Vertical control and retail price stability

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Disclaimers:
– The views expressed in this research are those of the authors and do not reflect the position of the Banco de la República or its board of directors.

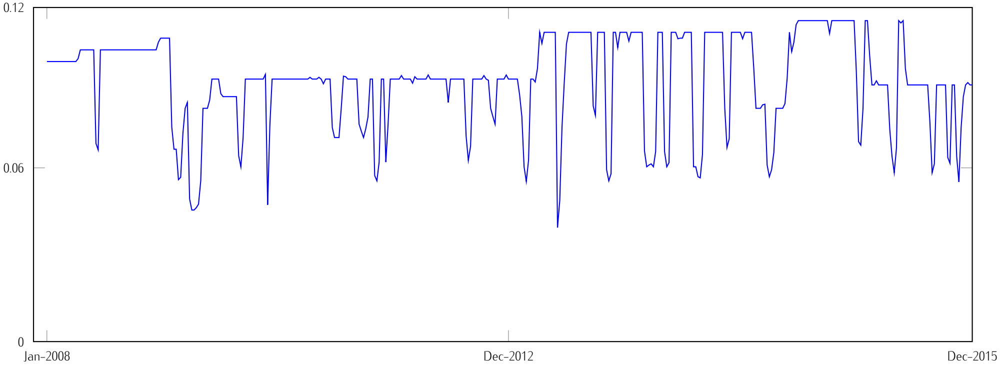
– Researchers' own analyses calculated (or derived) based in part on data from Nielsen Consumer LLC and marketing databases provided through the NielsenIQ Datasets at the Kilts Center for Marketing Data Center at The University of Chicago Booth School of Business.

– The conclusions drawn from the NielsenIQ data are those of the researchers and do not reflect the views of NielsenIQ. NielsenIQ is not responsible for, had no role in, and was not involved in analyzing and preparing the results reported herein.

Motivation

- Nominal retail prices for food and groceries are largely stable.
- Previous literature has extensively documented this phenomenon across a wide range of products.
- Two data aggregation approaches:
  1. **Brand-(retailer) level (aggregate) retail data:** Coffee (Nakamura and Zerom, *REStud*, 2010; Bonnet et al., *REStat*, 2013).
     - Retail prices are significantly less volatile than coffee commodity prices.
  2. **UPC-store level (granular) retail data:** Multiple grocery products (Midrigan, *Ecta*, 2011); Beer (Goldberg and Hellerstein, *REStud*, 2013).
     - Price variability is driven primarily by sales.
     - Non-sale (*regular*) prices remain constant for many weeks.
     - Regular price levels change infrequently.

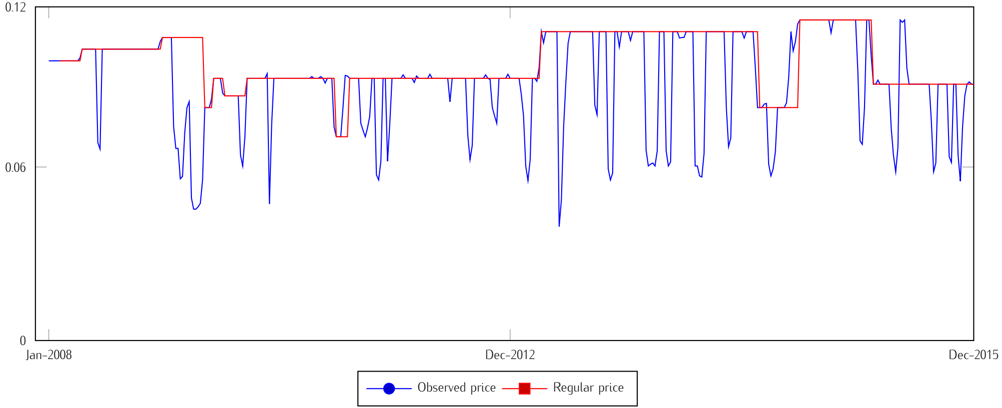
Example: RTE breakfast cereal



Weekly price of a brand of cereals in a specific store of a supermarket chain in California, 2008–2015

Source: NielsenIQ. Authors' own graph.

