Introduction to Industrial Organization

Vertical Relationship and Retail Chain

Jian-Da Zhu

National Taiwan University

December 19, 2019

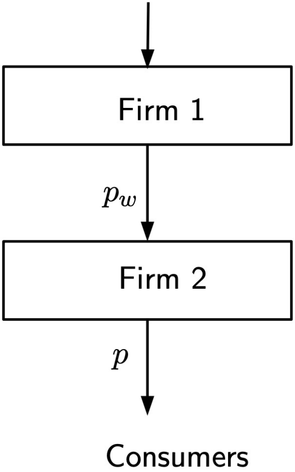
Outline

- Vertical Relationship
  - Overview
  - Vertical Restraints
  - Double Marginalization
- Empirical Studies: Retail Gasoline Market
  - Hastings (2004, AER)
- Retail Chain
  - Ellickson et al (2013, RAND)

Overview and Vertical Restraints

Overview

- Firm 1: upstream firm.
- Firm 2: downstream firm.
- Note:
  - It may not be monopoly. It could be any possible market structure in upstream or downstream parts.
  - If firm 2 does not produce anything from the input (only resell the products), it is called a retailer, and firm 1 is called a wholesaler (manufacture).



Vertical Restraints

a. Linear price: the wholesaler sells the products to the retailer by p_w, and the retailer sells the products at price p in the final good market.
   - Total quantity: $q = D(p)$, where $D(.)$ is the final good market demand.
   - Total payment by retailer $T(q) = p_w q$.

b. Franchise fee (Two-part tariff): the wholesaler charges a franchise fee A and sells products by price p_w for each unit.
   - Total payment by retailer $T(q) = A + p_w q$.

c. Resale Price Maintenance (RPM): the wholesaler restricts the final price p.
   - price ceiling: $p \leq \bar{p}$.
   - price floor: $p \geq \underline{p}$.

   Note : In a special case, the wholesaler can combine these two to set a fixed price: $\bar{p} = \underline{p}$, then $p = \bar{p} = \underline{p}$.

Vertical Restraints

d. Quantity fixing: the wholesaler restricts the quantity sold by the retailer in the final good market.
   - Quantity rationing: $q \leq \bar{q}$.
   - Quantity forcing: $q \geq \underline{q}$.

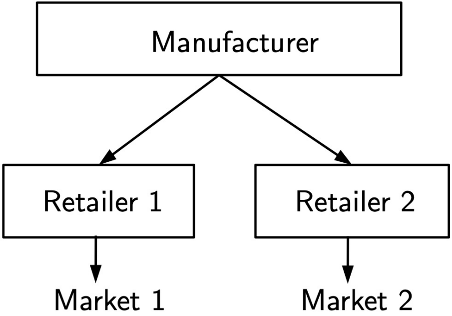
   Note : We assume that the retailer cannot store or dispose of the good. If the demand for the final good $D(.)$ is known, resale price maintenance is equivalent to quantity fixing.

e. Exclusive dealing: an arrangement whereby a retailer or wholesaler is "tied" to purchase from a supplier.
   - For instance, franchised fast food restaurants are required to get their supplies from a particular company.
   - Tied petrol stations that only deal with one petroleum supplier.

Vertical Restraints

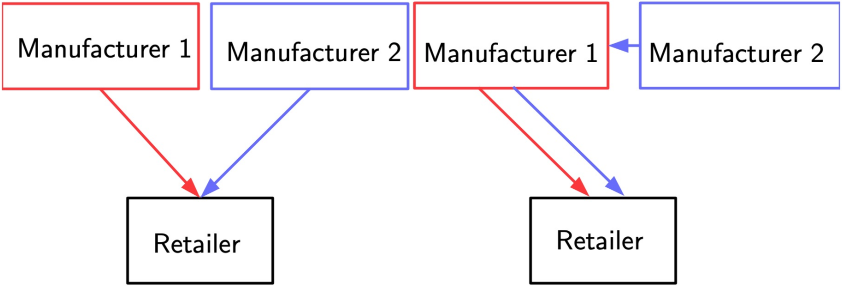
f. Exclusive territories:

- Retailer 1 and retailer 2 sell products in two different markets. (spatial or market segmentation)



Vertical Restraints

g. Tie-in purchase: One of the input suppliers forces the downstream firm to purchase the other input from him.

