
Tariff News: Channels of Transmission

- **Intertemporal Substitution:**
  Higher future tariffs make current C and I relatively cheaper

  \[ \tilde{c}_t = \tilde{c}_{t+1} - \frac{1}{\sigma} \tilde{r}_{t+1}(\tau^m_{t+1}) \]

  \[ \tilde{p}^k_t = r^k \tilde{r}^k_{t+1} + (1 - \delta) \tilde{p}^k_{t+1} - \tilde{r}_{t+1}(\tau^m_{t+1}) \]

- **Investment demand falls:**
  Higher future tariffs lower expected asset prices

  \[ \tilde{p}^k_t = r^k \tilde{r}^k_{t+1}(\tau^m_{t+1}) + (1 - \delta) \tilde{p}^k_{t+1}(\tau^m_{t+1}) - \tilde{r}_{t+1}(\tau^m_{t+1}) \]

- **With sticky prices, real interest rate does not drop much and second channel dominates.**
Uncertainty: Channels of Transmission

1. Aggregate demand falls because of precautionary motive.
2. Markups increase. (as in Fernandez-Villaverde et al., 2015)

- Uncertainty about tariffs increases the variance of future desired prices.

- When different varieties are substitutes, profit function is asymmetric → losses from overpricing smaller than losses from underpricing.

- Producers raise prices to avoid being stuck with relatively low price in the future → markups rise, especially in foreign market.
Taking Stock of the Model Results

- 2018 increase in TPU lowers investment by nearly 1 percent

  - Experiment 1 (mean effect): Anticipation of higher tariffs reduces investment by about 0.5 percent

  - Experiment 2 (variance effect): Uncertainty about future tariffs reduces investment by 0.3 percent
Conclusions

- **Measurement**: We construct firm-level and aggregate measures of TPU using both textual analysis and estimation of a stochastic volatility process.

- **Quantification**: We provide empirical evidence that the 2018 increase in TPU may have reduced U.S. investment by about 1-2 percent.

- **Transmission**: We study quantitatively the role of changes in expected tariffs and in volatility of future tariffs in an open-economy DSGE model with heterogenous firms and sticky prices.


Cross-Section: 2018 vs. 2017 Investment Growth

The graph illustrates the cross-sectional comparison of investment growth between 2018 and 2017 across various industries. The y-axis represents the capital growth (Ppt difference, 2018 vs. 2017), while the x-axis indicates the TPU (Change, 2018 vs 2017). Each dot on the graph corresponds to a different industry, showing the change in investment growth for each sector.
TPU from Hassan et al. (2019)
TPU from Baker et al. (2016)


- CIMPR TPU (right axis)
- BBD TPU (left axis)
News-Based vs. Tariff Volatility TPU

![Graph showing News-Based vs. Tariff Volatility TPU](image-url)
## Correlation of tariff volatility with other shocks

<table>
<thead>
<tr>
<th>External Shocks</th>
<th>Correlation</th>
<th>(p-value)</th>
<th>Granger F-test</th>
<th>(p-value)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Oil shocks(^a)</td>
<td>(-0.08)</td>
<td>(0.45)</td>
<td>0.65</td>
<td>(0.52)</td>
</tr>
<tr>
<td>Monetary policy shocks(^b)</td>
<td>(-0.05)</td>
<td>(0.70)</td>
<td>0.78</td>
<td>(0.46)</td>
</tr>
<tr>
<td>TFP growth shocks(^c)</td>
<td>(-0.01)</td>
<td>(0.91)</td>
<td>0.07</td>
<td>(0.94)</td>
</tr>
<tr>
<td>Unanticipated tax shocks(^d)</td>
<td>(-0.00)</td>
<td>(0.99)</td>
<td>0.19</td>
<td>(0.83)</td>
</tr>
<tr>
<td>Defense spending shocks(^e)</td>
<td>0.06</td>
<td>(0.53)</td>
<td>0.95</td>
<td>(0.39)</td>
</tr>
<tr>
<td>Capital tax vol. shocks(^f)</td>
<td>0.14</td>
<td>(0.28)</td>
<td>1.04</td>
<td>(0.36)</td>
</tr>
</tbody>
</table>

**Note:** The entries in the table denote the pairwise correlations and Granger-causality tests between the tariff volatility shock identified under the baseline VAR specification and a set of external instruments. The regressions underlying the pairwise Granger causality tests include a constant and two lags of each external instrument. Sample period for the volatility shocks is 1960:Q3 to 1984:Q4.

