

**The Targeting of Advertising**

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# THE TARGETING OF ADVERTISING \*

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# THE TARGETING OF ADVERTISING

## ABSTRACT

An important question that firms face in advertising is developing effective media strategy. Major improvements in the quality and quantity of consumer information (due to information technology) and the growth of targeted media vehicles (due to media fragmentation and new communication channels) imply that firms now have the know-how and the means to precisely target advertising to segments of consumers within a market. This paper examines advertising strategy with a model that allows competing firms to target advertising to different groups of consumers within a market. When firms can target advertising, we find they advertise more to consumers that have a strong preference for their product than to comparison shoppers who can be attracted to the competition. Advertising less to comparison shoppers can be seen as a way for firms to endogenously increase differentiation in the market. In addition, targeting allows a firm to eliminate “wasted” advertising to consumers whose preferences do not match the attributes provided by its product. As a result, the targeting of advertising increases equilibrium profits. Targeting can either lead to lower advertising expenditures by reducing wastage (if advertising is inexpensive) or lead to higher advertising expenditures because of improved advertising effectiveness (if advertising is costly).

The model demonstrates 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 than the ability to target pricing for firms in a competitive environment.

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

## 1. INTRODUCTION

Advertising is one of the most important decisions a marketer makes and media purchasing is the largest element of advertising spending. Ensuring that media is bought effectively and not directed towards the “wrong people” has always been a challenge for marketers.<sup>1</sup> Traditionally, the objective in media planning was to minimize wasted advertising by reducing the quantity of advertising sent to consumers who are not active in the category. However, today firms can do much better than reduce advertising to non-users. They have both the know-how and the means to target advertising to segments of consumers *within a market*. This ability comes from two key changes in the marketing environment. Today, firms have much better information on consumers, their preferences and their media habits (see “Star Turn,” *The Economist*, March 9, 2000). This is the result of significant improvements in the ability to collect and process consumer-level information. The second change is the fragmentation of existing media (broadcast TV for example) and a multitude of new advertising media (the Internet, satellite shopping channels, and infomercials). Sophisticated media buying now provides firms with the ability to target specific segments within a market (see “Infinite Variety,” *The Economist*, November 19, 1998). Because firms need to ensure that marketing spending has impact, it is not surprising that they are increasingly active in the use of targeted advertising.

In media planning, firm objectives are often to target advertising to specific consumer groups. For example, consider the U.S. light beer market in which Miller Lite and Coors Light are major competitors. The light beer market is comprised of distinct demographic groups which vary in their consumption profile. Miller Lite, the “diet beer” has traditionally been directed to mature male beer drinkers in their mid to late thirties who are concerned about their waistline. In contrast, Coors Light has been more popular among young and relatively new 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 preference.<sup>2</sup> An important question for firms is the decision about how to allocate media budgets between segments where they have a strong franchise and segments of uncommitted consumers who choose between competing brands. This question is critical given the ability that firms now have to better target their advertising. Intuition would suggest that concentrating advertising on consumers who are strongly predisposed to buy a firm’s product should be advantageous (for Miller, this would mean targeting advertising effort to mature male beer drinkers). These consumers are better disposed to buy and they are willing to pay high prices.

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<sup>1</sup>This 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.”

<sup>2</sup>See 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. Roy (2000) could potentially be seen as a justification for why the high preference segments for Miller Lite and Coors Light are different; this difference could be seen as just a basic product differentiation decision.

However, the real marketing battle in many cases is perhaps fought over consumers who do not have a strong preference for one of the competing products (in the light beer example, this would be the intermediate segment). Without a strong advertising effort these consumers may be lost to the competition. Will the attractiveness of an intermediate segment with weak preferences lead to aggressive advertising by both firms or will firms limit competition for these consumers with lower advertising? We consider this problem using a model of a differentiated market with two competitive firms, each of which sells a single product. We examine how the ability to target advertising to specific segments affects advertising and pricing decisions.

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 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 target their advertising? We also examine how the ability to target advertising affects the level of advertising spending 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.

In the model, a firm's advertising provides complete information about its products to potential consumers. Each firm has a group of consumers who have a strong preference for its product i.e., they only consider buying from that firm (up to a reservation price). There is also a group of consumers who compare the prices of both firms and buy at the lowest price. Advertising is costly and the cost of informing a group of consumers is directly proportional to its size. The targeting of advertising implies that firms can design media vehicles to target advertising messages to specific segments in the market. A firm that cannot target advertising, advertises uniformly to the entire market.

We show that when firms have the ability to target advertising, each firm advertises more to the segment that has a strong preference for its product than to the segment of consumers who comparison shop. When comparison shoppers are informed about both products, they perceive no differentiation between them. In this situation, price competition is intense and firms cannot earn profits. Firms respond by reducing advertising to the comparison shoppers. Consequently, there are times when comparison shoppers are informed about only one firm's product. In this situation, that firm has monopoly power over the comparison shopper segment. The indirect effect of this is to reduce the intensity of price competition. Thus, advertising less to comparison shoppers is an indirect way of creating market differentiation. The targeting of advertising also provides a 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.

