Causes of Retail Pharmacy Closures

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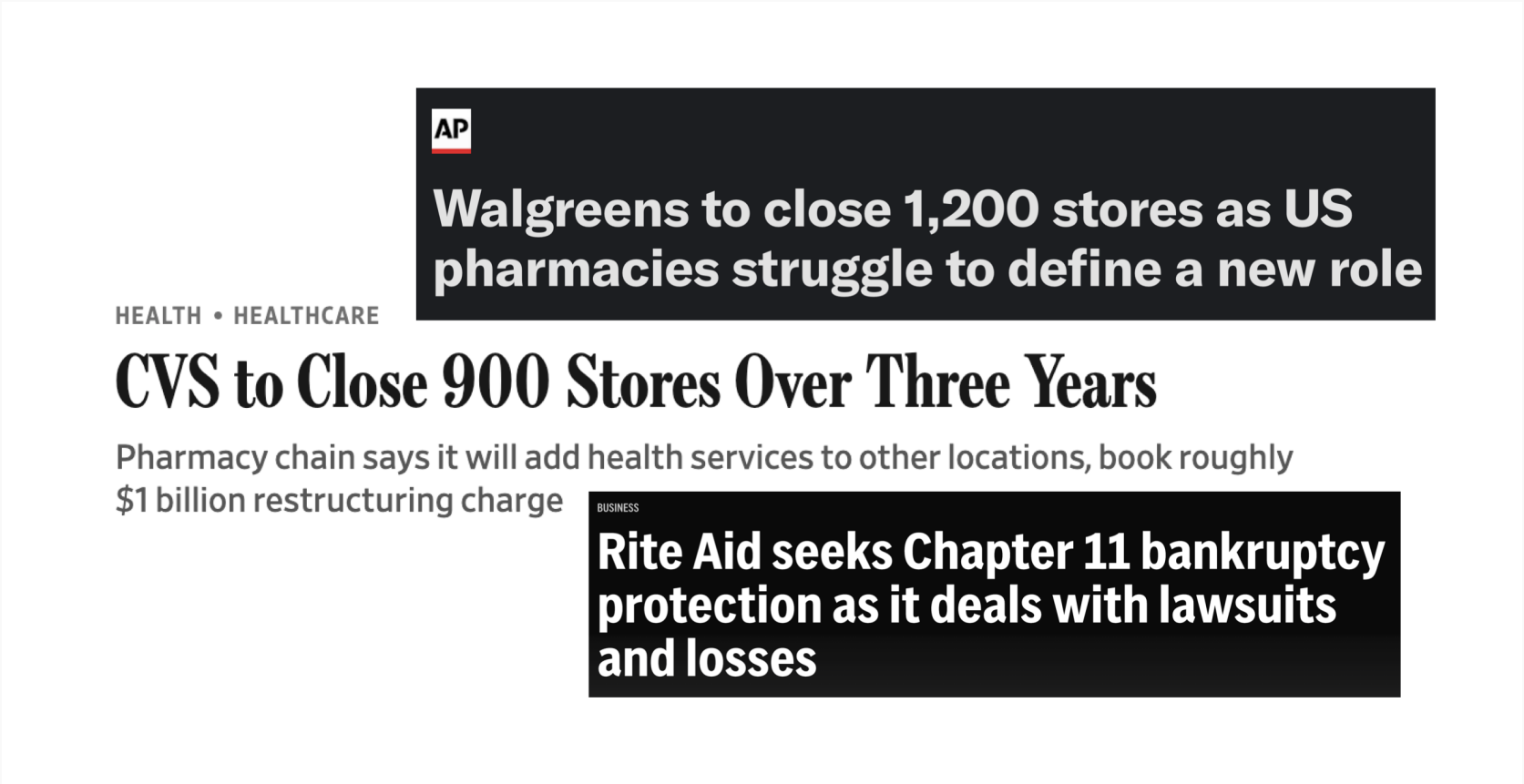
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Job Market Paper

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The Question and the Answer

Pharmacies are closing



- Thousands of closures so far; thousands ahead

Access concern: policy blames the drug margin

- Public concern on drug access crisis: "pharmacy desert"
- Policy pulls a single lever: raise the drug dispensing margin
  - Hearings, FTC report, state/federal legislatures
  - "Retail pharmacy access across the United States has been in decline for years, due in large part to reimbursement pressures (...) Ensuring dispensing fees accurately reflect pharmacy costs may also help enhance predictability in pharmacy finances and improve pharmacy access" [Senate Finance Committee, 2026]
- Premise is half right: reimbursement did fall

BUT there are two types of pharmacies

- CVS and Walgreens also earn profit on the front store
  - The prescription draws the trip; the basket pays for it

- Ignored second decline: front store is declining as well
  - "Sales were lower in the consumer health and beauty categories, which carry a higher margin"
    [CVS Health Corporation, 2020]
  - "Retail sales decreased (...) reflecting a challenging retail environment and channel shift (...)"
    [Walgreens Boots Alliance, 2024]

This paper

Question

- Do closures affect consumers/patients?
- Do pharmacies close because dispensing became unprofitable, or because the front store collapsed?
- Would restoring dispensing margins keep pharmacies open where access is at risk, and would consumer gain from the restoration justify the cost?

This paper

What I do

- New data linking pharmacy sales, drug prices, and consumers' full shopping baskets (drug fill + CPGs in the same trip)
- Descriptive facts against the reimbursement/desert story
- Multi-category demand model $\rightarrow$ store-level profit
  $\rightarrow$ dynamic entry/exit model $\rightarrow$ policy evaluation

Summary of findings

- No "desert" problem
  - They do exist, but closures are not exacerbating
- Closures stem from front-store, not falling drug margins
  - Customers more price sensitive, switched to big-box/wholesale
- Long run under current conditions: shrinks nearly by half
  - . . . yet distance to nearest pharmacy barely moves
- Restoring margins saves only tenth of the decline
  - Induced stores in competitive markets
  - Consumer gain: 1 cent per public dollar

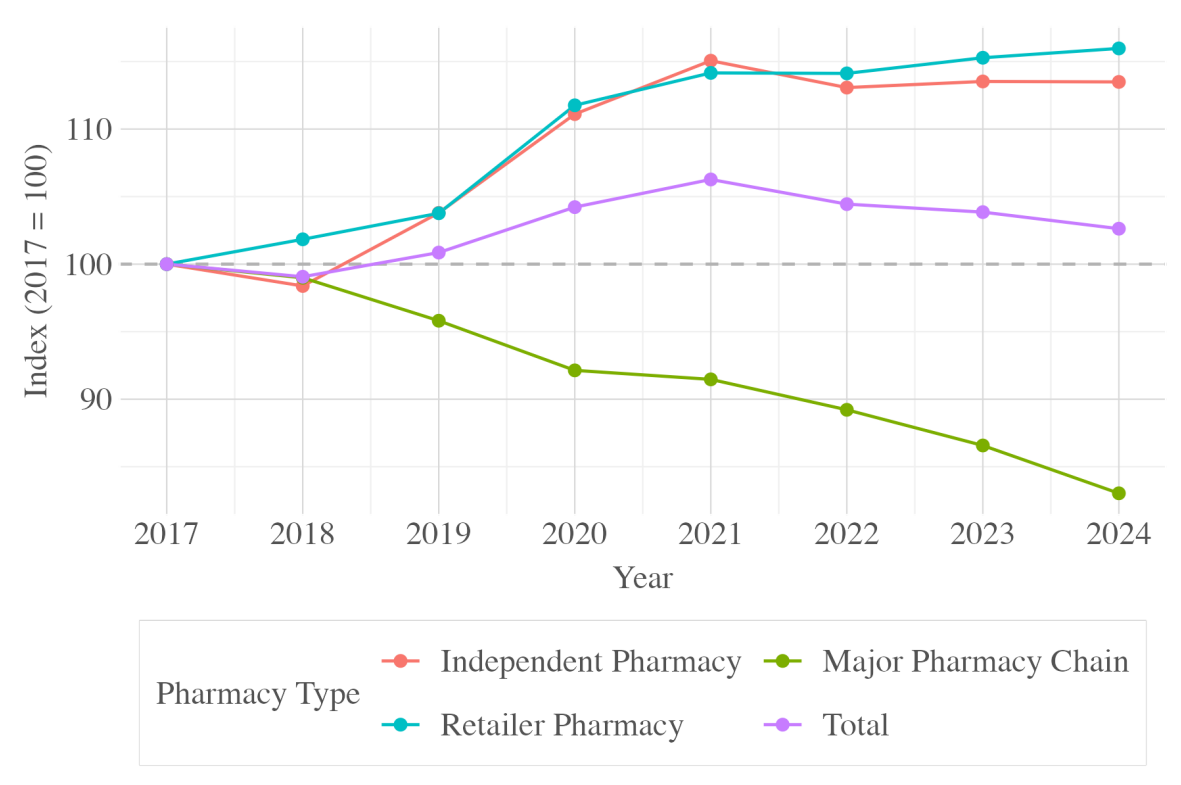
$\Rightarrow$ Diagnosing the wrong cause leads to ineffective policy proposal

