# Distribution Channel and Vertical Bargaining

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# Delivery Structure is Strategically Evolving

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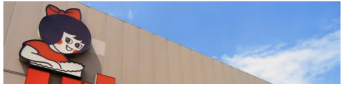
News

## Utz Brands expands direct store delivery network in Florida deal

The deal adds another 65 routes to Utz's existing DSD routes in the US state.

Henry Mathieu August 13, 2024

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## Nestlé to exit direct store delivery for frozen pizza and ice cream, cutting thousands of jobs

Published May 8, 2019

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## Kroger Streamlines, Modernizes Direct Store Delivery Systems

Partnership with Itasca Retail to focus on automating receiving solutions

Emily Crowe 6/15/2022

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## International Wholesale Supply Acquires Direct Store Delivery Division of Mid-America Distribution

PRESS RELEASE - AUG 1, 2025

*Strategic acquisition expands IWS's Midwest footprint and strengthens its service to Travel Center, Grocery, and Convenience Store markets*

# Background

- Distribution channel design is a core operational decision: who controls replenishment to the shelf — supplier or retailer?
- Stockouts cost U.S. retailers $82B annually; COVID exposed grocery supply chains as fragile (USDA-AFRI Food Supply Chain Resilience Project)
- Service quality is a competitive margin in retail (Cachon & Fisher, MNSC 2000; Matsa, QJE 2011)
- Vertical bargaining models typically negotiate over prices alone, treating service as exogenous (Draganska, Klapper, Villas-Boas, MkSci 2010)
- We model joint bargaining over wholesale prices *and* fill-rates
  - Fill-rate = cases delivered / cases ordered
- Key insight: operational control $\neq$ bargaining power

# The Puzzle: Distribution Asymmetry in Retailing

| Direct Store Delivery (DSD) | Distribution Center (DC) |
|---|---|
| Supplier controls replenishment | Retailer controls inventory |
| Own trucks restock shelves | Warehouse consolidation |
| Higher service costs | Economies of scale |
| Coca-Cola, Frito-Lay model | Walmart, Kroger model |

**The Fundamental Trade-off:**

- **DSD:** Superior service quality (fewer stockouts) but higher logistics costs—who pays?
- **DC:** Cost control and coordination but weaker service performance—who suffers?
- **Critical question:** How does this operational choice affect pricing, bargaining power, and surplus division?

# Research Agenda

Study how distribution channel (DC vs. DSD) shapes pricing and bargaining outcomes.

Key questions:

- How does distribution asymmetry affect retail and wholesale prices via fill-rates?
- How does it shift bargaining power and profit allocation in retailer–supplier dyads?
- Do investments in logistics efficiency create more value for the supply chain than shifts in bargaining power?

▸ Contributions & Related Literature

# Preview of Results

- **Service quality rivals price competition**
  - Fill-rate elasticity $\approx 2.39$ vs. price elasticity $\approx -3.75$
- **Operational control $\neq$ bargaining power**
  - Retailers have *higher* power when suppliers control logistics ($\lambda = 0.579$ vs. $0.552$)
- **Improved service level expands the surplus, bargaining re-slices it**
  - Raising DC fill-rates to DSD levels: +13% channel profit, shared by both sides
  - Bargaining power shifts: no new surplus created (purely zero-sum transfers)

# Contributions & Literature

▸ Research Agenda

**1. Channel Coordination** (Desai et al. 2004; Cui et al. 2007; Inderst & Shaffer 2019; Lim et al. 2022)

*Gap:* Prior work abstracts from how replenishment affects demand via stock availability

*We:* Link delivery structure $\rightarrow$ fill-rates $\rightarrow$ demand $\rightarrow$ price competition

**2. Vertical Relationships** (Desiraju & Moorthy 1997; Villas-Boas 2007; Draganska et al. 2010; Abhishek et al. 2016)

*Gap:* Service quality treated as exogenous; wholesale price is sole negotiation object

*Our contribution:*

- Endogenize service performance as contractible margin jointly determined with wholesale prices
- Bargaining power depends on *who controls replenishment and bears operational risk*

**3. Supply Chain Strategy** (Wan 2022; Clark, Horstmann & Houde 2024)

*Gap:* Channel choice viewed as operational, not strategic

*Our findings:* Operations expands surplus (+13%); bargaining shifts merely redistributes it ($0 new value)

