The Impact of the 2018-19 Trade War on U.S. Prices and Welfare

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The views expressed are those of the authors and do not necessarily reflect the position of the Federal Reserve Bank of New York, the Federal Reserve System, the National Bureau of Economic Research, or any other institution to which the authors are affiliated.

Motivation

- Over the course of 2018, the Trump Administration imposed import tariffs on approximately $ 283 billion of U.S. imports
  - Rates ranging between 10 % and 50 %
- U.S. trading partners, especially China, have retaliated with tariffs averaging 16 % on approximately $ 121 billion of U.S. exports
- The U.S. has plunged into its first episode of large-scale competitive tariff protection since the Great Depression of the 1930s
- Questions raised about the future of international trade integration

Main Findings

- Over the course of 2018, the U.S. experienced
  - Substantial increases in the prices of intermediate and final goods
  - Large changes to its international sourcing patterns
  - Reductions in availability of imported varieties
  - Complete passthrough of tariffs into domestic prices
- No evidence so far of an improvement in the terms of trade, so the entire incidence of the tariff falls on U.S. importers
- By the end of 2018, U.S. tariffs were costing U.S. importers
  - $ 3.2 billion per month in added tax costs
  - $ 1.4 billion per month in deadweight welfare (efficiency) losses
- If a successful outcome of the trade war were to create the number of steel and aluminum jobs lost in the last ten years
  - Deadweight welfare loss per job saved is $232,000
  - Around four times the annual wage of a steel worker ($52,500)
- Tariffs have changed the pricing behavior of U.S. producers
  - Protecting them from foreign competition
  - Enabling them to raise prices and markups

Related Literature

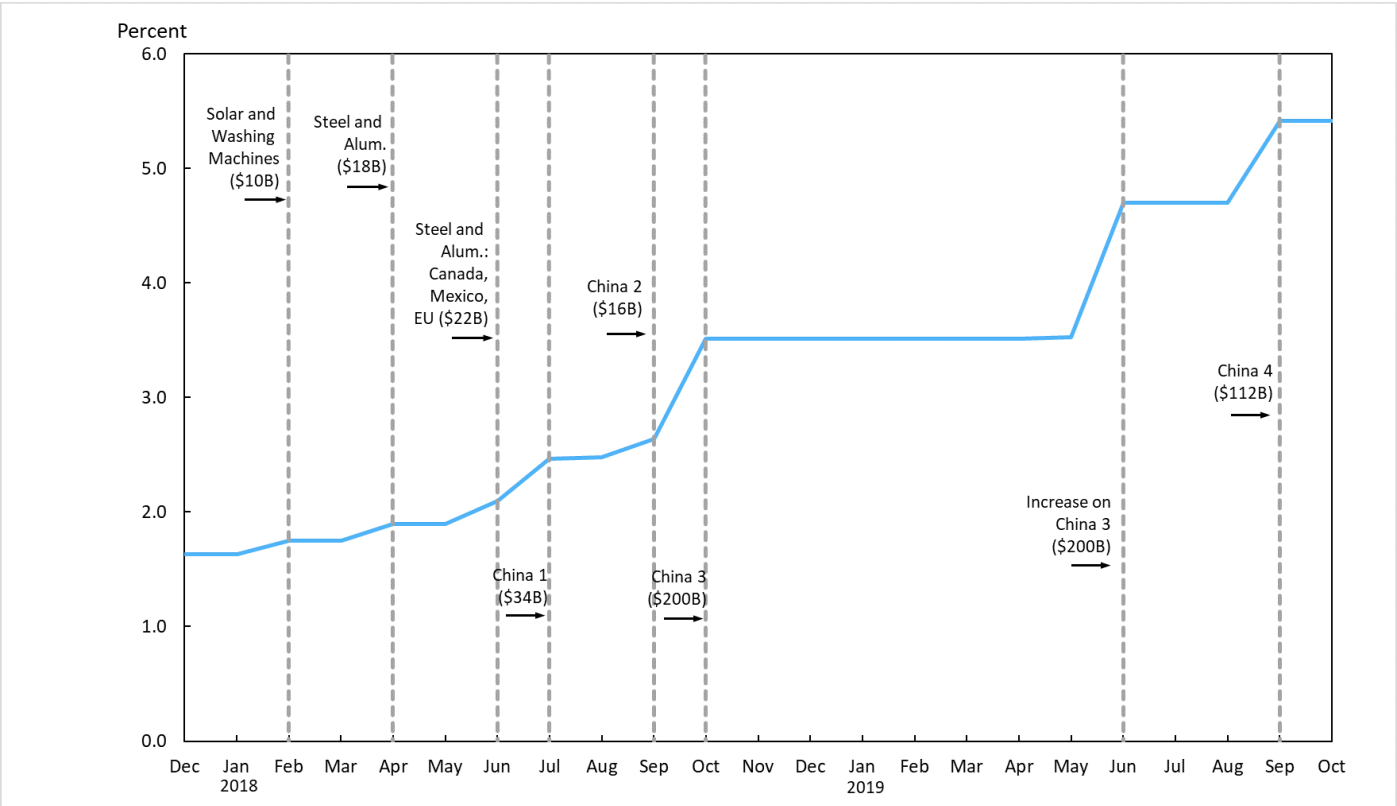
- Growing body of research on the impact of the 2018-19 trade war
  - Amiti, Redding and Weinstein (2019, 2020)
  - Fajgelbaum, Goldberg, Kennedy and Khandelwal (2019)
  - Cavallo, Gopinath, Neiman and Tang (2019)
  - Flaaen, Hortaçsu and Tintelnot (2019)
  - Blanchard, Bown and Chor (2019)
  - Waugh (2019)

Outline

- Overview of the Trade War
- Conventional Price Impacts : Data
- Conventional Price Impacts : Theory
- Estimating Price and Welfare Losses
- Longer-Term Perspective