When firms move from a strategy of uniform advertising to targeted advertising, the total amount spent on advertising can either increase or decrease. 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 also not able to realize the demand potential in the market because few consumers are informed. In this case, targeting helps firms to 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 target advertising leads to lower advertising expenditures.

We also analyze how targeted advertising interacts with targeted pricing. Our analysis shows that in a competitive environment, the ability to target advertising is more important for profits 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 have the ability to set targeted prices. In contrast, the ability to target prices creates increased competition for comparison shoppers and no improvement in profits. We also examine the market outcomes when firms invest to obtain the ability to target advertising. Given the increased profits associated with targeted advertising, both firms will acquire targeting capability if the fixed cost to obtain it is sufficiently low. Similarly, both firms choose not to target advertising when the fixed cost is very high. But interestingly, when the cost of targeting is in an intermediate range, asymmetric firms arise endogenously. While one firm invests to obtain targeting capability, the other chooses not to invest. Differences in the ability to target advertising are also a way to reduce competition for comparison shoppers.

Several papers have looked at the impact of advertising on product information and pricing. In particular, Butters (1977) proposes a message-sending model where advertising provides information about the existence of products (and their characteristics) and the higher the level of advertising a firm chooses, the more likely it is that a representative consumer is exposed to it. Grossman and Shapiro (1984) and Stahl (1994) extend this to a market with horizontal differentiation and analyze the impact of informative advertising on market competition and the provision of variety. Soberman (2003) also analyzes a similar model to understand the effect of advertising on prices. All these papers assume that advertising is uniform throughout the market.

Allowing for different levels of advertising to be directed at different segments (or locations) within the market, Esteban et al. (2001) consider a monopolistic firm that faces a market where customers have heterogeneous reservation prices. They argue that the monopolist will direct heavier advertising weights to the consumers who are willing to pay more for the product and that the overall level of advertising falls with targeting. Roy (2000) considers the competition for a homogeneous good where firms can target consumers and compete on prices after observing the competitor's advertising, and characterizes the equilibrium targeting behavior. In contrast, this paper considers

a differentiated market (that reduces to homogeneous good if  $h = 0$ , as described below) where firms can target consumers according to their preferences and set prices without knowing the competitor's advertising.<sup>3</sup> In addition to characterizing the targeting equilibrium, we consider the question in both uniform pricing and targeted pricing contexts. Roy argues that firms choose to advertise to different individual consumers. This idea might be seen as related to the result in this paper that firms advertise less to the comparison shopper segment than to the segment of consumers that has a high preference for the firm. However, the result in Roy depends on the assumptions that pricing decisions are made after observing the competitor's advertising and that firms are able to target advertising to individual consumers. The equilibria being considered depend crucially on a high degree of coordination of the firms' actions (given the infinite number of equilibria) by only targeting individual consumers with no overlap. Stegeman (1991) considers a model with a large number of competitors selling an homogeneous good where consumers may have different valuations for the good, firms can target the advertising to consumers with different valuations, and he focuses on welfare results. Because the good is homogeneous, there is not, however, the possibility of having some consumers with a strong preference for each of the different products and having some that are indifferent between the products.

In the literature, targeted 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, 2003) 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 targeted product modifications (Iyer and Soberman 2000). Some of the effects in this literature are discussed in section 3.3. Our paper contributes to this research by analyzing the impact of targeted advertising in a competitive setting. The rest of the paper runs as follows. Section 2 describes the basic model. In Section 3, we present the main results of the paper and some anecdotal information from retail markets to support the analysis. Finally, Section 4 presents concluding remarks.

## 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.<sup>4</sup> We start by

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<sup>3</sup>Several of the main results also generalize to the symmetric equilibrium in the case in which firms set prices after observing the competitor's advertising. Analyzing the case in which firms set prices after observing the competitor's advertising seems to be more appropriate for the case of large visible advertising campaigns. However, for the case of direct mailings, or more targeted, less visible advertising, the assumption of pricing without observing the competitor's advertising may be more appropriate. Butters (1977), Grossman and Shapiro (1984), and Stahl (1994) consider pricing without observing the competitor's advertising.

<sup>4</sup>The model and results can be extended to a market with  $N$  firms where each firm has demand from a high preference segment and a comparison shopping segment that is common.

describing 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 that firm as long as its price 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, do not search (to allow us to focus on the informative effects of advertising), and would buy the product with the lowest 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. Higher values of  $h$  represent greater differentiation between the firms because more consumers would have different preferences across firms. When  $h = 0$ , all consumers comparison shop between the two firms and the competition between the firms reduces to Bertrand price competition.