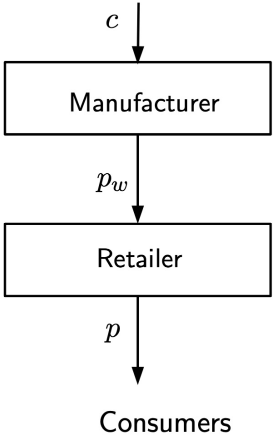


Tie-in Purchase

Double Marginalization

Double Marginalization

- Assumptions:
  - Demand in the final good market: $D(p) = 1 - p$.
  - Linear pricing: p_w.
  - Constant marginal cost for manufacturer: c.
- Obtain the equilibrium in two cases:
  - Decentralized case.
  - Integration case.



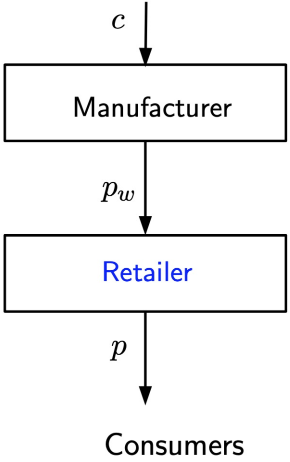
Double Marginalization

- Decentralized case:
  - Retailer's profits maximization problem:

$$\max_p (p - p_w)(1 - p)$$

  - F.O.C:

$$p = \frac{1 + p_w}{2} \equiv p^*(p_w);$$
$$q = \frac{1 - p_w}{2};$$
$$\pi_r = \left(\frac{1 - p_w}{2}\right)^2.$$



Double Marginalization

- Decentralized case:
  - Manufacturer's profits maximization problem:

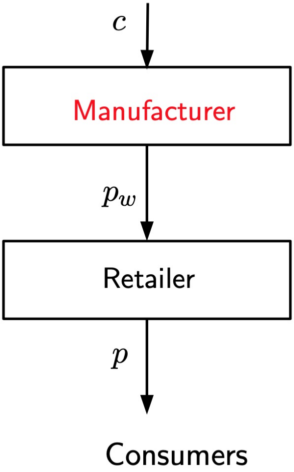
$$\max_{p_w} (p_w - c) D(p^*(p_w))$$

$$\Rightarrow \max_{p_w} (p_w - c)\left(\frac{1 - p_w}{2}\right)$$

  - F.O.C:

$$p_w^D = \frac{1 + c}{2};\ p^D = \frac{3 + c}{4};$$

$$q_w^D = q^D = \frac{1 - c}{4};$$



Double Marginalization

- Decentralized case:
  - Profits for the manufacturer:

$$\pi_m^D = \frac{(1-c)^2}{8}$$

.

  - Profits for the retailer:

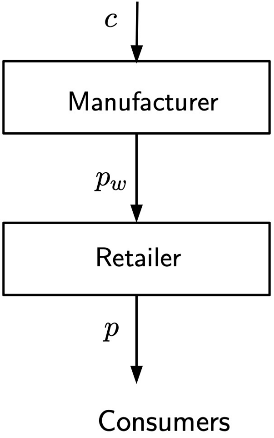
$$\pi_r^D = \frac{(1-c)^2}{16}$$

.

  - Total profits:

$$\pi^D = \pi_m^D + \pi_r^D = \frac{3(1-c)^2}{16}$$

.



Double Marginalization

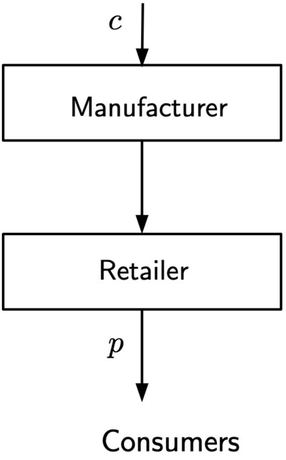
II Integration case:

- Profits maximization problem:

$$\max_p (p-c)(1-p)$$

- F.O.C.:

$$p^I = \frac{1+c}{2};$$
$$q^I = \frac{1-c}{2};$$
$$\pi^I = \frac{(1-c)^2}{4}.$$



Double Marginalization

- Comparison between decentralized and integration cases.
  - The total profits increase after the merger.

$$\pi^I = \frac{(1-c)^2}{4} > \pi^D = \frac{3(1-c)^2}{16}.$$

  - Consumers' welfare is higher under the integration case.

$$p^I = \frac{1+c}{2} < p^D = \frac{3+c}{4};$$
$$q^I = \frac{1-c}{2} > q^D = \frac{1-c}{4}.$$

- A chain of monopolies can induce double price distortion, which is called double marginalization.