Facts and Model Estimates

Data: tracking drugs and CPGs

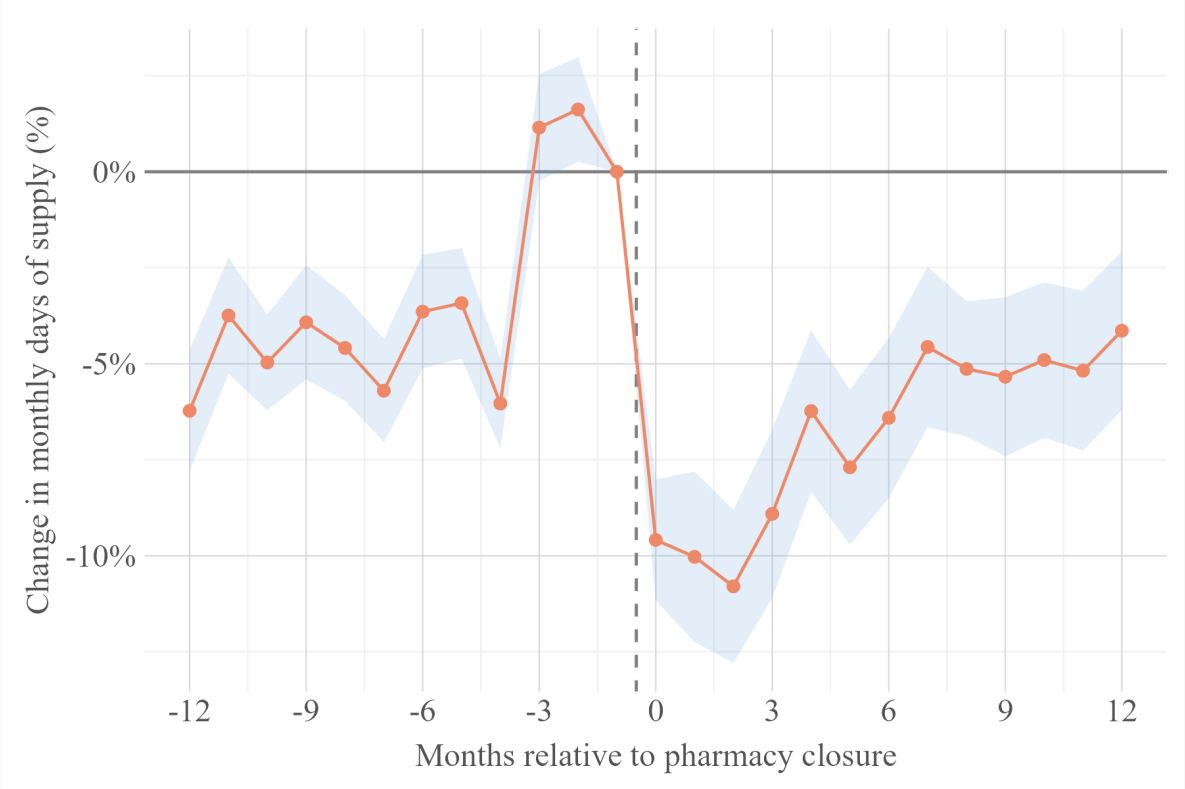
- **Numerator household panel** (2019–2024)
- **Infogroup establishment panel** (2013–2024)
- **NCPDP dataQ pharmacy info** (2013, 2018, 2023)
- **Merative MarketScan claims** (2013–2024)
- **Pharmacy/government (NCPA + NADAC + CMS)**
- **Multi-state independent operator** (2019–2024, proprietary)

Fact 1: Pharmacy contraction is a chain phenomenon



- Major Pharmacy Chain: CVS, Walgreens, Rite Aid
- If drug margins were the driver, the drug-focused format (independents) should die first, but it is growing

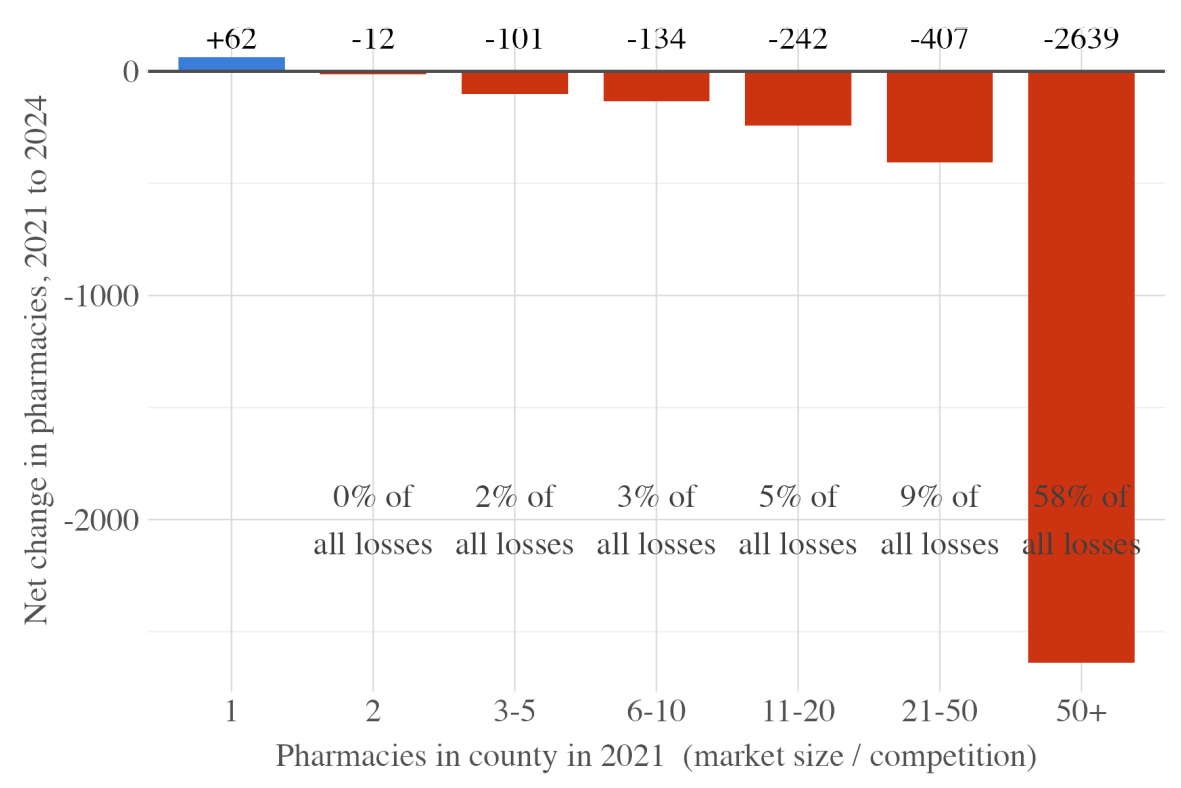
Fact 2: Displaced patients relocate fills, not lose them