A fraction  $\delta$  of consumers is originally informed about all the products in the market, independently of the consumer's preferences about the products. Uninformed consumers, with fraction  $(1 - \delta)$ , are endowed with some preferences over product attributes, but, without advertising do not know which products exist, or their characteristics. The role of advertising about a product is to convey that the product exists and its product attributes, so that an originally uninformed consumer can evaluate her degree of preference for the product and decide whether to buy it or not to buy it. In essence,  $\delta$  represents the fraction of the market that does not depend on advertising in order to be informed about the available products. The remainder of the market,  $(1-\delta)$ , needs advertising in order to become active.<sup>5</sup> Advertising directed towards these consumers provides them with complete information on the product and its characteristics, i.e., does the product possess the attributes that the consumer requires in order to consider it for purchase. Without advertising, only a fraction  $\delta$  of the market considers a firm's product. With advertising, this fraction increases to one. Of course, this simply implies that advertising facilitates consideration of the product by the consumer. If the product does not fit a consumer's needs or the price is too high, she will not buy.

The characterization of advertising is consistent with behavioral research that has documented how advertising makes a product and its characteristics salient in the consumers' 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).<sup>6</sup> For new products, awareness is clearly the first stage in creating demand for a product. Consumers also use advertising for new products to obtain

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<sup>5</sup>One could also consider the case where the fraction of a certain type of consumers is more informed about one product than the other. The results from this case would be similar to the ones presented here substituting advertising intensity by degree of ex-post information.

<sup>6</sup>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.

information about key product features. 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. 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 on reminder-advertising aimed at keeping the brand top-of-mind. In our model, this simply means that advertising increases the consideration of the product by consumers.

We assume that the cost to advertise to the entire market is  $A$ . When advertising can be targeted to particular segments in the market, we assume that the cost to advertise to each segment is linearly related to its size.<sup>7</sup> Therefore, if a firm is able to target advertising the costs are  $Ah$  for the high preference consumer segment and  $As$  for the comparison shopping segment. There is some discussion that targeted media vehicles are more costly on a per reader basis (Esteban et al. 2001). Incorporating this effect into the model would just make the targeting of advertising less profitable without affecting the main messages of the paper. The paper considers below fixed costs of obtaining a targeting technology in section 3.4. Note that a firm does not have an incentive to target advertising to the  $h$  segment of its competitor since those consumers will not buy its product. We consider advertising that informs all of a given segment or none of it.<sup>8</sup>

### 3. EQUILIBRIUM ANALYSIS OF ADVERTISING AND PRICE COMPETITION

We start the analysis with the case when firms do not have the ability to target advertising or pricing to specific segments of the market. It provides a base case which we use to interpret and understand the impact of targeting.

#### 3.1. Uniform Advertising and Price Competition

First, we consider the market outcome when neither firm advertises. We need to identify the profit that firms earn by serving only the fraction  $\delta$  of the population that does not depend on advertising to be informed about products. For this case, the equilibrium is in mixed price strategies. The reasoning is as follows: Suppose that one firm, say Firm 2, chooses a price  $p_2$  that is not too low. Then it will pick up demand from its high preference segment and from those comparison shoppers who are informed. Then Firm 1 can undercut  $p_2$  to attract all informed comparison shoppers (these consumers make a comparison and choose Firm 1 because its  $p_1$  is slightly lower). Otherwise, Firm 1 will set prices at the reservation price to maximize the profit from its informed  $h$  consumers. A

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<sup>7</sup>Some research has discussed the possibility of the response to advertising being S-shaped or nonlinear. See, for example, Thompson and Teng (1984), Eastlack and Rao (1986), Mahajan and Muller (1986), Rao (1986), Sasieni (1989). The advertising technology in the model and its results can be both consistent with the case of extreme S-shape and with the case of linear costs.

<sup>8</sup>In an extension available from the authors upon request, we extend the model to a continuous representation of advertising and show that the results are similar when firms can advertise to any proportion of a segment.

similar reasoning applies to Firm 2's responses to Firm 1's choice of  $p_1$ . Denote the cdf (cumulative distribution function) of the mixed strategy price distribution without advertising to be  $G_i(p)$ . In equilibrium, the profit of firm  $i$  when charging a price  $p$  in the mixed strategy profile is given by  $\pi_i(p) = \delta hp + \delta sp[1 - G_j(p)]$  with  $i \neq j$  where,  $1 - G_j(p)$  is the likelihood that Firm  $j$  charges a price above  $p$  and then all the comparison shoppers buy from Firm  $i$ . Thus,  $\delta s[1 - G_j(p)]$  is the expected number of informed comparative shoppers that will buy from Firm  $i$  at price  $p$ . Using standard analysis (e.g., Varian 1980, Narasimhan 1988, Baye et al. 1992), the equilibrium profit is the guaranteed profit that a firm can realize by charging the reservation price and selling only to its  $h$  segment,  $\pi_i(r) = \delta hr, \forall i$ . This leads to the following lemma that describes the market outcome when neither firm advertises.

