Lecture 9: Advertising

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There are two polar views on Advertising:

Informative Advertising:

Advertising as information channel.

Firms advertise to promote awareness of products and characteristics (prices and qualities).

This reduces search costs for the consumers and improve market performance.

Persuasive Advertising:

Advertising used to fool consumers.

Using advertising firms can create facke product differentiation.

We focus on informative adverising. Information transmission.

We start with a classical model: advertising and product differentiation.

How are advertising and pricing related to each other?

How do advertising and product differentiation relate to each other?

Do firms overivest or underinvest in advertising?

PRODUCT DIFFERENTIATION AND PRICE ADVERTISING

Simple version of Grossman and Shapiro (1984). Main Ingredients of the model:

Linear city-model: Consumers are uniformly distributed along a segment of lenght 1.

They utility from consuming a product is v. Inelastic demand.

Two firms, 1 and 2, located at the extremes of the segment. Product differentiation is given.

Consumers incur a marginal transportation cost t to buy the product.

Consumers are ex-ante fully ignorante: they do not know the existence of firms. Consumers are inactive: they cannot search. The only way for a transaction to take place is via firms advertising.

Advertising technology

Firms are not able to target their advertising. We will later study a model of targeting advertising.

If a firm, say firm 1, advertises with intensity ϕ_1, then:

(i) ϕ_1 consumers receive the adv.

(ii) firm 1 faces a cost $A(\phi_1) = a\phi_1^2/2$.

Note that the advertising cost function is increasing and convex in effort ϕ.

One-shot game: Frms simulateneoulsy choose their prices and their advertising levels. Symmetric Nash Equilibrium.

Strategy profile is $\{(p_1, \phi_1), (p_2, \phi_2)\}$

Solving the game

Derive the demand of a firm.

Given $s = \{(p_1, \phi_1), (p_2, \phi_2)\}$, we have:

ϕ_1 consumers would observe the price p_1 and the location of firm 1.

Take one of this consumer. Then two possibilities:

(i) with probability $(1 - \phi_2)$ this consumer does not observe the price and the location of firm 2.

This consumer will buy from firm 1 if and only if:

$$v - p_1 - tx > 0$$

where x is the distance between this consumer and firm 1.

(ii) with probability ϕ_2 this consumer also observes the price and the location of firm 2.

This consumer will buy from firm 1 if and only if

$$v - p_1 - xt > v - p_2 - t\left(1 - x\right)$$

Recall the linear city model: the fraction of consumers which are fully informed and that will buy from firm 1 is $x = \left(p_2 - p_1 + t\right) 2t$.

Thus demand of firm 1 is

$$D_1(s) = \phi_1 \left[(1 - \phi_2) + \phi_2 \frac{p_2 - p_1 + t}{2t} \right]$$

and similarly:

$$D_2(s) = \phi_2 \left[(1 - \phi_1) + \phi_1 \frac{p_1 - p_2 + t}{2t} \right]$$

The profit of firm 1 and firm 2 are respectively:

$$\begin{aligned} E\pi_1(s) &= p_1 D_1(s) - \frac{a\phi_1^2}{2} \\ E\pi_2(s) &= p_2 D_2(s) - \frac{a\phi_2^2}{2} \end{aligned}$$

To find a Nash equilibrium we solve the following conditions:

$$\begin{aligned} \frac{\partial E\pi_i(s)}{\partial p_i} &= 0,\ i = 1,2 \\ \frac{\partial E\pi_i(s)}{\partial \phi_i} &= 0,\ i = 1,2 \end{aligned}$$

Solve for $i = 1$

$$\begin{aligned} p_1 &= \frac{p_2 + t}{2} + \frac{1 - \phi_2}{\phi_2} t \\ \phi_1 &= \frac{1}{a} p_1 \left[1 - \phi_2 + \phi_2 \frac{p_2 - p_1 + t}{2t} \right] \end{aligned}$$

Recall the linear city model we have already seen. Then look at:

$$p_1 = \frac{p_2 + t}{2} + \frac{1 - \phi_2}{\phi_2} t$$

The first term is the same as the fully information case. The second term reflects the extra market power that firm 1 gains because of imperfect information.