- Pre-closure increase, ∼10% dip at trough, back on path within ∼6 months

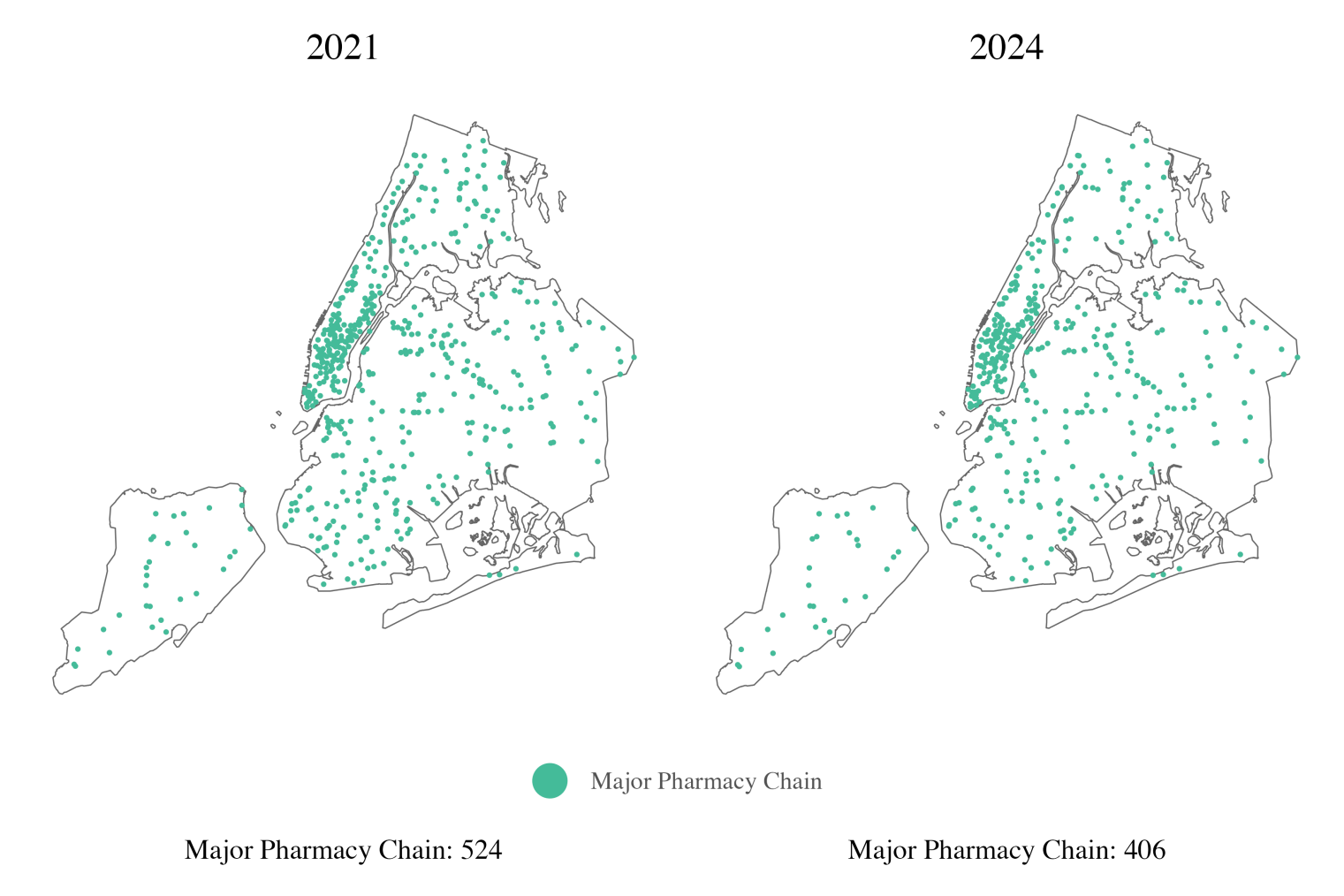
▸ Specification ▸ Market-level

Fact 3: Exits concentrate where pharmacies are dense



- One-pharmacy counties *gained* stores
- Counties with 50+ pharmacies: 58% of all net losses

Fact 3: Exits concentrate where pharmacies are dense



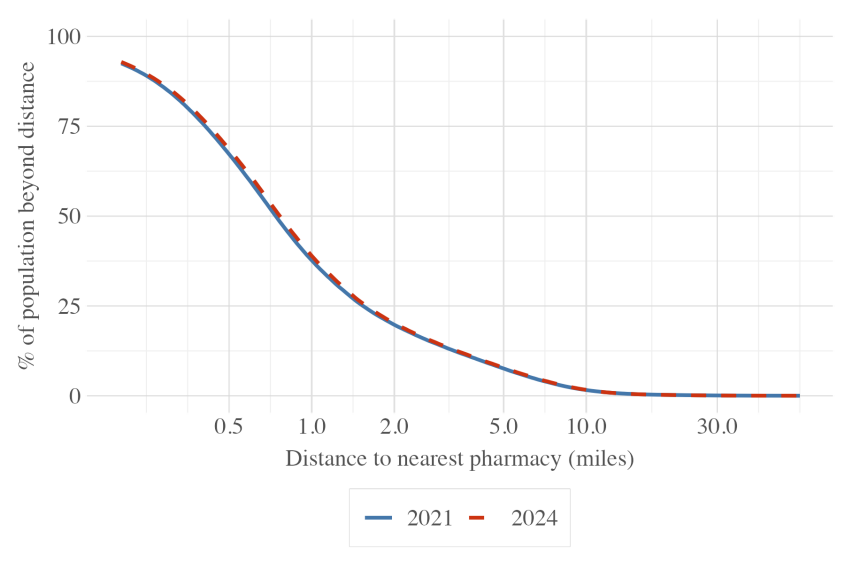
▸ All Pharmacy Types

Fact 3: Exits concentrate where pharmacies are dense

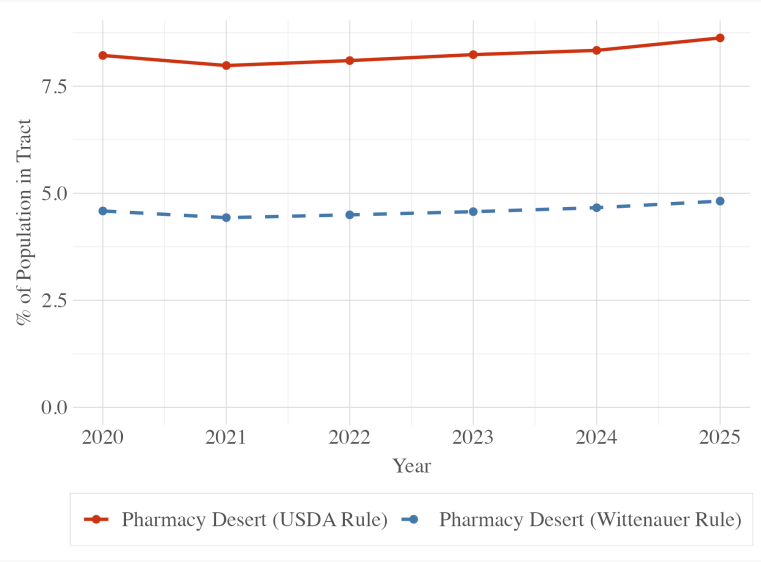


▸ All Pharmacy Types

Fact 3: Exits not leading to "pharmacy desert"



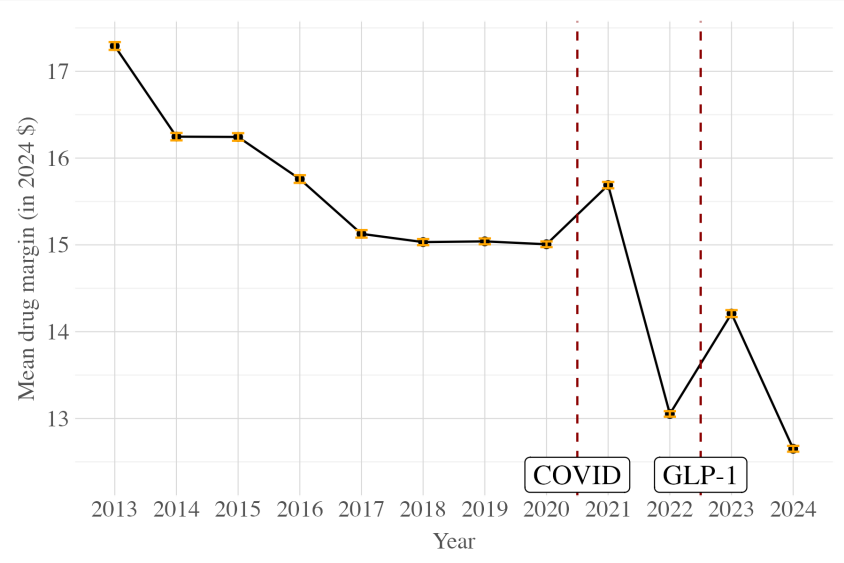
Distance to nearest pharmacy



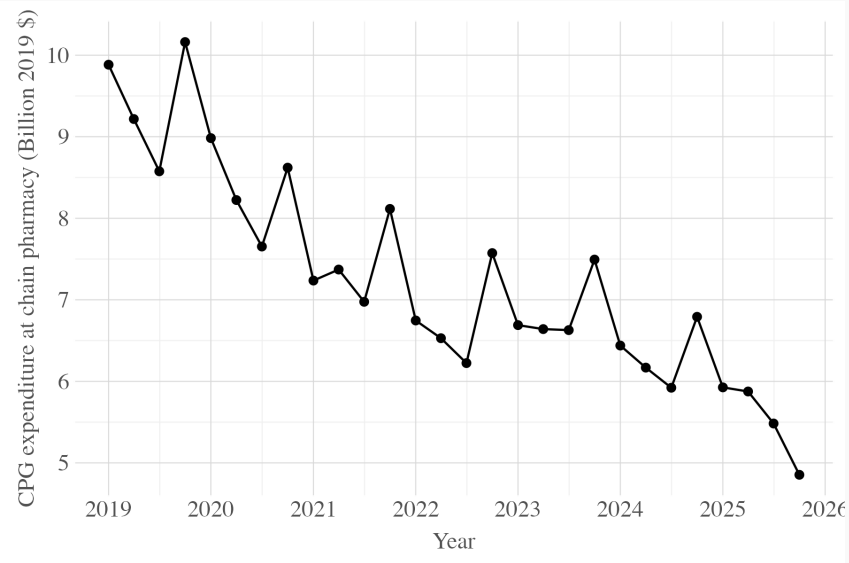
Population in "pharmacy desert"

