

The Targeting of Advertising *

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ABSTRACT

An important question that firms face in advertising is developing effective media strategy. Given the fragmentation of media (broadcast TV for example) and a multitude of new advertising media (the Internet, satellite shopping channels, and infomercials), firms have the ability to target advertising to specific segments of consumers in a market. This paper examines advertising strategy with a model that allows for the targeting of advertising to different groups of consumers in a market with competing firms. When firms can target advertising to specific segments in the market, we find that they choose to advertise more to consumers that have a strong preference for their product than to comparison shoppers who are likely to be attracted away to competing products. Advertising less to comparison shoppers who shop across products can be seen as a way for firms to endogenously create additional differentiation in the market. In addition, targeting makes advertising more effective by eliminating “wasted” advertising to consumers who would not buy their product. Therefore the targeting of advertising increases equilibrium profits. Targeting can lead to lower advertising expenditures by reducing the wastage created by sending advertising to consumers who are unlikely to buy. But, interestingly, targeting can also lead firms to an increase in advertising spending. When advertising is expensive, the inability to target advertising leads to less advertising expenditures. In contrast, when firms can target advertising in these conditions, advertising spending is higher because improved effectiveness makes higher expenditures worthwhile.

The model allows us to demonstrate how advertising strategies of firms are affected by firms being able to target pricing. Regardless of whether advertising is targeted or not, the gain that a firm realizes by being able to charge higher prices to consumers who have a distinct preference for its product is offset by increased price competition for comparison shoppers. In contrast, when firms have the ability to choose different advertising levels for different groups of consumers, it leads to higher profits independent of whether firms have the ability to set targeted prices. This implies that the targeting of advertising is more valuable for firms in a competitive environment than the ability to target pricing.

Keywords: Media Precision, Advertising, Targeting, Price Discrimination.

1. Introduction

Advertising is the area where marketing managers have ultimate decision-making authority and media purchasing is far and away the largest element of advertising spending. An important challenge in advertising planning is the efficient use of the advertising dollar and ensuring that the advertising spending is correctly targeted to consumers according to their preferences for the product. Nowhere is this more the case than in the selection and planning of media vehicles in order to achieve optimal deployment of advertising.¹ Traditionally, the objective in media planning has been to reduce wasted advertising by reducing the extent to which advertising reaches consumers who are not users of a product category. However, increasingly firms are also concerned about targeting advertising to specific consumer segments within a product category. Firms' concern about wastage of advertising and the need to better target is relevant in today's markets given both the fragmentation of existing media (broadcast TV for example) and the multitude of new advertising media (the Internet, satellite shopping channels, and infomercials). Table 1 below indicates how fragmented media spending has become. Better information technology, detailed consumer information and the availability of sophisticated media buying have also increased the ability of firms to target specific segments of the market (see "Star Turn," The Economist, March 9, 2000).

Table 1
U.S. Ad Expenditures by Type of Media 2000
billions \$

Media Type	Total Spending	% of Total
Newspapers	49.2	20.8
Magazines	12.3	5.2
Broadcast TV	44.4	18.8
Cable TV	12.3	5.2
Radio	19.6	8.3
Yellow Pages	13.4	5.7
Direct Mail	44.7	18.9
Business Papers	4.7	2.0
Internet	5.1	2.2
Miscellaneous	34.7	14.7
Total	236.3	100.0

Source: Universal McCann, New York, Marketing News July 2, 2001.

Despite the importance of this activity, there seems to be a lack of research that analyzes the targeting of advertising and its effect on markets and the competitive strategies of firms. In media

¹This is a classic concern and goes back to at least John Wanamaker's (a 19th century department store owner) comment "Half the money I spend on advertising is wasted and the trouble is I don't know which half."

planning firms attempt to focus advertising to specific consumer groups. As an example, consider the U.S. light beer market in which Miller Lite and Coors Light are major competitors. The light beer market comprises of distinct demographic groups which vary in their consumption profile. Miller Lite, the “diet beer” has traditionally been directed to the mature male beer drinkers in their mid to late thirties who are becoming concerned about their waistline. In contrast, Coors Light has been more popular among young and relatively newer beer drinkers (men and women in their early 20’s). But, a substantial proportion of light beer consumption resides in the intermediate segment comprised of young adults in their late twenties to early thirties. These consumers are more uncommitted in their brand preferences.² An important question for firms is the decision about how to allocate media budgets between the segment in which they have strong a franchise and the segment of uncommitted consumers who choose between competing brands. This question becomes more important with improvements in the ability of firms to target advertising media.

Intuition would suggest that concentrating advertising on captive consumers who are strongly predisposed to buy a firm’s product can be advantageous because this results in guaranteed sales and higher prices. However, it is consumers without a strong preference who are more likely to be attracted away by competition and so it can be argued that a firm should direct advertising to these consumers. Will competition for consumers who have weak preferences across firms lead to higher advertising or will firms try to limit competition for these consumers and reduce advertising? This paper provides an analysis of this trade-off in a model of competition between firms. We model firms competing with targeted advertising and examine how the ability to focus advertising on specific groups of consumers affects market competition and the choice of advertising and prices.

The following questions are analyzed in the paper: When firms have the ability to target different levels (media weights) of advertising to different consumer segments, how will they choose these media weights? Should a firm advertise more to consumers who have a strong preference for its product or to consumers who are more likely to switch to a competing product? How are equilibrium pricing and profits in a market affected by the firms’ ability to focus their advertising? We also examine how the ability to focus advertising affects the overall level of advertising used by firms. Recent advances in consumer information and database technologies also mean that firms can price discriminate and offer different prices to different groups of consumers. We examine how the ability to target advertising interacts with targeted pricing.

The model captures advertising and price competition between firms. Advertising has the role of informing consumers of relevant product information which is necessary for considering the product. Each firm has a group of consumers who have a strong preference for its product in the sense that

²See the discussion “Competition: A Whole New Ball Game in Beer”, *Fortune*, September 19, 1994, p.79, and Lee, Thomas, “Miller’s Time May Be Running Out: Brewer’s Sales Remain Flat Amid Talk That Philip Morris Will Sell to Foreign Firm”, *St. Louis Post-Dispatch*, March 10, 2002, p.E1.

they would only consider buying from that firm up to a reservation price. There is also a group of consumers who compare the prices at both firms and buy at the lowest price. Advertising is costly and the cost of informing a group of consumers is directly proportional to the size of that group. The targeting of advertising implies that firms can design media vehicles to focus advertising messages to particular segments in the market. A firm that is unable to target advertising, advertises uniformly to the entire market.

We show that when firms have the ability to target advertising, they will advertise more to the segment that has a distinct preference for their product than to the segment of consumers who comparison shop and switch between the firms. When firms reduce advertising to the comparison shoppers, they do not compete for these consumers all the time. Advertising less to the price elastic consumers who shop around is a strategic method of creating additional market differentiation, thereby reducing price competition. The targeting of advertising also provides the direct benefit of eliminating “wasted” advertising to consumers who prefer to buy the competing product. For these reasons, the ability to target advertising increases the equilibrium profits of firms.

The total advertising spending of firms can either increase or decrease with targeting. When advertising is expensive, the inability to target advertising leads firms to choose low levels of advertising. While this means less wasted advertising, firms are not able to realize the full demand potential because fewer consumers are reached. In this case targeting helps firms realize higher demand. In contrast, when advertising is inexpensive, then a firm chooses high advertising levels with uniform advertising. This implies that the extent of wastage is significant and the ability to focus advertising leads to lower advertising expenditures. We also examine the market outcomes when firms invest to obtain the ability to target advertising. As expected, both firms choose to invest in targeting when the costs of targeting are sufficiently low. Similarly, both firms choose not to target advertising when the targeting costs are very high. But the interesting result from this analysis is that for intermediate costs, ex-ante symmetric firms might make asymmetric investments in targeting: While one firm invests in the targeting technology, the other chooses not to invest. Differentiation in the ability to target advertising becomes another way to reduce the competition for the comparison shoppers.

We also analyze how targeted advertising interacts with targeted pricing. Our analysis suggests that in a competitive environment, the ability to target advertising is more important for increasing profitability than the ability to target pricing. When firms have the ability to choose different advertising levels for different groups of consumers, it leads to higher profits independent of whether or not firms also have the ability to set targeted prices. In contrast, the ability to only target prices creates increased competition for the comparison shoppers and no improvement in equilibrium profits.

We also extend the model to the case of continuous advertising where a firm can choose to reach any proportion of the market and show that the insights discussed above hold for this extension. We also provide an empirical illustration of the theory for local advertising in retail markets.

Related Research

Butters (1977) examines the role of advertising in providing information about the existence of products and their characteristics (and prices). Grossman and Shapiro (1984) extend this to a market with horizontal differentiation and analyze the impact of informative advertising on market competition and the provision of variety. Soberman (2001) also analyzes a similar model to understand the effect of advertising on prices. There is also research that views the quantity of advertising as a signal of quality when buyers cannot identify the quality of products before buying (see for example Nelson 1974, Klein and Leffler 1981, and Milgrom and Roberts 1986). Previous research in marketing has examined advertising policies assuming aggregate response functions. For example, Sasieni (1989) analyzes optimal advertising pulsing policies for different types of response functions. Thompson and Teng (1984) examine optimal pricing and advertising policies of firms given specific demand models such as the Bass and the Vidale-Wolfe models. Rao (1986) develops an advertising-sales model in continuous time to study the consequences of temporal aggregation for estimation. Finally, Eastlack and Rao (1986) conduct a series of market experiments to measure the sales response of advertising and pricing changes.

There is no analytical research that examines the ability of firms to focus or target advertising to specific segments of consumers in a market. In the literature, directed marketing activity has been analyzed in context of other marketing elements. Price discrimination based on past consumer-behavior (past purchases) has been examined by Villas-Boas (1999, 2001) and Fudenberg and Tirole (2000). Previous research has also examined targeted coupon promotions (Shaffer and Zhang 1995), location-specific pricing (Thisse and Vives 1988), and the impact of directed product changes (Iyer and Soberman 2000). This paper contributes to this research by analyzing the market impact of the targeting of informative advertising.

The rest of the paper runs as follows. In Section 2 we describe the basic model. We present the main results of the paper in Section 3. Section 4 describes an empirical illustration of the model to local advertising in retail markets that illustrates the main ideas of the paper. In Section 5, we present an extension of the basic model to a more general case of continuous advertising. Finally, in Section 6 we conclude.

2. The Model

We develop a model of a market with two firms $i = 1, 2$. Each firm produces its product at a constant marginal cost of production which is assumed to be zero without loss of generality. We start by describing the consumer market.