The second equation

$$\phi_1 = \frac{1}{a} p_1 \left[1 - \phi_2 + \phi_2 \frac{p_2 - p_1 + t}{2t} \right]$$

Interpretation: the optimal advertising level for firm 1 is such that marginal benefit of advertising and marginal cost of adv are the same.

We solve for a symmetric Nash equilibrium, i.e $p_1 = p_2 = p^*$ and $\phi_1 = \phi_2 = \phi^*$ we obtain

$$\begin{aligned} p^* &= \frac{p^* + t}{2} + \frac{1 - \phi^*}{\phi^*} t \\ \phi^* &= \frac{1}{a} p^* \left[1 - \phi^* \frac{1}{2} \right] \end{aligned}$$

That is:

$$
\begin{aligned}
p^* &= \sqrt{2at} \\
\phi^* &= \frac{2}{1+\sqrt{2a/t}}
\end{aligned}
$$

and the firms profit in equilibrium will be:

$$
E\pi^* = \frac{2a}{\left(1+\sqrt{2a/t}\right)^2}
$$

Comments

Note that $p^* = \sqrt{2at} > t =$price in equilibrium in the fully information case.

Thus, less competition. Note that as advertising is more costly the equilibrium price increases.

In a sense consumers pay for the information they receive: they face higher prices.

Advertising decreases when advertising cost increases.

Further, more is product differentiation (higher t) the higher is the advertising level

SURPRISING: an increase in advertising cost, leads to higher profits. Two effects:

(i) direct effect: when a increases firms advertise less and therefore the demand decreases (this tends to reduce profits)

(ii) indirect effect: since firms advertise less it is also more likely that consumers observe only one firm, then competition is less (higher prices).

Social optimum

Is the equilibrium outcome efficient?

In this model the losses in social welfare derives from:

1) transportation cost

2) advertisment cost

Consider a social planner who sets ϕ optimaly. Two possibilities:

1) ϕ^2 a consumer observes 2 prices. The expected trasportation cost is $t/4$

2) $\phi(1-\phi)$ a consumer observes 1 price. The expected trasportation cost is $t/2$

Thus the social welfare is

$$\phi^2 (v - t/4) + 2\phi (1 - \phi) (v - t/2) - 2 \left(\frac{a\phi^2}{2} \right)$$

The social planner will set ϕ to maximize the social welfare. That is

$$\phi^{SP} = \frac{2\sqrt{v} - t}{2v - 3t/2 + 2a}$$

It is easy to see that it could be the case that firms advertise too much.

The incentive to advertise too much could arise when the business stealing effect is high enough.

Firms want to steal demand to the other firm.

The Targeting of Advertising

Based on Iyer et al. (2005).

The objective in media planning is to minimize wasted advertising by reducing ads sent to consumers who are not interested.

New technologies make this possibility easier. So, the attention to the effect of targeting advertising on firms' competition, pricing, and level of advertising.

In what follows we present a very simple model which is able to grasp some of these effects.

Model

Two firms, 1 and 2. Unit mass of consumers, inelastic demand and reservation price r.

A mass h of consumers is loyal to firm 1, an equal mass to firm 2, while a mass $s = 1 - 2h$ is fully price sensitive, $h < 1/2$.

Consumers only buy if they receive ads from firms.

Absence of targeting advertising

Firms may advertise and pay A. If they do so all consumers observe the price.

The strategy of a firm is composed by: an advertising strategy, $\alpha \in [0,1]$ probability of advertising; and a pricing strategy, distribution $F(p)$ with support σ.

Nash Equilibrium.

Lemma 1. If $hr > A$, firms advertise in equilibrium with probability 1. Otherwise, the equilibrium involves firms using mixed advertising strategy.

The intuition is easy. Note that a firm charging a price r and advertising obtains a profit of at least $hr - A$, regardless of what the other firm will do.

Hence, if $hr - A > 0$ firms will advertise with probability 1.

