Markups and Cost Pass-through Along the Supply Chain*

Santiago Alvarez-Blaser
Harvard University

Alberto Cavallo
Harvard University

Alexander MacKay
University of Virginia

Paolo Mengano
Esade Business School

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2 Data

2.1 Prices, Costs, and Quantities

Our analysis relies on two distinct data sources that together allow us to measure markups and examine pricing behavior along the value chain. The first source comprises detailed product-level information from a global manufacturer. The second consists of a vast collection of retail prices provided by PriceStats, a private company related to the The Billion Prices Project (Cavallo and Rigobon, 2016). Developed in the Pricing Lab at Harvard Business University, this combined dataset offers a unique opportunity to study price formation and pass-through mechanisms along the entire supply chain, from production to retail.

The first dataset, originating from a large global manufacturer active in the sector of nondurable household products, includes monthly SKU-level records of revenues, quantities, and costs from Canada, Mexico, the United Kingdom, and the United States. Our definition of a product is a combination of a brand, a product form, a package size, and a variant (for example, fragrance). Our raw data has multiple SKUs that correspond to identical products according to our definition. To prepare the data for the analysis, we aggregate across these SKUs, and we then link these products to the retail online prices in the second dataset. We calculate unit prices and unit costs by dividing revenues and costs by the quantity sold. The measure of costs we were provided reflects variable costs, including raw materials, packaging, manufacturing operating expenses, transportation, and warehousing.

The second dataset includes retail prices and is provided by PriceStats, a private firm that collects prices from online retailers using web-scraping techniques and uses them to provide insights into daily price changes and product details, including category and sale status. Although the products in our data are also sold through brick-and-mortar channels, we

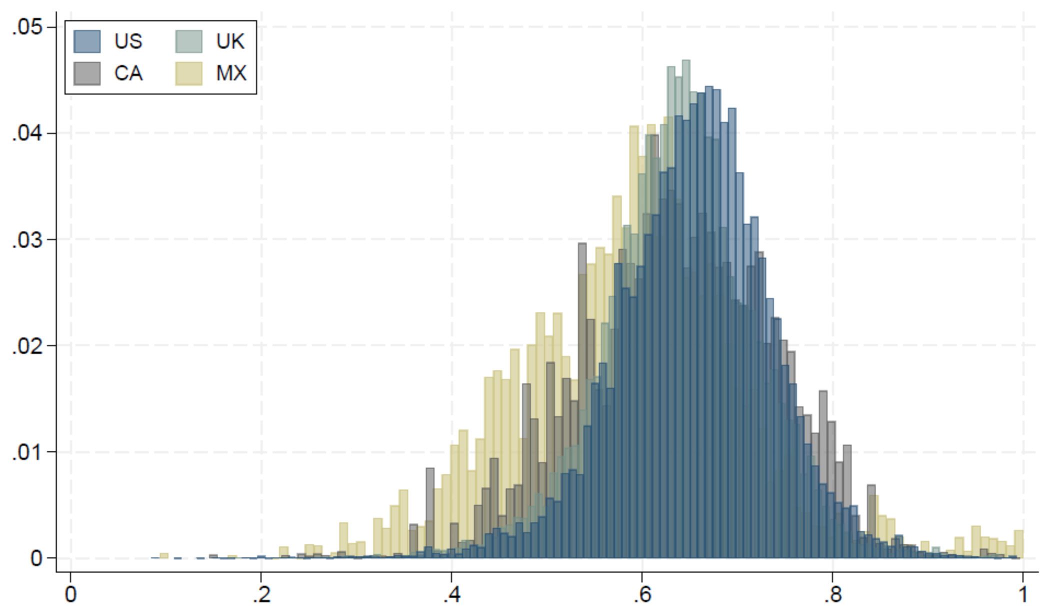
2.2 Product Markups

A key object of interest for our study is the supply chain *total markup*. For product i at time t, we compute this value as the Lerner index in terms of retail price and production cost, $\mu_{it}^{TOT} = \frac{p_{it}^{R} - c_{it}}{p_{it}^{R}}$. This markup reflects the wedge between the price that consumers pay and the production costs, and it usually takes on values between 0 (price equals cost) and 1 (prices substantially greater than costs).

Figure 1 shows total markups in Canada, Mexico, the United Kingdom, and the United States. The distribution of total markups is remarkably similar across countries, with average values around 0.65. In magnitudes, the total markups are broadly consistent with recent estimates in the retail sector (Döpper et al., 2022) and the broader economy (De Loecker et al., 2020, De Loecker and Eeckhout, 2018). See Table A.3 for additional summary statistics.

Finally, we compute retail markups as the Lerner index with retail and wholesale prices, $\mu_{it}^R = \frac{p_{it}^R - p_{it}^M}{p_{it}^R}$, following other papers that study retail markups (Aguirregabiria, 1999, Eichenbaum et al., 2011, Anderson et al., 2018, among others). The rationale for this approach is that the marginal cost of a product for a retailer is its replacement cost, with other retailing costs fixed

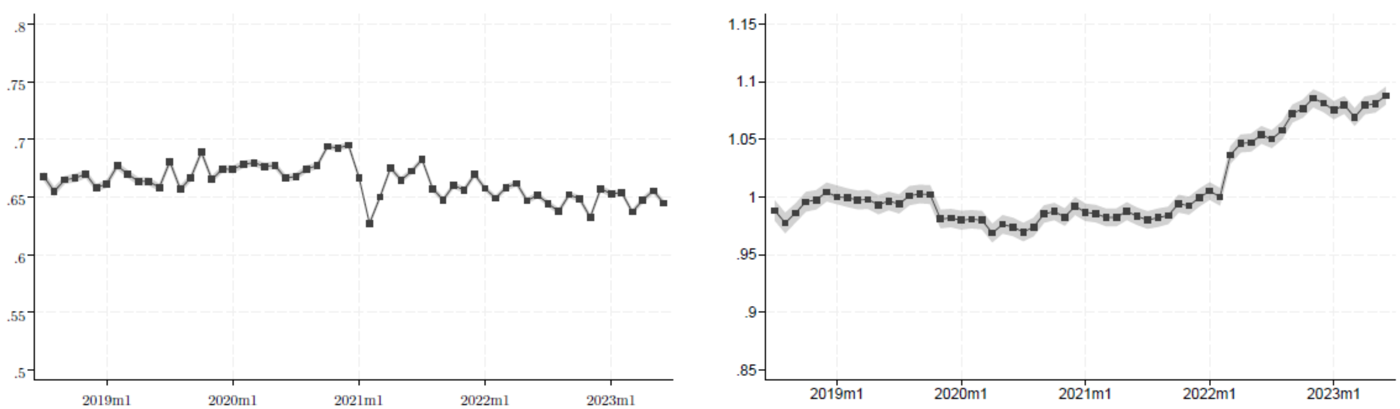
Figure 1: *Total Markups*



Notes: This figure shows the sales-weighted frequency distribution of total markups ($\frac{p_{it}^R - c_{it}}{p_{it}^R}$) along the supply chain for each country.

