

Pricing to Customers in Firm-to-Firm Relationships

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Motivation

- Price **rigidity**, crucial for the transmission of shocks in the economy
- Sluggishness with which prices respond to shock depends on
 - ① Number of products sold by the firm (Midrigan, 2011; Bhattacharai and Schoenle 2014)
 - ② **Competitiveness** in the market (Amiti et.al 2019; Mongey, 2021; Cavallo et.al 2024)
 - ③ Sectoral characteristics (Nakamura and Steinsson, 2010, Pasten et al., 2020, Rubbo, 2023)
 - ④ Size of the shock (Cavallo, Lippi, and Miyahara, 2024)
- Firms operate within complex production chains: **pricing decisions** and, therefore, the relevant **notion of market**, lie at the **supplier-buyer** level (Alviarez et al., 2023)

Question: How do **bilateral market shares** in firm-to-firm relationships affect **price adjustment decisions** and the transmission of **cost-push shocks**?

What we do

- New evidence of price-rigidity characteristics within **supplier-buyer** relationships, at the **product-variety** level
- Assess the role that supplier-buyer match characteristics, in particular **bilateral market share**, play in price-adjustment decisions
 - Validate our results, using a COVID-19 *market structure shock*
- Study the **transmission of oil price shocks** given supplier-buyer characteristics
- Propose a **theoretical model** aiming to match and quantify main features of the data

What we find

- **Fact 1:** Partial **synchronization** in price adjustment of supplier-variety pairs across buyers
- **Fact 2:** Bilateral market share is an **important determinant** of the price level, the frequency and magnitude of prices adjustments
- **Fact 3:** Sellers with larger and less concentrated bilateral market share, more prompt to synchronize price changes
- **Fact 4:** **Pass-through** of oil price shocks is higher in relationships with larger supplier bilateral market share
- Through our **model** with: **Non-constant demand elasticities** (Kimball) + demand shifters at the **supplier-buyer** level
 - Reproduce our main stylized facts
 - Counterfactual exercise: Ignoring the heterogeneous structure of supplier-buyer market shares would **underestimate** the effect of cost shocks on aggregate prices by ≈ 0.5 pp.

Data

The Data

- Universe of **daily firm-to-firm** (supplier-buyer) transactions in Chile, 2018-2023.
 - Access to firms' unique tax identification numbers of both the supplier and the buyer
 - Information: Date of transaction, value, price per unit, type of product, and location
 - Use Machine Learning tools to aggregate prices at the **variety** level to the product-subclass level, [Acevedo et.al. (2022)]
- Generate price “triplet” p_{ijv} , i :supplier, j :buyer and v :variety
 - Restrict varieties to be associated with products in the official CPI and PPI baskets.
 - Each variety must appear at least 24 times (for any supplier)
- Merged with Balance Sheet information about **both** supplier **and** buyer
 - Total Sales, employment, industries, input purchases

Example: Class, Subclass, Varieties

Class	Subclasses (CPC code)	Observed varieties
Processed paper and paperboard	(32141) Composite paper and paperboard	Light yellow painted cardboard 53.5x73 <i>proarte</i> Gummed paper roll 72x100m
	(32142) Creped, embossed or perforated paper	
	(32143) Kaolin-coated paper and paperboard	
	(32149) Other coated or treated paper	
Toilet tissue stock, kraftliner, and other paper	(32131) Toilet and facial tissue stock	Emuwipes wet wipe box 2x85+5 units Large white pulp 6 units; large colored pulp 12 units
	(32132) Kraftliner, uncoated	
	(32133) Other uncoated kraft paper	
	(32134) Fluting paper	
	(32135) Testliner	
Newsprint and other uncoated paper	(32121) Newsprint	Drawing block; materials block 100x1; block 20x2 Corrugated cardboard 100m
	(32122) Hand-made paper and paperboard	
	(32129) Other uncoated graphic paper	

Fact 1: Partial Synchronization in p_{ijv} adjustments

Fact 1: Synchronization in price adjustment

- N_{ivt} : total number of buyers of supplier i for variety v at time t
- K_{ivt} : total number of buyers that experienced a price adjustment from seller i

Probability	Panel	Cross-Section
$P(K = N = 1)$	17.6%	24.0%
$P(K = 1 \wedge N > 1)$	2.9%	2.1%
$P(N > K > 1)$	6.5%	3.9%
$P(K = N \wedge N > 1)$	5.4%	4.0%
Total	32.4%	34.0%

Note: The *Panel* probabilities are at *ivt* level and the *Cross-Section* are at *iv* level.

- **Partial synchronization** in price changes from one supplier to different buyers
- When prices are changed simultaneously, the magnitude of revisions increases

Fact 2: Bilateral market shares matter for frequency and magnitude of price adjustments

Supplier bilateral market shares

The share of supplier i , selling variety v , in buyer j 's total purchases of products in v 's subclass:

$$s_{ijvy} = \frac{p_{ijvy} q_{ijvy}}{\sum_{k \in Z_{vj}} \sum_{l \in S_v} p_{kjly} q_{kjly}},$$

- p_{ijvy} and q_{ijvy} : price and quantity sold of variety v by supplier i to buyer j in year y
- Z_{vj} : All possible suppliers of firm j of variety v
- S_v : All the varieties that belong to subclass S
- If $s_{ijvy} > s_{i'jvy}$: i more “relevant/dominant” supplier of v to buyer j , relative to supplier i'
- Also define buyer-side bilateral share x_{ijvy} : how important buyer j is for supplier i 's total sales.
 - $s_{ij} = 1$ does not imply $x_{ij} = 1$

Supplier-variety vs supplier-variety-buyer market structure



- Left: Average market share across iv . Right: Average bilateral market shares across ijv

Fact 2: Price adjustment and bilateral market shares

Estimate correlations in a panel setting saturated with fixed effects and relevant controls from the literature (price gap, price age, etc)

$$y_{ijvt} = \alpha + \beta s_{ijv} + \gamma X_{ijvt} + FE_i + FE_j + FE_s + FE_t + \varepsilon_{ijvt}.$$

We show that $\beta > 0$ when dependent variable y_{ijvt} is:

- Price Level: $\log(p_{ijvt})$
- Extensive Margin: Dummy variable for upward price adjustments $\Delta p_{ijvt} > 0$
 - Prob. of positive price revisions 1.7% **higher** when $s_{ijvy} = 1$
- Intensive Margin: Magnitude of price adjustments $|\Delta p_{ijvt}|$ if $\Delta p_{ijvt} > 0$

Fact 2: Price adjustment and bilateral market shares

	(1) Ln(P)	(2) Ln(P)	(3) $ \Delta p_{ijv} \Delta p_{ijv} \neq 0$	(4) $ \Delta p_{ijv} \Delta p_{ijv} \neq 0$	(5) $ \Delta p_{ijv} \Delta p_{ijv} > 0$	(6) $ \Delta p_{ijv} \Delta p_{ijv} > 0$	(7) $ \Delta p_{ijv} \Delta p_{ijv} < 0$	(8) $ \Delta p_{ijv} \Delta p_{ijv} < 0$
S_{ijvy}		0.323*** (0.001)		0.001*** (0.000)		0.001*** (0.000)		0.001 (0.000)
x_{ijvy}		-1.019*** (0.003)		-0.018*** (0.001)		-0.023*** (0.001)		-0.007*** (0.002)
Price gap (t-1)	0.028*** (0.001)	0.025*** (0.001)	0.004*** (0.000)	0.004*** (0.000)	0.003*** (0.000)	0.003*** (0.000)	0.002*** (0.000)	0.002*** (0.000)
Price Age	-0.039*** (0.000)	-0.038*** (0.000)	0.027*** (0.000)	0.016*** (0.000)	0.027*** (0.000)	0.016*** (0.000)	0.029*** (0.000)	0.020*** (0.000)
# Transactions		-0.041*** (0.000)		-0.036*** (0.000)		-0.036*** (0.000)		-0.034*** (0.000)
Relationship Duration		0.008*** (0.000)		0.014*** (0.000)		0.013*** (0.000)		0.011*** (0.000)
Constant	7.671*** (0.000)	7.683*** (0.001)	0.055*** (0.000)	0.092*** (0.000)	0.051*** (0.000)	0.088*** (0.000)	0.066*** (0.000)	0.102*** (0.000)
N	130,338,866	130,338,866	38,779,375	38,779,375	29,636,020	29,636,020	9,115,784	9,115,784
Adjusted R2	0.706	0.708	0.117	0.128	0.135	0.148	0.200	0.204
Within R2	0.002	0.010	0.018	0.031	0.024	0.039	0.012	0.018

Fact 3: Bilateral market shares matters for price synchronization

Fact 3: Price Synchronization and bilateral market shares

- Suppliers with a **larger** and **less concentrated** bilateral market share s_{ijv} are more prompt to synchronize price changes to their buyers.