Double Marginalization

- Two monopolies produce two complementary goods also have the incentive to integrate with each other horizontally. Profits can be increased after the integration.
- If upstream or downstream industry is competitive, the vertical integration does not increase the profits.
- There are several sufficient vertical restraints other than linear pricing to avoid the welfare loss or profits loss.
    a. Franchise fees
    b. Resale price maintenance
    c. Quantity forcing

Double Marginalization

a. Franchise fees:

$$T(q) = A + p_w q,$$

where $p_w = c$, and $A = ?$

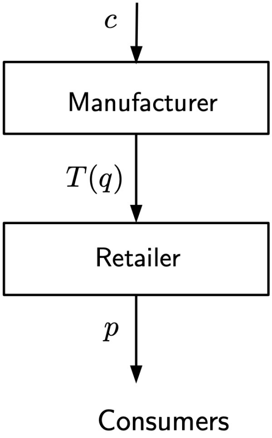
I. Decentralized case:

- Retailer's profits maximization problem:

$$\max_p (p - c)(1 - p) - A$$

- F.O.C:

$$p^D = \frac{1+c}{2};\ q^D = \frac{1-c}{2}.$$



Double Marginalization

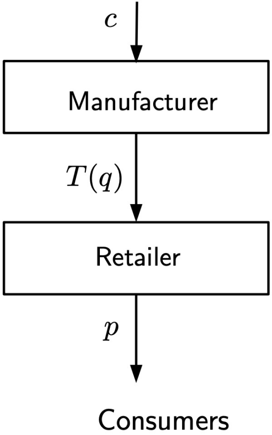
I. Decentralized case:
   - Profits for the retailer:

$$\pi_r^D = \frac{(1-c)^2}{4} - A.$$

   - The manufacturer can set

$$A = \frac{(1-c)^2}{4}.$$

   - $\pi_r^D = 0;\ \pi_m^D = \frac{(1-c)^2}{4}$.
   - $\pi^D = \pi^I = \frac{(1-c)^2}{4}$.
   - Under the franchise fees $T(q) = \frac{(1-c)^2}{4} + cq$, there is no profits or welfare loss.



Double Marginalization

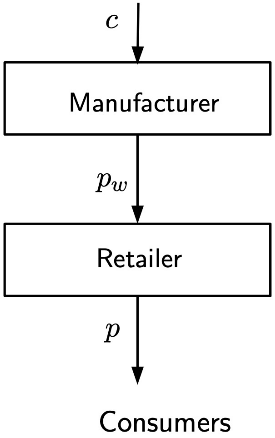
b. Resale price maintenance (RPM):

$$p_w = p^I = \frac{1+c}{2}, \text{and } p \leq p^I.$$

c. Quantity forcing:

$$p_w = p^I = \frac{1+c}{2}, \text{and } q \geq q^I,$$

where $q^I = \frac{1-c}{2}$.



Empirical Evidence: Gasoline Retail Market

- The empirical studies usually care about how the vertical relationship affect market competition.
- Hastings (2004, AER), "Vertical Relationships and Competition in Retail Gasoline Markets: Empirical Evidence from Contract Changes in Southern California".
- Since the late 1990's, West Coast cities have experienced high retail gasoline prices than other regions of the country.
- Much of the debate is about the effect of vertical contracts between refiners and retail stations on retail competition and price levels.
- Research question: how does the vertical contracts between refiners and retail stations affect the retail competition and price levels?
- This paper uses an acquisition event to answer this question.

Types of Gasoline Stations

- Two types of gasoline: branded and unbranded.
- If a retail station is a branded station, it can have one of three basic vertical contract types with the branded refiner.
  - Company operated station (company-op):
    - The refiner owns the station and an employee of the refiner manages the station.
    - The refiner sets the retail price directly and pays the employee a salary.
  - Lessee dealer:
    - The refiner owns the station and leases it to a residual claimant.
    - The lessee is responsible for setting the retail price.
  - Dealer-owned station:
    - The retailer owns the station property and signs a contract with a branded refiner to sell its brand of gasoline.
- If a station sells unbranded gasoline, it is an independent gasoline station.

