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A model of targeted advertising with customer recognition

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Abstract: A two-period duopoly model is developed to examine the competitive effects of targeted advertising with customer recognition (TACR). In the model, two competing firms sell goods to end consumers in the first period, during which customer recognition is obtained. In the second period, advertising can be targeted toward different consumer types. Advertising is assumed to be persuasive in the way that consumer valuation is increased. Equilibrium decisions and profits in each period are derived, showing that the firm who loses the current competition will win in the future. As a result, forward-looking firms price less aggressively so that their long-term profits can be enhanced with the help of TACR. Particularly, TACR improves profits through three important effects: valuation increasing, customer poaching, and anti-competition. Finally, this paper investigates the welfare issues, showing that firms enhance profits at the expense of consumer surplus. It is, therefore, suggested that public sectors take a step to protect consumers with the rapid development of targeting technology.

Key words: targeted advertising; customer recognition; price discrimination; purchase history

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Nowadays, firms easily obtain the information about consumers' previous purchases with the help of a variety of information-related skills such as credit cards, cookies and direct user authentication[1]. Using this information, firms may adopt various individual marketing strategies such as behavior-based price discrimination[2] and behavior-based product personalization[3]. This paper tries to investigate the effects of behavior-based advertising targeting, which has been widely practiced, for example, by Amazon, eBay, YouTube, DoubleClick, Google, to name a few.

We establish a two-period duopoly model where two firms compete for horizontally heterogeneous consumers. Each firm has a group of loyal consumers who consider buying only its product. There is also a group of comparison shoppers who make a choice between the two brands. Seeing consumers' product choices in period 1, firms acquire the ability of recognition in period 2, based on which advertising and prices can be personalized. Advertising is assumed to be persuasive in the way that consumer valuation for the advertised product is enhanced.

Based on the theoretical model, we find that, when firms have the ability to apply TACR, the firm who loses period 1 competition gains a great advantage to win comparison shoppers in period 2. This is because if a firm loses period 1 competition, it will learn that consumers who buy its products come precisely from the loyal segment, and then in period 2, it can (whereas the rival firm cannot) adopt tailored strategies according to consumer types. As a result, TACR in period 2 enables the "losing" firm to "poach" the comparison segment. This anticipation inspires the two firms to price less aggressively in period 1. In a nutshell, we claim that TACR plays three important roles in enhancing profits, i.e., valuation increasing, customer poaching, and anti-competition. Furthermore, we also discuss the welfare issues and find that TACR boosts social welfare at the expense of consumer surplus. This finding tells one that consumers should be protected by public sectors with the emergence of targeting technology. For example, the Office of Fair Trading in the UK imposes strict restrictions on firms' behaviors in order to protect consumers.

The current paper is inspired by the literature on targeted advertising[4-12], all of which ignore firms' learning processes. By proposing a two-period duopoly model where firms learn consumer preferences in the initial period and advertising targeting is practicable in the subsequent period, we show that targeted advertising boosts profits through three important effects.

The other relevant area of research is the issue of behavior-based price discrimination and customer recognition[2, 13-15]. Our present work complements this strand of literature by demonstrating that behavior-based price discrimination combined with targeted advertising aggravates competition in the second period but mitigates competition in the first. Unlike the aforementioned works, we focus on targeted advertising instead of price competition.

1 Assumptions

Consider two firms, denoted as firm A and firm B, competing for a duopoly market. Assume that firm i of-

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fers product i to end consumers at a constant marginal production cost, which is normalized to zero without loss of generality (throughout this paper, $i, j = A, B, i \neq j$). Let p_i denote the selling price of product i.

On the demand side, consumers have a common valuation v for each product. To denote consumers' heterogeneous preferences, following Varian[16] and Narasimhan[17], we assume that there are three segments of customers in the market: Each firm has a segment of loyal customers with equal size β, and the remaining segment is comprised of comparison shoppers with size α. Loyal consumers are price insensitive in the way that they purchase only from the firm they are loyal to as long as the price charged by that firm is below v. In contrast, comparison shoppers are price sensitive in the way that they are indifferent between brands and purchase the product with the lowest price as long as this price is not higher than v. The total mass of consumers is normalized to one so that we have $\alpha + 2\beta = 1$, $\alpha \in (0, 1)$ and $\beta \in (0, 1/2)$.

