Generic Advertising in an Asymmetric Cournot Oligopoly

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Motivation

- Benefit-to-cost ratios for generic advertising programs reported by researchers across a broad range of commodities are in the range of 4:1 to 6:1. Why do we still observe dissatisfactions among producers, particular small ones?

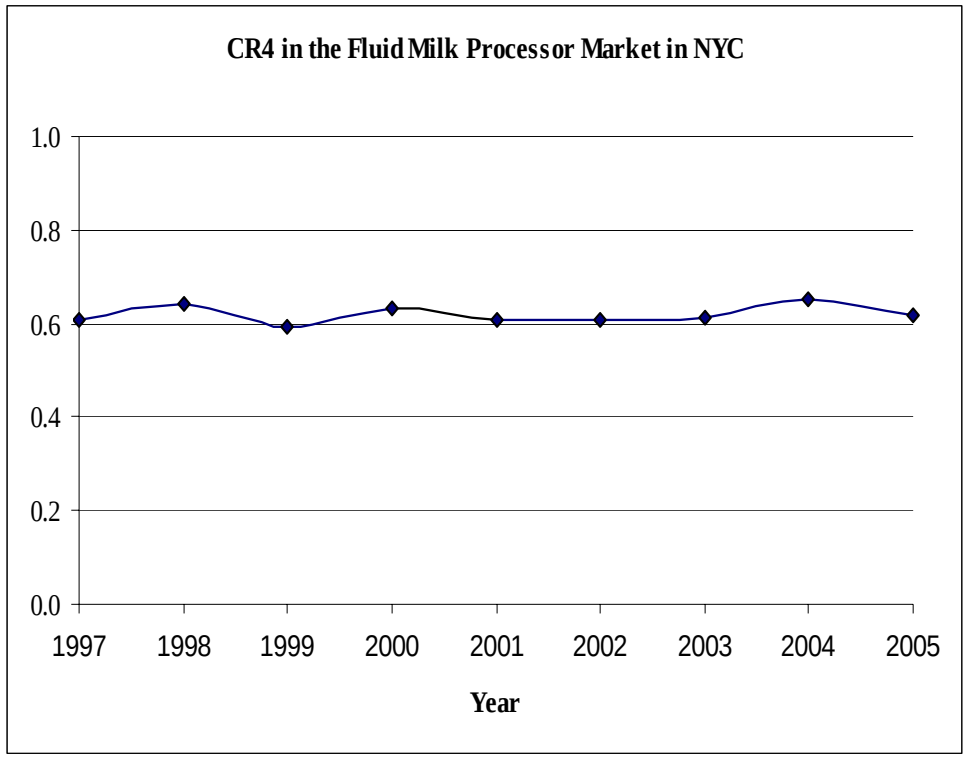
- **Market structure?** The majority of previous studies have evaluated generic advertising impacts under the assumption of perfect competition

- **Demand rotation?** The majority of previous studies have evaluated generic advertising impacts under the assumption that advertising only shifts the market demand curve

Market Structure

- Many industries with ongoing generic advertising have structural characteristics of high market concentration, and/or a dominant firm controlling a significant portion of the market

- In October 2005, Elmhurst Dairy Inc. alone processed 26% of the fluid milk sold in New York City, followed by Farmland Dairies LLC (21%), Oaktree Farm Dairy Inc. (8%), and Cream-O-Land Dairies LLC (7%)

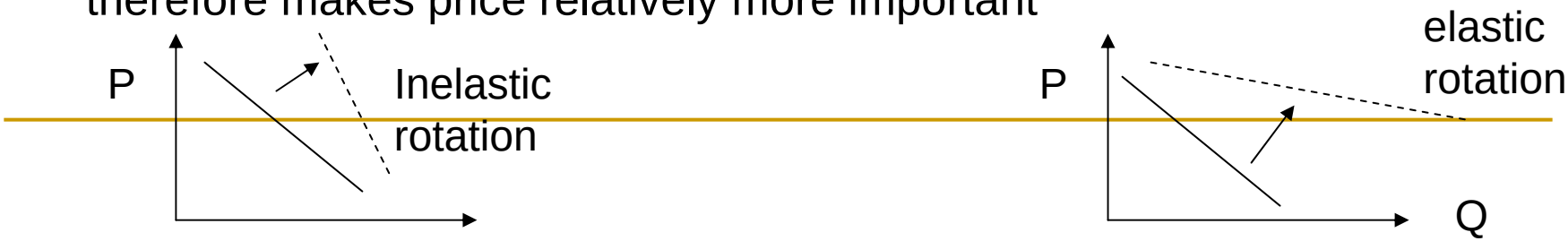


Demand Rotation

Generic advertising can also rotate the market demand curve:

- Generic advertising can rotate the demand curve if it changes the dispersion of consumers' valuation for the product advertised (Johnson and Myatt, 2006; Zheng, Kinnucan and Kaiser, 2008). When fluid milk processors promoted milk's weight loss benefits, this may make those who like milk become milk lovers but dissuade those seeking nutritional elements from milk as a cheap source to purchase milk (inelastic rotation)