Background of the Event

- In March of 1997, ARCO announced the "long-term" lease of the majority of the independent Thrifty gasoline stations in Southern California.
- Thrifty Oil Company was the largest independent chain of retail gasoline stations in Southern California.
- ARCO branded the Thrifty stations and completed the branding by September 1997.
- Some of the Thrifty stations were converted to lessee-dealer ARCO stations, some were converted to dealer-owned company-supplied or jobber-supplied stations, and some were converted to company-ops.
- Approximately two-thirds of the stations became company-operated ARCO stations, and the remainder were dealer-run.

Research Design: Difference-in-Differences

- The research design is based on a sharp discrete changes provided by the Thrifty purchase.
- The gasoline stations are grouped into local submarkets of stations in direct competition with each other.
- Some stations competed with a Thrifty, and some were not located near any Thrifty station.
- Treatment group: the stations that were competing with a Thrifty station before; control group: all other stations.
- Treatment after ARCO purchase Thrifty: an increase in the market share of company-operated stations
- We can use this research design to test if it has an effect on local prices.

Data

- The data are a panel of station-specific prices available for the months of February, June, October, and December of 1997.
- Area: the greater Los Angeles and San Diego metropolitan areas.
- Market definition: a station with a price observation competes with any station within one mile along a surface street or freeway.
- Treatment definition: there is a Thrifty located within one mile.

Panel A

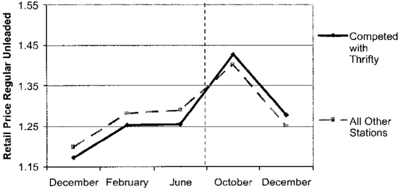
Percent of stations in sample	Los Angeles	San Diego
ARCO	19.41	13.21
Chevron	17.84	17.61
Mobil	15.88	13.21
Shell	14.12	17.61
Texaco	8.43	12.58
Unocal	12.55	11.95
Minor brands	5.25	8.18
Independents	6.52	5.66
Number of observations	$N = 510$	$N = 159$

Panel B

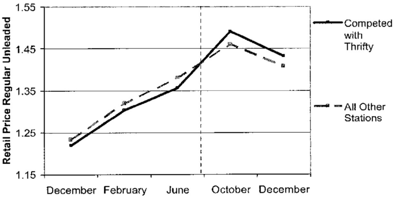
Average price (Standard deviation)	Los Angeles	San Diego
February, 1997	1.273	1.320
	(0.060)	(0.035)
June, 1997	1.285	1.375
	(0.068)	(0.049)
October, 1997	1.405	1.468
	(0.070)	(0.056)
December, 1997	1.266	1.414
	(0.073)	(0.0610)

Difference-in-Differences Results

- The stations in the treatment group had a higher price than the average price of stations in the control group.
- After the conversions, these stations had about a 2- to 3-cent higher average price than other stations.



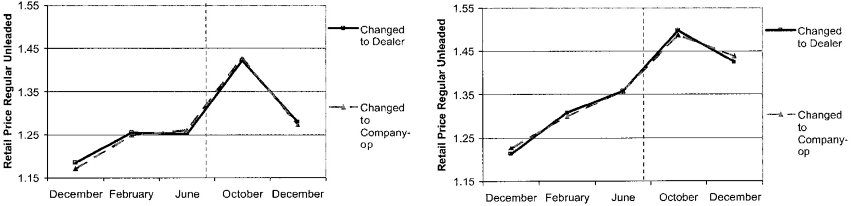
(a) Los Angeles



(b) San Diego

Difference-in-Differences Results

- If we further divide the treatment group into two groups: (i) stations that now compete with a company-op station, and (ii) those that now compete with a dealer.
- The panels show no apparent difference in the price behavior between stations in markets with an increase in the share of company-op ARCOs and those with an increase in the share of dealer-run ARCOs.



(a) Los Angeles (b) San Diego

Summary

- The empirical results indicate that the presence of independent retailers leads to lower local retail prices.
- When these independent retailers are replaced with branded retailers, either company operated or dealer operated, local prices increase.