3.1 Markups Over Time

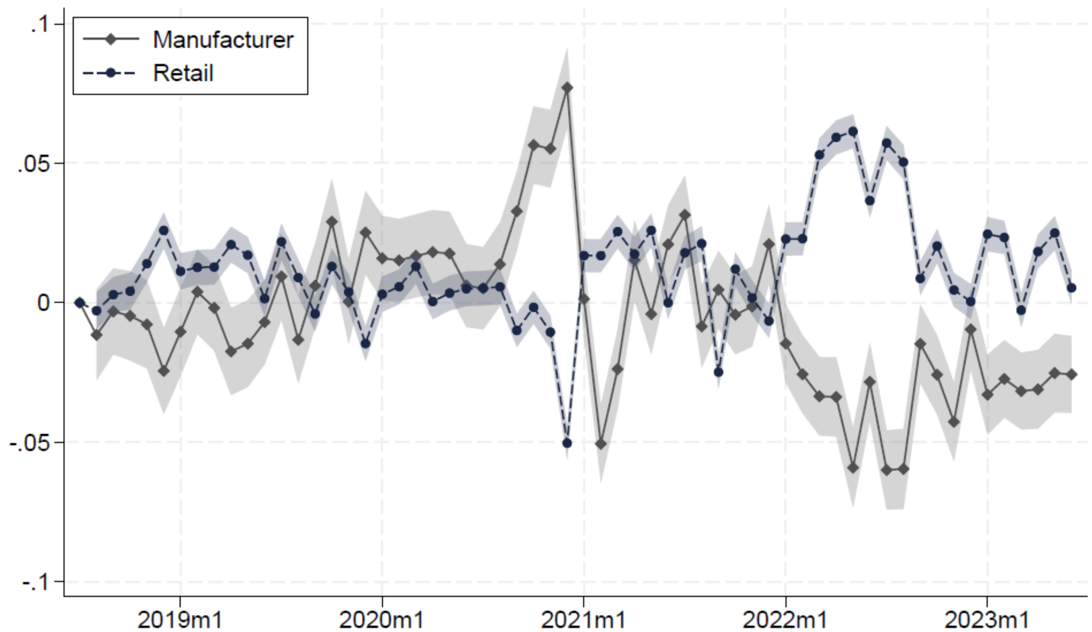
Figure 2: *Time Series of Prices and Total Markups*



(a) *Total Markups* **(b)** *Retail Prices*

Notes: This figure shows the time series trends in total markups (a) and retail prices (b) in the United States. Total markups are defined as the Lerner Index using retail prices and manufacturing costs. Point estimates and 95% (robust) confidence intervals are obtained from a regression on period and product fixed effects using sales weights.

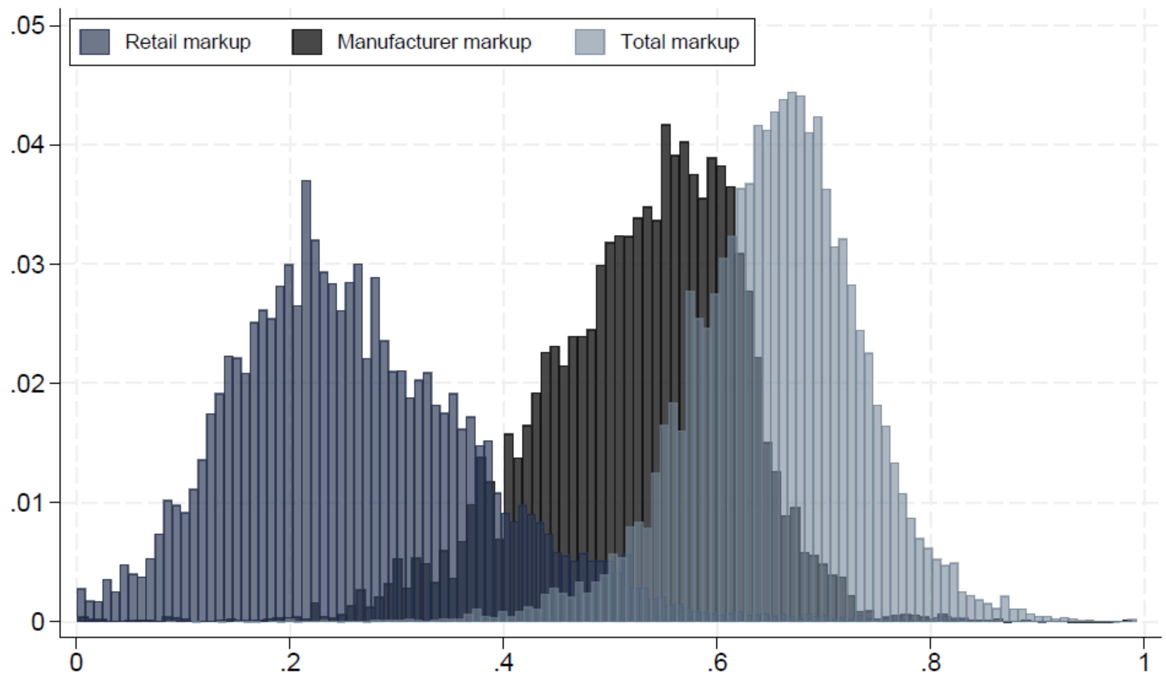
Figure 3: *Markup Dynamics*



Notes: This figures shows the negative dynamic correlation of markups along the supply chain in the United States. Changes in average markups and 95% (robust) confidence intervals resulting from a regression on period and product fixed effects using sales weights.