- Chakravarti and Janiszewski (2004) show that generic advertising increased the consumer's sensitivity to changes in price for the case of differentiated products. They find that when generic advertising discussed a differentiating attribute, demand for the premium brands (e.g., Tropicana orange juice) increased and demand for the nonpremium brands (e.g., Winn Dixie orange juice) decreased. The reverse is found if generic advertising discussed a nondifferentiating attribute. In both cases, demand rotated counterclockwise (elastic rotation). Their inference is that generic advertising on one attribute reduces accessibility to information about nonadvertised attributes and therefore makes price relatively more important



Objective and Summary Findings

- **Objective:** within the context of an asymmetric Cournot oligopoly, we study how generic advertising affects a firm's profits through three impacts—a cost shock, a demand shift, and a demand rotation force

- **Summary findings:** convex demand or elastic demand rotation favors large firms over small firms

Layout

- Model
- Marketing implication
- Policy implication
- Conclusion

An Asymmetric Cournot Model

Profits for the *i*th firm (for $i = 1,2,\ldots,N$) are

$$\pi_i = P(Q,\tau)q_i - C_i - \tau q_i, \qquad (1)$$

$P = P(Q,\tau)$: the inverse market demand curve

τ: per-unit quantity tax

Q: industry output; q_i: firm i's output

C_i: firm i's total cost; marginal cost is assumed constant, c_i

Model-Continued

Differentiating π_i with respect to q_i yields the first order condition

$$P(Q,\tau)+q_iP_Q(Q,\tau)-c_i-\tau=0. \qquad (2)$$

Totally differentiating (2) and rearranging yield firm *i*'s output change

$$dq_i=-(P_Q+q_iP_{QQ})/P_QdQ-(P_\tau-1+q_iP_{Q\tau})/P_Qd\tau. \qquad (3)$$

Summing (3) over *i* and rearranging yield the industry output effect of τ, $dQ/d\tau$, and the individual firm's output effect, $dq_i/d\tau$. The profit effect can be expressed as $q_iP_Q(dQ/d\tau-dq_i/d\tau)+(P_\tau-1)q_i$ by totally differentiating firm *i*'s profits, and making use of the first order condition.

The Profit Effect

$$\frac{d\pi_i}{d\tau} = \frac{s_i[\overbrace{(P_\tau - 1)(s_i NE - 2E + 2)}^{\text{Net Price Impact}} + \overbrace{QP_{Q\tau}(s_i N + s_i - 2)}^{\text{Supplement al Impact}}]}{-\Omega/(QP_Q)}. \quad \text{Cournot} \quad (4)$$

s_i : firm i's market share. P_τ : marginal price effect.

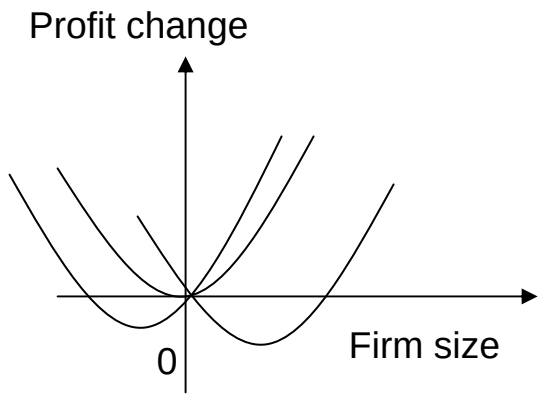
$E \equiv -QP_{QQ}/P_Q$: the elasticity of the inverse demand curve. $E>0$ for convex demand (e.g., constant elasticity of demand); $E<0$ for concave demand; $E=0$ for linear demand.

$P_{Q\tau}$: how P_τ changes with Q . If advertising induces a flatter demand curve (elastic rotation), $P_{Q\tau} > 0$; If advertising induces a steeper demand curve (inelastic rotation0, $P_{Q\tau} < 0$.

$$\frac{d\pi_i}{d\tau} = \frac{2(P_\tau - 1)s_i}{-\Omega/(QP_Q)}. \quad \text{Perfect Competition} \quad (5)$$

- Implications: convex demand or elastic demand rotation generally favors large firms

The Case of Linear Demand



- Since E equals zero for a linear demand curve, the net price impact does not depend on firm size
- Let a general linear demand be $P = a(\tau) - b(\tau)Q$, where $a(\tau) > 0$, $b(\tau) > 0$, $P_\tau = a_\tau - b_\tau Q$, and $P_{Q\tau} = -b_\tau$. Therefore, $b_\tau < 0$ means an elastic rotation and $b_\tau > 0$ means an inelastic rotation

$$\frac{d\pi_i}{d\tau} = \frac{2(a_\tau - 1)s_i - s_i^2 b_\tau Q(N+1)}{-\Omega/(QP_Q)}$$

