Online Appendix
"Tariff Passthrough at the Border and at the Store: Evidence from US Trade Policy"

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This Appendix has four sections. First, we detail our data sources. Second, we sketch an economic environment and use it to derive estimating equations consistent with our empirical approach. Third, we provide additional details and results related to our analysis of import and export prices. Fourth, we provide additional details and results related to our analysis of retail prices.

A Data Sources

In this Appendix section, we describe the data sources used, as summarized in Table A1. With the exception of the data marked as restricted or proprietary, all other data used in the paper can be downloaded from the Billion Prices Project Dataverse at Harvard University: https://dataverse.harvard.edu/dataverse/BPP. Information on how to access the BLS restricted micro data is available at www.bls.gov/rda/, and access to the Datamyne can be obtained at www.datamyne.com.

Data	Source	Status
Import Prices - IPP Microdata	Bureau of Labor Statistics	Restricted Access
Export Prices - IPP Microdata	Bureau of Labor Statistics	Restricted Access
Retail Prices	Billion Prices Project / PriceStats	Published with paper
Country of Origin Retailer 1	Billion Prices Project	Published with paper
Country of Origin Retailer 2	Retailer 2	Proprietary
HS code classification	3CE	Published with paper
Customs Bills of Lading	Datamyne	Restricted Access

Table A1: Data and Sources

B Environment

In this Appendix section, we present a simple static framework to motivate our regression specifications. Consider a supply chain with the following sequence. A firm located in country j exports good i at time t to a US importer at a US dollar price $P^{\mathcal{I}}_{i,j,t}$. The importer then pays an ad-valorem tariff $\tau_{i,j,t}$ to the government, resulting in a total import cost of $P^{\mathcal{I}}_{i,j,t}(1+\tau_{i,j,t})$. Finally, the importer combines this input with proportional marketing and distribution costs before selling that good to consumers at a retail price $P^{\mathcal{R}}_{i,j,t}$ (also in dollars).

We assume the foreign exporter manufactures the good using a Cobb-Douglas technology with constant returns to scale that uses some inputs (like labor) whose prices are sticky in the local currency and others (like imported inputs) whose prices are not. We therefore write the exporter's marginal cost, translated to US dollars, as $C^{\mathcal{I}}_{i,j,t} = A_{i,j,t}(W_{j,t}S_{j,t})^{\phi}$, where $A_{i,j,t}$ captures the combined effect of the firm's productivity and the cost of inputs with prices sticky in the foreign currency, $W_{j,t}$ represents the price of the sticky local currency input (such as the wage), $S_{j,t}$ is the number of US dollars purchased by each unit of country j's currency, and ϕ is the elasticity of the exporter's production function with respect to that local currency input.

The exporter's price equals a markup over this marginal cost: $P^{\mathcal{I}}_{i,j,t} = \mu^{\mathcal{I}}_{i,j,t}C^{\mathcal{I}}_{i,j,t}$. The exporter incurs a cost when it changes its price for the good, so will only do so when the resulting increase in operating profits exceeds this cost. When the exporter changes the price, its markup $\mu^{\mathcal{I}}_{i,j,t}$ is assumed to be a function of its market share, which we assume depends on its own price relative to an industry price level $P^{\mathcal{I}}_{t}$, multiplied by the tariff, since import demand for the good depends on its price inclusive of tariffs. We therefore write: $\mu^{\mathcal{I}}_{i,j,t} = \mu^{\mathcal{I}}\left((1+\tau_{i,j,t})P^{\mathcal{I}}_{i,j,t}/P^{\mathcal{I}}_{t};\boldsymbol{\theta}^{\mathcal{I}}\right)$, where $\theta^{\mathcal{I}}$ collects parameters governing the shape of import demand and use $\Gamma^{\mathcal{I}} \equiv -\frac{\partial \ln \mu^{\mathcal{I}}(x)}{\partial \ln x}$ to denote the opposite of the elasticity of the markup.[1] We take logs, differentiate, and substitute these relationship to write:

$$d\ln\left(P^{\mathcal{I}}_{i,j,t}\right) = \gamma^{\mathcal{I}}d\ln(1+\tau_{i,j,t}) - \gamma^{\mathcal{I}}d\ln\left(P^{\mathcal{I}}_{t}\right) + \beta^{\mathcal{I}}d\ln(W_{j,t}) + \beta^{\mathcal{I}}d\ln(S_{j,t}), \tag{A1}$$

where $\gamma^{\mathcal{I}} \equiv -\frac{\Gamma^{\mathcal{I}}}{1+\Gamma^{\mathcal{I}}}$ is the passthrough of tariffs to the ex-tariff import price and $\beta^{\mathcal{I}} \equiv \frac{\phi}{1+\Gamma^{\mathcal{I}}}$ is the passthrough of local costs and exchange rates to the import price. Since $\gamma^{\mathcal{I}}$ equals tariff passthrough to ex-tariff import prices, $1+\gamma^{\mathcal{I}}$ equals the rate of passthrough from tariffs to total

[1] We assume the exporter is too small to internalize any impact on the final retail price charged by the importer.

(i.e. inclusive of tariff) import prices.

Equation (A1) forms the basis for our empirical strategy. Because some exporters may choose not to change prices, some of our estimates using trade data are conditional on observing a price change. In the extreme case with $\gamma^{\mathcal{I}} = -1$, it would imply that ex-tariff import prices fell proportionately with tariffs and the total price of imports remained constant. This hypothetical would reveal that the passthrough of tariffs to the total import cost was zero (i.e. $1+\gamma^{\mathcal{I}} = 0$) and that the tariff's cost fell entirely on the exporter. Alternatively, if $\gamma^{\mathcal{I}}$ were estimated to equal 0, it would imply that ex-tariff import prices did not change with the tariffs, but rather, that the tariffs were fully passed through to the total import price (i.e. $1+\gamma^{\mathcal{I}} = 1$). The importer, in this case, bears much of the tariff's cost. We estimate a closely related specification in our analysis of passthrough to retail prices.

C More Import and Export Results

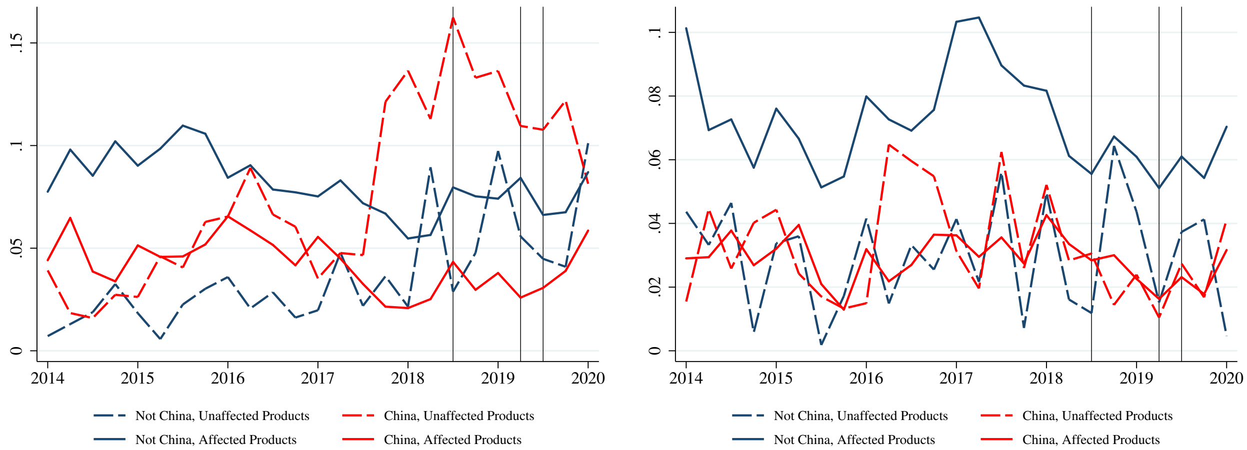
In this Appendix section, we offer a number of additional details and results from our analyses of import and exports prices, many of which are referenced from the main text.

C.1 More Details on Import Price Data

In the main text, we mention that we focus only on market transactions in the BLS import data. More than one-third of the BLS import prices are non-market transactions such as intrafirm trade or shipments among related parties. Neiman (2010) studies the differences in these market and related party prices. In our analyses of the tariff on Chinese imports, we also exclude a small number of goods that are impacted both by a China tariff and another product-based tariff (such as steel and aluminum products, lumber, washing machines, and solar panels). We additionally exclude data on imports from India because in June 2019 the United States ended India's developing country exemption, which had given it access to US most favored nation tariff rates.

