The Economic Effects of Trade Policy Uncertainty

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Federal Reserve Board

Macroeconomic Implications of Trade Policies and Trade Shocks

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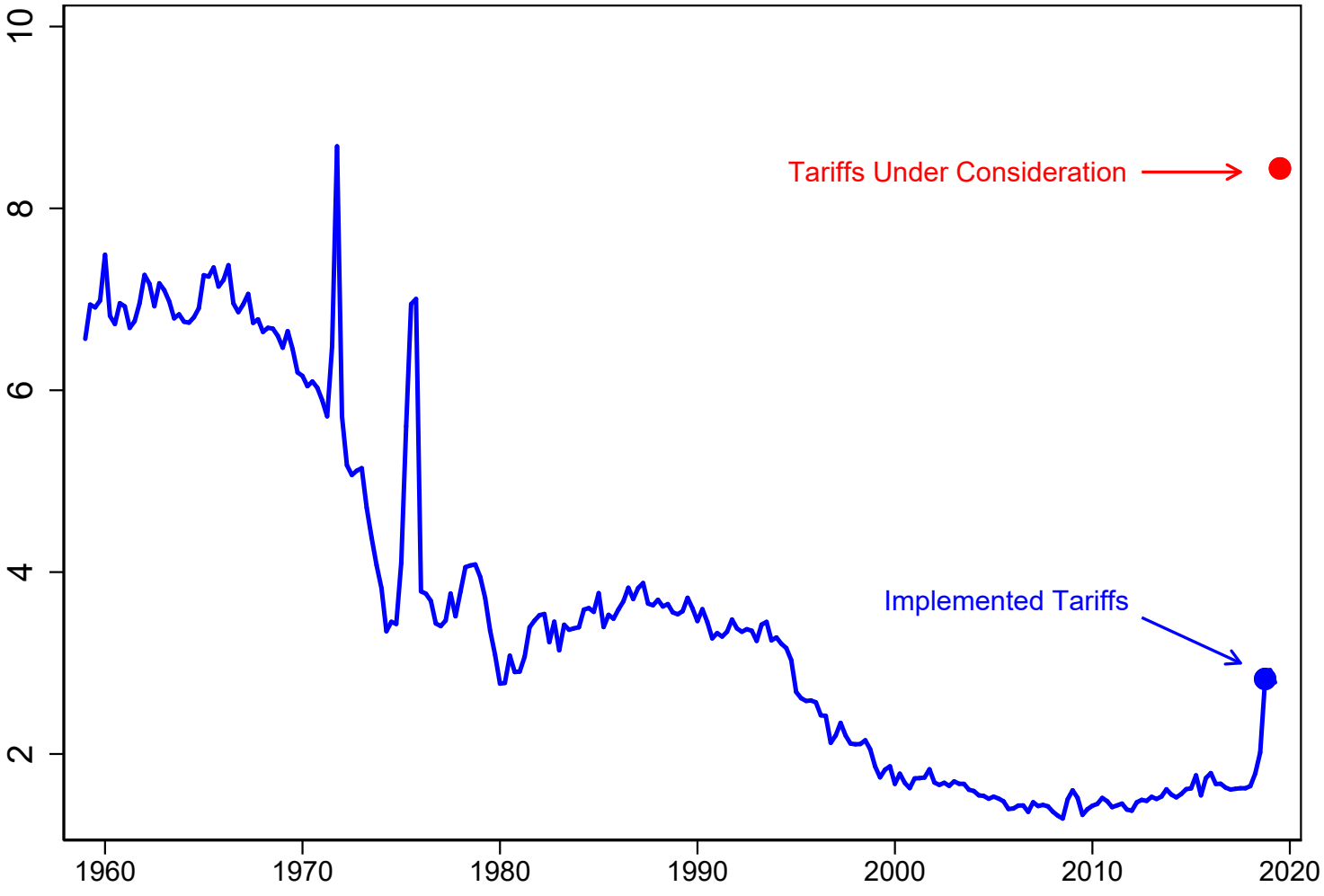
The End of Free Trade?

Countries around the world are reconsidering international trade arrangements.

- Brexit
- From NAFTA to USMCA
- U.S. vs China trade policy actions and negotiations
- U.S. vs E.U. trade negotiations

What are the effects of the increased uncertainty associated with these trade policy developments?

The End of Free Trade?



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

Forward to Model

Three Questions About Trade Policy Uncertainty

1. **Measurement**: How to measure trade policy uncertainty (TPU)?

2. **Quantification**: What are the macroeconomic effects of increased TPU?

3. **Transmission**: How does TPU affect the economy?

Our Contribution

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

2. **Quantification**: Increase in TPU reduced (U.S.) investment by about 2 percent and output by 1 percent.

3. **Transmission**: TPU reduces activity through anticipation effects (expectation of higher future tariffs) and uncertainty effects (higher dispersion of future tariffs).

Firm-Level TPU

Measuring Firm-Level TPU: Textual Analysis

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

- Our sample: 160,000 transcripts, 7,500 firms, 2005Q1-2018Q4.

We proceed in two steps:

1. Search the earning call transcripts for trade policy (TP) terms
   - E.g., *tariff**, *import dut**, *import barrier**, *trade polic**
2. Search for uncertainty (U) terms within **10** words to TP terms
   - E.g., *risk**, *threat**, *tension**, *uncertain**

TPU = Number of joint instances of TP and Uncertainty (normalized by number of words in the call)

Examples of *TP* and *TPU*

TP:

Goodyear Tire & Rubber - 2013Q3

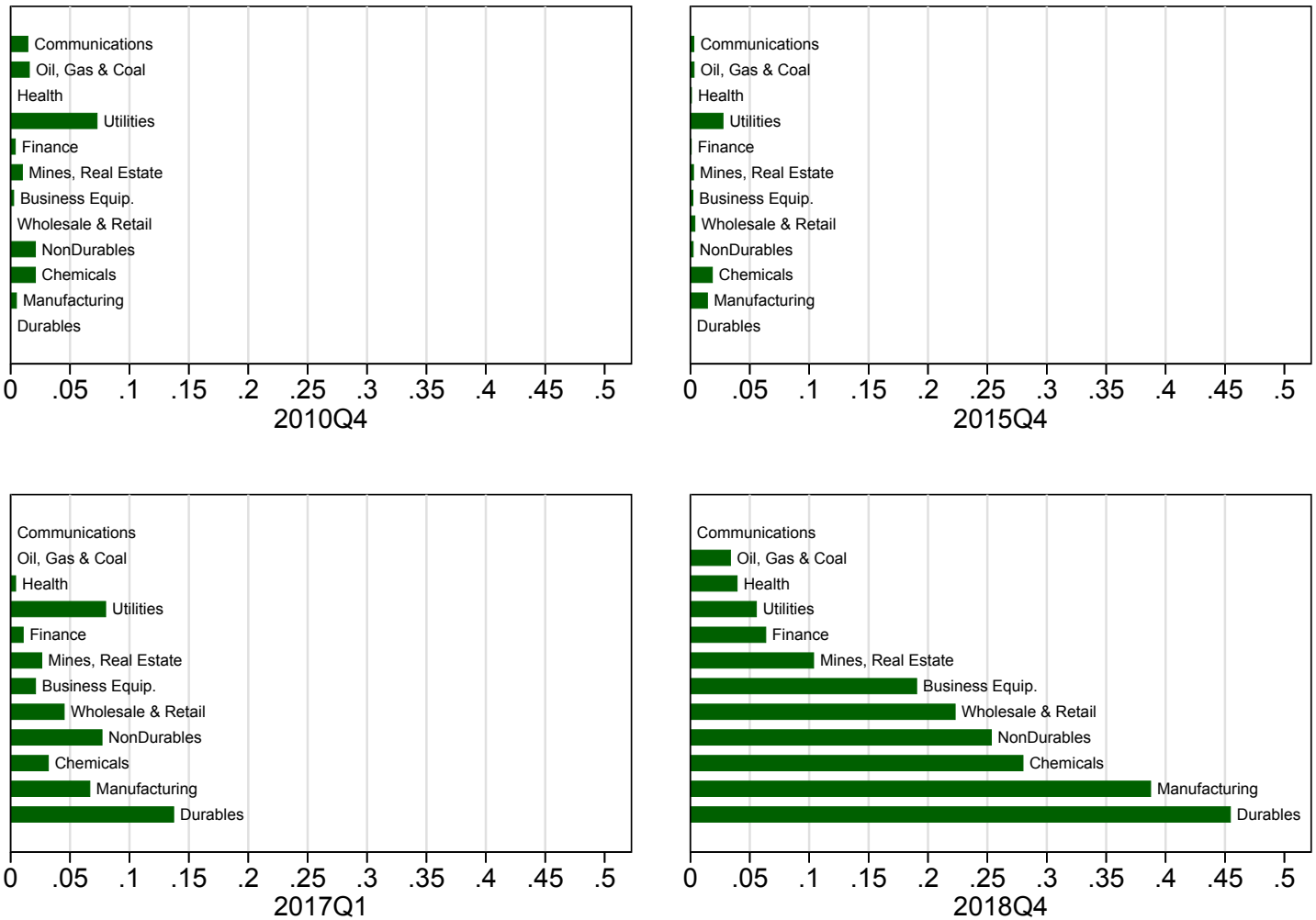
- *"You will note for the fourth quarter, however, that North America will be down year over year, again reflecting the aberration of a year ago, when fourth-quarter dealer orders for low-end tires were high post expiration of Chinese tire* **tariffs***."*

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. (2016)

Quantifying the Effects of Firm-Level TPU on Investment

- We use Compustat balance-sheet data over 2015Q1-2018Q4
- (Cumulative) Investment $I_{i,t+h}$ constructed from fixed assets $k_{i,t}$ as:

$$I_{i,t+h} = log k_{i,t+h} - \log k_{i,t-1}, \text{ where } h = 0, 1, 2, 3, 4$$

- Following Jorda (2005), we estimate:

$$I_{i,t+h} = \alpha_i + \alpha_t + \beta_h TPU_{i,t} + \Gamma' X_{i,t} + \varepsilon_{i,t}$$

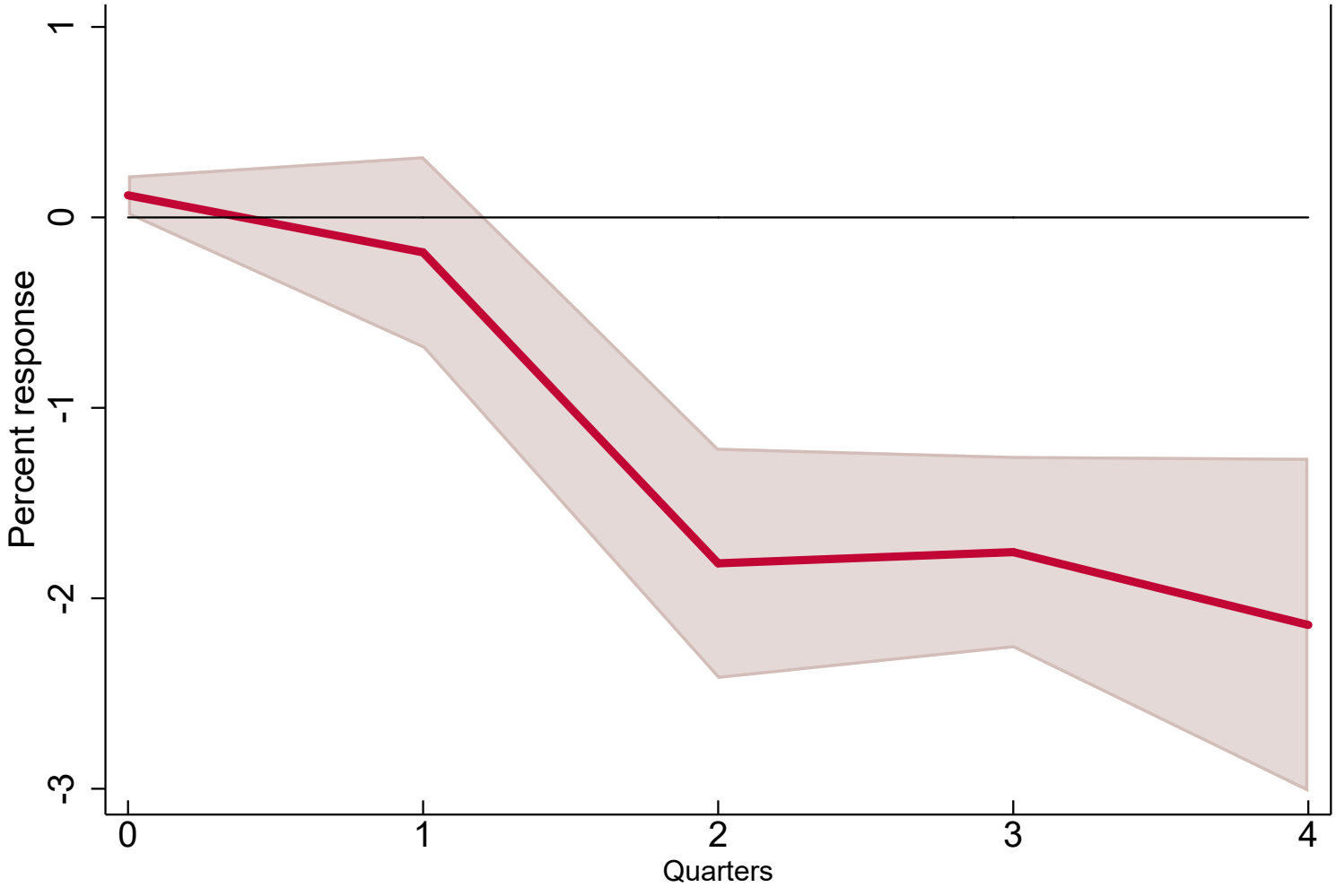
- α_i and α_t: firm and time fixed effects