\(^a\) Crude oil supply shock from Hamilton (2003).

\(^b\) Monetary policy shocks from Romer and Romer (2004); (1969:Q1–1984:Q4).

\(^c\) Residuals from a first-order autoregressive model of the log-difference in the utilization-adjusted total factor productivity; see Fernald (2012).

\(^d\) Unanticipated tax shocks from Mertens and Ravn (2011).

\(^e\) Defense spending news shocks from Ramey (2011).

\(^f\) Capital tax volatility shocks from Fernandez-Villaverde et al. (2015).
3. No Time Effects

The graph shows the percent response with a 68% confidence interval over four quarters. The x-axis represents the quarters, and the y-axis shows the percent response. The shaded area indicates the range within which the true response is expected to fall with 68% confidence. The lines represent the estimated responses, with the blue line being the central estimate and the red lines indicating the upper and lower bounds of the confidence interval.
Note: LDA Analysis on Transcripts from All Years. Most Common Bigrams, Grouped by Topic.
Firm-Level TPU: Variation Across Firms and Time

Note: TPU for selected firms.
Effects of Tariffs: Demand-Switching

- Tariffs increase the relative price of imported goods $\rightarrow$ consumers switch towards domestic varieties

$$m_t = -\theta \times (p_{m,t} + \tau^m_t) + a_t$$

- This effect tends to boost domestic output but
  - Symmetric retaliation abroad reduces foreign demand
  - Supply-side distortions reduce domestic production
**Effects of Tariffs: Supply-Side Distortions**

- Price of consumption bundle is $P \left( P_D, P_M, \tau_t^m \right)$

- Tariffs reduce relative price of domestic good

  $$PROFITS = \frac{P_D}{P \left( P_D, P_M, \tau_t^m \right)} Y - r^k K - w L$$

- Tariffs are akin to a uniform increase in taxes on K and L

  $$PROFITS = \frac{P_D}{P \left( P_D, P_M, 0 \right)} Y - r^k \left( 1 + \tau^k \right) K - w \left( 1 + \tau^L \right) L$$

  → Contractionary effect on investment and output
**Effects of Tariffs: Firm Entry**

- Firm exports at \( t \) if productivity is above threshold \( z_{m}^{*} \)

\[
p^{k} \Delta k + W_{t} c_{m} = z_{m}^{*} \pi (W_{t}, K_{mt}) (\Gamma_{\exp}^{\nu} - \Gamma_{\noexp}^{\nu}) + E \Delta V
\]

where \( m \in \{ \text{Exporter at } t-1, \text{Non Exporter at } t-1 \} \)

- Gain in market size \( (\Gamma_{\exp}^{\nu} - \Gamma_{\noexp}^{\nu}) \) shrinks because of demand switching at home and abroad

- \( \rightarrow \) Thresholds \( z_{m}^{*} \) declines and so Entry declines and exit increases

- Aggregate productivity declines as cross-sectional correlation between output and idiosyncratic productivity declines
Model Experiment: Robustness (I)
Model Experiment: Robustness (II)

Tariffs

Expected
Realized

Standard Dev. Tariffs

Investment

Consumption

GDP

Exports

Interest Rate

Marginal Cost

Mass of Exporters

Capital Differential

Prob. Entry

Prob. Stay Exporter

Baseline

Flex Prices & Wages

Separable Preferences

Static Entry/Exit

& Unilateral Tariffs

Back
Aggregate Effects: Stochastic Volatility TPU

Tariff Volatility

Quarters

Private Investment

Quarters
Aggregate Effects: Additional Controls

- News-Based TPU Index
- Private Investment