Suppose that advertising is persuasive in the way that consumers who are exposed to firm i's advertising have a higher valuation, V, for product i. Define the increment $\Delta = V - v > 0$. In essence, the increment Δ can be viewed as an additional loyalty created by advertising. Following Iyer et al.[8], we assume that the cost of advertising is linearly related to the size of the advertised segment and let c denote the marginal cost. Hence, to target ads to the loyal segment, the firm incurs a cost of βc; to target the comparison segment, the cost is αc; and the firm should spend expenditures equal to c so that the entire market is filled with its ads.

To model the characteristics of TACR, we introduce a two-period game played between firms. In period 1, the size of each segment is common knowledge to both firms. However, an individual's specific type is a "mystery". At the end of period 1, comparison shoppers are won by one of the two firms if they quote different prices. If firms charge the same price, they share the selective segment equally. In period 2, based on consumer purchase history, each firm acquires the ability to target advertising and price discriminate between its old customers and the rival's. That is to say, each firm can advertise only to its previous customers without affecting the rival's clientele.

To rule out trivial cases, we assume that targeted advertising or targeted pricing cannot be implemented within the same segment. Thus, under trivial cases where the two firms halve the selective segment in period 1, neither firm would obtain the ability of targeting in period 2. Furthermore, we assume that each consumer purchases at most one unit of the good in each period. In period 1, firms simultaneously set prices. In period 2, they first decide whether to advertise. The tie-breaking role is if a firm is indifferent between choosing to advertise or not to advertise, it will choose not to advertise. Seeing the advertising strategies adopted in the market, they then set prices simultaneously.

Before establishing our model, we impose the following assumptions.

Assumption 1 $v > \Delta > c$;

Assumption 2 $c > (\alpha + \beta)\Delta$;

Assumption 3 $\beta v > \alpha\Delta$.

Assumption 1 implies that advertising is limited in its impact of increasing consumer valuation and that it is not too costly to discourage firms from investing in advertising. Assumption 2 rules out the possibility that firms have incentives to advertise even without customer recognition. Assumption 3 characterizes the relative importance of loyal consumers to firms. It technologically requires that v is sufficiently large relative to Δ, or β is not sufficiently small relative to α. This assumption ensures the existence of mixed pricing strategies whenever there is no pure strategy equilibrium in prices.

2 Benchmark Model

We start the analysis by investigating the benchmark case where firms can neither target advertising nor price discriminate because, for example, consumers are anonymous or consumer purchase history is unavailable. The price decisions set by firms remain the same in both periods. We note that in period 1 firms should first decide whether to adopt uniform advertising (since customer recognition is unavailable) before price decisions. However, this possibility is ruled out by Assumption 2.

In each period, two firms engage in price competition. Following the technical route as in Narasimhan[17], we easily show that there is no pure strategy equilibrium in prices. If such an equilibrium exists, any deviant firm can always undercut the equilibrium price by an infinitesimal degree to capture the entire selective segment, earning more profits. As a result, the price equilibrium can only be in mixed strategies (i.e., mixed strategy Nash equilibrium, MSNE), the existence of which is proved by construction.

Denote the equilibrium distribution function by $F_i(p)$, which is the possibility that firm i's price is lower than p. At the symmetric equilibrium where $F_i(p) = F_j(p) = F(p)$, each firm's expected profit is given by

$$\pi(p) = \beta p + \alpha p \bar{F}(p) \tag{1}$$

where the first term of the right hand side is the revenue received from the captive segment and the second term is from the selective segment. Maximizing Eq. (1) yields the following proposition, where we use the superscripts "no" and "cr" throughout this paper to denote the equilibrium results without and with customer recognition, respectively.