# Roadmap of Talk

Data

Model & Estimation

Model Results

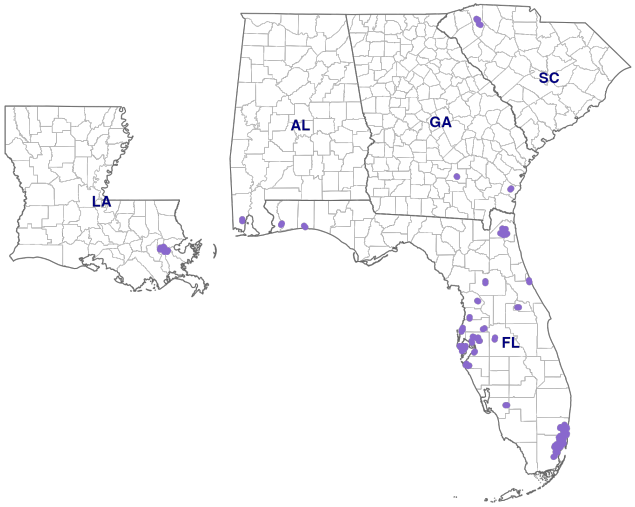
Conclusion

# Data — Summary Statistics (April 2020 – March 2021)

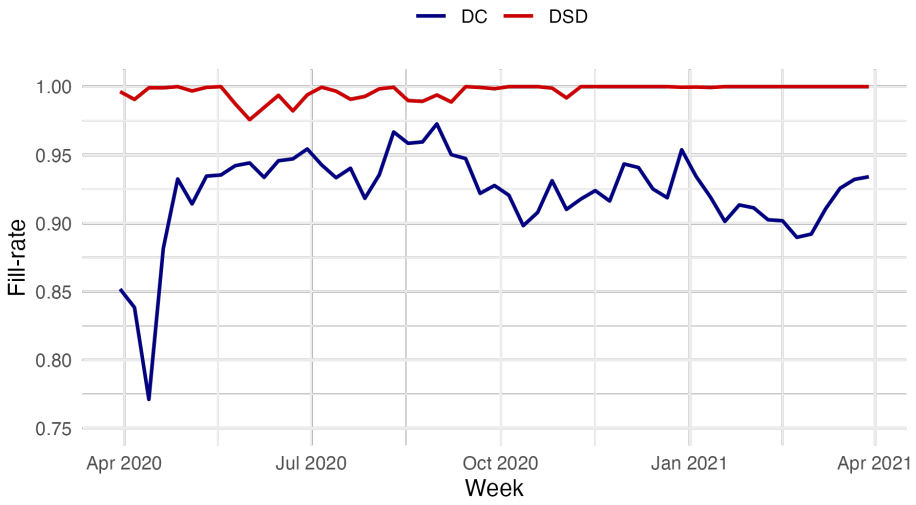
| Variables | Unit | Source | Mean | St. Dev. |
|---|---|---|---|---|
| **Store–Brand–Week Variables (DecaData): Milk Category** | | | | |
| Wholesale Cost | $ per lb | DecaData | 0.814 | 0.42 |
| Retail Price | $ per lb | DecaData | 1.11 | 0.55 |
| Cases Received | # | DecaData | 10.4 | 36.4 |
| Ordered Cases | # | DecaData | 11.5 | 38.0 |
| Replenishment Frequency | Deliveries/week | DecaData | 0.880 | 0.103 |
| Store Fill-Rate | Fraction | DecaData | 0.923 | 0.163 |
| Competitor Fill-Rate | Fraction | DecaData | 0.932 | 0.851 |
| **Market-Level Variables (ZIP-code Aggregated):** | | | | |
| Competing Stores | # | DecaData | 2.29 | 0.672 |
| Retailers in Market | # | DecaData | 1.37 | 0.528 |
| Brands in Market | # | DecaData | 25.0 | 1.48 |
| Suppliers in Market | # | DecaData | 16.3 | 1.55 |
| Median Household Size | Persons | Census | 2.51 | 0.323 |
| Median Age | Years | Census | 42.5 | 5.39 |
| Median Household Income | $ | Census | 67,133 | 14,298 |
| Median Home Value | $ | Census | 168,531 | 56,075 |