2.1. The Consumer Market

The market is comprised of a unit mass of consumers. Each consumer has a demand of at most one unit of the product. Consumers have a common reservation price r for the product. Assume that each firm has a segment of consumers who have high preference for its product in the sense that they consider buying only from the firm as long as the price at this firm is below the reservation price r . The proportion of these consumers per firm is given by h . The remaining consumers are comparison shoppers who are indifferent between the firms and would buy the product with the lower price (as long as this price is below the reservation price). The size of this segment s is given by $s = 1 - 2h$. Note that h represents the extent of ex-ante market differentiation, with higher values representing greater differentiation between the firms. When $h = 0$, all consumers comparison shop between the two firms and the competition between the firms reduces to Bertrand price competition.

2.2. Consumer Information Structure

We model the role of advertising in conveying relevant product information to consumers. Consumers may know the structure of the product market in terms of the presence of different products, but they might not know which product has exactly the characteristics that they prefer. An advertisement that reaches a consumer provides the consumer with information on the relevant attributes/characteristics of the product. Without the advertising message, consumers do not have information about the existence of the product and will not consider it for purchase. One can think of advertising simply providing information to a consumer about which product has the attribute relevant for the consumer. Note that this simply implies that advertising facilitates consideration of the product by the consumer.³

The characterization of advertising is consistent with behavioral research that has documented that advertising can make a product and its characteristics salient in consumer memory. This in turn enhances the likelihood that consumers consider the product if its characteristics do indeed match consumer tastes (see Mitra and Lynch 1995). For new products, awareness is clearly the first

³Thus advertising can be seen as creating heterogeneity in the set of products that consumers consider depending upon the number of firms from whom the consumers receive advertising. As shown in Mehta et al (2003) there can be substantial heterogeneity in the consideration sets of consumers in a market.

stage in creating demand for a product. Consumers also use advertising for new products to obtain information about key product features.

But the formulation is also consistent with the role advertising plays in mature product categories. Keeping a product “top-of-mind” and priming the consumer to consider it is critical in established categories such as beer and soft drinks wherein product features of the major brands are well-known. For example, in the soft drinks market, one might argue that the product features of Coke and Pepsi are known to most consumers. Yet these brands spend a significant amount of their budget in reminder advertising aimed at keeping the brand top-of-mind.

2.3. The Advertising Technology

Advertising messages are costly and the cost to advertise to the entire market is A . However, when advertising can be focused on particular segments in the market, we assume that the cost to advertise to each segment is related to its size. Therefore, if a firm is able to target advertising the relevant costs are Ah for the high preference consumer segment and As for the comparison shopping segment. Note that a firm does not have an incentive to target advertising to the segment of h consumers of its competitor, as they will not consider buying its product. We consider advertising that informs all of a given segment or none of it. In section 5.1 we show that the results continue to hold when advertising is continuous and when firms can advertise to any proportion of the market.

3. Equilibrium Analysis of Advertising and Price Competition

Consider first the base case when firms do not have the ability to focus advertising or pricing to particular segments of the market. This provides the base case which we use to interpret and understand the effect of the ability to focus advertising.

3.1. Uniform Advertising and Price Competition

Consider that in equilibrium both firms advertise. With uniform advertising, firms can reach the entire market for a cost A . The price equilibrium will then be in mixed strategies. The reasoning for this is as follows: Suppose that one firm, say Firm 2, chooses a price p_2 that is not too low, then Firm 1 would like to undercut p_2 in order to attract the comparison shoppers. Otherwise, Firm 1 will set prices at the reservation price in order to maximize the profit from its h consumers. A similar reasoning applies to Firm 2’s responses to Firm 1’s choice of p_1 . Denote the c.d.f of the mixed strategy price distribution to be $F_i(p)$. In a symmetric equilibrium ($F_i(p) = F(p)$), the profit of a

firm when charging a price p in the mixed strategy profile will be given by:

$$\pi(p) = hp + sp[1 - F(p)] - A \tag{1}$$

Using standard analysis (e.g., Varian 1980), the equilibrium profit is the guaranteed profit that a firm can realize by charging the reservation price and selling only to its h segment, $\pi(r) = hr - A$, if this expression is positive. Otherwise, the equilibrium profit ends up being zero. The advertising equilibrium of this model can now be characterized beginning with the following lemma.

Lemma 1: When $hr > A$, firms advertise in equilibrium with probability one. When $hr \leq A$, then the equilibrium will involve firms using mixed advertising strategies.

Firms will advertise 100% of the time if the guaranteed profits are large enough to cover the cost of advertising. This happens when the extent of differentiation (h) or the reservation price are large enough. The derivation of the price equilibrium for this case is similar to Varian (1980) or Narasimhan (1988) and is as follows:

$$F^*(p) = \begin{cases} 0 & \text{if } p < \frac{hr}{1-h} \\ 1 - \frac{r-p}{p} \left(\frac{h}{1-2h}\right) & \text{if } \frac{hr}{1-h} \leq p \leq r \\ 1 & \text{if } r < p \end{cases}$$

Denote the probability of a charging a price above any given price p , $H(p) = 1 - F(p)$. It can be seen that $\frac{\partial H(p)}{\partial h} > 0$. Thus, as expected, the average price charged by a firm increases with the extent of differentiation between the firms (i.e., larger h).

The interesting case is the one in which firms do not find it optimal in equilibrium to advertise with probability one. In other words, in less differentiated markets or if the reservation price for the product is small compared to the cost of advertising, firms employ mixed strategies in advertising. We can interpret the probability with which firms advertise as the frequency or the intensity of advertising within an advertising planning period. To derive the symmetric equilibrium for the case in which firms employ mixed strategies in advertising, define α as the probability of advertising by a firm. From the property of a mixed strategy equilibrium the profits between advertising and not advertising should be equal which implies the following equilibrium condition:

$$hp + (1 - \alpha)sp + \alpha sp(1 - F(p)) - A = 0 \tag{2}$$

From the above, if $A > (1-h)r$, then the firms will never advertise. This will imply the degenerate case where a firm is not operating because it does not pay for the firm to advertise even if it were to charge the reservation price and yet get all the comparison shoppers. For the rest of the paper, we

assume $A < (1 - h)r$, the advertising costs are not too large, and thereby rule out the degenerate case. Solving for the equilibrium leads to the following Proposition:

Proposition 1: When $hr \leq A$, and with uniform advertising, the equilibrium profits are zero and the equilibrium probability with which firms advertise is $\alpha^* = 1 - \frac{A-hr}{sr}$. In addition, firms employ mixed pricing strategies with c.d.f. $F^*(p) = 1 - \frac{r-p}{p} [\frac{A}{(1-h)r-A}]$ for $p \in [\frac{A}{1-h}, r]$.

The equilibrium probability (or frequency) of advertising decreases with the cost of advertising and increases with the reservation price. It is also easy to see that $\frac{\partial H(p)}{\partial h} > 0$ and $\frac{\partial H(p)}{\partial A} > 0$. Thus the expected price increases with both market differentiation (the size of the h segment) and advertising costs.

The relationship between α^* and market differentiation is more interesting: The frequency of advertising decreases with the size of the comparison shopping segment (i.e., lower differentiation) if $A < \frac{r}{2}$. However, advertising frequency increases in the size of the comparison shopping segment when $A > \frac{r}{2}$. An increase in the advertising frequency creates two effects that govern firm competition: An increase in α creates a competitive effect because it increases the set of comparison shoppers who are informed by the advertising of both firms. But increased advertising also provides a demand benefit by informing more of the high preference segment which only considers its favorite firm. When costs of advertising are low ($A < \frac{r}{2}$), firms advertise with higher frequency all else being equal. In this case, a reduction in market differentiation (increases in s) means that the reduction in profits from increased price competition will be greater than the positive impact on profits of informing more of the high preference consumers. The strategic response of firms is to reduce the equilibrium frequency of advertising to mitigate price competition. The opposite is true when advertising costs are sufficiently high ($A > \frac{r}{2}$). In this case, the benefit of increased demand outweighs the competitive effect and firms respond by increasing the frequency of advertising.⁴

To sum up, when advertising media costs are low, firms will choose lower levels of advertising in more competitive markets. However, when the costs of advertising media are sufficiently high, firms facing more competitive markets will choose higher levels of advertising. The reader will also note that informative advertising can help firms to endogenously create market differentiation. In other words, when markets become more competitive firms can respond by strategically choosing lower levels of advertising. This benefits firms, not only because it reduces the cost of advertising, but also because it reduces the set of consumers who comparison shop the two firms.

⁴It is equally valid to interpret α^* as the equilibrium “reach” or the proportion of the population reached, where the reach of the two firms are independent.

3.2. Competition with Targeted Advertising

We now analyze the main issue of the paper pertaining to media precision and the ability of firms to target advertising to particular segments of the market. The ability to target advertising has two valid interpretations for the purposes of this paper. It can imply the availability of more precise media vehicles which allow firms to better focus advertising on specific segments of the market. Alternatively targeting can also imply better information about consumer preferences that firms can use for deploying communication activities. The targeting technology in our model implies that firms can direct advertising to the high preference and the comparison shopper segments separately. Given our assumption that the cost of advertising is proportional to the consumers reached, we have that the cost of targeting the h segment only of a firm will be hA , while the cost of targeting advertising to the comparison shopping segment only will be sA .

Because firms can choose to advertise to the high preference consumers only and charge the reservation price, the guaranteed profits from the h segment will be $h(r - A)$. Thus firms will always advertise to their h consumers as long as $r > A$. For the rest of the analysis we will assume that this holds.⁵ Note that with the ability to focus advertising, firms will not advertise to the other firms' h consumers as these consumers will not buy from the firm. Next, consider advertising to the comparison shopping segment: in general, advertising to this segment will involve mixed advertising strategies. Suppose that both firms advertise with probability one. Then, if advertising is costly, either of the firms has an incentive to deviate by reducing the frequency of advertising by a small amount. While the firm's expected demand from the comparison shopping segment goes down by a small amount, this is offset by the two effects that have a positive impact on profits: the firm saves on the cost of advertising and also gets the strategic benefit of reduced price competition for the comparison shoppers. Writing the probability of advertising to comparison shoppers as β , the profit function for a firm, when advertising to s will be:

$$\pi(p) = hp + (1 - \beta)sp + \beta sp[1 - F(p)] - A(h + s) \quad (3)$$

The following proposition summarizes the equilibrium with targeted advertising.

Proposition 2: When advertising can be targeted, and $r > A$, the equilibrium profit is $h(r - A)$ and firms advertise to their h consumers with probability one and to comparison shoppers with a probability of $\beta^* = 1 - \frac{A}{r}$. In addition, firms employ mixed strategy pricing with c.d.f. $F^*(p) = 1 - \frac{rh + As}{s(r - A)} \frac{r - p}{p}$ for $p \in [\frac{hr + As}{h + s}, r]$.

⁵This simply means that the total market's reservation value is greater than the costs of advertising. Otherwise, firms will not advertise even under targeting, implying the degenerate case where there is no active market.