Proposition 1 Without customer recognition, in each period, firms choose the price according to c. d. f.,

$$F^{\mathrm{no}}(p) = 1 - \frac{\beta(v-p)}{\alpha p} \quad p \in \left[\frac{\beta v}{\alpha+\beta},\ v\right]$$

and earn equal profits

$$\pi^{\mathrm{no}} = \beta v \tag{2}$$

Proof Each firm can always guarantee itself a profit of βv by simply setting a monopoly price, i. e., $p = v$. In equilibrium, each firm must be indifferent between quoting any price within the support $p \in [p_{\min},\ v]$, where the lower bound $p_{\min}$ is the minimum price each firm can charge. Therefore, $\beta p + \alpha p \bar{F}(p) = \beta v$, solving which yields $F(p) = 1 - \frac{\beta(v-p)}{\alpha p}$. When a firm quotes a price equal to $p_{\min}$, its product is purchased by the selective segment with probability one, i. e., $\beta p_{\min} + \alpha p_{\min} = \beta v$ or $p_{\min} = \frac{\beta v}{\alpha+\beta}$. This completes the proof.

3 Targeted Advertising with Customer Recognition

In this section, we proceed to the main analysis by assuming that firms can use a variety of mechanisms to identify individual customers' first period purchase history based on which ads and prices can be targeted. Let p_{it} and $F_{it}(p)$ denote, respectively, firm i's price in period t ($t = 1, 2$) and the probability that this price is lower than p. We use the superscripts "n", "o", "s" and "l" to refer to new customers, old customers, switchers and loyal customers, respectively.

3.1 Second period equilibrium

Without loss of generality, suppose that firm i has won the switchers in period 1, i. e., $p_{i1} < p_{j1}$. In period 2, firm i's old customers consist of both its captive segment and the comparison shoppers. Firm j's previous customers are precisely its loyal customers. Obviously, it is profitable for firm j to target ads to old customers (since $\beta\Delta > \beta c$ by Assumption 1), and it also has a choice to target ads to new customers or not. As to firm i, it definitely does not target ads to new customers who can never be induced. However, firm i cannot distinguish between the loyal segment and the selective one, both of which are listed in the purchase history record without any differences. Thus, firm i may or may not advertise to its old customers. Therefore, there are 2×2 subgames we need to solve, i. e.,

Subgame 1: Firm i does not advertise; firm j targets ads only to its old customers.

Subgame 2: Firm i does not advertise; firm j advertises to the entire market.

Subgame 3: Both firms target ads to their own old customers.

Subgame 4: Firm i targets ads to its old customers; firm j uses uniform advertising.

The derivations of the above four subgames are analogous to the benchmark model, which are hence omitted due to space limitations. The detailed derivation can be obtained from the authors upon request. The equilibrium results are listed in the next proposition.

Proposition 2 With customer recognition, supposing that $p_{i1} < p_{j1}$, in period 2, firm j targets ads only to its old customers and charges them a personalized price,

$$p_{j2}^{\mathrm{o,\,cr}} = v + \Delta$$

1) If $\beta\Delta > (\alpha+\beta)c$, firm i targets advertising to its old customers. To firm i's old customers, firm i and firm j charge prices according to, respectively,

$$F_{i2}^{\mathrm{cr}}(p) = 1 - \frac{\beta v - \alpha\Delta}{(\alpha+\beta)(p-\Delta)} \qquad p \in \left[\frac{\beta(v+\Delta)}{\alpha+\beta},\ v+\Delta\right]$$

$$F_{j2}^{\mathrm{n,\,cr}}(p) = 1 - \frac{\beta(v-p)}{\alpha(p+\Delta)} \qquad p \in \left[\frac{\beta v - \alpha\Delta}{\alpha+\beta},\ v\right)$$

where firm i has a mass point at $v + \Delta$, i. e., $m_i = \frac{\beta v - \alpha\Delta}{(\alpha+\beta)v}$.

2) If $\beta\Delta \leqslant (\alpha+\beta)c$, firm i does not advertise. To firm i's old customers, firm i and firm j charge prices according to, respectively,

$$F_{i2}^{\mathrm{cr}}(p) = 1 - \frac{\beta v}{(\alpha+\beta)p} \qquad p \in \left[\frac{\beta v}{\alpha+\beta},\ v\right]$$

$$F_{j2}^{\mathrm{n,\,cr}}(p) = 1 - \frac{\beta(v-p)}{\alpha p} \qquad p \in \left[\frac{\beta v}{\alpha+\beta},\ v\right)$$

where firm i has a mass point at v, i. e., $m_i = \frac{\beta}{\alpha+\beta}$.