  $X_{i,t}$: Tobin's q, cash-flow, openness, lagged I, lagged TPU

  β_h: response of $\log k$ in $t + h$ to change in TPU in quarter t

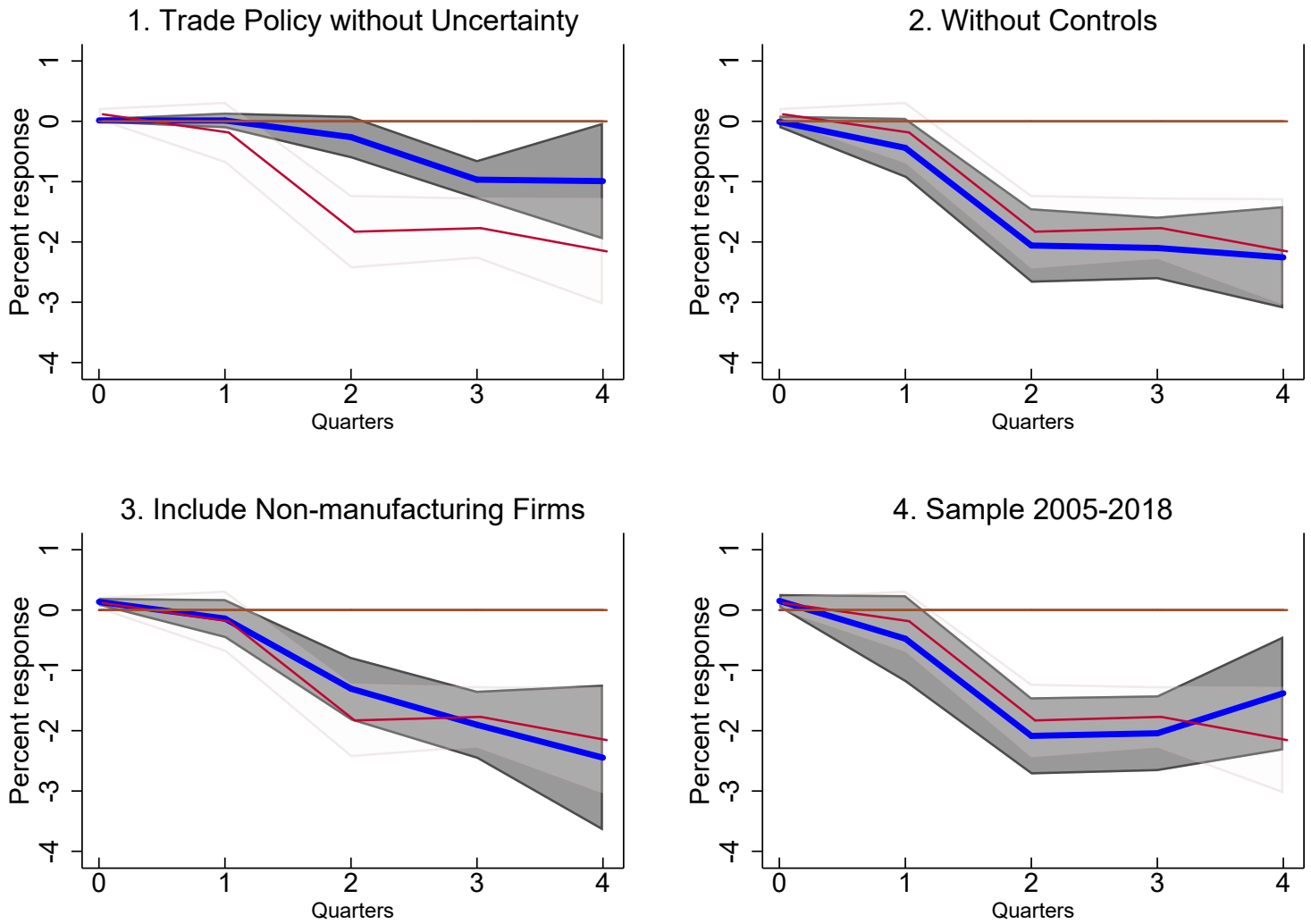
- We restrict sample to firms in manufacturing, agriculture and mining

Firm-Level Response to High TPU



Cumulative response of log fixed assets after increase in *TPU* Cross-Section in 2018

Local Projections: Robustness



Aggregation of Firm-Level Estimates

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

$$\underbrace{-2.1\%}_{\substack{\text{effect on K}\\ \text{of firm}\\ \text{hit in 2018}}} \times \underbrace{10.4\%}_{\substack{\text{share of firms}\\ \text{hit by high}\\ \text{TPU in 2018}}} \times \underbrace{43\%}_{\substack{\text{asset share of}\\ \text{mfg. firms}}} \times \underbrace{\$24 \text{ tn}}_{\substack{\text{stock of US}\\ \text{fixed assets}\\ \text{in 2018}}} \div \underbrace{\$2.8 \text{ tn}}_{\substack{\text{US investment}\\ \text{in 2018}}} \simeq \underbrace{-1\%}_{\substack{\text{decline in}\\ \text{private NR}\\ \text{investment}}}$$

- Caveat: Calculation ignores indirect effects through general equilibrium channels
  - E.g. Uncertainty reduces aggregate demand via precautionary motives.
  - Limiting case: All firms are equally worried. No cross-sectional differential response, but large aggregate response.