Retail Chain

Retail Chain

- Definition: A retail chain is a retail outlet in which several locations share a same brand.
- Typical example: Walmart
- Related research issues:
  - Chain store effect: brand effect or other cost-saving effect
  - Cannibalization effect: introducing a new store could decrease the sale of the incumbent stores with the same brand.
  - Entry and market structure: number of stores in the market
  - Entry deterrence: retail chains compete with each others.
  - Location choice problem: an important decision for the retailers.
  - Store formats issue
  - Performance issue

Important Literature

- Structural models for the chain store effect:
  - Jia (2008): WalMart vs Kmart.
    - only two players in a supermodular game
    - only one single store per firm in a location
  - Nishida (2014): Okinawa convenient stores.
    - only two players in a supermodular game
    - allow any number of stores to be placed in a location
  - Holmes (2011): Walmart 1971-2005.
    - Only consider one firm's dynamic decisions
  - Ellickson, Houghton, and Timmins (2013)
    - allow any number of potential rivals (three players in the paper)
    - allow any number of stores to be placed in a location
- Other reduced form papers

Ellickson, Houghton, and Timmins (2013)

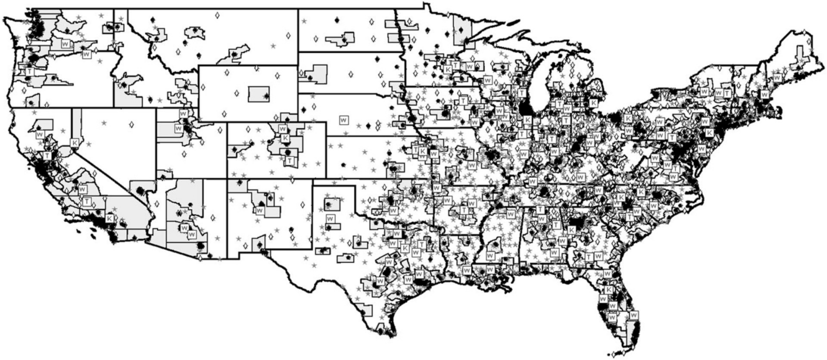
- Research questions: What is the "chain store effect" ?
  - To estimate the parameters in a competition model for chain stores.
  - Simulate the scenario without the chain store effect in the counterfactual experiment.
- Discount store industry: Wal-Mart, Kmart, and Target.
- Two-stage estimation methods:
  - First stage: estimate the strategic components of store-level profits via pairwise maximum score estimation.
  - Second stage: recover set-valued estimates of the common, market-level fixed effect and decompose that fixed effect to estimate the remaining components of firm profit.

Data

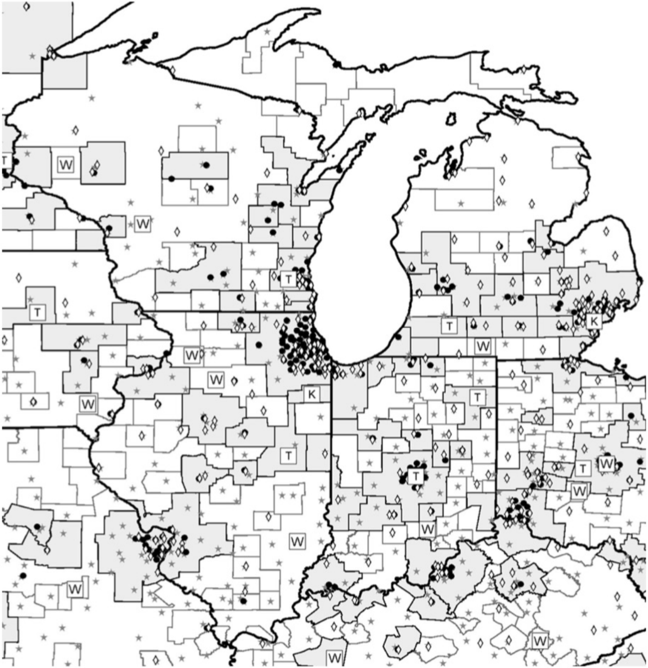
- The data were collected from Trade Dimensions Retail Tenant Database for 2006.
- Data contains all 6150 stores. (Wal-Mart: 3,345; Target: 1,443; Kmart: 1,362)
- Locations for each store and distribution centers.
- Use core-based statistical areas (CBSAs) as a market (a location).
- Of the 1351 markets that contain at least one discount store, 358 are metro areas, 554 are micro areas, and 439 are isolated counties.
- Population and income data for each market.
- Wal-Mart favors rural locations, Kmart smaller urban locales, and Target more urban settings.

