Part III. Sources of market power

Chapter 6. Advertising and related marketing strategies

Slides

Industrial Organization: Markets and Strategies

Paul Belleflamme and Martin Peitz, 2d Edition

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Chapter 6. Learning objectives

- Understand to what end and to what effect firms devote resources to advertising.
- Be able to distinguish between the different views on advertising: informative, persuasive and complementary advertising.
- Understand how a monopolist chooses advertising expenditures and how this choice affects welfare.
- Understand how advertising decisions are made in oligopoly settings and how they affect price competition.

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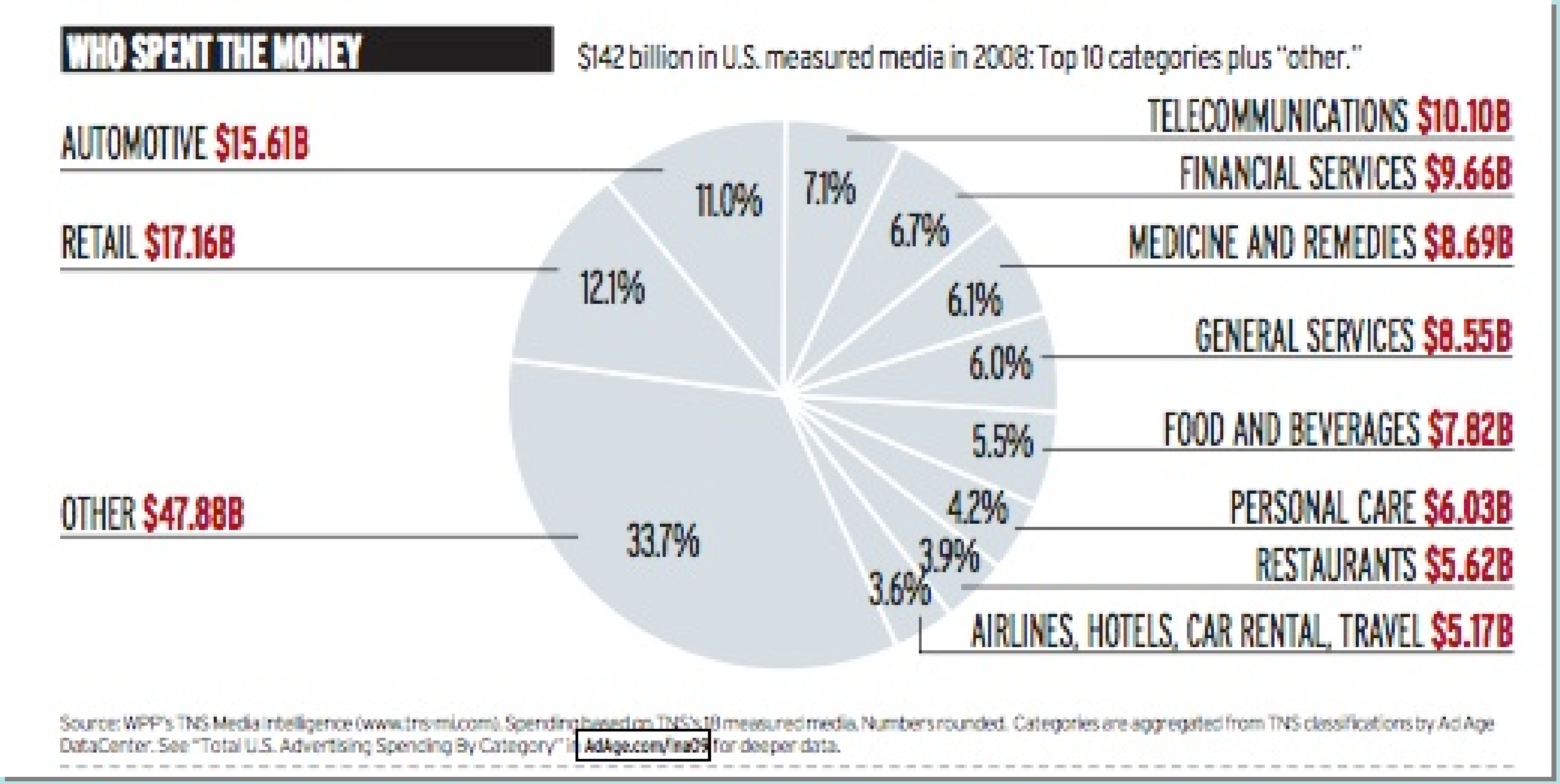
Case. **U.S. media spending on advertising**



(Data from *AdvertisingAge*, July 2009)

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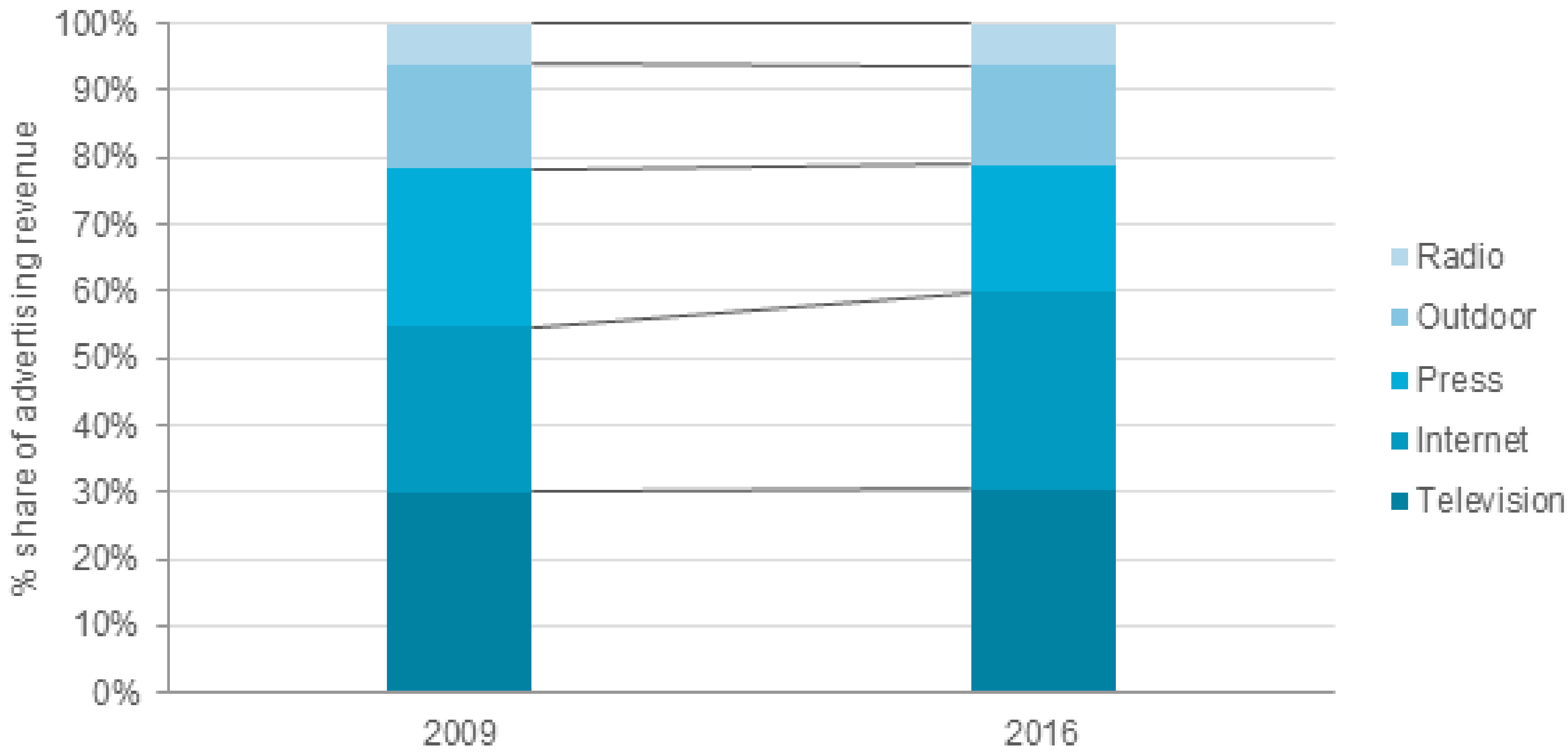
Case. U.S. media spending on advertising



(From *AdvertisingAge*)

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Why do firms advertise?