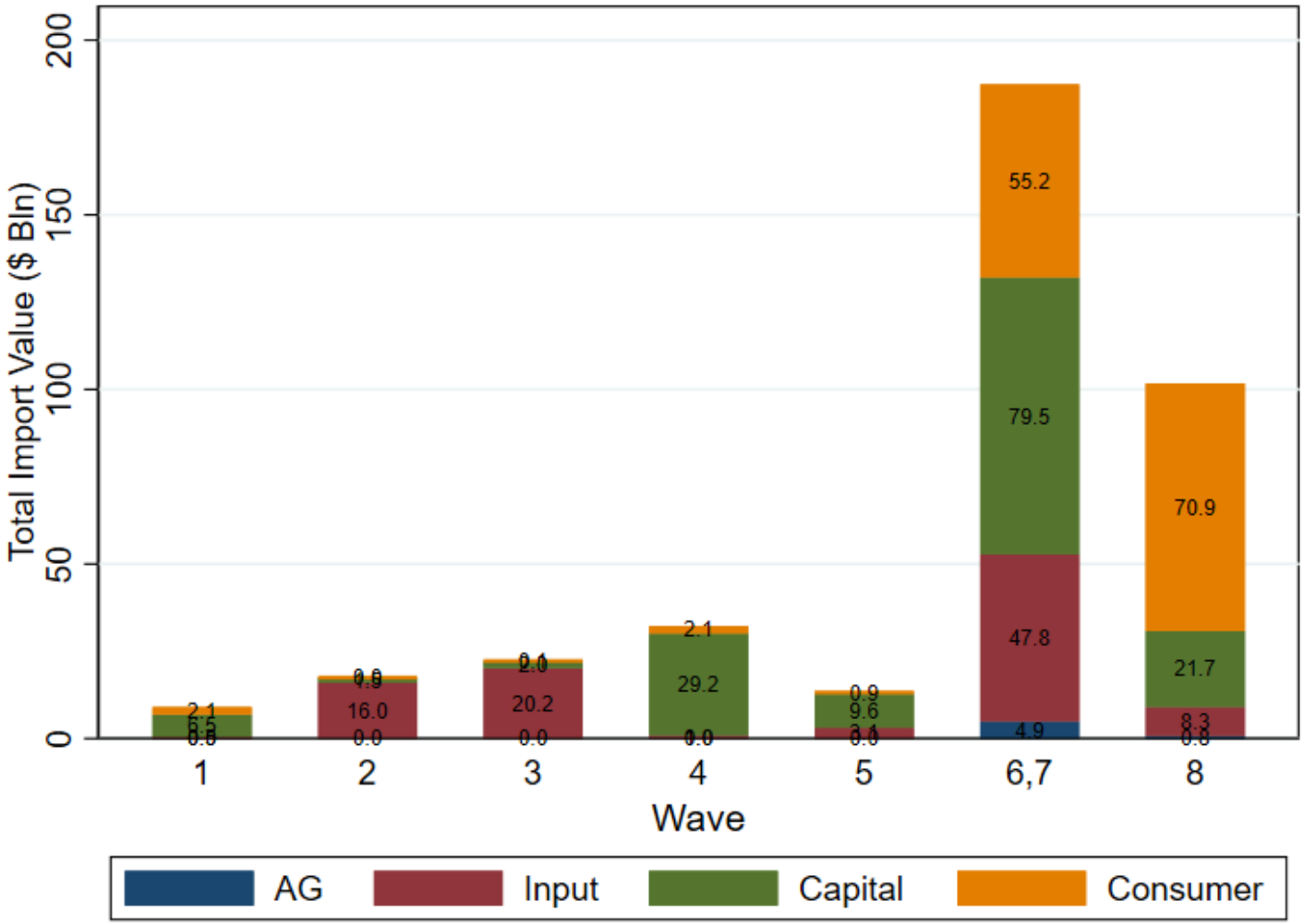
Average Tariff Rates

- Six waves of import tariffs during 2018 and two waves during 2019



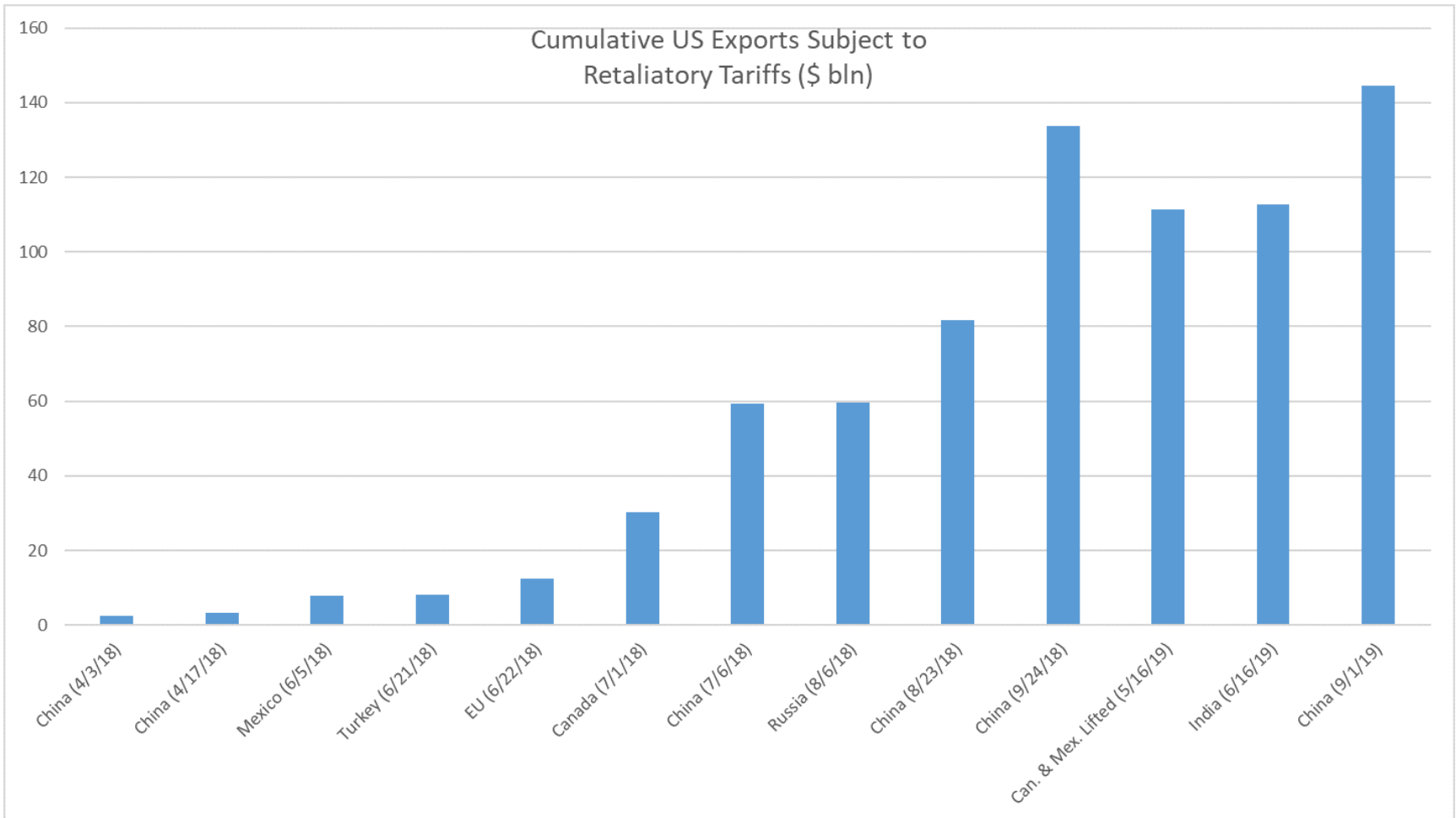
Notes: Tariffs on the 10-digit Harmonized Tariff Schedule (HTS) product code by country, weighted by 2017 annual import value. Dashed vertical lines indicate the implementation of each of the six major waves of new tariffs during 2018 and the two waves during 2019; tariffs implemented after the 15th of the month counted for the subsequent month. Source: US Census Bureau; USTR; USITC; authors' calculations.

Import Value Affected by End Use



Notes: Import value by Census Bureau end use classification; AG is agriculture; Input refers to intermediate inputs; Capital refers to capital goods; Consumer refers to consumer goods.

Foreign Retaliation



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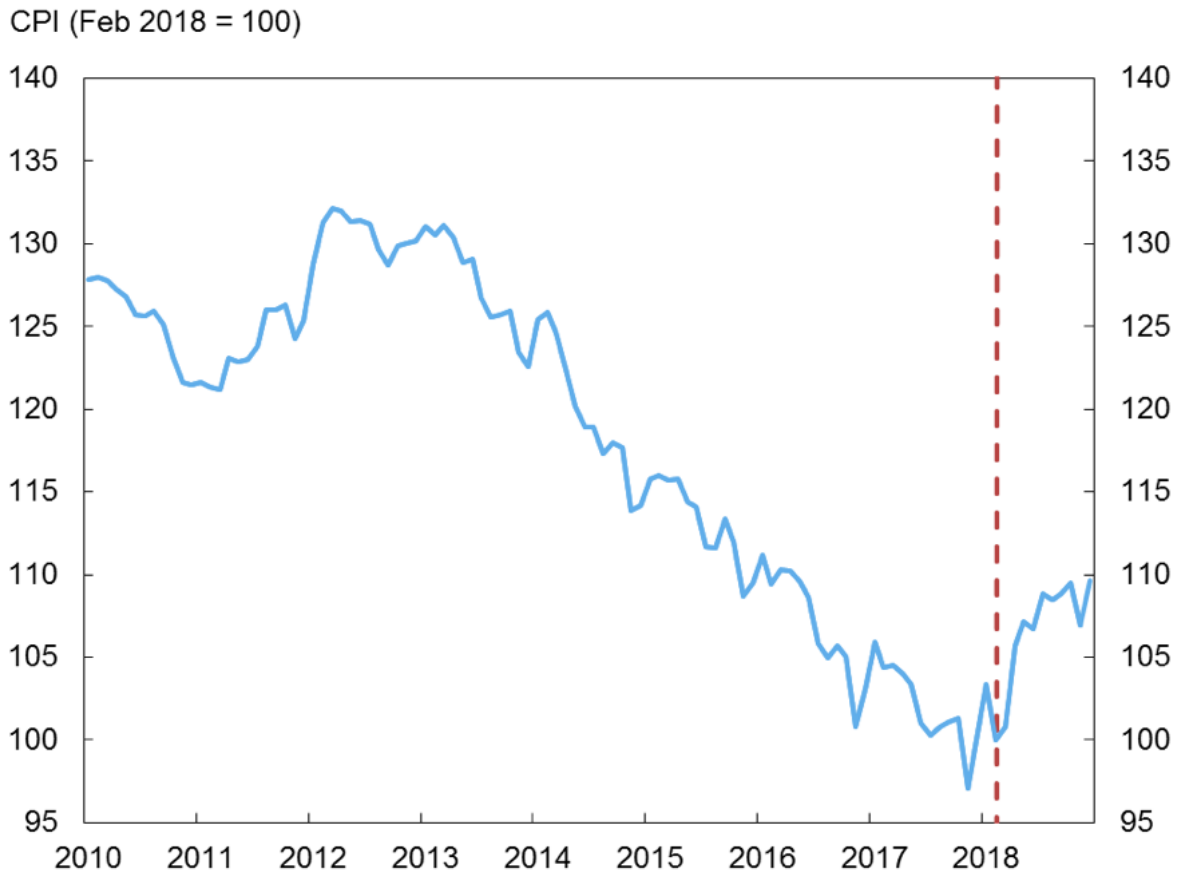
Major Appliances CPI