▸ Replenishment Frequency ▸ Reduced-form Analysis ▸ Retail Price ∼ Fill-rate Relationship ▸ Wholesale Price ∼ Fill-rate Relationship

# Data — Hyperlocal competition across 51 markets



# Data — Service quality diverges sharply by channel



# Roadmap of Talk

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# Structural Model: Roadmap

- **Goal:** Quantify how distribution asymmetry (DC vs. DSD) affects bargaining power and the division of channel surplus.
- Step 1: Estimate spatial nested logit demand exploiting variation in prices and market attributes (Ellickson, Grieco, and Khvastunov, RAND 2020)
- Step 2: Recover retail marginal costs by estimating Bertrand–Nash pricing competition among stores.
- Step 3: Estimate Nash-in-Nash bargaining over prices and fill-rates; recover DC and DSD bargaining weights (Draganska, et al. Mkt Sci 2010; Lim et al., MSOM 2022)
- Step 4: Evaluate counterfactuals: (i) raise DC fill-rates to DSD levels, (ii) shift bargaining power

# Steps 1 and 2: Consumer Demand and Retailer Pricing

- **Step 1 — Demand.** Household $h$ chooses brand $b$ at store $s$ in market $m$:

$$u^h_{bsm} = \underbrace{\gamma_0 x_{bs} + \gamma_1 (x_{bs} \otimes z_m)}_{\text{price, variety, fill rate}} + \underbrace{\tau_0 d_{sm} + \tau_1 (d_{sm} \otimes z_m)}_{\text{store isolation}} + \varepsilon^h_{bsm}$$

  $d_{sm}$ = avg. distance from $s$ to rivals; $z_m$ = market demographics. Price and fill rate instrumented.

- **SML** $\Rightarrow$ elasticities, diversion ratios, attribute valuations.

- **Step 2 — Nash–Bertrand pricing.** Store $s$ prices its assortment $\Omega^s$ jointly:

$$\pi^s = \sum_{j \in \Omega^s} \Big( p_j - \underbrace{p^w_j}_{\text{wholesale}} - \underbrace{c^s_j}_{\text{retail MC}} - \underbrace{h^s_j \, \text{FillRate}_j (1 - \text{DSD}_j)}_{\text{service cost}} \Big) M \, s_j(\mathbf{p})$$

  **The asymmetry:** under DSD the *supplier* keeps shelves full and the service cost switches off. Under DC the *retailer* pays it.

- FOCs + Step 1 elasticities $\Rightarrow$ store–brand markups and implied marginal costs.

# Step 3: Vertical Nash–in–Nash Bargaining – Intuition

- **Question:** How does bargaining power differ between DSD and DC?
- **Approach:** Nash bargaining over wholesale prices & fill-rates
- **Profit split determined by two forces:**

  **Bargaining Power** ($\lambda$) – *Structural negotiating ability*
  - Does DSD contract give retailers more leverage?
  - **Exogeneous, this is what we estimate**

  **Bargaining Position** – *Fallback options matter*
  - If negotiation fails, what would each party earn elsewhere?
  - Strong alternatives = strong position = bigger share
  - E.g.: Retailer with many suppliers has better alternatives than retailer with few suppliers
  - **Endogeneous, computed from demand model**

# Step 3: Vertical Nash–in–Nash Bargaining

- Each supplier $f$ sells multiple brands $b \in \mathcal{B}_f$ to stores $s \in \mathcal{S}_f$. Contract $j = (f, b, s)$ is a supplier–brand–store triple in $\Omega^f$.
- **Supplier profit:**

$$\Pi_f = \sum_{j \in \Omega^f} \Big[ \big(p_j^w - c_j^m - h_j^f \, \mathrm{DSD}_j\big) M \, s_j(p, r) \Big],$$

$p_j^w$ = wholesale price, $c_j^m$ = manufacturing cost, and $h_j^f$ = the per-unit cost of contracted fill-rate when $\mathrm{DSD}_j = 1$.

▸ Fill-rate Details

- For each contract $j$, wholesale price and fill-rate $(p_j^w, r_j)$ solve a Nash–in–Nash problem:

$$\max_{p_j^w,\, r_j} \left(\pi_j^s - d_j^s\right)^{\lambda_j} \left(\Pi_j^f - d_j^f\right)^{1-\lambda_j},$$

with retailer bargaining power parameter $\lambda_j \in (0, 1)$ and disagreement payoffs (bargaining position) $(d_j^s, d_j^f)$.