Suppose that $hr - A \leq 0$ (there are few loyal consumers) and that firms advertise with probability 1. Then they must randomize in price and r must be the upper bound of the price distribution. Thus, the profit of a firm is $hr - A \leq 0$, a contradiction.

We now consider the equilibrium when $hr \leq A$ (few loyal consumers).

Proposition Suppose $hr \leq A$. In the unique symmetric equilibrium the following holds: firms advertise with probability $\alpha = 1 - (A - hr)/sr$ and price randomly according to the following c.d.f

$$F(p) = 1 - \frac{r-p}{p}\frac{A}{(1-h)r - A},$$

where $p \in \left[\frac{A}{1-h}, r\right]$. Firms obtain zero profits in expectation.

Proof.

Let firms randomize: α, F. If a firm advertise a price p, then it obtains

$$E\pi(p) = hp + (1-\alpha)ps + \alpha ps[1-F(p)] - A$$

Two observations: 1) the upper bound must be r, 2) the firm must obtain zero profits. Hence

$$E\pi(p) = hp + (1-\alpha)ps + \alpha ps[1-F(p)] - A = hr + (1-\alpha)rs - A \quad (1)$$

$$E\pi(r) = hr + (1-\alpha)rs - A = 0 \quad (2)$$

Solving obtain the proposition.

Intuition.

Recall that we are in a situation in which the loyal segment is not sufficiently profitable for firms.

By randomizing in advertising, firms create a sort of product differentiation: with some probability a firm that has advertised will also get the non-loyal consumers because the other firm is out.

Nevertheless, there is price dispersion which emerges because firms face the following trade-off:

charge high prices to exctract a lot of money from loyal consumers *vs*, charge lower prices to steal demand from the other firm.

Some Comparative Statics:

Let $hr \leq A$. If $A < r/2$, then ads frequency increases in h, while the reverse is true if $A > r/2$.

Intution: if h increases two effects:

Less competition, thus, more incentive to advertise, i.e. higher α.

Less total demand $(1 - 2h + h)$, thus lower incentive to advertise, i.e. lower α.

If advertising is not very expensive then the first effect dominates the second, otherwise the reverse holds.

Presence of Targeting

Firms are able to direct advertising to the high prefence consumers and to the price sensitice consumers.

Let α the probability that a firm advertises to loyal consumer, (at a cost Ah), while β the probability that advertises to the price sensitive one (at a cost As), $\alpha, \beta \in (0, 1)$.

Note we consider that a firm cannot price discriminate. So, the price charge is the same for all consumers.

Proposition If $r > A$ then in equilibrium firms advertise to their loyal consumer with probability 1, while they advertise to price sensitive consumer with probability $\beta = 1 - A/r$. In equilibrium firms price according to

$$F(p) = 1 - \frac{rh + As}{s(r - A)} \frac{r - p}{p}$$

and $\sigma = \left[\frac{hr+A}{h+s} r, r\right]$. Finally, in equilibrium firms obtain an expected profit equal to $h(r - A)$.

The proof is very similar to the case of un-targeted advertising. Since $r > A$ it is always worth advertising the loyal consumers at a price r.

If $\beta = 1$ firms compete a la bertrand in the non-loyal segment. Thus, $\beta < 1$ so that with some probability the firm is monopolist in that segment. The equilibrium price distribution is obtained by imposing the usual indifference conditions.

Note that for all $A < r$, then targeted advertising allows firms to obtain higher profits. Indeed,

If $A < hr$, under un-targeted strategy firms obtain profits $hr - A$, while under targeted strategy firms obtain profits $h(r - A)$.

If $hr < A < r$, under un-targered strategy firms obtain zero profits, while under targeted strategy obtain positive profits.

Does targeting increases the amount of money that firms spend in advertising or reduce it?

Proposition Total advertising expenditure are lower with targeted when $A < r/2$ and higher when $A > r/2$.

When advertising is relatively inespensive, in the non-targeted model firms advertise a lot and waste a lot of resources. In this case the targeting allow firms to reduce such waste and therefore firms advertise less.

When advertising is expensive, in the non-targerted model firms advertise little. When targeting is possible, firms spend more because now the possibility of targeting make the returns from ads higher.