	(1)	(2)	(3)	(4)	(5)	(6)
	Synchro	Synchro	Synchro	Synchro	Synchro	Synchro
$sd_{ivt}(s_{ijvy})$	-0.053*** (0.001)	-0.146*** (0.002)			-0.055*** (0.001)	-0.155*** (0.002)
$mean_{ivt}(s_{ijvy})$			0.009*** (0.000)	0.019*** (0.001)	0.005*** (0.001)	0.016*** (0.001)
Constant	0.120*** (0.000)	0.213*** (0.000)	0.052*** (0.000)	0.114*** (0.000)	0.119*** (0.000)	0.210*** (0.000)
N	4,747,579	2,774,833	9,864,721	4,493,646	9,864,721	2,774,833
Adjusted R^2	0.148	0.168	0.067	0.075	0.148	0.169
Sample	All	$K > 1$	All	$K > 1$	All	$K > 1$

Fact 4: Transmission of Oil price shocks

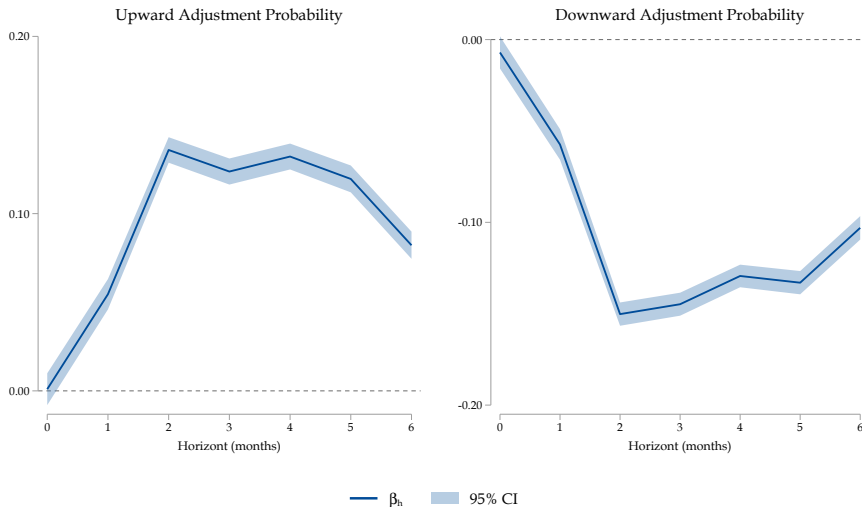
Conditional Adjustment probability

- The specification builds on Karadi et al.(2022):

$$I_{ijs,t+h}^{+,-} = \alpha_i + \alpha_j + \alpha_s + \beta_h(\Delta \hat{P}_t^{oil}) + \gamma_h X_{ij} + \phi w_t + \epsilon_{ijs},$$

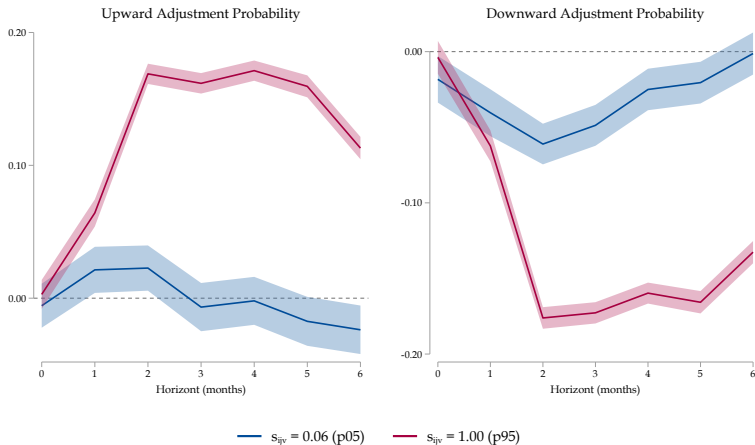
- $I_{ijs,t+h}^{+,-}$: 1 if seller i changes price to buyer j of subclass s between month t and $t + h$
- $\Delta \hat{P}_t^{oil}$: instrumented with oil supply shocks, [Baumeister and Hamilton \(2019\)](#)
- X_{ij} : match specific characteristics + subclass, month, supplier-industry, and customer-industry FE.
- **Network Position:** Focus on all buyers of suppliers whose $\frac{\text{Total Oil Sales}}{\text{Total Sales}} > 0.5$
- **Key:** Weight $\Delta \hat{P}_t^{oil}$ by each j 's exposure by quantifying the share of oil related-products in total intermediate purchases

Probability of price adjustment to a 1SD $\Delta^+ \hat{P}_t^{oil}$



Price adjustment probability: bilateral market share seller s_{ijs}

$$I_{ijs,t+h}^{+,-} = \alpha_i + \alpha_j + \alpha_s + \beta_h(\Delta P_t^{oil} \times s_{ijs}) + \gamma_h X_{ij} + \phi w_t + \epsilon_{ijs},$$



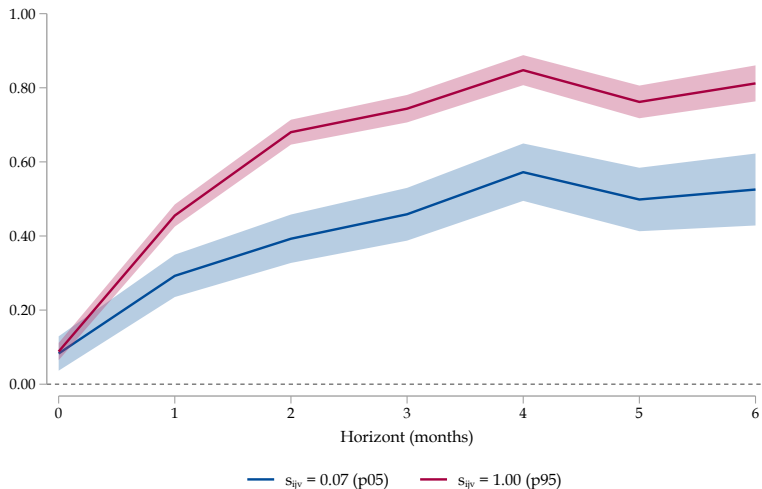
Cumulative price pass-through (Intensive Margin)

- We estimate the following Local Projection-IV regression

$$\begin{aligned}\pi_{t-1,t+h}^{K,ijv} = & \alpha + \beta_h^K (\Delta \ln P_{c,t}) + \phi_h^K (\Delta \ln P_{c,t} \cdot Z_{ijt}) \\ & + \sum_{j=1}^{12} \delta^j \pi_{t-j} + \sum_{j=1}^{12} \gamma^j \Delta P_{c,t-j} + \psi X_t + \varepsilon_t,\end{aligned}$$

- where $\pi_{t-1,t+h}^{K,ijv}$ is the log change in $P^{K,ijv}$ between $t+h$ and $t-1$.
- Again, we rely on Oil shock surprises as instruments for the first stage.

Pass through conditioning in s_{ijvt}



Similar results when excluding COVID-19 period

A simple theoretical framework

Model (Gopinath & Itskhoki, 2010; Aruoba et al., 2024)

Taking stock, our facts suggest:

- Partial synchronization of price adjustment across buyers
- s_{ijvt} shapes the frequency *and* magnitude of price changes
- Larger seller's $\bar{s}_{ijv} \Rightarrow$ more synchronized adjustments
- Heterogeneous oil-cost pass-through along s_{ijvt}

Two key assumptions in the model:

(a) State-dependent pricing Adjustment to **buyer j** subject to a menu-cost κ

(b) Variable-elasticity demand (Kimball aggregator)

$\Rightarrow$ markups, pass-through and adjustment probability depend on the supplier's position on residual demand.

Environment. Continuum of upstream suppliers $i \in [0, 1]$, each producing one intermediate variety, sold to downstream sectors $j \in \{1, \dots, J\}$.

Demand with variable elasticities (Kimball)

Downstream aggregator. In each sector j varieties are combined as

$$\int_0^1 G_j \left(\frac{n_{ij} y_{ij}}{Y_j} \right) di = 1,$$

with n_{ij} a relationship-specific demand shifter and Y_j sector- j total intermediate use.

Variable elasticity & super-elasticity.

$$\epsilon_{ij}(s_{ij}) = -\frac{G'_j(s_{ij})}{s_{ij} G''_j(s_{ij})}, \quad \sigma_{ij}(s_{ij}) \equiv \frac{\partial \ln \epsilon_{ij}}{\partial \ln p_{ij}},$$

both *vary* with $s_{ij} = \left(\frac{n_{ij} y_{ij}}{Y_j} \right)$: the firm's relative price/position on residual demand.

- Differences in n_{ij} across buyers $\Rightarrow$ differences in ϵ_{ij} across j
- s_{ij} summarizes the position on the residual-demand curve $\Rightarrow$ maps *bilateral market share* to demand curvature.

Optimal pricing and oil-cost pass-through

Marginal cost. Wage W , oil price e , idiosyncratic productivity z_i :

$$MC_i(z_i, e) = \frac{W^{1-\phi} e^\phi}{z_i}.$$

Flexible-price optimum. Variable-elasticity markup rule:

$$p_{ij} = \mu_{ij}(p_{ij}) MC_i \quad \mu_{ij}(p) \equiv \frac{\epsilon_{ij}(p_{ij})}{\epsilon_{ij}(p_{ij}) - 1}$$

Pass-through (linearized around symmetric s.s.).

$$\frac{\partial \ln p_{ij}}{\partial \ln e} \approx \phi \Psi_{ij}, \quad \Psi_{ij} \equiv \Psi(s_{ij}) = \left(1 + \frac{\sigma_{ij}(s_{ij})}{\epsilon_{ij}(s_{ij}) - 1} \right)^{-1} \in (0, 1].$$

- $\sigma_{ij} > 0 \Rightarrow$ **incomplete** pass-through (markup absorbs part of the shock).
- CES limit ($\sigma_{ij} = 0$) $\Rightarrow \Psi_{ij} = 1$, complete pass-through.

