Entry and Competition in Concentrated Markets.

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Estimation of equilibrium price and quantity determi- nation in an oligopoly market:

- Market structure, i.e. the number of incumbent firms is given.
- The firms play two stage game. In the first stage, firms anticipate the oligopoly postentry equilibrium price and quantity before they make a decision whether to enter or not. In the second stage, firms then are in oligopoly equilibrium.

- Entry cost, exit values should be the structural variables determining the market structure. But those variables are not observable. Hence, economic models should be used to recover them.
- Another difficulty is that the potential entrant is not observable either. Here again, assumptions need to be made.
- To estimate the model, cross section of many isolated markets are necessary.

A Simple Model of Entry and Market Size

- Market size is S
- Inverse demand curve is $P = D - \frac{Q}{S}$, where P is the market price and Q is the total quantity. ($D > C$ is assumed)
- If there are n firms, then the output per firm is $q = \frac{Q}{n}$.
- The total cost function of a firm is $C(q) = F + Cq$ where F is the fixed cost, C is the marginal cost.

- Profit function:

$$\pi = \left(D - \frac{(n-1)\overline{q}}{S} + \frac{q}{S} \right) q - (F + Cq)$$

$\overline{q}$: quantity of other firms.

- The first order condition with respect to q is:

$$\pi' = \left(D - \frac{(n-1)\overline{q}}{S} + \frac{q}{S} \right) - \frac{q}{S} - C = 0$$

In equilibrium, because all firms are the same, $\overline{q} = q$. Hence,

$$\frac{(n+1)q}{S} = D - C, q = \frac{(D-C)S}{n+1}$$

$$p = D - \frac{Q}{S} = \frac{D}{n+1} + C\frac{n}{n+1}$$

- Profit

$$\begin{aligned}\pi &= \left(\frac{D}{n+1} + C\frac{n}{n+1}\right) \times \frac{(D-C)S}{n+1} - \left(F + C\frac{(D-C)S}{n+1}\right) \\ &= \left(\frac{D-C}{n+1}\right)^2 S - F\end{aligned}$$

- The market size that gives zero profit for n firms is

$$S = F\left(\frac{n+1}{D-C}\right)^2$$

- The market size per firm that gives zero profit for n firms is

$$S = \frac{F}{n}\left(\frac{n+1}{D-C}\right)^2 \approx n\frac{F}{(D-C)^2}$$

- Zero profit market size for n firms:

$$S = \frac{F}{n}\left(\frac{n+1}{D-C}\right)^2$$

- quantity per firm:

$$q = \frac{(D-C)S}{n+1} = F\frac{n+1}{D-C}$$

- equilibrim price:

$$p = \frac{D}{n+1} + C\frac{n}{n+1}$$

- As market size S increases, so does the number of firms n.
- As market size increases, and number of firms increase, price converges downwards to the competitive price (marginal cost C)
- Quantity per firm increases. As price goes down, higher output per firm is needed for the profit to cover the fixed cost of entry.
- As the number of firms n increases, market size per firm increases as well.

Retail and Professional Market Entry Thresholds

Data

- cross section of geographically concentrated markets.
- 202 isolated local markets (county set in western U.S. that are far away from other towns and cities.)
- Number of firms (doctors, dentists, druggists, plumbers, tire dealers) in each local market. No information on prices, quantities, etc. are used.

Dentist: Minimum population that supports one, two dentists: $S_1 \approx 500$, $S_2 \approx 1,000 \sim 2,000$

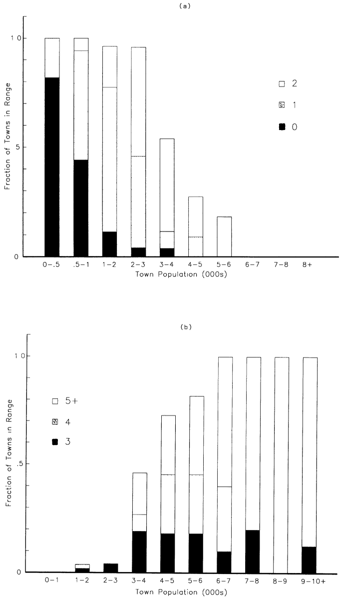

FIG. 3.—Dentists by town population

Model Estimation: Ordered Probit

Empirical Model

Π_N: Profit of a firm in a market that has N firms.

$$\Pi_N = \frac{S(Y, \lambda)}{N} V_N(Z, W, \alpha, \beta) - F_N(W, \gamma) + \epsilon$$

- V_N: Variable profit margin.
- Y: Variable affecting market size.
- Z: Variable affecting demand (demand shifter) given market size.
- W: cost shifter
- ϵ: each firm in the same market has the same error term.

Let

$$\overline{\Pi}_N \equiv \frac{S(Y, \lambda)}{N} V_N(Z, W, \alpha, \beta) - F_N(W, \gamma)$$

Suppose the error term ϵ is i.i.d. $N(0,1)$ distributed. Then, the probability that there is no firm:

$$\begin{aligned} Pr(\Pi_1 < 0) &= Pr\left(\overline{\Pi}_1 + \epsilon < 0\right) = Pr\left(\overline{\Pi}_1 < -\epsilon\right) \\ &= 1 - Pr\left(-\epsilon < \overline{\Pi}_1\right) = 1 - \Phi\left(\overline{\Pi}_1\right) \end{aligned}$$

The probability that there is one firm:

$$\begin{aligned} Pr(\Pi_1 \geq 0, \Pi_2 < 0) &= Pr(\Pi_1 \geq 0) - Pr(\Pi_1 \geq 0, \Pi_2 \geq 0) \\ &= Pr(\Pi_1 \geq 0) - Pr(\Pi_2 \geq 0) = \Phi\left(\overline{\Pi}_1\right) - \Phi\left(\overline{\Pi}_2\right) \end{aligned}$$

because $\Pi_1 = \overline{\Pi}_1 + \epsilon > \Pi_2 = \overline{\Pi}_2 + \epsilon$