C.2 Frequency and Size of Imports

The price indices in Figure 1(a) reflect the frequency of import price changes as well as the size of any non-zero price changes. Since the BLS data are at the level of individual goods, we can observe if the stability of ex-tariff prices reflects “wait and see” behavior or any other important changes in the patterns of price stickiness.



(a) Price Decreases

(b) Price Increases

Figure A1: Frequency of Monthly Price Changes (Quarterly Averages)

Notes: Figure A1 shows the quarterly averages of the proportion of US imports with ex-tariff price decreases and increases in each month. These price change frequencies use price data collected by the International Pricing Program at the BLS. The vertical lines denote the quarters when tariffs were introduced or raised: 2018:Q3 (25% on $34bn in July 2018, 25% on $16bn in August 2018, and 10% on $200bn in September 2018), 2019:Q2 (increase the September 2018 wave to 25% in May 2019), and 2019:Q3 (15% on $112bn in September 2019).

Figure A1(a) plots the share of prices each month which decrease, averaged across the three months in each quarter to smooth the otherwise volatile series. It does this separately for four categories of goods: those of the type unaffected by the tariffs and imported from countries other than China, those unaffected even though they are imported from China, those affected but imported from outside of China, and those affected and imported from China, where only this latter group includes goods where the importer must actually pay a tariff. There are no obvious differences across the four groups and, if anything, the prices of products in that last set of goods appear to be the most stable. Figure A1(b) plots the equivalent statistics for price increases and, again, finds little evidence of important changes in pricing behavior brought about by the tariffs.

C.3 Additional Regression Results for Import Prices

Table A2 reports some additional results from estimating Equation (1) in the paper using monthly data from January 2005 to February 2020. Column (1) reports the cumulative impact of 12 months of tariffs in a specification that does not condition on any other variables. The estimated coefficient of -0.065 means, for example, that a 10 percent tariff would be associated with a 0.65 percent lower ex-tariff price and a 9.35 percent higher overall price faced by the importer. Column (2), reported also in the paper, adds sectoral fixed effects plus the China-specific fixed effects ϕ and the magnitude of this estimate is roughly preserved. Column (3) removes the tariff and China-specific covariates and estimates a relatively standard passthrough regression, showing that when the dollar depreciates by about 10 percent, import prices rise by about 2.17 percent. Column (4) estimates the tariff impact using a specification that also controls for sectoral effects and exchange rates. Our exchange rate passthrough estimate is largely unchanged but the tariff response drops to a value that is statistically indistinguishable from zero. Column (5) estimates the same specification as column (4), but looks for nonlinearity in the tariff passthrough rate by estimating a separate passthrough rate for goods initially subject to 10 percent or 25 percent tariffs. Goods that were subject to different tariff rates are excluded from this regression, and we can only estimate an 8 months passthrough rate.[2] The results are difficult to interpret, not only due to the change in sample and timing, but also as both coefficients are positive, though neither is economically large. Column (6) reports results from the specification in column (4) with standard errors clustered at the sector level. We again obtain a fairly tight confidence interval around zero for the import tariff passthrough rate.

We now consider a second type of regression in which we only include non-zero price changes. In particular, for each price spell of good i, we define t_1 as the first month of the spell and t_0 as the first month of the previous spell. We then estimate:

$$\begin{aligned}\frac{1}{t_1-t_0}\ln\left(\frac{P^{\mathcal{I}}_{i,j,k,t_1}}{P^{\mathcal{I}}_{i,j,k,t_0}}\right) &= \delta^{\mathcal{I}}_k+\phi^{\mathcal{I},\Omega}_{\text{CN}}+\phi^{\mathcal{I},-\Omega}_{\text{CN}}+\gamma^{\mathcal{I}}\tau_{\text{CN},k,t_1} \\ &+ \beta^{\mathcal{I},S}\frac{1}{t_1-t_0}\ln\left(\frac{S_{j,t_1}}{S_{j,t_0}}\right)+\beta^{\mathcal{I},X}\frac{1}{t_1-t_0}\ln\left(\frac{X_{j,t_1}}{X_{j,t_0}}\right)+\epsilon_{i,j,k,t_1,t_0}, \quad \text{(A2)}\end{aligned}$$

where the term $(t_1 - t_0)$ serves to scale the changes so all correspond to a monthly frequency. In this specification, τ_{CN,k,t_1} equals the tariff level for goods from China in sector k at t_1 and is meant to allow estimates of γ to capture differential inflation rates for goods impacted by the tariffs.[3] Since the changes in the price, exchange rate, and producer price index are all scaled

[2]The goods initially taxed at 10 percent in September 2018 then experienced another tariff increase to 25 percent in May 2019. In order to estimate only the pass-through of this initial 10 percent tariff, we also exclude observations for these goods in or after May 2019.

[3]This specification may not be well-suited for thinking about changes where t_0 is after the tariff was imposed,

		(1)	(2)	(3)	(4)	(5)	(6)
Tariffs 1 yr.	$\left(\sum_{l=0}^{11} \gamma_{\text{CN},l}^{\mathcal{I}}\right)$	-0.065	-0.057		-0.005		-0.005
		(0.021)	(0.023)		(0.025)		(0.035)
ERPT 1 yr.	$\left(\sum_{l=0}^{11} \beta_{l}^{\mathcal{I},S}\right)$			0.217	0.218	0.217	0.218
				(0.022)	(0.023)	(0.028)	(0.048)
PPI PT 1 yr.	$\left(\sum_{l=0}^{11} \beta_{l}^{\mathcal{I},X}\right)$			0.047	0.047	0.050	0.047
				(0.031)	(0.033)	(0.034)	(0.042)
10% Tariffs 8 mo.	$\left(\sum_{l=0}^{7} \gamma_{\text{CN},l}^{\mathcal{I}}\right)$					0.084	
						(0.035)	
25% Tariffs 8 mo.	$\left(\sum_{l=0}^{7} \gamma_{\text{CN},l}^{\mathcal{I}}\right)$					0.038	
						(0.036)	
	Adj. R^2	0.000	0.002	0.003	0.004	0.003	0.003
	Obs.	835,722	835,722	835,722	835,722	827,061	835,722
	Sector FEs?	No	Yes	Yes	Yes	Yes	Yes
	Clustered SEs?	No	No	No	No	No	Yes

Table A2: Regression Analysis of Chinese Import Tariffs Using Monthly Data

Notes: Fixed effects $(\phi_{\text{CN}}^{\Omega})$ and $(\phi_{\text{CN}}^{-\Omega})$ are included in all regressions but we do not report the coefficients in the table because they are not economically significant in all cases. Robust standard errors shown in parentheses unless otherwise specified.

to represent monthly changes, we report the estimate of $\gamma^{\mathcal{I}}$ multiplied by 12 to capture the annualized equivalent of the change in inflation associated with goods affected by the tariffs. Given this, plus the fact that these regressions drop any observations where the left-hand-side equals zero, these estimates would be expected to be larger in magnitude than what was found in Table A2.

Table A3 reports the estimates of Equation (A2). The results are qualitatively consistent with those from the monthly specifications shown in Table A2 and are similarly robust to clustering standard errors at the sector level. The import tariffs on Chinese goods are associated with changes in the ex-tariff import price that are economically or statistically insignificant, depending on the specification. By contrast, exchange rate passthrough in these estimates rises to roughly

but our results appear qualitatively robust to dropping such observations.

37 percent.

		(1)	(2)	(3)	(4)	(5)
Tariffs (Annualized)	$12 \times \gamma^{\mathcal{I}}$	-0.305 (0.129)	-0.193 (0.138)		-0.094 (0.147)	-0.094 (0.194)
ERPT	$\beta^{\mathcal{I},S}$			0.365 (0.052)	0.365 (0.052)	0.365 (0.068)
PPI PT	$\beta_l^{\mathcal{I},X}$			0.637 (0.098)	0.651 (0.098)	0.651 (0.173)
	Adj. R^2	0.000	0.006	0.015	0.016	0.016
	Obs.	99,687	99,687	99,687	99,687	99,687
	Sector FEs?	No	Yes	Yes	Yes	Yes
	Clustered SEs?	No	No	No	No	Yes

Table A3: Regression Analysis of Chinese Import Tariffs, Conditional on Price Changes

Notes: Fixed effects $(\phi^{\Omega}_{\text{CN}})$ and $(\phi^{-\Omega}_{\text{CN}})$ are included in all regressions but we do not report the coefficients in the table because they are not economically significant in all cases. Robust standard errors shown in parentheses unless otherwise specified.