- Distance to nearest pharmacy unchanged
- Increase in population in pharmacy desert: 0.36 p.p. (USDA), 0.23 p.p. (Wittenauer)
  - 88% in urban areas: 0.60 to 1.01 miles

Fact 4: Both declines are real, but exits track the front store



Dispensing margin: falling



Chain front-store spending: collapsing

- Note: Patients did not see falling dispensing margin
- County panel: net losses follow CPG measures, not the margin

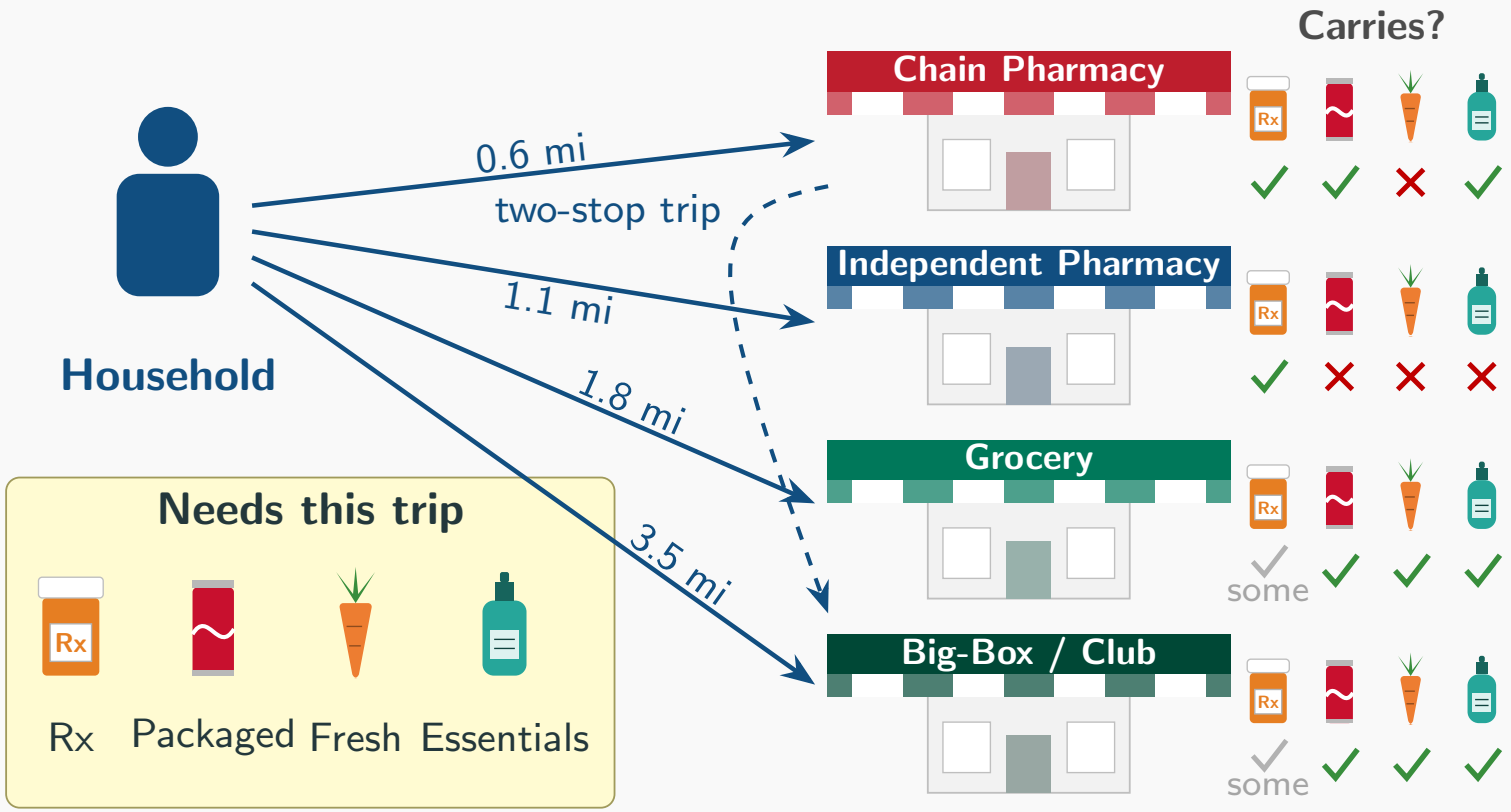
Why a structural model?

- Why did front store collapse?
  $\Rightarrow$ Welfare (consumers "forced" to shop elsewhere?)

- Entry/exit is forward-looking on total store profitability
  $\Rightarrow$ Need both business profits in dollars, store by store

- Three objects that reduced-form cannot provide:
  1. **Demand** under different stores and prices
  2. **Profit margins**: revenue observed, marginal costs not
  3. **Fixed costs**: only entry/exit observed

Demand: multi-category shopping



- **Trip**: which store(s)? — distance, extra stop
- **Basket**: how much of each? — prices, tastes, fill

Demand: multi-category shopping

- Extend Thomassen et al. (2017) multi-category trip model
- *Challenge*: co-purchase can be taste (fill makes me buy) or trip anchoring (already here)
- *Resolution*: drug filled deterministically conditional on latent need (exogenous)
  - Fact 2 (no adherence loss): observed fill = need
  - CPG quantity difference between fill vs. no fill for consumer-store, net of permanent tastes and day shocks

▸ Demand detail

Demand estimates: real price sensitivity increased

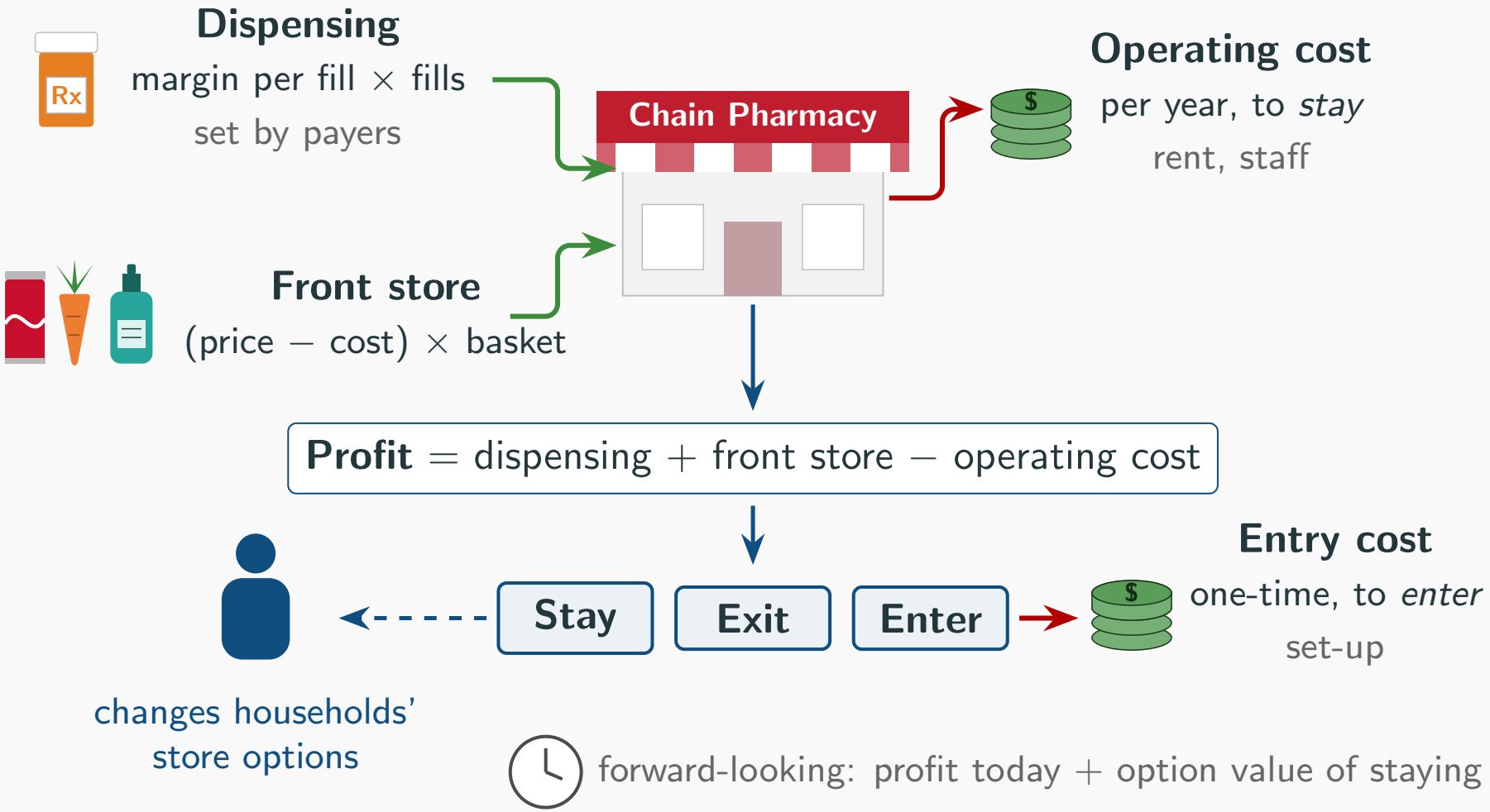
Model re-estimated independently each year, 2019–24, using GMM