Relationship-specific state-dependent pricing

Loss from inaction (2nd-order approx. - Gopinath–Itskhoki 2010).

$$L_{ij} \approx \frac{1}{2} K_{ij} \left(\ln p_{ij}^* - \ln \bar{p}_{ij} \right)^2 \propto \Psi_{ij} \left(\epsilon_{ij}(s_{ij}) - 1 \right) \left(\ln MC_i \right)^2.$$

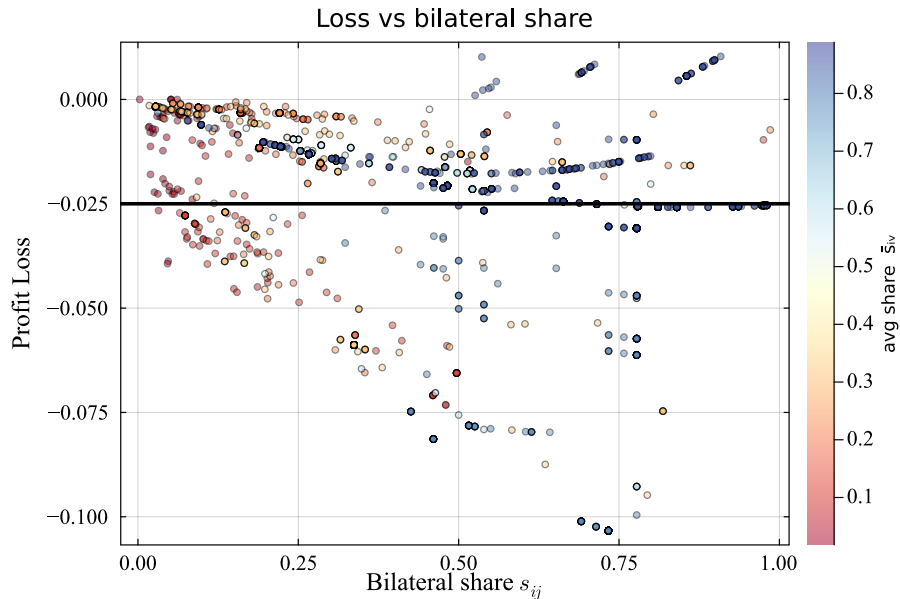
State-dependent adjustment.

$$\Pr(\text{adjust } p_{ij}) = \Pr(\kappa_i \leq L_{ij}), \quad \kappa_i = \kappa : \text{seller's } i \text{ menu-cost}$$

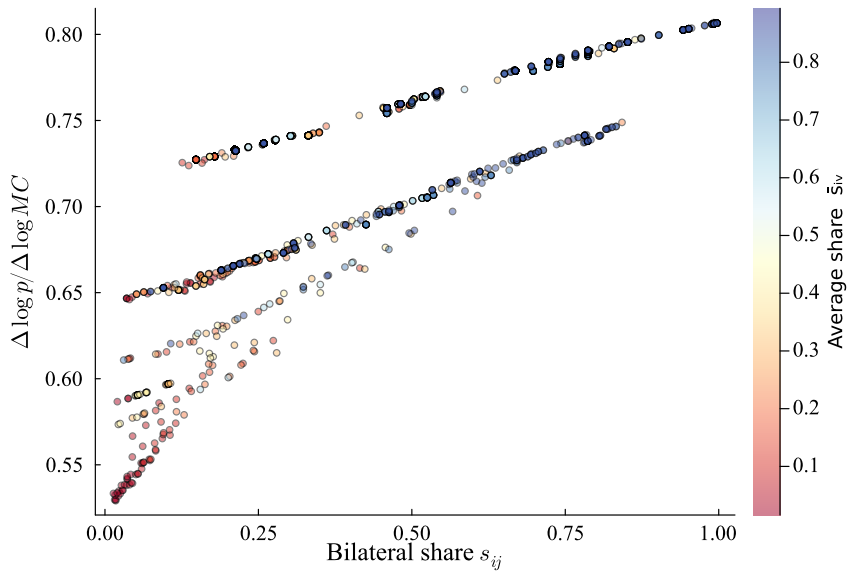
Quantitative Analysis

- **Network** Calibrate n_{ij} (Pareto dist) to match the empirical distribution of $\bar{s}_{iv|j}$ ▶ Match n_{ij}
- **Demand** Discipline Kimball demand $G_j(\cdot)$ with parameters from the lit. ▶ Calibration
- **Shocks** Common cost-shock (oil) that affects supplier's i heterogeneously given different production functions $MC_{i,1} = m_i MC_{i,0}$ where $m_i \sim U(1, 1.2)$
 - Common shock affecting all i equally $\Rightarrow$ full pass-through, Sangani (2026).

Quantitative illustration



Quantitative illustration



Relevance of accounting for ij bilateral market shares?

- A **uniform network**: every active supplier of j receives the same demand shifter:

$$\tilde{n}_{ij} = \begin{cases} \frac{1}{|\mathcal{A}_j|} \sum_{i' \in \mathcal{A}_j} n_{i'j} & \text{if } s_{ij,0} > 0 \\ 0 & \text{otherwise,} \end{cases}$$

$\mathcal{A}_j = \{i : s_{ij,0} > 0\}$ is the active supplier set of buyer j in the baseline equilibrium.

- Total aggregate price: $\mathcal{P} = \left[\frac{1}{J} \sum_{j=1}^J P_j^{1-\sigma} \right]^{1/(1-\sigma)}$ where P_j : Kimball price aggregator

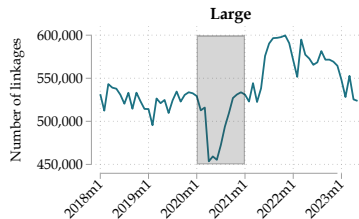
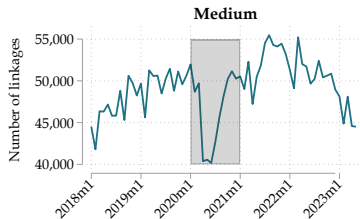
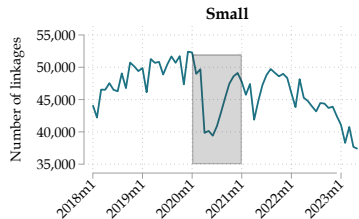
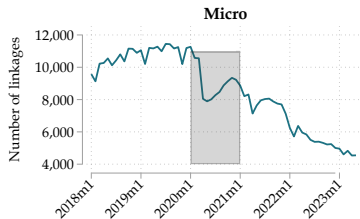
	$\Delta P_{\text{calib}} - \Delta P_{\text{uniform}}$ (pp)		Share adjusting	
	$\sigma = 2$	$\sigma = 5$	calibrated	uniform
<i>Uniform shock $\mathcal{U}[1.0, 1.2]$</i>				
Average across simulations	+0.55	+0.42	32.7	29.2
SE	(0.18)	(0.19)	(0.4)	(1.4)

Conclusions

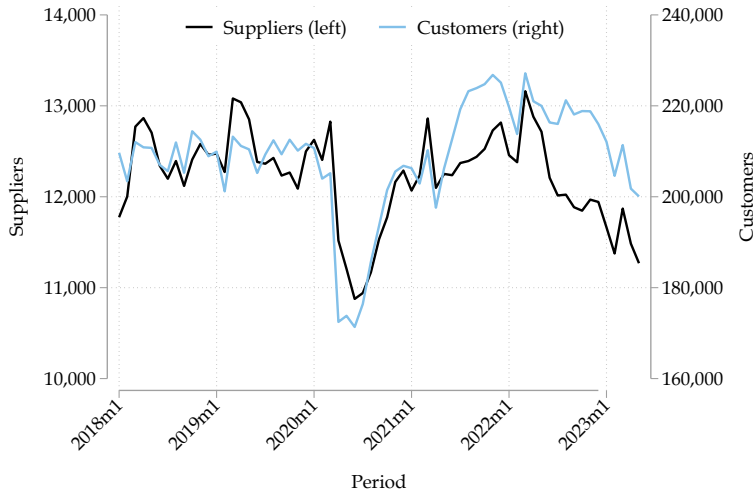
- Evidence that market structure, at the supplier-product-buyer level, is important for price adjustment decisions and pass-through of energy price shocks
 - Largest fraction of price adjustments from seller to buyers are not synchronized
 - Important role of bilateral market have in determining price dynamics.
- Propose a model with heterogeneous pricing behavior across buyers within the same seller.
 - Set up with **common market shares** across buyers, **underestimate** the final effect of cost-push shock of aggregate prices.
 - Despite average prob. of revisions being similar $\Rightarrow$ **accounting for *ijv* heterogeneity relevant for shocks propagation.**

Appendix

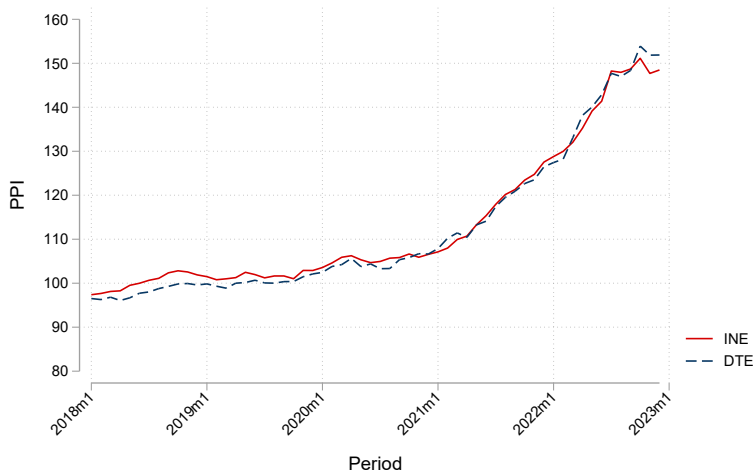
Procyclical linkages and composition changes