C.4 Tariffs on Steel Imports

Prior to the tariffs placed on Chinese imports in July 2018, the United States placed a 25 percent tariff on steel imports from all countries in March 2018. At the time, exemptions were made for imports from Argentina, Australia, Brazil, Canada, Mexico, the European Union (EU), and South Korea. By June, the exemptions were lifted for Canada, the EU, and Mexico, so June 2018 effectively brought a second wave of steel tariffs. The exemptions for the remaining countries were made permanent. Equivalent to our analysis in Figure 1(a), therefore, we can compare import price indices—inclusive of tariffs—for steel imports from these three groups of countries.

Figure A2 shows the evolution of steel prices, which had been quite volatile during the preceding four years. The first two vertical lines indicate the initiation of steel tariffs for two groups of countries in March and June 2018. The third line indicates an increase in the tariff rate applied to steel from Turkey. Steel prices from all three groups tracked each other relatively closely until the steel tariffs were introduced. After that point, prices on imports from all countries rose, but imports from the affected countries (shown in red) jumped to roughly 20

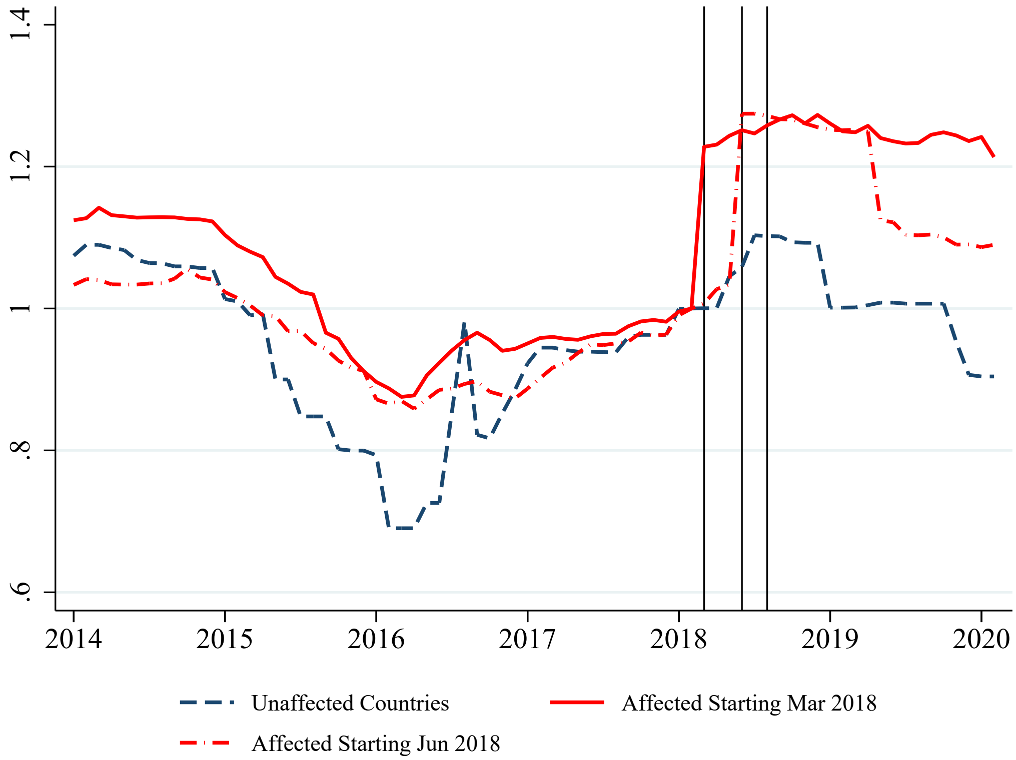


Figure A2: Steel Import Price Indices, by Tariff Wave

Notes: Figure A2 shows price indices for US steel imports inclusive of tariffs. All indices are normalized to equal 1 in March 2018 and use price data collected by the International Pricing Program at the BLS. The vertical lines denote the months when tariffs were introduced or increased: March 2018 (25% on all countries except the EU, Canada, Mexico, Australia, Argentina, Brazil and South Korea), June 2018 (ending of the exemption for the EU, Canada, Mexico), August 2018 (doubling of the rate on steel from Turkey to 50%).

percent above those from unaffected countries.[4]

We summarize our import findings by noting that, whether looking at imports from China or imports of steel products, and whether looking at aggregated price indices or regression estimates that use variation across individual products, our analyses paint a similar picture of the 12-month price response to US import tariffs imposed in 2018 and 2019. Ex-tariff prices do not obviously behave differently for goods affected by trade policy compared to those that were not affected, implying the tariffs exhibited nearly complete passthrough into the total import cost and that the incidence of the tariffs lies largely with the United States.

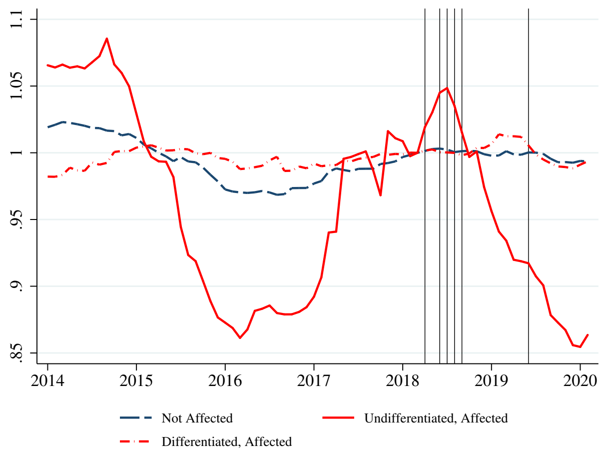
[4]For Figure A2, we allocate products into these three groupings statically, so the red dashed line drops in May 2019 simply because the US steel tariffs were dropped then for imports from Canada and Mexico. Steel imports from the EU, which were also imposed in June of 2018 and are included in that dashed red line, remain affected. Regression analyses suggest similar conclusions but estimates are imprecise given the small number of imported steel products in our import prices dataset.

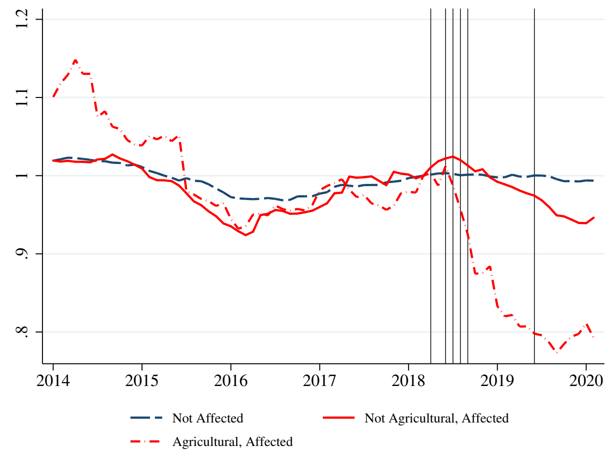
Using the same data, methods, and time period, we estimate that the passthrough of exchange rate changes into import prices are in the range of 20 to 40 percent after one year, consistent with estimates found in a large literature, a rate much lower than the passthrough rate of tariffs into total import prices. This finding suggests being cautious when interpreting results obtained from using standard models in trade and international macroeconomics that assume a symmetric response to these two types of shocks. For example, the implications from these standard models might be more appropriately applied to longer-run outcomes, or they might be amended to allow for more uncertainty or mean-reversion in the shocks, features that might naturally explain our findings. Furthermore, as a practical matter, our result suggests that the recent depreciation of the Chinese renminbi did not offset the impact of the tariffs for US importers.

C.5 More Findings on US Exports

Why did US exporters drop their prices so much more when faced with foreign tariffs than foreign exporters did when faced with US tariffs? As we noted in the paper, differences in the types of goods affected by the trade policy played a key role. We use the Rauch (1999) classification to identify differentiated goods, for which substitutes are likely more difficult to locate, and find that they account for more than 90 percent of the affected imports to the United States from China but less than half of the US exports to countries that imposed retaliatory tariffs. Relatedly, whereas affected US imports were rarely agricultural goods—goods often thought of as non-differentiated—US agriculture products accounted for roughly 10 percent of affected US exports in our sample. Table 1 showed that undifferentiated goods are those for which import tariffs generate ex-tariff price differences, which explains why US imports saw little or no ex-tariff price declines while US exports suffered moderate ex-tariff price declines. In Figures A3(a) and A3(b) we demonstrate that, in an accounting sense, undifferentiated goods (including most agricultural goods) are those products driving the decline in US export prices.