- **Drug–retail taste interaction**: small and stable over time

- **What moved**:
  - Real price sensitivity up ∼20% with the 2021 inflation surge
  - Fill trips did not move much, but CPG-only trips moved to big-box, wholesale clubs, and online stores
  - Price sensitivity, not price differentials, changed

▸ Decomposition ▸ Drug interactions ▸ Trip costs

Supply: dynamic oligopoly



Supply: dynamic oligopoly

- CPG profit margins: Bertrand-Nash
  - Invert the chains' observed national pricing
- Dispensing margin: payer-set (exogenous for pharmacy)
  - Construct using patient composition and state-level policy
- Fixed costs: dynamic entry/exit game
  - Finite dependence (no value function, no stance on beliefs) (Arcidiacono and Miller (2011))
  - Shock dispersion from state fee changes $\times$ fill-volume exposure within county-year

▸ Supply detail ▸ Cost validation

Supply validation

- Predicted vs. observed county-level exits: correlation 0.97+

Fixed operating cost	Model	External benchmark
Chain pharmacy	$3.78M	$3.5M–$4.1M (Walgreens 10-K, FY23–24)
Independent pharmacy	$1.25M	$0.9M (NCPA Digest) $0.35-$1.28 (Proprietary operator)

XXX: numbers predate the 2026-11-03 rerun

▸ Predicted vs. observed exits

Counterfactual

Headline counterfactual

Margin restored to its real-terms peak (+$4.17 per fill)

- No-policy long run: nearly half closes!
- Policy adds back 9% of these closures
  - 98% of induced stores in counties with 3+ pharmacies
  - Counties with ≤ 1 pharmacy gain +5%
- Fiscal cost $30B/year
- The no-policy long-run costs consumers $20B/year
  - $18B survivors' prices, $2B travel costs
  - Share of annual spending: 1.85%

XXX: long run = stationary local-moment equilibrium, solved as a fixed point;

numbers predate the 2026-11-03 rerun

▸ CV formula ▸ Counterfactual distance

Takeaway

- Closures not a dispensing-driven access crisis
  - Risk is rather the viability of drug–front store business model
- Reimbursement is the wrong policy instrument
- Next steps:
  - Short-term: Decomposing observed closures, variations of counterfactual policies (e.g., targeted subsidies)
  - Long-term: Endogenize the drug margin: payer (PBM) and pharmacy contracting layer

Thank you!

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Technical report, United States Senate.

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Walgreens Boots Alliance Form 10-K.
Technical report, Securities and Exchange Commission.

Research agenda:
Quant marketing tools to public and private problems

Demand, pricing, and targeting tools on both sides of markets for essential goods:

- **Public problems**: ▸ Detail
  Water utility pricing — discounts vs. enforcement for delinquent bills
- **Private problems**: ▸ Detail
  Package sizes — who lost the bulk discount during inflation
- **Demand spillovers**: ▸ Detail
  Prescription stimulants — rank competition ⇒ "addiction runs"
- **Targeting at scale**: (R&R, *JPE: Micro*) ▸ Detail
  Early childhood education — do pilots fail at scale?

Also: speculative demand, deposit–rent contract menus, consumption theory under borrowing constraints

Personalized water utility pricing (with Jean-Pierre Dubé)

- **Question**: Can a public utility collect unpaid bills without hurting distressed households — discounts or enforcement?
- **Answer**: Deep discounts barely work, but enforcement does
  - Bill discounts of up to 80% reduce delinquency only marginally
  - Threat of shut-off cuts delinquency by 3+pp
  - Targeting matters: 60%+ of past assistance leaked to households earning over twice the income cap
- **How**: Partnership with a large U.S. water utility
  - Uncollected balances +230% since 2019
  - RCT across 20,000 households with random discounts
  - Personalized pricing that balances household debt and municipal revenue

◂ Back

Package sizes and the unequal burden of inflation (with Youngeun Lee and Younggeun Yoo)

- **Question**: Who bears the burden of inflation when the same product comes in many package sizes?
- **Answer**: Households at *all* income levels shifted to larger packages
  - Many also moved to big-box and warehouse clubs
  - But per-unit prices of large packages rose fastest, shrinking the bulk discount exactly when households sought it most
- **How**: Household-panel + card-transaction data
  - Next: model of package choice under nonlinear pricing to separate access, liquidity, and preferences — and how manufacturer/retailer assortment shapes who bears inflation

◂ Back

Addiction runs: rank competition in stimulant use (with Giyoung Kwon and Younggeun Yoo)

- **Question**: Why does prescription-stimulant use among students keep rising at an unprecedented rate?
- **Answer**: Because grading is a rank competition
  - Use rises with curved grading
  - Third of non-users would start if peer use rose by half
  - Strategic complementarity generates multiple equilibria and a tipping point into a high-use "addiction run"
  - Changing the competition (absolute or group-separated grading) beats policing individual use
- **How**: Two original surveys — college students + the first survey of university disability-services administrators, and an equilibrium model of rank-based evaluation

◂ Back

Scale-up of an influential early education program (with Andrés Hojman and Juan Pantano; R&R, JPE: Micro)

- **Question**: Do successful pilots fail at scale? Early Head Start's weak evaluation is the leading exhibit for "yes"
- **Answer**: No
  - On comparable populations, the scaled program is as effective as the pilot
  - Apparent decline reflects who was served, compliance, and children's fallback care options
- **How**: Machine learning to transport treatment effects between the two programs' populations, adjusting for compliance and substitutes

◂ Back

Appendix: closure event-study specification

Stacked Poisson event study
(cohort c = closure month; controls = not-yet-treated):

$$\mathbb{E}\big[y_{ict} \mid \text{treated}_i, k_{ct}\big] = \exp\Big(\sum_{k \neq -1} \beta_k \, \mathbf{1}\{\text{treated}_i\} \cdot \mathbf{1}\{k_{ct} = k\} + \alpha_{ic} + \lambda_{ct} \Big)$$

- y_{ict}: days supplied, *all* pharmacies including mail order
- α_{ic} patient-by-cohort
- λ_{ct} cohort-by-calendar-month effects
- SEs clustered on pharmacy
- Treated: >50% of pre-closure fills at the closing pharmacy; continuous enrollment required (purges contributor exit)
- β_k: proportional effects

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Appendix: market-level fill volume does not respond