Example: RTE breakfast cereal



Source: NielsenIQ. Authors' own graph.

Regular price: modal price observed in a given time window (Kehoe and Midrigan, 2008; Midrigan, 2011).

More

Motivation

- Observed retail price stability often contrasts with frequent variation in input prices Inputs
- What explains the observed stability in retail prices?
- Previous empirical literature mainly focuses on two factors:
  - **Market power:** markup adjustment along the vertical chain
    (Nakamura and Zerom, 2010; Bonnet et al., 2013; Goldberg and Hellerstein, 2013; Hong and Li, 2017)
  - **Price adjustment costs**
    (Aguirreagabiria, 1999; Nakamura and Zerom, 2010; Goldberg and Hellerstein, 2013)
- IO theory suggests that vertical control plays a key role:
  - **Wholesale two-part tariffs (TPT)**: Align manufacturer incentives by internalizing rival profits
    (Rey and Vergé, 2010)
  - **Resale price maintenance (RPM)**: Reduces price responsiveness to local shocks in retail costs
    (Jullien and Rey, 2007)

This paper

Research question:
When price adjustment is costly, do vertical control practices introduce additional nominal price rigidity?

Approach

- Estimate demand using U.S. scanner data on RTE cereals.
- Model supply under three alternative vertical conduct assumptions.
- Explicitly account for retail price **adjustment costs** (which include menu costs, managerial costs of setting new prices, price advertising, etc.).
- For each supply conduct:
  - compute bounds on retail price adjustment costs; and
  - quantify both cost pass-through and the frequency of price adjustments resulting from simulated cost shocks.

Main contribution

- Previous literature shows that industry structure, firm conduct, and vertical relationships play a crucial role in explaining retail price stability
  (Bonnet et al., 2013, Hong and Li, 2017, Haucap et al., 2021)
  - **Main common result:** vertical control (either through RPM or vertical integration) leads to higher pass-through of cost shocks, on average, compared to linear pricing.
  - **Mechanism:** vertical control reduces total markups.
  - **Key missing ingredient:** adjustment costs.
    - Retail prices flexibly adjust every period.
    - Markup adjustment is the only mechanism rationalizing observed price stability.
- This evidence is at odds with previous theoretical results.

This paper's main takeaways

Relative to linear pricing, vertical control with costly price adjustment:

- leads to more rigid prices;
- implies both a **lower frequency of price adjustments** and **lower average pass-through**.

Related literature

- **Vertical relationships and pass-through:**
  Bonnet et al. (2013), Goldberg and Hellerstein (2013), Ho and Li (2017), Haucap et al. (2021), Alvarez-Blasser et al. (2025).

- **Sources of incomplete pass-through:**
  Aguirreagabiria, 1999, Slade (1998, 1999), Bettendorf and Verboven (2000), Hellerstein (2008), Hellerstein and Villas-Boas (2010), Nakamura and Zerom (2010), Goldberg and Verboven (2000), Campa and Goldberg (2006), Leibtag et al. (2007), Noton (2016).

- **Menu costs and aggregate price stability:**
  Kehoe and Midrigan (2008), Midrigan (2011).

Data overview

1. *NielsenIQ* database 2008-2015 (U. Chicago Kilts Center for Marketing).
    - Scanner data reported by supermarket chains.
    - UPC level data on sales of ready-to-eat breakfast cereals.
    - On a weekly basis: retail prices, volume sales, product description.

2. Additional data collected from several sources:
    - Brand characteristics: cereal boxes.
    - Cost shifters: US Department of Labor, World Bank, US Department of Agriculture, Nasdaq.