The first point to note is that the equilibrium probability of advertising to the comparison shoppers β^* , is strictly less than one. This means that firms advertise more to the segment of consumers who have greater preference for their product than to comparison shoppers who choose between the two firms. This highlights the following general rationale: informative advertising to the consumers who have a stronger preference for a firm's product allows the firm to extract consumer surplus. Therefore, the firm would always prefer to advertise to these consumers. Assume now that the firms always advertise to comparison shoppers who are undecided between the two products. In this case, it is optimal for a firm to unilaterally reduce the level of advertising to the comparison shoppers who perceive no differentiation between the two firms. By doing so, the firm does not always compete with the other firm for these consumers. The competing firm enjoys monopoly power over these consumers when it is advertising but the focal firm is not advertising. The strategic effect of this is to reduce the intensity of price competition. Thus, advertising with probability less than one helps a firm to endogenously create differentiation between the firms in the competitive part of the market. Furthermore, the direct effect of focused advertising is that it eliminates the wastage caused by advertising that falls on the competitor's h segment. Consequently, as Proposition 2 shows, the ability to focus advertising to specific segments leads to an increase in profit over the case of uniform advertising.

Note that the advertising intensity to the comparison shopping segment increases with the reservation price (because with higher r there is more surplus to extract from consumers who are reached by advertising) and decreasing in A . Targeted advertising also has some interesting effects on advertising spending, and on pricing.

Proposition 3: Compared to the case of uniform advertising, total advertising expenditures are lower with targeted advertising when $A < \frac{r}{2}$ and higher when $A > \frac{r}{2}$.

Advertising expenditures can actually decrease with targeted advertising when $A < \frac{r}{2}$, i.e., when advertising is relatively inexpensive. Given that the ability to focus advertising should increase the effectiveness of advertising, it is surprising that it can lead to a **reduction** in advertising expenditures. To understand this, consider the situation faced by a firm that cannot focus its advertising. In this case the firm cannot control the wasted advertising that reaches the h customers of the other firm who will not buy. When advertising is inexpensive, a firm will choose high levels (i.e., frequency) of advertising, all else being equal. Therefore, without the ability to focus advertising, inexpensive advertising means that the extent of wastage is significant. The ability to target advertising allows the firm to eliminate this wastage leading to a decrease in the overall level of advertising expenditures. In contrast, when advertising is expensive, firms choose low levels of advertising under uniform advertising. While there is little wastage in this case, firms are not able to realize the demand potential because fewer consumers are reached. In this case, the ability to target advertising allows

firms to realize higher demand by increasing advertising to both a firm's own consumers and the comparison shoppers and this leads to an overall increase in advertising expenditures.

Targeted advertising also increases the average prices that firms charge. With targeted advertising a firm is always able to advertise to the h segment, while advertising with probability β to the comparison shopping segment. A consequence of this is reduced price competition between firms leading to higher average prices being charged in equilibrium.

To summarize, Propositions 2 and 3 highlight the effects of media precision and the ability to focus advertising. Firms advertise more to consumers who have a stronger preference for their products. In addition, firms are able to eliminate advertising to the competitor's h segment who would not buy its product. Therefore, targeted advertising increases the equilibrium profits. Targeted advertising also has interesting effects on advertising expenditures: When advertising is inexpensive, the ability to focus advertising leads to a reduction of wasteful advertising. However, when advertising is expensive, targeting leads to greater spending on advertising.

3.3. The Value of Targeted Advertising

How much would firms in a competitive market be willing to pay for the ability to target advertising? In other words, what is the incremental value of the ability to target advertising. Recall that in a world with uniform advertising, the equilibrium profit is $\pi_u = hr - A$ when $A < hr$ and zero if $A > hr$. With targeted advertising the equilibrium profit is $\pi_{ta} = h(r - A)$. The value of advertising targeting V_{ta} for firms in a competitive market is as follows:

Proposition 4: If $A < hr$, then $V_{ta} = A(1 - h)$ while if $A > hr$, then $V_{ta} = h(r - A)$.

When advertising is not very costly $A < hr$, the value of targeting decreases with market differentiation and actually increases with the cost of advertising. In this case, firms in the uniform advertising world would always advertise and this implies that a greater proportion of the advertising is wasted. The wastage increases with the cost of advertising and with market differentiation (greater h). With greater differentiation, the wastage effect under uniform advertising will be higher. Therefore the value of targeting increases with the cost of advertising and in more competitive markets with smaller number of h consumers. In other words, when advertising is inexpensive, the benefit of targeting is primarily based on cost savings.

In contrast, when advertising is costly ($A > hr$), the value of advertising increases with market differentiation but decreases with the cost of advertising. When advertising is costly, firms in the no targeting world do not always advertise and price competition eliminates profits when they do. With targeting, firms earn profit of $h(r - A)$, i.e., targeting allows each firm to extract surplus from its high

preference segment. Here, the value of targeting comes primarily from the increase in the revenue that it allows (as opposed to cost-based when $A < hr$). Thus, the value of targeting is positively related to both the extent of differentiation and the net margin on sales to the h consumers ($r - A$). These findings suggest that the ability to target advertising is always valuable for competing firms. The main determinants of a firm's behavior will be the availability of media that can be targeted and the cost of learning about consumer preferences.

3.4. Incentives to Invest in Targeting Capability

While the previous section highlights the value of targeting, in this section we analyze the case where each firm can make an *ex ante* investment f to acquire the ability to target advertising. This can be thought of as investments in market research, expertise or information technology that allow media to be focused on segments based on preferences for products in the market. We have in mind a game in which firms simultaneously decide whether or not to invest in targeting and then compete in advertising and price.

In order to analyze this situation, we must identify the optimal strategies as a function of firm capabilities. Note that the optimal strategies when both firms use uniform advertising and when both firms target advertising are described in sections 3.1 and 3.2. Thus, to complete the analysis, we need to analyze the case where a firm with targeting capability (say Firm 1) faces a firm that can only advertise uniformly (Firm 2). We first solve the price and advertising sub-game and then analyze the decision to invest in targeted advertising.⁶ Let β_1 be the probability that Firm 1 advertises to comparison shoppers (it advertises to its high preference segment with probability 1) and α_2 be the probability that Firm 2 advertises uniformly to the market. In this situation, when both firms advertise to comparison shoppers, the firms' pricing will be in mixed strategies, because each firm has an incentive to undercut the other to attract comparison shoppers. We start the equilibrium characterization with the following lemma:

Lemma 2: The outcome with both $\alpha_2 = 1$ and $\beta_1 = 1$ cannot be part of the equilibrium.

Suppose Firm 2 (the uniform advertising firm) advertises with a probability one. Then Firm 1 (the targeting firm) earns higher profit by advertising with a probability less than one to the comparison shoppers. When Firm 2 is already reaching all the consumers in the market, reducing the advertising to the comparison shoppers helps Firm 1 to reduce the level of market competition.

Lemma 2 means that at least one of the two firms will not always advertise. This implies three possible cases: two cases where either one of the firms advertises with probability less than one

⁶As mentioned in the previous section, we restrict our attention to the range of advertising costs which rule out the degenerate situation where it is not possible for firms with uniform advertising ability to operate, i.e., $A < (1 - h)r$.

(while other advertises with probability one) and the third case in which both the firms advertise with probability less than one. The details of the derivation of all the cases are provided in the Appendix. Proposition 5 provides the details of the equilibrium. The superscript n on the profit for Firm 1 indicates that the expression pertains to the price and advertising sub-game before the investment decision f .

Proposition 5: There are two types of equilibria possible: Either $\beta_1 < 1$ and $\alpha_2 = 1$, or $\beta_1 = 1$ and $\alpha_2 < 1$. Furthermore, Firm 1 always advertises to its h segment with probability one.

1. For low cost of advertising $0 < A < hr$, the equilibrium involves $\beta_1 = 1 - \frac{A}{r}$ and $\alpha_2 = 1$. Firm 1's profits are $\pi_1^n = h(r - A)$ and Firm 2's profits are $\pi_2 = rh - A(1 - s)$.
2. For high cost of advertising $A > \frac{r}{2}$, the equilibrium involves $\beta_1 = 1$ and $\alpha_2 = 1 - \frac{A-hr}{sr}$. Firm 1's equilibrium profits are $\pi_1^n = A - A(h + s)$ while Firm 2 makes zero profit.
3. For intermediate costs $hr < A < \frac{r}{2}$, both types of equilibria are possible. But the equilibrium with $\beta_1 < 1$ and $\alpha_2 = 1$ Pareto dominates the equilibrium with $\beta_1 = 1$ and $\alpha_2 < 1$.

When the costs of advertising are sufficiently low ($A < hr$) the equilibrium involves $\beta_1 < 1$ and $\alpha_2 = 1$. With lower costs of advertising, the firm with uniform advertising is able to always advertise. In response, the firm with the ability to target advertising chooses $\beta_1 < 1$ in order to reduce the competition for the comparison shoppers and therefore β_1 decreases in A in this range. At the other extreme, when the cost of advertising is sufficiently high ($A > \frac{r}{2}$) the equilibrium involves $\beta_1 = 1$ and $\alpha_2 < 1$. The firm with uniform advertising finds it too expensive to always advertise. In contrast, the ability to target advertising and eliminate wasted advertising allows Firm 1 to always advertise. Finally, in the intermediate range of A while both types of equilibria are possible, the equilibrium with the targeting firm advertising with probability less than one and the other firm always advertising Pareto dominates the other equilibrium (both firms make greater profits than in the other equilibrium). While analyzing the decision to invest in targeting, we pick the Pareto dominant equilibrium as the relevant one when advertising costs are in the intermediate range.

The above results highlight some interesting aspects of competition between the two firms who have different capabilities. For A above $\frac{r}{2}$, the inability of Firm 2 to always advertise confers a positive externality on Firm 1. Firm 1 makes $A - A(h + s)$ which is strictly greater than the profit earned by only serving its high preference segment. In other words (from the perspective of Firm 1), all potential profit on comparison shoppers is dissipated when advertising costs are low enough because Firm 2 finds it optimal to always advertise. When advertising costs are high, the reduced advertising by Firm 2 mitigates the competition for the comparison shoppers. Firm 1's profit is

increasing in A when $A > \frac{r}{2}$. Here, even though an increase in A makes it more expensive for Firm 1 (the target advertising firm) to advertise, it also has the effect of making Firm 2 (the uniform advertising firm) to advertise less. For Firm 1, the profit impact of having a weaker competitor outweighs the added cost of communicating with the market.

We now analyze the decisions of the firms to invest f in order to obtain targeting capability. Figure 1 illustrates the payoffs of the firms under different choices of the investment on targeting ability. In this Figure, π_u is the profit where both firms use uniform advertising, π_t is the profit where both firms use targeted advertising, π_a is the profit of a firm with targeting capability when its competitor does not, and π_d is the profit of a firm that uses uniform advertising against a firm that targets its advertising (all profit quantities are net of f).