3) The profits of firm i and firm j are, respectively,

$$\pi_{i2}^{\mathrm{cr}} = \begin{cases} \beta(v+\Delta) - (\alpha+\beta)c & \text{if } \beta\Delta > (\alpha+\beta)c \\ \beta v & \text{otherwise} \end{cases} \tag{3}$$

$$\pi_{j2}^{\mathrm{cr}} = \begin{cases} \beta(v+\Delta-c) + \dfrac{\alpha(\beta v - \alpha\Delta)}{\alpha+\beta} & \text{if } \beta\Delta > (\alpha+\beta)c \\ \beta(v+\Delta-c) + \dfrac{\alpha\beta v}{\alpha+\beta} & \text{otherwise} \end{cases} \tag{4}$$

Proof The proof is analogous to the benchmark case.

The advertising equilibrium shows that, firm j owns an advantage to utilize TACR in period 2, because it clearly knows that the period 1 buyers are precisely its loyal customers. In contrast, firm i is only able to exclude the customers who did not buy its product out of the advertising targets. Only when the marginal advertising cost is low enough and the fraction of loyal consumers is large enough, i. e., $\beta\Delta > (\alpha+\beta)c$, can firm i have an incentive to adopt TACR.

The price equilibrium shows that firm j always uses personalized prices. It successfully squeezes the maximum surplus from the captive segment and charges new consumers a lower price to "pay to switch". However, firm i has to employ uniform pricing strategy. Remarkably, price competition in period 2 is not "fair". When setting a uniform price, firm i must ensure that enough surplus can be extracted from the captive segment, whereas firm j needs not to worry about that.

Due to the above advantages, unsurprisingly, firm j earns a higher profit than firm i in period 2, i. e., $\pi_{i2}^{cr} < \pi_{j2}^{cr}$. In essence, firm i's enhanced profitability stems only from the increased loyal consumers' valuations. On the contrary, both customer poaching and consumer valuation increasing are important sources to firm j's profits.

3.2 First period equilibrium

We now consider the first period pricing equilibrium. When firms make pricing decisions in period 1, they rationally anticipate the profits they will obtain in period 2. If in period 1 there exists a pure pricing strategy equilibrium where $p_{i1} = p_{j1} = p_1$, switchers will buy either firm's product with equal probability. The first period profit each firm earns is given by $(\beta + \alpha/2)\, p_1$. In period 2, neither firm can recognize individual customers' types. The two firms do not advertise and each earns a second period profit βv. Thus, each firm's aggregate profits of the two periods are given by

$$\Pi(p_1) = \left(\beta + \frac{\alpha}{2}\right)p_1 + \delta\beta v \tag{5}$$

Now suppose that there exists no pure pricing equilibrium. We prove the existence of an MSNE by construction. Since in period 2 it must be that one of the two firms earns a higher profit than the other, we use π_H to denote the profit as shown in Eq. (4), and denote the profit as shown in Eq. (3) by π_L. In the symmetric equilibrium where $F_{j1}(p) = F_{i1}(p) = F_1(p)$, using the common discount factor δ, each firm expects aggregate profits of the two periods as

$$\Pi(p_1) = \beta p_1 + \alpha p_1 \bar{F}_1(p) + \delta(F_1(p)\pi_H + \bar{F}_1(p)\pi_L) \tag{6}$$

Considering the above two possibilities, we obtain the following proposition.

Proposition 3 With customer recognition, in period 1, if $\delta \geqslant \delta_L$, firms set prices equal to consumers' reservation price, i. e., $p_1^{cr} = v$. Otherwise, firms choose prices according to c. d. f.,

$$F_1^{cr}(p) = 1 - \frac{\delta_L \beta(v-p)}{\delta_L \alpha p - \delta\alpha v} \qquad p \in \left[\frac{\delta_L \beta v + \delta\alpha v}{\delta_L(\alpha+\beta)},\ v\right]$$