- ...
- ...
- ...
- ...

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Why do consumers respond to advertising?

- 1st view: advertising is persuasive
  - It alters consumers' tastes.
  - It ↑ product differentiation & consumers' loyalty.
  - Likely effects (to be confirmed)
    - Demand becomes less elastic; prices ↑; entry becomes more difficult; welfare ↓.
- 2nd view: advertising is informative
  - It conveys information about existence, prices and characteristics of products (directly or indirectly).
  - Likely effects (to be confirmed)
    - Demand becomes more elastic; prices ↓; welfare ↑.

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Why do consumers respond to advertising? (cont'd)

- 3rd view: advertising is complementary
  - Complementary to the advertised product.
  - It enters into the consumer's utility function, in complement with the product itself.
    - Idea: consumers consumes 'social images' by combining products and advertising.
  - Likely effects (to be confirmed)
    - Similar to persuasive view.
    - Yet, it may be beneficial through its direct valuation by the consumers.

Having a Louis Vuitton bag may allow you to look as cool as Sean Connery if (1) you actually possess such a bag and (2) the ad links the bag to the cool attitude that you want to project in your relevant peer group.

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How to distinguish the 3 views empirically?

- Classify advertising spots
  - Possible to identify directly informative advertising.
  - Much harder to separate indirectly informative and persuasive advertising.
- Find industries subject to a shock and analyze the effect of advertising on market outcomes
  - E.g., a certain type of advertising becomes (il)legal
- Look at implied purchasing behavior
  - Informative advertising is valuable for inexperienced consumers but not for experienced consumers.
  - Persuasive & complementary advertising affect both types in the same way.
  - Testable hypothesis: *informative advertising affects demand of inexperienced consumers more strongly*.

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Case. **Yoplait 150**

- Data
  - Yoplait 150: 1st low calorie, low fat yogurt, introduced into the US market in 1987.
  - Scanner data collected at Sioux Falls, South Dakota and Springfield, Missouri (about 4,000 households)
  - Weekly prices at drugstores and supermarkets over three years (1986-1988).
  - A.C. Nielsen TV meters: household TV advertisement exposures.
- Main result
  - Advertisement affects initial purchases much more than repeat purchases.
  - Supports the view that *advertising was predominantly informative* in the Yoplait 150 case.

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Price and non-price strategies in monopoly

- Dorfman-Steiner model
  - Include non-price variable into monopoly problem: firm chooses price, p, <u>and</u> advertising expenditure, A.
  - Demand: $Q(p,A)$ with $Q_p < 0$ and $Q_A > 0$ (consumers respond to more advertising by increasing demand)
  - Monopoly's problem: choose p and A to maximize

$$\Pi(p,A) = pQ(p,A) - C(Q(p,A)) - A$$

$$\frac{\partial \Pi}{\partial p} = (p - C')Q_p + Q = 0 \Leftrightarrow \frac{p - C'}{p} = -\frac{Q}{pQ_p} = \frac{1}{\eta_{Q,p}}$$

$$\frac{\partial \Pi}{\partial A} = (p - C')Q_A - 1 = 0 \Leftrightarrow \frac{p - C'}{p} = \frac{1}{Q_A}\frac{1}{p} = \frac{Q}{AQ_A}\frac{A}{pQ} = \frac{1}{\eta_{Q,A}}\frac{A}{pQ}$$

with $\eta_{Q,A} =$ advertising elasticity of demand

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Price and non-price strategies in monopoly (cont'd)

- Dorfman-Steiner model (cont'd)
  - Equating the 2 previous values:

$$\frac{1}{\eta_{Q,p}} = \frac{1}{\eta_{Q,A}} \frac{A}{pQ} \Leftrightarrow \frac{A}{pQ} = \frac{\eta_{Q,A}}{\eta_{Q,p}}$$

Advertising expenditure / revenue
→ *Advertising intensity*

Advertising elasticity of demand /
Price elasticity of demand

- **Lesson**: A monopoly sets its advertising intensity to the ratio of the advertising elasticity of demand over the price elasticity of demand.

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Closer look at how advertising affects demand

- Persuasive advertising
  - Continuum of consumers of mass equal to 1
  - Each consumer buys at most 1 unit of the product
  - Heterogeneous valuation: θ uniformly distributed on $[0,1]$
  - Persuasive advertising 'inflates' consumers' valuations $\rightarrow$ willingness to pay: $g(A)\theta$, with $g(0) = 1$ and $g'(A) > 0$
  - At p, consumers who buy are such that $\theta \geq p/g(A)$
  - Hence, demand is $Q(p,A) = 1 - p/g(A)$
  - Price-elasticity: $\eta_{Q,p} = p/(g(A) - p)$
  - $\downarrow$ with A as $g'(A) > 0$: more advertising makes demand less elastic, as predicted by persuasive view.

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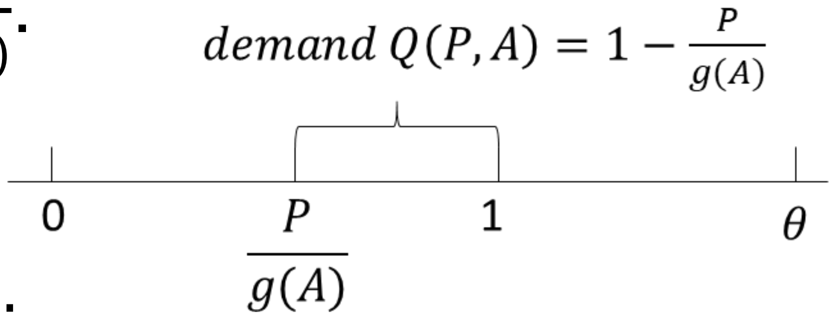
Closer look (cont'd)

- $a_A = \theta g(A) - p > 0$, if $\theta > \frac{p}{g(A)}$.
- Demand $Q(p, A) = 1 - \frac{p}{g(A)}$.



- Price elasticity of demand is

$$\frac{\partial Q}{\partial p}\frac{p}{Q} = -\left(-\frac{1}{g(A)}\right)\frac{p}{1 - \frac{p}{g(A)}} = \frac{p}{g(A) - p}$$

- $\frac{\partial \varepsilon}{\partial A} < 0 \Rightarrow \mathrm{A} \uparrow$, then less elastic demand.

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Closer look (cont'd)

- Informative advertising
  - N consumers, with decreasing demand function, $d(p)$
  - Initially, all consumers are unaware of the product; they are made aware if they receive an ad.
  - Monopolist sends A advertising messages.
  - Same probability for each consumer to receive an ad
  - Probability of not receiving an ad (for N large): $e^{-A/N}$
  - Hence, demand is $Q(p,A) = N(1 - e^{-A/N})\, d(p) \equiv G(A)\, d(p)$
  - Note: $G'(A) > 0 > G''(A)$
  - Price-elasticity: $\eta_{Q,p} = p\, d'(p) / d(p)$, insensitive to the number of advertising messages: more advertising does not make demand less elastic, as predicted by informative view.