To elaborate on these findings, we now consider two types of regression specifications to study US exports, analogous to what we did for the case of US imports. Our preliminary regression analysis of the first specification is consistent with the visual conclusion reached from Figure 1(b) in the paper. Specifically, we start by running the following equation with all monthly





(a) Differentiated and Non-Differentiated Goods (b) Agricultural and Non-Agricultural Goods

Figure A3: Decomposition of US Export Price Indices

Notes: Figure A3 shows price indices for US exports exclusive of tariffs. All indices are normalized to equal 1 in March 2018 and use price data collected by the International Pricing Program at the BLS. The vertical lines denote the months when tariffs were introduced or increased: April 2018 (China initiated tariffs on US products), June 2018 (the EU, Mexico, and Turkey initiated tariffs), July 2018 (China expanded tariffs and Canada initiated tariffs), August 2018 (China expanded tariffs and Russia initiated tariffs), September 2018 (China expanded tariffs), and June 2019 (India initiated tariffs).

observations, including periods in which there is no price change:

$$\Delta \ln \left(P^{\mathcal{E}}_{i,j,k,t}\right) = \delta^{\mathcal{E}}_k + \sum_{l=0}^{11} \gamma^{\mathcal{E}}_l \Delta\tau_{k,t-l} + \sum_{l=0}^{11} \beta^{\mathcal{E},S}_l \Delta \ln \left(S_{j,t-l}\right) + \sum_{l=0}^{11} \beta^{\mathcal{E},X}_l \Delta \ln \left(X_{j,t-l}\right) + \epsilon_{i,j,k,t}, \quad \text{(A3)}$$

where we now use the superscript $\mathcal{E}$ to denote that the data and the relationships in equation (A3) correspond to US exports.

Table A4 reports the results from estimating (A3) on monthly data. As shown in column (1) there is about a 35 percent passthrough of the retaliatory tariff into ex-tariff US export prices after 12 months. That is, a 10 percent tariff imposed on US exports reduces US ex-tariff export prices by about 3.5 percent. The estimate reduces to 2.6 percent when controlling for other price-determining factors, as seen in column (4), which is our benchmark specification for exports included in the paper. The cumulative one-year ERPT estimates are close to 20 percent. This estimate is little changed when we simultaneously include tariff measures as a covariate. Retaliation from China accounts for about three-quarters of our observations, so in column (5), we separately estimate the one-year cumulative effect of the retaliatory tariffs for US goods exported to China and for US goods exported elsewhere. Whereas shipments to countries other than China show no statistically significant decline in the ex-tariff export price, the effect is very strong when estimated separately for China, with an estimated one-year ex-tariff export price decline of about 45 percent. Column (6) finds some evidence that larger tariffs produce a larger decline on the ex-tariff price of US exports, though the coefficient on the squared term is statistically insignificant at the 5 percent level. Lastly, column (7) shows that our results are robust to clustering standard errors at the sector level.

		(1)	**(2)**	**(3)**	**(4)**	**(5)**	**(6)**	**(7)**
Tariffs 1 yr.	$\left(\sum_{l=0}^{11} \gamma_l^{\mathcal{E}}\right)$	-0.354	-0.329		-0.259		-0.056	-0.259
		(0.087)	(0.089)		(0.089)		(0.188)	(0.122)
Squared Tariffs 1 yr.	$\left(\sum_{l=0}^{11} \gamma_l^{\mathcal{E},Sq}\right)$						-1.704	
							(1.024)	
China Tariffs 1 yr.	$\left(\sum_{l=0}^{11} \gamma_l^{\mathcal{E},\mathrm{CN}}\right)$					-0.452		
						(0.124)		
Non-China Tariffs 1 yr.	$\left(\sum_{l=0}^{11} \gamma_l^{\mathcal{E},-\mathrm{CN}}\right)$					0.247		
						(0.131)		
ERPT 1 yr.	$\left(\sum_{l=0}^{11} \beta_l^{\mathcal{E},S}\right)$			0.196	0.195	0.194	0.195	0.195
				(0.018)	(0.018)	(0.018)	(0.018)	(0.030)
PPI PT 1 yr.	$\left(\sum_{l=0}^{11} \beta_l^{\mathcal{E},X}\right)$			0.255	0.250	0.245	0.249	0.250
				(0.038)	(0.038)	(0.037)	(0.038)	(0.050)
	Adj. R^2	0.000	0.001	0.002	0.002	0.002	0.002	0.002
	Obs.	446,527	446,527	446,527	446,527	446,527	446,527	446,527
	Sector FEs?	No	Yes	Yes	Yes	Yes	Yes	Yes
	Clustered SEs?	No	No	No	No	No	No	Yes

Table A4: Regression Analysis of Retaliatory US Export Tariffs, Monthly Data

Notes: Robust standard errors in parentheses unless otherwise specified.

As we did in Section C.3 for imports, here we also consider a second specification that only includes non-zero price changes. We define $\{t_0, t_1\}$ as above, estimate the following:

$$\begin{aligned} \frac{1}{t_1 - t_0} \ln\left(\frac{P^{\mathcal{E}}_{i,j,k,t_1}}{P^{\mathcal{E}}_{i,j,k,t_0}}\right) &= \delta_k^{\mathcal{E}} + \gamma^{\mathcal{E}} \tau_{k,t_1} + \beta^{\mathcal{E},S} \frac{1}{t_1 - t_0} \ln\left(\frac{S_{j,t_1}}{S_{j,t_0}}\right) \\ &+ \beta^{\mathcal{E},X} \frac{1}{t_1 - t_0} \ln\left(\frac{X_{j,t_1}}{X_{j,t_0}}\right) + \epsilon_{i,j,k,t_1,t_0}, \end{aligned} \tag{A4}$$

and report our results in Table A5. Here, our estimates of exchange rate passthrough rise to about 33 percent, similar to the results from import regressions conditional on a price change, as reported in Table A3. As in Table A3, we multiply the magnitude of the coefficient on tariff passthrough by 12 in order to annualize the estimates. All the estimated effects of the tariffs shown in the first row are large in magnitude and statistically significant, and column (5) makes it clear that US exports to China underlie the results. Column (6) shows that the results in column (4) are robust to clustering standard errors at the sector level. As before, we note that in comparison to the results presented in Table A4, it is not surprising that the magnitudes of these results are larger since these condition on a price change and exclude observations where the left-hand-side is zero. We conclude from Figures 1(b), Figure A3, and Tables A4-A5 that the retaliatory tariffs applied to US exports exhibited significantly lower passthrough than was the case for the US tariffs on imports, in large part because the US exports that were retaliated against were less differentiated compared to the goods targeted by US import tariffs.

		(1)	**(2)**	**(3)**	**(4)**	**(5)**	**(6)**
Tariffs	$12 \times \gamma^{\mathcal{E}}$	-0.632	-0.656		-0.505	-0.505	
(Annualized)		(0.138)	(0.144)		(0.139)	(0.127)	
China Tariffs	$12 \times \gamma^{\mathcal{E},\mathrm{CN}}$					-0.605	
(Annualized)						(0.163)	
Non-China Tariffs	$12 \times \gamma^{\mathcal{E},-\mathrm{CN}}$					0.188	
(Annualized)						(0.309)	
ERPT	$\beta^{\mathcal{E},S}$			0.335	0.334	0.334	0.334
				(0.029)	(0.029)	(0.029)	(0.056)
PPI PT	$\beta^{\mathcal{E},X}$			1.028	1.022	1.020	1.020
				(0.079)	(0.079)	(0.079)	(0.164)
	Adj. R^2	0.000	0.001	0.012	0.012	0.012	0.012
	Obs.	68,080	68,080	68,080	68,080	68,080	68,080
	Sector FEs?	No	Yes	Yes	Yes	Yes	Yes
	Clustered SEs?	No	No	No	No	No	Yes

Table A5: Regression Analysis of Retaliatory Export Tariffs, Conditional on Price Change

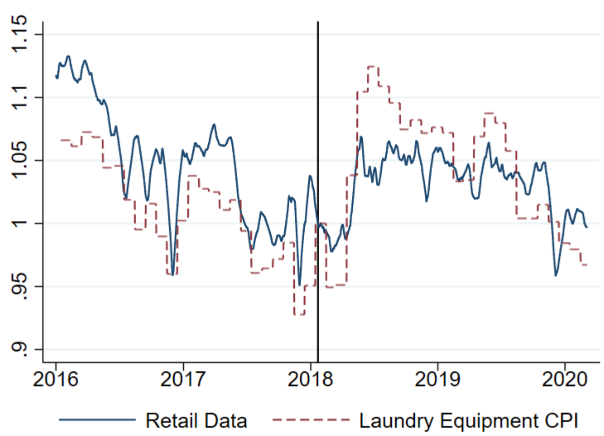
Notes: Robust standard errors in parentheses unless otherwise specified.