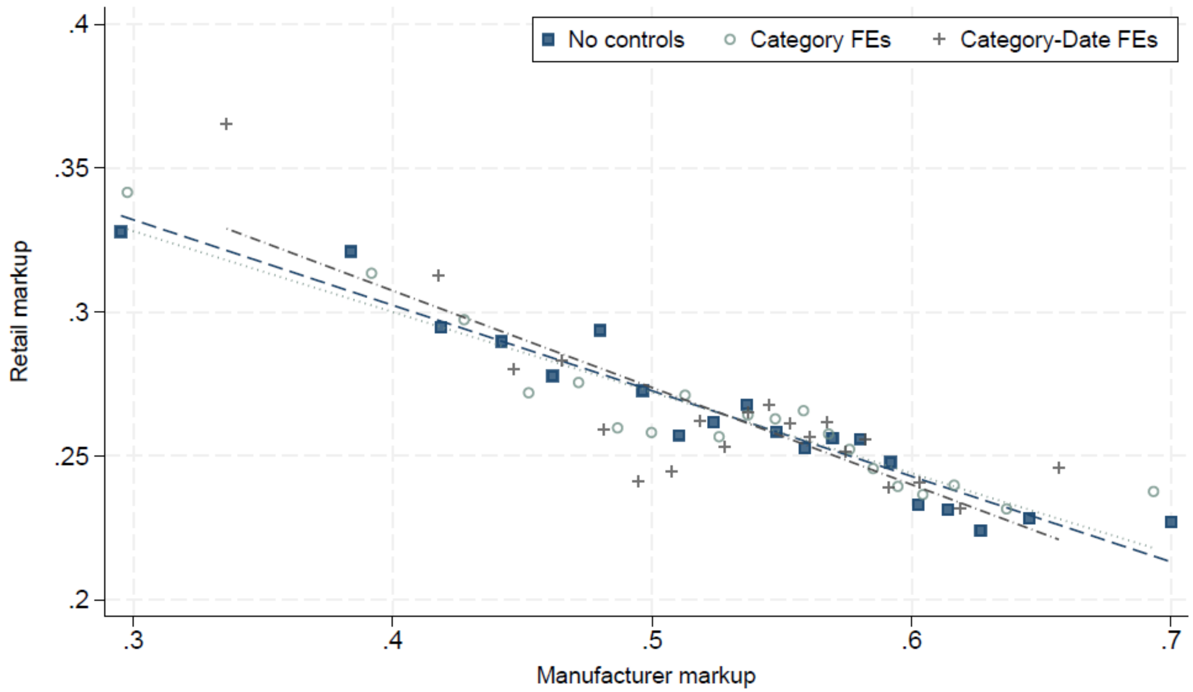
Another notable pattern is that markups are consistently higher for the manufacturer than for the retailers. The average manufacturer markup is 0.54, compared to a retailer markup of 0.26.[7] This indicates that manufacturers and retailers are not symmetric in terms of competitive pressures, bargaining positions, or both.

Figure 4: *Markups Along the Supply Chain*



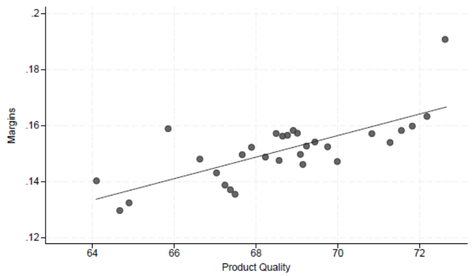
Notes: This figure shows the sales-weighted frequency distribution of markups along the supply chain in the United States. Retail markups ($\frac{p^R - p^M}{p^R}$) are shown in dark blue, manufacturer markups ($\frac{p^M - c}{p^M}$) in dark grey, and total markups ($\frac{p^R - c}{p^R}$) in light blue.

Figure 5: *Markups Correlation Along the Supply Chain*

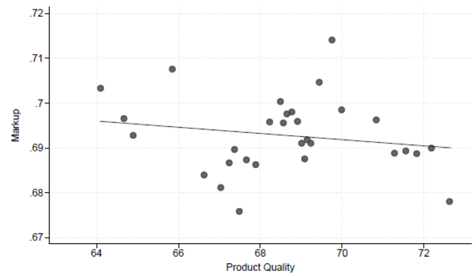


Notes: This figure shows the negative correlation of markups along the supply chain in the United States. Bins include sales-weighted values residualized on product and category times period fixed effects.

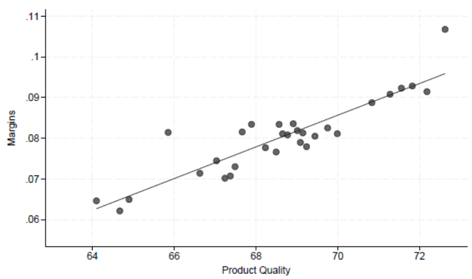
Figure 6: *Quality Differentiation Along the Supply Chain*



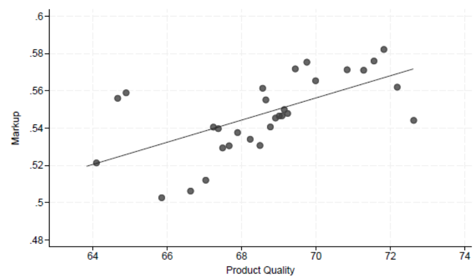
(a) *Total Margins*



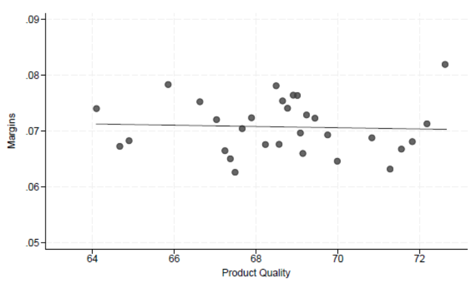
(b) *Total Markups*



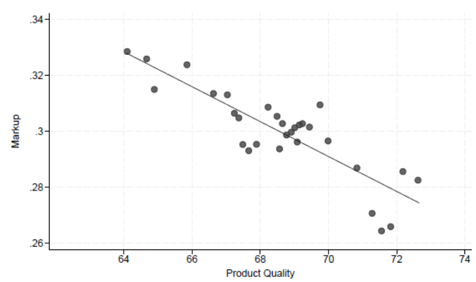
(c) *Manufacturer Margins*



(d) *Manufacturer Markups*



(e) *Retail Margins*



(f) *Retail Markups*

Notes: This figure shows the relation of product (a) total margins, (b) total markups, (c) manufacturer margins, (d) manufacturer markups, (e) retail margins, and (f) retail markups to an indicator of product differentiation. Values are residualized on linear and quadratic package size, to account for quantity discount, and on a set of fixed effect including product category interacted with periods, and retailer.