Each firm's aggregate profits are given by

$$\Pi^{cr} = \begin{cases} (1+\delta)\beta v + \dfrac{\alpha}{2}v & \text{if } \delta \geqslant \delta_L \\ \beta v + \delta\beta(v + \Delta - c) + \dfrac{\delta\alpha(\beta v - \alpha\Delta)}{\alpha+\beta} & \\ \qquad\qquad \text{if } \delta < \delta_L \text{ and } \beta\Delta > (\alpha+\beta)c & \\ \beta v + \delta\beta(v + \Delta - c) + \dfrac{\delta\alpha\beta v}{\alpha+\beta} & \text{otherwise} \end{cases} \tag{7}$$

where

$$\delta_L = \begin{cases} \dfrac{(\alpha+\beta)v}{(\alpha+\beta)c + \beta v - \alpha\Delta} & \text{if } \beta\Delta > (\alpha+\beta)c \\ \dfrac{\alpha(\alpha+\beta)v}{\alpha\beta v + \beta(\alpha+\beta)(\Delta - c)} & \text{otherwise} \end{cases}$$

Proof First, suppose that no pure price strategy equilibrium exists. In this case, there only exist mixed pricing strategies. Each firm guarantees itself a profit of $\beta v + \delta\pi_H$ by charging a price equal to v or a profit of $\delta\pi_L$ by setting a price equal to zero. Clearly, $\beta v + \delta\pi_H > \delta\pi_L$ and we have the maximum price each firm can charge, i. e., $p_{1\max} = v$. Denote the minimum price each firm may charge as $p_{1\min}$; then in equilibrium firms must be indifferent between quoting any price within the support $p \in [p_{1\min},\ v]$. Thus, we have $\beta p + \alpha p \bar{F}_1(p) + \delta(F_1(p)\pi_H + \bar{F}_1(p)\pi_L) = \beta v + \delta\pi_H$, from which it is obtained that $F_1^{cr}(p) = 1 - \dfrac{\beta(v-p)}{\alpha p - \delta(\pi_H - \pi_L)}$. When one firm charges a price equal to $p_{1\min}$, it appoaches all the switchers in period 1 and earns π_L in period 2. In this case, we have $(\alpha+\beta)p_{1\min} + \delta\pi_L = \beta v + \delta\pi_H$ or $p_{1\min} = \dfrac{\beta v + \delta(\pi_H - \pi_L)}{\alpha+\beta}$. Thus, when $p_{1\min} < v$, i. e., $\delta(\pi_H - \pi_L) < \alpha v$, firms choose prices according to c. d. f. $F_1^{cr}(p)$ with the support $p \in [p_{1\min},\ v]$. The aggregate profits are given by $\Pi^{cr} = \beta v + \delta\pi_H$.

If $\delta(\pi_H - \pi_L) \geqslant \alpha v$, clearly no firm has an incentive to charge a price lower than v under which case the deviant firm would experience a profit decline. Technically, for any $p_1 < v$, we have $(\alpha+\beta)p_1 + \delta\pi_L < (\alpha+\beta)p_{1\min} + \delta\pi_L = \beta v + \delta\pi_H$. Therefore, when $\delta(\pi_H - \pi_L) \geqslant \alpha v$, there exists an unique subgame perfect Nash equilibrium where $p_{i1} = p_{j1} = p_1 = v$. The aggregate profits are $\left(\beta + \dfrac{\alpha}{2}\right)v + \delta\beta v$. This completes the proof.

Compared with the benchmark case, firms with customer recognition earn higher profits. Our attention is paid to the profit mechanism. We claim that firms' enhanced profitability may be owing to three aspects: 1) increasing consumer valuation; 2) customer poaching; and 3) reduced price competition. When $\delta < \delta_L$, the profit increment is either $\delta\beta(\Delta - c) + \dfrac{\delta\alpha(\beta v - \alpha\Delta)}{\alpha+\beta}$ or $\delta\beta(\Delta - c)$

$+\frac{\delta\alpha\beta v}{\alpha+\beta}$. The increment $\delta\beta(\Delta-c)$ results from firms' targeted ads to loyal segments. This is the valuation increasing effect of persuasive advertising. The remaining increment, $\frac{\delta\alpha(\beta v-\alpha\Delta)}{\alpha+\beta}$ or $\frac{\delta\alpha\beta v}{\alpha+\beta}$, stems from firms' targeted prices to new customers. This is the customer poaching effect in the second period. If $\delta\geqslant\delta_{\mathrm{L}}$, the profit increment is $\frac{\alpha}{2}v$. In this case, firms anticipate heavily their future profits at the time of price setting in the first period. Neither of them would charge a price lower than v, under which the deviant firm wins the first period competition but exposes itself to a disadvantage in the second period. This is the anti-competitive effect in the first period. Therefore, TACR plays a multiple role in improving firms' profits.