D Additional Retail Results

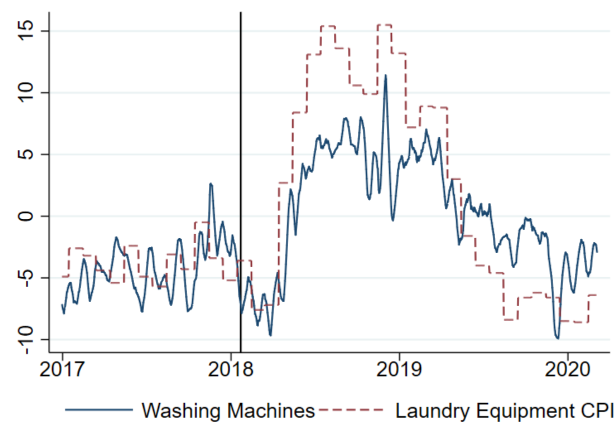
In this Appendix section, we offer a number of additional details and results from our analyses of retail prices, many of which are referenced from the main text.

D.1 Washing Machines

Nearly all washing machine imports (other than the few exceptions mentioned above) faced tariffs, regardless of their provenance, with statutory rates ranging from 20 to 50 percent starting in January 2018. This sector has received significant attention from academics, and is the focus of Flaaen, Hortaçsu, and Tintelnot (2019), as well as from policymakers and journalists, in part because it is one of the few categories of affected goods that coincides closely with a sectoral consumer price index (CPI) provided by the BLS, namely that for "Laundry Equipment." We obtain prices for about 700 washing machines from the private firm PriceStats as well as from the Billion Prices Project (BPP), which collected them by scraping, at a daily or weekly frequency, the online web pages of 16 large multi-channel retailers in the United States.[5] See Cavallo and Rigobon (2016) for a full description of these and closely-related data.



(a) Price Indices



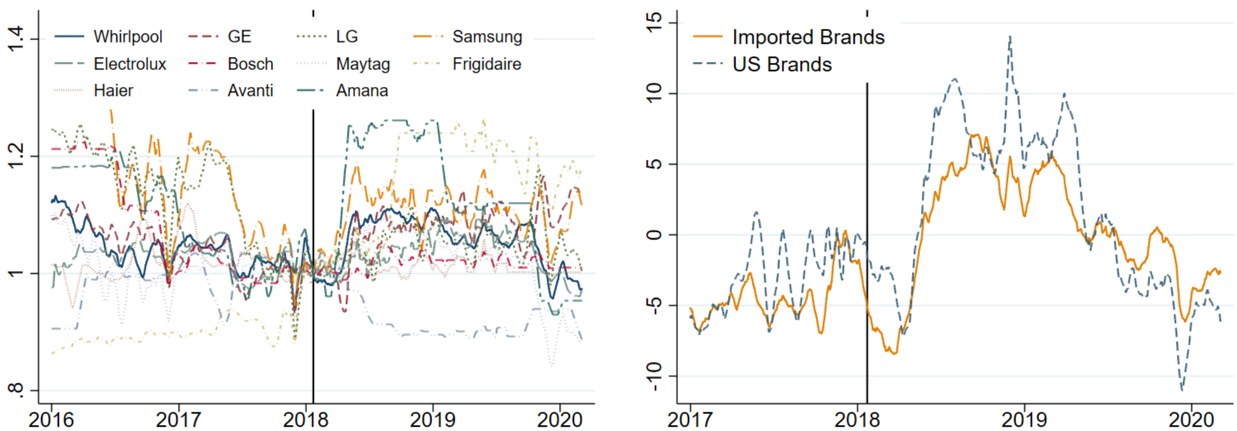
(b) Annual Inflation

Figure A4: Retail Washing Machine Prices from the BPP and the CPI

Notes: Figure A4(a) compares a price index for washing machines using online prices with the Bureau of Labor Statistic's Consumer Price Index for Laundry Equipment (not seasonally adjusted, all urban consumers, U.S. city average). Both indices are normalized to equal 1 on January 22nd 2018. Figure A4(b) shows the annual inflation rate for the same indices.

[5]Washing machines are defined as goods appearing in the data for at least one year, with product descriptions that include the words "washing machine" or "washer", and which exclude particular disqualifying words such as "washer fluid". As with our analyses of trade data, all our retail price analyses exclude adjacent prices that differ by more than 2.3 log points in absolute value.

Figure A4(a) shows indices for these washing machine prices from the BPP data, calculated as an equally-weighted average of good-level price changes, as well from the CPI data. The price indices are normalized to equal 1 in February 2018, the month that tariffs were imposed, as indicated with a vertical black line. Figure A4(b) shows the annual inflation rates corresponding to these indices. Prior to the imposition of these tariffs, the BPP and CPI price indices for washing machines behaved similarly and declined by about 5 percent per year. Within a few months of the import tariffs, however, both series exhibit a break, with inflation rates switching from negative to positive values for both series. In the second half of 2018, washing machine inflation was typically between 5 and 10 percent in the BPP data and between 10 and 15 percent in the CPI data. This simple evidence strongly suggests moderate to high passthrough of the washing machine tariffs to retail prices.



(a) Price Indices

(b) Annual Inflation

Figure A5: Retail Washing Machine Prices from the BPP, Variation Across Brands

Notes: Figure A5(a) shows price indices for individual brands of washing machines, normalized to equal 1 on January 22nd 2018. Figure A5(b) shows the annual inflation rate for brands classified as domestic or imported based on publicly available information.

Underlying this high passthrough rate, however, is significant heterogeneity across different washing machine brands. Figure A5(a) plots the annual inflation rates brand-by-brand and shows that while the prices for Samsung washing machines clearly increased in response to the tariffs, the rate of inflation in Haier washers appears unchanged when comparing the pre- and post-tariff periods. It may be tempting to attribute such a heterogeneous response to heterogeneity in the tariff policies. Figure A5(b) demonstrates, however, that the basic pricing patterns look the same for US brands, which likely are not directly affected by the tariffs, and for imported brands, which likely are affected.[6] Consistent with the conclusions in Flaaen, Hortaçsu, and Tintelnot (2019), tariffs not only caused prices to increase for those washing machines that were affected, but also, led more generally to price hikes, including on products unaffected by the tariffs.

D.2 Micro Data for Two Large U.S. Retailers

Panel A of Table A6 summarizes the resulting dataset. Our data include about 38,000 products from Retailer 1. For Retailer 2, we matched the scraped price data to the top 100,000 products by sales rank, leaving about 56,000 products. Combined, the data include more than 90,000 products covering nearly 2,000 different 6-digit HS categories. Roughly two-thirds of the products, about 61,000, are imported from one of more than 80 countries. About 44,000 products are imported from China, with 36,000 of them in categories affected by the tariffs. Importantly for our purposes, there is significant and somewhat evenly distributed coverage across goods that are or are not in affected categories and that are or are not sourced from China.[7]

Since our analyses focus on price changes in these data, Panel B of Table A6 offers some basic summary statistics characterizing the dynamic pricing behavior of these goods. Retailer 1 has slightly stickier prices, with median price spells lasting 9.7 months, and 46 percent of products never experiencing a price change compared to corresponding respective values of 8.1 months and 33 percent for Retailer 2. Broadly, however, the two retailers exhibit similar pricing patterns.

Table A7 show the number of products in the data that correspond to the different COICOP categories, further splitting them by the time when their HS categories were first impacted by the Chinese tariffs. These numbers therefore include goods that are not from China but can still be part of an HS category affected by the Chinese tariffs. The majority of our goods (69 percent) are household products, with another 13 percent electronics and 18 percent belonging to other categories. In terms of tariff waves, about 15 percent of our goods were in HS categories impacted by the first two waves of tariffs (at a additional rate of 25 percent), while 64 percent of the goods were affected in the September 2018 tariffs.

Finally, for HS code classification we noted in the paper that in some cases we asked a

[6] We split these US brands (GE, Maytag, and Whirlpool) from the imported brands (Amana and Haier from China, Avanti from Denmark, Bosch from Germany, Frigidaire from Sweden, and LG and Samsung from South Korea) using online marketing reports, which may be imprecise for ascertaining the manufacturer's country of origin. This is a useful example of the importance of analyses that use product-level information on the country of origin, which we turn to below.