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Closer look (cont'd)

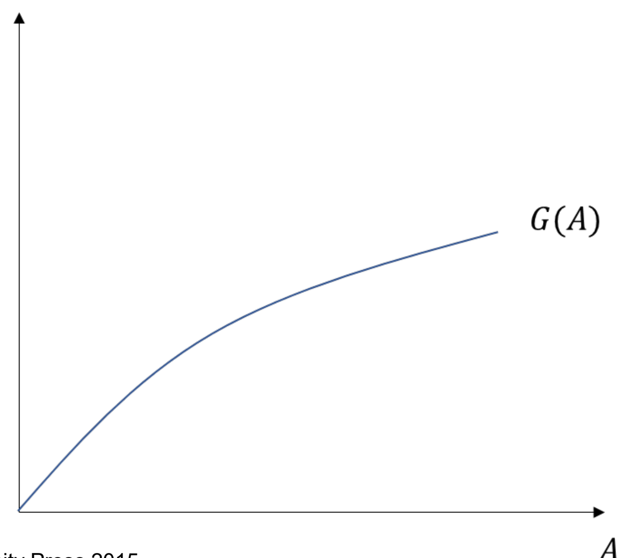
- Probability of not receiving AD is

$$\left(1-\frac{1}{N}\right)^{A} \approx e^{-\frac{A}{N}}$$

- Demand $Q(p,A) = \overbrace{N\underbrace{(1-e^{-\frac{A}{N}})}_{\text{Prob. That an individual consumer receives the AD}}}^{G(A)\text{ is the market expansion effect of ADV.}}\mathrm{d}(\mathrm{p}) \equiv G(A)d(p)$

- $G(A)\ G'(A) = e^{-\frac{A}{N}} > 0$

- $G''(A) = -\frac{e^{-\frac{A}{N}}}{N} < 0$



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Closer look (cont'd)

- Price elasticity:

$$-\frac{\partial Q}{\partial p}\frac{p}{Q} = -d'(p)G(A)\frac{p}{G(A)d(p)} = -\frac{d'(p)}{d(p)}$$

- Price elasticity is unaffected by A, it could be increasing in A.

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Some welfare effects of advertising

- Is advertising socially desirable?
  - We study the issue in the previous monopoly model
    - Starting point: monopoly solution, (p_m, A_m)
    - Change advertising to some nearby level A
    - Monopolist reacts with profit-maximizing price $p_m(A)$
    - Compute change in welfare, where welfare is defined by

$$W(p,A) = \Pi(p,A) + \int_{p}^{r(A)} Q(p,A)\,dp,$$

with $r(A)$ satisfying $Q(r(A),A) = 0.$

Maximum price consumers are willing to pay (may vary with A)

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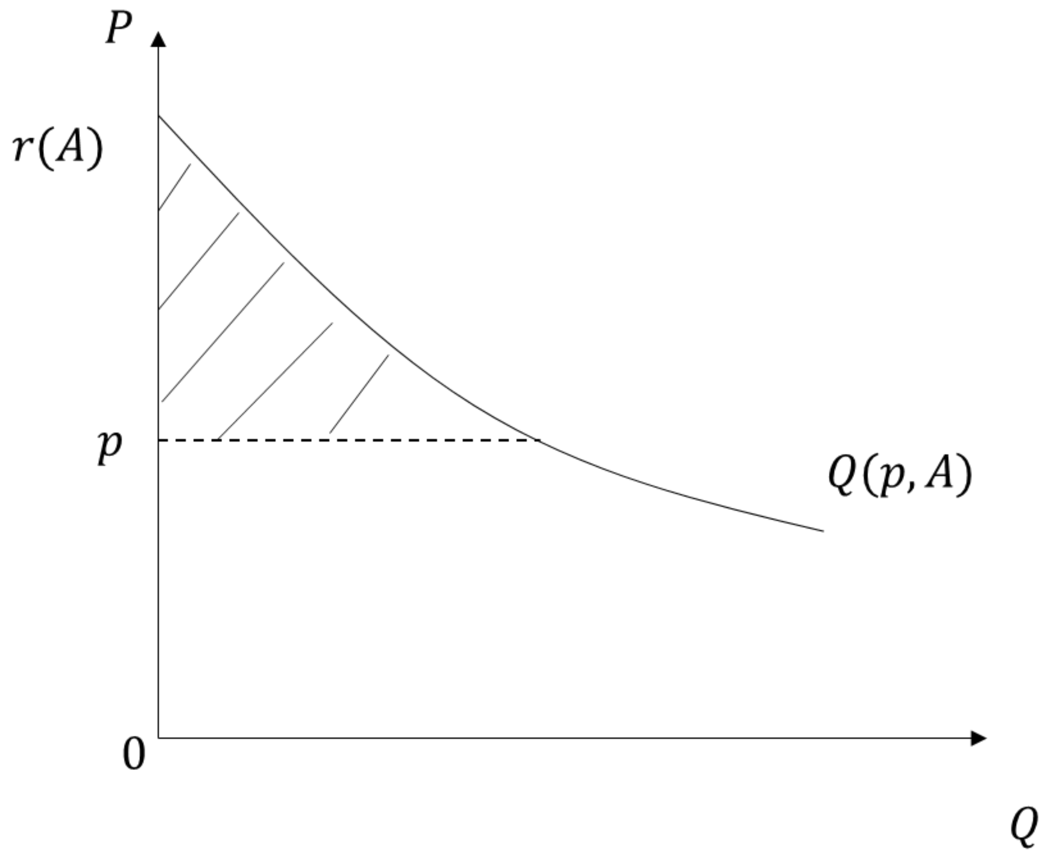
Some welfare effects of advertising (cont'd)



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Some welfare effects of advertising (cont'd)

- We want to evaluate

$$\left.\frac{dW(p_m(A),A)}{dA}\right|_{A=A_m} = \left\{ \underbrace{\frac{d\Pi(p_m(A),A)}{dA} + Q\left(r\left(A\right),A\right)r'\left(A\right)}_{=0} \right.$$
$$\left. -Q\left(p_m\left(A\right),A\right)p'_m\left(A\right) + \int_{p_m(A)}^{r(A)} Q_A\left(p,A\right)dp \right\}\Bigg|_{A=A_m}.$$

$$\Rightarrow \quad \left.\frac{dW\left(p_m\left(A\right),A\right)}{dA}\right|_{A=A_m} \boxed{= -Q\left(p_m,A_m\right)p'_m\left(A_m\right)} + \boxed{\int_{p_m}^{r(A_m)} Q_A\left(p,A_m\right)dp.}$$

If advertising ↑ monopoly price, it ↓ consumer surplus and thus, welfare.

Additional consumer surplus that advertising generates on the infra-marginal units because of the demand shift.

Negative or positive effect

Positive effect

Net effect ?