- After falling steadily for years, the price of major appliances (including washing machines) began rising sharply following the tariffs



Notes: Monthly CPI of ELI HK01 Major Appliances. Series indexed to 100 in February 2018. The red dashed line indicates the implementation of the January 22nd tariffs on washing machines. Source: BLS.

Measuring Import Price Changes

- U.S. customs data reports foreign export values and quantities for around 16,000 10-digit Harmonized System (HS) products
  - Divide values by quantities to obtain unit values before the tariffs are applied (foreign export prices)
  - Multiply unit values by duty rates to obtain tariff-inclusive import prices
- Compute 12-month relative price change for HTS10 good i from country j in month t

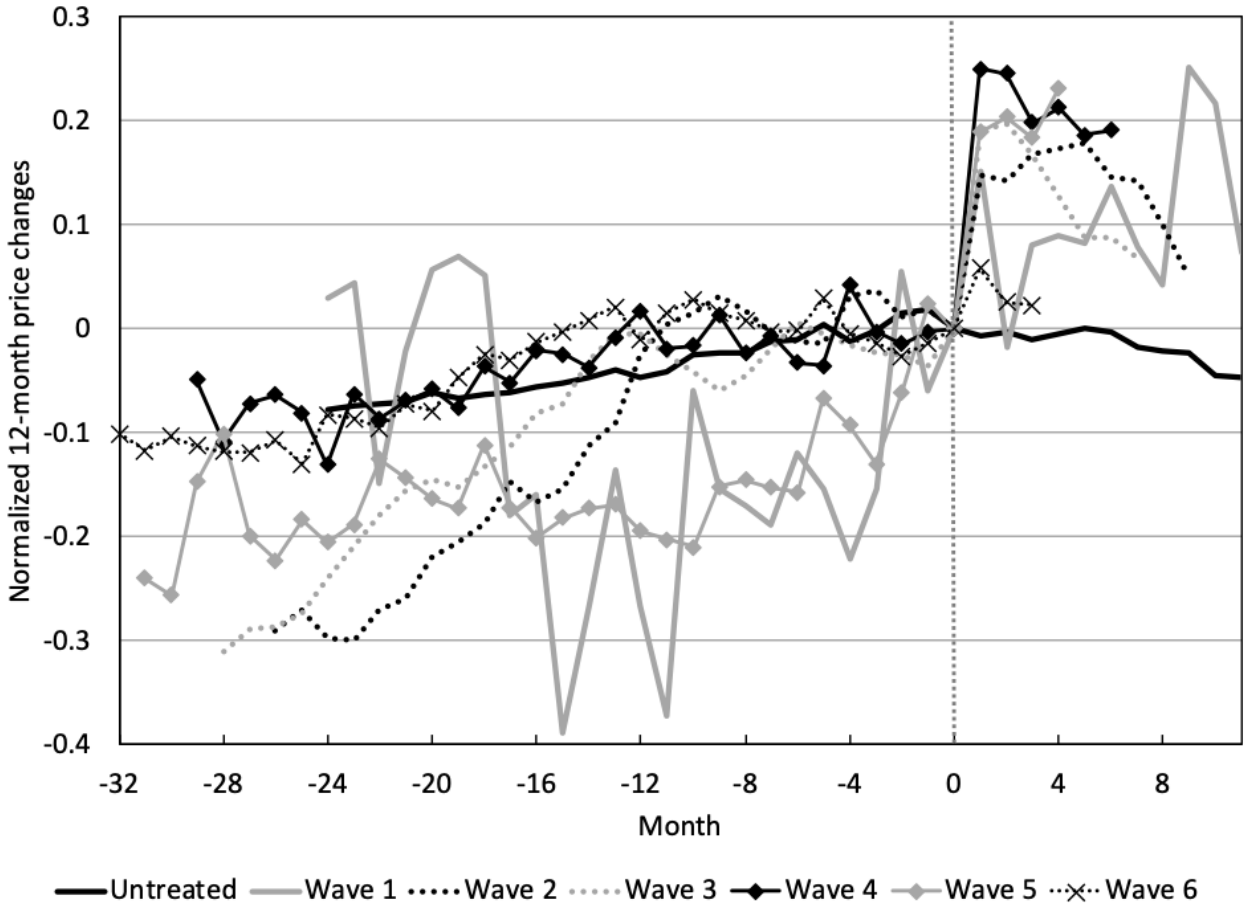
$$\hat{p}_{ijt} = \frac{p_{ijt}}{p_{ijt-12}}$$

- Compute an import price index for each tariff wave and for untreated countries and products using import share weights

$$\hat{p}_{wt} - 1 = \left[\prod_{i,j \in w} \left(\hat{p}_{ijt} \right)^{s_{ijt}^{w}} \right] - 1$$

- Compare these price changes to month zero (before the tariffs)
- Subtract the month zero price change (so equals zero in month zero)