LEMMA 1: *When neither firms advertises, each firm earns a profit of  $\pi = \delta hr$  and firms employ the same mixed pricing strategies such that  $G(p) = 1 - \frac{r-p}{p}(\frac{h}{1-2h})$  for  $p \in [\frac{hr}{1-h}, r]$ .*<sup>9</sup>

We now consider the case when both firms advertise. With uniform advertising, firms can reach the entire market for a cost  $A$ . As before, because of Bertrand price competition that exists for comparison shoppers, the price equilibrium is in mixed strategies. Denote the cdf of the mixed strategy price distribution of Firm  $j$  to be  $F_j(p)$ . The profit of Firm  $i$  when charging a price  $p$  in the mixed strategy profile is given by  $\pi_i(p) = hp + sp(1 - F_j(p)) - A$ . As before, if both firms always advertise the equilibrium profit is the guaranteed profit that a firm realizes by charging the reservation price and selling only to its  $h$  segment,  $\pi(r) = hr - A$ . This is the profit of firms when they advertise. If it greater than the profit associated with not advertising, i.e.,  $\pi = \delta hr$ , then firms always advertise in equilibrium. Equilibrium advertising is thus characterized by the following lemma.

LEMMA 2: *When  $hr(1-\delta) > A$ , firms advertise in equilibrium with probability one. When  $hr(1-\delta) \leq A$ , then the equilibrium will involve firms using mixed advertising strategies.*

Basically, firms always advertise if the incremental guaranteed profits from the high preference segment are large enough to cover the cost of advertising. This happens when the extent of differentiation ( $h$ ), the reservation price, or the fraction of consumers who need advertising to be informed,  $(1 - \delta)$ , is large enough. In this case the derivation of the price equilibrium is similar to Lemma 1. Because the relative importance of the high preference and comparison shoppers is not affected by advertising, the unique equilibrium is symmetric and  $F(p) = G(p)$ . Simple calculations show that  $\frac{\partial F(p)}{\partial h} < 0$ . Thus, the average price charged by a firm increases with the extent of differentiation between the firms (i.e., a larger  $h$ ).

The interesting case is when firms do not find it optimal to advertise with probability one. In other words, in less differentiated markets, if the reservation price for the product is small compared

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<sup>9</sup>All proofs are available in a Technical Appendix, available upon request from the authors.

to the cost of advertising, or if the fraction of the market affected by advertising is small, firms will use mixed strategies in advertising. We can interpret the probability with which firms advertise as the intensity of advertising within a planning period. Basically, what a firm decides is the likelihood that a consumer becomes informed (or aware of the product) during the period. The more intense the advertising is, the higher the likelihood that the consumers become informed. In order to focus on this basic effect of advertising, we assume that each period is independent and that there are no carry-over effects. It would be interesting to study the impact of carry-over effects in this context of targeting of advertising. However, there is evidence that the main driver of brand choice in many low involvement categories (like cookies, potato chips and Ready-To-Eat cereal) is top of mind awareness (Dickson and Sawyer 1990).

In this set-up it can be shown that there is a unique equilibrium and it is symmetric. In order to derive the equilibrium when firms employ mixed strategies in advertising, define  $\alpha$  as the probability of advertising by a firm. From the property of a mixed strategy equilibrium, the profits between advertising and not advertising are equal which implies the following equilibrium condition  $\pi = hp + \delta sp(1 - F(p)) + (1 - \delta)[(1 - \alpha)sp + \alpha sp(1 - F(p))] - A = \delta hr$ . From this, if  $A > r(1 - h(1 + \delta))$ , then the firms will not advertise, i.e., advertising is not feasible and firms depend entirely on the fraction of the market that does need advertising to be informed for sales. When  $A \in (rh(1 - \delta), r(1 - h(1 + \delta)))$ , advertising strategies are mixed: advertising costs are low enough such that advertising is economic (at least sometimes) but not so low that firms choose to advertise with probability one. Solving for the equilibrium leads to the following proposition:

**PROPOSITION 1:** *When  $A \in (rh(1 - \delta), r(1 - h(1 + \delta)))$  and advertising is uniform, the equilibrium profits are  $\delta hr$  and the equilibrium probability with which firms advertise is  $\alpha^* = 1 - \frac{A - (1 - \delta)hr}{(1 - \delta)sr}$ . In addition, when firms advertise, they employ mixed pricing strategies with cdf  $F(p) = 1 - \frac{r - p}{p} \frac{A + \delta hr}{r[1 - h(1 + \delta)] - A}$  for  $p \in [\frac{A + \delta hr}{1 - h}, r]$ .*

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  $\frac{\partial F(p)}{\partial h} < 0$  and  $\frac{\partial F(p)}{\partial A} < 0$ . Thus the expected price increases with both market differentiation (the size of the  $h$  segment) and advertising costs.