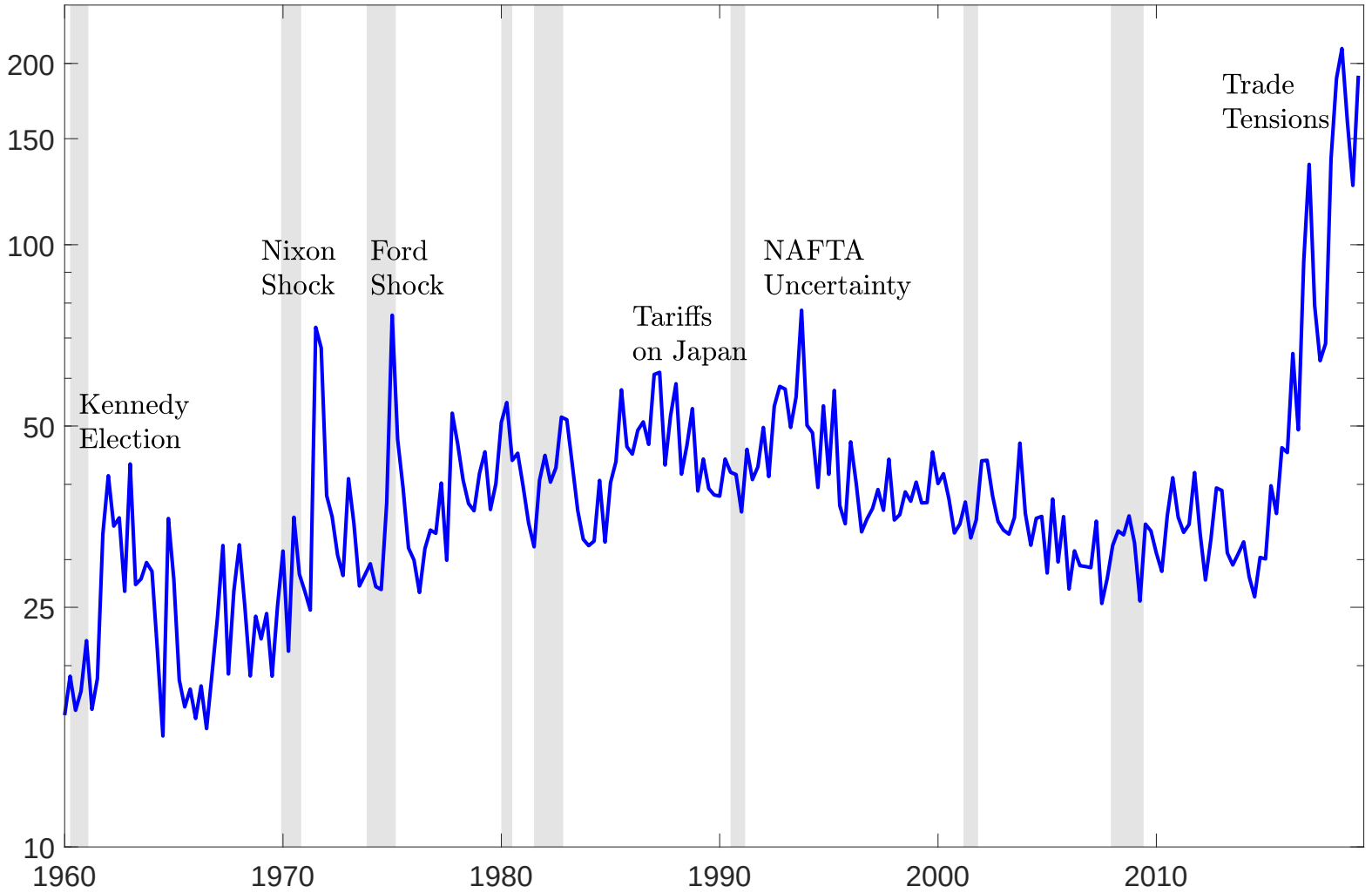
Aggregate TPU

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

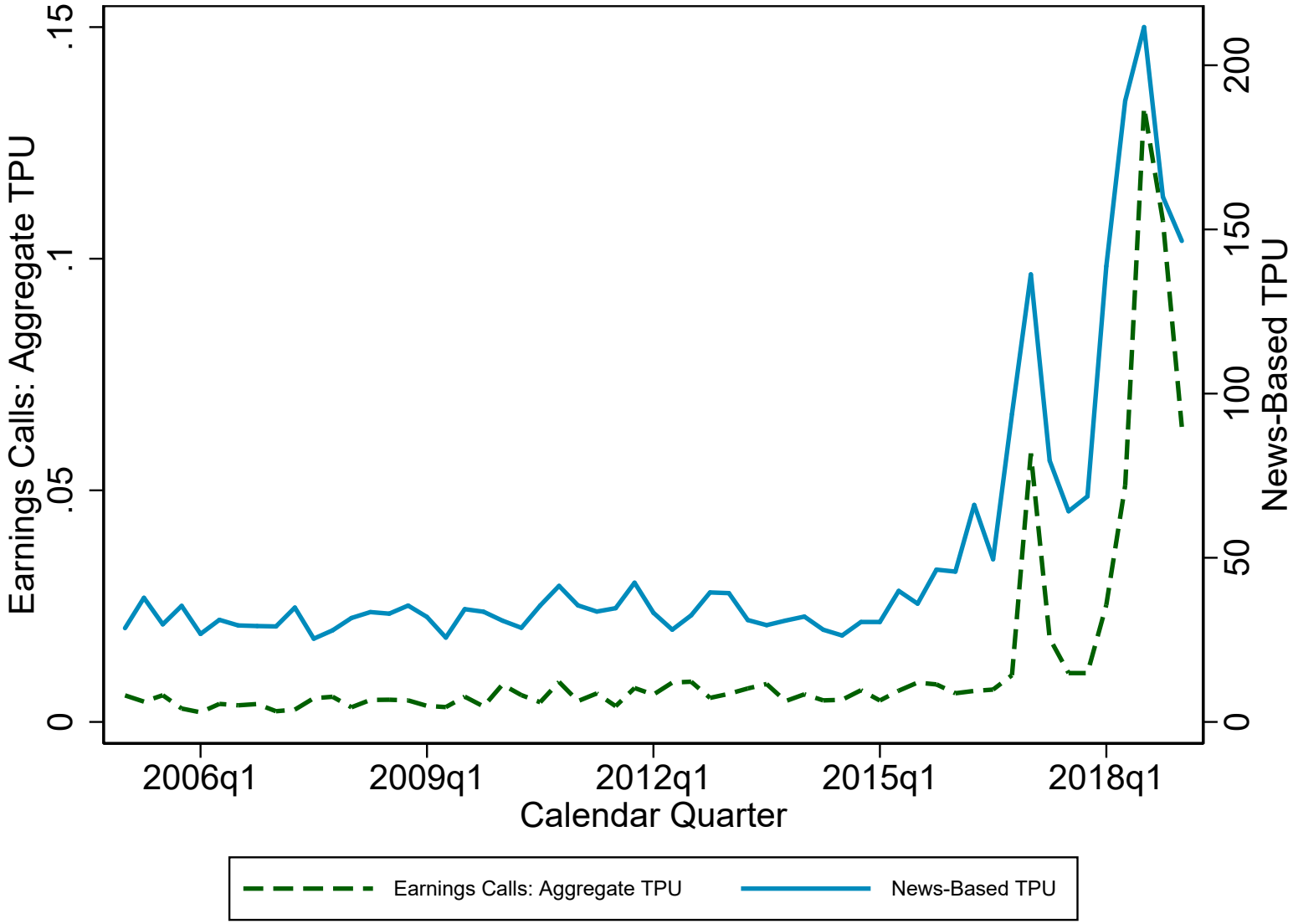
News-Based TPU



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

Comparison with Baker et al. (2016)

News-Based vs. Earnings Calls Based TPU



Foreign Firms 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)

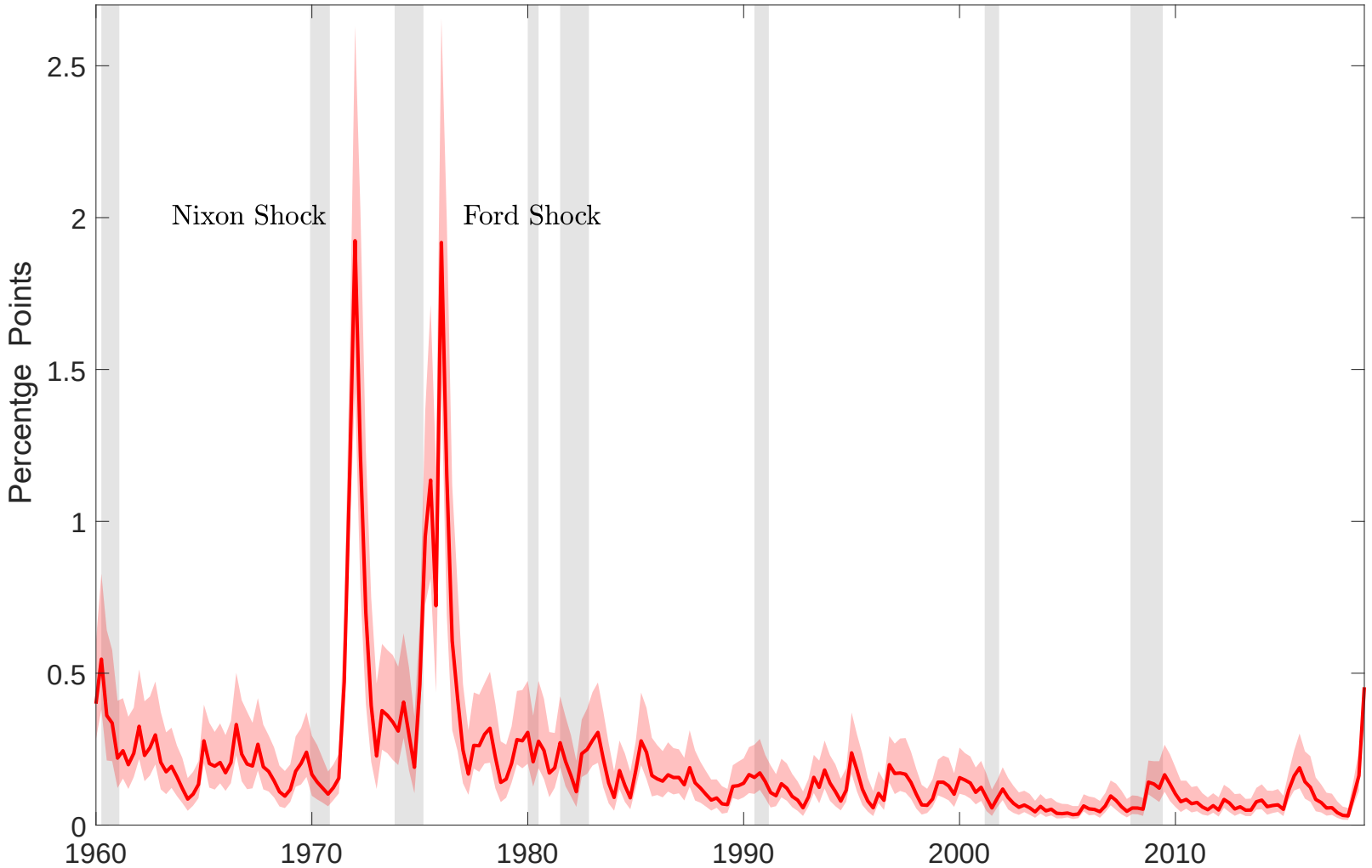
- We estimate the process:

$$\tau_t = (1-\rho_\tau)\,\mu_\tau + \rho_\tau \tau_{t-1} + \exp(\sigma_t)\,\varepsilon_t, \quad \varepsilon_t \sim N(0,1)$$

$$\sigma_t = (1-\rho_\sigma)\,\sigma + \rho_\sigma \sigma_{t-1} + \eta\, u_t, \quad u_t \sim N(0,1)$$

- u_t affects spread of values for tariffs (i.e. tariff volatility shock)

Tariff Volatility TPU



Filtered series of tariff volatility. Shaded area: 68-percent credible sets.

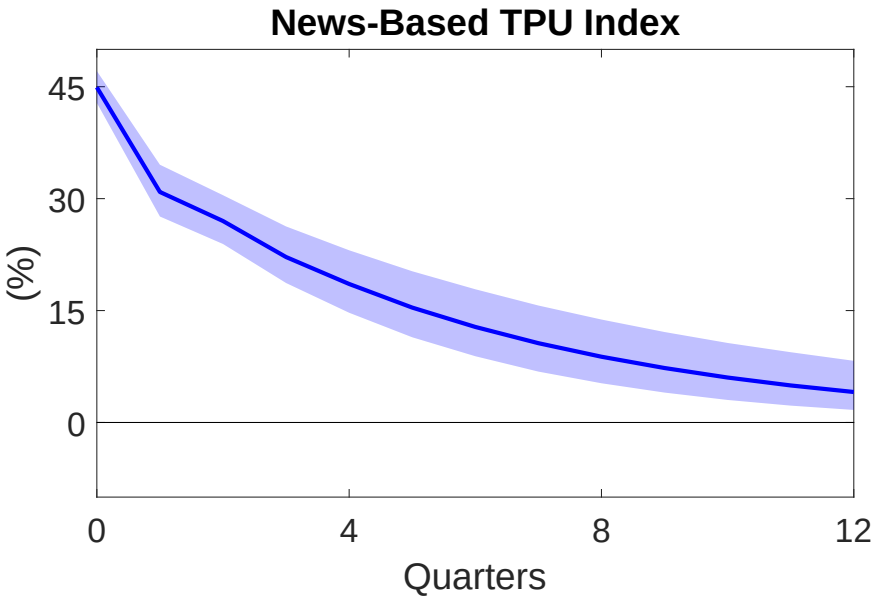
Comparison with news-based TPU

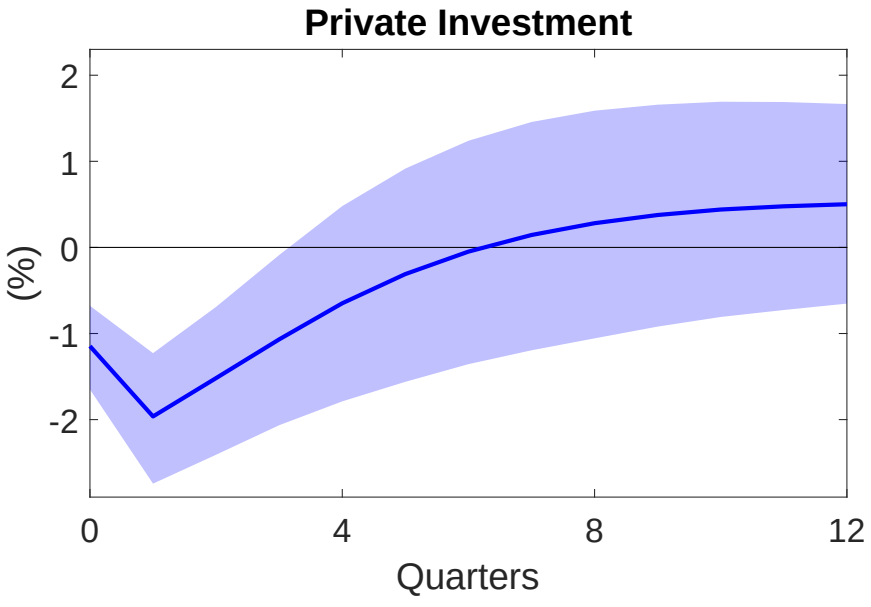
Quantifying the Effects of Aggregate TPU

- Estimation of VAR using quarterly data for the United States
- Baseline bivariate specification and ordering:
  1. News-Based TPU
  2. Real business fixed investment per capita
- Alternative specifications (see paper):
  - Tariff volatility TPU
  - Medium-scale VAR: 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





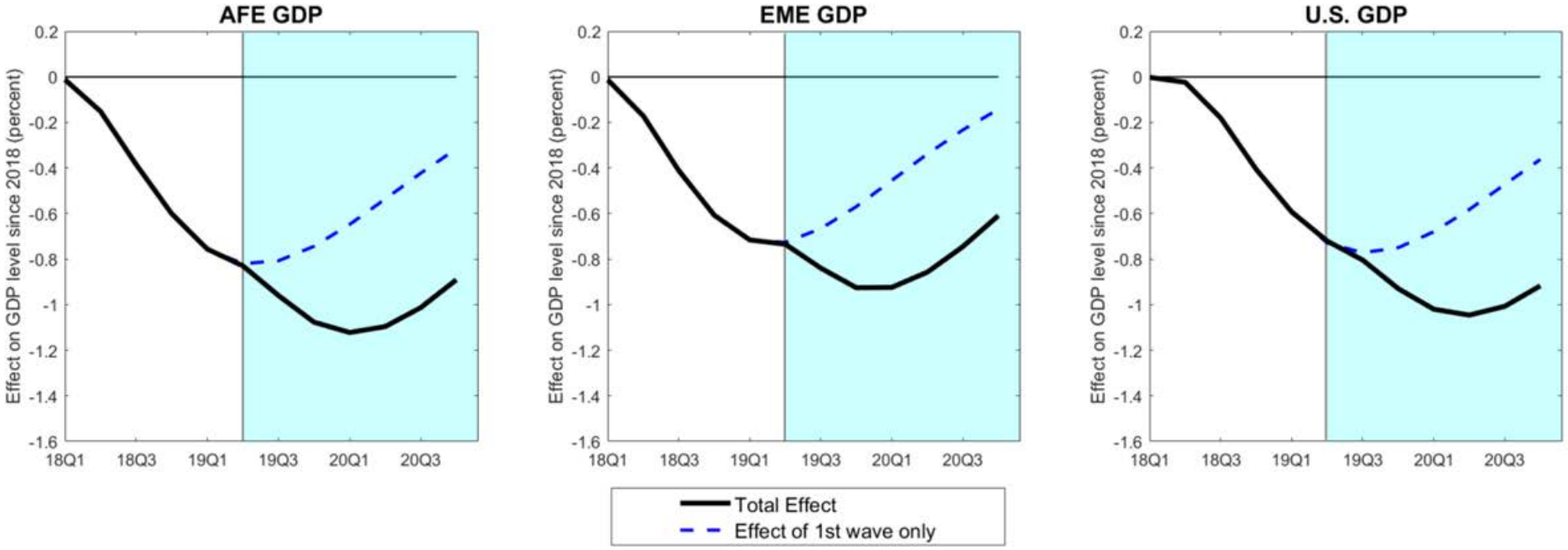
SV TPU Larger VAR

Quantifying the Effects of Aggregate TPU, Take Two

- Estimation of a global VAR using monthly data
- Baseline specification and ordering:
  1. News-Based TPU
  2. U.S., AFE, and EME industrial production
  3. Broad real dollar
  4. World imports
  5. U.S. stock prices and credit spreads
  6. U.S. import tariffs
- Sample: 1985M1-2019M5

Quantifying the Effects of Aggregate TPU, Take Two

- 2018 increase in TPU (1st wave) reduced global output by 0.8 percent
- 2019H1 increase in TPU (2nd wave) reduced global output by an additional 0.3 percent



Taking Stock of the Empirical Evidence

- 2018 Increase in TPU and Investment:

  $\rightarrow$ Firm level (direct exposure): $\simeq$ 1 percent decline in aggregate U.S. fixed investment.