Import Price Changes up to 2018

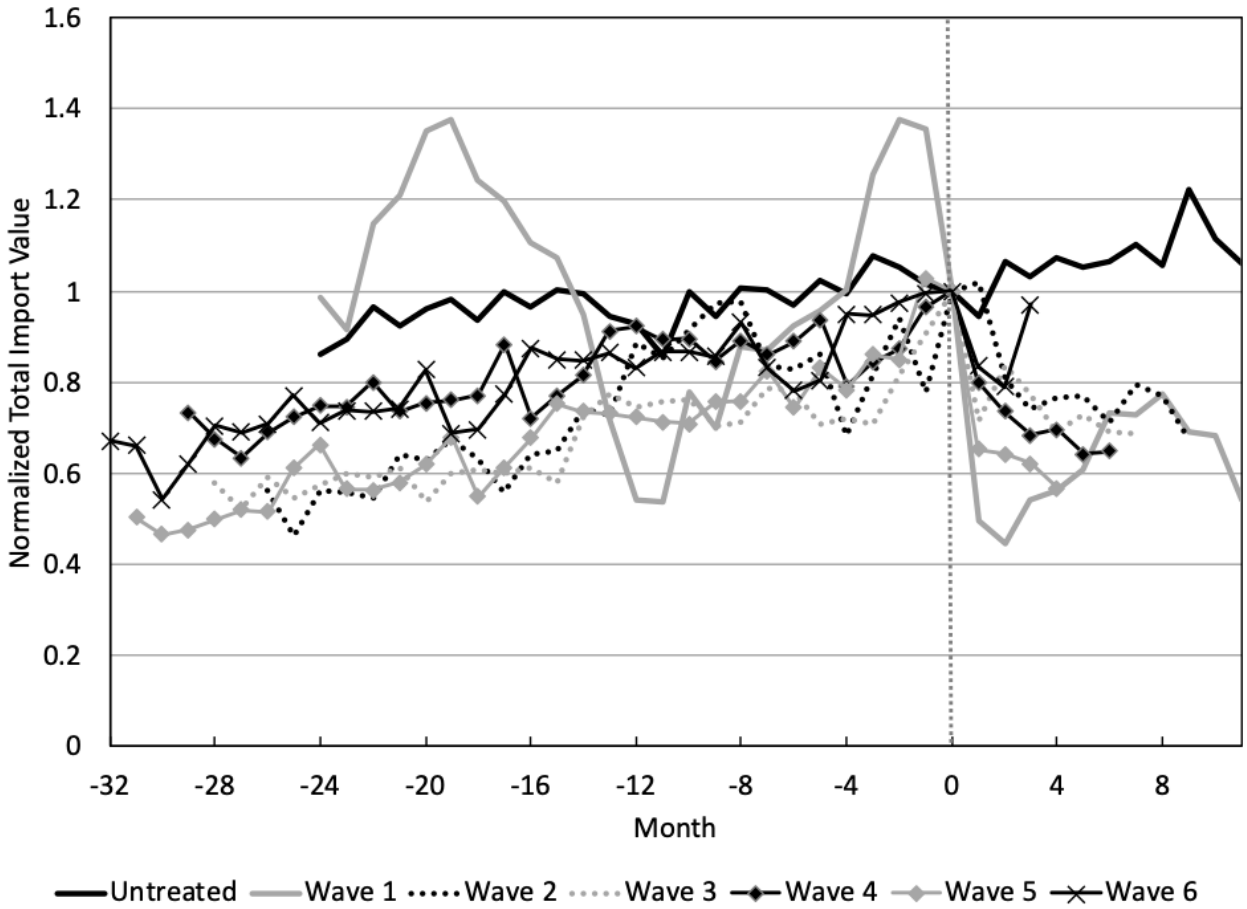


Notes: Proportional change in an import-share-weighted average of 12-month relative changes in U.S. import unit values inclusive of tariffs (import values divided by input quantities) for each tariff wave and for unaffected countries and products; proportional changes for each wave are normalized to equal zero in the month prior to the introduction of the tariff; for the untreated month zero is defined as in the first tariff wave; tariff waves are defined in Section 2 of the paper.

Measuring Import Value Changes

- Compute total import value for each tariff wave and for untreated products and countries
- Normalize import value in month zero to be one
  - Import values are measured relative to imports in the last month before the tariffs were applied

Import Value Changes up to 2018



Notes: 12-month proportional changes in the value of U.S. imports by tariff wave and for unaffected countries and products; each series is normalized to the value one in the month prior to the introduction of the tariff; for the untreated month zero is defined as in the first tariff wave; tariff waves are defined in Section 2 of the paper.

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Import Demand and Export Supply

- Model the impact of the tariffs using a conventional import demand and export supply framework

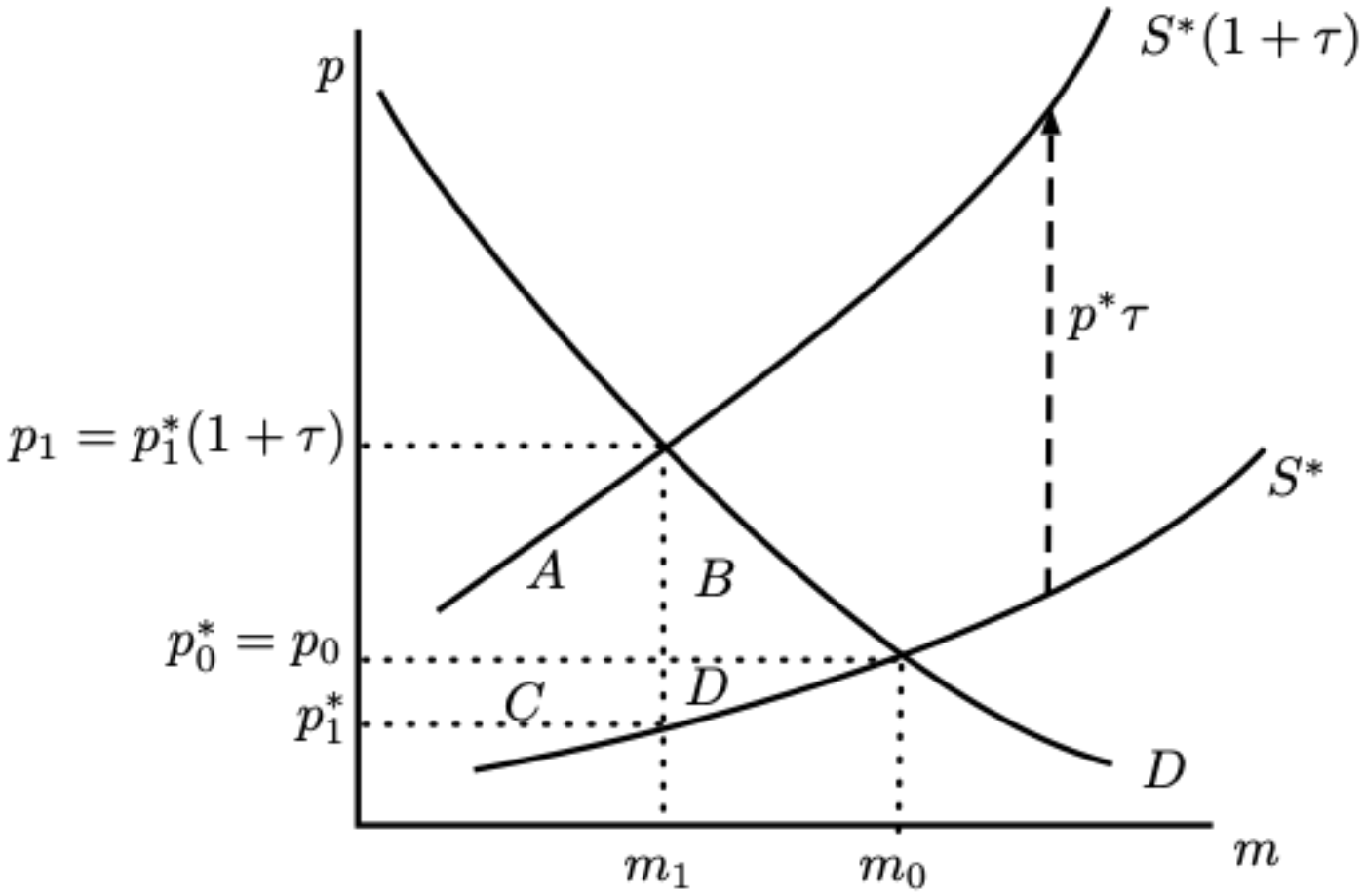
- Foreign export supply curve (S^*) rises with prices
  - Foreign producers increase production
  - Foreign consumers decrease consumption

- Home import demand curve (D) falls with prices
  - Home producers increase production
  - Home consumers reduce consumption

- *Ad valorem* tariff on imports of τ raises the cost of the imported good from p^* to $p^*(1+\tau)$