4 Cost Pass-Through

4.1 Along the Supply Chain

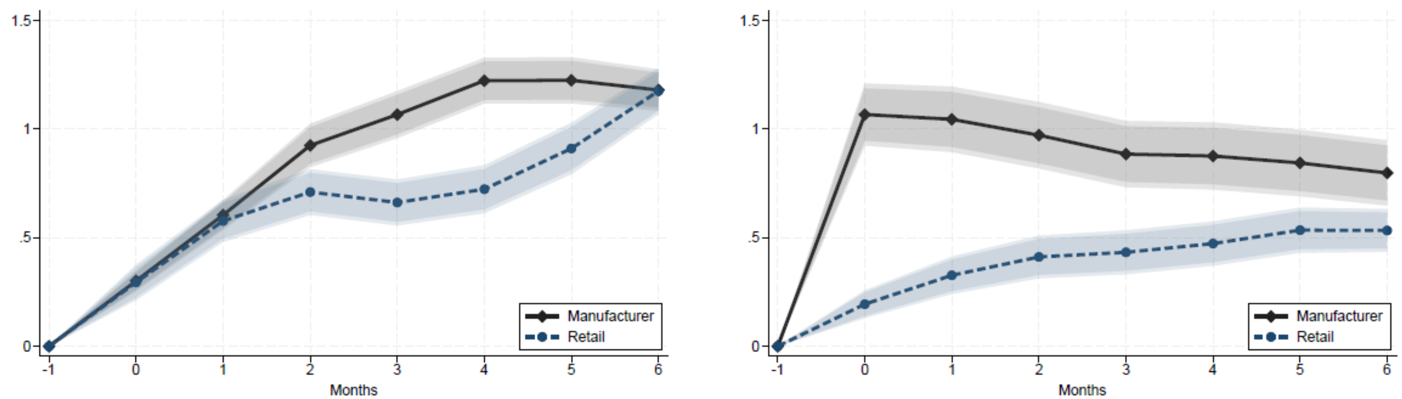
We measure the pass-through mechanisms at both the manufacturer and the retail levels to unravel the complementary dynamics between manufacturing costs and retail pricing strategies. Specifically, we compute the pass-through of costs at the manufacturer level using the following specification:

$$p_{ist}^{M} = a + \sum_{z=0}^{T} \alpha_z^M \hat{c}_{ist-z}^{M} + \sum_{z=0}^{T} \beta_z^M C_{st-z}^{M} + \phi_i + \varepsilon_{ist} \tag{1}$$

Similarly, the pass-through at the retailer level is estimated using the following specification:

$$p_{ijst}^{R} = b + \sum_{z=0}^{T} \alpha_z^R \hat{p}_{ist-z}^{M} + \sum_{z=0}^{T} \beta_z^R P_{st-z}^{M} + \gamma_j + \gamma_i + \nu_{jist} \tag{2}$$

Figure 7: *Cost Pass-through Along the Supply Chain*

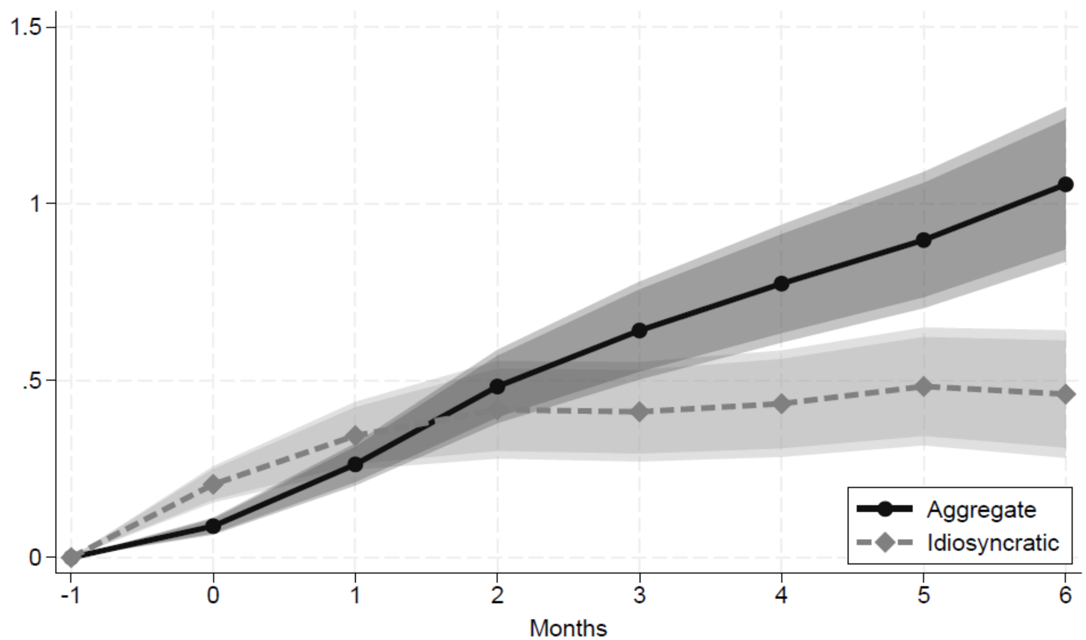


(a) *Aggregate* **(b)** *Idiosyncratic*

Notes: These figures show the cumulative pass-through of costs to wholesale prices (a) and of wholesale prices to retail prices (b), estimated using Equation (1) and Equation (2). Solid lines are the point estimates, and shaded areas are the 95 and 90 percent confidence bands computed using the delta methods.

To further contextualize these dynamics, we use pass-through estimates to calculate the change in retail price due to a $1 increase in production cost, incorporating adjustments at both the manufacturing and retail levels, as shown in Figure 8. This cumulative response is calculated as $\theta_t^{\text{AGG}} = \sum_{i=0}^{t} \beta_i^R (\sum_{j=0}^{t-i} \beta_j^M)$, and as $\theta_t^{\text{IDIO}} = \sum_{i=0}^{t} \alpha_i^R (\sum_{j=0}^{t-i} \alpha_j^M)$, with θ_t^{AGG} and θ_t^{IDIO} being the cumulative retail price adjustment at time t to aggregate or idiosyncratic costs, and α^X and β^X with $X = \{M, R\}$ recovered from Equation (1) and (2).[11] The figure

Figure 8: *Pass-through from Production Cost to Retail Price*



Notes: This figure shows the cumulative pass-through of production costs to retail prices. The cumulative responses are calculated as $\theta_t^{\text{AGG}} = \sum_{i=0}^{t} \beta_i^R (\sum_{j=0}^{t-i} \beta_j^M)$, and as $\theta_t^{\text{IDIO}} = \sum_{i=0}^{t} \alpha_i^R (\sum_{j=0}^{t-i} \alpha_j^M)$, with θ_t^{AGG} and θ_t^{IDIO} being the cumulative retail price adjustment at time t to aggregate or idiosyncratic costs, and α^X and β^X with $X = \{M, R\}$ recovered from Equation (1) and (2). Standard errors are constructed by bootstrapping 100 times with replacement.