Figure 1: Normal form of decision to invest to obtain targeting capability.

		Firm 2	
		Uniform	Targeted
Firm 1	Uniform	π_u, π_u	$\pi_d, \pi_a - f$
	Targeted	$\pi_a - f, \pi_d$	$\pi_t - f, \pi_t - f$

Proposition 6:

1. When $0 < A < \frac{r}{2}$, both firms will target if $f < Ah$, only one firm will target if $f \in [Ah, A(1 - h)]$, and neither firm will target if $f > A(1 - h)$.
2. When $A > \frac{r}{2}$, both firms will target if $f < h(r - A)$, only one firm will target if $f \in [h(r - A), Ah]$, and neither firm will target if $f > Ah$.

For the entire feasible range of advertising costs there is a consistent pattern of equilibrium outcomes that are obtained. There are three types of equilibrium outcomes that are possible: i.e., both firms invest in targeting, both do not target, and only one of the two firms targets. When f is sufficiently low the equilibrium involves both firms investing in targeting. On the other hand, if

the costs of targeting are high both firms will choose to use uniform advertising and not invest in targeting. But the more interesting point is that when targeting costs are in an intermediate range, there is an asymmetric equilibrium in the decision to invest in targeting. In other words, ex-ante identical firms differentiate in the decision to acquire the ability to target advertising: while one firm makes the investment f , the other chooses not invest and pursues uniform advertising. The gains from targeting are greater for a firm that faces a competitor that uses uniform advertising than for a firm that faces a competitor who already has targeting ability. Targeting yields a saving because advertising to the high preference segment of the competitor is eliminated. However, when a firm faces a competitor who can target, obtaining targeting capability increases competition for the comparative shopping segment and this attenuates the gains from targeting. Furthermore, the decision to not invest in targeting also implies the direct benefit of savings in the cost of targeting.

3.5. Comparing Targeted Prices and Targeted Advertising

Until now we have focused on markets where firms had the ability to target advertising but could only compete with uniform pricing strategies. This is of course the mainstream case of most product markets where firms can focus advertising to different consumer segments through the media plan, but where the product is sold to consumers through traditional retail channels. But with advances in information technology, the growth of the Internet and better point-of-sale technologies firms increasingly have the ability to price discriminate and target specialized prices to different segments.

In this section we examine the effect of targeted pricing and ask how it interacts with the ability of firms to target advertising. A natural way to begin this investigation is to ask what would happen if firms could target price but under the base case of uniform advertising. This case allows us to tease out the effects of advertising targeting relative to that of pricing. The case of uniform advertising and targeted pricing applies to situations where the media options to reach a target population are limited yet consumers are easy to classify at the time of purchase. Such situations may be common in developing economies where media options are few but local sales persons and distributors often possess sophisticated knowledge about their customers. Note that if a firm advertises, the profit from charging the reservation price as in section 3 will be $hr - A$. Therefore as in Lemma 1, if $hr > A$, then firms will advertise with probability one.

If $hr < A$ then firms will employ mixed advertising strategies. Similar to section 3, we solve for a symmetric equilibrium and denote γ as the probability of advertising. We can write the profit of a firm when it advertises as:

$$hr + (1 - \gamma_u)sp + \gamma_usp(1 - F(p)) - A \tag{4}$$

The equilibrium profit in this case is zero, while the equilibrium probability of advertising is $\gamma_u^* = 1 - \frac{A-hr}{sr}$. Comparing this with the case of uniform advertising and pricing, we can see that the incentive to advertise is unaffected by the ability to set targeted prices (the equilibrium advertising is identical to the case of uniform pricing derived in section 3). The equilibrium profits also do not change from the uniform price case. This is because while targeted pricing allows firms to increase the price charged to the high preference consumers (to the reservation price r), it also increases competition for the comparison shoppers relative to the base case. In equilibrium these effects cancel out and firms do not benefit from targeted pricing versus the base case. With targeted pricing, the comparison shoppers are better off while the high preference segment is not better off and pays the reservation price.

We now consider the case where firms can target both advertising and pricing. The importance of this case is apparent given the ability that direct marketers have to offer tailored prices to consumers and the increased availability of individual-level consumer information. Analyzing this problem helps us to understand how the ability to focus advertising would interact with a firm's ability to target pricing. When firms can target both price and advertising, each firm can guarantee itself a profit of $h(r - A)$. This is because the firm can choose to send advertising only to their h segment and charge the reservation price. Similar to section 3.2, firms do not advertise to the h consumers of the competitor and employ a mixed advertising strategy to the comparison shopping segment. We can write the following equilibrium condition for the comparison shopping segment where γ_t is the probability of advertising to comparison shoppers:

$$(1 - \gamma_t)sp + \gamma_tsp(1 - F(p)) - As = 0 \tag{5}$$

The following proposition characterizes the equilibrium:

Proposition 7: When advertising and pricing can be targeted, the equilibrium profit is $h(r - A)$ and firms advertise to their h consumers with a probability one and to comparison shoppers with a probability of $\gamma = 1 - \frac{A}{r}$. In addition, firms employ mixed pricing strategies with $F(p) = 0$ for $p < A$, $F(p) = \frac{r(p-A)}{p(r-A)}$ for $p \in [A, r]$ and $F(p) = 1$ for $p > r$.

Neither the advertising strategy nor the profits of firms are affected when firms that can target advertising obtain the ability to target prices. Similar to section 3.2 where advertising can be targeted but prices are uniform, firms advertise to their h segment with probability of one and the probability of advertising to comparison shoppers is identical. The contrasting effects of targeting for both pricing and advertising are summarized in Table 2.

Table 2
Equilibrium Outcomes as a Function of Targeting*

Advertising Probabilities by Segment, Profits

Range: $A > hr$

Advert.	Case 1	Case 2	Case 3	Case 4
	Uniform Advert.	Target Advert.	Uniform Advert.	Target Advert.
	Uniform Pricing	Uniform Pricing	Target Pricing	Target Pricing
Advert. (h)	$1 - \frac{A-hr}{sr}$	1	$1 - \frac{A-hr}{sr}$	1
Advert. (s)	$1 - \frac{A-hr}{sr}$	$1 - \frac{A}{r}$	$1 - \frac{A-hr}{sr}$	$1 - \frac{A}{r}$
Profits	0	$h(r - A)$	0	$h(r - A)$

*with targeted pricing, the price to the h segment is r and the price to the s segment is in mixed strategies.

The benefit of targeted pricing is the ability to charge reservation prices and extract surplus from the high preference segment. However, targeted pricing also increases price competition with comparison shoppers because a firm can reduce price to these consumers without reducing the price to its h segment. The results shown in Table 2 demonstrate that these effects cancel out. Regardless of whether advertising is uniform or targeted, the profits of firms are unaffected by having the ability to set targeted prices.

To summarize, the targeting of advertising leads to increases in firm profits independent of whether firms are able to target pricing or not. In fact, the increase in profits due to targeted advertising (over the base case) is independent of whether firms can set targeted prices. Moreover, if the firms are not able to target advertising, the equilibrium profits remain the same independent of whether or not firms can target pricing. This adds an important perspective to the literature on targeting and competitive price discrimination. Several papers have pointed out that competitive price discrimination can lead to lower equilibrium profits compared to the case of uniform pricing. For example, Thisse and Vives (1988) show that when firms compete by offering location-based pricing, the equilibrium profits are even lower than the profits of the uniform-price competition case. Winter (1997) and Corts (1998) show that (third-degree) price discrimination by imperfectly competitive firms leads to more intense competition and lower equilibrium profits compared to the case of uniform pricing. Similar to these papers, targeted pricing in our model is competitive third-degree price discrimination and consistent with the literature, it leads to no profit advantage for firms. When firms target pricing, they can price discriminate between their own segment and the comparison shopping segment. This implies that firms can set the reservation price for their high preference segment while competing for the consumers in the comparison shopping segment with a different targeted price. Targeting leads to increased price competition in the comparison shopping

segment such that the gains in a firm's high preference segment are eliminated by reduced profits from the comparison shopping segment. However, as we show, targeted advertising always leads to increases in equilibrium profits. This underscores the importance of media planning techniques and databases to improve the targeting of advertising. Thus, a message of the analysis is that in a competitive environment, the ability to target advertising is likely to be more important for firm profits than the ability to target pricing.

Firms advertise more (i.e., more frequently) to consumers who have strong preference for their product than to comparison shoppers when advertising can be targeted. Advertising to consumers with strong preferences leads to a guaranteed sale, whereas whether a firm sells to a comparison shopper depends upon whether the consumer is reached by the other firm's advertising and also on the prices charged. Next, the targeting of advertising allows firms to increase the effectiveness of advertising activity. When advertising is inexpensive ($A < \frac{r}{2}$), targeting leads to lower advertising because advertising that falls on consumers who prefer the competitor's product is eliminated. When advertising is expensive, it means being able to send higher advertising to consumers who will buy. It is also interesting to note that with targeting as the costs of advertising decrease the expected prices charged in the market decreases. This implies that with targeting a higher intensity of advertising is associated with lower prices being charged on average.

4. Empirical Illustration: Local Retail Advertising

Our analysis suggests that firms will benefit from targeted advertising. This implies that firms in competitive markets should utilize targeted as opposed to uniform advertising strategies when suitable media technology is available and when it is possible to cost-effectively learn about consumer preferences. In addition, given that firms have the ability to target, we would expect them to send higher weights of media to consumers that have a stronger pre-disposition to purchase their products. This phenomenon should be most prevalent in the case of retail advertising about store events and specials of which consumers would otherwise have no knowledge. Local advertising plans of retailers provide an interesting context to illustrate the ideas of this paper. We investigate the local advertising activity of hypermarchés in France.⁷

Retail markets are suitable for our investigation because the distance that a consumer lives from a retailer and other demographic factors are likely to be strong indicators of a consumer's preference to shop at a retailer. Second, given that the majority of local advertising for retailers is printed catalogues, flyers and brochures targeting specific urban areas (and not others) is possible. Finally,

⁷The information in this section is based on a series of detailed interviews with marketing managers of CORA, Casino and Carrefour (three of the largest retailers in France).

the majority of local advertising by retailers is informative in nature and it informs consumers about the sales events and specials for different categories of goods at the retailer.

Our discussions with company representatives indicate that three large hypermarchés in France develop their creative and promotional programs for local advertising nationally but manage the deployment of media for local advertising at the store level (the media decisions are the quantity of printed items distributed by each store, and the addresses to which they are delivered). These retailers construct patronage maps in which the retail trading area for each store (in terms of the strength of their franchise) is divided into primary, secondary and tertiary territories. The hypermarchés use independent researchers to conduct in-store surveys (at the check out) and analyze loyalty and credit card purchases. The retailer then uses the data to estimate its share of total hypermarché sales by urban area (in France, cities are divided into arrondissements and each village has its own city hall and postal district). The addresses of customers are matched to specific shopping behavior reported in the survey.