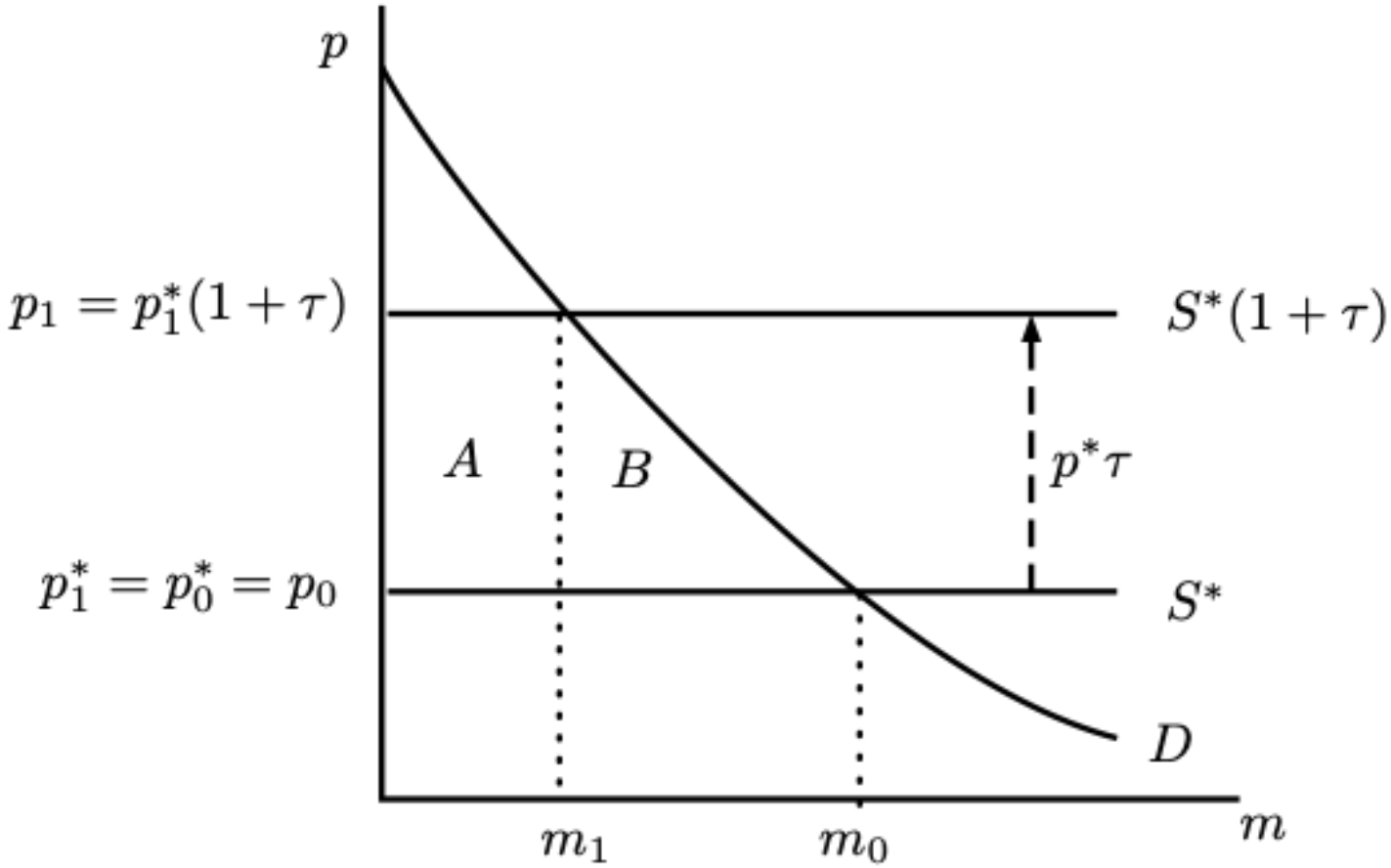
- For simplicity show the impact of the tariff starting from an initial equilibrium with zero tariffs (free trade)

Import Demand and Export Supply



- Home consumers lose areas $A + B$
- Home government gains areas $A + C$ in tax revenue
- Net welfare effect equals $C - B$

Perfectly Elastic Export Supply



- Home consumers lose areas $A + B$
- Home government gains area A in tax revenue
- Net welfare effect equals $-B$

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Estimating Import Price and Value Effects

- Use the natural experiment provided by the Trump administration's trade war to estimate the effects of tariffs on prices and welfare

- Regress the 12-month change in an economic outcome (x_t^* / x_{t-12}^*) on the change in one plus the applied tariff

$$\ln\left(\frac{x_{ijt}^*}{x_{ijt-12}^*}\right) = \alpha + \beta \ln\left(\frac{1+\tau_{ijt}}{1+\tau_{ijt-12}}\right) + u_{ijt}$$

- Economic outcomes:
  - Foreign export prices (p_{ijt}^*)
  - Import values (m_{ijt})

Impact of U.S. Tariffs on Importing

	(1)	(2)	(3)	(4)	(5)
	$\Delta\ln(p_{ijt})$	$\Delta\ln(m_{ijt})$	$\Delta\ln(m_{ijt})$	$\Delta\ln(p_{ijt}\times m_{ijt})$	$\Delta\ln(p_{ijt}\times m_{ijt})$
$\Delta\ln(1+\text{Tariff}_{ijt})$	-0.012	-1.310***	-5.890***	-1.424***	-6.364***
	(0.023)	(0.090)	(0.590)	(0.086)	(0.773)
N	1,647,617	1,647,617	3,318,912	2,487,370	4,461,376
R^2	0.021	0.024	0.099	0.012	0.102

Notes: Observations are at the HTS10-country-month level for the period January 2017 to December 2018. Variables are in 12 month log change. All columns include HTS10 product fixed effects and country x year fixed effects. The dependent variable in column (1) is the log change of prices (before U.S. duties are applied) charged by foreign exporters. The dependent variables in column (2) and (3) are the log change and the change in the inverse hyperbolic sine of U.S. import quantities. The dependent variables in column (5) is the log change and the change in the inverse hyperbolic sine of U.S. import values. We use the inverse of the hyperbolic sine transformation $[\log(x+(x^2+1)^{0.5})]$ to be able to estimate changes when import quantities or values are zero in t or t–12. Columns 1-3 drop any observations with a ratio of unit values in t relative to t–12 greater than 3 and less than 1/3. Standard errors, clustered at the HTS 8-digit level, are reported in parentheses. * $p < 0.10$ ** $p < 0.05$ *** $p < 0.01$.

- No effect foreign export prices (p^*_{ijt}) (see also Fajgelbaum et al. 2018)
- Substantial effect on import values (m_{ijt})
- Importance of the extensive margin for import values

Estimating Deadweight Welfare Effects

- Assuming that the import demand curve has a constant slope, the deadweight welfare loss can be estimated as

$$\frac{1}{2} p_1^* \tau \left(m_0 - m_1 \right) = \frac{1}{2} \left(p_1^* m_1 \right) \tau \left(\frac{m_0 - m_1}{m_1} \right)$$

- Where τ, p_1^* and m_1 are observed
- We estimate the percentage change in imports due to the tariff as

$$-\beta \ln \left(\frac{1 + \tau_t}{1 + \tau_{t-12}} \right) = -\ln \left(\frac{m_1}{m_0} \right) \approx \left(\frac{m_0 - m_1}{m_1} \right)$$

- Therefore the deadweight welfare loss is estimated as

$$-\frac{1}{2} \left(p_1^* m_1 \right) \tau \beta \ln \left(\frac{1 + \tau_t}{1 + \tau_{t-12}} \right)$$

Deadweight Welfare Effects

Month	Deadweight Loss	Tariff Revenue	Total Cost to Importers
Jan	0	0	0
Feb	0.1	0.1	0.2
Mar	0.1	0.1	0.2
Apr	0.3	0.4	0.7
May	0.2	0.4	0.6
Jun	0.4	0.7	1.2
Jul	0.9	1.4	2.4
Aug	0.9	1.4	2.3
Sep	1.0	1.6	2.6
Oct	1.5	3.2	4.6
Nov	1.4	3.0	4.4
Dec	1.4	3.2	4.7
Total	8.2	15.6	23.8

Note: Deadweight welfare loss and tariff revenue measured in current prices in billions of dollars. Column 3 is the sum of columns 1 and 2; see the text for the details of these calculations.

Impact of Foreign Tariffs on U.S. Exporting

	(1) $\Delta\ln(p_{iUSt})$	(2) $\Delta\ln(m_{iUSt})$	(3) $\Delta\ln(m_{iUSt})$	(4) $\Delta\ln(p_{iUSt}\times m_{iUSt})$	(5) $\Delta\ln(p_{iUSt}\times m_{iUSt})$
$\Delta\ln(1+\text{Tariff}_{ijt})$	0.077**	-1.233***	-3.498***	-1.134***	-3.942***
	(0.034)	(0.146)	(0.710)	(0.130)	(0.827)
N	1,320,495	1,320,495	2,784,226	2,191,243	3,930,620
R^2	0.014	0.011	0.076	0.013	0.072

Notes: Observations are at the HTS10-country-month level for the period January 2017 to December 2018. Variables are in 12 month log change. Standard errors are. All columns include HTS10 product fixed effects and country-year fixed effects. Columns 1-3 drop any observations with a ratio of unit values in t relative to t–12 greater than 3 and less than 1/3. The dependent variable in column (1) is the log change of prices (excluding the tariff) charged by U.S. exporters. The dependent variables in column (2) and (3) are the log change and the change in the inverse hyperbolic sine of U.S. export quantities. The dependent variables in column (4) and (5) are the log change and the change in the inverse hyperbolic sine of U.S. export values. We use the inverse of the hyperbolic sine transformation $[\log(x+(x^2+1)^{0.5})]$ to be able to estimate changes when import quantities or values are zero in t or t–12. Standard errors, clustered at the HS 6-digit level, are reported in parentheses. * $p < 0.10$ ** $p < 0.05$ *** $p < 0.01$.