Linkages are procyclical



Representativeness of the data (PPI)



Note: The sum of weights is 0.97 of 100, and there are 165 of 173 products

Consistent with Acevedo et al. (2022)

► [Additional validation](#)

Frequency of price adjustment at supplier-buyer level f_{ijv}

	Mean	SD	P10	P25	P50	P75	P90	N
f_i	0.34	0.28	0.05	0.13	0.25	0.50	0.84	15,684
dp_i	0.13	0.19	0.05	0.07	0.10	0.14	0.21	15,684
f_{ijv}	0.33	0.29	0.00	0.10	0.25	0.50	0.77	10,617,338
dp_{ijv}	0.11	0.20	0.03	0.05	0.07	0.12	0.19	8,514,741
$\sigma_{iv}(f_{ijv})$	0.16	0.10	0	0.08	0.16	0.23	0.28	15,684
$\sigma_{iv}(dp_{ijv})$	0.10	0.19	0	0.02	0.06	0.10	0.21	15,684

Note: We obtain f_{ijv} as follows $f_{ijv} = \frac{\sum_{t=1}^{T_{ijv}} \mathbf{1}(\Delta \log P_{ijvt} > 0.005)}{T_{ijv}}$

► Descriptive

► By sector

► Size and subclasses

► Size and customers

► Firms Linkages

► Frequency over time

► Sectoral Heterogeneity

► Sector-to-sector Het

Destruction of links and price-adjustments

- We rely on the destruction of supplier-client relationships that occurred during 2020-2022 as a source of exogenous variation. [► Evidence](#)

- **First Stage:**

$$\Delta s_{ijv} = \alpha_0 + \alpha_1 \Delta Z_{js} + \alpha_2 X_{ijv} + FEs + \epsilon_{ijv}$$

- ΔZ_{js} : change in the total number of suppliers of buyer j for variety v between 2020-2022 and 2018-2019
- **Second Stage:** Used the predicted Δs_{ijv} and estimate:

$$\Delta f_{ijv} = \Delta s_{ijv} + \Delta x_{ijv} + \Delta f_{i,inputs} + f^0 + s_{ijv}^0 + x_{ijv}^0 + FE_j + FE_s + \epsilon_{ijv},$$

- Study if Δs_{ijv} and Δx_{ijv} , **before and after** the pandemic, led to **significant changes** in the frequency of price adjustment from supplier i , variety v , to buyer j

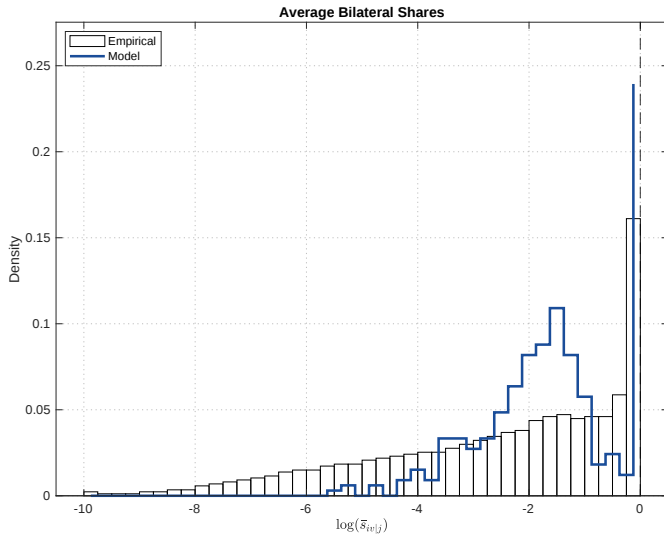
Destruction of links and price-adjustments

► Back

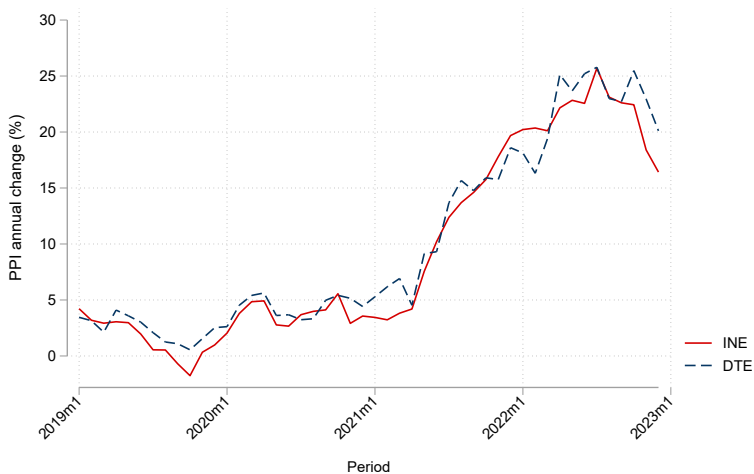
	First Stage	Second Stage		
		(1)	(2)	(3)
	Δs_{ijv}	Δf_{ijv}	Δf_{ijv}^+	Δf_{ijv}^-
ΔZ_{js}	-0.054*** (0.001)			
Δs_{ijv}		0.310*** (0.025)	0.489*** (0.028)	-0.181*** (0.035)
Δx_{ijv}	0.335*** (0.008)	-0.228*** (0.013)	-0.321*** (0.017)	0.073*** (0.020)
$\Delta f_{i,inputs}$	0.006*** (0.001)	-0.125*** (0.003)	-0.011*** (0.003)	-0.234*** (0.005)
f^0	0.008*** (0.000)	-0.744*** (0.001)	-0.456*** (0.002)	-0.485*** (0.002)
s_{ijv}^0	-0.258*** (0.001)	0.052*** (0.007)	0.083*** (0.007)	-0.028*** (0.010)
x_{ijv}^0	0.114*** (0.004)	-0.101*** (0.007)	-0.124*** (0.008)	-0.004 (0.011)
N	1,342,675	1,342,675	863,916	286,024
Adjusted R2	0.216	0.290	-0.041	0.315
F-statistic	9040.5			

Across industries

	Agriculture	Mining	Manufactures	Electricity
f_{ijvt}	0.357 (0.479)	0.222 (0.416)	0.237 (0.425)	0.357 (0.479)
Panel A. Overall price dispersion				
FE_i	0.253 (0.117)	0.367 (0.335)	0.094 (0.079)	0.174 (0.069)
FE_j	0.098 (0.050)	0.080 (0.033)	0.063 (0.043)	0.151 (0.071)
FE_{vt}	0.334 (0.079)	0.288 (0.107)	0.453 (0.123)	0.276 (0.063)
E_{ijvt}	0.394 (0.070)	0.333 (0.195)	0.216 (0.079)	0.400 (0.047)
Panel B. Within seller-product dispersion				
FE_j	0.394 (0.092)	0.333 (0.105)	0.216 (0.148)	0.508 (0.244)
E_{ijvt}	0.606 (0.092)	0.667 (0.105)	0.784 (0.148)	0.508 (0.244)
Obs.	775085	78195	87356832	121724
R^2	0.569	9.672	0.516	0.499

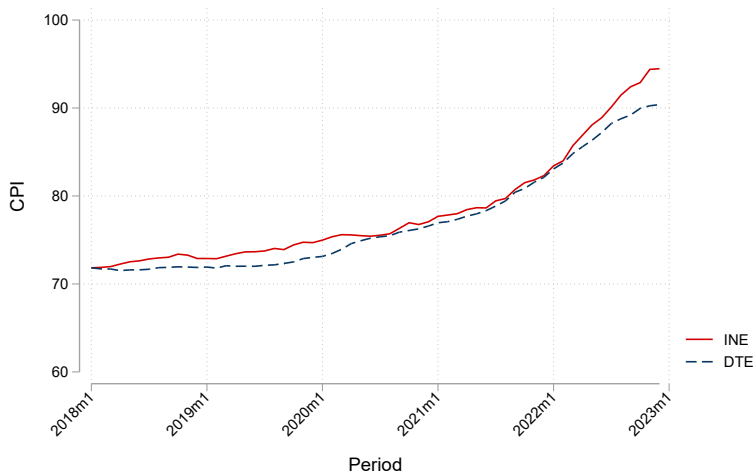


Representativeness of the data (PPI annual change)



Note: The sum of weights is 0.97 of 100, and there are 165 of 173 products

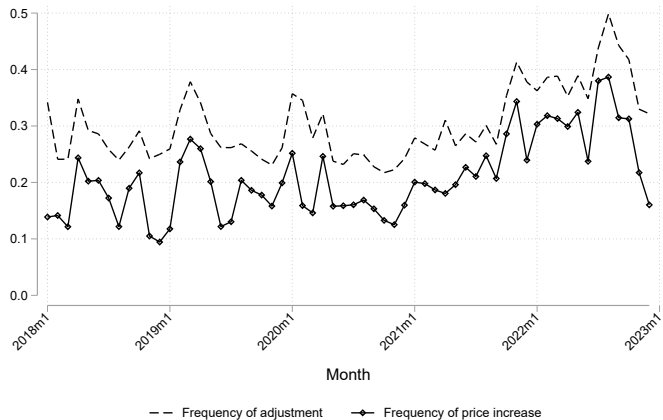
Representativeness of the data (CPI)



Note: The sum of weights is 71.83 of 100, and there are 254 of 303 products

Evolution frequency price change: CPI

[back](#)