A summary of the criteria used to determine the territories is shown in Table 3. In general, the primary area for one hypermarché corresponds to a tertiary area for its competitors and vice versa. Based on several patronage maps, we show a representative map for an urban area in central France (Figure 2). The patronage maps of each store are annually updated to accommodate for changes in customer profiles. Apparently, one of the difficult issues in constructing a patronage map is deciding how close to the competitor’s store the border of the secondary territory should be drawn. To assist with this task, ISDM, a market research firm headquartered near Paris, estimates “zones de bascule” for retailers. Roughly translated, these can be thought of “zones of switchers”. ISDM divides the entire country into pockets of three hundred households and using a combination of survey data, driving distances and traffic density designates “zones de bascule” for participating retailers. A hypermarché marketing manager noted that the studies of ISDM are useful for fine-tuning the patronage map.

Table 3
Customer Territory Characteristics
Hypermarchés in France

Key Segment	Territory Criteria	Distance from Hypermarché	Typical Behavior
Primary	SOM>30%	Close to hypermarche	Regular Shoppers
Secondary	10%<SOM<30%	Similar traveling to competitor	Occasional but not Regular
Tertiary	SOM<10%	Closer to the competitor	Rare Shoppers

Source: Interviews by the authors Jan-April 2002

Figure 2: Patronage Map for a Hypermarché with 1 Major Competitor Nearby



The map shows how the territories of the focal store are affected by the presence of a nearby competitor. Our interviews indicate that the presence of a nearby competitor tends to increase the size of the secondary zone and reduce the relative importance of primary and tertiary zones. Second, the primary zone of each hypermarché generally extends further on the side of the hypermarché that is furthest from the competitor. This makes sense but it underlines the risk of depending solely on distance from the hypermarché as a basis for establishing patronage zones.

The second issue pertains to the media strategies employed by the retailers. French hypermarchés classify their printed advertising efforts based on the theme of the brochure, catalogue, or flyer. Interestingly, the theme also plays a key role in determining the media strategy used by the

hypermarché. The local advertising efforts are summarized in Table 4.

Table 4
Local Advertising Summary
Hypermarchés in France

Theme Type	Example	Objective
Regular Weekly Specials	Food, household items, clothing	reward patronage, maintain image
Seasonal Events	Valentine, Father's/Mother's Day, X-mas, Easter	build traffic, reward patronage
Special Events	Gardening, The Fair of Wines, Summer Sports	build traffic, reward patronage
Shock Specials	School Supplies, Baby Products, Food	build traffic, generate trial

Theme Type	Primary	Secondary	Tertiary
Regular Weekly Specials	yes	no	no
Seasonal Events	yes	yes	no
Special Events	yes	yes	no
Shock Specials	yes	yes	yes
Total	100%	50%	>10%

Source: Interviews by the authors Jan-April 2002

The table shows that the retailers send 100% of their advertising brochures to primary consumers, significantly less to secondary consumers, and less again to tertiary consumers. Advertising activity is therefore focused more on the retailer's core customers than on the consumers for whom the retailer competes intensely. In fact, the hypermarchés regularly purchase surveys of local advertising from two market research firms (Agena 3000 and Arbalète). These surveys show that the intensities of local advertising from direct competitors in urban districts tend to be negatively correlated. One interviewee suggested that the hypermarchés "cooperate" to limit the amount of junk mail sent to each household. Two further points are worth highlighting. While most of a hypermarché's core customers are found in primary areas, the hypermarché has no information on the majority of households in any given area (many of these households are not customers). The important point is that the territory and distance correlates highly with a household's pre-disposition to respond to the advertising events of the store. Second, while there are many regular product categories for which customers may shop at the hypermarché independent of the advertising, it is important to note that French hypermarchés are much bigger than regular supermarkets and a significant proportion of their sales come from consumer spending on discretionary products. Many of the themes used for local advertising promote items and products that are discretionary. Consumers might not consider these items at all were it not for the advertising. Furthermore, given both the size of the store and the distance that one must park from them, a shopping trip to a hypermarché is a time consuming

undertaking. In this sense, the advertising plays the role of making consumers aware of purchase opportunities that they might otherwise not pursue. Thus advertising of sales and special events have an important role in informing and motivating consumers to consider shopping at the retailer.

5. Extensions

5.1. Continuous Advertising

In the base model, firms can choose between advertising that informs all of a given segment or none of it. Here we extend the analysis to a situation where firms can choose to advertise to any fraction ϕ of a segment between 0 and 1. For any given advertising intensity ϕ , if there is targeting, every consumer within the targeted segment sees the advertising with a probability of ϕ . The cost of advertising is proportional to the size of the segment and is increasing and convex (we use a quadratic cost function) in the fraction of the segment being informed. Because the strategy space for the firms includes mixed pricing strategies, advertising intensities can be a function of the pricing profile chosen by each firm. As a result, the cost function for advertising, when targeting is possible, is written as i.e. $A = \frac{k}{2}q\phi_j^2$ where j is the type of consumer, q is the size of the segment. For the case of uniform advertising, this cost function reduces to $A = \frac{k}{2}\phi^2$.

5.1.1. Uniform Advertising (Continuous Case)

We begin our analysis of continuous advertising, by considering a situation of uniform advertising and price competition. If both firms advertise in equilibrium, the price equilibrium will be in mixed strategies for the same reasons as in the base case. Given that the advertising intensity may be a function of the pricing profile, we define $\phi_o(p_o)$ to be the advertising level chosen by the competitor that corresponds to his choice of price p_o . The profit function for a firm can then be written as:

$$\pi = p \left[\phi h + \phi s(1 - F(p)) + \phi s \int_{\underline{p}}^p (1 - \phi_o(p_o)) f(p_o) dp_o \right] - \frac{k}{2}\phi^2 \quad (6)$$

The full solution is provided in the Appendix. In this case firms use pure advertising strategies and the equilibrium level of advertising is $\phi = \frac{r(h+s)}{k+rs} < 1$ (when advertising is sufficiently expensive, $k > hr$). Thus in equilibrium firms have imperfect reach in the market. Similar to the discrete case, imperfect reach in this model helps firms to create endogenous differentiation because there are consumers in the comparison shopping segment who are reached by one firm but not by the other. Advertising increases in the reservation price but decreases in the cost of advertising, i.e., $\frac{\partial \phi}{\partial r} > 0$, $\frac{\partial \phi}{\partial k} < 0$. However, $\frac{\partial \phi}{\partial s}$ is positive if $k > r$ and is negative when $k < r$. The intuition is the same as

in the base case: When advertising is expensive firms would advertise at lower levels all else being equal. Firms advertise more as the proportion of comparison shoppers increases, because the effect of advertising in increasing demand dominates the competitive effect of advertising in activating more consumers in the comparison shopping segment. When advertising is less expensive the competitive effect of advertising dominates and firms therefore advertise less as s increases. The equilibrium profits are $\frac{k\tau^2}{2} \frac{(h+s)^2}{(k+rs)^2}$. Finally, and similar to the discrete advertising analysis, the average price increases in the cost of advertising, the reservation price and the size of the high preference segment.

5.1.2. Targeted Advertising and Uniform Pricing (Continuous Case)

We now turn to the case where advertising is continuous and can be targeted to specific segments. As in the discrete case, when firms can target advertising, they will choose zero advertising to the competitor's h segment. For a given price p , define $\phi_h(p)$ to be the probability of advertising to the high preference consumers and $\phi_s(p)$ to be the probability of advertising to the comparison shoppers. Reasoning analogous to the uniform advertising case implies that the price equilibrium is one of mixed strategies.⁸ We again denote the advertising intensity of the competitor to comparison shoppers as $\phi_o(p_o)$ when charging price p_o and $f(p_o)$ is the probability density function of the competitor's price.

The objective function for each firm is:

$$\pi = p \left[\phi_h(p)h + \phi_s(p)s(1 - F(p)) + \phi_s(p)s \int_{\underline{p}}^p (1 - \phi_o(p_o))f(p_o)dp_o \right] - h\frac{k}{2}\phi_h^2(p) - s\frac{k}{2}\phi_s^2(p)$$

The full solution of this case is presented in the appendix. We present the following proposition that characterizes the advertising and pricing strategies:

- Proposition 8:
1. The advertising strategies for both the high preference segment and the comparison shopping segment is in mixed strategies. In addition, the level of advertising to the high preference segment is strictly greater than the level of advertising to the comparison shopper segment and $\phi_h(p)$ and $\phi_s(p)$ are negatively correlated.
 2. In equilibrium, price is positively correlated with the level of advertising for the high preference segment and negatively correlated with the level of advertising for comparison shoppers.

The equilibrium condition can be derived to be $\pi = \frac{hk}{2}\phi_h^2(p) + \frac{sk}{2}\phi_s^2(p)$. The advertising level that firms choose is related to the price chosen. Therefore, advertising to both segments are in mixed

⁸Unless $\phi_s = 0$, there will always be some comparison shoppers who are informed and the firms will have an incentive to undercut each other. The analysis shows that $\phi_s = 0$ is not part of the equilibrium.

strategies. However, we still recover the basic finding that firms advertise more to their own segment than to comparison shoppers. With targeting, not only are firms able to eliminate wasteful advertising to the other firm's h segment, they are also able to focus heavier weights on customers who prefer their products. Furthermore, the equilibrium condition indicates that level of advertising to the high preference and comparison shopping segment are negatively correlated. Thus, all else being equal, an increase in the advertising to the high preference segment reduces the advertising to comparison shoppers.

Interestingly, with targeted advertising, the equilibrium price is positively correlated to the level of advertising for a firm's high preference segment and negatively correlated to the level of advertising for comparison shoppers. This points to the importance for brand managers to coordinate the pricing strategy not only with the level of total advertising but also with the segment-specific advertising weights employed in a firm's media plan.

For different parameter values one can also compute numerically the equilibrium price distributions with and without targeting. Figure A1 in the appendix presents a comparison of minimum prices. Note that for more expensive advertising the minimum price is lower under advertising targeting. This obtains because for expensive advertising the advertising levels to the comparison shoppers are higher with targeting. As a result, the proportion of comparison shoppers who consider both products is higher under targeted advertising than under uniform advertising. One can also check that both with and without targeted advertising, average prices are lower when advertising is less expensive. This obtains because lower advertising costs lead to higher advertising and a greater fraction of the comparison shopper segment being informed of both firms.