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# Demand Estimation Results

| | Store/Week FE | Hausman IV | Gandhi-Houde IV |
|---|---|---|---|
| $\tau_{\text{dist}}$ | $0.027^{**}$ | $0.068^{**}$ | $0.085^{***}$ |
| | (0.013) | (0.029) | (0.013) |
| $\gamma_{\text{log price}}$ | $-0.647^{***}$ | $-0.913^{***}$ | $-1.102^{***}$ |
| | (0.014) | (0.031) | (0.069) |
| $\eta_{\text{fill}}$ | $0.203^{***}$ | $0.435^{***}$ | $0.420^{**}$ |
| | (0.019) | (0.051) | (0.211) |
| $\mu$ (nesting parameter) | $0.602^{***}$ | $0.601^{***}$ | $0.603^{***}$ |
| | (0.008) | (0.009) | (0.010) |
| Own-price elasticity | $-2.206^{***}$ | $-2.948^{***}$ | $-3.749^{***}$ |
| | (0.039) | (0.089) | (0.233) |
| Fill-rate elasticity | $1.158^{***}$ | $2.530^{***}$ | $2.389^{**}$ |
| | (0.109) | (0.296) | (1.204) |
| Log-likelihood | $-10{,}672$ | $-10{,}661$ | $-10{,}648$ |

$^{***}p < 0.01$, $^{**}p < 0.05$, $^{*}p < 0.1$. SEs in parentheses. Observations $= 99{,}313$

# Bargaining Model Estimates by Distribution Channel

| | DSD | DC | Difference |
|---|---|---|---|
| **Panel A: Bargaining Power** | | | |
| $\lambda$ (retailer weight) | 0.579*** (0.224) | 0.552*** (0.141) | 0.027*** |
| **Panel B: Service Cost Parameters** | | | |
| Delivery frequency ($\kappa_1/\delta_1$) | 0.509*** (0.051) | 0.330*** (0.007) | — |
| Fill-rate, linear ($\kappa_3/\beta$) | 1.426*** (0.026) | 1.567*** (0.006) | — |

$^{***}p < 0.01$, $^{**}p < 0.05$. SDs in parentheses (Panel A), and SEs (Panel B).

▸ Alternative Identification Strategies

# Counterfactuals: Service improvement vs. Bargaining

| | Surplus Change | Split (R / S) | Welfare |
|---|---|---|---|
| **Panel A: Fill-Rate Investment (Value Creation)** | | | |
| DC fill-rate: 93.9% $\rightarrow$ 99% | +$2.21M (+13.4%) | +$1.20M / +$1.01M | Pareto improving |
| Demand expansion | +13.7% | | |
| **Panel B: Bargaining Power Shift (Redistribution)** | | | |
| $\lambda$: 0.552 $\rightarrow$ 0.600 | $0 new surplus | +$0.86M / $-$0.86M | Zero-sum |
| $\lambda$: 0.552 $\rightarrow$ 0.750 | $0 new surplus | +$3.55M / $-$3.55M | Zero-sum |

**Takeaway:** Improving DC fill-rates creates surplus shared by both sides. Shifting bargaining power redistributes existing surplus without creating any new value.

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# Conclusion

**Distribution Channels in Food Supply Chains**

- **Service quality rivals price:** Fill-rate elasticity (2.39) $\approx$ price elasticity ($-3.75$)
- **Operational control $\neq$ bargaining power:** The side that pays when shelves are empty has less leverage in negotiations
- Service improvement expands the *total pie*, higher bargaining only re-slices it
- **Managerial/policy implication:** Invest in supply chain infrastructure and distribution, not contract renegotiation
- **Methodological contribution:** Structural IO model of vertical bargaining with prices and service quality