Stats

Preliminary evidence: Incomplete pass-through of costs to retail prices

Explanatory variable	*Dep. var.: log retail price*
Log Earnings of manufacturing employees	**0.302*****
	(0.108)
Log LA area employment cost index	**0.022****
	(0.010)
Log Corn	0.022
	(0.019)
R^2	0.738
Observations	78069

All regressions include a constant and product, county, month of the year, and year fixed effects.
Standard errors clustered at the product level are given in parentheses.
***,**: significant at 1% and 5% levels, respectively.

Demand model: Summary, sample and results

1. **Key components of demand modeling**
   - We use standard discrete-choice methods (BLP, 1995; Nevo, 2001).
   - We allow the coefficients on the constant and price terms to vary with **individual income**.
   - We use input prices and a manufacturer-specific transport cost index to correct for price endogeneity (Miller and Weinberg, 2017).

2. **Estimation subsample:**
   - **3 cereal producers**: Kellogg, General Mills, and Post.
   - **21 cereal brands**: leading UPCs based on 2015 market shares.
   - **2 supermarket chains**: major California-based retailers with no presence in other states.
   - **42 products**: brand–supermarket combinations.
   - **2,502 markets**: week–county combinations.

3. **Estimated elasticities:**
   - Median own-price elasticity: **-2.91**
   - Previous estimates in the literature range from -3.02 (Nevo, *Ecta*, 2001) to -2.29 (Döpper et al., *JPE*, 2025).

Supply: baseline setup

- J differentiated products in the market, indexed by j.
  - **Product:** a supermarket-UPC combination.
- N manufacturers, indexed by f, compete in wholesale prices. Each f:
  - produces a subset $\mathcal{G}_f$ of products;
  - distributes its products through multiple competing retailers; and
  - holds all the bargaining power.
- R retailers, indexed by r, compete in retail prices.
  - Each r carries a subset $\mathcal{B}_r$ of the products in the market.
- Three alternative vertical conduct assumptions:
  - **Linear pricing:** each f charges a per-unit wholesale price for each product, and each r sets its retail prices **unilaterally**.
  - **Linear pricing with RPM:** each manufacturer **sets both** wholesale and retail prices for its products.
  - **Two-part tariffs with RPM:** each f **sets both** wholesale and retail prices for its products and charges a franchise fee.

Price setting: Linear pricing

Manufacturer

Each f sets wholesale prices according to the following program:

$$\max_{w_{jt}} \ \pi_t^f = \sum_{j \in \mathcal{G}_f} (w_{jt} - \mu_{jt}) s_{jt}(\mathbf{p}_t(\mathbf{w}_t))M.$$

Retailer

Each r sets retail prices, taking wholesale prices as given, according to the following program:

$$\max_{p_{jt}} \ \pi_t^r = \sum_{j \in \mathcal{B}_r} (p_{jt} - w_{jt} - c_{jt}) s_{jt}(\mathbf{p}_t)M.$$

where,

w_{jt}: wholesale price of product j at period t.
s_{jt}: market share of product j at t.
p_{jt}: retail price of product j at t.
μ_{jt}: marginal cost of product j at t.
c_{jt}: retail marginal cost of product j at t.
M: Market size.

Price setting: Vertical control via RPM

Manufacturer f:

- Offers contracts consisting of $\{w_{jt}, p_{jt}\}$ to each retailer r.
- If two-part tariffs apply, the contract also specifies F_{jt}.
- Sets prices according to the following program:

$$\max_{w_{jt}, p_{jt}, F_{jt}} \pi_t^f = \underbrace{\sum_{j \in G_f} (w_{jt} - \mu_{jt}) s_{jt}(\mathbf{p}_t) M}_{\text{Variable profit}} + \underbrace{F_{jt}}_{\text{Franchise fee}},$$

$$\text{subject to: } \pi_t^r - F_{jt} \geqslant 0, \text{ for all } r = 1, \ldots, R.$$

where,

w_{jt}: wholesale price of product j at period t.
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M: Market size.