For the parameters we checked the targeting of advertising leads to an increase in profits as it does in the model of discrete advertising (see Figures A2 and A3 in the appendix). The main effect of targeted advertising is to allow higher levels of advertising to those consumers who actually have the potential to buy the product. Markets where firms focus advertising are more profitable due to a combination of (a) shifting spending from consumers who will never buy to those who will and (b) higher levels of spending due to increased impact. Furthermore, we can also obtain the other key result obtained in the discrete case: Firms advertise more to consumers who prefer their product more than to consumers who are likely to also consider a competing product. In addition, firms select the highest advertising for the high preference segment when the reservation price r is offered and this happens precisely when the advertising for comparison shoppers is at its lowest. Conversely, the advertising intensities for each segment are identical when the lowest price in the support, \underline{p} , is charged.

5.2. Welfare Implications

Consider the case where advertising is uniform in the base model. Total welfare is given by total demand multiplied by the reservation price less the cost of advertising. When $A < hr$, we follow Lemma 1 and firms advertise. Welfare is given by $W_{ua} = r - 2A$. When $A \in (hr, r(1-h))$, advertising is probabilistic. The total demand is $2\alpha h + s(\alpha^2 + 2\alpha(1-\alpha))$ where α is the probability of advertising. Substituting for α^* (Proposition 1), we can calculate total demand and each firm spends α^*A on advertising. Thus, total welfare with uniform advertising is $W_{ua} = \frac{((1-h)r-A)^2}{(1-2h)r}$. The expression W_{ua} exhibits the expected characteristics: it increases in r and decreases in A . When advertising can be targeted and $A \in (0, hr + sr)$, we know that firms advertise to the high preference consumers with a probability of one and to comparison shoppers with a probability of $\beta^* = 1 - \frac{A}{r}$. Here, welfare is calculated in the same way but the cost of advertising has two components (the advertising to the h consumers hA and the advertising to comparison shoppers $s\beta A$). The total welfare in this situation is $W_{ta} = \frac{1}{r}(r^2 - A^2 - 2hAr + 2hA^2 - 2r + 2A + 4hr - 4hA)$.

It can be shown that targeted advertising improves welfare. There are three sources of improved welfare. First, targeting allows firms to advertise to the high preference segment 100 % of the time. Because $r > A$, this increases welfare. Second, advertising by each firm to the competitor's h segment is eliminated (since this advertising has no effect on demand it is wasted). Finally, it is interesting to note that the level of advertising directed towards comparison shoppers under targeted advertising by the competing firms is the first best level that would be chosen by a central planner.

6. Conclusion

One of the central questions that firms face in advertising and media planning is the manner in which they should focus advertising to specific consumers. How should firms allocate their media budgets between consumers who have a distinct preference for their brand and consumers who consider competing products? The paper provides a logic for why firms in competitive markets should focus more informative advertising on consumers who have a distinct preference for their products. When firms reduce advertising to price elastic consumers who comparison shop they endogenously create additional market differentiation reducing the intensity of competition. The targeting of advertising also provides firms with the direct benefit of eliminating wasted advertising to consumers who have a distinct preference for the competing product. Due to these reasons, the ability to target advertising increases the equilibrium profits of firms.

Targeting improves the effectiveness of advertising. By reducing the wastage created by sending advertising to consumers who are unlikely to buy, we might expect improved targeting to lead to lower advertising expenditures. The analysis shows that this conclusion might not always hold.

When advertising is expensive, the inability to target advertising leads firms to make low advertising expenditures. In this case, when firms can target advertising, advertising spending is higher because the increased effectiveness of advertising makes higher expenditures worthwhile.

An interesting implication of the analysis is that in a competitive environment, the ability to target advertising is more important for increasing firm profitability than the ability to target pricing. When firms have the ability to choose different advertising levels for different groups of consumers, it leads to higher profits independent of whether or not firms also have the ability to set targeted prices. In contrast, the ability to only target prices creates increased competition for the comparison shoppers.

We can think of two useful extensions to the current model. First, an interesting extension would be to evaluate the effects of targeting when firms are asymmetric in terms of the size of their own consumer segments. Second, it would be useful to formally analyze the phenomenon of advertising leakage across segments.

APPENDIX

Proof of Proposition 1

We look for the symmetric equilibrium of the competition between the two firms. Let the probability with which firms advertise be α . Then when a firm advertises, from (2) the guaranteed profit of a firm from charging the reservation price r will be $hr + (1 - \alpha)sr - A$. Equating this to the profits when the firm does not advertise we have the equilibrium of $\alpha^* = 1 - \frac{A-hr}{sr}$.

A possible totally mixed strategy equilibrium pricing strategy is the following: Each firm can charge a price according to some continuous c.d.f $F(p)$ with support between r and some lower bound z . To derive the equilibrium price distribution, substitute α^* into (2) to obtain $F(p) = 1 - \frac{r-p}{p} [\frac{A}{(s+h)r-A}]$. To identify the minimum price in the distribution, note that when a firm charges the minimum price we have $\pi(z) = zh + (1 - \alpha)zs + \alpha zs - A = 0$. From this the minimum price can be derived to be $z = \frac{A}{1-h}$ after recalling that $s = 1 - 2h$.

Proof of Proposition 2

Each firm can earn a guaranteed of $h(r - A)$ by targeting advertising only to its high preference segment and charging the reservation price. The profit to a firm while also advertising to the comparison shopping segment with probability β is given by (3) in the text. By considering the profit when a firm is also advertising to the comparison shopping segment and charging the reservation price and equating this to the guaranteed profit when not advertising to the comparison shoppers, we have the equilibrium condition

$$\pi(r) = rp + (1 - \beta)sr - A(h + s) = h(r - A) \tag{i}$$

From this the equilibrium probability of advertising to the comparison shoppers can be derived to be $\beta^* = 1 - \frac{A}{r}$. Given this the equilibrium price distribution can be easily derived by using a procedure which is similar to the one shown for Proposition 1.

Proof of Proposition 3

It follows directly from comparing the total advertising in Propositions 1 and 2.

Proof of Proposition 4

When $A < hr$, firm profits are $hr - A$ when advertising is uniform and $h(r - A)$ with targeted advertising. $V_{ta} = \pi_{ta} - \pi_{ua} = A(1 - h)$. When $A > hr$, firms profits are zero with uniform advertising and $h(r - A)$ with targeted advertising. Hence $V_{ta} = h(r - A)$.

Proof of Lemma 2

Suppose Firm 1 has the ability to target while Firm 2 employs uniform advertising. Assume that Firm 1 advertises to the comparison shoppers with probability $\beta_1 = 1$ and Firm 2 advertises uniformly with probability $\alpha_2 = 1$ (note that it is the case that Firm 1 always advertises to its high preference consumers). Let $W_i(p)$ ($i = 1, 2$), be the probability that Firm i is charging a price above p . Using standard arguments as in Narasimhan (1988) the price support of both the firms are identical and in (z, r) . For any price p , the profit functions are as follows:

$$\pi_1(p) = hp + spW_2(p) - A(h + s) \quad (\text{ii})$$

$$\pi_2(p) = hp + spW_1(p) - A \quad (\text{iii})$$

Given that $\alpha_2 = 1$ and $\beta_1 = 1$, Firm 1 can only charge r if Firm 2 has a mass point at r because otherwise Firm 1 when charging r would be better off by setting $\beta_1 = 0$. Let Firm 2 charge r with some positive probability q_2 . Considering Firm 2's profits at the extreme prices we have the equilibrium condition $\pi_2(r) = hr - A = \pi_2(z) = (h + s)z - A$. From which we get $z = \frac{hr}{h+s}$. Firm 1's profit when charging r will be $\pi_1(r) = hr + srq_2 - A(h + s)$, and when charging z will be $\pi_1(z) = hz - A(h + s)$. From this we have that in any equilibrium $hr + srq_2 - A(h + s) = hr - A(h + s)$, which can only be true if $q_2 = 0$. But this contradicts our assumption that $q_2 > 0$. Therefore, an equilibrium with $\alpha_2 = 1$ and $\beta_1 = 1$ is not possible.

Proof of Proposition 5

Case i : Let $\beta_1 < 1$ and $\alpha_2 = 1$. From standard arguments as in Narasimhan (1988) the price support of the firms will still be (z, r) . As in the proof of Lemma 2 above, with $\alpha_2 = 1$, Firm 1 when advertising cannot charge r unless Firm 2 is charging r with some positive probability q_2 . Thus, for Firm 1 when advertising to the comparison shoppers and charging r , we have $\pi_1(r) = hr + q_2 - A(h + s)$ and when charging z is $\pi_1(z) = (h + s)z - A(h + s)$. Firm 1 when not advertising can charge r and make a guaranteed profit of $h(r - A)$. From this we have that in equilibrium $z = \frac{hr + As}{h + s}$ and $q_2 = \frac{A}{r}$. Firm 2's profit is given by $\pi_2(p) = hp + (1 - \beta_1)sp + \beta_1 spW_1(p) - A$. When Firm 2 chooses z , we have $\pi_2(z) = (h + s)z - A = hr - A(1 - s)$. From this and from considering Firm 2's profits at r we get $\beta_1 = 1 - \frac{A}{r}$. The equilibrium profits are $\pi_1 = h(r - A)$ and $\pi_2 = hr - A(1 - s)$. The conditions for the feasibility of this case obtains from the requirements $hr - A(1 - s) > 0$ which is $A < \frac{r}{2}$.

Case ii : Consider next the case $\beta_1 = 1$ and $\alpha_2 < 1$. Firm 2's profit for any p in the support when advertising is $\pi_2(p) = hp + spW_1(p) - A$. Given that its profit when not advertising is zero we have the equilibrium condition $\pi_2(p) = 0$. When Firm 2 advertises and charges z we have that $hz + sz - A = 0$ from which $z = \frac{A}{h+s}$. Next we have that Firm 1's profit for any price p in the support is $\pi_1(p) = hp + \alpha_2 spW_2(p) + (1 - \alpha_2)sp - A(h + s)$. This means that $\pi_1(z) = (h + s)z - A(h + s) = A - A(h + s)$.

To derive the equilibrium α_2 , note that $\pi_1(r) = hr + (1 - \alpha_2)sr - A(h + s) = A - A(h + s)$. Therefore, $\alpha_2 = 1 - \frac{A - hr}{sr}$. The equilibrium profits are $\pi_1 = A - A(h + s)$ and $\pi_2 = 0$. The condition for the feasibility of this case obtains from the requirement $\alpha_2 < 1$ which implies $A > hr$.