Thank you! upaudel@ttu.edu ujjwolpaudel.github.io

# Reduced-form Analysis

▸ Back

- $i =$ store, $b =$ brand, $t =$ week; Fill-rate$_{ibt}$ $=$ $\frac{\text{\#Cases-shipped}_{ibt}}{\text{\#Cases-ordered}_{ibt}}$.
- Two-way fixed effects regressions:

$$\begin{aligned} y_{ibt} \;&= \beta_1 \,\text{Fill-rate}_{ibt} + \beta_2\, \mathbf{1}\big[\text{DC}_i\big] + \beta_3 \left(\text{Fill-rate}_{ibt} \times \mathbf{1}\big[\text{DC}_i\big]\right) \;+\; \mathbf{X}'_{ibt}\boldsymbol{\beta}_4 + \\ &\quad \eta_i + \theta_b + \alpha_t + \delta_{m(i)}\, t + \varepsilon_{ibt}, \end{aligned} \tag{1}$$

  - $\eta_i =$ store FEs, $\theta_b =$ brand FEs, $\alpha_t =$ week FEs, $\delta_{m(i)}\ t =$ linear trends specific to market containing store $i$, $\mathbf{X} =$ vector of controls.
  - $y_{ibt}$ takes either $\log(P_{ibt})$ (retail price) or $\log(C_{ibt})$ (wholesale price).
  - $\beta_1 =$ effect on DSD stores; $\beta_1 + \beta_3 =$ effect on DC stores

# Effect of Distribution Asymmetry on Retail Price

| Dependent Variable: | Log Brand–Store–Week **Retail Price** | | |
|---|---|---|---|
| | (1) | (2) | (3) |
| Fill-rate | 2.16*** | 2.14*** | 2.13*** |
| | (0.501) | (0.495) | (0.492) |
| $\mathbf{1}[\text{DC Store}]$ | 1.72*** | 1.68*** | 1.67*** |
| | (0.492) | (0.485) | (0.482) |
| Fill-rate $\times$ $\mathbf{1}[\text{DC Store}]$ | -2.15*** | -2.13*** | -2.12*** |
| | (0.501) | (0.495) | (0.492) |
| Week, Brand FEs | Yes | Yes | Yes |
| Store FEs, Controls | | Yes | Yes |
| Market Trends | | | Yes |
| Observations | 91,644 | 91,644 | 91,644 |

$^{***}p < 0.01$, $^{**}p < 0.05$, $^{*}p < 0.1$. SEs clustered by store-market-week. Back

# Effect of Distribution Asymmetry on Wholesale Price

| Dependent Variable: | Log Brand–Store–Week **Wholesale Price** | | |
|---|---|---|---|
| | (1) | (2) | (3) |
| Fill-rate | 1.56*** | 1.49*** | 1.48*** |
| | (0.268) | (0.233) | (0.227) |
| $\mathbf{1}[\text{DC Store}]$ | 1.09*** | 0.965*** | 0.951*** |
| | (0.262) | (0.228) | (0.222) |
| Fill-rate $\times$ $\mathbf{1}[\text{DC Store}]$ | -1.57*** | -1.49*** | -1.47*** |
| | (0.268) | (0.233) | (0.226) |
| Week, Brand FEs | Yes | Yes | Yes |
| Store FEs, Controls | | Yes | Yes |
| Market Trends | | | Yes |
| Observations | 91,644 | 91,644 | 91,644 |

$^{***}p < 0.01$, $^{**}p < 0.05$, $^{*}p < 0.1$. SEs clustered by store–market–week. ▸ Back

# Vertical Bargaining Details

- **Fill-rate cost under DSD:** ‣ Back

$$h_j^f = \begin{cases} \kappa_1 N_j + \kappa_2 r_j + \phi_j + \xi_j, & \text{if } \mathrm{DSD}_j = 1, \\ 0, & \text{if } \mathrm{DSD}_j = 0, \end{cases}$$

$N_j =$ replenishment frequency, $r_j =$ negotiated fill-rate, and $(\kappa_1, \kappa_2) =$ marginal costs of execution and service.

- **Per-unit margins:** $m_j^s = p_j - p_j^w - c_j^s - h_j^s\, r_j(1 - \mathrm{DSD}_j), \qquad m_j^f = p_j^w - c_j^m - h_j^f\, \mathrm{DSD}_j.$
- $\Rightarrow$ Fill-rate cost incidence depends on channel: supplier (DSD) vs. retailer (DC).