The observed differences in pass-through behavior between the manufacturer and the retailers have several implications. The manufacturer's ability to quickly adjust prices in response to cost shocks suggests a high degree of pricing power and flexibility. Conversely, the gradual pass-through by retailers indicates a distinct approach. Policymakers need to consider the different speeds at which cost changes are transmitted through the supply chain. Quick adjustments by manufacturers can lead to immediate inflationary pressures, while the slower response by retailers can smooth out these effects over time. Understanding these dynamics can help regulators identify potential areas where market interventions might be necessary to prevent excessive price volatility and protect consumer interests. The limited pass-through to final retail prices suggests that consumers might be partially shielded from immediate cost shocks, but prolonged cost increases could eventually filter through, affecting affordability. By considering these factors, policymakers can better manage the impacts of cost changes on the economy and ensure that market dynamics remain balanced and fair for all stakeholders.

4.2 Expected and Unexpected Cost Shocks

The period under examination was characterized by significant global shocks that were largely unforeseen. In Figure 9, we leverage the detailed cost breakdown from the dataset to illustrate the shifts in overall, expected, and unexpected costs. As highlighted by the coefficient of variation in Table A.2, unexpected costs, despite having an average close to zero, significantly contributed to the overall cost variation, similarly to expected costs. Given the significant

$$p_{ist}^{M} = a + \sum_{z=0}^{T} \left\{ \alpha_{e,z}^{M} \hat{c}_{ist-z}^{e,M} + \beta_{e,z}^{M} C_{st-z}^{e,M} + \alpha_{u,z}^{M} \hat{c}_{ist-z}^{u,M} + \beta_{u,z}^{M} C_{st-z}^{u,M} \right\} + \phi_i + \varepsilon_{ist} \tag{3}$$

Figure 9: *Expected and Unexpected Costs Changes Over Time*

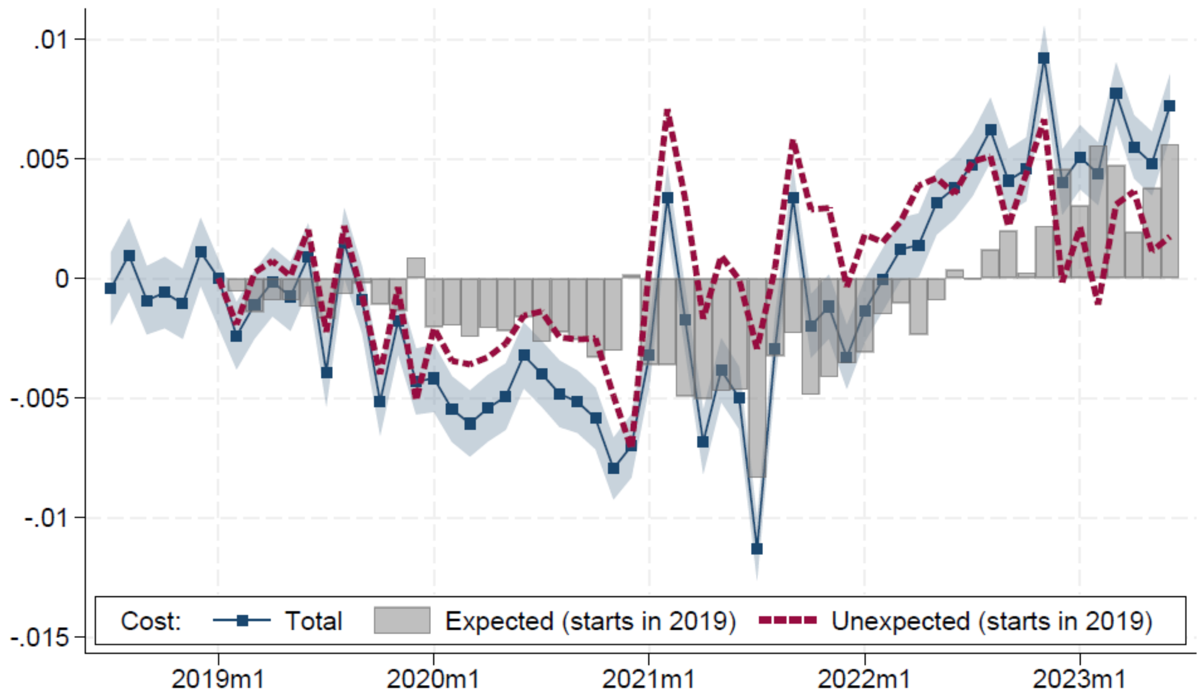
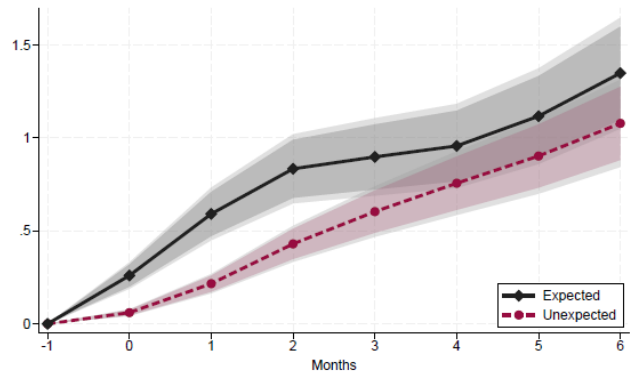
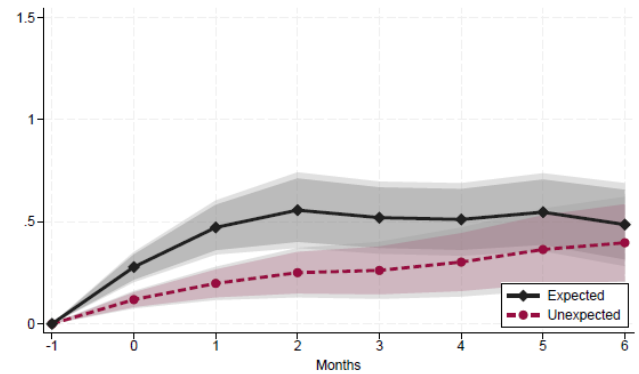