Finally consider the case $\beta_1 < 1$ and $\alpha_2 < 1$. We can show that this will not be an equilibrium. Firm 1 when not advertising can charge the reservation price and guarantee itself a profit of $\pi_1 = h(r - A)$ and similarly the guaranteed profit of Firm 2 is zero. When advertising, Firm 1's profit function can be written as $\pi_1(p) = hp + \alpha_2 spW_2(p) + (1 - \alpha_2)sp - A(h + s)$. The minimum price z_1 for Firm 1 will therefore be given by $hz_1 + sz_1 - A(h + s) = h(r - A)$ which gives $z_1 = \frac{hr + As}{h + s}$. Similarly the profit function of Firm 2 when advertising is $\pi_2 = hp + \beta_1 spW_1(p) + (1 - \beta_1)sp - A$. The minimum price z_2 that Firm 2 can charge will then be given by $hz_2 + sz_2 - A = 0$ From this we have $z_2 = \frac{A}{h + s}$. In general, we can see that $z_1 \neq z_2$. This cannot be part of an equilibrium, because the firms must be charging the same minimum price in equilibrium. Let $z_1 > z_2$ and so let the candidate minimum price be z_1 for both firms. In this case, given Firm 1's strategy, Firm 2 will be making greater than zero profits (which it makes when not advertising). This violates the equilibrium condition for Firm 2. Similarly, if $z_1 < z_2$, the candidate minimum price for both firms will be z_2 . In this case Firm 1 will be making greater profits than $h(r - A)$ which violates the equilibrium condition.

Proof of Proposition 6

To analyze the equilibrium to the game of Figure 1, we identify firm profits for each of the outcomes. These are summarized in Table A1.

Table A1
Summary of Profits*
Targeting Capability requires an investment of f

Region for A	Both Uniform π_u	Targeting/Uniform $\pi_a - f$ π_d		Both Targeted $\pi_t - f$
$0 < A < \frac{r}{2}$	$hr - A$	$h(r - A) - f$	$hr - A(1 - s)$	$h(r - A) - f$
$\frac{r}{2} < A < r(h + s)$	0	$A - A(h + s) - f$	0	$h(r - A) - f$

*based on Propositions 1, 2, and 5.

When $0 < A < \frac{r}{2}$

1. Both firms choosing uniform advertising is the equilibrium when $\pi_u > \pi_a - f$ and this implies that $hr - A > h(r - A) - f$. Simplifying, this becomes $f > A(1 - h)$. Therefore, $f > A(1 - h)$ implies that neither firm invests to obtain targeting capability.

2. Targeting/Uniform is the equilibrium when $\pi_u < \pi_a - f$ and $\pi_d > \pi_t - f$. Substituting, these conditions imply that $hr - A < h(r - A) - f$ and $hr - A(1 - s) > h(r - A) - f$ respectively. Simplifying, this becomes $f < A(1 - h)$ and $f > Ah$. Because $h < \frac{1}{2}$, these conditions define an interval where only one firm invests to obtain targeting capability.
3. Both targeting is the equilibrium when $\pi_d < \pi_t - f$ which implies $hr - A(1 - s) < h(r - A) - f$. Simplifying, this becomes $f < Ah$.

When $A > \frac{r}{2}$

The solution procedure is similar as in the case above.

Proof of Proposition 7

Similar to Proposition 2, each firm earns a guaranteed profit of $h(r - A)$ by targeting advertising to its high preference consumers only and charging r . Following the reasoning of Lemma 1, an equilibrium where both firms employ pure advertising strategies to comparison shoppers does not exist. Thus, the equilibrium condition for comparison shoppers is shown in equation 5. The reservation price r is the upper bound of the c.d.f. of the mixed pricing strategy for comparison shoppers when a firm advertises. Substitute into equation 5 to obtain $\gamma_t = 1 - \frac{A}{r}$. Substitute back into equation 5 to derive $F(p) = \frac{r(p-A)}{p(r-A)}$. The lower limit of the c.d.f. obtains when $F(p) = 0$ which implies that $z = A$.

Full Solution of Uniform Advertising and Uniform Pricing for the Continuous Case

We first provide the analysis of uniform advertising for the continuous case. The profit function for a firm is:

$$\pi = p \left[\phi h + \phi s(1 - F(p)) + \phi s \int_{\underline{p}}^p (1 - \phi_o(p_o)) f(p_o) dp \right] - \frac{k}{2} \phi^2$$

The first order condition for advertising implies that:

$$p \left[h + s(1 - F(p)) + s \int_{\underline{p}}^p (1 - \phi_o(p_o)) F(p_o) dp \right] = k\phi.$$

Multiply both sides by ϕ and substitute back into the objective function to obtain $\pi(p) = \frac{k\phi^2}{2}$ for all the prices in the equilibrium support. From the invariance of profit in the mixed strategy price equilibrium, the equilibrium profit is a constant for every price in the equilibrium support and hence firms use pure advertising strategies. Therefore, $\phi_o(p_o) = \phi$ (a constant) in the symmetric equilibrium.

To derive the equilibrium value of ϕ , note that when charging the reservation price r , the equilibrium condition is $r(h + s(1 - \phi)) = k\phi$ from which we obtain: $\phi = \frac{r(h+s)}{k+rs}$. For an internal solution, we require that $k > hr$ (this corresponds to the condition that $A > hr$ in the discrete case). As a result, the equilibrium profit is $\frac{kr^2}{2} \frac{(h+s)^2}{(k+rs)^2}$. Substituting the expression for ϕ into the first order condition, we obtain:

$$F(p) = 1 - \frac{k}{s} \frac{r-p}{rp}$$

The minimum price in the support can be easily identified as $\underline{p} = \frac{kr}{k+r(1-2h)}$.

The comparative statics for price and advertising with respect to advertising cost, reservation price and the size of the high preference segment are: $\frac{\partial}{\partial k}(1 - F(p)) > 0$; $\frac{\partial}{\partial h}(1 - F(p)) > 0$; $\frac{\partial \phi}{\partial k} < 0$; $\frac{\partial \phi}{\partial r} > 0$ and $\frac{\partial \phi}{\partial s}$ is positive if $k > r$ and negative if $k < r$.

Proof of Proposition 8

The first order condition for ϕ_h is:

$$\frac{\partial \pi}{\partial \phi_h} = hp - hk\phi_h = 0 \Rightarrow p = k\phi_h$$

The first order condition for ϕ_s is:

$$\frac{\partial \pi}{\partial \phi_s} = ps(1 - F(p)) + ps \int_{\underline{p}}^p (1 - \phi_o(p_o))f(p_o)dp - sk\phi_s = 0$$

This implies that

$$p \left[(1 - F(p)) + \int_{\underline{p}}^p (1 - \phi_o(p_o))f(p_o)dp \right] = k\phi_s$$

Now substitute for p and $p \left[(1 - F(p)) + \int_{\underline{p}}^p (1 - \phi_o(p_o))f(p_o)dp \right]$ into the objective function in the main text to obtain the following expression:

$$\pi = h\frac{k}{2}\phi_h^2(p) + s\frac{k}{2}\phi_s^2(p) \tag{iv}$$

Because of the discrete nature of the market, the pricing equilibrium is in mixed strategies. Since $p = k\phi_h$ (as implied by the first order condition for ϕ_h), ϕ_h must also be a mixed strategy. Then equation (iv) implies that advertising to comparison shoppers is also a mixed advertising strategy. In addition, because $p = k\phi_h \Rightarrow \phi_h = \frac{p}{k}$ therefore $k > r$ is a necessary condition for an “internal solution” because r is the highest price observed in a mixed pricing strategy. This is a more restrictive than the condition on k in the no targeting case. (Values of $k < r$ imply that the upper range of the price support is associated with a corner solution in advertising of $\phi_h = 1$). Accordingly, we can focus on the parameter combinations where $k > r$. Note that $(1 - F(p)) + \int_{\underline{p}}^p (1 - \phi_o(p_o))f(p_o)dp$ is

the fraction of comparison shoppers that a firm will acquire at price p and this is clearly less than 1. As a result, the first order conditions shown above imply that $\phi_h(p) > \phi_s(p)$ for all p . Similar to the discrete case, advertising to the high preference segment is always higher than advertising to comparison shoppers. In addition, equation (iv) implies that $\phi_h(p)$ and $\phi_s(p)$ are negatively correlated. This proves the first part of Proposition 8.

Because $\phi_h(p) = \frac{p}{k}$, we substitute into equation (iv) and rearrange to obtain $\phi_s^2(p) = \frac{2\pi}{ks} - \left(\frac{p}{k}\right)^2 \frac{h}{s}$. By the property of a mixed strategy equilibrium π is a constant. Therefore, it is easy to show that $\frac{\partial \phi_s(p)}{\partial p} < 0$. Therefore, advertising to comparison shoppers decreases in the price charged. Also because $\phi_h(p) = \frac{p}{k}$, advertising to the high preference consumers increases in the price charged. This proves the second part of the proposition.

Full Characterization of the Equilibrium

Define: $g(p) = \int_{\underline{p}}^p (1 - \phi_o(p_o)) f(p_o) dp$ and note that

$$\frac{\partial g(p)}{\partial p} = (1 - \phi_o(p)) f(p)$$

Using the first order condition for $\phi_s(p)$ we write

$$1 - F(p) = \frac{k\phi_s(p)}{p} - g(p) \Rightarrow F(p) = 1 - \frac{k\phi_s(p)}{p} + g(p)$$

From which we can obtain $f(p) = \frac{k}{p^2} - \frac{k\phi'_s(p)}{p\phi_s(p)}$. We derive

$$\phi_s(p) = \left(\frac{2\pi}{ks} - \left(\frac{p}{k} \right)^2 \frac{h}{s} \right)^{\frac{1}{2}}$$

Differentiating again, we obtain

$$\phi'_s(p) = \left(\frac{2\pi}{ks} - \left(\frac{p}{k} \right)^2 \frac{h}{s} \right)^{-\frac{1}{2}} - \frac{ph}{sk^2}$$

Because the support for p is continuous, π is constant so $\frac{\partial \pi}{\partial p} = 0$ between \underline{p} and r . These expressions imply that:

$$\frac{\phi'_s(p)}{\phi_s(p)} = - \frac{\left(\frac{2\pi}{ks} - \left(\frac{p}{k} \right)^2 \frac{h}{s} \right)^{-\frac{1}{2}} p \frac{h}{sk^2}}{\left(\frac{2\pi}{ks} - \left(\frac{p}{k} \right)^2 \frac{h}{s} \right)^{\frac{1}{2}}} = - \frac{ph}{sk^2} \frac{1}{\left(\frac{2\pi}{ks} - \left(\frac{p}{k} \right)^2 \frac{h}{s} \right)} = - \frac{ph}{2\pi k - p^2 h}$$

Using the expression already derived for $f(p)$, we substitute for $\frac{\phi'_s(p)}{\phi_s(p)}$ to obtain the p.d.f. in

terms of the exogenous variables and π (the equilibrium profit): $f(p) = \frac{k}{p^2} + \frac{kh}{2\pi k - p^2 h}$.