Discount Store Industry

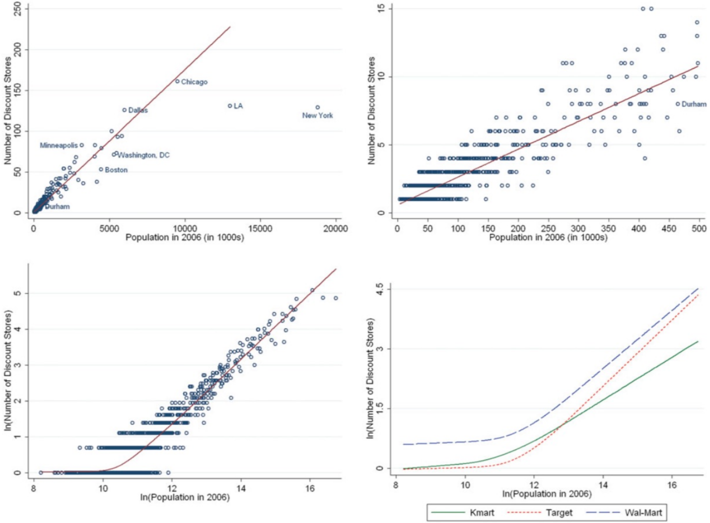
THE DISCOUNT STORE INDUSTRY



Target stores are denoted by solid black circles, Wal-Mart stores are denoted by gray stars, and Kmart stores are denoted by white diamond shapes. Distribution centers appear as squares inset with the operating firm's initial. The shaded regions indicate the boundaries of metropolitan statistical areas. Micropolitan statistical areas and isolated counties, which also serve as markets in our model, have been left off this particular map to improve clarity.


W
W
T
T
W
W
W
K
T
T
K
W
W
T
T
W
T
W
W
W
W
W
W
W

Stores v.s. Population



Model

- The per-store payoff to firm $f = \{T, K, W\}$ of each store in market j as

$$
\begin{aligned}
\pi_j^f =& \beta^{f,Own} \ln(N_j^f + 1) + \beta^{f,Own2} \left(\ln(N_j^f + 1)\right)^2 \\
&+ \beta^{f,Own3} \Big(\ln(Pop_j)\Big) \Big(\ln(N_j^f + 1)\Big) + \beta^{f,Other} \ln(N_j^{-f} + 1) \\
&+ \beta^{f,HQ} \ln(HQ_j^f) + \beta^{f,DC} \ln(DC_j^f) + \beta^{f,X} X_j + \theta_j,
\end{aligned}
$$

where

N_j^f: number of stores firm f operates in market j
N_j^{-f}: number of stores firm f faces in market j
HQ_j^f: distance from market j to firm f's headquarter
DC_j^f: distance from market j to firm f's nearest distribution center.

Model

- Per-store payoff to firm $f = \{T, K, W\}$ in market j:

$$\begin{aligned}\pi_j^f =& \beta^{f,Own}\ln(N_j^f+1) + \beta^{f,Own2}\left(\ln(N_j^f+1)\right)^2 \\ &+\beta^{f,Own3}\left(\ln(Pop_j)\right)\left(\ln(N_j^f+1)\right) + \beta^{f,Other}\ln(N_j^{-f}+1) \\ &+\beta^{f,HQ}\ln(HQ_j^f) + \beta^{f,DC}\ln(DC_j^f) + \beta^{f,X}X_j + \theta_j,\end{aligned}$$

where

X_j: market exogenous attributes, such as income, population, ...($\beta^{W,X} = 0, \forall X$).

θ_j: market-specific fixed effect:

$$\theta_j = f(X_j; \gamma^X) + \xi_j$$

ξ_j: unobserved (to the econometrician) attribute

Model

- Total firm-level profits:

$$\Pi^f = \sum_{j=1}^{J} N_j^f \times \pi_j^f$$

  - $\frac{\partial \pi_j^f}{\partial N_j^f} > 0$: Net agglomeration effect dominates business-stealing effect.
  - $\frac{\partial \pi_j^f}{\partial N_j^f} < 0$: Business-stealing effect dominates net agglomeration effect.
- Three assumptions:
  - Endogenous attributes of each market are firm specific, such as number of stores.
  - Unobserved effect ξ_j is common across firms and additively separable in profit function.
  - After controlling for ξ_j, any remaining errors are median independent of N_j^f, N_j^{-f}, DC_j^f.