No rotation		
$b_\tau = 0$	$a_\tau < 1$	Every firm loses
	$a_\tau = 1$	No effect
	$a_\tau > 1$	Every firm gains

Elastic rotation		
		A firm gains if
$b_\tau < 0$	$a_\tau < 1$	$s_i > 2(a_\tau - 1)/[b_\tau Q(N+1)]$
	$a_\tau = 1$	Every firm gains
	$a_\tau > 1$	Every firm gains

Inelastic rotation		
$b_\tau > 0$	$a_\tau < 1$	Every firm loses
	$a_\tau = 1$	Every firm loses
		A firm gains if
	$a_\tau > 1$	$s_i < 2(a_\tau - 1)/[b_\tau Q(N+1)]$

Marketing Implication

- Why some leading firms are willing to initiate voluntary generic advertising programs on their own? E.g., fresh cut flower wholesalers and sugar processors and importers. For elastic rotation, either all firms benefit with large firms disproportionately, or firms with a sufficiently large market share benefiting from the advertising

- If leading firms initiate voluntary generic advertising programs, they want to craft an advertising message that makes the market demand more elastic rather than more inelastic

- When a leading firm considers a voluntary generic advertising, a central issue that needs to be addressed is whether its size is large enough to reap sufficient benefits brought by the advertising-induced demand expansion to cover the related costs?

How Big Should I Be?

A leading firm can profitably fund a voluntary generic advertising program on its own if and only if its market share satisfies

$$(s_1 P_\tau - 1)(s_1 NE - 2E + 2) + s_1 Q P_{Q\tau}(s_1 N + s_1 - 2) - (N-1)(2 - s_1 E) > 0 . \quad \text{General} \qquad (6)$$

$$2(s_1 a_\tau - N) - s_1^2 b_\tau Q(N+1) > 0 . \qquad \text{Linear} \qquad (7)$$

Take $N = 8$, $a_\tau = 5$, $b_\tau = -0.1$ and $Q = 10$ as a numerical example. First, in the absence of demand rotation, the leading firm's market share has to be larger than N / a_τ to profitably fund the program. Second, in the presence of elastic demand rotation, the market share threshold decreases to 0.89, a less strict condition. That is, elastic demand rotation reduces the market share threshold for voluntary generic advertising

Policy Implication

- A number of generic advertising programs exempt the smaller firms from paying the tax. From 1996–2002, processors marketing 500,000 pounds or more per month funded the program. Since August 2002, processors marketing more than 3 million pounds funded the program. Where to draw the cut-off line is an important concern to legislators, marketing boards, and stakeholders, but receives little economic study
- We identify the condition under which an industry can profitably raise the tax for one group while exempting the smaller firms. This condition can be used to determine the upper limit of the cut-off line

The Condition

Raising the tax for Group 1 will increase the industry profits if and only if

$$(w_1 P_\tau - 1)(HNE - 2E + 2) + w_1 Q P_{Q\tau}(HN + H - 2) + 2w_2(1 + N - E) + N_2(HE - 2) > 0. \quad (8)$$

$$2(w_1 a_\tau - 1) - w_1 b_\tau Q(N + 1)H + 2(w_2 + w_2 N - N_2) > 0. \quad \text{Linear} \quad (9)$$

In (9), the market concentration (H, the Herfindahl index), number of firms in the market (N and industry output (Q) are common knowledge to the marketing board (or legislator). Demand convexity (E) and advertising effectiveness (P_τ and $P_{Q\tau}$) are usually obtained by economic valuations. Given ex ante knowledge of the above conditions, the sign of (9) can be solely determined by N_2.

Numerical Example

$$2(w_1 a_\tau - 1) - w_1 b_\tau Q(N+1)H + 2(w_2 + w_2 N - N_2) > 0 . \qquad \text{Linear} \qquad (9)$$

The marketing board needs to *i)* rank firms by size first and *ii)* pick the N_2 smallest firms. The largest N_2 that satisfies (9), denoted as N_2^*, is the maximum number of the smaller firms that are allowed to free ride. The largest firm's production in the N_2^* firms therefore defines the upper limit of the "smaller" firms that are allowed to free ride.

Assume that the eight firms have market shares of 0.4, 0.4, 0.1, 0.04, 0.02, 0.02, 0.01, and 0.01. The industry concentration is 0.33. $a_\tau = 5$ and $b_\tau = -0.1$ are given. For $N_2 = 5$, we have $w_2 = .1$ and the lfs of (9) equals 1.47; For $N_2 = 6$, we have $w_2 = .2$ and the lfs of (9) equals –0.02. Therefore, N_2^* equals five. The largest firm's share among the N_2^* firms is 0.04, which should be used to define the upper limit of the "smaller" firms that are allowed to free ride.

Conclusion

- One message: convex demand or elastic demand rotation favors large firms under imperfect competition

- We suggest that demand rotation be part of program effectiveness evaluations