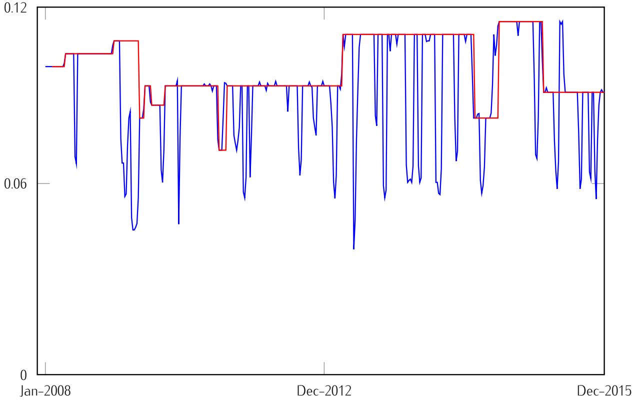
Key differences across conduct models

	Markup		Internalization of price effects	
	Retailer	Manufacturer	Retailer	Manufacturer
Linear tariffs	Positive	Positive	Own brands	Own brands
LT–RPM	Positive	Zero	—	All brands
TPT–RPM	Zero	Positive	—	All brands

Price setting: Limitations of a static model

In our data, we observe that:

- Prices do not change every period.
- Instead, for each product we observe one of two outcomes:
  - its price differs from the previous period; or
  - its price remains constant.
- A standard static model:
  - Assumes that prices always flexibly adjust to demand and/or cost shocks.
  - Is thus insufficient to account for the observed price pattern.
- **Our solution:** We assume that retailers incur price **adjustment costs**.



Weekly prices of a brand of cereals in a supermarket in California

Source: NielsenIQ. Authors' own graph.

Price setting: The role of adjustment costs

In the presence of adjustment costs:

- In each period t, the retail price setter compares the extra profit from changing the price with the adjustment cost.
    - **Case 1:** If the extra profit exceeds the adjustment cost, the firm sets a new price in period t according to the corresponding profit-maximization program and incurs a positive cost.
    - **Case 2:** Otherwise, the firm keeps the previous period's price and incurs no adjustment cost.

- **Case 2 implies that:**
    - The firm deviates from the standard static first-order conditions.
    - Margins and marginal costs are not identified in these periods.
        - We recover these using periods with price changes only.
        - We then estimate the full vector of marginal costs via an auxiliary OLS regression.

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To back out bounds on adjustment costs, we follow a data-driven **revealed-preference approach** (Goldberg and Hellerstein, 2013):

- Whenever we observe $p_{jt} \neq p_{jt-1}$, we interpret this as **Case 1**.
- Whenever we observe $p_{jt} = p_{jt-1}$, we interpret this as **Case 2**.

Upper bound on Adjustment costs from Case 1

Let $h \in \{r, f\}$.

h is willing to change the price of product j at t if:

$$\underbrace{\pi_t^h(p_{jt}, \mathbf{p}_{-jt})}_{h\text{'s actual profit at } t} - \underbrace{A_{jt}}_{\text{adjustment cost}} \geq \underbrace{\pi_t^{hc}(p_{jt-1}, \mathbf{p}_{-jt})}_{h\text{'s counterfactual profit at } t}.$$

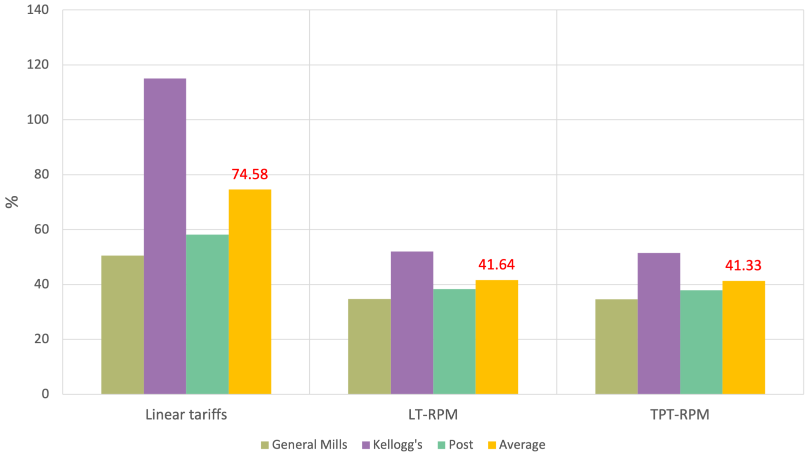
Rearranging terms, an **upper bound** on adjustment costs can be computed as:

$$A_{jt} \leq \overline{A_{jt}} = \pi_t^h(p_{jt}, \mathbf{p}_{-jt}) - \pi_t^{hc}(p_{jt-1}, \mathbf{p}_{-jt}).$$