  $\rightarrow$ Aggregate VAR (direct + indirect effect): $\simeq$ 2 percent decline in U.S. investment.

- 2018 Increase in TPU and Output:

  $\rightarrow \simeq$ 1 percent decline in world output. About \$850 bn.

- Small or large?

Taking Stock of the Empirical Evidence

NYT, October 8, 2019: *"Trade war could put Swiss-size dent in global economy - IMF warns."*

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, Taylor rule
  - Investment adjustment costs
  - Firm participation in export market subject to fixed cost (as in Alessandria and Choi, 2007)
- Goal: Trace out aggregate and firm-level effects of the 2018 increase in TPU.
- Assumption: Full retaliation of any trade policy action.

Effects of Tariffs

- Tariffs increase the relative price of imported goods $\rightarrow$ consumers switch towards domestic varieties Demand switching
- Tariffs induce supply-side distortions: They act like taxes on capital (K) and labor (L) Supply Distortion
- Tariffs reduce the value of exporting $\rightarrow$ mass of exporters shrinks and aggregate productivity declines Entry Distortion

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 dispersion of future tariffs (second moment)

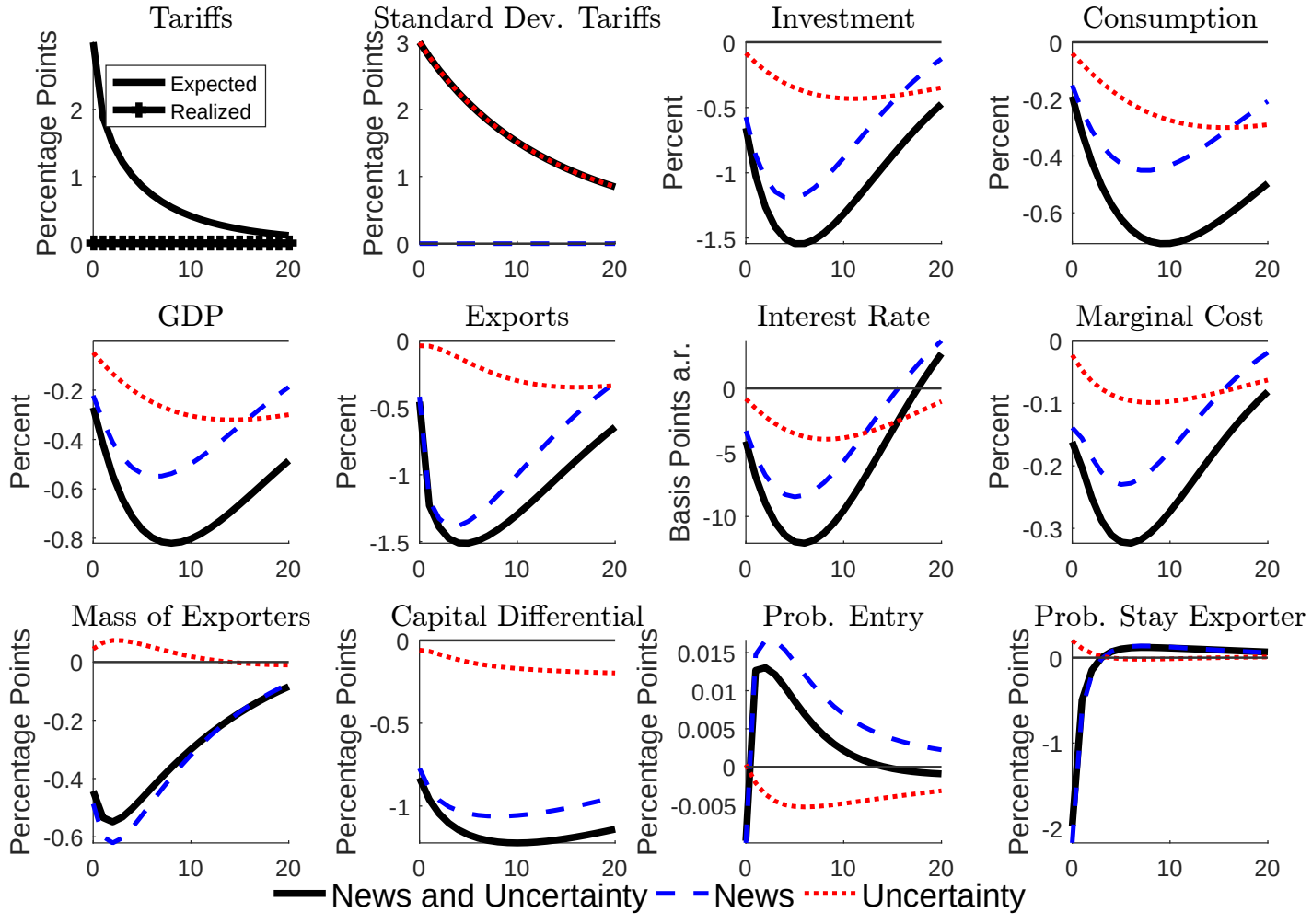
- Tariffs follow the estimated SV process:

$$\tau_t^m = (1-\rho_\tau)\,\mu_\tau + \rho_\tau \tau_{t-1}^m + \exp\left(\sigma_{t-1}^m\right)\varepsilon_t^\tau + \varepsilon_{t-1}^N \tag{1}$$

$$\sigma_t^m = (1-\rho_{\sigma^m})\,\sigma^m + \rho_{\sigma^m}\sigma_{t-1}^m + \eta\, u_t \tag{2}$$

- Scenario: Agents learn that tariffs can increase from $\tau^{SS} = 0.02$ to $\tau^{HIGH} = 0.08$ with probability 0.5 (but no actual tariff change materializes). Tariff Rates

Model Experiment: Results



TPU: Channels of Transmission

- Tariff news:
  - Higher future import prices lower expected profits and wages, depressing aggregate demand (despite intertemporal substitution incentive).
  - Given costly price adjustments, markups increase (input costs may be higher in the future), further reducing hours worked and consumption.
    - Sticky prices are key for amplification and for comovement.
    - With flex prices, fall in output is smaller as investment declines but consumption initially increases
  - Smaller expected export market reduces trade, with exporters reducing capital relatively more.
- Robustness: News Effects

TPU: Channels of Transmission

- Tariff uncertainty:
  - Higher uncertainty increases savings and reduces consumption (precautionary motive).
  - Given costly price adjustments, markups increase (as in Fernandez-Villaverde et al., 2015), reducing hours worked and consumption.
    - With flex prices, agents self-insure by accumulating capital.
  - Trade declines, with exporters reducing capital more.
    - Differently from Handley and Limão, 2017, export participation increases despite fixed export costs.
    - Key intuition: Differential capital stock adds a margin of adjustment.

- Robustness: Uncertainty Effects

Taking Stock of the Model Results

- 2018 increase in TPU lowers U.S. investment by 1.5 percent and GDP by nearly 1 percent
  - Model reproduces both firm-level and aggregate evidence.
  - Anticipation of higher tariffs accounts for 2/3 of these declines, while uncertainty about tariffs for the remaining 1/3 .
- Higher TPU reduces aggregate demand and trade.
  - Sticky prices (and markup response) are key for transmission.

Conclusions

- **Measurement**: We construct 3 measures of TPU using both firm-level and aggregate macroeconomic data.
- **Quantification**: We provide empirical evidence that the recent increase in TPU may have reduced investment by 2 percent and global output by about 1 percent.
- **Transmission**: Higher TPU reduces activity through changes in expected tariffs (first moment effect) and in volatility of future tariffs (second moment effect).

References I

Alessandria, G. and Choi, H. (2007). Do sunk costs of exporting matter for net export dynamics? *The Quarterly Journal of Economics*, 122(1):289–336.

Baker, S. R., Bloom, N., and Davis, S. J. (2016). Measuring economic policy uncertainty*. *The Quarterly Journal of Economics*, 131(4):1593.

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Handley, K. and Limão, N. (2017). Policy uncertainty, trade, and welfare: Theory and evidence for china and the united states. *American Economic Review*, 107(9):2731–83.

Hassan, T. A., Hollander, S., van Lent, L., and Tahoun, A. (2017). Firm-Level Political Risk: Measurement and Effects. NBER Working Papers 24029, National Bureau of Economic Research, Inc.

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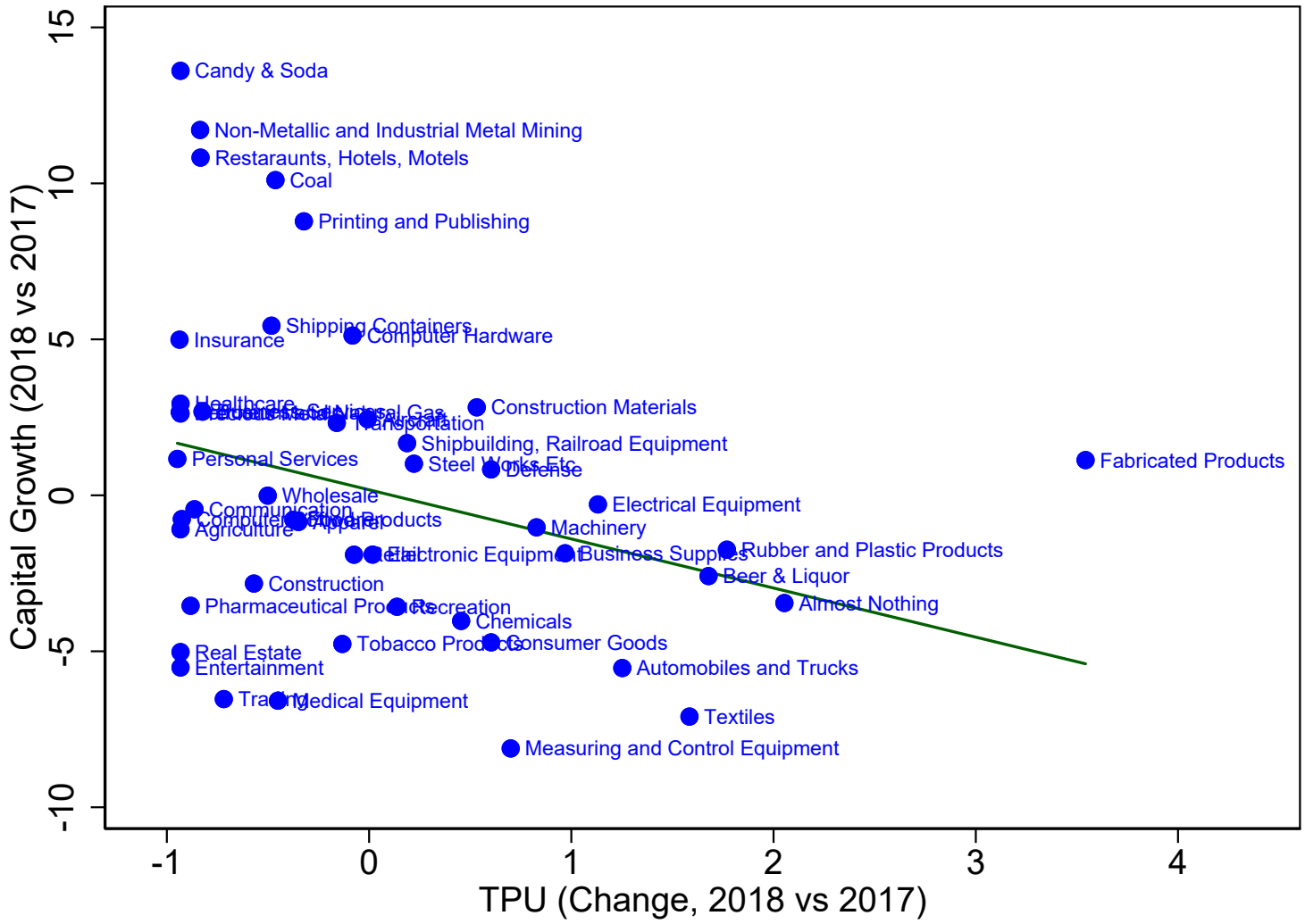
1. *"The Economic Effects of Trade Policy Uncertainty"*, IFDP Number 1256, September 2019.