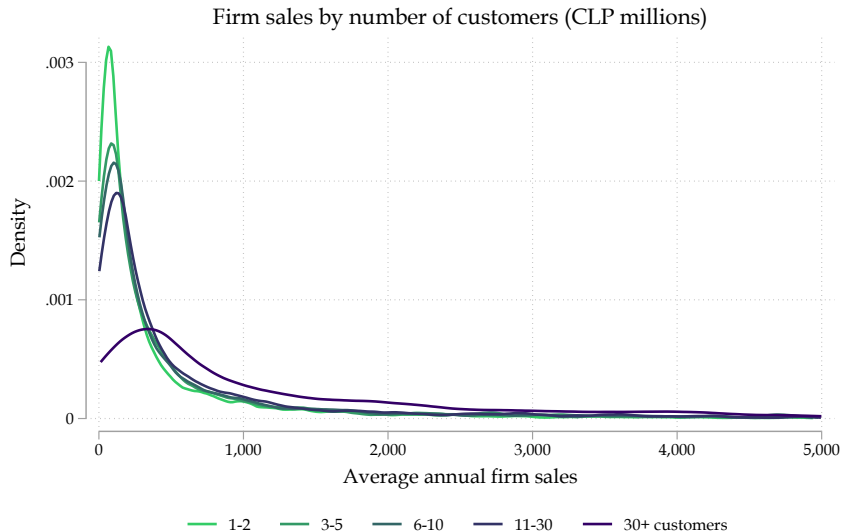


Descriptive statistics: supplier characteristics

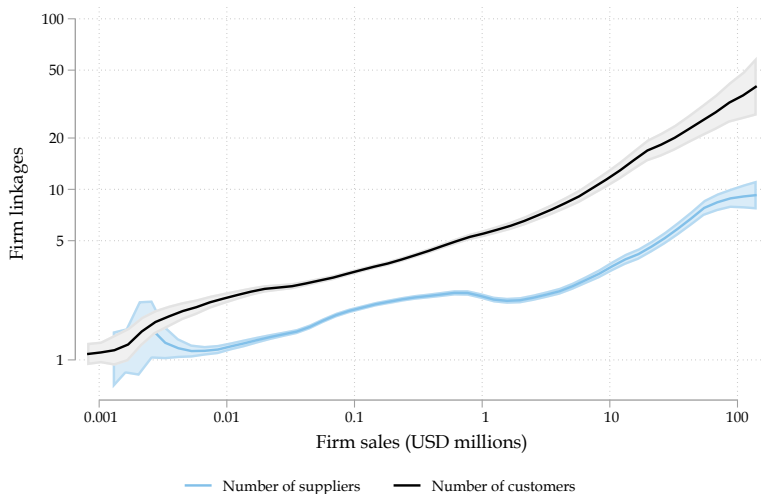
	Mean	Std. Dev.	p10	p25	p50	p75	p90	Obs.
Average sales (CLP millions)	7,050	133,640	35.19	87.13	250.45	882.1	3,657	15,568
Number of customers	45.5	966.7	1.0	1.3	3.3	11.4	35.5	15,568
Number of products sold	2.4	3.2	1.0	1.0	1.3	2.5	4.8	15,568

- We have 15,369 firms and a total of 10,348,986 supplier-client-variety triplets.
- Average annual sales are 6825 million pesos ($\approx$ 7.5 million USD), median sales 244 million pesos (0.21 million USD)

Descriptive statistics: size and downstream customers

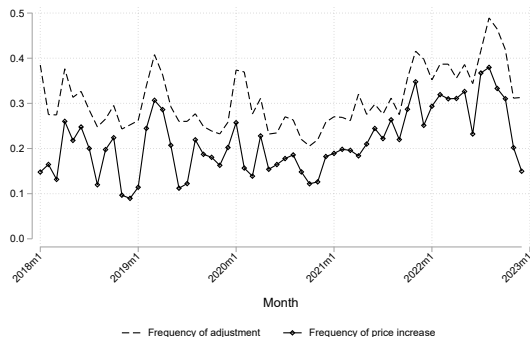
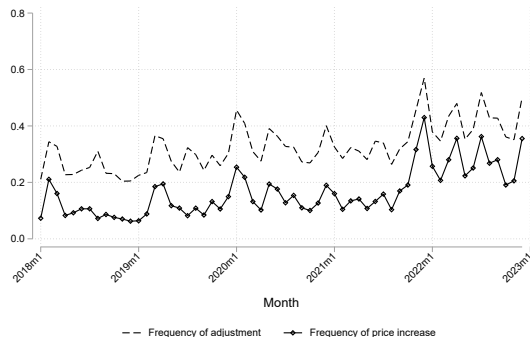


Large firms are more connected: up and downstream



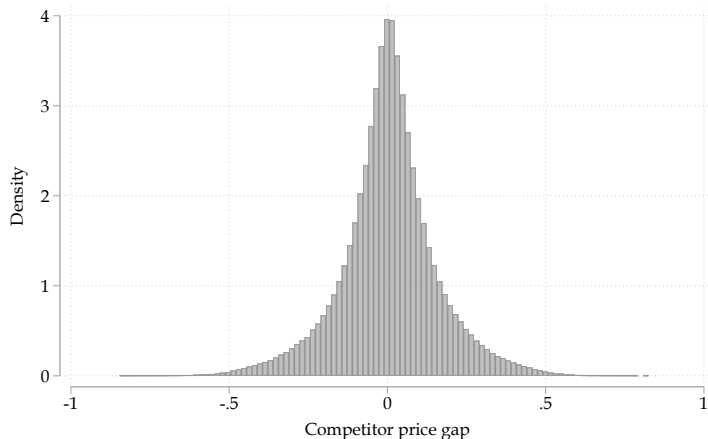
Evolution frequency price change: PPI and CPI frequent transactions

Figure: Frequency of price change (left) and CPI (right) frequent transactions



Competitor-price gap (strategic complementarities)

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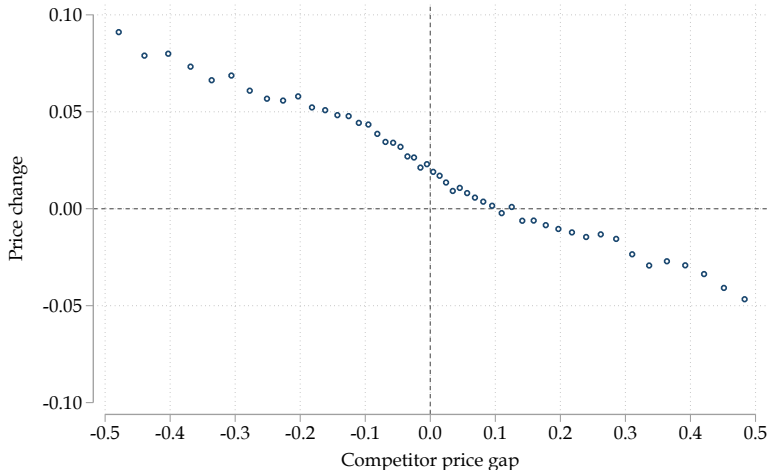


Note: competitor gap truncated at 50 percent

Filteblue of supplier-product and month FE, using OLS (Karadi, Schoenle and Wursten (2022)). Using subclasses (bundling varieties, keeping constant number of varieties)

Magnitude of adjustment as function of competitor price gap

Figure: Magnitude of adjustment ($t+1$) as function of the gap



Note: competitor gap truncated at 50 percent

Fact 1: Synchronization in price adjustment - Magnitudes

Average change	Panel		Cross-Section	
	Mean	Std. Dev.	Mean	Std. Dev.
$\Delta \ln(P) P(K = N = 1)$	0.054	0.330	0.069	0.255
$\Delta \ln(P) P(K = 1 \wedge N > 1)$	0.017	0.131	0.019	0.107
$\Delta \ln(P) P(N > K > 1)$	0.027	0.110	0.032	0.103
$\Delta \ln(P) P(K = N \wedge N > 1)$	0.068	0.225	0.079	0.210

Note: The *Panel* probabilities are at *ivt* level and the *Cross-Section* are at *iv* level.

- When prices are changed simultaneously, the magnitude of revisions tend to increase

Extensive Margin of Price Rigidity - International product bar codes

	(1)	(2)	(3)	(4)
	$\Delta p_{ijvt} > 0$	$\Delta p_{ijvt} > 0$	$\Delta p_{ijvt} < 0$	$\Delta p_{ijvt} < 0$
Price gap (t-1)	-0.103*** (0.003)	-0.102*** (0.003)	-0.002* (0.001)	-0.002* (0.001)
Price Age	0.086*** (0.001)	0.074*** (0.001)	-0.007*** (0.000)	-0.007*** (0.000)
s_{ijpy}		0.009*** (0.003)		0.011*** (0.002)
x_{ijpy}		0.035** (0.016)		-0.011 (0.009)
# Transactions		-0.193*** (0.002)		-0.009*** (0.001)
Duration		0.156*** (0.002)		0.011*** (0.001)
Constant	0.287*** (0.005)	0.287*** (0.006)	0.034*** (0.002)	0.026*** (0.002)
N	656,334	656,334	656,334	656,334
Adjusted R2	0.131	0.152	0.130	0.131
Within R2	0.026	0.048	0.001	0.002