We can now derive the boundary condition $F(r) = 1$ to be:

$$\int_{\underline{p}}^r \frac{k}{p^2} + \frac{kh}{2\pi k - p^2 h} dp = 1 \quad (\text{v})$$

This is the first condition that must be satisfied in a symmetric equilibrium. Because $\phi_s(p) = \left(\frac{2\pi}{ks} - \left(\frac{p}{k}\right)^2 \frac{h}{s}\right)^{\frac{1}{2}}$, we use the first order condition for $\phi_s(p)$ to get

$$k \left(\frac{2\pi}{ks} - \left(\frac{p}{k}\right)^2 \frac{h}{s}\right)^{\frac{1}{2}} = p \left[(1 - F(p)) + \int_{\underline{p}}^p (1 - \phi_o(p_o)) f(p_o) dp \right]$$

At the reservation price (the highest price in the support), we know that $F(p) = 1$ and $f(p) = \frac{k}{r^2} + \frac{kh}{2\pi k - r^2 h}$. Substituting we obtain the second equilibrium condition:

$$k \left(\frac{2\pi}{ks} - \left(\frac{r}{k}\right)^2 \frac{h}{s}\right)^{\frac{1}{2}} = r \int_{\underline{p}}^r \left[1 - \left(\frac{2\pi}{ks} - \left(\frac{p}{k}\right)^2 \frac{h}{s}\right)^{\frac{1}{2}} \right] \left[\frac{k}{p^2} + \frac{kh}{2\pi k - p^2 h} \right] dp \quad (\text{vi})$$

The two equations (v) and (vi) can be solved for the two unknowns π and \underline{p} and they define the equilibrium. In Figure A1 we show the comparison of the minimum price under the targeted and uniform advertising cases for a range of the advertising cost parameter and in Figures A2 and A3 below we show the a comparison of the profits under the targeted and uniform advertising cases (Figure A2 is the case where advertising costs are low and Figure A3 is the case where advertising costs are high).

Figure A1: Minimum Price in Mixed Pricing Strategy for a Range of k where $h=1/3$

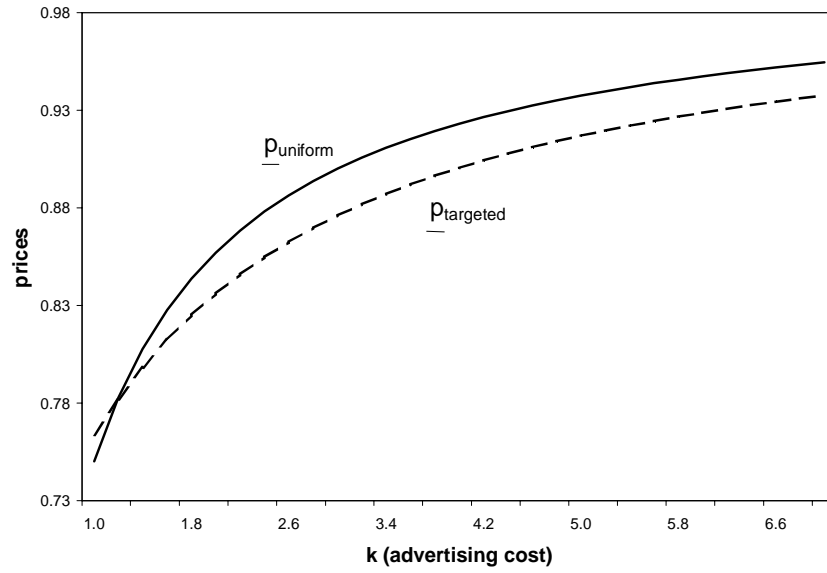


Figure A2: Profit Levels as a Function of High Preference Segment Size (for $k = 1$)

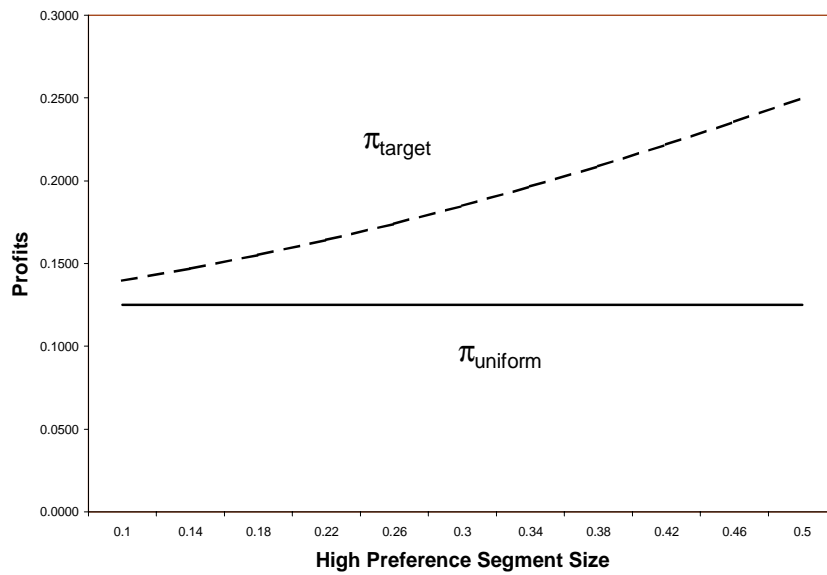
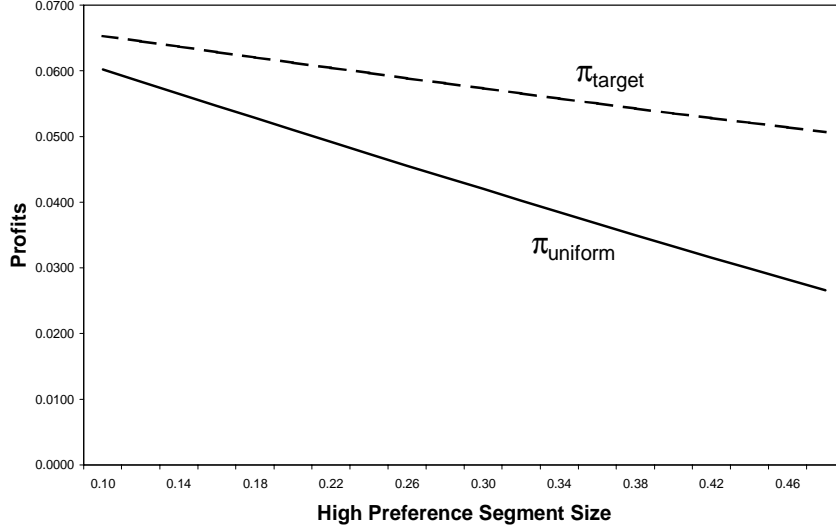


Figure A3: Profit Levels as a Function of High Preference Segment Size (for $k = 5$)



Welfare Calculations of Section 5.2

$W_{ua} = Dr - C_A$ where D is total demand, r is the reservation price and C_A is the cost of advertising. When $A < hr$, firms advertise so the welfare is given by the total population's benefit of consuming less the cost of advertising. Hence, $W_{ua} = r - 2A$ in this region. When $A \in \{hr, hr + sr\}$, from Proposition 1, $\alpha^* = 1 - \frac{A-hr}{sr}$ therefore $W_{ua} = -\frac{(-r+hr+A)^2}{(-1+2h)r}$.

Note that $\frac{\partial W_{ua}}{\partial A} = -2\frac{-r+hr+A}{(-1+2h)r}$. The denominator is negative so the numerator determines the sign. If we assume the numerator is positive, then $-r + hr + A > 0 \Rightarrow A > (1-h)r$ but $1-h = h+s$ and $A < r(h+s)$ by assumption. Therefore the numerator is negative and $\frac{\partial W_{ua}}{\partial A} < 0$. $\frac{\partial W_{ua}}{\partial r} = -(-r + hr + A) \frac{-r+hr-A}{(-1+2h)r^2}$. Similarly, it is easy to show that this is positive.

Targeted Advertising

Since $A \in \{hr, hr + sr\}$ note that since $A < r(h+s)$ therefore $Ah < rh$ so the level of advertising to the high preference consumers is always 1. The level of advertising to comparison shoppers is $\beta^* = 1 - \frac{A}{r}$

As before $W_{ta} = Dr - C_A$. Since $D = 2h + 2\beta - \beta^2 - 4h\beta + 2h\beta^2$, therefore:

$$W_{ta} = -\frac{1}{r} \left(-r^2 + 2rA - A^2 - 2hAr + 2hA^2 \right)$$

Comparison of Welfare with Targeting to Welfare without Targeting

When $A < hr$, $W_{ta} - W_{ua} = -\frac{1}{r}(-r^2 + 2rA - A^2 - 2hAr + 2hA^2) - (r - 2A)$. This simplifies to $A \frac{A+2hr-2hA}{r} > 0$ for all A .

When, $A \in \{hr, hr + sr\}$, $W_{ta} - W_{ua} = -\frac{1}{r}(-r^2 + 2rA - A^2 - 2hAr + 2hA^2) + \frac{(-r+hr+A)^2}{(-1+2h)r} = h \frac{-4rA+4A^2+4hAr-4hA^2+r^2h}{(-1+2h)r}$. This is a downward facing parabola in A with the following roots.

$$A_1 = \left(\frac{1 - 1 + h + \sqrt{(1 - 3h + 2h^2)}}{2(-1 + h)} \right) r$$

$$A_2 = \left(\frac{1 - 1 + h - \sqrt{(1 - 3h + 2h^2)}}{2(-1 + h)} \right) r$$

In order for $W_{ta} - W_{ua} < 0$, we need either $A_1 > hr$ or $A_2 < (h + s)r$. For $A_1 > hr$, we need $\frac{1 - 1 + h + \sqrt{(1 - 3h + 2h^2)}}{2(-1 + h)} > h \Rightarrow \sqrt{(1 - 3h + 2h^2)} < (1 - 3h + 2h^2)$. But this implies that $(1 - 3h + 2h^2) > 1 \Rightarrow h > \frac{3}{2}$ which is outside the allowable range for h . Similarly, for $A_2 < (h + s)r$, we need $\frac{1 - 1 + h - \sqrt{(1 - 3h + 2h^2)}}{2(-1 + h)} < 1 - h \Rightarrow \sqrt{(1 - 3h + 2h^2)} < (1 - 3h + 2h^2)$. Therefore $A_1 > hr$ and $A_2 > (h + s)r$ for all allowable h .

Note that because $r > A$, it is welfare maximizing for the captive segment to always receive advertising from their preferred firm. The welfare function for comparison shoppers is given by $W_s = rs(\beta^2 + 2\beta(1 - \beta)) - 2s\beta A$. A central planner would optimize this function with respect to β . $\frac{\partial W_s}{\partial \beta} = r(2 - 2\beta) - 2A = 0 \Rightarrow \beta = 1 - \frac{A}{r}$. Thus a central planner would advertise at each firm with the same probability that is chosen competitively.

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