# FOCs in Vertical Bargaining

- For each contract $j = (f, b, s)$, the wholesale price and fill-rate $(p_j^w, r_j)$ solve a Nash–in–Nash problem:

$$\max_{p_j^w,\, r_j} \left(\pi_j^s - d_j^s\right)^{\lambda_j} \left(\Pi_j^f - d_j^f\right)^{1-\lambda_j},$$

  with store bargaining weight $\lambda_j \in (0,1)$ and disagreement payoffs $(d_j^s, d_j^f)$.

- **Wholesale price condition:** ‣ Back

$$\lambda_j(\Pi_j^f - d_j^f)\frac{\partial \pi_j^s}{\partial p_j^w} + (1-\lambda_j)(\pi_j^s - d_j^s)\frac{\partial \Pi_j^f}{\partial p_j^w} = 0.$$

- **Fill-rate condition:** ‣ Back

$$\lambda_j(\Pi_j^f - d_j^f)\frac{\partial \pi_j^s}{\partial r_j} + (1-\lambda_j)(\pi_j^s - d_j^s)\frac{\partial \Pi_j^f}{\partial r_j} = 0.$$

- Higher fill-rates increase demand but raise service cost; bargaining determines both wholesale margins and fill-rates given the delivery channel.

# Empirical Bargaining System in Matrix Form

- To make the model compact, let $T^s$ and $T^f$ denote the retailer and supplier ownership matrices, $\Delta^s = \partial s / \partial p^s$ be the Jacobian of market shares with respect to retail prices.
- Then **retailer margins:**

$$m^s = -(T^s \odot \Delta^s)^{-1} s(p, r). \tag{2}$$

- Mapping retailer to supplier margins:

$$m^f = \mathrm{Diag}(\Lambda) \odot (T^f \odot \mathbf{S})^{-1} (T^s \odot \mathbf{S})\, m^s, \tag{3}$$

where **S** contains own shares on the diagonal and diversion shares off-diagonal.

- Then **retail prices satisfy:**

$$\begin{aligned} \mathbf{p} = \mathbf{c^s} + \mathbf{c^f} + \mathbf{h^s} \odot (\mathbf{1} - \mathbf{r}) \odot (\mathbf{1} - \mathbf{DSD}) + \mathbf{h^f} \odot (\mathbf{1} - \mathbf{r}) \odot \mathbf{DSD} \\ - \left( \mathrm{Diag}(\Lambda) \odot (T^f \odot \mathbf{S})^{-1} (T^s \odot \mathbf{S}) + \mathbf{I} \right) \left[ T^s \odot \Delta^s \right]^{-1} \mathbf{s}(\mathbf{p}, \mathbf{r}). \end{aligned} \tag{4}$$

where **I** is the identity matrix and service costs depend on $(\mathbf{1} - \mathbf{r})$ and the delivery channel.

- Together, (2)–(4) & fill-rate equilibrium condition determine $(\mathbf{p}, \mathbf{p^w}, \mathbf{r})$ in equilibrium. ▸ Back

# Bargaining Power Estimates Under Alternative Identification

▸ Bargaining Power Parameter Estimates

| | $\hat{\lambda}$ | $\hat{\lambda}_{\text{DSD}}$ | $\hat{\lambda}_{\text{DC}}$ | $\Delta$ |
|---|---|---|---|---|
| *Panel A. Baseline (observed wholesale prices)* | | | | |
| Bargaining power parameter | 0.580 | 0.579 | 0.552 | $+0.027^{***}$ |
| *Panel B. Structural estimation (demand-implied margins)* | | | | |
| (1) Full controls | 0.619 | 0.638 | 0.619 | $+0.019$ |
| | (0.050) | (0.107) | (0.050) | |
| (2) Full controls and market FEs | 0.747 | 0.782 | 0.747 | $+0.034$ |
| | (0.029) | (0.143) | (0.029) | |
| First-stage $F$ | 149.4 | | | |
| $N$ | 86,129 | | | |

Panel A: $\lambda$ computed from observed wholesale prices ($\lambda_j = m_j^s/(m_j^s + m_j^f)$). Panel B: demand-implied margins via two-step GMM (Draganska et al. 2010); no wholesale price data used. Both identify the same direction and similar magnitudes: $\hat{\lambda}_{\text{DSD}} > \hat{\lambda}_{\text{DC}}$. $^{***}p < 0.01$.