- Similar pattern of results for U.S. exports following foreign retaliation

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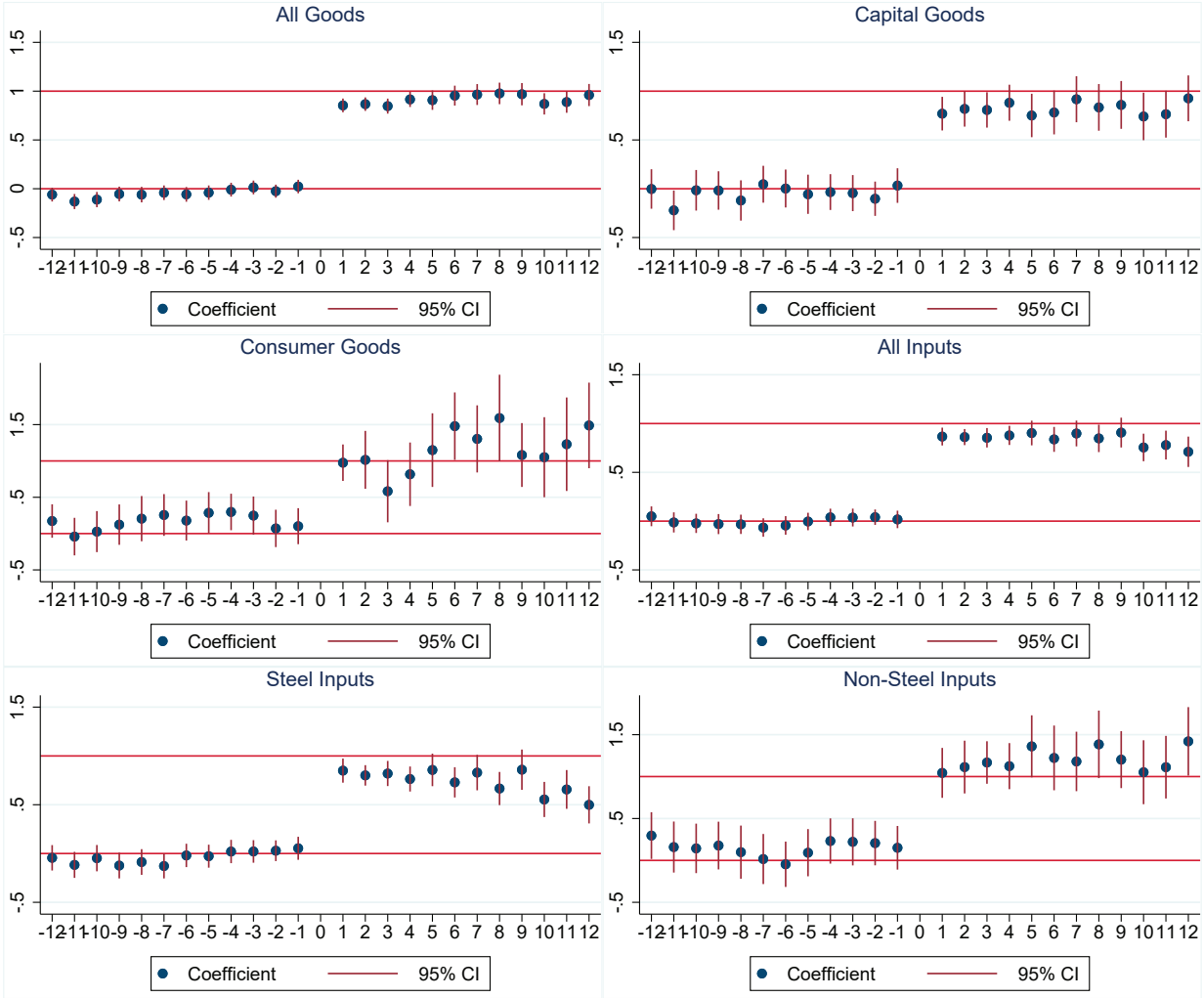
Event Study Specification

- Consider the following event-study regression specification

$$\ln x_{jit} = \eta_{ji} + \sum_{s=-12}^{12} \beta_{ks} \left(\mathbb{I}_{jis} \times \ln \left(\frac{1+\tau_{jis}}{1+\tau_{ji0}} \right) \right) + \delta_{jt} + \mu_{it} + u_{jit},$$

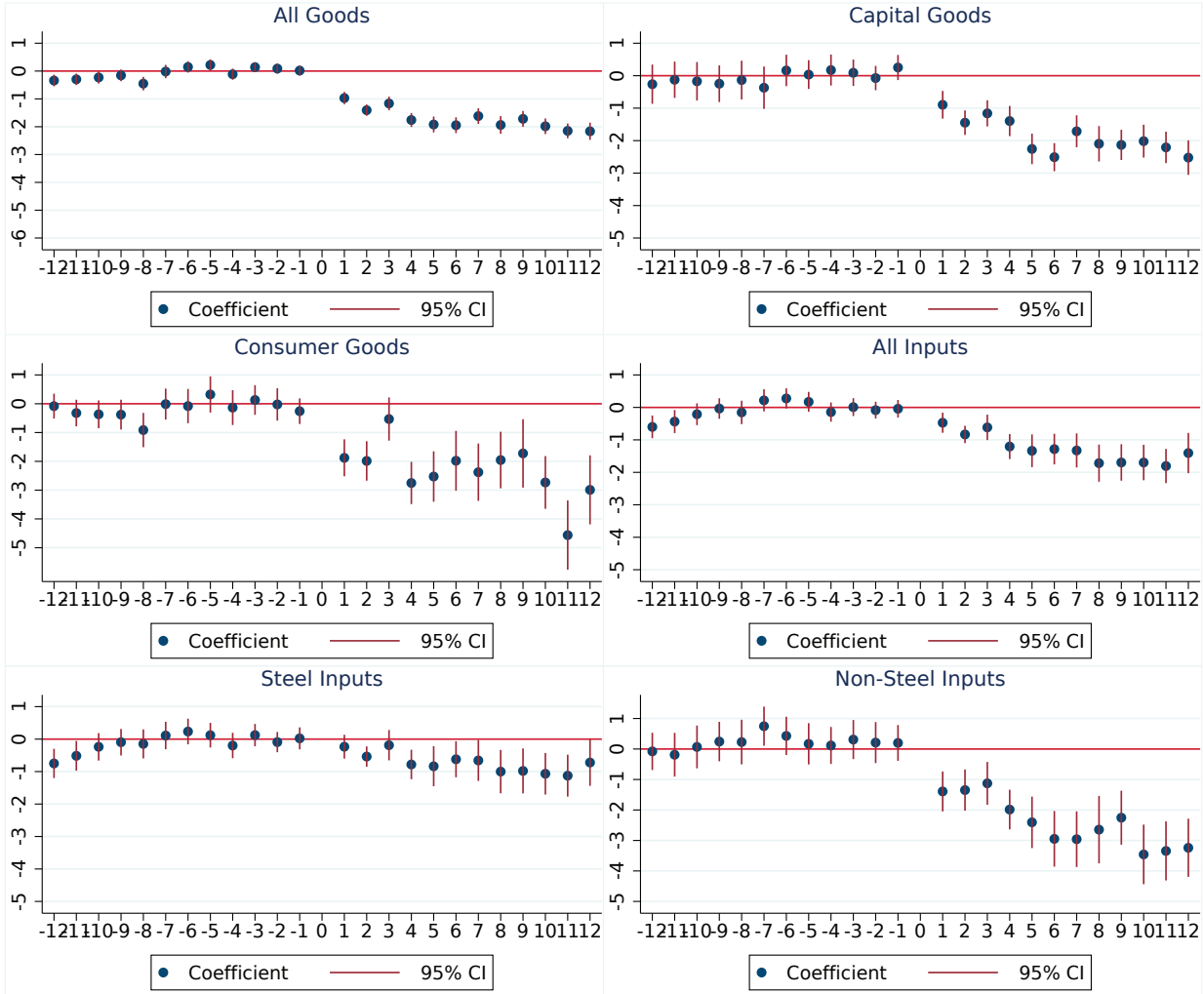
- j denotes HS 10-digit products, i is an exporter and t captures month
- η_{ji} is a product-exporter fixed effect
- $\mathbb{I}_{jis}$ are indicator variables for months relative to the treatment month $s = 0$, which corresponds to when the tariff wave was introduced
- δ_{jt} are product-year fixed effects
- μ_{it} are exporter-year fixed effects
- u_{jit} is a stochastic error

Import Price Passthrough Through 2019



Notes: Estimated coefficients and 95 percent confidence intervals from event-study specification.