Figure 10: *Pass-through from Production Cost to Retail Price by Cost Type*



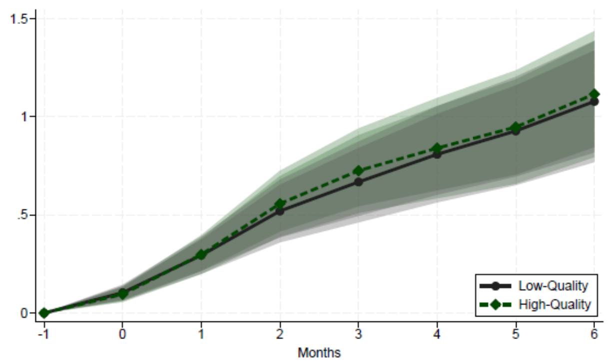
(a) *Aggregate Cost*



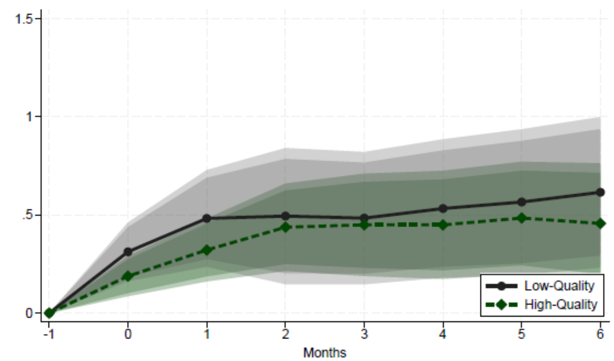
(b) *Idiosyncratic Cost*

Notes: These figure show the cumulative pass-through of production costs to retail prices for expected and unexpected costs. The cumulative responses are calculated separately for expected and unexpected costs as $\theta^{\text{AGG}}_{y,t} = \sum_{i=0}^{t} \beta_i^R (\sum_{j=0}^{t-i} \beta^M_{y,j})$, and $\theta^{\text{IDIO}}_{y,t} = \sum_{i=0}^{t} \alpha_i^R (\sum_{j=0}^{t-i} \alpha^M_{y,j})$, with $\theta^{\text{AGG}}_{y,t}$ and $\theta^{\text{IDIO}}_{y,t}$ being the cumulative adjustment of the retail price at time t to aggregate or idiosyncratic costs with $y = \{e, u\}$ for expected and unexpected changes. α_e^X and α_u^X are recovered from Equation (3), and β^X from Equation (2) with $X = \{M, R\}$. Standard errors are constructed by bootstrapping 100 times with replacement.

Figure 11: *Pass-through from Production Cost to Retail Price by Product Quality*



(a) *Aggregate Cost*



(b) *Idiosyncratic Cost*

Notes: These figure show the cumulative pass-through of production costs to retail prices by product quality. The cumulative responses are calculated as $\theta^{\text{AGG}}_{q,t} = \sum_{i=0}^{t} \tilde{\beta}^R_{q,i}(\sum_{j=0}^{t-i} \tilde{\beta}^M_{q,j})$ and $\theta^{\text{IDIO}}_{q,t} = \sum_{i=0}^{t} \tilde{\alpha}^R_{q,i}(\sum_{j=0}^{t-i} \tilde{\alpha}^M_{q,j})$ with $\theta^{\text{AGG}}_{q,t}$ and $\theta^{\text{IDIO}}_{q,t}$ being the cumulative adjustment of the retail price at time t to aggregate or idiosyncratic costs and q = 1 for high-quality products, else 0. The coefficients are recovered from Equation (4) and Equation (5) with $\tilde{\alpha}^X_{q,t} = \alpha^X_t + \text{I}_{q,t} \times \left(\alpha^X_{q,t}\right)$ and $\tilde{\beta}^X_{q,t} = \beta^X_t + \text{I}_{q,i} \times \left(\beta^X_{q,t}\right)$ with $\text{I}_{q,i} = 1$ if product i has above average quality, else 0, and $X = \{M, R\}$. Standard errors are constructed by bootstrapping 100 times with replacement.

for the manufacturer:

$$p^M_{ist} = a + \sum_{z=0}^{T} \{\alpha^M_z \hat{c}^M_{ist-z} + \beta^M_z C^M_{st-z} + \text{I}_{q,i} \times (\alpha^M_{q,z} \hat{c}^M_{ist-z} + \beta^M_{q,z} C^M_{st-z})\} + \phi_i + \varepsilon_{ist} \quad (4)$$

and for retailers:

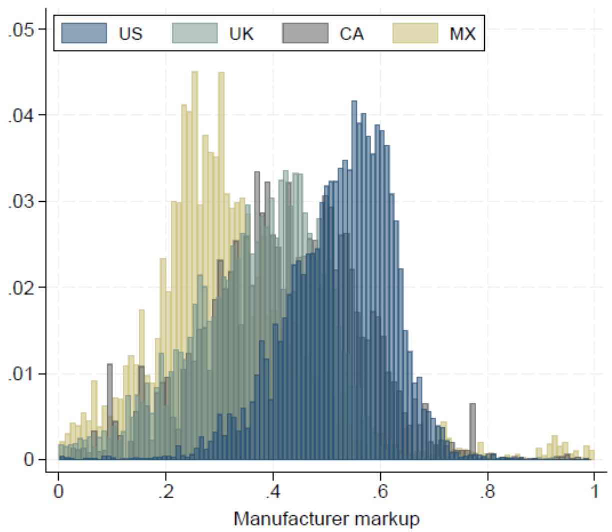
$$p^R_{ijst} = b + \sum_{z=0}^{T} \{\alpha^R_z \hat{p}^M_{ist-z} + \beta^R_z P^M_{st-z} + \text{I}_{q,i} \times (\alpha^R_{q,z} \hat{p}^M_{ist-z} + \beta^R_{q,z} P^M_{st-z})\} + \gamma_j + \gamma_i + \nu_{jist} \quad (5)$$

Table 1: *International Comparison*

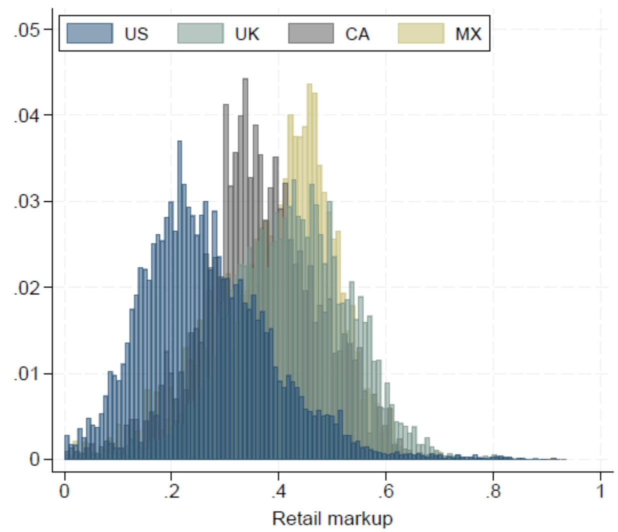
	Countries			
	US	UK	Canada	Mexico
Average Total Markup (μ_t^T)	0.66	0.64	0.65	0.60
Larger Markup	Manufacturer	Retailers	Manufacturer	Retailers
Negative Time Series Corr(μ_t^M,μ_t^R)	Yes	Yes	Yes	No
Negative Cross-Sectional Corr(μ_{it}^M,μ_{it}^R)	Yes	Yes	Yes	No
Slower Retail PT (1M)	Yes	Yes	Yes	Yes
Larger PT of Expected Costs (1M)	Yes	Yes	Yes	No
Aggregate Manufacturer PT (6M)	1.18	0.46	0.81	0.37
Aggregate Retail PT (6M)	1.18	1.26	0.92	0.31
Idiosyncratic Manufacturer PT (6M)	0.80	0.71	0.42	0.61
Idiosyncratic Retail PT (6M)	0.53	0.38	0.44	0.42

Notes: This table summarizes the main results across the countries included in our sample. Slower retail pass-through is assumed when the estimated pass-through of idiosyncratic and aggregated shocks after one month are larger for the manufacturer than for the retailers.