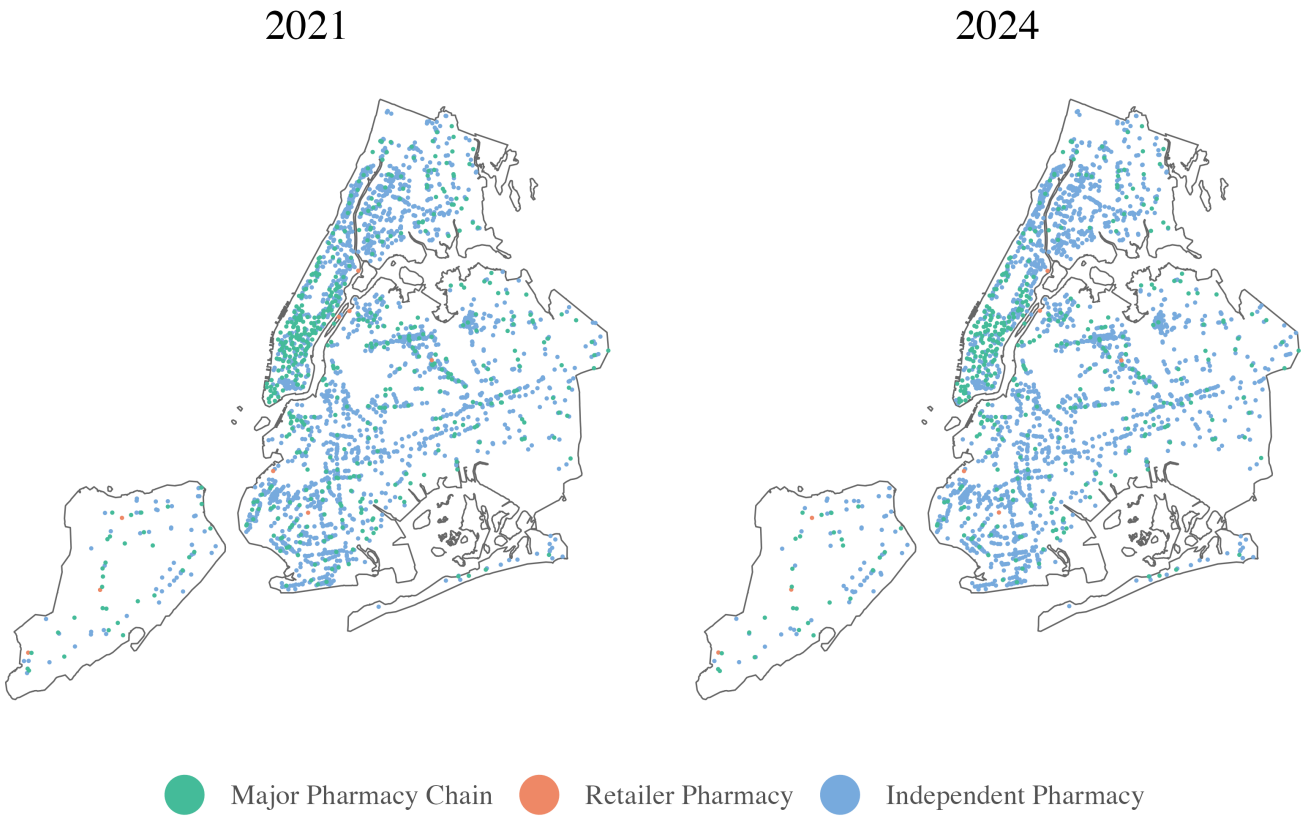
Within-patient Poisson at the MSA level:

$$\mathrm{DaysSupply}_{it} = \beta\, \Delta \log \mathrm{Stock}_{m(i),t} + \eta_i + \tau_t + \varepsilon_{it}$$

- β: elasticity of prescription consumption w.r.t. local pharmacy availability, from within-patient over-time variation
- Precise zero: a 10% net contraction moves prescription days by 0.03% of the mean; CI rules out losses $>$0.4%

◂ Back

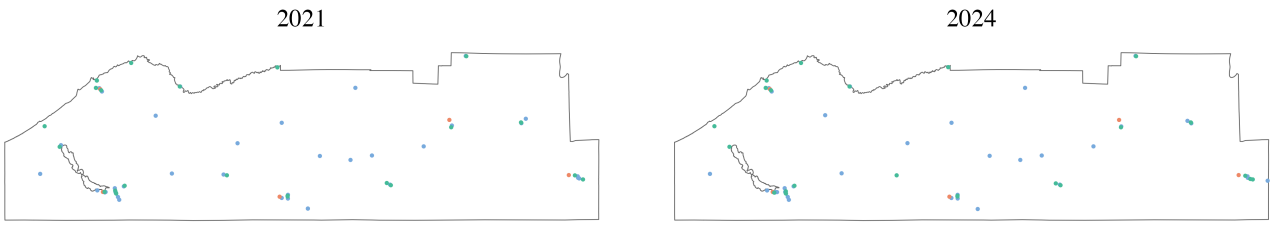
Fact 3: Exits concentrate where pharmacies are dense



2021	2024
Major Pharmacy Chain: 524	Major Pharmacy Chain: 406
Retailer Pharmacy: 9	Retailer Pharmacy: 8
Independent Pharmacy: 2,212	Independent Pharmacy: 2,277

◂ Back

Fact 3: Exits concentrate where pharmacies are dense



Major Pharmacy Chain: 27
Retailer Pharmacy: 5
Independent Pharmacy: 36

Major Pharmacy Chain: 27
Retailer Pharmacy: 5
Independent Pharmacy: 34

◂ Back

Detail: demand model

- Discrete choice has no within-trip quantity margin
- My central object is that: how the basket moves when a prescription is filled

Identification — price endogeneity as the example:

- National firm-week pricing $\Rightarrow$ no response to local conditions or any consumer's tastes; aggregate co-movement absorbed by year FEs + time dummies
- Also: distance in trip costs only; within- vs. cross-trip covariance separates correlated tastes from complementarity

▸ Utility ▸ Store choice

Appendix: basket utility and the drug–retail interactions

Variable utility of basket c with quantities q and binary fill y:

$$V_i(c, q_{ic}, y_{ic}) = \sum_{k \in \{x,f,p\}} A_{ic}^k \, q_{ic}^k - \tfrac{1}{2} \, q_{ic}' \, \Lambda \, q_{ic} - \left(\lambda_{xy} \, q_{ic}^x + \lambda_{fy} \, q_{ic}^f + \lambda_{py} \, q_{ic}^p\right) y_{ic} + \kappa_c \, y_{ic}$$

$$A_{ic}^k = \max_{j \in c \,:\, k \text{ available}} \left(\mu_{itjk} - \alpha_i \, p_j^k\right)$$

- $\Lambda \succ 0$: own-category satiation diagonal, cross-category effects off it
- Drug is binary $\Rightarrow$ no own curvature, interacts only through λ_{ky}
- Fill-induced shift in the basket (interior, one-category case): $\Delta q^{x*} = -\lambda_{xy}/\lambda_{xx}$, so $\lambda_{ky} < 0 =$ complements in preferences

◂ Back

Appendix: store choice, trip costs, and heterogeneity

Basket choice is logit conditional on taste draws ν; distance enters trip cost Γ:

$$P_i(c \mid \nu) = \frac{\exp\big[w_i(c) - \Gamma_i(c)\big]}{\sum_{c' \in \mathcal{C}_{it}} \exp\big[w_i(c') - \Gamma_i(c')\big]},$$

$$\Gamma_i(c) = (\gamma_{11} + \gamma_{12}\nu_{i1}^{\Gamma})\,\mathbf{1}[n(c) = 2] + (\gamma_{21} + \gamma_{22}\nu_{i2}^{\Gamma})\,\mathrm{dist}_{ic},$$

$$\mu_{itjk} = \xi_{b(j),k} + \beta_{0k}\big(\beta_h\,\mathrm{hh}_i + \beta_s\,\ln(\mathrm{size}_j) + \psi_t + \sigma_1\nu_i + \sigma_2\nu_{it} + \sigma_3\nu_{ik} + \sigma_4\nu_{ijk}\big),$$

$$\alpha_i = \left(\alpha_1 + \frac{\alpha_2}{\mathrm{income}_i/\mathrm{hh}_i}\right)\nu_i^{\alpha}$$

- $w_i(c)$: value of a corner-aware quadratic program (no closed form), recomputed per draw
- Needers ($\kappa_r \to \infty$): only pharmacy-containing baskets; fill lands at the basket's best pharmacy, $\kappa_c = \max_{j \in c: S_j = 1} \xi_{b(j),y}$
- Shock persistence (ν_i permanent vs. ν_{it} trip-level) separates correlated shopping tastes from true complementarity