Import Value Dynamics Through 2019



Notes: Estimated coefficients and 95 percent confidence intervals from event-study specification.

Conclusions

- Using the evidence to date from the 2018 trade war, we find empirical support for the real income losses from import tariffs
- The U.S. tariffs were almost completely passed through into U.S. domestic prices so far
- Over 2018
  - Cumulative deadweight welfare loss of $ 8.2 billion
  - Cumulative additional tax cost to importers of $ 15.6 billion
- Substantial adjustments in international sourcing patterns
  - $ 132 billion of imports lost or redirected
  - $ 51 billion of exports lost or redirected
- Even with the elapse of additional time, we continue to find almost complete passthrough of US tariffs into US prices
- The only sector for which we have found a fall in exporter prices in response to US tariffs is the steel sector
- We omit other potentially large costs such as policy uncertainty
  - Handley and Limão (2017) and Pierce and Schott (2016)
  - Substantial falls U.S. and Chinese equity markets

Thank You

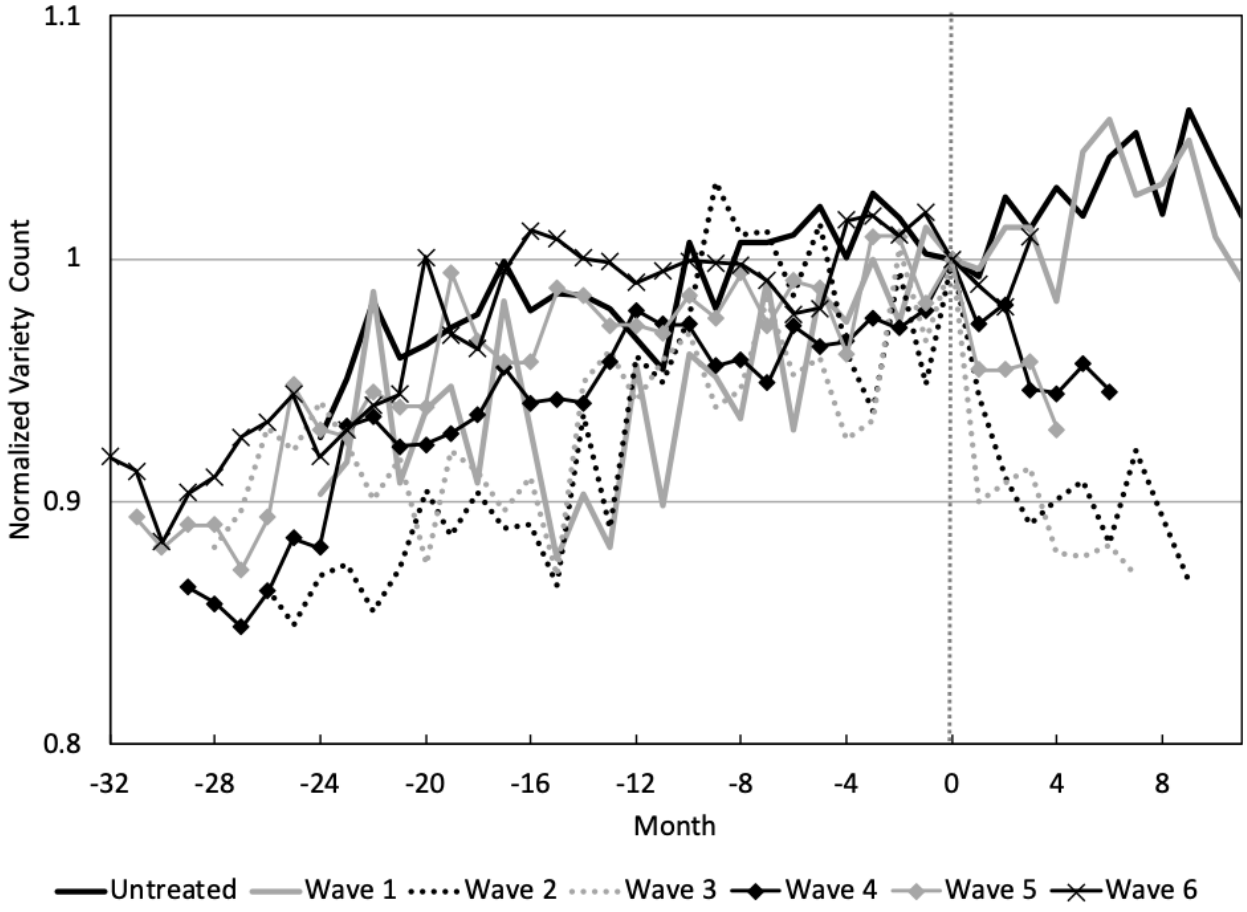
Import Varieties and Welfare

- Conventional framework assumes that domestic and foreign varieties of goods are perfect substitutes
- Increases in trade barriers can also reduce welfare by restricting the ability to import differentiated foreign varieties
- Assuming constant elasticity of substitution (CES) preferences, we can decompose the overall import price index
  - Variety correction term (Feenstra 1994)
  - Import price index for common varieties

$$\mathbb{P}_t = \left(\frac{\lambda_t}{\lambda_{t-12}} \right)^{\frac{1}{\sigma - 1}} \mathcal{P}_t$$

$$\mathcal{P}_t = \prod_{i,j \in \Omega_t} \left(\frac{p_{ijt}}{p_{ijt-12}} \right)^{s_{ijt}}$$

Import Variety Changes up to 2018



Notes: 12-month proportional changes in the number of import varieties, defined as an HTS10-country code, by tariff wave and for unaffected countries and products; each series is normalized to the value one in the month prior to the introduction of the tariff; for the untreated month zero is defined as in the first tariff wave; tariff waves are defined in Section 2 of the paper.

more

Import Price Indexes and Tariffs

	(1) $\Delta\ln(\text{Common Goods Price Index}_{jt})$	(2) $\ln(\text{Variety Adjustment}_{jt})$	(3) $\Delta\ln(\text{Price Index}_{jt})$
$\Delta\ln(1+\text{Tariff}_{j,t})$	0.996***	0.048***	1.044***
	(0.039)	(0.009)	(0.041)
N	91,150	91,150	91,150
R^2	0.177	0.092	0.177

Notes: A variety is defined at the HTS10-country-month, aggregated up to the HS6-month level for January 2017 to December 2018 in 12 month changes. All regressions include HS6 and time fixed effects. The elasticity of substitution in column 1 and 3 is set equal to 5.89, from column 3 in Table 1. Price ratios are cleaned on top and bottom 1/3 and 3, and lambda ratios are cleaned on top and bottom 5 percentiles. Standard errors, clustered at the HS6 level, are reported in parentheses. * $p < 0.10$ ** $p < 0.05$ *** $p < 0.01$.

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- U.S. Domestic Producer Prices