The relationship between  $\alpha^*$  and market differentiation is more interesting: the frequency of advertising decreases with the size of the comparison shopping segment (i.e., lower differentiation) when  $A < \frac{r(1 - \delta)}{2}$ . However, advertising frequency increases in the size of the comparison shopping segment when  $A > \frac{r(1 - \delta)}{2}$ . This reversal can be explained by two effects that higher advertising frequencies have on the nature of competition. First, higher advertising frequency increases the fraction of comparison shoppers that are informed about both firms ( $\alpha^2$ ). This increases the incentive to price aggressively since fully-informed comparison shoppers compare prices and buy

from the firm with the lowest price. The second effect of increased advertising frequency is that more of the total market is actually able to buy each firm's product,  $\frac{\partial(h+s)}{\partial s} > 0$ . This provides a demand benefit to each firm.

When costs of advertising are low ( $A < \frac{r(1-\delta)}{2}$ ), firms advertise aggressively. In this case, a reduction in market differentiation (i.e., increases in  $s$ ) means that the reduction in profits from increased price competition is greater than the positive impact of acquiring demand from more of the market. As a result, the optimal advertising level drops. Here, firms manage non-cooperatively the degree of competition in the market by reducing the proportion of fully informed comparative shoppers. The inverse applies when advertising costs are sufficiently high ( $A > \frac{r(1-\delta)}{2}$ ). In this case, the benefit of increased demand outweighs the competitive effect. As a result, the optimal level of advertising is higher when the size of the comparison shopping segment increases.

### 3.2. Competition with Targeted Advertising

We now analyze the main issue of the paper pertaining to the ability of firms to target advertising to particular segments of the market. The advertising targeting technology being considered implies both more precise media vehicles that allow firms to target advertising to specific segments of the market and better information on consumer preferences across segments.<sup>10</sup> In the model, this translates to firms being able to direct advertising to the high preference and to the comparison shopper segments separately. Given our assumption that the cost of advertising is proportional to the consumers reached, the cost of targeting the  $h$  segment of a firm is  $hA$ , while the cost of targeting the comparison shopping segment is  $sA$ .

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  $r(1 - \delta) > A$ . For the rest of the analysis we assume that this holds.<sup>11</sup> Note that with the ability to target advertising, firms do not advertise to the other firms'  $h$  consumers as these consumers will not buy. Next, consider advertising to the comparison shopping segment: in general, advertising to this segment involves 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 marginally reducing the frequency of advertising. While the firm's expected demand from the comparison shopping segment goes down by a small amount, all profits from this segment are dissipated when it is fully informed 100% of the time. As a result, a firm will save on the cost of advertising by reducing its frequency of advertising. Writing the probability of advertising to comparison shoppers as  $\beta$ , the profit function for a firm when advertising to  $s$  is

<sup>10</sup>Roy (2000) can be thought of as looking only at the first effect.

<sup>11</sup>This simply means that the reservation value of all consumers who require advertising to become informed is greater than the cost of advertising. Otherwise, firms will not advertise, implying the degenerate case where firms only serve the fraction of the market that is informed about the available products without advertising ( $\delta$ ).

$\pi(p) = hp + \delta sp(1 - F(p)) + (1 - \delta)((1 - \alpha)sp + \alpha sp(1 - F(p))) - A(h + s)$ . The following proposition summarizes the equilibrium with targeted advertising.

**PROPOSITION 2:** *When advertising can be targeted, and  $r(1 - \delta) > A$ , 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  $\beta^* = 1 - \frac{A}{r(1 - \delta)}$ . In addition, firms employ mixed strategy pricing with cdf  $F(p) = 1 - \frac{r-p}{p} \frac{rh+As}{s(r-A)}$  for  $p \in [\frac{hr+As}{h+s}, r]$ .*

First, note that the probability of advertising to the comparison shoppers  $\beta^*$ , is strictly less than one (even as  $A \rightarrow 0$ , the probability of advertising is less than one). Therefore, when advertising can be targeted, firms advertise more to their respective high preference segments than to comparison shoppers. By targeting advertising to consumers who have a strong preference for its product, a firm increases the consumer surplus it extracts from the market. Either firm has an incentive to advertise to comparison shoppers with a probability less than one. The effect of advertising with a probability less than one is to reduce competition for comparison shoppers. In fact, the competing firm enjoys monopoly power over these consumers when it is advertising but the focal firm is not. This has the indirect effect of reducing the intensity of price competition (which allows higher profits to be earned from the high preference segment). Thus, advertising with probability less than one helps a firm to endogenously create differentiation in the competitive part of the market. Furthermore, the direct effect of targeted advertising is to eliminate wastage caused by advertising that falls on the competitor's  $h$  segment. Consequently, as Proposition 2 shows, the ability to target 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 there is more surplus to extract from consumers who are reached by advertising. Targeted advertising also has interesting effects on advertising spending and pricing.

**PROPOSITION 3:** *Compared to the case of uniform advertising, total advertising expenditures are lower with targeted advertising when  $A < \frac{r(1-\delta)}{2}$  and higher when  $A > \frac{r(1-\delta)}{2}$ .*

Advertising expenditures decrease with targeted advertising when  $A < \frac{r(1-\delta)}{2}$ , i.e., when advertising is relatively inexpensive. However, we also find that targeting can lead to an increase in advertising expenditures when  $A > \frac{r(1-\delta)}{2}$ . This phenomenon obtains due to the competitive context of our model and the resulting interaction of advertising and price.