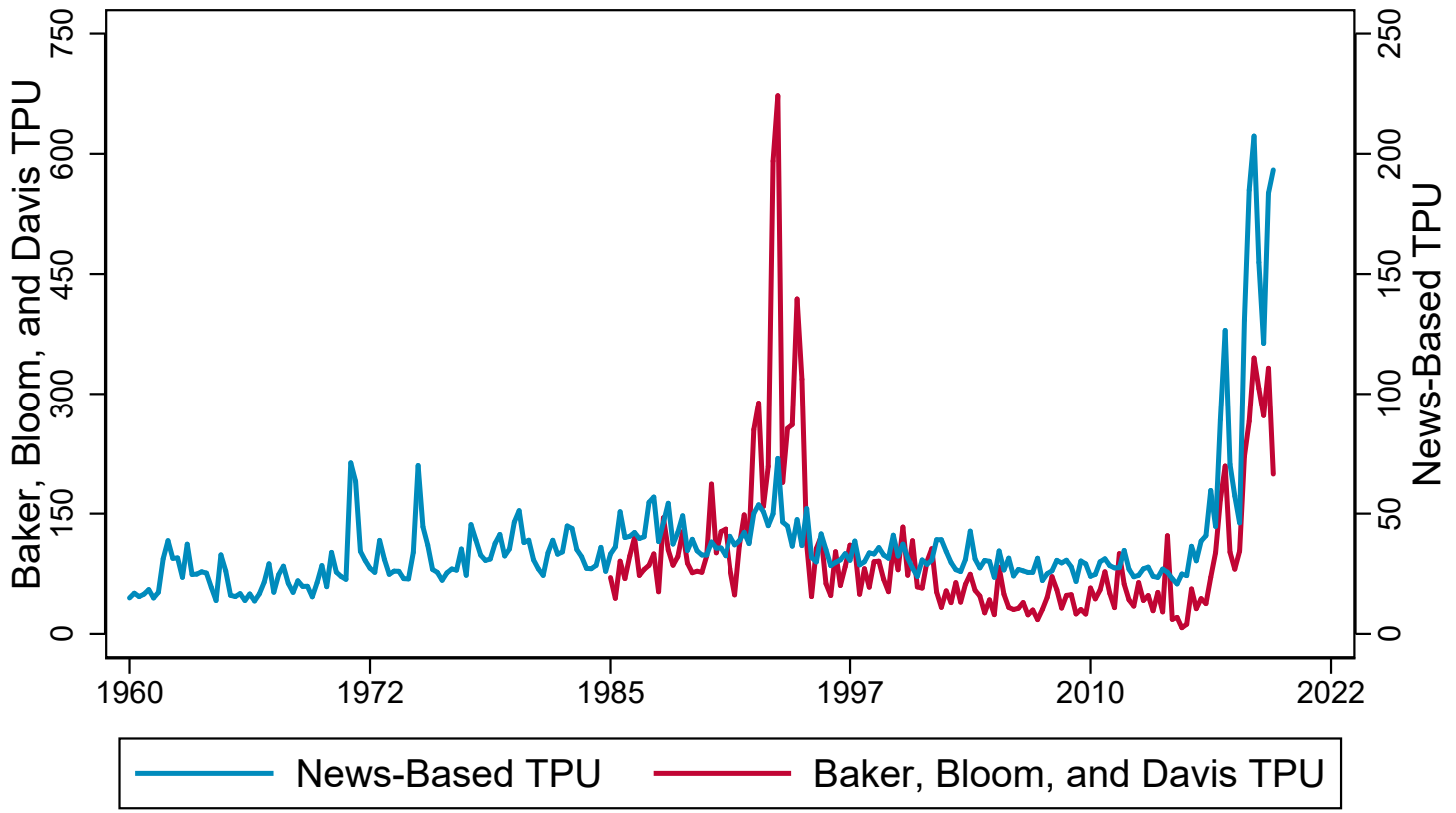
2. *"Does Trade Policy Uncertainty Affect Global Economic Activity?"*, FEDS Notes, September 4, 2019.

Cross-Section: 2018 vs.2017 Investment Growth



Back

News-Based TPU vs Baker et al. (2016) TPU



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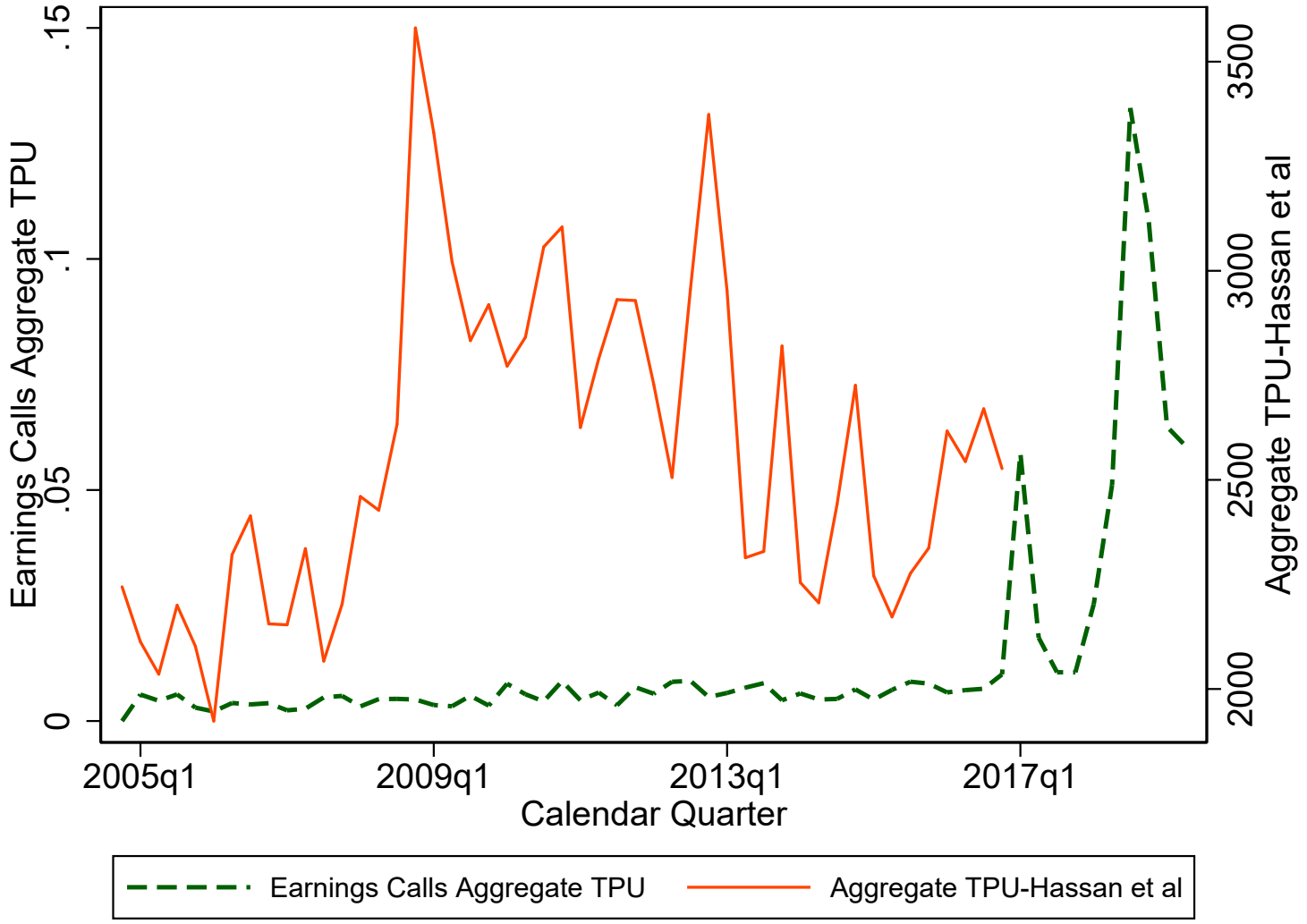
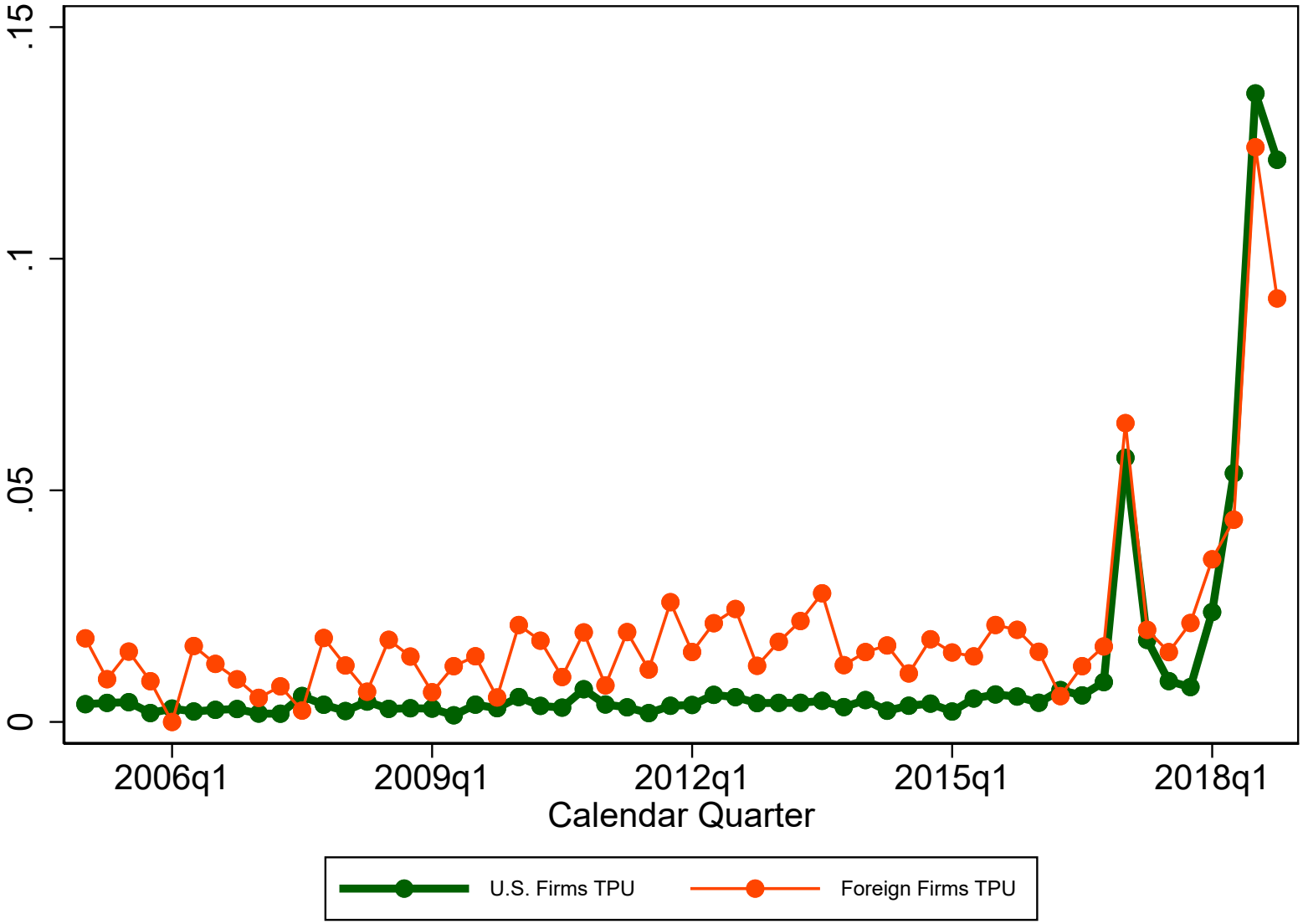
TPU from Hassan et al. (2016)



