Advertising Competition in Retail Markets

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Introduction

- Focus: Non-price retail advertising

- Motivating questions:
  - Is non-price retail advertising consistent with equilibrium behavior?
  - Do firms have incentive to achieve restrictions in advertising, either via regulation (or collusion)?
  - Would banning non-price retail advertising raise or reduce consumer welfare?

- Literature on retail advertising
  - The classic empirical study by Benham (1972)
  - Theoretical work by Bagwell-Ramey (1994)

- Literature on regulatory restrictions on advertising
  - Theoretical works are rare
  - Empirical study has mixed findings
We modify Bagwell-Ramey: Firms have private information about production costs.

We purify Bagwell-Ramey:

- The special case where the support of possible costs is sufficiently small: The main predictions of Bagwell and Ramey extend in the incomplete-information game.
- The general case in which the support of possible cost types may be large: We establish conditions under which the main predictions still emerge in the incomplete-information game.

Structure:

- Firms: private cost shocks, choose price and advertising
- Consumers: Informed, Uninformed of advertising

Model finds Advertising, Random, Pricing equilibrium

- Results confirm and extend Bagwell-Ramey themes
- Results consistent with Benham
Introduction, Cont

- Our results:
  - Profit: Pricing eq > Advertising eq
  - Avg.Price: Pricing eq < Advertising eq < Random eq
  - Free-Entry Welfare: Pricing eq > Advertising eq > Random eq

- Benham’s result:
  - Three cases of advertising: Price ad, Non-price ad, Ban ad
  - Pricing: Price ad < Non-price ad < Ban ad

- Associating our result with Benham’s
Static Game
Basic Structure

- \( N \geq 2 \) ex ante identical firms
- Homogeneous good
- Cost: \( \theta \in [\underline{\theta}, \bar{\theta}], F(\theta), f(\theta) \equiv F'(\theta) \)
- Demand: \( D(p) > 0 > D'(p) \)
- Unit Mass of Consumers: \( I \) informed, \( U = 1 - I \) uninformed
  - Informed observe firms’ advertising expenditures
  - Uninformed use random search rule

Stage Game:
- Firms privately observe cost types
- Firms simultaneously choose \((A, p)\): ad levels and prices
- Given any ad info, each consumer chooses a firm to visit, then observes that firm’s price, and demands the corresponding number of units.
Net Revenue and Monopoly Prices

Net Revenue for firm $i$: $r(p, \theta_i) \equiv (p - \theta_i)D(p)$

Monopoly price: $p(\theta_i) = \arg\max r(p, \theta_i)$

- Consumer visits one firm: Monopoly price is embedded
- Extension allows for consumers’ sequential search

$r(p(\theta_i), \theta_i)$ is strictly decreasing

$p(\theta_i)$ is strictly increasing

Assume: $p(\bar{\theta}) > \bar{\theta}$
Advertising, Market Share and Profit

- Symmetric Advertising Strategy for firm $i$: $A(\theta_i) : [\theta, \bar{\theta}] \rightarrow \mathbb{R}_+$
- Firm’s Market Share, $m$: determined by its ad level, rival firms’ ad levels, and consumer search rules
- Expected Market Share: $M(A(\theta_i); A) \equiv E_{\theta_i}[m(A(\theta_i), A(\theta_{-i}))]$
- Interim-stage expected profit (all-pay auction):
  \[
  \Pi(A(\theta_i), \theta_i; A) \equiv r(p(\theta_i), \theta_i)M(A(\theta_i); A) - A(\theta_i)
  \]
  \[
  \equiv R(A(\theta_i), \theta_i; A) - A(\theta_i)
  \]
- Direct Form:
  \[
  \Pi(\hat{\theta}, \theta; A) \equiv \Pi(A(\hat{\theta}), \theta; A) \equiv R(\hat{\theta}, \theta; A) - A(\hat{\theta})
  \]
- SCP: Lower types are more willing to raise advertising to increase market share (profit-if-win is higher)
Equilibrium

- Symmetric Perfect Bayesian Equilibrium
  - Firm: Ad strategy maximizes expected profit, monopoly price embedded
  - Informed Consumer: Bayesian Beliefs. Given ads, visit firm with lowest expected price
  - Uninformed Consumers: Random search

- Focus: Advertising and Random Equilibria
  - Advertising Equilibrium \((\text{Sorting with } \text{str dec } A)\): Informed use advertising search
  - Random Equilibrium \((\text{Pooling with } A = 0)\): All consumers use random search
Proposition 1: There exists a unique advertising equilibrium, and in this equilibrium $A(\theta)$ is strictly decreasing, differentiable and satisfies $A(\bar{\theta}) = 0$.