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Some welfare effects of advertising (cont'd)

- We need to find the sign of $\frac{\partial p_m(A)}{\partial A}$
- $p^m(A)$ solves $\frac{\partial \pi(A^*)}{\partial p} = 0$, the totally differentiating w.r.t. A

$$\frac{\partial^2 \pi}{\partial p^2} dp + \frac{\partial^2 \pi}{\partial p \partial A} dA = 0$$

- Solving for $\frac{\partial p}{\partial A}$,

$$\frac{\partial p}{\partial A} = -\frac{\frac{\partial^2 \pi}{\partial p \partial A}}{\underbrace{\frac{\partial^2 \pi}{\partial^2 p^2}}_{\ominus\text{, by the concavity of profit.}}}$$

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Some welfare effects of advertising (cont'd)

- sign of $\frac{\partial p}{\partial A}$ = sign of $\frac{\partial^2 \pi}{\partial p \partial A}$
- From $\frac{\partial \pi}{\partial p} = (p - c')Q_p + Q$,

$$\frac{\partial^2 \pi}{\partial p \partial A} = Q_A + (p - c')Q_{p,A} - \underbrace{c'' Q_A Q_p}_{\frac{\partial (c' Q_p)}{\partial A} = \frac{\partial c'(Q)}{\partial Q} \frac{\partial Q}{\partial p} \frac{\partial p}{\partial A}}$$

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Some welfare effects of advertising (cont'd)

- Informative advertising
- $Q(p, A) = N\left(1 - e^{-\frac{A}{N}}\right)d(p) \equiv G(A)d(p)$, where $Q_p = G(A)d'(p) < 0$, $Q_A = G'(A)d(p) > 0$, and $Q_{p,A} = G'(A)d'(p) < 0$
- $\frac{\partial^2 \pi}{\partial p \partial A} = G'(A)d'(p) + (p - c')G'(A)d'(p) - c''\, G'(A)d(p)G(A)d'(p)$

$$= G'(A)[\underbrace{d(p) + (p - c')d'(p)}_{0}] - c''Q_A Q_p$$

$$= -c''\underbrace{\underset{\oplus}{Q_A}\,\underset{\ominus}{Q_p}}_{\ominus}$$

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Some welfare effects of advertising (cont'd)

- sign of $\frac{\partial p}{\partial A}$ = sign of c''
- 1) $c'' < 0$ (concave cost) $\Rightarrow \frac{\partial p}{\partial A} < \ 0 \Rightarrow$ first welfare effect is $\oplus \Rightarrow \left.\frac{\partial w}{\partial A}\right|_{A=A_m} > 0$
- 2) $c'' > 0$ (convex cost) $\Rightarrow \frac{\partial p}{\partial A} > \ 0 \Rightarrow$ first welfare effect is $\ominus$ $\Rightarrow \left.\frac{\partial w}{\partial A}\right|_{A=A_m} \gtrless 0$

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Some welfare effects of advertising (cont'd)

- Persuasive advertising
- $Q(p, A) = 1 - \frac{p}{g(A)}$ where $g'(A) > 0,\ g(A) = \alpha A,\ C(Q) = cQ$
- FOC p

$$\frac{\partial \pi}{\partial p} = (p - c')Q_p - Q = 0$$
$$\Rightarrow \frac{\alpha A - 2p + c}{\alpha A} = 0$$
$$\Rightarrow p_m(A) = \frac{\alpha A + c}{2}$$
$$\Rightarrow p'\ (A) = \frac{\alpha}{2} > 0$$

First welfare effect is ⊖

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Some welfare effects of advertising (cont'd)

- FOC A

$$\frac{\partial \pi}{\partial A} = \frac{p(p-c)}{\alpha A^2} - 1 = 0$$

- plugging $p_m(A)$

$$\Rightarrow A_m = \frac{c}{[\alpha(\alpha-4)]^{\frac{1}{2}}}$$

- then

$$p_m(A_m) = \frac{c}{2} + \frac{\alpha c}{2[\alpha(\alpha-4)]^{\frac{1}{2}}}$$

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Some welfare effects of advertising (cont'd)

- **Lesson**: If additional advertising does not cause the monopolist to raise its price, then the monopolist will supply too little advertising. But if it does, then it induces 2 conflicting effects on welfare and the net effect is ambiguous.

- Effect of additional advertising on price?
  - Depends on the nature of advertising and on the monopolist's cost function.
    - Informative advertising: monopoly advertising is socially insufficient if marginal cost is constant or decreasing.
    - Persuasive advertising: even if advertising ↑ monopoly price, monopolist may provide too little advertising.

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Does advertising toughen or soften competition?

- Advertising can play 2 roles
  - "Constructive" role
    - Informs consumers about existence, characteristics and price of products

      $\rightarrow$ ambivalent effect on price competition
    - Or: $\uparrow$ perceived differences between brands

      $\rightarrow$ likely to soften price competition
  - Combative role
    - Helps firms steal each other's business

      $\rightarrow$ likely to toughen price competition
  - This general intuition needs to be confirmed by looking at specific market settings.

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Typologies of advertising

		Effect on rival firms?	
		Constructive role (Positive effect)	Combative role (Negative effect)
Effect on consumers?	Informative	*Promote a whole category of products*	*Inform about prices*
	Persuasive	*Increase perceived differentiation*	*Convince consumers to switch*

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Informative advertising

- Intuition
  - In monopoly, more informative advertising $\rightarrow$ more informed consumers $\rightarrow$ more profits
  - In oligopoly, more informative advertising $\rightarrow$ more informed consumers about several products $\rightarrow$ more intense competition $\rightarrow$ more or less profits?
- Model: extension of Hotelling model
  - 2 firms located at extreme points of $[0,1]$
  - Mass 1 of consumers uniformly distributed on $[0,1]$
  - Utility of consumer x (assuming linear transport costs):

$$\begin{aligned} &r - \tau x - p_1 \text{ if she buys 1 unit of good 1,} \\ &r - \tau(1-x) - p_2 \text{ if she buys 1 unit of good 2.} \end{aligned}$$

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Informative advertising (cont'd)

- Demands
  - Only a share λ_i of consumers know about the existence of product i.
  - Probability of being informed: independent of location
  - 3 types of consumers
    - Fully informed $\rightarrow$ share $\lambda_i \lambda_j \rightarrow$ indifferent consumer:

$$r - \tau\hat{x} - p_1 = r - \tau(1-\hat{x}) - p_2 \Leftrightarrow \hat{x} = \tfrac{1}{2} - \tfrac{1}{2\tau}(p_1 - p_2)$$

    - Partially informed (know good i only) $\rightarrow$ share $\lambda_i(1-\lambda_j) \rightarrow$ buy if

$$r - \tau - p_i \geq 0 \text{ (suppose } r \text{ large enough, so OK)}$$

    - Uninformed $\rightarrow$ share $(1-\lambda_i)(1-\lambda_j) \rightarrow$ don't buy