The new price is the solution to the corresponding static profit maximization problem.

Lower bound

Results: Implied industry markups



Source: NielsenIQ. Authors' own calculations.

For reference: Nevo (2001) estimates of RTE cereal industry markups lie between 38.5% and 42.2%.

Results: Adjustment cost upper bounds for selected brands

Note: Averages across retailers and markets.

Counterfactuals

To assess the role of vertical control in pass-through:

- We simulate a 10% increase in total retail marginal costs.
  - These include the wholesale price and distribution costs.
  - We conduct this exercise for each of our three alternative marginal-cost estimates, obtained under different vertical-conduct assumptions.

- We conduct two sets of counterfactual experiments:
  1. **Common cost shock:** Both retailers experience the shock.
  2. **Individual-specific cost shock:** Only one retailer experiences the shock.

- In each counterfactual, we compute pass-through elasticities under two repricing scenarios:
  A. **Free repricing:** Retailers adjust prices every period.
  B. **Costly repricing:** Retailers adjust prices only when the additional profit exceeds the estimated adjustment costs.

  *Here, we use our estimated **upper bounds** on adjustment costs.*

Main results

	No adjustment costs	Adjustment costs
Pass-through elasticity		
Linear pricing	46.6%	10%
Vertical control (RPM)	31.9%	4.7%
Price-change frequency		
Linear pricing	100%	33.1%
Vertical control (RPM)	100%	30.0%

For reference:

- Reduced-form pass-through elasticity estimates range from 2.2% to 30.2%.
- The average frequency of regular price changes is 15%.

Summary and Conclusion

- This paper examines the role of vertical control through RPM on retail price stability when there are price adjustment frictions.

- **Main results:**
  Relative to linear pricing, vertical control with costly price adjustment:
  - leads to more rigid prices;
  - implies both a **lower frequency of price adjustments** and **lower average pass-through**.
    This is consistent with theory (Jullien and Rey, *RAND*, 2007).

Comments:

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Thank you!

Price stickiness: central concern for Macroeconomics

- Monetary policy is less effective in real terms the more responsive prices are to shocks.
- In standard New Keynesian models: the degree of stickiness in individual goods prices determines the degree of aggregate price inertia.
- Even small **menu costs** may be sufficient to generate substantial aggregate nominal rigidities. (Akerlof & Yellen, 1985; Mankiw, 1985; Parkin, 1986; Blanchard & Kiyotaki, 1987).
- There are **regular** prices and **temporary** prices (Kehoe and Midrigan, 2012).
- Variation in regular prices ultimately determines how responsive aggregate prices are to monetary policy.

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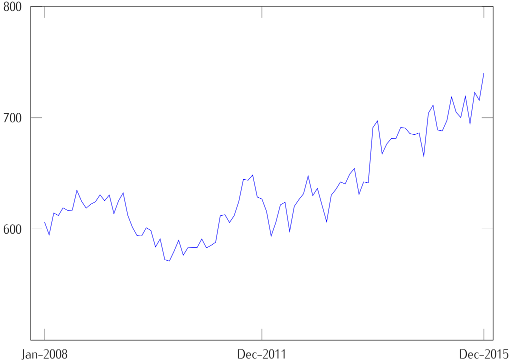
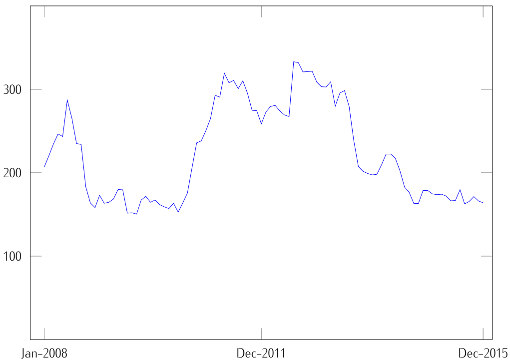
Input prices are less stable than retail prices



Average weekly earnings of production workers in non-durable manufacturing

Source: Bureau of Labour Statistics. Authors' own graph.