The probability that there are N firms:

$$Pr\left(\Pi_N \geq 0, \Pi_{N+1} < 0\right) = \Phi\left(\overline{\Pi}_N\right) - \Phi\left(\overline{\Pi}_{N+1}\right)$$

Form the likelihood based on those probabilities. That is, if a market has N firms, then the likelihood increment of that market is:

$$Pr\left(\Pi_N \geq 0, \Pi_{N+1} < 0\right) = \Phi\left(\overline{\Pi}_N\right) - \Phi\left(\overline{\Pi}_{N+1}\right)$$

Then, if there are $m = 1, ..., M$ markets, each of which have N_m firms, then the likelihood and the log likelihood are:

$$L(\theta) = \prod_{m=1}^{M} \left[\Phi\left(\overline{\Pi}_{N_m}\right) - \Phi\left(\overline{\Pi}_{N_m+1}\right)\right]$$

$$log(L(\theta)) = \sum_{m=1}^{M} log\left[\Phi\left(\overline{\Pi}_{N_m}\right) - \Phi\left(\overline{\Pi}_{N_m+1}\right)\right]$$

Model Specification

$$S(Y,\lambda) = \textit{town pop} + \lambda_1 \textit{nearby pop} + \lambda_2 \textit{posit. growth}$$

$$-\lambda_3 \textit{negat. growth} + \lambda_4 \textit{outside commuters}$$

$$V_N = \alpha_1 + X\beta - \sum_{n=2}^{N} \alpha_n$$

X includes both demand and marginal cost shifter.

$$F_N = \gamma_1 + \gamma_W W + \sum_{n=2}^{N} \gamma_n$$

W: price of agricultural land

Estimation Results

Variable	Doctors	Dentists
$S(Y, \lambda)$		
Nearby Pop.	1.15 (0.86)	-0.46 (0.32)
-growth	-1.89 (0.60)	0.63 (0.85)
+ growth	1.92 (0.01)	-0.35 (0.41)
Commuters	0.80 (1.26)	2.72 (0.98)
X		
Birth Rate	-0.59 (6.57)	9.86 (8.29)
65+ rate	-0.11 (0.55)	0.22 (0.74)
Per capita income	-0.00 (0.00)	0.04 (0.03)
Log heat. days	0.013 (0.05)	0.28 (0.07)

Variable	Doctors	Dentists
α_1	0.63 (0.46)	-1.85 (0.61)
α_2	0.34 (0.17)	
α_3		0.12 (0.14)
α_4	0.07 (0.05)	
α_5		0.20 (0.06)
γ_1	0.92 (0.30)	1.10 (0.25)
γ_2	0.65 (0.30)	1.84 (0.19)
γ_3	0.84 (0.13)	1.14 (0.46)
γ_4	0.18 (0.23)	
γ_5	0.42 (0.13)	0.66 (0.60)
γ_W	-1.02 (0.33)	-1.31 (0.37)

Entry Threshold Estimates (1000s)

	S_1	S_2	S_3	S_4	S_5
Doctors	0.88	3.49	5.78	7.72	9.14
Dentists	0.71	2.54	4.18	5.43	6.41
Druggists	0.53	2.12	5.04	7.67	9.39
Plumbers	1.43	3.02	4.53	6.20	7.47
Tire dealers	0.49	1.78	3.41	4.74	6.10

Entry Threshold:

$$\overline{\Pi}_N = \frac{S(Y,\lambda)}{N} V_N(Z, W, \alpha, \beta) - F_N(W, \gamma) = 0$$

$$\frac{S}{N} = \frac{\overline{F}_N}{\overline{V}_N} = \frac{\hat{\gamma}_1 + \hat{\gamma}_W \overline{W} + \sum_{n=2}^{N} \hat{\gamma}_n}{\hat{\alpha}_1 + \overline{X}\hat{\beta} - \sum_{n=2}^{N} \hat{\alpha}_n}$$

Entry Threshold ratios

	S_2/S_1	S_3/S_2	S_4/S_3	S_5/S_4
Doctors	1.98	1.10	1.00	0.95
Dentists	1.78	0.79	0.97	0.94
Druggists	1.99	1.58	1.14	0.98
Plumbers	1.06	1.00	1.02	0.96
Tire dealers	1.81	1.28	1.04	1.03

- The ratio is very close to 1 once there are more than 2 firms.
- Plumbers have ratios close to 1 at all number of firms.
- It is unlikely that there is a lot of difference in cost of entry.
- Later entrants have higher fixed cost.
- Apart from market size and market structure dummies, there is little intermarket variation in V_N.

- Leakage: commuters from outside have only small effect. Hence, one can assume that the market is isolated. For the sample with less isolated markets, s_{N+1}/s_N is smaller.

Tire price regression (OLS)

Dependent variable: retail tire price.

Constant	26.4 (4.69)	29.9 (4.87)
1	1.88 (2.12)	0.26 (2.33)
2	1.88	-0.62 (2.42)
3	-1.80 (2.05)	-2.60 (2.34)
4	-1.80	-3.36 (2.21)
5	-1.80	-1.99 (2.22)
Urban	-12.1 (2.62)	-11.0 (2.62)
Mileage	0.43 (0.05)	0.38 (0.05)
County retail wage	1.00 (0.53)	0.62 (0.53)
Other dummies	Michelin	11 brands
R sq.	0.43	0.51

Entry lowers prices, hence margins.