[7] The share of Chinese goods may not be representative of the total sales made by these retailers.

	Retailers 1 & 2	Retailer 1	Retailer 2	Imported Products	Manual HS Classification	Direct Imports
Panel A: Products						
Products	94,115	37,840	56,275	59,978	25,319	6984
Exporting Countries	82	65	66	81	70	15
HS6 Categories	1,992	1,651	831	1,498	1,336	212
Products Imported	61,106	21,144	39,962	59,978	21,157	6,966
Products Imported from China	44,423	13,646	30,777	43,490	14,450	6,680
Products in Affected Categories	74,763	34,237	40,526	40,333	23,435	6,276
Products from China Affected	35,969	12,072	23,897	30,101	13,104	5,977
Panel B: Pricing Behavior						
Products Without Price Changes (%)	38	46	33	47	37	25
Mean Product Life (months)	22	20	23	18	25	20
Abs. Val. Price Changes (med., %)	10.4	14.3	9.6	11.4	12.5	25.0
Abs. Val. Price Changes, Ex-Sales (med., %	9.3	11.2	8.3	10.0	24.2	24.7
Implied Duration (med., months)	8.7	9.7	8.1	9.7	10.6	7.0
Implied Duration, Ex-Sales (med., months)	11.0	12.5	8.9	11.2	14.0	10.1

Table A6: Summary Statistics from Two Major US Retailers

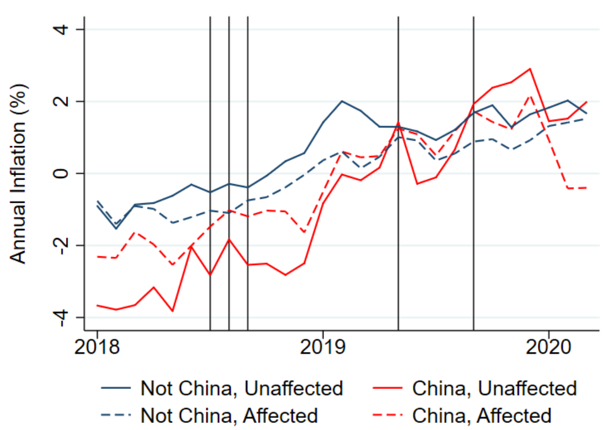
COICOP	Description	By Chinese Tariff					
		Not Affected	Jul-18	Aug-18	Sep-18	Sep-19	Total
100	Food & Beverages	3%	1%	1%	4%	13%	5%
200	Alcoholic Beverages and Tobacco	0%	0%	0%	0%	0%	0%
300	Clothing and Footwear	1%	0%	0%	0%	2%	1%
400	Housing (Maintenance and Repair Materials)	3%	2%	31%	11%	2%	8%
500	Household Goods and Furnishings	69%	79%	55%	72%	56%	69%
600	Health	3%	0%	0%	0%	1%	1%
700	Transport	1%	1%	6%	0%	1%	1%
800	Communications	1%	0%	0%	0%	0%	0%
900	Electronics (Recreation and Culture)	16%	18%	7%	9%	22%	13%
1200	Miscellaneous Goods	3%	0%	0%	2%	3%	2%
	Total	100%	100%	100%	100%	100%	100%

Table A7: Products by COICOP category and Chinese Tariff Wave

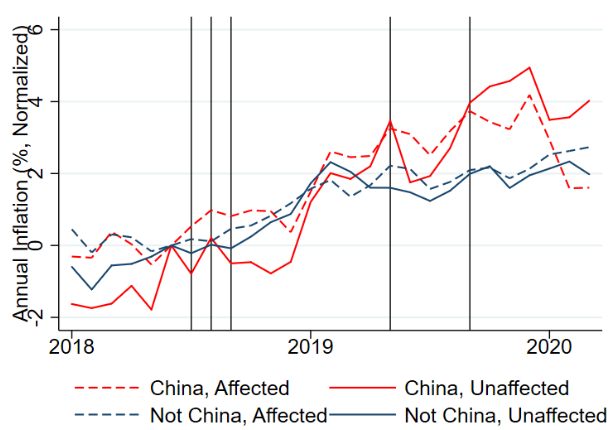
group of research assistants to respond manually to the additional questions required by the 3CE algorithm to help refine its match. Generally, these questions could easily be answered by looking at each product's page on the website of its retailer. When the requested information was not available online, we attempted to provide the most common or broadly representative answer possible. For example, if we were unable to answer a question about the material used to make a particular screw, we chose "steel" as that was the most common material used for screws when this information was provided. In cases where we could not visit the product's web page because it was no longer offered for sale, we tried to locate the product on other retailer websites and searched for a close substitute. We commonly resorted to the latter strategy. For example, if we could not find a particular 4-pack of batteries, we would look for identical batteries sold by the same retailer in a 6-pack.

D.3 Additional Retail Graphs and Regressions

We start by using these data to plot daily retail price indices and corresponding annual retail inflation rates separately for those products imported from China that were affected by the tariffs, products imported from China that were unaffected, products not imported from China but in categories that were affected, and products not imported from China and in categories that were not affected. Figure A6(a) shows the inflation rates for the four groups of products. Figure A6(b) normalizes this inflation rate on the date of the date of the tariffs. In both cases, it is difficult to discern any quantitatively important price differences brought about by the tariffs. The inflation rates in all groups behave similarly, though the exception may be unaffected products sold by China, as this goods sector exhibited the largest increase in inflation rates over the sample period.



(a) Annual Inflation



(b) Annual Inflation - Normalized

Figure A6: Retail Price Response to Chinese Import Tariffs by Two US Retailers

To more precisely identify the differential retail pricing behavior of products impacted by the tariffs, we use these data to estimate at a monthly frequency a regression specification similar to equation (1) in the paper. We regress the change in retail prices on current and lagged tariff changes, plus fixed effects allowing for different price trends per sector and additionally different trends for the total sets of Chinese products that are and are not affected by the tariffs:

$$\Delta \ln\left(P^{\mathcal{R}}_{i,j,k,t}\right) \quad = \quad \delta^{\mathcal{R}}_{k} + \phi^{\mathcal{R},\Omega}_{\text{CN}} + \phi^{\mathcal{R},-\Omega}_{\text{CN}} + \sum_{l=0}^{11} \gamma^{\mathcal{R}}_{\text{CN},l} \Delta \tau_{\text{CN},k,t-l} + \epsilon_{i,j,k,t}, \tag{A5}$$

where now the sectors k are defined as 3-digit COICOP codes and where we no longer include information on producer prices nor on exchange rates. The results, reported in Table A9, show that while the prices for products affected by the Chinese import tariffs grow relative to the price of products in the same sector that were not affected, the difference is not stark.

		All Goods (1)	All Goods (2)	Imported Goods (3)	All Goods (4)	Manual HS Classification (5)	Direct Imports (6)
Tariff 1 yr.	$\left(\sum_{l=0}^{11} \gamma_{\text{CN},l}\right)$	0.035 (0.020)	0.035 (0.026)	0.032 (0.021)		0.075 (0.025)	0.158 (0.091)
10% Tariffs 8 mo.	$\left(\sum_{l=0}^{7} \gamma_{l}\right)$				0.050 (0.026)		
25% Tariffs 8 mo.	$\left(\sum_{l=0}^{7} \gamma_{l}\right)$				0.126 (0.021)		
China, Affected	$\left(\phi^{\Omega}_{\text{CN}}\right)$	-0.001 (0.000)	-0.001 (0.000)	-0.001 (0.000)	-0.000 (0.000)	-0.001 (0.001)	-0.003 (0.002)
China, Not-Affected	$\left(\phi^{-\Omega}_{\text{CN}}\right)$	-0.000 (0.000)	-0.000 (0.001)	-0.000 (0.000)	0.001 (0.000)	-0.001 (0.000)	0.000 (0.002)
Adj. R^2		0.001	0.001	0.001	0.001	0.002	0.005
N		1,118,870	1,118,870	711,806	1,159,426	356,151	72,762
Products		70,900	70,900	46,191	76,187	22,046	5,190
Products from China		33,411	33,411	33,411	35,855	12,544	5,032
Sector FEs		Yes	Yes	Yes	Yes	Yes	Yes
Clustered SEs		No	Yes	No	No	No	No

Table A8: Additional Regression Analysis of US Retail Prices

The first column, also shown in the paper, estimates the regression using monthly data from both retailers for the time period running from January 2017 to February 2020. In the top row, the coefficient of 0.035 means that after one year, a 10 percentage point tariff increase on a good is associated with a 0.35 percent increase in that good's price relative to other goods in the same sector. If we use clustered standard errors we loose statistical significance. The benchmark result holds if we limit the sample to imported products (i.e. excluding those with the United States as the country of origin).