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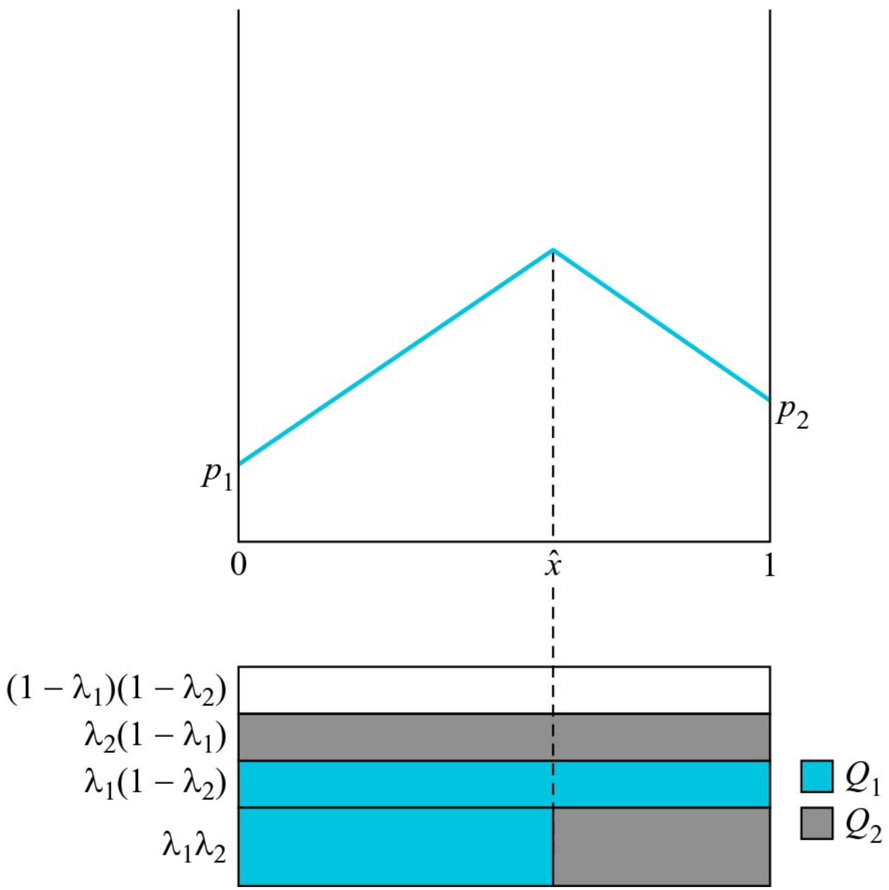
Informative advertising (cont'd)

- Demands (cont'd)



$$
\begin{aligned}
&Q_1(p_1,p_2,\lambda_1,\lambda_2)\\
&=\lambda_1\left[(1-\lambda_2)+\lambda_2\hat{x}(p_1,p_2)\right]\\
&=\lambda_1\left[(1-\lambda_2)+\lambda_2\tfrac{1}{2\tau}(\tau-p_1+p_2)\right]
\end{aligned}
$$

$\Downarrow$

More informative advertising from both firms
$\rightarrow$ larger share of fully informed consumers
$\rightarrow$ larger price elasticity of demand

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Informative advertising (cont'd)

- Price elasticity

$$\eta_{p_1,Q_1} = \frac{\partial Q_1}{\partial p_1}\frac{\partial p_1}{\partial Q_1} = -\frac{\lambda_1\lambda_2}{2\tau}\frac{p_1}{Q_1}$$

- At symmetric prices $p_1 = p_2$

$$\eta_{p_1,Q_1} = \frac{1}{2\tau}\frac{\lambda_2 p}{(1-\lambda_2)+\frac{\lambda_2}{p}} = -\frac{1}{2\tau}\frac{\lambda_2 p}{1-\frac{\lambda_2}{p}} = -\frac{\lambda_2 p}{(2-\lambda_2)\tau}$$

- Evaluated at symmetric adv $\lambda_1 = \lambda_2 = \lambda$

$$\eta_{p_1,Q_1} = -\frac{\lambda p}{(2-\lambda)\tau}$$

$$\frac{\partial\left|\eta_{p_1,Q_1}\right|}{\partial\lambda} = \frac{2p}{(2-\lambda)^2\tau} > 0$$

$\Rightarrow\uparrow\lambda\Rightarrow$demand becomes more elastic

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Informative advertising (cont'd)

- Equilibrium analysis
  - Firms simultaneously set prices and number of ads
    - To inform share λ_i of consumers (about existence, price, characteristics of good i), firm incurs

$$A(\lambda_i) = a\lambda_i^2 / 2$$

  - Firms' program

$$\max_{p_1, \lambda_1} (p_1 - c) Q_1(p_1, p_2, \lambda_1, \lambda_2) - A(\lambda_1); \text{ similarly for firm 2}$$

  - FOCs

$$\frac{\partial \pi_1}{\partial p_1} = \lambda_1 \left[(1 - \lambda_2) + \lambda_2 \tfrac{1}{2\tau} (\tau - 2p_1 + p_2 + c) \right] = 0$$

$$\Leftrightarrow p_1 = \frac{p_2 + c + \tau}{2} + \frac{1 - \lambda_2}{\lambda_2} \tau$$

Higher price than under full information

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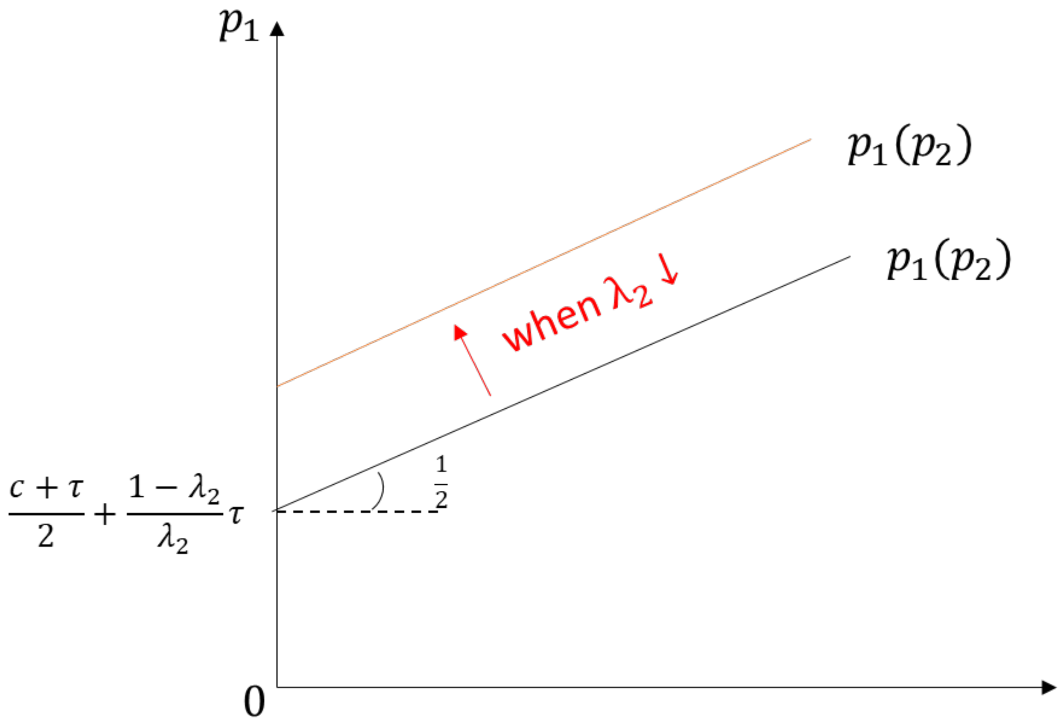
Informative advertising (cont'd)



1) If $\lambda_2 = 1$, $\frac{1-\lambda_2}{\lambda_2}\tau = 0$
2) If $\lambda_2 \in [0,1)$, $\frac{1-\lambda_2}{\lambda_2}\tau > 0$

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Informative advertising (cont'd)

- Equilibrium analysis
  - FOCs

$$\frac{\partial \pi_1}{\partial \lambda_1} = (p_1 - c)\left[(1-\lambda_2) + \lambda_2 \tfrac{1}{2\tau}(\tau - p_1 + p_2)\right] - a\lambda_1 = 0$$

$$\Leftrightarrow \lambda_1 = \frac{1}{a}(p_1 - c)\left[(1-\lambda_2) + \lambda_2 \tfrac{1}{2\tau}(\tau - p_1 + p_2)\right]$$