The analysis highlights two effects of targeting advertising. The first is reduced wastage and the second is the creation of a more effective marketing instrument. In particular, when a firm cannot target its advertising, it cannot eliminate wasted advertising to the  $h$  customers of the competitor. When advertising is inexpensive, a firm will choose high levels (i.e., frequency) of advertising, all else being equal. Therefore, without the ability to target, 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 expenditure. In contrast, when advertising is expensive, firms choose low levels of advertising under uniform advertising. Advertising is an ineffective marketing instrument because it is both expensive and much of it goes to the wrong consumers. As a result, many customers who would be willing to pay the equilibrium price are uninformed and thus, do not buy. In this case, the ability to target advertising allows firms to realize higher demand by increasing advertising to the part of the market that has interest in their respective products. This leads to an overall increase in advertising expenditure.

It is useful to compare the above results to the monopoly analysis of Esteban et al. (2001) who find that targeting decreases advertising expenditures. This finding is similar to the result in the first part of Proposition 3 in the sense that with targeted advertising firms can avoid advertising to consumers with lower willingness to pay for the product (given their other alternatives). However, our analysis shows that there are indeed conditions under which the inverse can happen and advertising expenditures increase when firms have the ability to target advertising.

Targeted advertising also increases the average prices that firms charge. With targeted advertising a firm always advertises to its  $h$  segment, while advertising with probability  $\beta$  to comparison shoppers. Consequently, there is reduced price competition between firms leading to higher average prices being charged in equilibrium.

### *3.3. Comparing Targeted Prices and Targeted Advertising*

Until now we have focused on markets where firms have the ability to target advertising but compete with uniform pricing strategies. This is the mainstream case of most product markets where firms target advertising to different consumer segments through the media plan and products are sold to consumers through traditional retail channels. However, with 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 happens if firms could target price, but were restricted to 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. For example, a major problem for firms in developing countries is finding media vehicles that deliver a targeted audience. On the other hand, various forms of pricing (volume discounts, bundling, coupons) often allow these firms to tailor prices based on customer-type. In this situation, the ability to target prices is stronger than the ability to target advertising.

In order to simplify the exposition, we normalize the fraction of the market that is informed without advertising to zero (i.e.,  $\delta = 0$ ) for the remainder of the paper.<sup>12</sup> Recall that when a firm advertises without targeting, the profit from charging the reservation price is  $hr - A$ . Therefore, following Lemma 1, if  $hr > A$ , then firms advertise with probability one. If  $hr < A$  then firms employ mixed advertising strategies. Similar to section 3.1, we solve for a symmetric equilibrium and denote  $\gamma$  as the probability of advertising. We can then write the profit of a firm when it advertises as  $hr + (1 - \gamma_u)sp + \gamma_usp(1 - F(p)) - A$ . 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 (uniformly) is unaffected by the ability to set targeted prices (the equilibrium advertising is identical to the case of uniform pricing derived in section 3.1). The equilibrium profits also do not change from the uniform price case. This obtains because targeted pricing allows firms to increase the price charged to the high preference consumers (to the reservation price  $r$ ) but it also increases competition for the comparison shoppers relative to the base case. In this model these effects cancel out and in equilibrium 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 worse off and pays the reservation price.

We now consider the case where firms can target both advertising and pricing. This case is directly applicable to direct marketers who offer tailored prices to consumers based on the increased availability of individual-level consumer information. Analyzing this problem helps us to understand how the ability to target advertising interacts 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  $\gamma_t$  is the probability of advertising to comparison shoppers  $(1 - \gamma_t)sp + \gamma_tsp(1 - F(p)) - As = 0$ . The following proposition characterizes the equilibrium:

**PROPOSITION 4:** *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. Independently of whether firms can target advertising

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<sup>12</sup>Note that the findings are not affected by this normalization. The only effect of allowing values of  $\delta > 0$  is to reduce the value of targeting.

or not, the advertising intensity to comparison shoppers is unaffected by gaining the ability to target prices. The reason is that the attractiveness of the comparison-shopping segment fully determines the incentive to advertise to it. This is a function of two factors: the size of the segment and the reservation price comparison shoppers are willing to pay. This incentive is independent of whether firms can target pricing or not. The difference in the two worlds (uniform versus targeted pricing) is that with uniform pricing, the incentive to cut price is reduced because profit is lost on high preference consumers when price is lowered. Of course, firms will only reduce price to the point where the profits they earn by capturing increased demand is at least as high as the guaranteed profit.

In contrast, in the world of targeted pricing and targeted advertising, competition in the comparison shopping segment is decoupled from the high preference segments. While the incentive to advertise is unchanged by targeted pricing, the incentive to price aggressively is higher. As a result, the average price for comparison shoppers is lower in the targeted pricing world.<sup>13</sup> Of course, these lower prices are perfectly offset by higher prices that are charged to high preference consumers (they always pay  $r$ ).