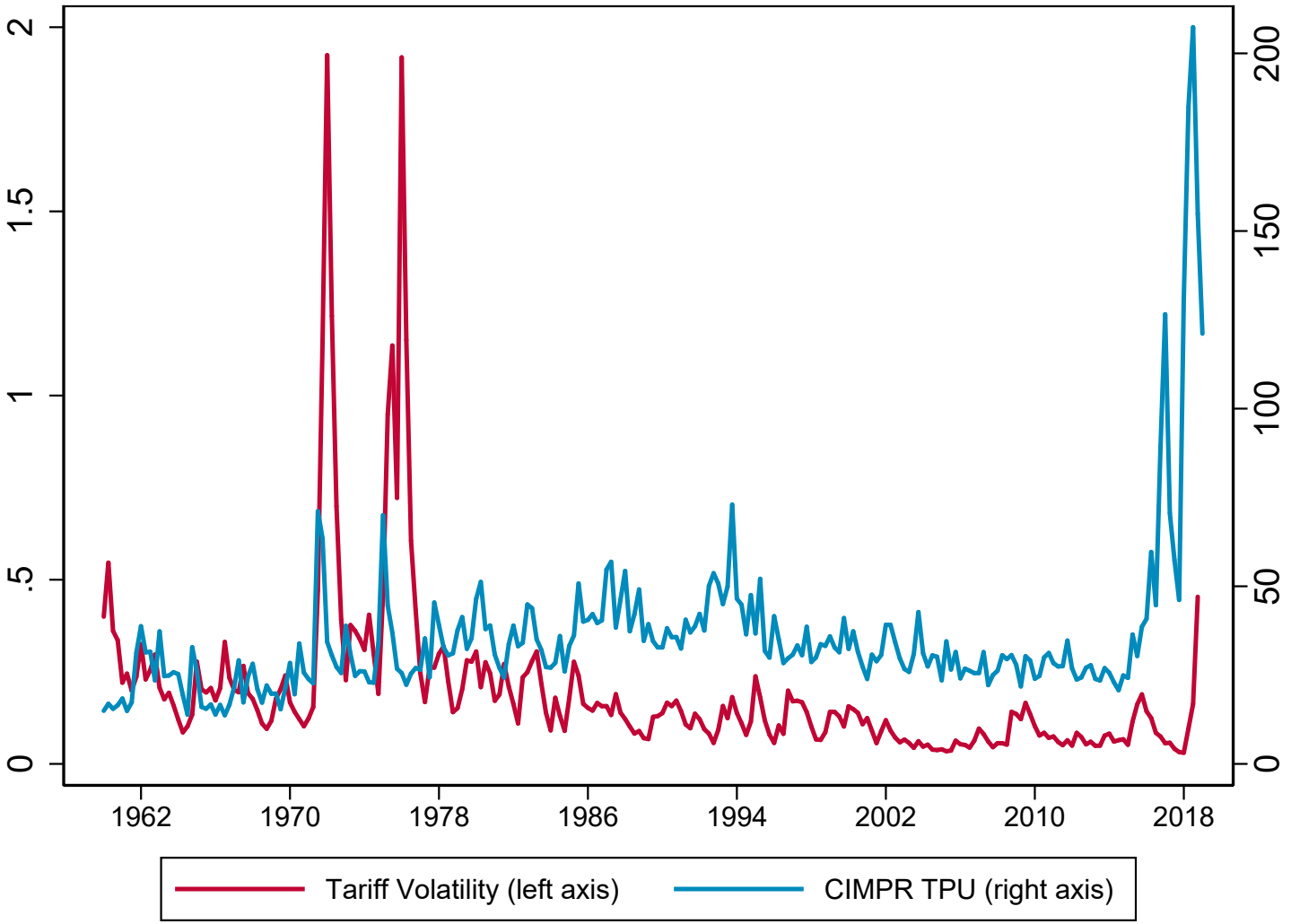
Back

US vs. Foreign Firms TPU



Back

News-Based vs. Tariff Volatility TPU



Back

Correlation of tariff volatility with other shocks

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

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).

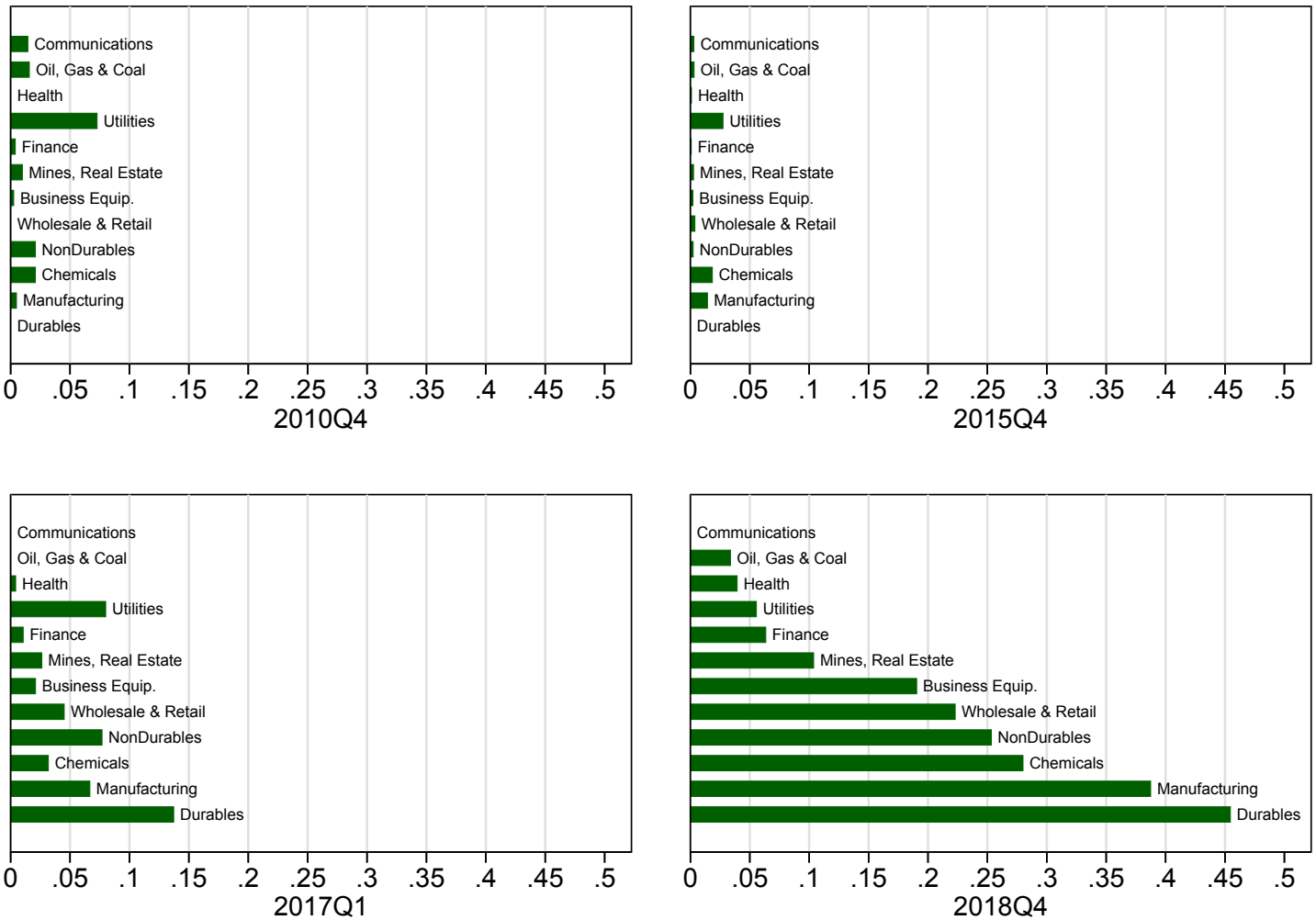
[d] Unanticipated tax shocks from Mertens and Ravn (2011).

[e] Defense spending news shocks from Ramey (2011).

[f] Capital tax volatility shocks from Fernandez-Villaverde et al. (2015).

Back

Variation Across Industries and Time



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

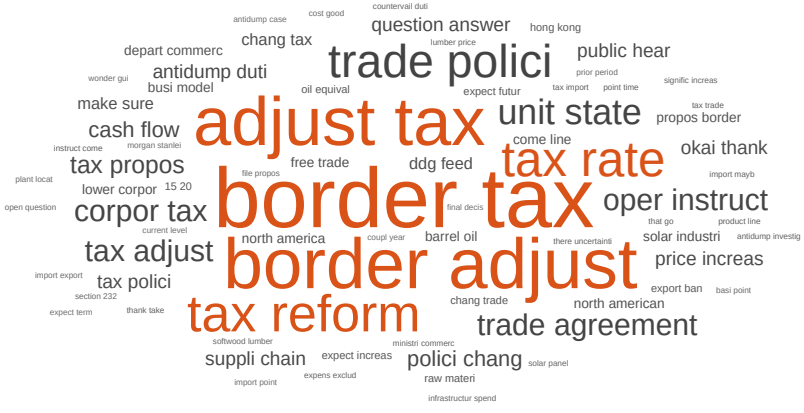
Comparison with Hassan et al. (2016)

Topics List in Earnings Calls

Topics 2005-2009

Topics 2010-2014

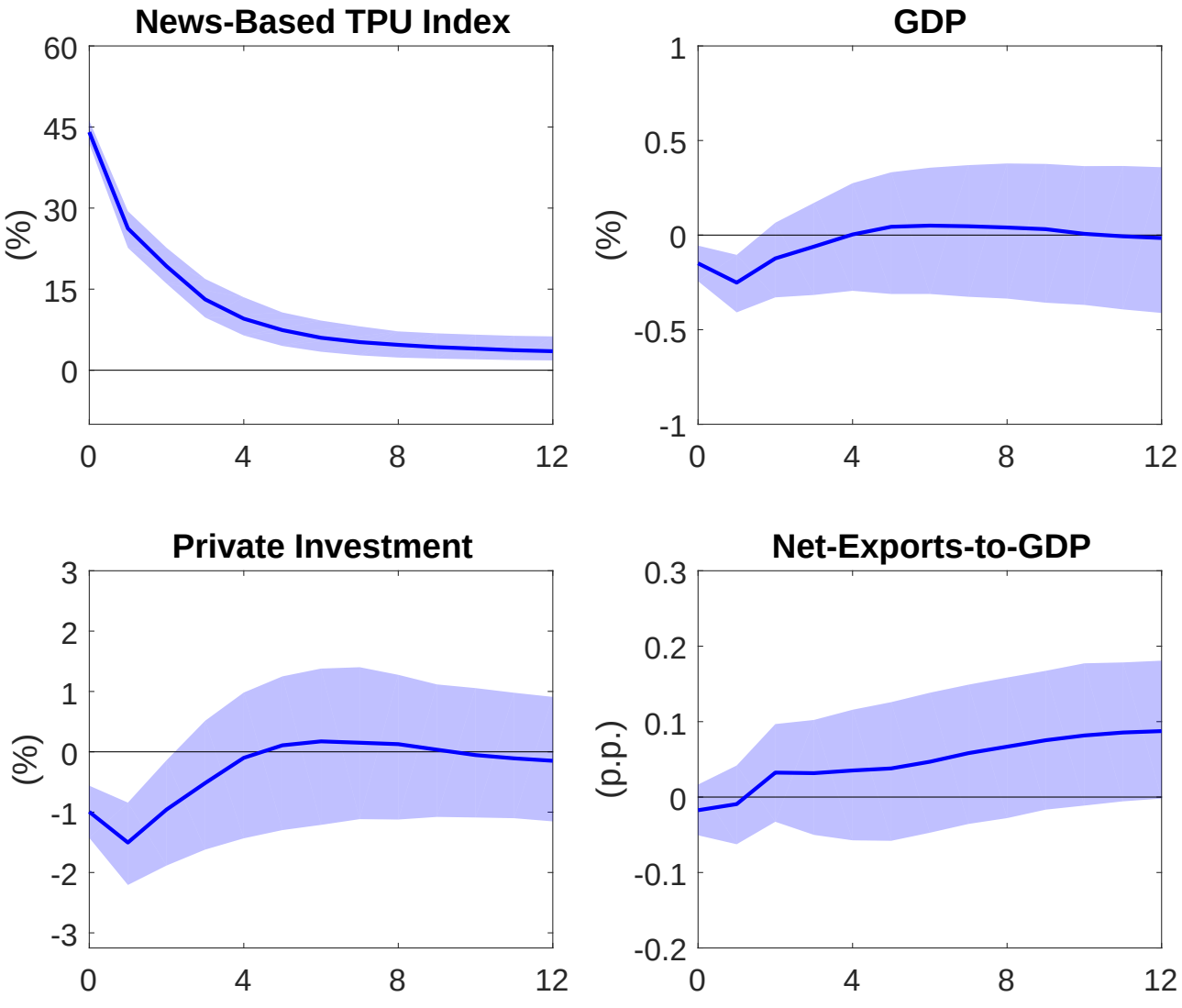
Topics 2015-2017



Topics 2018

Note: LDA Analysis on Transcripts from All Years. Most Common Bigrams, Grouped by Topic.