  - Symmetric equilibrium

$$p^* = \frac{p^* + c + \tau}{2} + \frac{1-\lambda^*}{\lambda^*}\tau \Leftrightarrow p^* = c + \frac{2-\lambda^*}{\lambda^*}\tau$$

$$\lambda^* = \frac{1}{a}(p^* - c)\left[(1-\lambda^*) + \lambda^* \tfrac{1}{2}\right] = \frac{1}{a}\frac{2-\lambda^*}{\lambda^*}\tau\left[(1-\lambda^*) + \lambda^* \tfrac{1}{2}\right]$$

$$\boxed{\lambda^* = \frac{2}{1+\sqrt{2a/\tau}},\ p^* = c + \sqrt{2a\tau},\ \pi^* = \frac{2a}{\left(1+\sqrt{2a/\tau}\right)^2}}$$

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$$\lambda^* = \frac{2}{1+\sqrt{2a/\tau}},\ p^* = c + \sqrt{2a\tau},\ \pi^* = \frac{2a}{\left(1+\sqrt{2a/\tau}\right)^2}$$

Informative advertising

- Observations
  - Higher price than under full information ($a > \tau/2 \Rightarrow p^* > c+\tau$)
    - Why? Lower elasticity of demand $\rightarrow$ higher markup
  - More product differentiation ($\tau\uparrow$) $\rightarrow$ higher prices
    - Stronger effect than under full information
  - Lower advertising cost ($a\downarrow$) $\rightarrow$ lower prices
    - Why? $a\downarrow \rightarrow$ advertising $\uparrow \rightarrow$ more informed consumers $\rightarrow$ more competition $\rightarrow$ prices $\downarrow$
  - Amount of advertising $\uparrow$ when $a\downarrow$ or $\tau\uparrow$
  - Profits increase as advertising becomes more costly
    - Why? Negative direct effect (higher costs) more than compensated by positive strategic effect (lower share of informed consumers $\lambda \rightarrow$ less intense competition)

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Informative advertising

$$p^{Hotelling} = c + \tau \lesseqgtr c + \sqrt{2a}\sqrt{\tau} = p^*$$

$$\Rightarrow \frac{\tau}{2} < a$$

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Informative advertising (cont'd)

- **Lesson**: Due to strategic effects of informative advertising, higher advertising costs translate into more market power → Firms' profits can be higher in a market with higher advertising costs.
- Applications
  - Testable hypothesis: Internet search engines → lower advertising costs → lower profits?
  - Industry lobbying in favor of advertising restrictions?
    - High a seen as collusive device
    - Advertising restrictions self-imposed by certain professions (e.g., lawyers, accountants)

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Persuasive advertising

- Intuition
  - In monopoly, more persuasive advertising $\rightarrow$ outward shift of demand $\rightarrow$ more profits
  - In oligopoly, does the increase in one firm's demand come at the expense of another firm's demand?
    - **Yes** $\rightarrow$ shift of demand between brands $\rightarrow$ business stealing $\rightarrow$ advertising may be excessive (prisoners' dilemma)
    - **No** $\rightarrow$ global demand expansion $\rightarrow$ advertising may be insufficient (public good nature)
- Modelling: 3 extensions of Hotelling model
  - Advertising increases willingness to pay
  - Advertising changes distribution of consumer tastes
  - Advertising increases perceived product differences

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Persuasive advertising (sketch; see details in book)

- Advertising ↑ willingness to pay
  - Utility of consumer x (with λ_i = advertising intensity)

$$\begin{array}{ll} r + \beta\lambda_1 - \tau x - p_1 & \text{if she buys 1 unit of good 1,} \\ r + \beta\lambda_2 - \tau(1 - x) - p_2 & \text{if she buys 1 unit of good 2.} \end{array}$$

- Advertising changes distribution of tastes
  - Symmetric distribution function

$$F(x; \lambda_1, \lambda_2) = (1 + \lambda_1 - \lambda_2)x - (\lambda_1 - \lambda_2)x^2$$

- **Lesson**: In both cases, advertising expenditures are simply a form of wasteful competition: if firms could cooperate, they would agree not to advertise.

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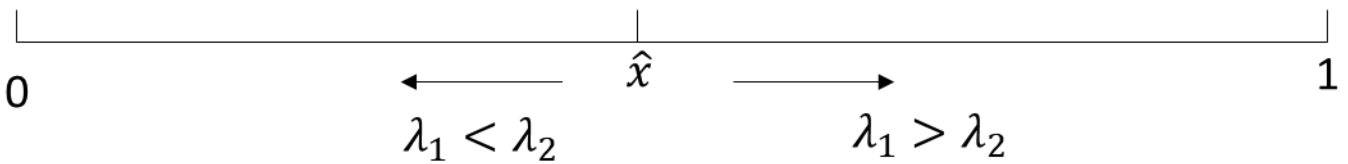
Persuasive advertising (cont'd)

- Indifferent consumer

$$(r + \beta\lambda_1) - \tau\hat{x} - p_1 = (r + \beta\lambda_2) - \tau(1 - \hat{x}) - p_2$$

- Solve for $\hat{x}$

$$\hat{x} = \underbrace{\frac{1}{2} + \frac{p_1 - p_2}{2\tau}}_{\text{old}} + \underbrace{\beta\frac{\lambda_1 - \lambda_2}{2\tau}}_{\text{new}}$$

- 

- If $\beta = 0$, the new term $= 0$;
- if $\lambda_1 = \lambda_2$, the new term $= 0$;
- if $\lambda_1 > \lambda_2$, the new term $> 0, Q_1 \uparrow$;
- if $\lambda_1 < \lambda_2$, the new term $< 0, Q_1 \downarrow$.

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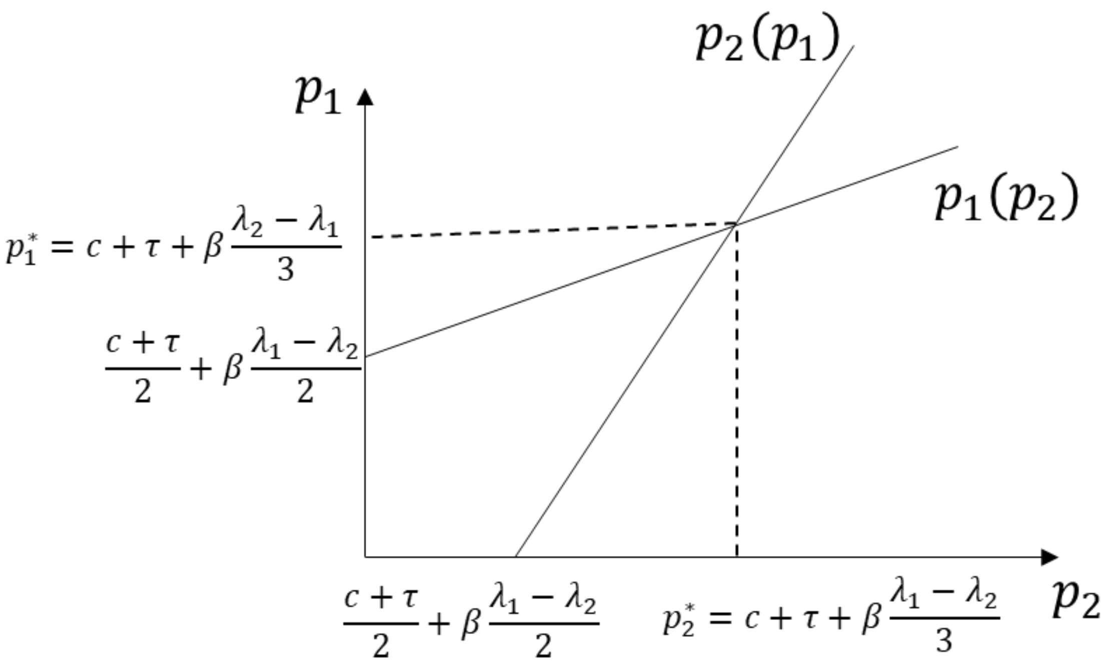
Persuasive advertising (cont'd)