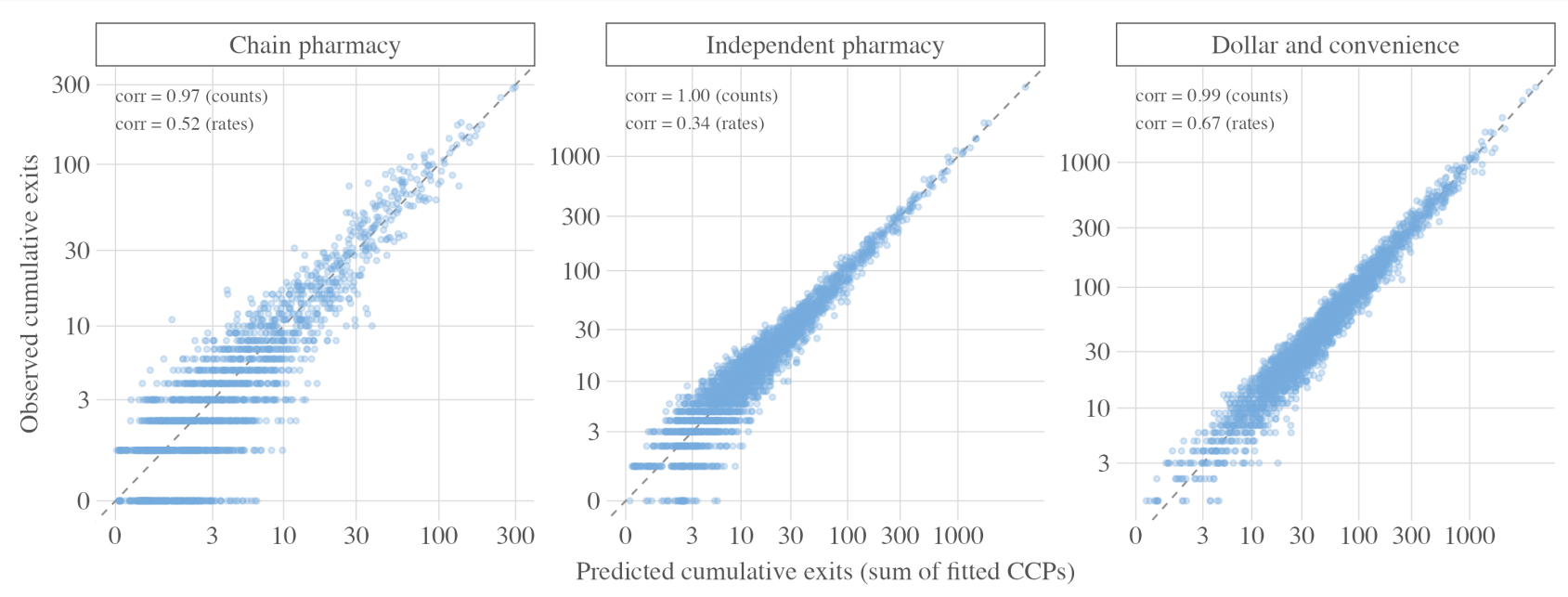
◂ Back

Detail: supply — margins, then fixed costs

- **Margins**: observed national prices are optimal for exactly one marginal cost $\Rightarrow$ invert the pricing game $\Rightarrow$ store-level variable profit in dollars
- **Fixed costs**: entry/exit weighs next year's profit and the continuation value; costs cannot be read off current profits
  - *Finite dependence*: "exit now" vs. "stay, then exit" differ only in next year's flow + exit rates: *no beliefs needed*
  - *Exit by type*: chains terminal (scrap 0); independents renewal (back to the slot's entrant position)
  - *Dispersion by shift-share*: state fee changes $\times$ fill volume; payers set fees, not stores

▸ Pricing eqs ▸ Dynamics eqs ▸ Shift-share ▸ Point ID / scale ◂ Back

Detail: exit counts do well predicted vs. observed



◂ Back

Appendix: pricing FOCs and marginal-cost recovery

Firm F sets national category prices to maximize

$$\Pi_F = \sum_{\ell \in A_F} \left(p_\ell^F - mc_\ell^F\right) Q_\ell^F + m^r \, Y_F,$$

and stacking the first-order conditions and inverting gives

$$mc^F = p^F + \Delta_F^{-1}\left(Q^F + m^r \, \frac{\partial Y_F}{\partial p^F}\right), \qquad [\Delta_F]_{\ell\ell'} = \frac{\partial Q_{\ell'}^F}{\partial p_\ell^F}.$$

- All demand objects and derivatives from the estimated system (finite differences) — no extra instruments
- Fill-traffic term: $\sum_F \partial Y_F / \partial p_\ell = 0$ — a price rise diverts fills to rivals, never destroys them $\Rightarrow$ high-fill chains price *below* the single-product benchmark

◂ Back

Appendix: finite dependence, chain stores (terminal exit)

Chain exit value $= 0$; flows dated $t+1$; banner b:

$$\ell_C^X(x_{st}) = \beta\,\mathbb{E}\big[\psi^C\big(\pi^{*,C}_{s,t+1} - \phi^C(s)\big) + \gamma_E - \ln P_b^X(x_{s,t+1}) \,\big|\, x_{st}\big]$$

$$\begin{aligned}\ln \frac{P_C^E(x_{st})}{P_\varnothing^E(x_{st})} &= -(1-\beta)\,\psi^C\kappa^{E,C} \\ &\quad + \beta\,\mathbb{E}\big[\psi^C\big(\pi^{*,C}_{s,t+1} - \phi^C(s)\big) + \ln P_C^E(x_{s,t+1}) - \ln P_b^X(x_{s,t+1}) \,\big|\, x_{st}\big] \\ &\quad - \beta^2\,\mathbb{E}\big[\psi^C\big(\pi^{*,C}_{s,t+2} - \phi^C(s)\big) + \gamma_E - \ln P_b^X(x_{s,t+2}) \,\big|\, \text{wait},\, x_{st}\big]\end{aligned}$$

- Nothing oblivious: $-\ln P_b^X$ is the equilibrium continuation of a store still in business, rivals' best responses included
- Entrant [Caoui et al., 2024]: enter in t, exit in $t+1$ vs. wait, enter in $t+1$, exit in $t+2$; entry cost $=$ cost of delay $(1-\beta)\psi^C\kappa^{E,C}$
- $\kappa_u^C = \psi^C\kappa^{E,C} =$ within-county-year entrant–incumbent contrast$/(1-\beta)$, after netting the weighted $t+2$ terms

▸ Equilibrium, weight ▸ Independents ◂ Back

Appendix: equilibrium concept and the chain entrant's weight

- One lattice game on the site grid, no market partition; strategies on own local features x_{st}
- Local moment-based equilibrium [Ifrach and Weintraub, 2017]: chain neighbors by banner = dominant, independent count = fringe
- Entry rows: rivals saw s occupied in $t+1$; reweight the $t+2$ term by $w_s = \prod_{j \in J(s)} \hat{P}_j\left(a^*_{j,t+1} \mid x_{j,t+1} - e_s\right) / \hat{P}_j\left(a^*_{j,t+1} \mid x_{j,t+1}\right)$
- $J(s)$: chain stores within 10 mi and open slots within 2 mi of s
- $a^*_{j,t+1}$: j's action in $t+1$; $x_{j,t+1} - e_s$: j's features with s counted as vacant
- Corrects the kernel, not the beliefs: only rivals' $t+1$ actions differ across the two paths
- Dimension = internalized neighbors: no small or isolated markets needed

◂ Back

Appendix: finite dependence, independents (renewal exit)

Exit returns the operator to the entrant position at the slot; the same correction on both margins:

$$\ell_I^X(x_{st}) = \beta\,\mathbb{E}\big[\psi^I\big(\pi^{*,I}_{s,t+1} - \phi^I(s)\big) + \ln P^E_{\varnothing}(x_{s,t+1}) - \ln P^X_I(x_{s,t+1}) \,\big|\, x_{st}\big]$$

$$\ln \frac{P^E_I(x_{st})}{P^E_{\varnothing}(x_{st})} = -\psi^I \kappa^{E,I} + \beta\,\mathbb{E}\big[\psi^I\big(\pi^{*,I}_{s,t+1} - \phi^I(s)\big) + \ln P^E_{\varnothing}(x_{s,t+1}) - \ln P^X_I(x_{s,t+1}) \,\big|\, x_{st}\big]$$

- In English: "exit now" vs. "stay a year, then exit" differ only in next year's flow + continuing, net of the slot's option, at next year's rates
- No Euler constant; the slot's option treated as independent of last year's occupancy: oblivious, fringe only (omitted ≈ 0.01 vs. κ_u 5–8)
- Linear in $(\psi^\tau, \psi^\tau\phi^\tau, \psi^\tau\kappa^{E,\tau}, \gamma)$, $\beta = 0.95$: no value function, no fixed point; κ^I_u from the within-county-year contrast, immune to profit measurement

▸ Chains ◂ Back

Appendix: point identification; the dispersion is a spread

Why point identification, not bounds

- Profits are *measured in dollars* (demand model); payoff shocks smooth decisions $\Rightarrow$ exit *rates* at each state, not inequalities $\Rightarrow$ equations
- Given dispersion, β, exit convention (chains terminal, independents renewal): fixed cost = level reconciling exit rates with profits
- Caveat: level joint with the convention (chains vs. zero scrap; independents vs. the slot's option, $+0.55$ if terminal); CFs invariant to it