Figure 12: *Markups Distributions*



(a) *Manufacturer Markup*

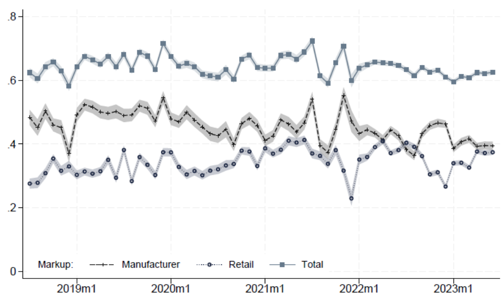


(b) *Retail Markup*

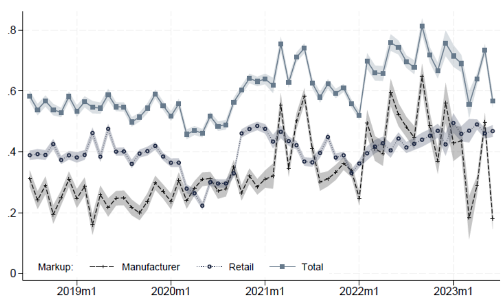
Notes: This figure shows the sales-weighted frequency distribution of markups along the supply chain. The manufacturer markup is defined as the Lerner index of wholesale prices and production costs, $\frac{p^M - c}{p^M}$, while the retail markup is defined as the Lerner index of retail prices and wholesale costs, $\frac{p^R - p^M}{p^R}$.

Figure 13: *Markup Dynamics*

(a) *United Kingdom*



(b) *Canada*

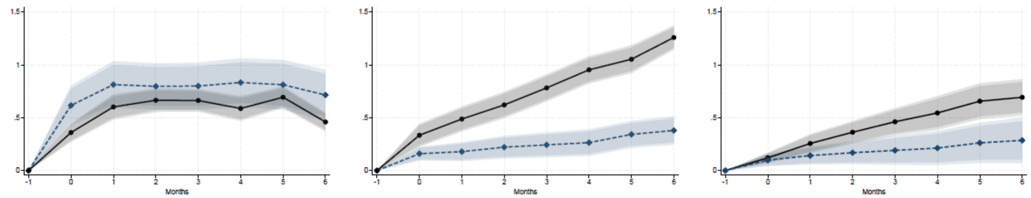


(c) *Mexico*

Notes: This figure shows the levels of markups in the United Kingdom, Canada, and Mexico. Manufacturer markups ($\frac{p^M-c}{p^M}$), total markups ($\frac{p^R-c}{p^R}$), and retailer markups ($\frac{p^R-p^M}{p^R}$). Averages and 95% (robust) confidence intervals resulting from a regression on period and product fixed effects using sales weights.

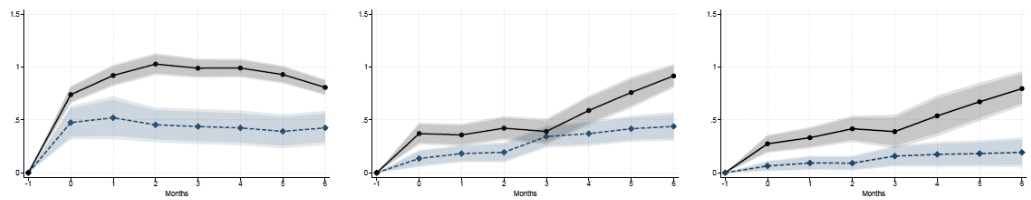
Figure 14: *Cost Pass-through Along the Supply Chain*

United Kingdom



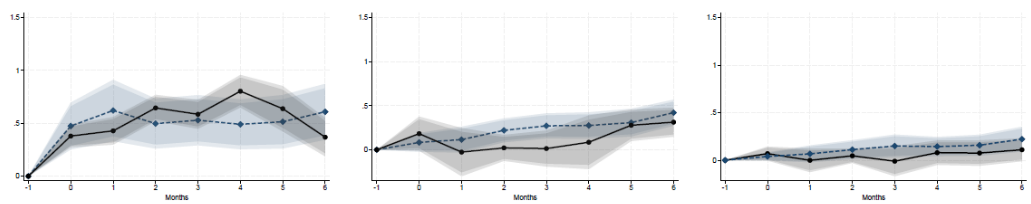
(a) *Manufacturer* **(b)** *Retail* **(c)** *Combined*

Canada



(d) *Manufacturer* **(e)** *Retail* **(f)** *Combined*

Mexico



(g) *Manufacturer* **(h)** *Retail* **(i)** *Combined*

Aggregate Idiosyncratic

Notes: These figures show the cumulative pass-through of costs to wholesale prices on the left, of wholesale prices to retail prices in the center, and of production costs to retail prices on the right. Coefficients are estimated using Equation (1) and Equation (2), jointly for all countries, using country dummies. The top panel includes results for the United Kingdom, the second for Canada, and the third for Mexico. Solid lines are the point estimates, and shaded areas are the 95 and 90 percent confidence bands computed using the delta methods.

6 Model

We propose a model of supply chain pricing behavior that rationalizes several of our key findings. The framework considers a manufacturer that supplies a set of products, $\mathcal{I}$, to multiple retailers. The supplier-buyer network is fixed, and pricing occurs in two stages. First, the manufacturer determines the optimal retail prices (p_i^R) that maximize joint manufacturer-retailer profits for the set of products $\mathcal{I}$. Second, the manufacturer and the retailer negotiate wholesale prices (p_i^M) through a bargaining process for each product separately. The model is consistent with conversations with the manufacturer and captures features of our data that standard models do not readily account for, including the negative correlation between manufacturer and retailer markups described in Section 3.

