What Happens When Wal-Mart Comes to Town

Panle Jia

- Review Breshnahan and Reiss

- A some earlier literature of comparative statics and market size

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- $Q = s(a - P)$ so $P = a - \frac{1}{s}Q$ (s is market size)

- $C_i(q) = f + cq$, $a > c$

- Stages

—1.n firms enter

—2.Cournot competition

- Stage 2

—Cournot stage outputs and price

$$q(n) = s\frac{(a-c)}{(n+1)}$$

$$Q(n) = nq$$

$$P(n) = \frac{a}{n+1} + \frac{nc}{n+1}$$

$$\pi(n) = (P-c)\,q$$

$$= s\frac{(a-c)^2}{(n+1)^2}$$

- Stage 1. n^* satisfies:

$$\pi(n^* + 1) - f_{n^*+1} \leq 0$$

$$\pi(n^*) - f_{n^*} \geq 0$$

- Unique equilibrium n^* (almost everywhere)

- Identities of entrants not unique, in general

Sutton (series of books, e.g. Sunk Costs and Market Structure)

- Market size s

- Case of exogenous fixed cost (f_i fixed)

—s increases share of largest firm goes to zero

- Alternative model with endogenous fixed cost

—Firms have marginal cost $c(f)$, $c' < 0$, $c'' > 0$

—What happens as s increases?

- Examples

Bresnahan and Reiss

- How does entry affect profitability?

—Illustrate their approach with an example.

- Two worlds out there.

—Cournot competition world

—Collusive world (ex post)

$$p = P(1) = \frac{a}{2} + \frac{c}{2}$$

$$q = \frac{1}{n}s\left(\frac{a}{2} - \frac{c}{2}\right)$$

$$\pi^{col}(n) = \frac{1}{n}s\left(\frac{a}{2} - \frac{c}{2}\right)^2$$

—Noncooperative in entry. So equilibrium n^{**} is where

$$\pi^{col}(n^{**} + 1) - f \leq 0$$
$$\pi^{col}(n^{**}) - f \geq 0$$

- How distinguish empirically?

—Compare markets that vary by s. Look at counts of numbers of firms (but no cost or price data)

—Look at

$$q(s)$$

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- Still static

- Adds cost complementarities (economies of density)

- Looks at same players across markets (rather than anonymous single unit firms)

Model

- Counties $m = 1, ... M$. (Separate markets)

- $i =$ w (Wal-mart) or k (K-Mart), or s (small stores)

- $D_{i,m} = \{0, 1\}$ entry decision

- Timing: w and k simultaneously move. Then small stores enter (pick up Breshahan and Reiss) have reaction function $N_{s,m}(D_{k,m}, D_{w,m})$.

- Profit of chain i in county m is enter the market is

$$\Pi_{i,m} = X_m \beta_i + \delta_{ij} D_{j,m} + \delta_{is} \ln \left(N_{s,m} + 1 \right)$$
$$+ \delta_{ii} \sum_{l \neq m} \frac{D_{i,l}}{Z_{ml}} + sqrt(1 - \rho^2) \varepsilon_m + \rho \eta_{i,m}$$

otherwise with no entry $\Pi_{i,m} = 0$

- Profit of small firm that enters is

$$X_m \beta_s + \sum_{i=k} \delta_{si} D_{i,m} + \delta_{ss} \ln(N_{s,m}) + \left(1 - \rho^2 \right) \varepsilon_m + \rho \eta_{s,m}$$

Solution Algorithm

Start with only decision theoretic

- Now a convex problem (have an increasing returns) so analog of FONC approach to solve problem not going to work

- Exhaustive search? 2000 rural counties so 2^{2000} different choices

- But can exploit features of the problem to simplify.

- Simplify the notation:

$$\Pi_{i,w} = X_w + \delta_{ww} \sum_{l \neq m} \frac{D_{w,l}}{Z_{ml}}$$

- Necessary condition for $(D_1^*, D_2^*, ... D_M^*)$

$$D_w^* = 1 \left[X_w + 2\delta_{ww} \sum_{l \neq m} \frac{D_{w,l}}{Z_{ml}} \geq 0 \right] \quad \text{all } m$$

- Define

$$V_w(D) = 1 \left[X_w + 2\delta_{ww} \sum_{l \neq m} \frac{D_{w,l}}{Z_{ml}} \geq 0 \right]$$

and $V(D) = (V_1(D), V_2(D), ... V_M(D))$, an increasing function

- Looking for a fixed point of $V(D)$ (optimum is a subset of set of fixed points)

- Tarski Theorem: the set of fixed points is nonempty and contains a greatest point and a least point

  - least point means compared to every other element of the set, it has a zero wherever the other elements have a zero

  - greatest point means compared to every other element of the set, it has a one wherever the other element has a one.