- 2nd stage

$$\max_{p_1} \pi_1 = (p_1 - c)\,\hat{x}$$

- FOC= 0 $\Rightarrow p_1 = \frac{1}{2}(c + \tau + p_2 + \beta(\lambda_1 - \lambda_2)$

$$\pi_1^* = \frac{(3\tau + \beta(\lambda_1 - \lambda_2))^2}{18c}$$



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Persuasive advertising (cont'd)

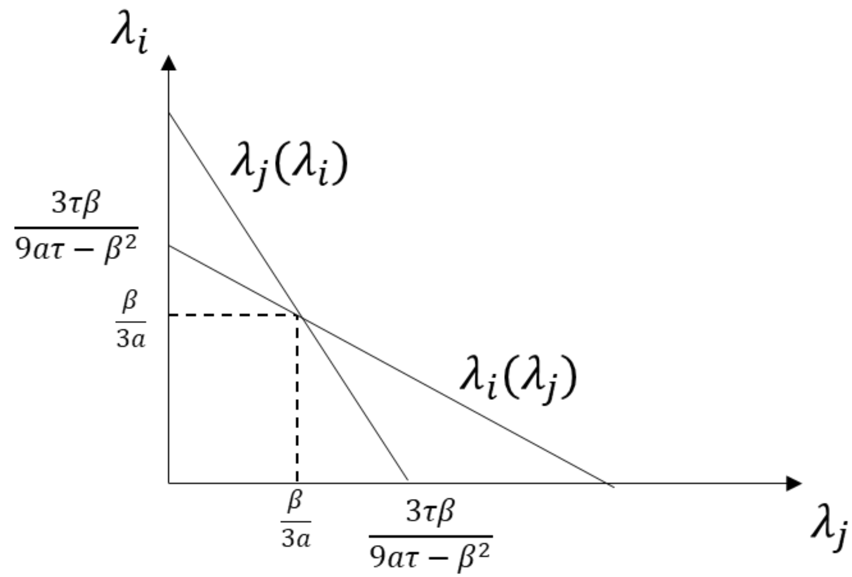
- 1st stage

$$\max_{\lambda_i} \pi_i^* - \frac{a}{2}\lambda_i^2$$

- FOC is

$$\frac{\beta}{9\tau}\left[3\tau + \beta(\lambda_i - \lambda_j)\right] - a\lambda_i = 0$$

- Solve for $\lambda_i(\lambda_j)$, and by symmetry, $\lambda_i^* = \lambda_j^* = \dfrac{\beta}{3a}$



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Persuasive advertising (cont'd)

same as Hotelling

$$p_i^*(\lambda_i^*, \lambda_j^*) = c + \tau + \frac{\beta(\frac{\beta}{3a} - \frac{\beta}{3a})}{3} = c + \tau$$

$$\Rightarrow \pi^* = \underbrace{\frac{\tau}{2} - \frac{\beta^2}{18a}}_{\text{Profits with adv.}} < \frac{\tau}{2}$$

Hotelling profits

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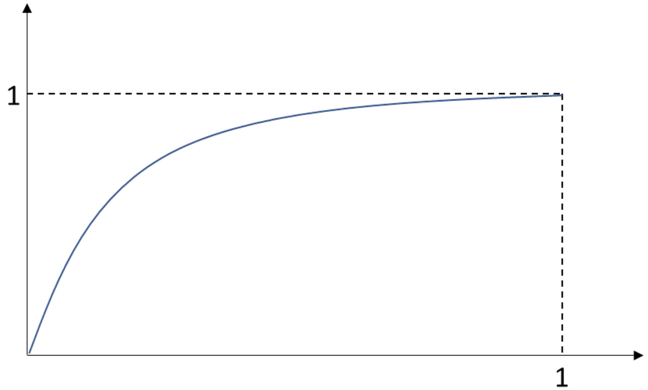
Persuasive advertising (cont'd)

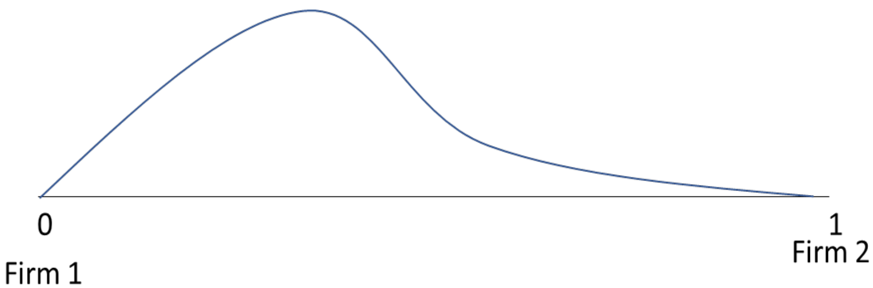
- **Advertising changes distribution of consumer tastes (2nd extension)**

- $F(x,\lambda_1,\lambda_2) = (1+\lambda_1-\lambda_2)x - (\lambda_1-\lambda_2)x^2$
- $f(x,\lambda_1,\lambda_2) = (1+\lambda_1-\lambda_2) - 2(\lambda_1-\lambda_2)x$

① If $\lambda_1 = \lambda_2, \Rightarrow F(x) = x, f(x) = 1$, it is a uniform distribution.

② If $\lambda_1 > \lambda_2$, $F(x)$ is concave.





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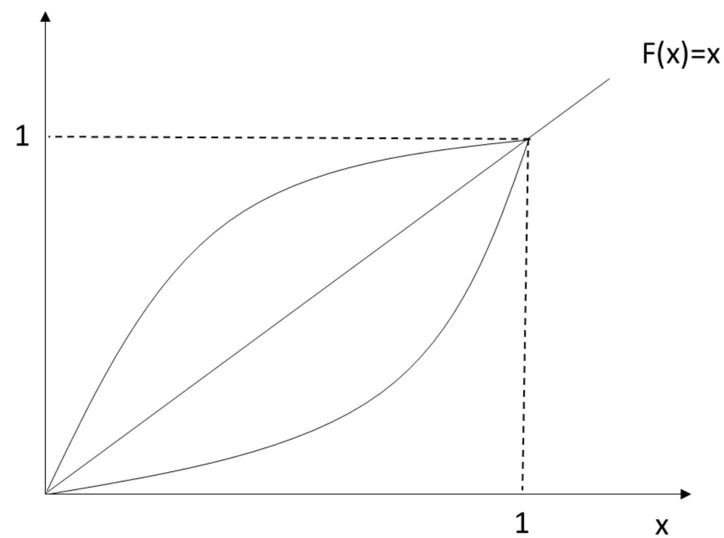
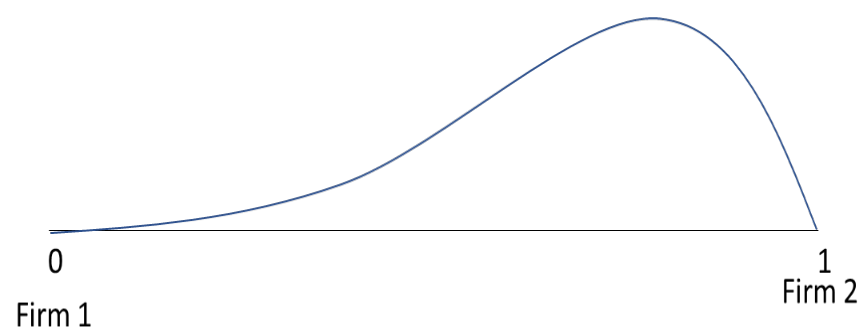
Persuasive advertising (cont'd)

① If $\lambda_1 < \lambda_2$, $F(x)$ is convex.