Structural Estimates (First-Stage)

	I		II		III		IV		V	
	β	Standard Error	β	Standard Error	β	Standard Error	β	Standard Error	β	Standard Error
Kmart-specific covariates										
$\ln(N_{own}+1)$	−.0808	.0126	−.339	.023	−.348	.023	−.211	.267	[b]	
$(\ln(N_{own}+1))^2$	.0002	.0067	−.038	.0027	−.043	.0026	.031	.097		
$\ln(Pop)(ln(N_{own}+1))$	−.0179	.0026	.0299	.0021	.0317	.0020	.005	.096		
$\ln(N_{Target}+1)$	−.4079	.0098								
$\ln(N_{Walmart}+1)$	−.3792	.0094								
$\ln(N_{other}+1)$			−.620	.011	−.6214	.0134	−.434	.059		
ln(Distance to HQ)	−.0013	.0006	−.0039	.0025	−.0038	.0022	−.072	.061		
ln(Population)	−.050	.010	−.080	.014	−.114	.016	.310	.091		
ln(Income)					.022	.017				
Target-specific covariates										
$\ln(N_{own}+1)$	−.046	.0067	−.134	.025	−.140	.0178	.085	.245	−.046	.016
$(\ln(N_{own}+1))^2$	.014	.0058	.0048	.0036	.0084	.0032	.082	.166	.0038	.002
$\ln(Pop)(ln(N_{own}+1))$	−.0288	.0028	−.0084	.0029	−.010	.0023	−.041	.158	−.0179	.002
$\ln(N_{Kmart}+1)$	−.423	.0076								
$\ln(N_{Walmart}+1)$	−.3798	.0105								
$\ln(N_{other}+1)$			−.527	.011	−.518	.010	−.276	.199	−.596	.0035
ln(Distance to HQ)	−.0153	.0077	−.0012	.0041	.0012	.0037	−.071	.114	.0033	.0015
ln(Population)	.0145	.0107	.042	.016	.013	.016	.436	.156	.021	.013
ln(Income)					.012	.019				
Wal-Mart-specific covariates										
$\ln(N_{own}+1)$	−.039	.012	−.240	.024	−.208	.022	−.295	.129	−.052	.015
$(\ln(N_{own}+1))^2$	.0141	.0072	.0095	.0041	.015	.0036	.102	.029	.008	.003
$\ln(Pop)(ln(N_{own}+1))$	−.0267	.0032	−.011	.003	−.017	.0029	−.028	.017	−.027	.002
$\ln(N_{Target}+1)$	−.4146	.012								
$\ln(N_{Kmart}+1)$	−.4235	.0074								
$\ln(N_{other}+1)$			−.369	.010	−.381	.0089	−.376	.063	−.438	.005
ln(Distance to HQ)	−.0010	.0002	.0019	.0056	−.0028	.0050	−.090	.049	.025	.004
ln(Population)	[a]		[a]		[a]		.358	.052	[a]	
Common covariates										
ln(Distance to DC)	−.00101	.00015	−.0032	.0010	−.0050	.0010	−.029	.012	−.0031	.0011
Number of comparisons	15,000		15,000		15,000		30,000		15,000	
Smoothed maximum score	14,546		13,649.2		13,657.5		21,657		13,193.43	

Results (Model I, First-Stage)

	β	SE	β	SE	β	SE
	K-Mart		Target		Wal-Mart	
$\ln(N_{own}+1)$	-.0808	.0126	-.046	.0067	-.039	.012
$(\ln(N_{own}+1))^2$	.0002	.0067	.014	.0058	.0141	.0072
$\ln(Pop)(\ln(N_{own}+1))$	-.0179	.0026	-.0288	.0028	-.0267	.0032
$\ln(N_{Kmart}+1)$	-	-	-.423	0076	-.4235	.0074
$\ln(N_{Target}+1)$	-.4079	.0098	-	-	-.4146	.012
$\ln(N_{Walmart}+1)$	-.3792	.0094	-.3798	.0105	-	-
ln(Distance to HQ)	-.0013	.0006	-.0153	.0077	-.0010	.0002
ln(Population)	-.050	.010	.0145	.0107	-	-
			Common covariates			
ln(Distance to DC)			-.00101	.00015		
Number of comparisons			15,000			
Smoothed Maximum score			14,546			

Empirical Results

- Target and Kmart both suffer more from the entry of the other than they do from the entry of Wal-Mart, suggesting that they are the closer substitutes.
- Target and Wal-Mart show evidence of greater agglomeration effects than Kmart.
- All firms show the evidence of a negative effect from increasing distance to both headquarters and distribution centers.