Extensive Margin of Price Rigidity - Variety/Seller FE

	(1)	(2)
	$\Delta P_{ijv} > 0$	$\Delta P_{ijv} < 0$
Price gap (t-1)	-0.030*** (0.000)	-0.006*** (0.000)
Price Age	0.015*** (0.000)	-0.017*** (0.000)
s_{ijvy}	0.024*** (0.000)	0.010*** (0.000)
x_{ijvy}	0.031*** (0.001)	0.022*** (0.001)
# Transactions	-0.128*** (0.000)	-0.017*** (0.000)
Relationship Duration	0.063*** (0.000)	0.013*** (0.000)
Constant	0.292*** (0.000)	0.091*** (0.000)
N	131,440,903	131,440,903
Adjusted R2	0.143	0.129
Within R2	0.026	0.004

Intensive Margin of Price Rigidity - International product bar codes

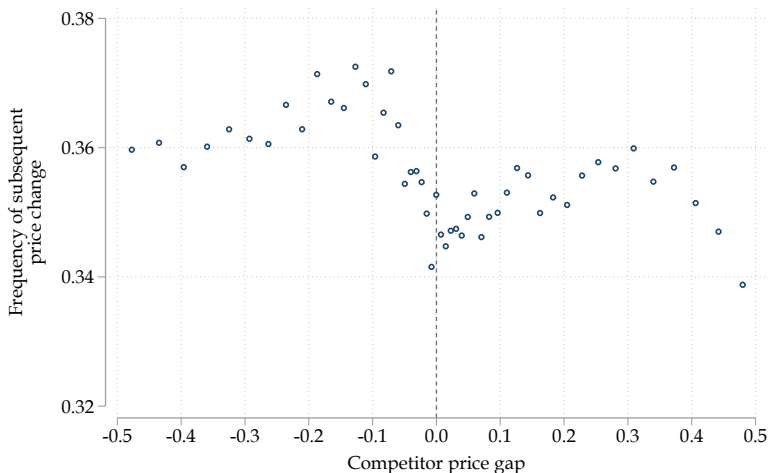
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
	Ln(P)	Ln(P)	$ \Delta p_{ijv} \Delta p_{ijv} \neq 0$	$ \Delta p_{ijv} \Delta p_{ijv} \neq 0$	$ \Delta p_{ijv} \Delta p_{ijv} > 0$	$ \Delta p_{ijv} \Delta p_{ijv} > 0$	$ \Delta p_{ijv} \Delta p_{ijv} < 0$	$ \Delta p_{ijv} \Delta p_{ijv} < 0$
Price gap (t-1)	0.156*** (0.005)	0.155*** (0.005)	0.021*** (0.001)	0.019*** (0.001)	0.022*** (0.001)	0.020*** (0.001)	0.002 (0.005)	0.004 (0.005)
Price Age	-0.018*** (0.001)	-0.026*** (0.001)	0.019*** (0.000)	0.016*** (0.000)	0.018*** (0.000)	0.015*** (0.000)	0.020*** (0.003)	0.016*** (0.003)
S_{ijpy}		0.336*** (0.009)		0.001 (0.002)		0.009*** (0.002)		-0.032*** (0.008)
X_{ijpy}		-0.528*** (0.033)		-0.020*** (0.005)		-0.022*** (0.006)		-0.012 (0.014)
# Transactions		-0.112*** (0.002)		-0.029*** (0.001)		-0.029*** (0.001)		-0.026*** (0.006)
Duration		0.107*** (0.003)		0.019*** (0.001)		0.019*** (0.001)		0.019*** (0.006)
Constant	9.125*** (0.008)	9.035*** (0.009)	0.033*** (0.002)	0.044*** (0.002)	0.032*** (0.002)	0.043*** (0.002)	0.059*** (0.005)	0.072*** (0.010)
N	656,334	656,334	164,333	164,333	149,011	149,011	14,120	14,120
Adjusted R2	0.854	0.856	0.290	0.299	0.341	0.353	0.314	0.317
Within R2	0.004	0.018	0.023	0.037	0.028	0.046	0.007	0.011

Intensive Margin of Price Rigidity - Variety/Seller FE

	(1) Ln(P)	(2) $\Delta \text{Ln}(P) I_{abs}$	(3) $\Delta \text{Ln}(P) I_{pos}$	(4) $\Delta \text{Ln}(P) I_{neg}$
Price gap (t-1)	0.072*** (0.001)	0.006*** (0.001)	0.005*** (0.001)	0.002** (0.001)
Price Age	-0.034*** (0.000)	0.016*** (0.000)	0.016*** (0.000)	0.019*** (0.000)
s_{ijvy}	0.371*** (0.000)	0.000 (0.000)	0.000* (0.000)	-0.002*** (0.000)
x_{ijvy}	-1.619*** (0.003)	-0.026*** (0.002)	-0.032*** (0.002)	-0.011** (0.004)
# Transactions	-0.040*** (0.000)	-0.036*** (0.000)	-0.035*** (0.000)	-0.031*** (0.000)
Relationship Duration	0.010*** (0.000)	0.013*** (0.000)	0.013*** (0.000)	0.010*** (0.000)
Constant	7.631*** (0.001)	0.090*** (0.000)	0.086*** (0.000)	0.103*** (0.001)
N	131,440,903	39,102,893	29,891,351	9,176,831
Adjusted R2	0.763	0.139	0.157	0.248
Within R2	0.014	0.030	0.039	0.017

Frequency of adjustment ($t+1$) as function of competitor price gap

Figure: Magnitude of adjustment as function of the gap



Note: competitor gap truncated at 50 percent

Descriptive statistics (freq. price increases)

Table: Frequency of price increases

	Mean	SD	P10	P25	P50	P75	P90	N
CPI product	0.24	0.21	0.00	0.06	0.20	0.38	0.56	12,947,624
PPI product	0.17	0.17	0.00	0.00	0.13	0.27	0.42	10,007,004
Total	0.21	0.20	0.00	0.00	0.17	0.33	0.50	22,954,628

Descriptive statistics (share of price increases)

Table: Share of price increases

	Mean	SD	P10	P25	P50	P75	P90	N
CPI product	0.72	0.29	0.33	0.50	0.75	1.00	1.00	10,486,557
PPI product	0.83	0.26	0.50	0.67	1.00	1.00	1.00	7,121,443
Total	0.77	0.28	0.40	0.57	0.86	1.00	1.00	17,608,000

Descriptive statistics (supplier characteristics)

	Mean	Std. Dev.	p10	p25	p50	p75	p90	Obs.
Average sales (CLP millions)	3,903	92,937	8	23	92	381	1,714	25,078
Number of customers	24.6	699.6	1.0	1.1	1.8	5.2	17.2	25,078
Number of subclasses sold	1.6	1.9	1.0	1.0	1.0	1.5	2.7	25,078

By sector

We have 25,078 firms and a total of 22,954,628 supplier-client-variety triplets

Descriptive statistics (supplier characteristics by sector)

Table 2: Supplier characteristics by economic sector

	Mean	Std. Dev.	p10	p25	p50	p75	p90	Obs.
1								
Average sales (CLP millions)	951	14,948	7	20	85	335	1,247	7,454
Number of customers	3.1	11.5	1.0	1.0	1.1	2.1	5.1	7,454
Number of subclasses sold	1.3	1.3	1.0	1.0	1.0	1.0	1.8	7,454
2								
Average sales (CLP millions)	95,645	805,937	43	125	372	1,329	5,040	234
Number of customers	5.6	26.5	1.0	1.0	1.4	2.6	6.8	234
Number of subclasses sold	1.2	0.6	1.0	1.0	1.0	1.0	1.6	234
3								
Average sales (CLP millions)	3,926	60,147	8	25	96	402	2,013	16,864
Number of customers	34.9	852.9	1.0	1.3	2.5	7.5	23.9	16,864
Number of subclasses sold	1.8	2.1	1.0	1.0	1.0	1.7	3.1	16,864
4								
Average sales (CLP millions)	4,157	32,407	3	7	25	120	1,164	526
Number of customers	8.7	42.1	1.0	1.2	2.1	5.2	12.9	526
Number of subclasses sold	1.2	0.8	1.0	1.0	1.0	1.0	1.4	526
Total								
Average sales (CLP millions)	3902.6	92937.2	7.6	22.8	92.0	381.4	1714.4	25,078
Number of customers	24.6	699.6	1.0	1.1	1.8	5.2	17.2	25,078
Number of subclasses sold	1.6	1.9	1.0	1.0	1.0	1.5	2.7	25,078

Note: 1 "Agriculture" 2 "Mining" 3 "Manufacture" 4 "Utilities"

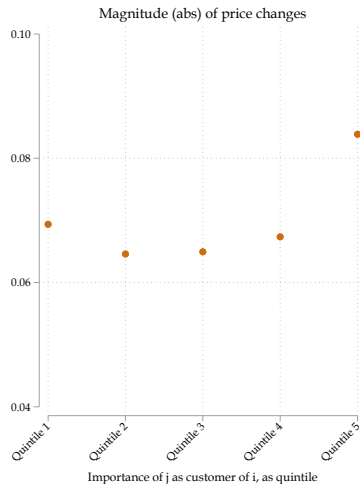
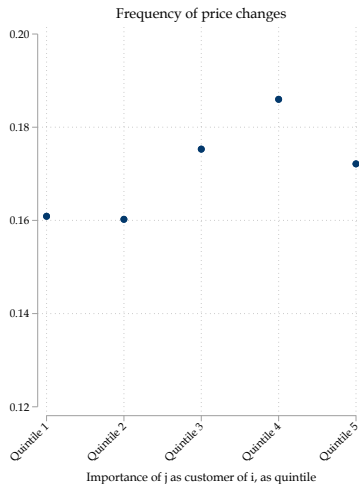
Descriptive statistics (supplier characteristics, subsample)