4 Welfare Issues

In this section, we investigate the welfare effects of TACR. For simplicity, we do not consider the discount factor adopted by firms, i.e., $\delta=1$.

4.1 Social welfare

In the benchmark case where firms have no customer recognition information, firms do not advertise and consumers' common valuation for each product is v. In equilibrium, individual consumers all buy one product and obtain a surplus of $v-p$. Since prices only split benefits between the seller and the buyer and have no influence on total welfare, social welfare in each period equals v. Therefore, total social welfare (SW) of the two periods without customer recognition is

$$\mathrm{SW}^{\mathrm{no}}=2v \tag{8}$$

With customer recognition, if $\delta_{\mathrm{L}}\leqslant 1$, firms do not advertise in both periods and we have $\mathrm{SW}^{\mathrm{cr}}=2v$.

If $\delta_{\mathrm{L}}>1$, there are two possibilities. Seeing Proposition 2, both firms target ads only to their old customers if $\beta\Delta>(\alpha+\beta)c$. In this case, firms' profits are given by

$$\pi_{i2}^{\mathrm{cr}}=\alpha p_{i2}^{\mathrm{cr}}\Pr(p_{i2}^{\mathrm{cr}}-\Delta<p_{j2}^{\mathrm{n,\,cr}})+\beta p_{i2}^{\mathrm{cr}}-(\alpha+\beta)c$$
$$\pi_{j2}^{\mathrm{n,\,cr}}=\alpha p_{j2}^{\mathrm{n,\,cr}}\Pr(p_{i2}^{\mathrm{cr}}-\Delta>p_{j2}^{\mathrm{n,\,cr}})+\beta p_{j2}^{\mathrm{n,\,cr}}-\beta c$$

The switchers' surplus is given by

$$\mathrm{CS}^{\mathrm{s,\,cr}}=\alpha(v+\Delta-p_{i2}^{\mathrm{cr}})\Pr(p_{i2}^{\mathrm{cr}}-\Delta<p_{j2}^{\mathrm{n,\,cr}})+\alpha(v-p_{j2}^{\mathrm{n,\,cr}})\Pr(p_{i2}^{\mathrm{cr}}-\Delta>p_{j2}^{\mathrm{n,\,cr}})$$

where the first (second) term of the right hand side is the switchers' surplus when they buy product i (j). Firm j's loyal consumers receive zero surplus; hence, the surplus of loyal customers in the market is

$$\mathrm{CS}^{\mathrm{l,\,cr}}=\beta(v+\Delta-p_{i2}^{cr})$$

Industry profits ($\pi_{i2}^{\mathrm{cr}}+\pi_{j2}^{\mathrm{n,\,cr}}$) plus consumer surplus ($\mathrm{CS}^{\mathrm{s,\,cr}}+\mathrm{CS}^{\mathrm{l,\,cr}}$) yields total social welfare in period 2. In period 1, there is no advertising and all the consumers make a purchase. Thus social welfare in period 1 is v. Therefore, when $\delta_{\mathrm{L}}>1$ and $\beta\Delta>(\alpha+\beta)c$, by simple algebra, social welfare is given by $\mathrm{SW}^{\mathrm{cr}}=2v+\Delta-c-\alpha\Delta\Psi$, where we use Ψ to denote $\Pr(p_{i2}^{\mathrm{cr}}-\Delta>p_{j2}^{\mathrm{n,\,cr}})$ for ease of exposition.

When $\beta\Delta\leqslant(\alpha+\beta)c$, seeing Proposition 2, only one firm targets ads to its loyal segment in period 2. There is no advertising in period 1 and all the consumers make a purchase in each period. Then, $\mathrm{SW}^{\mathrm{cr}}=2v+\beta(\Delta-c)$.