Monthly international corn and wheat prices

Source: The World Bank. Authors' own graph.

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Summary statistics of prices

Variable	Mean	Median	SD	Min	Max
Observed retail prices					
Cents/serving	24.62	24.42	5.83	5.27	45.29
Dummy for price change (=1 if yes)	**0.56**	1	0.50	0	1
Duration of a given price (No. of weeks)	**7.27**	5	5.94	1	37
Regular prices					
Cents/serving	26.18	25.52	5.76	9.41	42.22
Dummy for price change (=1 if yes)	**0.15**	0	0.36	0	1
Duration of a given price (No. of weeks)	**40.35**	29	31.18	1	145

Source: NielsenIQ. Authors' own calculations.

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Two-part tariffs with RPM: Model setup

- Each manufacturer f proposes take-it-or-leave-it contracts to the retailer that specifies a wholesale price and a franchise fee for each product j.
- Contracts include also a retail price whenever RPM is used.
- Each retailer announces which contracts it is willing to accept. These are public information.
- If the retailer accepts all contracts, they are implemented by manufacturers.
- If one offer is rejected, all firms earn zero profits and the game ends.

Two-part tariffs with RPM: static price setting

Retailer r's profit function is given by:

$$\Pi_t^r = \sum_{j \in \mathcal{B}_r} \left[(p_{jt} - w_{jt} - c_{jt}) s_{jt}(\mathbf{p}_t) M - F_{jt} - \mathbb{1}_{\{p_{jt} \neq p_{jt-1}\}} A_{jt} \right],$$

where:

F_{jt} : is product j's franchise fee at period t.

Two-part tariffs with RPM: static price setting

Each manufacturer offers a contract $\{p_{jt}, w_{jt}, F_{jt}\}$ to each retailer r. Prices are set by maximizing:

$$\Pi_t^f = \sum_{k \in G_f} \left[(w_{kt} - \mu_{kt}) s_{kt}(\mathbf{p}_t) M + F_{kt} \right],$$

subject to retailers' participation constraints:

$$\Pi_t^r \geqslant \overline{\Pi}_t^r, \text{ for all } r = 1, \ldots, R.$$

Solving for F_{jt} and plugging it in each manufacturer's profit function, yields:

$$\begin{aligned}\Pi_t^f = &\sum_{k \in G_f} (p_{kt} - \mu_{kt} - c_{kt}) s_{kt}(\mathbf{p}_t) M + \sum_{k \notin G_f} (p_{kt} - w_{kt} - c_{kt}) s_{kt}(\mathbf{p}_t) M - \sum_{k \notin G_f} F_{kt} \\ &- \sum_{k \in G_f} \mathbb{1}_{\{p_{kt} \neq p_{kt-1}\}} A_{kt} - \sum_{k \notin G_f} \mathbb{1}_{\{p_{kt} \neq p_{kt-1}\}} A_{kt}.\end{aligned}$$

Key differences across conduct models

- Linear tariffs:
  - Leads to the double marginalization problem—Too high margins.
  - Upstream firms only internalize own-brand price effects.

- Vertical control via RPM:
  - Linear tariffs:
    - The manufacturer sets wholesale prices equal to retail margins and extracts all the rents.
    - The manufacturer internalizes rival brand price effects through their optimal wholesale price.
    - Wholesale markups are maximum (equal to monopolist markups).