Column 4 shows that the coefficients become larger and more significant when we look for non-linearity by estimating a separate passthrough rate for goods initially subject to 10 percent or 25 percent tariffs. As with the import and export results, in this case goods that were subject to different tariff rates are excluded from this regression, and we can only estimate 8-month passthrough rates. The goods affected by the larger tariffs have over twice as much passthrough, with a 10 percentage point tariff increase associated with a 1.3% increase in prices.

As mentioned in the paper, one might reasonably worry that measurement error in the sectoral classification algorithm is limiting our ability to identify larger differences in the retail price dynamics between products affected and unaffected by the tariffs. To look for evidence of this, we consider two subsets of our data that are the least likely to contain sectoral classification errors. First, we exploit the fact that about one-quarter of the products were matched manually, requiring a research assistant to affirmatively check the association of a product's text description with the HS classification. Second, we obtained a list of products that were directly imported by Retailer 2, rather than purchased through an importer or wholesaler, so we can be confident that the retailer's perception of the HS code is the relevant one.

Columns 5 and 6 in Table A8 show the results for these two smaller datasets. As expected, the regression coefficients rise, particularly for goods that were directly imported by Retailer 2, for which the actual HS code used at the border is known. However, the magnitude of these coefficients is still quite low, so that a 10 percent tariff increase is associated with an increase in prices that ranges from 0.8 percent to 1.6 percent.

Table A9 further splits this sample into COICOP categories. As seen in Table A7, most categories like Food, Clothing, or Health have a small number of affected goods, so we view their large and insignificant point estimates as largely uninformative. Among those that are statistically significant, there appears to be large differences in passthrough rates. For Household goods (COICOP 500), which constitute the bulk of our sample, the coefficient is 0.059. Housing repair products (COICOP 400) have nearly three times as much passthrough, with a coefficient of 0.182. Categories such as "Other Goods" (COICOP 1200) and "Clothing" (COICOP 300) have much higher passthrough rates, but these are obtained from a much smaller sample of goods.

		Manual HS or Direct Import - By Category							
		Food & Beverages	Clothing & Footwear	Housing Materials	Household Goods & Furnishings	Health	Transport	Electronics	Miscellaneous Goods
Tariff 1 yr.	$\left(\sum_{l=0}^{11} \gamma_{\mathrm{CN},l}\right)$	0.643	0.858	0.182	0.059	0.130	0.314	0.062	0.448
		(0.591)	(0.442)	(0.087)	(0.032)	(0.136)	(0.161)	(0.070)	(0.199)
China, Affected	$(\phi_{\mathrm{CN}}^{\Omega})$	-0.003	-0.012	0.004	-0.000	-0.001	-0.001	-0.002	-0.005
		(0.007)	(0.006)	(0.001)	(0.000)	(0.002)	(0.003)	(0.001)	(0.005)
China, Not-Affected	$(\phi_{\mathrm{CN}}^{-\Omega})$	-	-0.012	0.004	-0.000	-0.001	-0.001	-0.002	-0.004
		-	(0.006)	(0.001)	(0.000)	(0.002)	(0.004)	(0.001)	(0.005)
Adj. R^2		0.001	0.006	0.002	0.001	0.003	0.017	0.001	0.006
N		232,473	1,694	37,824	322,487	1,379	2,136	54,875	3,868
Products		13,945	149	2,240	20,707	104	125	3,429	304
Products from China		3,665	112	828	14,661	83	93	1,581	227
Sector FEs		Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes

Table A9: Additional Regression Analysis of US Retail Prices

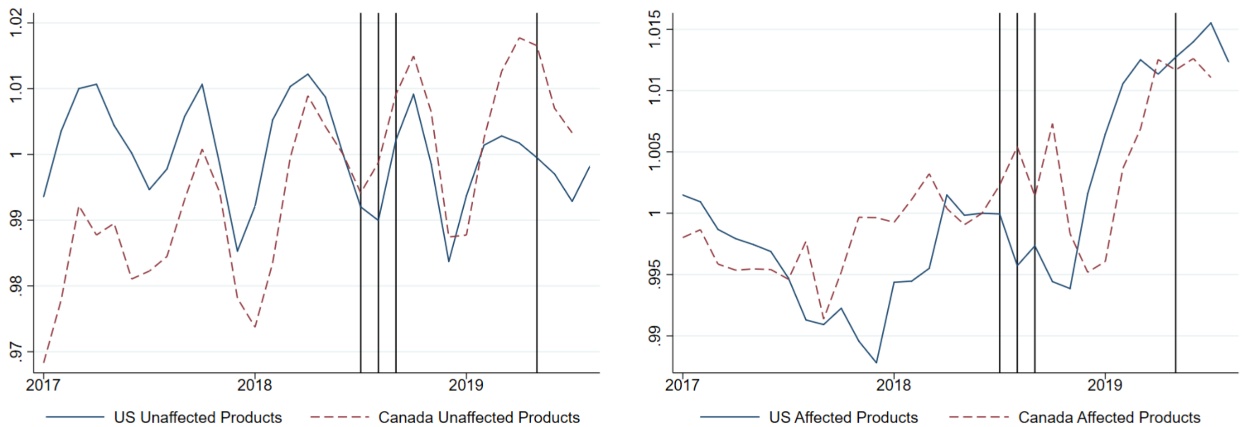
Notes: Our data does not contain enough affected or unaffected products for “Alcoholic Beverages” (COICOP 200) and “Communications” (COICOP 800) to run this regression at the sector level. Fixed effects $\left(\phi_{\mathrm{CN}}^{\Omega}\right)$ and $\left(\phi_{\mathrm{CN}}^{-\Omega}\right)$ are included in all regressions. Robust standard errors shown in parentheses.

D.4 More International Comparisons

As noted in the paper, one possible explanation for our low retail passthrough findings is that retailers increased their margins on unaffected goods to partially offset the margin reduction on affected goods, muting any changes in their overall margins. Or, consistent with the washing machine results in Figure A5(b), perhaps tariffs enabled the producers of unaffected goods to raise their markups. Both of these cases would stabilize the relative prices of affected and unaffected products within narrowly defined sectors. Rather than inferring the impact of tariffs by comparing the prices of affected and unaffected goods within sectors, in these cases we would expect to see the prices in affected US sectors rise (compared to the overall CPI) relative to the prices in countries that did not impose tariffs on these goods.

To consider these possibilities, in Figure A7 we start by comparing the sector-level price indices for affected and unaffected sectors underlying “Commodities less food and energy” in the United States and “Goods excluding food purchased from stores and energy” in Canada, data publicly available from the US Bureau of Labor Statistics and Statistics Canada.[8] Figure

[8]Based on the share of trade in the categories that is covered by the tariffs, we designate the following nine CPI sectors as “affected”: Furniture and bedding, Laundry equipment, Miscellaneous personal goods, Motor vehicle parts



(a) Unaffected Sectors

(b) Affected Sectors

Figure A7: Retail Price Indices for the United States and Canada, Data from CPI

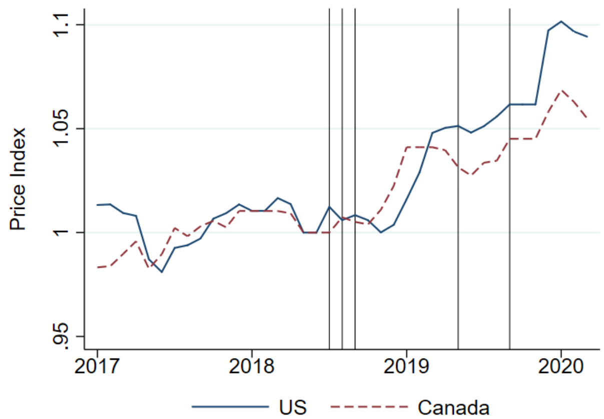
A7(a) shows the price indices for those sectors unaffected by tariffs. Before mid-2018, Canada's unaffected sectors had a higher inflation rate, though the price indices for unaffected sectors in the United States and Canada are both essentially flat after the imposition of the tariffs. Figure A7(b) then compares the price indices constructed for sectors affected by the tariffs. While starting with the imposition of the tariffs, there does appear to be a moderate increase in inflation among affected categories in the United States, interestingly, this also appears to be the case in Canada, though to a lesser degree.[9]

Figure A7 suggests that at least some of the price increases in the affected goods sectors may not truly reflect the tariffs, or may only reflect the general equilibrium effects of tariffs, since Canada has not imposed tariffs on imports from China. We note, however, that this analysis is highly imperfect and has limited power. The affected sectors are not chosen based on trade as a share of expenditures and do not distinguish trade from China and from other countries. Furthermore, the sectors are defined differently across the two countries, and even when the matching of sectors is good in concept, the two countries may consume very different products in practice. To avoid these issues, we next compare the prices for identical goods sold by Retailer 2 in the United States and in Canada.