- How find least? Start with $D^0 = (0,0,0,...)$. Look at $D^{t+1} = V(D^t)$. Take limit

- How find greatest? Start with $D^1 = (1,1,...1)$

Now introduce Wal-Mart K-Mart rivalry

- Hard? No easy because of a trick (and generalization of above ideas

- Let $\tilde{D}_k = -D_k$. Define

$$\Pi_w(D_w, \tilde{D}_k) = \sum_m \left[X_{mw} + \delta_{ww} \sum_{l \neq m} \frac{D_{w,l}}{Z_{ml}} + (-\delta_{wk}) \left(-D_{k,m} \right) \right]$$

- Supermodular function (positive cross partials). Marginal benefit of increasing a variable increases when other variables increase. So when $\tilde{D}_k$ increases, this increases marginal benefit to entry for Wal-Mart (Topki's theorem.)

- **Algorithm.** Find good equilibrium for Wal-Mart.

  - STart with $D_k^0 = 0$ for all.

  - Derive $D_w^0 = W(D_k^0)$ from before. (First bound, then do exhaustive search).

  - $D_k^1 = K(D_w^0)$. Iterate till get fixed point..

Table 1 (C): Summary Statistics for the Distance Weighted Number of Adjacent Stores

Variable	1988		1997	
	Mean	Std.	Mean	Std.
Distance Weighted Number of Adjacent Kmart Stores within 50 Miles	0.11	0.08	0.13	0.11
Distance Weighted Number of Adjacent Wal-Mart Stores within 50 Miles	0.10	0.08	0.19	0.19
Number of Counties	2065			

Source: the annual reference "Directory of Discount Department Stores" by Chain Store Guide, Business Guides, Inc., New York.

Table 3: Parameter Estimates from the Full Model

Kmart's Profit			Wal-Mart's Profit			Small Firms' Profit		
Variable	1988	1997	Variable	1988	1997	Variable	1988	1997
Log Population	1.49*	1.84*	Log Population	1.54*	2.16*	Log Population	1.65*	1.90*
	(0.09)	(0.13)		(0.15)	(0.15)		(0.18)	(0.26)
Log Retail Sales	2.19*	2.01*	Log Retail Sales	1.56*	1.85*	Log Retail Sales	1.04*	1.17*
	(0.25)	(0.23)		(0.35)	(0.25)		(0.12)	(0.16)
Urban Ratio	2.07*	1.55*	Urban Ratio	2.19*	1.73*	Urban Ratio	-0.46*	-0.78*
	(0.42)	(0.29)		(0.35)	(0.40)		(0.21)	(0.24)
Midwest	0.40*	0.32*	Log Distance	-1.31*	-1.01*	South	0.88*	1.03*
	(0.12)	(0.14)		(0.16)	(0.14)		(0.14)	(0.17)
Constant	-24.60*	-24.08*	South	0.94*	0.61*	Constant	-10.22*	-11.89*
	(2.07)	(2.07)		(0.13)	(0.11)		(0.98)	(1.56)
			Constant	-10.90*	-16.37*			
				(2.98)	(2.17)			
δ_{kw}	-0.48*	-0.93*	δ_{wk}	-1.54*	-1.13*	δ_{sk}	-1.20*	-1.00*
	(0.22)	(0.29)		(0.21)	(0.30)		(0.23)	(0.20)
δ_{kk}	0.63*	0.75*	δ_{ww}	1.22*	0.89*	δ_{sw}	-1.11*	-1.03*
	(0.20)	(0.36)		(0.43)	(0.39)		(0.16)	(0.21)
δ_{ks}	-0.07	-0.02	δ_{ws}	-0.03	-0.03	δ_{ss}	-2.14*	-2.41*
	(0.05)	(0.05)		(0.11)	(0.12)		(0.28)	(0.35)
ρ	0.53*	0.65*						
	(0.11)	(0.10)						
Function Value	62.84	30.80				Observation Number	2065	2065

Note: * denotes significance at the 5% confidence level, and † denotes significance at the 10% confidence level. Standard errors are in parentheses. See Table 2 for the explanation of the variables and parameters. $\sqrt{1-\rho^2}$ measures the importance of the market-level profit shocks.