  - Two-part tariffs:
    - Manufacturers internalize through fixed fees the impact on the retailer's profit (Rey and Vergé, 2010).
    - *Multiple equilibria:* For any wholesale price, manufacturers can always extract full rents through fixed fees.
    - We focus on a specific equilibrium with **zero** wholesale markups.

  - *RPM helps eliminate both intra- and inter-brand competition.*

Case 1: details

Example: Two-part tariffs with RPM

1. Actual variable profits:

$$\begin{aligned}\pi_t^f(p_{jt}, \mathbf{p}_{-jt}) =& (p_{jt} - \mu_{jt} - c_{jt}) s_{jt}(\mathbf{p}_t) M \\ &+ \sum_{k \in G_f} (p_{kt} - \mu_{kt} - c_{kt}) s_{kt}(\mathbf{p}_t) M \\ &+ \sum_{k \notin G_f} (p_{kt}^* - w_{kt}^* - c_{kt}) s_{kt}(\mathbf{p}_t) M.\end{aligned}$$

2. Counterfactual variable profits:

$$\begin{aligned}\pi_t^f(p_{jt-1}, \mathbf{p}_{-jt}) =& (p_{jt-1} - \mu_{jt} - c_{jt}) s_{jt}^c(p_{jt-1}, \mathbf{p}_{-jt}) M \\ &+ \sum_{k \in G_f} (p_{kt} - \mu_{kt} - c_{kt}) s_{kt}^c(p_{jt-1}, \mathbf{p}_{-jt}) M \\ &+ \sum_{k \notin G_f} (p_{kt}^* - w_{kt}^* - c_{kt}) s_{kt}^c(p_{jt-1}, \mathbf{p}_{-jt}) M.\end{aligned}$$

Lower bound on Adjustment costs from Case 2

Let $h \in \{r, f\}$.

h is willing to leave the price f product j constant at t if:

$$\underbrace{\pi_t^h(p_{jt-1}, \mathbf{p}_{-jt})}_{h\text{'s actual profit at } t} \quad \geq \quad \underbrace{\pi_t^{hc}(p_{jt}^c, \mathbf{p}_{-jt})}_{h\text{'s counterfactual profit at } t} \quad - \quad \underbrace{A_{jt}}_{\text{adjustment cost}}.$$

Rearranging terms, a **lower bound** on adjustment costs can be computed as:

$$A_{jt} \geq \underline{A_{jt}} = \pi_t^{hc}(p_{jt}^c, \mathbf{p}_{-jt}) - \pi_t^h(p_{jt-1}, \mathbf{p}_{-jt}).$$

The counterfactual price is the solution to the static profit maximization problem.

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Case 2: details

Example: Two-part tariffs with RPM

1. Actual variable profits:

$$\begin{aligned}\pi_t^f(p_{jt-1}, \mathbf{p}_{-jt}) =& (p_{jt-1} - \mu_{jt} - c_{jt}) s_{jt}(p_{jt-1}, \mathbf{p}_{-jt}) M \\ &+ \sum_{k \in G_f} (p_{kt} - \mu_{kt} - c_{kt}) s_{kt}(p_{jt-1}, \mathbf{p}_{-jt}) M \\ &+ \sum_{k \notin G_f} (p^*_{kt} - w^*_{kt} - c_{kt}) s_{kt}(\mathbf{p}_t) M.\end{aligned}$$

2. Counterfactual variable profits:

$$\begin{aligned}\pi_t^f(p^c_{jt}, \mathbf{p}_{-jt}) =& (p^c_{jt} - \mu_{jt} - c_{jt}) s^c_{jt}(p^c_{jt}, \mathbf{p}_{-jt}) M \\ &+ \sum_{k \in G_f} (p_{kt} - \mu_{kt} - c_{kt}) s^c_{kt}(p^c_{jt}, \mathbf{p}_{-jt}) M \\ &+ \sum_{k \notin G_f} (p^*_{kt} - w^*_{kt} - c_{kt}) s^c_{kt}(p^c_{jt}, \mathbf{p}_{-jt}) M.\end{aligned}$$