Table: Supplier characteristics - Subsample

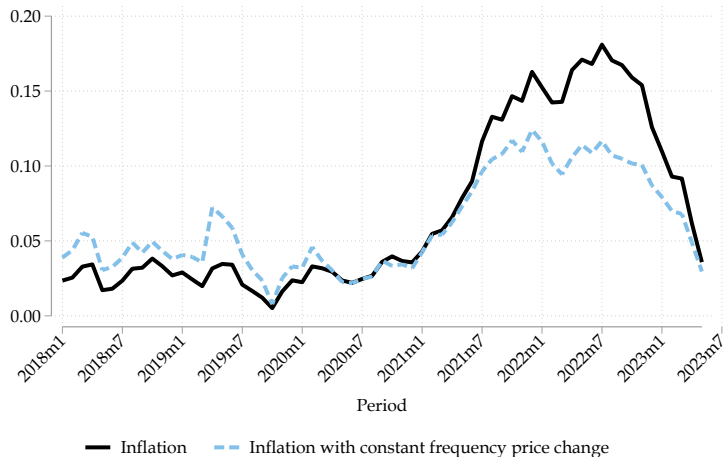
	Mean	Std. Dev.	p10	p25	p50	p75	p90	Obs.
Average sales (CLP millions)	13,134	118,547	24	90	404	2,088	12,585	4,109
Number of customers	123.9	1724.5	1.5	3.1	8.4	25.0	75.1	4,109
Number of subclasses sold	4.3	3.6	2.1	2.4	3.1	4.7	7.7	4,109

Firms selling more than one subclass

Frequency/magnitude price adj. and customer market share product level



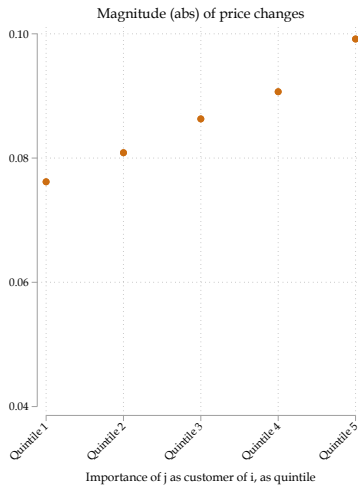
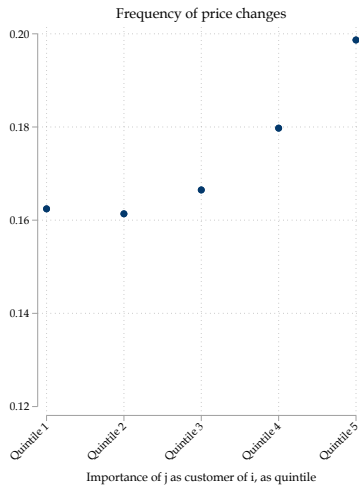
Decomposing inflation: intensive vs extensive margin



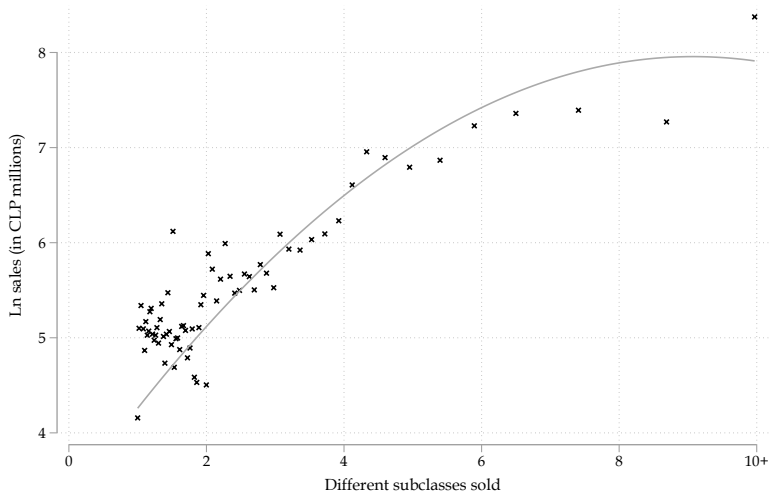
Economy-wide frequency of price adjustment increased during COVID-19

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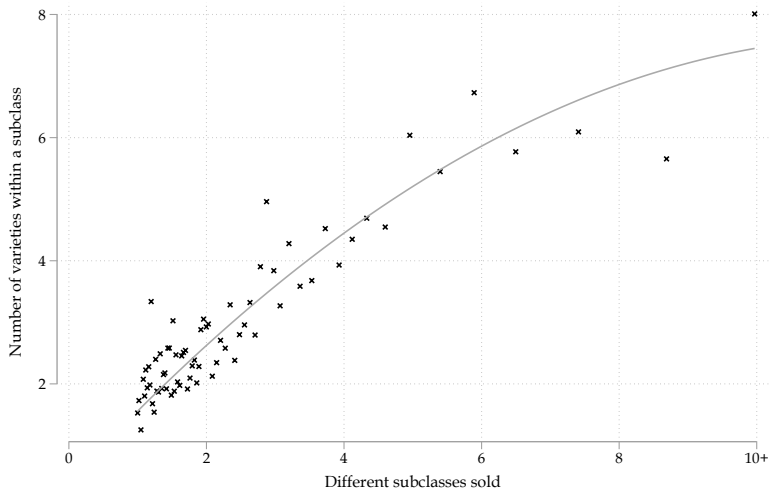
Frequency/magnitude price adj. and customer market share (product truncated)



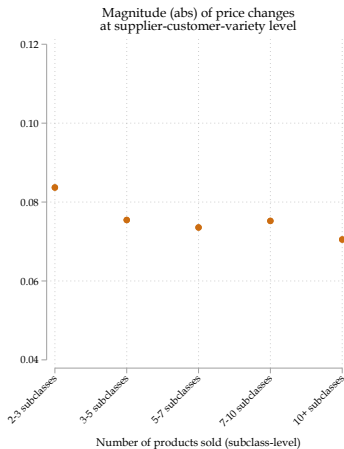
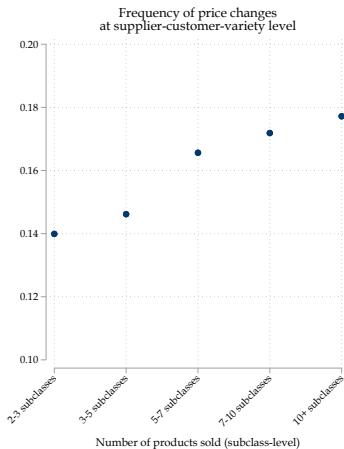
Size and subclasses



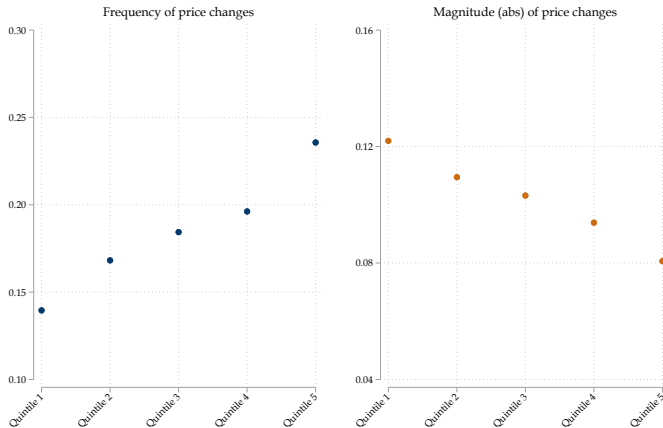
Variety and subclasses



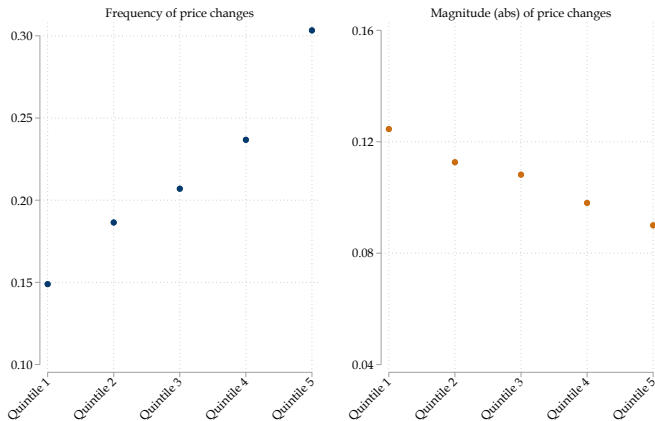
Frequency/magnitude price adj. and # of products sold



Frequency/magnitude price adj. and total sales

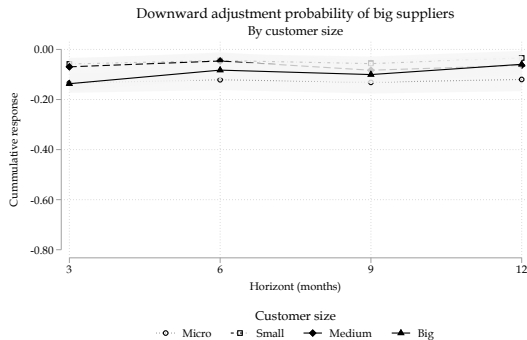
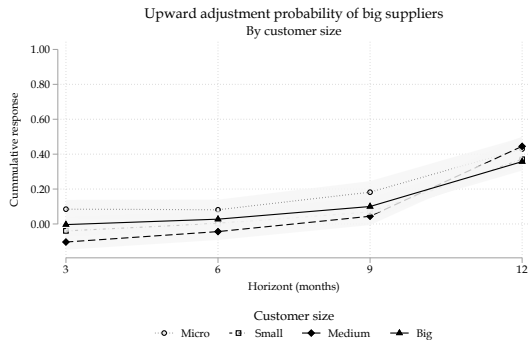