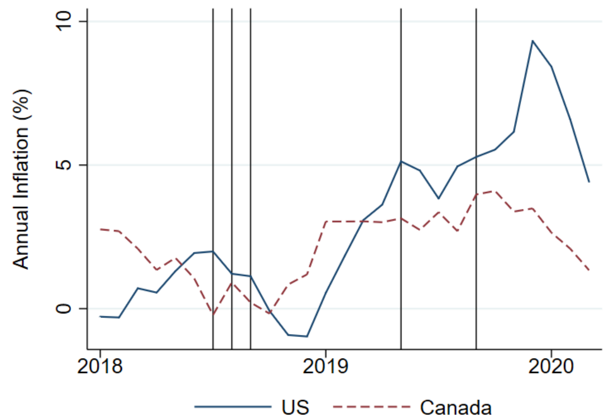
and equipment, Personal care products, Pets and pet products, Sewing machines, fabric and supplies, Sports vehicles including bicycles, and Tools, hardware, outdoor equipment and supplies. The remaining sectors are designated as "unaffected". We then do our best to manually match these sectors for Canada. We use price indices that are not seasonally adjusted because some of these series for Canada are not available with seasonal adjustments.

[9]This analysis for the United States is reminiscent of, and largely consistent with, a widely distributed report by Goldman Sachs (2019).

We identify 2,436 products that are sold by Retailer 2 in both the United States and Canada and plot the price indices and inflation rates separately for each country, using only the retail prices for those common goods in Figure A8.[10] Given that the overall CPIs for the United States and Canada evolved similarly over this period, the two panels do not suggest any particularly unusual dynamics in the US prices for these goods relative to the Canadian goods over the period when the tariffs were imposed.



(a) Price Indices



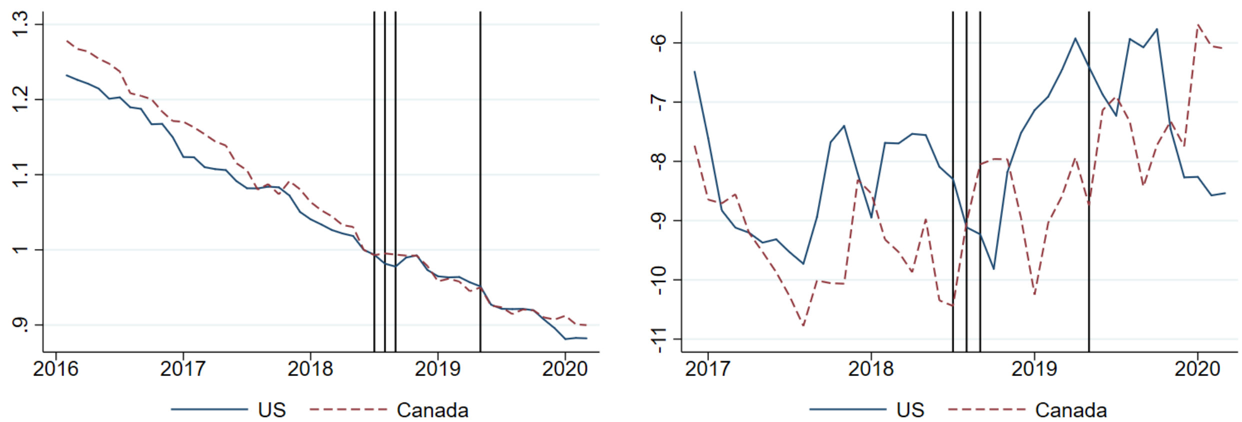
(b) Annual Inflation

Figure A8: US and Canadian Retail Prices from Retailer 2

The patterns in Figure A8, of course, only reflect data from a single retailer. While we could not match identical goods sold in the United States and Canada for more retailers, we added pricing data for sales in the two countries for six additional retailers that operate in those two countries and sell home goods, electronics, apparel, and furniture, including two other top-10 US retailers. We selected 43 3-digit product categories and created price indices for each category, country, and retailer. We used prices for about 350,000 products in the United States and about 120,000 in Canada. We then use equal weights for each retailer and the same average sectoral expenditure weights for both countries to generate US and Canadian price indices for these goods, where any differences can be thought of as reflecting within-retailer and within-category differences in inflation across the two countries. The results, plotted in Figure A9, again do not

[10]We identify identical products by looking for an exact match in model numbers, requiring that the model numbers have at least five characters. The model numbers are typically determined by the product manufacturers. They often will be identical other than the last two characters, which will be "us" or "ca". We do not consider such cases to be identical products and exclude them. In total, the matched products cover 19 3-digit COICOP categories and are largely furniture products, household appliances, tools and equipment, and home repair items. We note that we did not require these goods to be available during the identical time spans in each country.

obviously reveal that retailers raised prices for their US customers relative to their Canadian customers, even for the same set of goods, suggesting that retailer profit margins absorbed a significant amount of the adjustment to the import tariffs.



(a) Price Indices

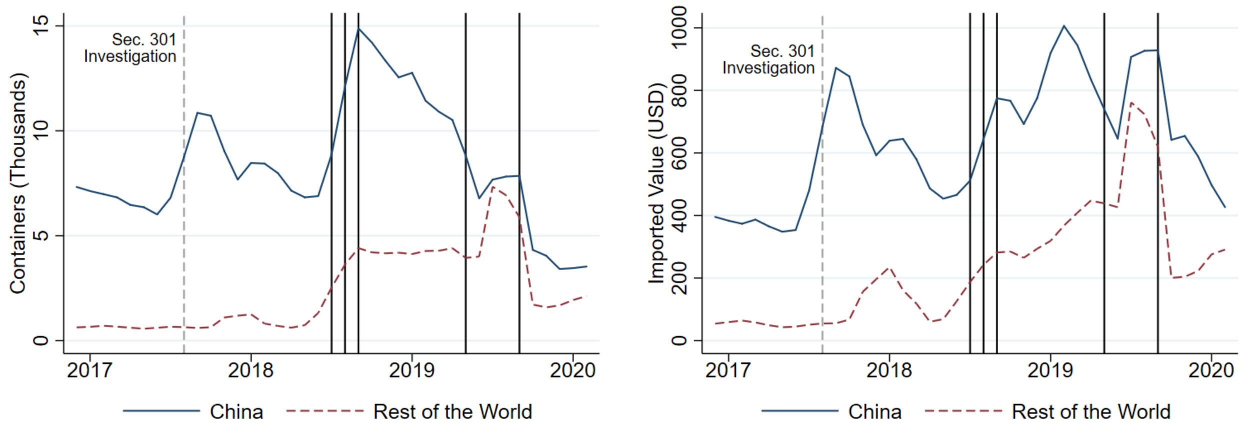
(b) Annual Inflation

Figure A9: US and Canadian Retail Prices, Multiple Retailers

Finally, we note that while we observe very high passthrough of tariffs to the import price at the economy-level, our retail results largely reflect prices set by the largest firms. It is possible that in terms of their negotiating power as buyers, these giant retailers differ from the average retailer and this difference may contribute to our finding of surprisingly modest passthrough to their retail prices. Indeed, when we restrict our analysis of import tariffs on Chinese goods to firms with two or more subdivisions reporting to the BLS—a proxy for large firms—the estimate corresponding to "Tariffs 1 yr." in column (4) of Table A2 decreases to -0.112 and is statistically significant at the 10 percent level.

D.5 Additional Front-Loading Results

The results for Figure 4 in the paper are very similar if we plot shipping containers or USD values instead of metric tons. This is shown in Figure A10, confirming that these two retailers engaged in some front-running behavior ahead of the tariffs and also were able to partially adjust in part by shifting to other countries as suppliers.



(a) Containers Imported, Thousands

(b) USD Value of Imports, Millions

Figure A10: Front-Running and Trade Diversion by Two Major US Retailers - Alternative Metrics

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