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 1. 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 for comparison shoppers because a firm can reduce price to these consumers without reducing the price to its  $h$  segment. The results shown in Table 1 demonstrate that these effects cancel out in this model. Regardless of whether advertising is uniform or targeted, the profits of firms are unaffected by having the ability to set targeted prices (see also Winter 1997, Corts 1998, Klemperer 2003).

#### *3.4. Incentives to Invest in Targeting Capability*

We now consider the situation where firms can make fixed investments in order to obtain the ability to target their advertising. Most often this simply consists of purchasing targeting information from market research firms. In order to explain the investment behavior of firms, it is useful to highlight the value of targeting ability in two different situations. With uniform advertising and  $\delta = 0$ , firms earn profit of  $\pi_u = hr - A$  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,  $\pi_{ta} - \pi_u$ , is thus:

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<sup>13</sup>Note that the pricing distribution with uniform pricing first order stochastically dominates the pricing distribution for comparison shoppers with targeted pricing. This implies that the average price under uniform pricing is strictly greater than the average price for comparison shoppers under targeted pricing.

LEMMA 3: 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 increases with the cost of advertising. In this case, firms in the uniform advertising world always advertise and this implies that a greater proportion of the advertising is wasted. The wastage increases with the cost of advertising and with the fraction of the market that does not generate profit ( $h + s$ ). With greater differentiation, the wastage effect under uniform advertising decreases. Therefore, the value of targeting increases with the cost of advertising and in more competitive markets (with smaller number of  $h$  consumers). Said differently, the benefit of targeting is primarily based on cost savings when advertising is inexpensive.

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-saving 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 show that the ability to target advertising is *always* valuable for competing firms.

It follows then, that if the cost to obtain targeting capability is not too high, firms will make the investments to obtain targeting capability. This will be confirmed in the analysis that follows. However, as the cost to obtain the capability increases, a market outcome where only one of the two competing firms obtains targeting capability can also result.

Assume that firms can make an *ex ante* investment  $f$  to acquire the ability to target advertising. As noted earlier, this reflects the fact that a driver of increased targeting is improved information to guide marketing decisions. Examples of such investments might be payments to a market research firm for a syndicated database or the purchase of information technology that allows a firm to better understand the media behaviour of its customers. This game can be represented as a two-stage game where firms first decide whether or not to invest in targeting and then compete in advertising and price.

To analyze this situation, we first 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 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 make the

investments to target advertising.<sup>14</sup> Let  $\beta_1$  be the probability that Firm 1 advertises to comparison shoppers (it advertises to its high preference segment with probability 1) and  $\alpha_2$  be the probability that Firm 2 advertises uniformly to the market. In this situation when both firms advertise to comparison shoppers, the firms' prices are 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 4: *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 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 4 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 (while the other advertises with probability one) and the third case in which both the firms advertise with probability less than one. 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: *When only Firm 1 targets its advertising there are two possible types of equilibria: 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 a 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 a 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 of advertising,  $hr < A < \frac{r}{2}$ , 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 always advertises. In response, the firm with the ability to target advertising chooses  $\beta_1 < 1$  in order to reduce the competition for comparison shoppers ( $\beta_1$  also decreases in  $A$  in this range). At the other extreme,

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<sup>14</sup>As mentioned in the previous section, we restrict our attention to the range of advertising costs which rule out the degenerate case where firms with uniform advertising ability do not advertise, i.e.,  $A < (1 - h)r$ .

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  $A$  both types of equilibria are possible. However, the equilibrium with the targeting firm advertising with probability less than one and the uniform firm always advertising is Pareto dominant. 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 interesting aspects of competition between the two firms which 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) 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 based on their decisions to either invest or not invest in targeting capability. In this Figure,  $\pi_u$  is the profit where both firms use uniform advertising,  $\pi_t$  is the profit where both firms use targeted advertising,  $\pi_a$  is the profit of a firm with targeting capability when its competitor does not, and  $\pi_d$  is the profit of a firm that uses uniform advertising against a firm that targets its advertising (all profit quantities are net of  $f$ ).

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 range of advertising costs there is a consistent pattern of equilibrium outcomes. There are three types of equilibrium outcomes that are possible. 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 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 to invest and advertises uniformly.<sup>15</sup> The analysis demonstrates that the benefits of 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.

### *3.5. Local Retail Advertising and Some Anecdotal Support*

Retail markets are well suited to provide anecdotal support for our analysis because they are characterized by the interplay of numerous consumer segments each of which has different degrees of preference for the stores in a given area. In addition, the majority of advertising by retailers is informative in nature, i.e., it informs consumers about sales events and specials for different categories of goods at the retailer. The information we present is based on a series of detailed interviews with marketing managers of CORA, Casino and Carrefour (three of the largest retailers in France).