Frequency/magnitude price adj. and sales (one-product firms)

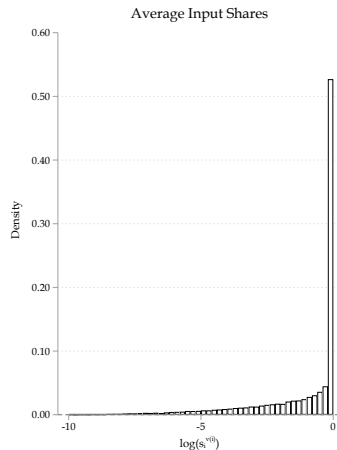
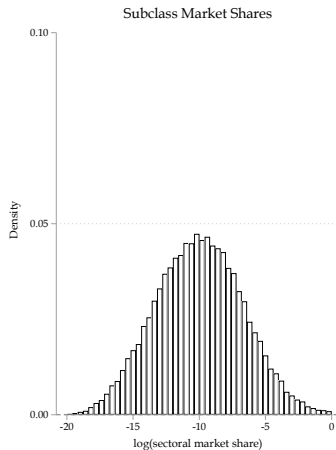


Adjustment probability cond. size

Figure: Heterogeneity in the Extensive of Price Adjustment: Big suppliers and customer size



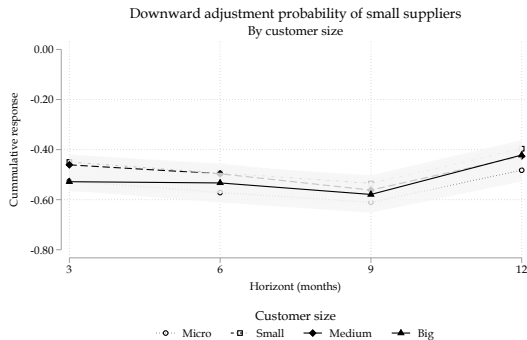
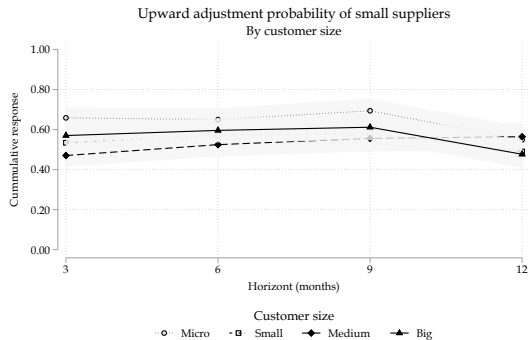
Bilateral market shares



Bargaining power at the supplier-client relationship

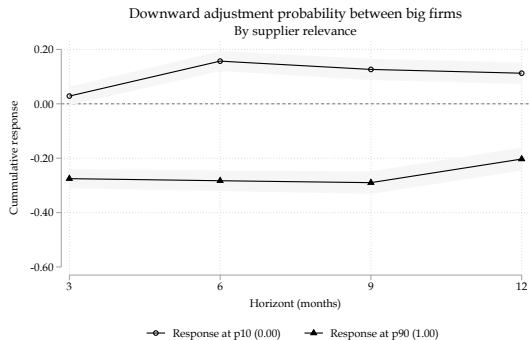
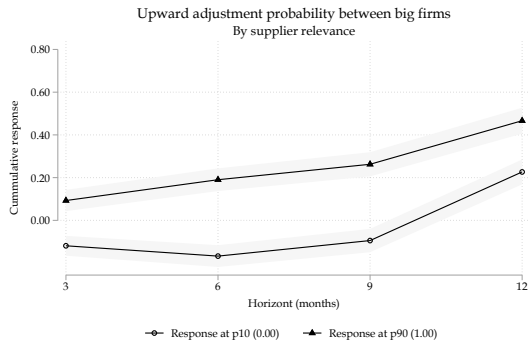
Adjustment probability cond. size

Figure: Heterogeneity in the Extensive of Price Adjustment: Small suppliers and customer size



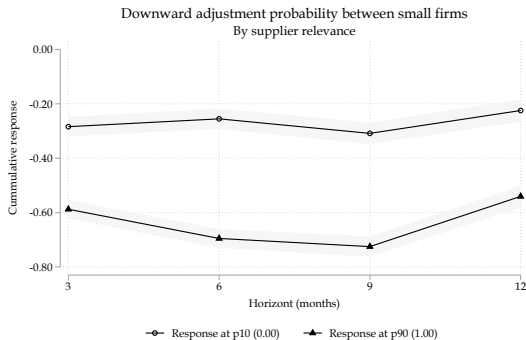
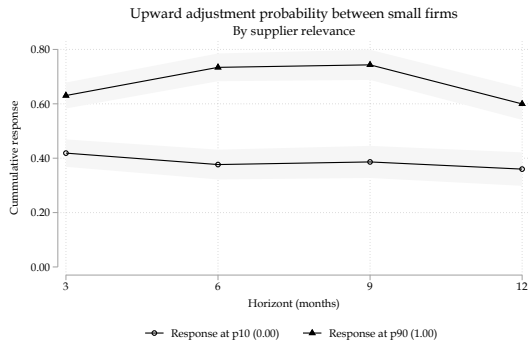
Supplier Relevance between large firms

Figure: Heterogeneity in the Extensive of Price Adjustment: Supplier Relevance between Large Firms

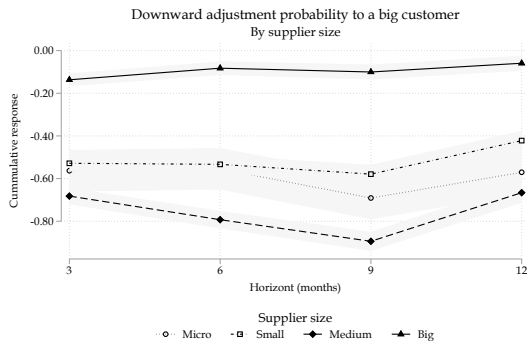
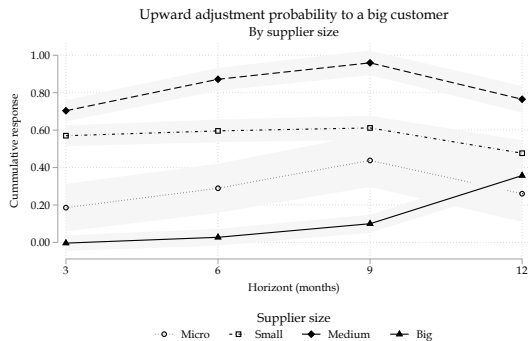


Supplier Relevance between small firms

Figure: Heterogeneity in the Extensive of Price Adjustment: Supplier Relevance between Small Firms



Price adjustment probability: supplier size for big customers

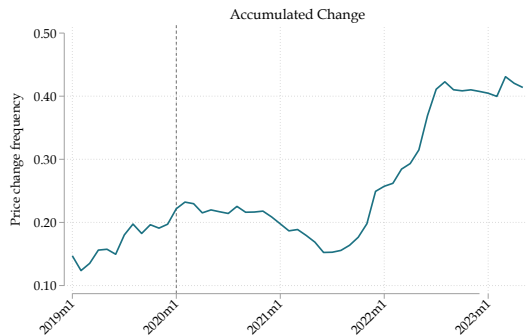
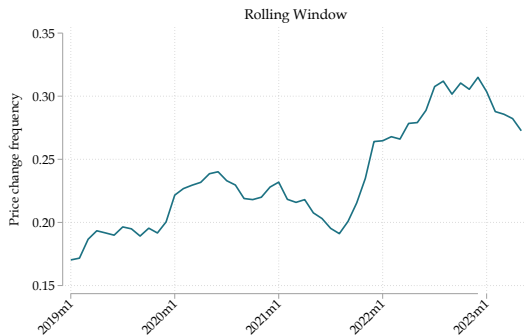


Upward adjustment probability increases in firm size, except for big firms. Mild asymmetry

$Pr(I_{ijv,t+h}^+) > Pr(I_{ijv,t+h}^-)$, except for micro firms.

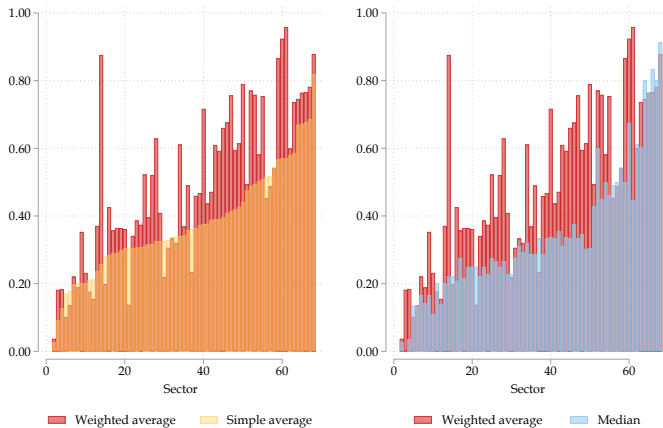
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Frequency price change over time



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Implied sectoral heterogeneity in frequency price change



- Significant price stickiness heterogeneity across sectors
- Consistent with evidence from the US, [\[Nakamura and Steinsson \(2010\)\]](#)

Average pass-through of oil-intensive suppliers