The dispersion is a spread — of what the firm sees and I do not

- Within county-year: leases, acquisition offers, outside options, residual site costs (\$0.8M C, \$0.5M I; XXX pre-rerun)
- *Not* cross-market fixed-cost dispersion: market FEs absorb that — why the fee experiment lives within county-year

▸ Shift-share ▸ Fixed-cost recovery ◂ Back

Appendix: the shift-share that pins the shock dispersion

Split profit into the national component and the payer deviation:

$$\pi_{st}^{*,\tau} = \underbrace{\pi_{st}^{\mathrm{ret},\tau} + \bar{m}_{rt}\, Y_{st}^{\tau}}_{\pi_{st}^{0,\tau}} + \underbrace{\left(m_{r,mt} - \bar{m}_{rt}\right) Y_{st}^{\tau}}_{\text{fee shock} \times \text{fill-volume exposure}}$$

$$\ell_{st}^{X} - \beta\, \hat{C}_{s,t+1} = \beta\psi^{\tau}\, \pi_{s,t+1}^{0,\tau} + \beta\psi^{\tau} \left(m_{r,m,t+1} - \bar{m}_{r,t+1}\right) Y_{s,t+1}^{\tau} - \beta\psi^{\tau}\phi_1^{\tau} k_s - \beta\psi^{\tau} g(r_s)'\gamma - \underbrace{\beta\psi^{\tau}\phi_0^{\tau}(m)}_{\text{market FE}} + \delta_t^{\tau} + e_{s,t+1}$$

- Market FEs absorb rents; year FEs the national margin path
- Flows dated $t+1$, scaled by β, instrumented by their time-t values
- Within county-year: twice the fill volume = twice the dollar shock from the same fee change $\Rightarrow$ exit odds must respond twice as much
- $\psi^{C} = 1.28$, $\psi^{I} = 2.09$ per \$M $\Rightarrow$ $\sigma_{\varepsilon}^{C} =$ \$0.78M, $\sigma_{\varepsilon}^{I} =$ \$0.48M (XXX pre-rerun)

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Appendix: fixed-cost recovery (point identification)

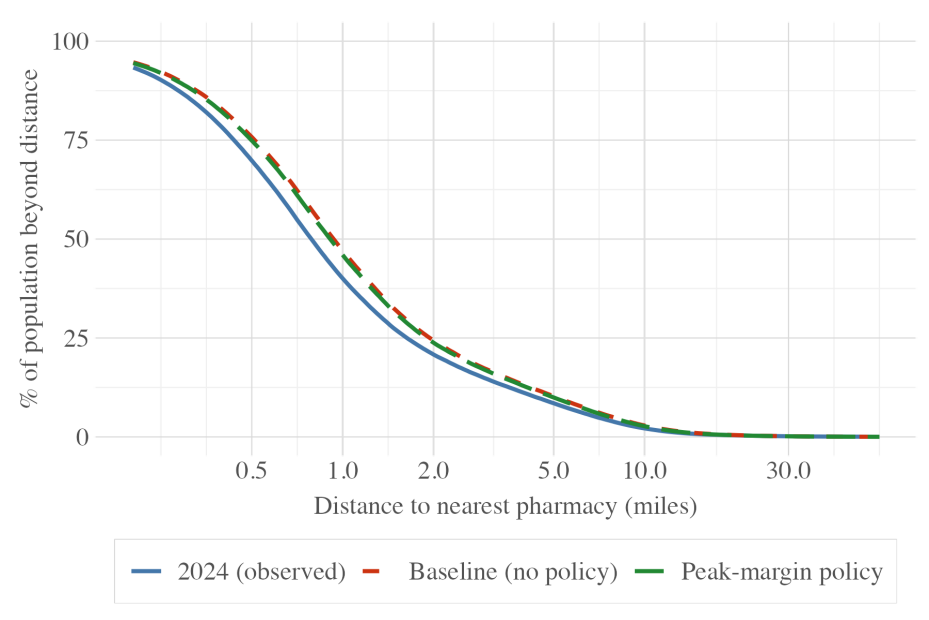
Given $\hat{\psi}^{\tau}$, β, and the exit convention, the operating-cost index is the mean Bellman residual over incumbent site-years:

$$\hat{\phi}_u^{\tau} = \mathbb{E}_w\Big[\hat{\psi}^{\tau}\,\hat{\pi}^{*,\tau}(x_{s,t+1}, k_j) - \beta^{-1}\big(\hat{\ell}_{\tau}^{x}(x_{st}, k_j) - \beta\,\hat{C}_{s,t+1}\big)\Big], \qquad \hat{\phi}^{\tau} = \hat{\phi}_u^{\tau}\,\hat{\sigma}_{\varepsilon}^{\tau}$$

- Equations, not inequalities: smooth exit *rates* at every state plus dollar profits $\Rightarrow$ the level is pinned
- Level vs. zero scrap for chains (Euler constant on the stay side); vs. the slot's option for independents ($+0.55\,\sigma$ if terminal)
- $\phi^{C} =$ \$3.78M vs. Walgreens \$3.5–4.1M; $\phi^{I} =$ \$1.25M vs. audited \$0.35–1.28M XXX: pre-rerun
- Counterfactuals invariant to the levels

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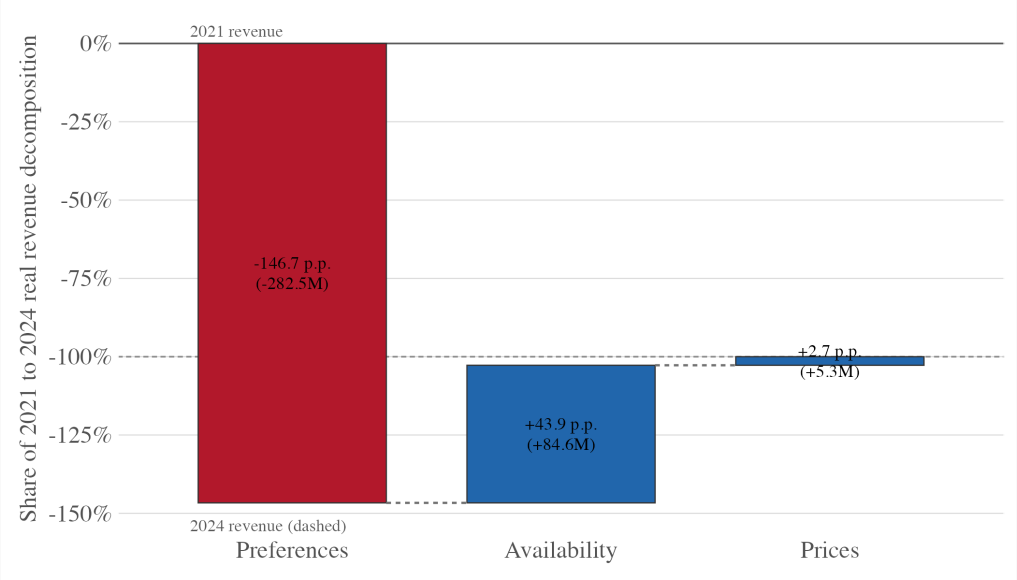
Appendix: even removing 26,000 stores barely moves distance



- Mean 1.8 → 2.1 mi, Median 0.8 → 0.9 mi, Share >10 mi: 2.1 → 2.9%
- Marginal closures have a neighbor nearby XXX: pre-rerun numbers

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Decomposing chain front-store collapse



- 2021 $\rightarrow$ 2024, -26.6%
- Shopping environment alone: $\sim 1.5\times$ the total decline
- Store-network evolution *helped* chains (offset $\sim 44\%$), own price increases roughly revenue-neutral
- In plain terms: people do not buy their CPGs at these stores anymore — the trips that carried the basket no longer happen

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Appendix: exact consumer welfare (compensating variation)

Quasilinearity makes the logsum difference an exact money metric, consumer by consumer:

$$\mathrm{CV}_{it}(\nu) = \frac{1}{\alpha_i}\left[\ln \sum_{c \in \mathcal{C}_{it}^1} e^{w_i(c)-\Gamma_i(c)} - \ln \sum_{c \in \mathcal{C}_{it}^0} e^{w_i(c)-\Gamma_i(c)}\right]$$

- CV = EV (no income effects); $1/\alpha_i$ converts utils to dollars, weighting the change by who values it
- One union-choice-set solve prices all configurations at once; re-pricing enters by duplicating alternatives at counterfactual prices
- Levels not identified (logsum constant) — only differences, as % of modeled spending; adherence health value excluded (lower bound at the desert margin)

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