To sum up, total social welfare of the two periods is

$$\mathrm{SW}^{\mathrm{cr}}=\begin{cases}2v & \text{if } \delta_L\leqslant 1\\ 2v+\Delta-c-\alpha\Delta\Psi & \text{if } \delta_L>1 \text{ and } \beta\Delta>(\alpha+\beta)c\\ 2v+\beta(\Delta-c) & \text{otherwise}\end{cases} \tag{9}$$

Proposition 4 TACR is good for social welfare, i.e., $\mathrm{SW}^{\mathrm{cr}}>\mathrm{SW}^{\mathrm{no}}$.

Proof Comparing Eqs. (8) and (9) yields the proposition.

As expected, TACR benefits social welfare. As long as firms find it is profitable to implement targeted advertising, there is definitely a welfare increase since the marginal advertising cost is assumed to be lower than the consumer valuation increment, i.e., $\Delta>c$.

4.2 Consumer surplus

Next, we investigate whether TACR also benefits consumers. Social welfare minus the two firms' total profits gives the value of consumer surplus (CS), i.e., $\mathrm{CS}=\mathrm{SW}-2\Pi$. By simple algebra, we easily obtain consumer surplus under each scenario, i.e.,

$$\mathrm{CS}^{\mathrm{no}}=2\alpha v \tag{10}$$

$$\mathrm{CS}^{\mathrm{cr}}=\begin{cases}\alpha v & \text{if } \delta_{\mathrm{L}}\leqslant 1\\ 2\alpha v+\alpha(\Delta-c)-\dfrac{2\alpha(\beta v-\alpha\Delta)}{\alpha+\beta}-\alpha\Delta\Psi & \text{if } \delta_L>1 \text{ and } \beta\Delta>(\alpha+\beta)c\\ 2\alpha v-\beta(\Delta-c)-\dfrac{2\alpha\beta v}{\alpha+\beta} & \text{otherwise}\end{cases} \tag{11}$$

Proposition 5 TACR hurts consumers, i.e., $\mathrm{CS}^{\mathrm{cr}}<\mathrm{CS}^{\mathrm{no}}$.

Proof Comparing Eqs. (10) and (11) yields the proposition.

TACR benefits firms at the expense of consumer surplus, although it improves social welfare. The main reason lies in the anti-competitive effect of customer recognition. In this light, we point out that TACR results in a win-lose situation between the seller and the buyer.

5 Conclusion

This paper investigates the competitive effects of TACR. We find that with the ability of advertising targeting based on consumer purchase history, the firm which loses the first period competition will obtain a relative advantage during the second period competition, for the reason that it is the "losing" firm rather than the "winning" firm who learns that its old customers are precisely the loyal ones. Anticipating future profits, forward-looking firms strategically set a high price or even a monopoly price in the initial period. In light of this view, TACR not only plays valuation increasing and customer poaching roles, but also involves an important anti-competitive effect. This finding explains why so many firms are eager to apply TACR. However, we claim that TACR is good for social welfare but bad for consumer surplus. It is suggested that public sectors, i. e., the office of fair trading, take a step to protect consumers.

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基于顾客认知的定向广告模型

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摘要:建立了基于顾客认知的2个阶段双寡头定向广告竞争模型.假设2个相互竞争的企业在第1阶段销售期过后,可根据销售记录认知异质的顾客,从而可以在第2阶段针对不同类型的顾客向其投放定向广告,而广告能够提高目标受众对产品的价值感知.通过对各个销售阶段企业均衡决策及均衡利润的分析发现,在当前销售期输掉竞争的企业反而能通过定向广告策略赢得未来销售期的竞争.于是,企业为了获得更高的长期利润会主动削弱彼此之间的价格竞争.进一步的分析表明,定向广告主要通过3个方面的作用提高企业利润,即价值增值、窃取顾客以及缓和竞争.最后,通过对社会福利及消费者剩余的讨论发现,基于顾客认知的定向广告虽然有助于增加企业利润,却损害了消费者的利益.因此,随着定向技术的迅速发展,有关公共部门应采取措施保护好消费者的利益.

关键词:定向广告;顾客认知;价格歧视;购买记录

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