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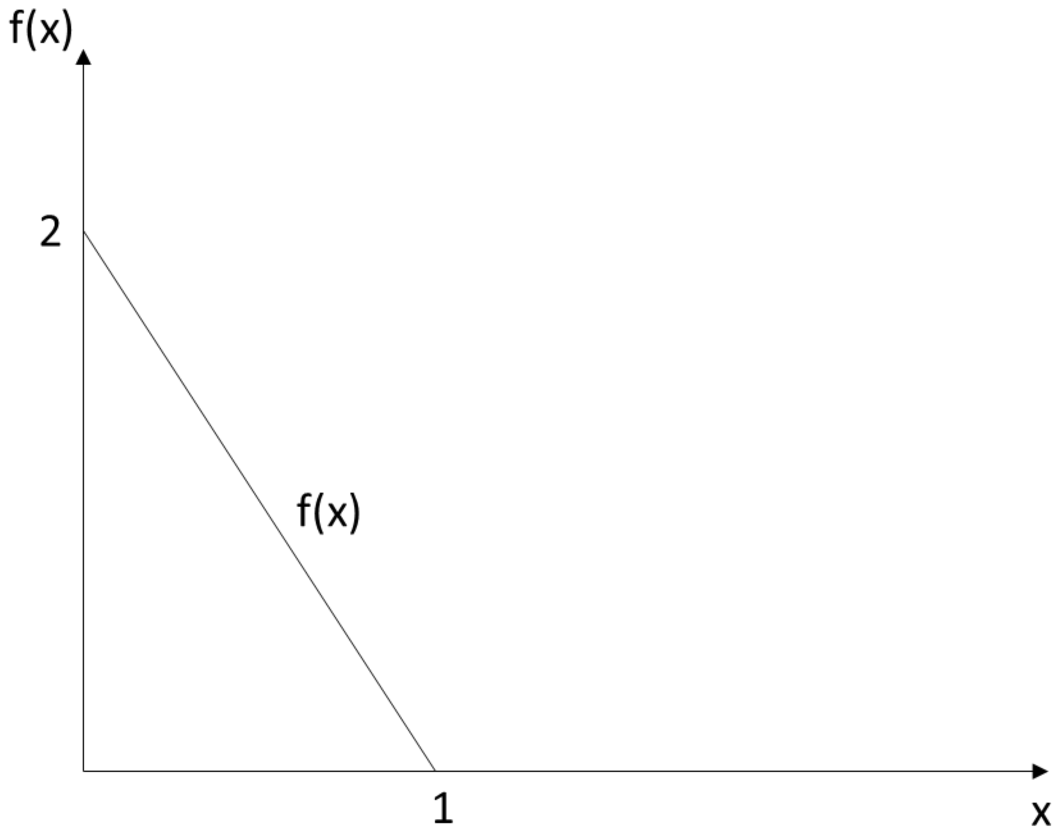
Persuasive advertising (cont'd)

- If $\lambda_1 = 1, \lambda_2 = 0$, then $f(x) = 2 - 2x$



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Persuasive advertising (cont'd)

$$Q_1 = (1 + \lambda_1 - \lambda_2)\left(\frac{1}{2} + \frac{p_2 - p_1}{2\tau}\right) - (\lambda_1 - \lambda_2)(\frac{1}{2} + \frac{p_2 - p_1}{2\tau})^2$$

- Then

$$\max_{p_1,\lambda_1} (p_1 - c)Q_1 - \frac{a}{2}\lambda_1^2$$

(See page 156, bottom).

$\Rightarrow p_1^* = p_2^* = c + \tau \rightarrow$ as in Hotelling

$\Rightarrow \lambda_1^* = \lambda_2^* = \dfrac{\tau}{4a}$

- If you choose λ_1 first and then p_1, $\lambda_1^* = \lambda_2^* = \dfrac{\tau}{6a}$.

$$\pi^* = \underbrace{\frac{\tau}{2} - \frac{\tau^2}{32a}}_{\text{profits with adv.}} < \frac{\tau}{2}$$

Hotelling profit

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Persuasive advertising (cont'd)

- **Advertising increases perceived product differences (3rd extension)**
- The indifferent consumer $\hat{x}$ solves

$$r - (\tau + \beta\lambda_1 + \beta\lambda_2)\hat{x} - p_1 = r - (\tau + \beta\lambda_1 + \beta\lambda_2)(1 - \hat{x}) - p_1$$

$$\Rightarrow \hat{x} = \frac{1}{2} + \frac{p_2 - p_1}{2(\tau + \beta\lambda_1 + \beta\lambda_2)}$$

- 2nd stage

$$\max_{p_1}\ (p_1 - c)\hat{x}$$

$$FOC = 0 \Rightarrow p_1(\lambda_1, \lambda_2) = \underbrace{c + \tau}_{\text{Hotelling}} + \beta(\lambda_1 + \lambda_2)$$

- Then we can solve for π_1

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Persuasive advertising (cont'd)

$$\max_{\lambda_1} \pi_1 - \frac{a}{2}\lambda_1^2$$

- FOC is

$$\frac{\beta}{2} - a\lambda_1 = 0$$

- By symmetry,

$$\lambda_1^* = \lambda_2^* = \frac{\beta}{2a}$$

$$\Rightarrow p_1^* = p_2^* = c + \tau + \beta\left(\frac{\beta}{2a} + \frac{\beta}{2a}\right) = c + \tau + \boxed{\frac{\beta^2}{a}}$$

⊕, higher than in Hotelling

$$\Rightarrow \pi_1^* = \frac{\tau}{2} + \frac{3\beta^2}{8a}$$

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Persuasive advertising (cont'd)

- If firms chooses λ_1, λ_2 cooperatively in the 1st stage,

$$\max_{\lambda_1,\lambda_2} \pi_1 + \pi_2 - \frac{a}{2}\lambda_1^2 - \frac{a}{2}\lambda_2^2$$

$$= \tau + \beta(\lambda_1 + \lambda_2) - \frac{a^2}{2}(\lambda_1 + \lambda_2)$$

- FOC w.r.t. λ_1

$$\beta - a\lambda_1 = 0 \Rightarrow \lambda_1 = \frac{\beta}{a}$$

- FOC w.r.t λ_2

$$\beta - a\lambda_2 = 0 \Rightarrow \lambda_2 = \frac{\beta}{a}$$

twice as much as in equilibrium, $\lambda_1^* = \frac{\beta}{2a}$

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Persuasive advertising (sketch cont'd)

- Advertising $\uparrow$ perceived product differences
  - Advertising intensities affect degree of product differentiation (i.e., transport cost):

$$\tau(\lambda_1, \lambda_2) = \tau + \beta\lambda_1 + \beta\lambda_2$$

- **Lesson**: Here, firms invest in advertising to relax price competition and, thereby, achieve higher profits. Because advertising is a public good, firms would even be better off by coordinating their advertising decisions.

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Review questions

- Which industries advertise a lot? Give two examples and discuss the likely reasons for high advertising expenditures.
- Discuss the difference between persuasive advertising and advertising as a complement.
- Consider informative advertising about a product's existence. Does an increase in the advertising cost function necessarily lead to lower profits? Discuss.
- Discuss possible effects of persuasive advertising under imperfect competition.

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