VAR with News-Based TPU: 1960-2018



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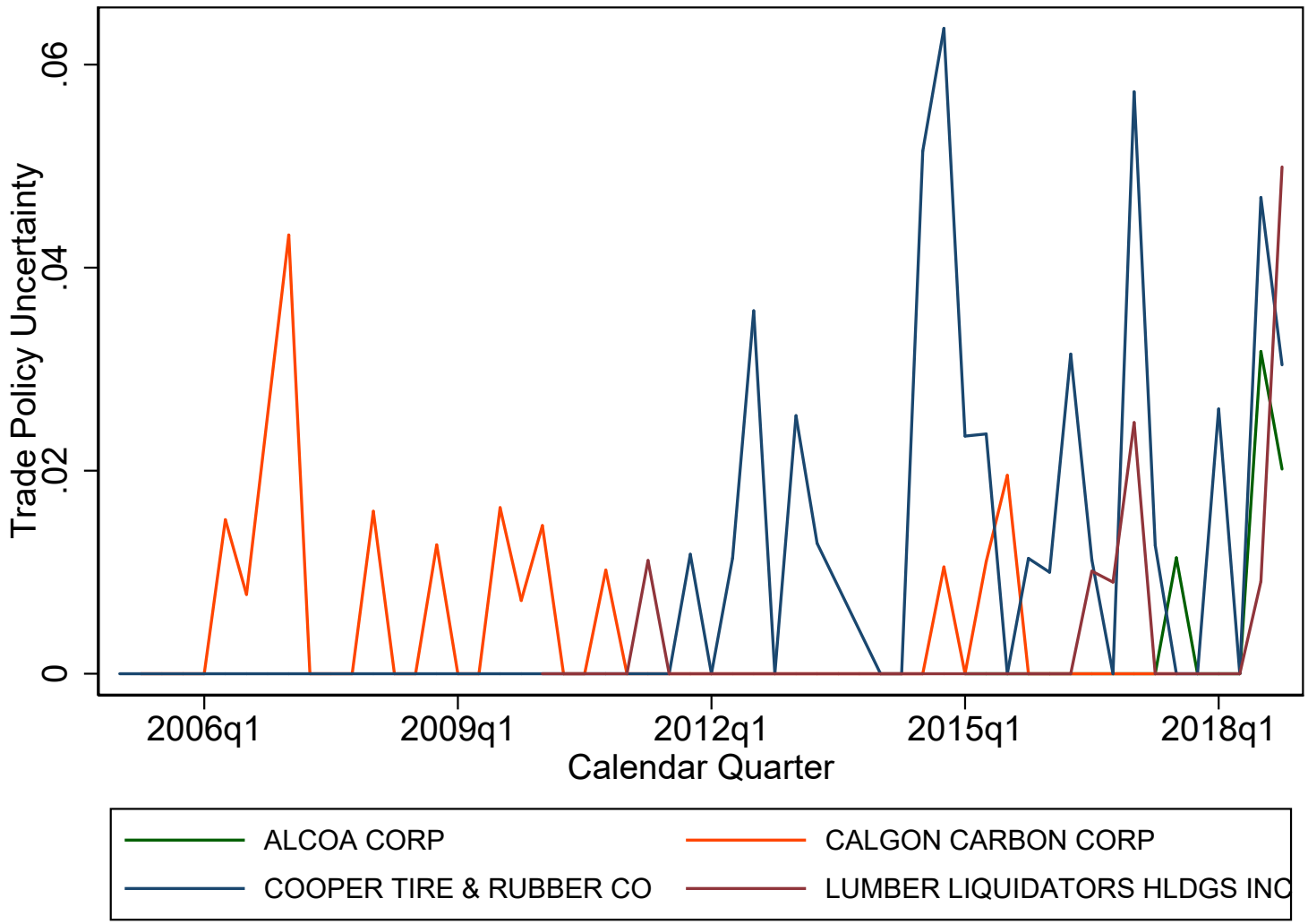
Measuring Firm-Level TPU: Variation Across Firms and Time



Note: TPU for selected firms.

Effects of Tariffs: Demand-Switching

Back

- Tariffs increase the relative price of imported goods → consumers switch towards domestic varieties

$$\underset{\text{imports}}{m_t} = \underset{\substack{\text{trade}\\ \text{elasticity}}}{-\theta} \times \underset{\substack{\text{price of}\\ \text{imports}}}{(p_{m,t} + \tau_t^m)} + \underset{\substack{\text{domestic}\\ \text{absorption}}}{a_t}$$

- 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

Back

- Price of consumption bundle is $P\left(P_D, P_M, \underset{+}{\tau_t^m}\right)$
- Tariffs tax revenues by reducing relative price of domestic good

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

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

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

$\rightarrow$ Contractionary effect on investment and output

Effects of Tariffs: Firm Entry

Back

- Firm exports at t if productivity is above threshold z_m^*

$$\underbrace{p^k \Delta k}_{\text{extra investment}} + \underbrace{W_t c_m}_{\text{fixed cost}} = \underbrace{z_m^{*\gamma}}_{\text{threshold}} \underbrace{\pi\left(W_t, K_{mt}\right)}_{\text{unit profit}} \underbrace{\left(\Gamma^{\nu}_{\text{exp}} - \Gamma^{\nu}_{no\,\text{exp}}\right)}_{\text{market size gain}} + \underbrace{E\Delta V}_{\text{gain in contin. value}}$$

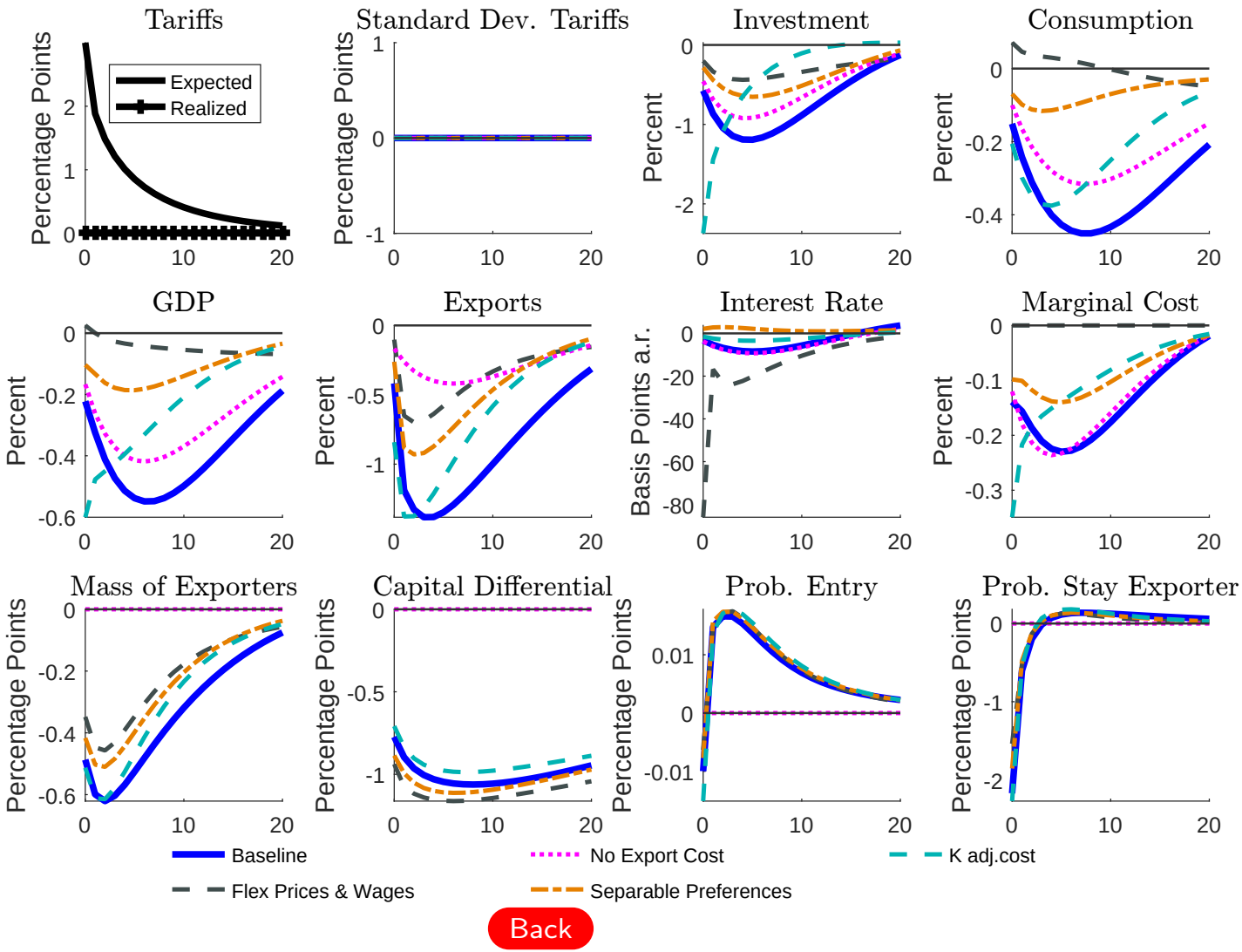
  where $m \in \{$ Exporter at t-1 , Non Exporter at t-1 $\}$

- Gain in market size $\left(\Gamma^{\nu}_{\text{exp}} - \Gamma^{\nu}_{no\,\text{exp}}\right)$ shrinks because of demand switching at home and abroad

- $\rightarrow$ Thresholds z_m^* declines and so Entry declines and Exit increases