Advertising search rule is optimal for informed consumers

Fully sorting $A$ and decreasing $M(\theta; A) = \frac{U}{N} + [1 - F(\theta)]^{N-1}I$

Integrate local IC:

$$\Pi(\theta, \theta; A) = r(p(\bar{\theta}), \bar{\theta}) \frac{U}{N} + \int_\theta^{\bar{\theta}} D(p(x)) \left( \frac{U}{N} + [1 - F(x)]^{N-1}I \right) dx$$

profit-at-the-top Information Rent
Expected Profits

- **Advertising Eq**: Integrating by parts, expected profit is:

\[ E_\theta[\Pi(\theta, \theta; A)] = \]

\[ r(p(\bar{\theta}), \bar{\theta}) \frac{U}{N} + E_\theta \left[ D(p(\theta)) \frac{F}{f}(\theta) \left( \frac{U}{N} + [1 - F(\theta)]^{N-1} I \right) \right] \]

- **Random Eq**: Integrating by parts, expected profit is:

\[ E_\theta \left[ r(p(\theta), \theta) \frac{1}{N} \right] = \]

\[ r(p(\bar{\theta}), \bar{\theta}) \frac{1}{N} + E_\theta \left[ D(p(\theta)) \frac{F}{f}(\theta) \left( \frac{1}{N} \right) \right] \]

- Ad Eq induces sorting and thus promotes productive efficiency (lower \( \theta \) has higher \( M \))

- Random Eq induces pooling and thus allocates equal market share: productive efficiency is sacrificed. But ad expenses are avoided
Comparison of Advertising and Random Equilibria

\[ E_\theta[\Pi(\theta, \theta; A)] = \]

\[ r(p(\overline{\theta}), \overline{\theta})M(\overline{\theta}; A) - A(\overline{\theta}) + E_\theta \left[ D(p(\theta)) \frac{F}{f}(\theta)M(\theta; A) \right] \]

- Market allocation:
  - Ad Eq (sorting): \( M(\theta; A) = \frac{U}{N} + [1 - F(\theta)]^{N-1} I \)
  - Random Eq (pooling): \( M(\theta; A) = \frac{1}{N} \)

- Profit-at-top is min under Ad eq but max under Random eq

- Expected information rents:
  - Downward demand: Lower \( \theta \) has higher demand \( D(p(\theta)) \) \( \implies \)
    Increasing \( M \) for lower \( \theta \) is good \( \implies \) Sorting is good
  - Log concavity of \( F \): \( \frac{F}{f}(\theta) \) increases \( \implies \) Increasing \( M \) for high \( \theta \) is good (it relaxes IC for types below \( \theta \)) \( \implies \) Pooling is good
Comparison of Advertising and Random Equilibria, Cont

- **Proposition 2:** (i) Informed consumers enjoy strictly higher expected consumer surplus in the advertising equilibrium than in the random equilibrium, and uninformed consumers enjoy exactly the same expected consumer surplus in both equilibria. (ii) If $F$ is log-concave and $D$ is sufficiently inelastic, or if the support of possible cost types is sufficiently small, then firms make a strictly higher expected profit in the random equilibrium than in the advertising equilibrium.

  - Result (i): Informed consumer expects to pay $E_{\theta}[p(\theta)]$ in the random eq and $E_{\theta}[p(\theta_{\text{min}})]$, where $\theta_{\text{min}} \equiv \min\{\theta_1, \ldots, \theta_N\}$, in the advertising eq.