6.1 Supply Chain Pricing

In the first stage, the manufacturer determines the retail prices that maximize supply-chain profits for its own products:[16]

$$\max_{\{p_i^R\}} \sum_{i \in \mathcal{I}} \left(p_i^R - c_i\right) q_i \tag{6}$$

[16] In practice, manufacturers often avoid directly setting retail prices through contracts. Instead, they incentivize retailers to adhere to preferred prices using a combination of "list prices" at the retail level and "promotional" rebates to the retailer. Moreover, manufacturers tend to focus on the behavior of the end consumer and spend extensive resources on its analysis. As one typical example, in a March 2023 earnings call, the executives of General Mills discuss pricing and elasticities several times, referring to retail consumer behavior. `https://seekingalpha.com/article/4589620-general-mills-inc-gis-q3-2023-earnings-call-transcript`

In the second stage, the manufacturer and the retailer bargain over the split of profits for each product. Because total profits are set in the first stage, it suffices for the manufacturer and retailer to negotiate over the wholesale price. The negotiation between the manufacturer and retailer follows a Nash bargaining protocol, which maximizes the following Nash product:

$$\max_{p_i^M} \left[\left(p_i^M - c_i\right) q_i\right]^{\tau_i} \left[\left(p_i^R - p_i^M\right) q_i\right]^{1-\tau_i}, \ \forall i \in \mathcal{I}, \tag{7}$$

where p_i^M is the wholesale price. The first component represents the profits of the manufacturer, expressed as manufacturer margin $(p_i^M - c_i)$ times quantity. The second component is retailer profits, expressed as retail margins $(p_i^R - p_i^M)$ times quantity. Here, τ_i and $(1 - \tau_i)$ represent the bargaining weights of the manufacturer and retailer, respectively, reflecting their relative bargaining power.

The quantity of the product, q_i, is set with the retail prices in the first stage, thus it is taken as given in the second stage. As such, the bargaining problem simplifies to a negotiation over margins:

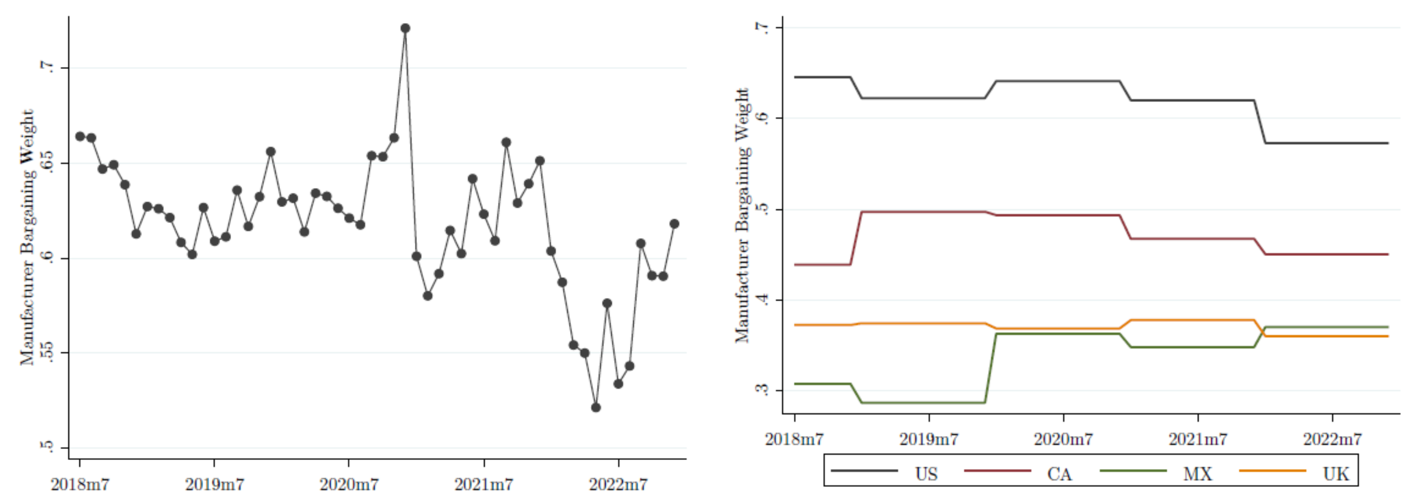
$$\max_{p_i^M} \left(p_i^M - c_i\right)^{\tau_i} \left(p_i^R - p_i^M\right)^{1-\tau_i}, \ \forall i \in \mathcal{I}. \tag{8}$$

In equilibrium, the solution to the bargaining problem yields a share of profits for the manufacturer that are equal to the bargaining weight, τ_i. This can be expressed as

$$\frac{p_i^M - c_i}{p_i^R - c_i} = \tau_i. \tag{9}$$

Using our data on retail prices, wholesale prices, and production costs, we can recover the manufacturer's bargaining weights directly from the data.

Figure 15: *Manufacturer Bargaining Power*



(a) *U.S.* **(b)** *All countries*

Notes: This figure shows the time series of the manufacturer's bargaining weights in the U.S. (a) and across all countries (b). Bargaining weights are calculated using (9) and aggregated at the country-month level, weighted by sales.

The manufacturer exhibits lower bargaining power outside of the U.S. (Figure 15b) when negotiating wholesale prices. The average bargaining weights are 0.47 in Canada, 0.33 in Mexico, and 0.36 in the United Kingdom. The evolution over time also varies across countries: in Canada, bargaining power has steadily declined since late 2019; in the United Kingdom, it remained unchanged over the period; while in Mexico, the manufacturer's bargaining power increased substantially in 2020.

Table 3: *Bargaining Weights Predictors*

	(1)	(2)	(3)	(4)	(5)
Production Cost	-0.467***	-0.467***	-0.457***	-0.408***	-0.431***
	(0.002)	(0.002)	(0.004)	(0.003)	(0.004)
Total Margin	0.546***	0.517***	0.613***	0.412***	0.400***
	(0.002)	(0.002)	(0.003)	(0.003)	(0.004)
Sales per Capita	0.046***	0.054***	0.076***	0.054***	0.047***
	(0.001)	(0.001)	(0.002)	(0.001)	(0.001)
GDP per Capita	0.367***	0.107***	0.447***	0.395***	0.470***
	(0.005)	(0.030)	(0.011)	(0.055)	(0.063)
CPI	-0.177***	-0.081***	-0.217***	-0.200***	-0.127***
	(0.018)	(0.021)	(0.030)	(0.036)	(0.041)
Quality					2.291***
					(0.079)
Country FEs		X			
Non US			X		
US Only				X	X
Observations	88151	88151	32252	55899	40037
R^2	0.596	0.603	0.629	0.352	0.387

Notes: This table shows the outcome of regressing (log) bargaining weights on (log) production costs, (log) total margins, (log) product sales, (log) GDP per capital, and (log) CPI. Standard errors in parentheses. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.