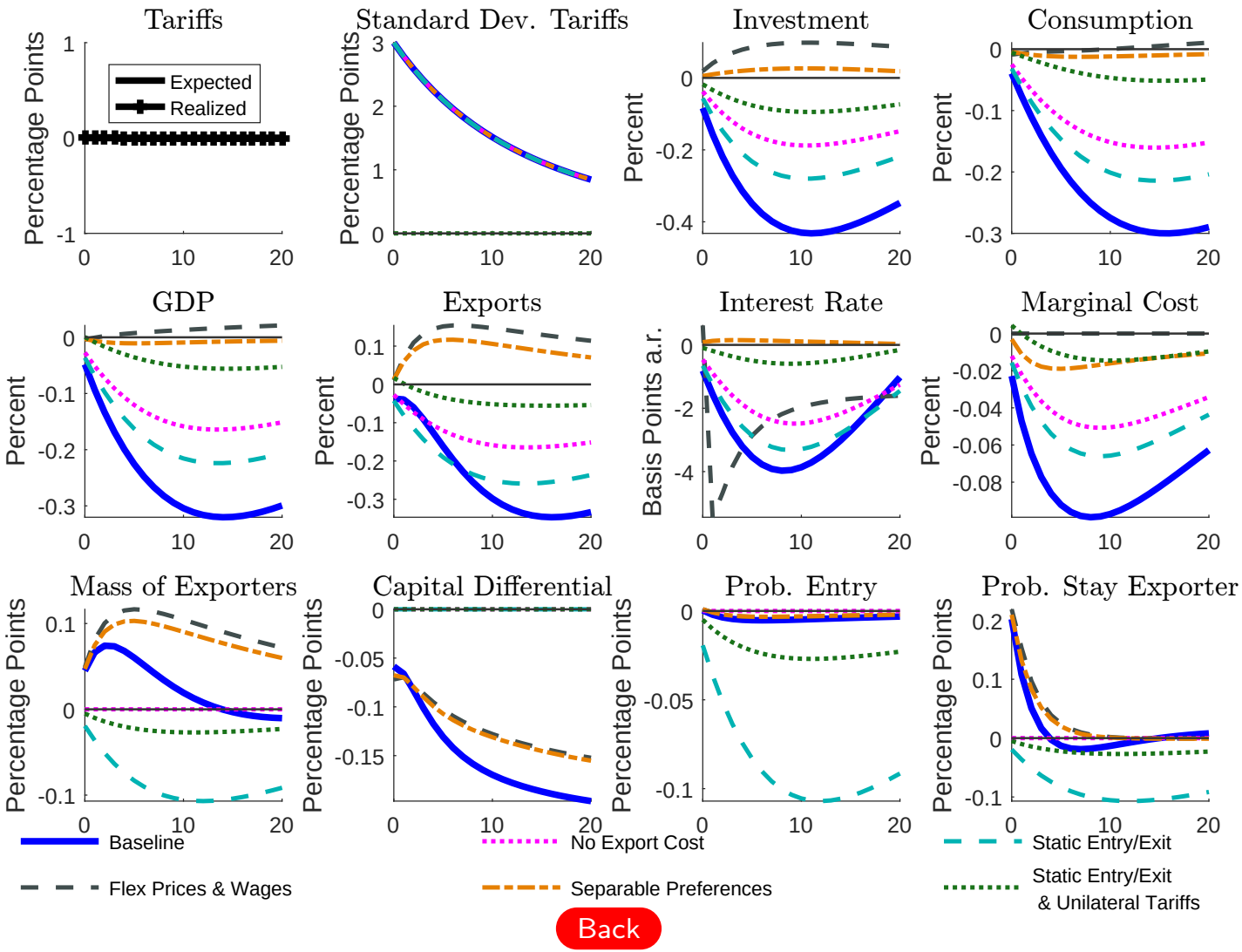
- Aggregate productivity declines as cross-sectional correlation between output and idiosyncratic productivity declines

Tariff News: Robustness



Back

Tariff Uncertainty: Robustness



Back

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 $\tau^{HIGH} = 0.08$ Tariff Rates

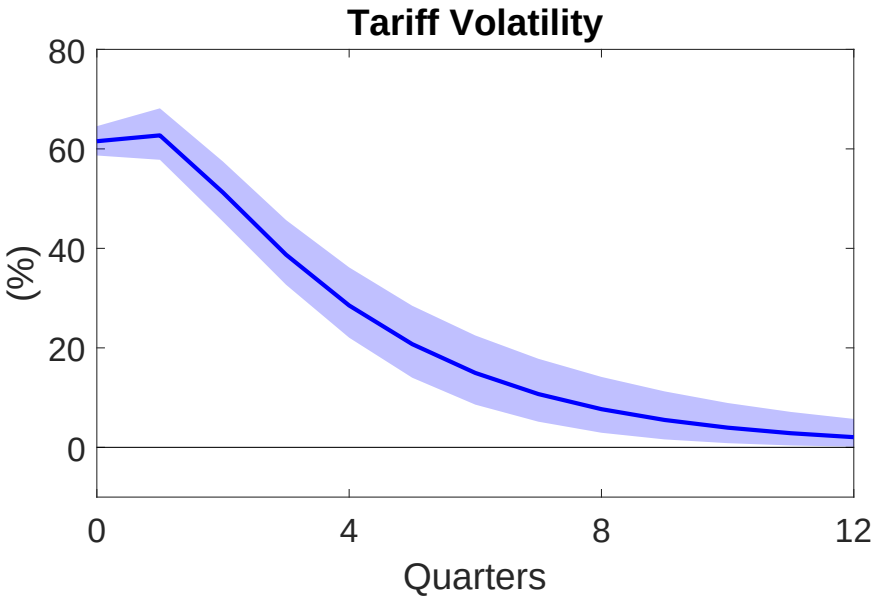
$$\varepsilon_0^N = p_0 \cdot 0.08 + (1 - p_0) \cdot 0.02 = 0.03$$

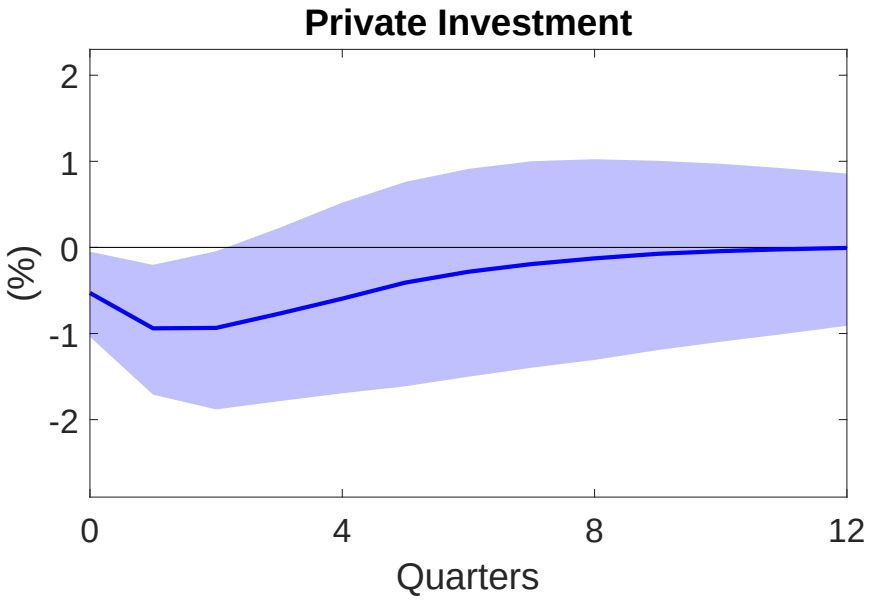
$$\sigma_0^m = \sigma^m(p_0) = \log(0.03)$$

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

2. From $t = 1, ..., T$ **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: $\varepsilon_t^N = p_t \cdot 0.08 + (1 - p_t) \cdot 0.02$

Aggregate Effects: Stochastic Volatility TPU



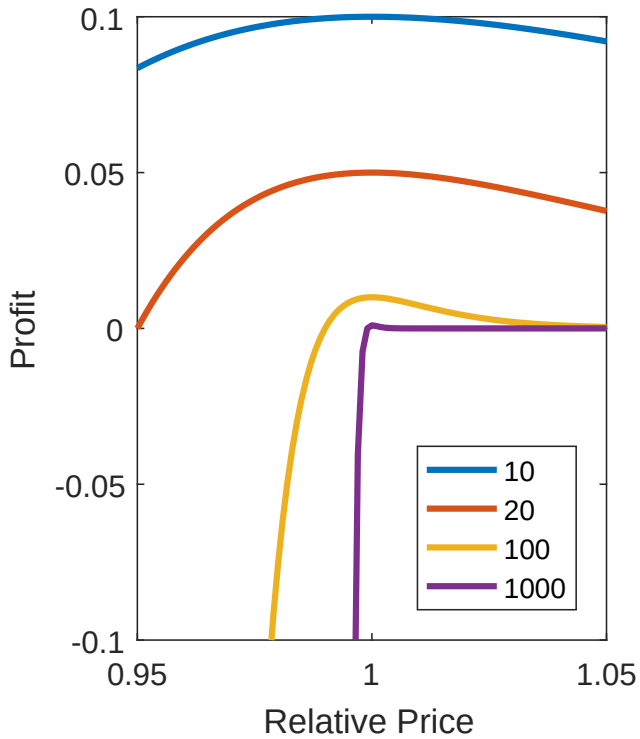


Back

Uncertainty: Channels of Transmission

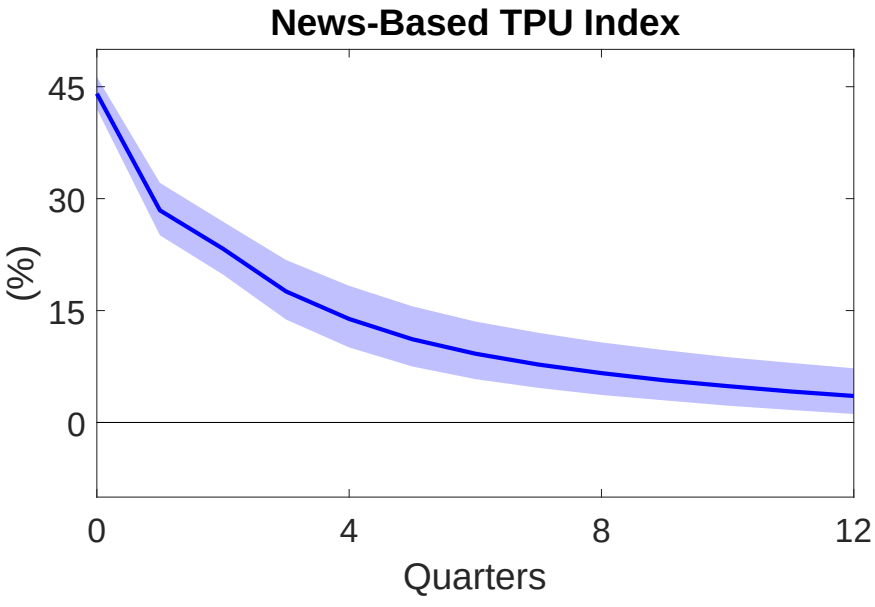
1. Higher uncertainty reduces aggregate demand (precautionary motive).
2. Markups increase (as in Fernandez-Villaverde et al., 2015).

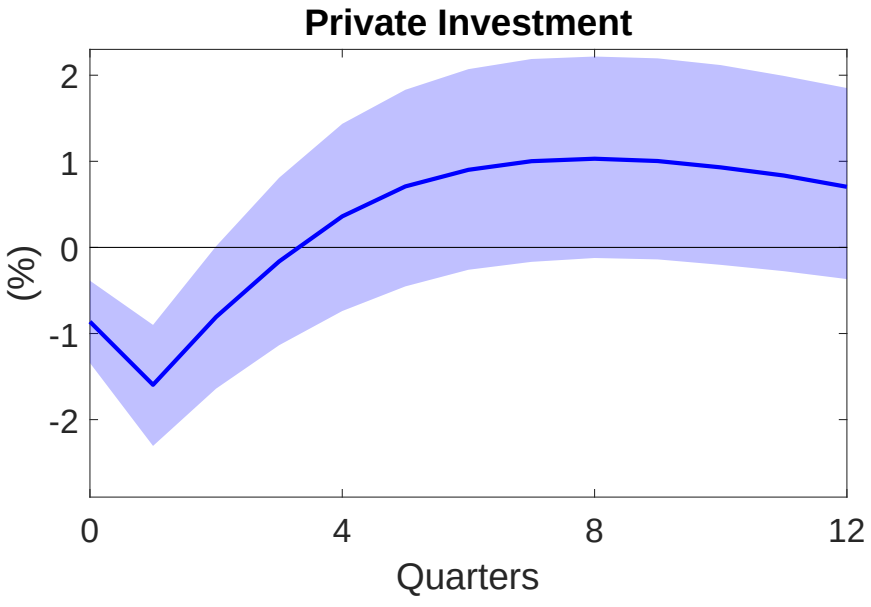
- Uncertainty about tariffs increases the variance of future desired prices.
- When different varieties are substitutes, profit function is asymmetric $\rightarrow$ losses from overpricing smaller than losses from underpricing.



- Producers raise prices to avoid being stuck with relatively low price in the future $\rightarrow$ markups rise, especially in foreign market.

Aggregate Effects: Additional Controls





Back

Quantifying the Effects of Aggregate TPU, Take Two