Table 8 (A): Number of Small Firms with Different Market Structure

	1988		1997	
	Percent	Total	Percent	Total
No Kmart or Wal-Mart	100.0%	12070	100.0%	10946
Only Kmart in Each Market	54.0%	6519	63.8%	6985
Only Wal-Mart in Each Market	56.7%	6849	63.0%	6898
Both Kmart and Wal-Mart	28.6%	3457	38.4%	4198
Wal-Mart Competes with Kmart	64.9%	7831	64.8%	7090
Wal-Mart Takes Over Kmart	72.9%	8796	72.3%	7918

Table 8 (B): Competition Effect for Kmart and Wal-Mart

	1988		1997	
Number of Kmart Stores	Percent	Total	Percent	Total
Base Case	100.0%	431	100.0%	408
Wm in Each Market	78.0%	336	79.9%	326
Wm Exits Each Market	111.1%	479	149.5%	610
Not Compete with Small	108.1%	466	102.7%	419

	1988		1997	
Number of Wal-Mart Stores	Percent	Total	Percent	Total
Base Case	100.0%	658	100.0%	1014
Km in Each Market	48.3%	318	71.8%	728
Km Exits Each Market	128.6%	846	108.6%	1101
Not Compete with Small	102.6%	675	101.5%	1029

Table 8 (C) : Chain Effect for Kmart and Wal-Mart

	Kmart		Wal-Mart	
	1988	1997	1988	1997
Percentage of Profit Explained by Chain Effect	14.0%	17.4%	10.2%	12.3%
Reduction in Number of Stores with No Chain Effect	40	46	125	109

Note: for the first four rows in Table 8(A), I fix the number of Kmart and Wal-Mart stores as specified and solve for the equilibrium number of small stores. For the last two rows in Table 8(A) and all rows (except for the rows of 'Base Case') in Table 8(B), I re-solve the full model using the specified assumptions. 'Base Case' in Table 8(B) is what we observe in the data when Kmart competes with Wal-Mart.

Table 9: The Impact of Wal-Mart's Expansion on Small Stores

	1988	1997
Observed Decrease in the Number of Small Stores	748	748
Predicted Decrease from the Full Model	558	383
Percentage Explained	75%	51%
Predicted Decrease from Ordered Probit	247	149
Percentage Explained	33%	20%

Note: for the full model, the predicted 558 store exits in 1988 are obtained by simulating the change in the number of small stores using the 1988 coefficients for Kmart's and the small stores' profit functions, but the 1997 coefficients for Wal-Mart's profit function. The column of 1997 uses the 1997 coefficients for Kmart's and small stores' profit functions, but the 1988 coefficients for Wal-Mart's profit function. For the ordered probit model, the predicted store exits are the difference between the expected number of small stores using Wal-Mart's 1988 store number and the expected number of small stores using Wal-Mart's 1997 store number, both of which calculated using the probit coefficient estimates for the indicated year.

Table 10: The Impact of Government Subsidies

	Average Number of Stores		Changes in the Number of Stores Compared to the Base Case	
	1988	1997	1988	1997
Base Case				
Kmart	0.21	0.20		
Wal-Mart	0.32	0.49		
Small Firms	3.79	3.43		
Subsidize Kmart's Profit by 10%				
Kmart	0.22	0.21	0.01	0.01
Wal-Mart	0.31	0.49	-0.01	0.00
Small Firms	3.77	3.41	-0.03	-0.02
Subsidize Wal-Mart's Profit by 10%				
Kmart	0.21	0.19	0.00	-0.01
Wal-Mart	0.34	0.52	0.02	0.03
Small Firms	3.74	3.39	-0.05	-0.04
Subsidize Small Firms' Profit by 100%				
Kmart	0.21	0.20	0.00	0.00
Wal-Mart	0.32	0.49	0.00	0.00
Small Firms	4.61	4.23	0.81	0.80

Note: for each of these counter-factual exercises, I incorporate the change in the subsidized firm's profit and re-solve the model to obtain the equilibrium numbers of stores.