Producer Price Indexes and Tariffs

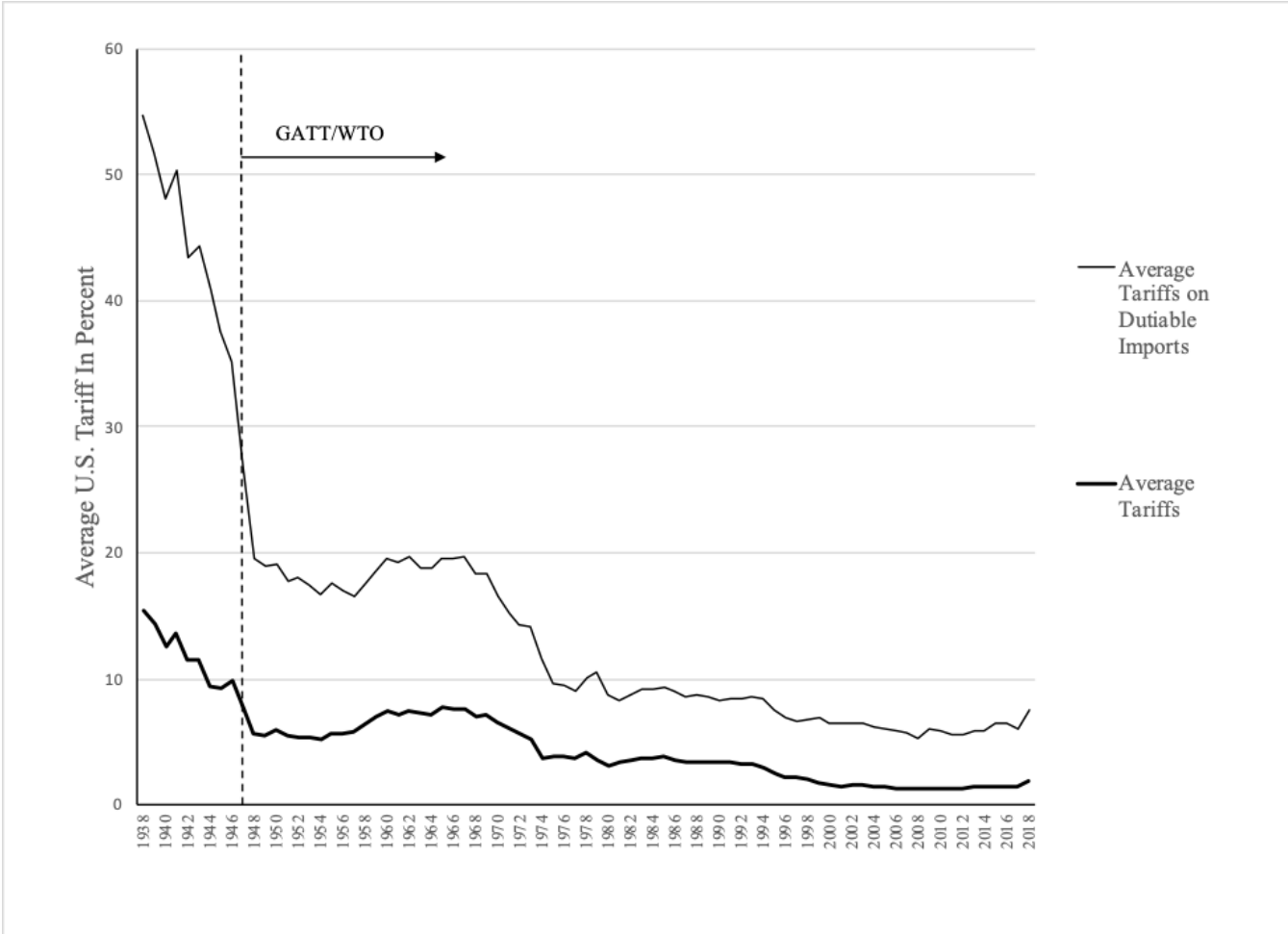
- Use disaggregated NAICS6 producer price indexes
- Merge with input-output tables and HTS10-digit tariffs to compute
  - Output tariffs
  - Input tariffs
- Adjust output tariff measure by share of imports in domestic consumption
- Adjust input tariff measure by share of imported intermediate inputs in total variable costs

Producer Price Indexes and Tariffs

Dependent Variable: $\Delta\log(PPI_{it})$	12-Month Change
Panel A: Regression Coefficients:	
Input Import Intensity$_i$ x $\Delta\ln(1+\text{Input Tariff}_{it})$	1.864***
	(0.704)
Import Share$_i$ x $\Delta\ln(1+\text{Output Tariff}_{it})$	0.407**
	(0.198)
Fixed Effects: Industry and Time	Yes
Panel B: Implied Aggregate Effects:	
Input Tariff Effect:	0.847
Output Tariff Effect:	0.177
Total Effect:	1.024
N	8,088
#Industries	337
R^2	0.521

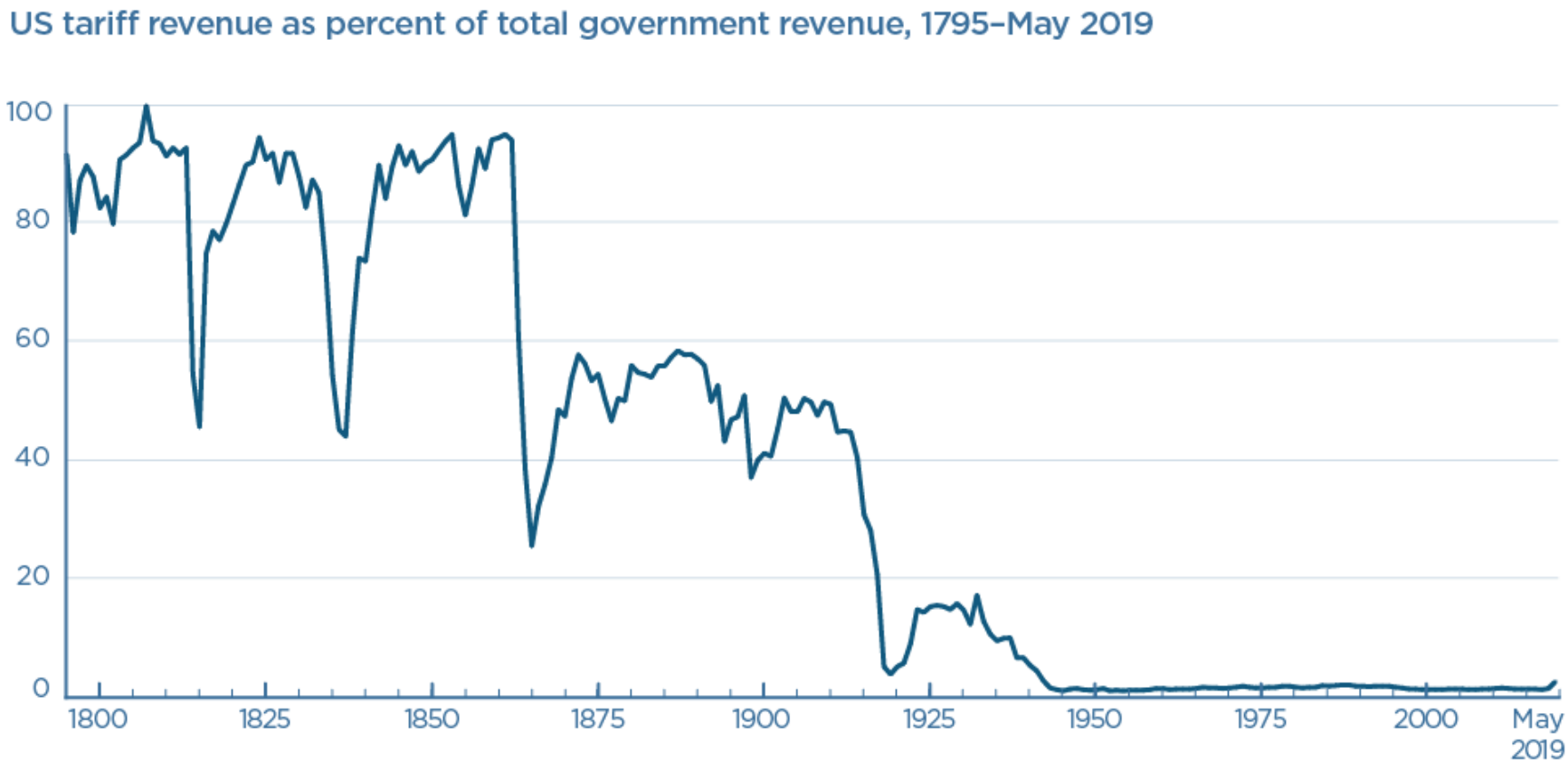
Notes: The dependent variable is the 12-month change in log PPI, while the tariffs are entered as the 12-month changes in log(1+Tariff$_{it}$). The sample period is monthly data from January 2017 to December 2018. Standard errors in parentheses, clustered on BEA IO code. The denominator in the input import intensity is the sum of material inputs and the wage bill. Standard errors, clustered at the BEA IO level, are reported in parentheses. * $p < 0.10$ ** $p < 0.05$ *** $p < 0.01$.

U.S. Tariffs (1938-2018)



Note: Average U.S. tariffs weighted by import shares. Dutiable imports are those subject to tariffs. Source: Irwin (2017) and authors calculations.

U.S. Tariff Revenue (1795-2019)



Source: Bown, Chad P. and Douglas A. Irwin, Washington Post, July 16, 2019.