  - Result (ii): $F$ is log-concave and $D$ is sufficiently inelastic if $D(p(\theta))\frac{F}{\theta} (\theta)$ nondecreasing. Holds also for any constant-elasticity demand, if $\bar{\theta} - \theta$ suff. small.
**Proposition 3:** Assume that $\min(N^s, N^p) \geq 1$. (i) If $F$ is log-concave and $D$ is sufficiently inelastic, or if the support of possible cost types is sufficiently small, then $N^p \geq N^s$ (concentration is at least as high in the advertising equilibrium as in the random equilibrium). (ii) Social surplus is as high in the advertising equilibrium as in the random equilibrium; further, if $N^s \geq 2$, then social surplus is strictly higher in the advertising equilibrium than in the random equilibrium.

- Firms and Uninformed consumers are indifferent between Ad and Random eq
- Informed consumers enjoy lower transaction price in Ad eq
- Welfare ranking requires no addtl' asspts
- Extends Bagwell-Ramey & interprets Benham
Pricing Equilibrium

- Purification of Varian (1980) with incomplete info and $D' < 0$
- Find pricing equilibrium: strictly increasing in $\theta$
- Expected Profit:

$$E_\theta[\Pi(\theta, \theta; \rho)] = r(p(\bar{\theta}), \bar{\theta}) \frac{U}{N} + E_\theta \left[ D(\rho(\theta)) \frac{F}{f}(\theta) \left( \frac{U}{N} + (1 - F(\theta))^{N-1} I \right) \right]$$

- **Proposition 4**: There exists a unique and symmetric pricing equilibrium, and in this equilibrium the pricing function $\rho(\theta)$ satisfies $\rho(\theta) > \theta$ and is strictly increasing and differentiable. Expected profit and consumer surplus are both strictly higher in the pricing equilibrium than in the advertising equilibrium. When the number of firms is endogenized, at least as many firms enter in the pricing equilibrium as in the advertising equilibrium; furthermore, if at least two firms enter in the pricing equilibrium, then social surplus is strictly higher in the pricing equilibrium than in the advertising equilibrium.
Pricing Equilibrium, Cont.

- Same profit-at-the-top as Ad eq. But submonopoly pricing increases in-store demand, elevating expected information rents
  - Ad eq is all-pay auction, Pricing eq is 1st-price auction
  - Downward sloping demand: info rents in Pricing eq depend on bid, even given the market share allocation
  - Cheaper to signal with price than ads

- More complete interpretation of Benham
  - Transaction Prices: price ads < non-price ads < ban ads
  - Long-run Welfare: price ads > non-price ads > ban ads
  - Profit and Concentration: Log-concave $F$ and suff inelastic $D$ $\implies$ more profit and firms when ban ads
Extension: Sequential Search

- Allows for consumers’ sequential search with costs
- Advertising eq exists, where lower cost firms advertise more
- Firms use new pricing function, \( p^*(\theta) \)
- “Limit price” by higher-cost firms deters sequential search of all (random eq) or uninformed (ad eq)
- \( D(p^*(\theta)) \frac{F}{f}(\theta) \) nondec. becomes *more* likely, raising profitability of random eq
Extension: Repeated Game

- Collusion: Is a self-enforcing ban on ads optimal?
- Repeated game with iid cost shocks across firms and time
- Generalization beyond the particular comparison between the advertising and random equilibria
- The same assumption: $F$ is log-concave and $D$ is sufficiently inelastic, or the support of possible cost types is sufficiently small. For patient firms:
  - There exists an optimal SPPE that is stationary, wherein firms pool at zero advertising following all equilibrium-path histories.
  - Any optimal SPPE is stationary, wherein firms pool at zero advertising following all equilibrium-path histories.
Motivating Questions:

- Is non-price retail advertising consistent with equilibrium behavior?
- Do firms have incentive to achieve restrictions in advertising, either via regulation (or collusion)?
- Would banning non-price retail advertising reduce consumer welfare?

Answers: Yes

- Model with incomplete info
- Purify Bagwell-Ramey and include pricing Eq
- Interpret Benham