Structural Estimates (Second Stage)

TABLE 2 Second-Stage Estimates

	I	III	V
ln(Population)	(.3179, .4095)	(.2212, .2888)	(.2481, .3496)
	[.2883, .4392]	[.1996, .3104]	[.2344, .3633]
ln(Median income)	(−.3555, .3221)	(−.3034, .2327)	(−.3139, .4369)
	[−.4189, −.3848]	[−.3335, .2628]	[−.3426, −.4656]
Constant	(−.0032, −.00054)	(−.00227, −.00017)	(−.0033, −.00037)
	[−.00354, −.000176]	[−.00243, −.000014]	[−.00347, −.000205]

- Larger markets (more population) are more profitable.
- The net effects are all positive for population.
- The set estimates for log median income are neutral.

Empirical Results

TABLE 3 Increase In Population Required To Offset Or Induce Entry

Initial Number of Own Stores, Population	Change	Kmart	Target	Wal-Mart
Originally 1 own store,	1 → 2 own stores	41,078	38,134	36,132
population of 50,000	1 → 2 rivals	68,011	49,419	53,349
Originally 2 own stores,	2 → 3 own stores	89,718	83,881	79,483
population of 150,000	2 → 3 rivals	132,531	100,194	107,370
Originally 4 own stores,	4 → 5 own stores	93,952	86,846	82,170
population of 250,000	4 → 5 rivals	131,287	103,213	109,828
Originally 8 own stores,	8 → 9 own stores	112,231	102,908	97,080
population of 500,000	8 → 9 rivals	148,083	120,623	127,852

- Wal-Mart requires the smallest increase in population to offset another of its own stores.
- Target requires the smallest increase in population to offset the entry of a rival store.

Counterfactual Results

TABLE 4 Counterfactual: Change in Number of Stores

Type of Market	Average Population	Markets with No Change (%)	Average and Net Change in Total Stores	Kmart	Target	Wal-Mart
Isolated counties	24,564	82.9	.10	.08	.86	−.11
			47	36	61	−50
Small micro/metropolitan area	71,677	75.9	−.172	−.02	.14	−.23
			−123	−1	45	−167
Metro > 200,000	323,555	4.9	−.57	−.46	.06	−2.54
			−59	−48	251	−262
Metro > 500,000	691,872	0	6.8	−2.9	2.44	−6.76
			313	−134	758	−311
All	97,649	69.9	.14	−.11	16.47	−.61
			178	−147	1115	−790

- In most of the small metro and non-metro markets, the equilibrium configuration does not change under the counterfactual exercise because they were served by at most one store of each type.

Results

TABLE 4 Counterfactual: Change in Number of Stores

Type of Market	Average Population	Markets with No Change (%)	Average and Net Change in Total Stores	Kmart	Target	Wal-Mart
Isolated counties	24,564	82.9	.10	.08	.86	−.11
			47	36	61	−50
Small micro/metropolitan area	71,677	75.9	−.172	−.02	.14	−.23
			−123	−1	45	−167
Metro > 200,000	323,555	4.9	−.57	−.46	.06	−2.54
			−59	−48	251	−262
Metro > 500,000	691,872	0	6.8	−2.9	2.44	−6.76
			313	−134	758	−311
All	97,649	69.9	.14	−.11	16.47	−.61
			178	−147	1115	−790

- Wal-Mart, which benefits most from local chain effects, is hurt the most under this scenario and ends up opening 790 fewer stores.
- In contrast, Target responds to this reduction in competition by adding 1115 outlets, mostly in the largest markets.

Conclusion

- Wal-Mart benefits most from local chain economies.
- Target shows a greater ability to respond to rival competition.
- Empirical method:
  - Use profit inequalities to offset the market-level fixed effects in the first stage.
  - Use equalized marginal profitability to obtain the boundary for market-level parameters.

Homework 11

- Pick up an industry with upstream and downstream structures.
- In your example, what is the market structure for the upstream and downstream parts?
- Do you know any vertical contract in this industry? Is it similar to any vertical restraint mentioned in the lecture?
- Do you observe any vertical merger from the history? What's the effect of vertical merger?