The analysis suggests that because firms benefit from targeted advertising, we should observe firms making significant investments in order to obtain the ability to target advertising. Second, given that firms have the ability to target, we would expect them to send higher weights of media to consumers that have a strong pre-disposition to purchase their products. Finally, the model predicts that when firms can target their advertising activity, they will advertise to their high preference segments almost all of the time. In contrast, we should observe less advertising activity to those segments that are analogous to our model's comparative shopping segment.

First, our discussions with the managers indicate that significant resources are dedicated to identifying and understanding the key segments for each store. Each store constructs a patronage map in which the retail trading area for each store (in terms of the strength of their franchise) is divided into primary (high preference), secondary and tertiary territories (comparison shoppers). Figure 2 shows a representative map for an urban area in central France. The hypermarchés use independent researchers to conduct in-store surveys (at the check out) and analyze loyalty and credit card purchases. In addition, ISDM, a market research firm, estimates "zones de bascule" for retailers. Roughly translated, these can be thought of as "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. The main point is that retailers obtain the ability to target through significant fixed investments in market research, analysis and integrating information from different sources. As assumed in the model, this ability has been

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<sup>15</sup>This might be seen as related to Mills and Smith (1996) who argue that asymmetric firms arise endogenously if the fixed costs to acquire a lower marginal cost of production are in an intermediate range. Note however while a firm having lower costs always hurts the competitor, in this paper a firm investing in targeting ability benefits the competitor if the competitor has low targeting ability.

facilitated by advances in information technology. These costs are unrelated to the quantity of local advertising (or media) that is ultimately purchased.

Second, the media strategies employed by the retailers echo the predictions of the model. The local advertising efforts are summarized in Table 2. 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. In particular, flyers are sent *every week* to primary (high preference) customers. This is analogous to the decision of firms with targeting capability to advertise to high preference consumers with a probability of one. Moreover, advertising levels directed to the retailer's primary customers are higher than the levels directed to consumers for whom the retailer competes intensely.<sup>16</sup> Finally, the managers stated that the timing of advertising to secondary and tertiary customers did not have any particular pattern. They also mentioned that they would like to know their competitor's advertising schedule "in advance" so they could schedule their activities in the competitor's off-weeks. This suggests that the mixed strategy representation of advertising to comparison shoppers may be reasonable. The comments of the managers also provide evidence that managers are sensitive to the profit-reducing impact of having secondary (or tertiary) shoppers that receive flyers simultaneously. Similar to the model with uniform pricing, retail managers create differentiation by limiting the intensity of advertising to segments that compare prices.

#### 4. CONCLUSION

One of the central questions that firms face in advertising and media planning is how they should target 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 target more advertising to 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. For these reasons, the ability to target advertising increases the equilibrium profits of firms.

Targeting also 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

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<sup>16</sup>Another force that could make the retailers advertise less to the secondary than to the primary consumers is that the secondary consumers may incur a additional disutility of going to the retailer.

advertising expenditures. In this case, the ability to target advertising leads to higher advertising spending 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 target prices only creates increased competition for the comparison shoppers. The intuition for the main messages presented here seems to suggest that these messages should generalize to other functional forms. Firms advertise more to the consumers that have a greater preference for their product and this endogenously creates more differentiation in the market. Competing firms benefit more from targeting of advertising (which increases differentiation) than from targeting of pricing (which can be seen as reducing differentiation at each consumer).

The model also provides useful implications for managers. First, a standard dilemma for marketing managers is that most marketing initiatives only provide a temporary advantage over the competition. Once the competition reacts to an initiative, the advantage is lost and frequently, firms have simply increased their cost of doing business. In contrast, the ability to target advertising provides lasting benefits that are not lost when competitors respond by implementing targeting of their own. Because of reduced waste, targeted advertising can simultaneously make all firms better off. Second, as noted above, in a competitive environment, the ability to target advertising is more valuable than the ability to price discriminate. Targeting allows a firm to send advertising to consumers who really like its products and this has minimal competitive implications. This finding provides strong impetus for managers to dedicate significant effort to improve performance in media buying through the integration of research on consumer preferences and media habits. Finally, the ability to target advertising does not necessarily mean that advertising spending will drop as implied in Esteban et al (2001). When advertising is both expensive and uniform, its effectiveness as a marketing instrument is limited. As the precision and frequency of targeted advertising within an industry increases, managers may find that advertising budgets need to be increased. Finally, as a potential extension it would be interesting to evaluate the effects of targeting when firms are asymmetric in terms of the size of their high preference segments. It would also be useful to formally analyze how the phenomenon of advertising spill across segments affects the pricing behavior and profitability of firms.

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Table 1

**Equilibrium Outcomes as a Function of Targeting ( $\delta = 0$ )\***

Advertising Probabilities by Segment, Profits

Range:  $A > hr$ 

<b>Advert.</b>	<b>Case 1</b>	<b>Case 2</b>	<b>Case 3</b>	<b>Case 4</b>
	Uniform Advert. Uniform Pricing	Target Advert. Uniform Pricing	Uniform Advert. Target Pricing	Target Advert. 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.

Table 2

**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

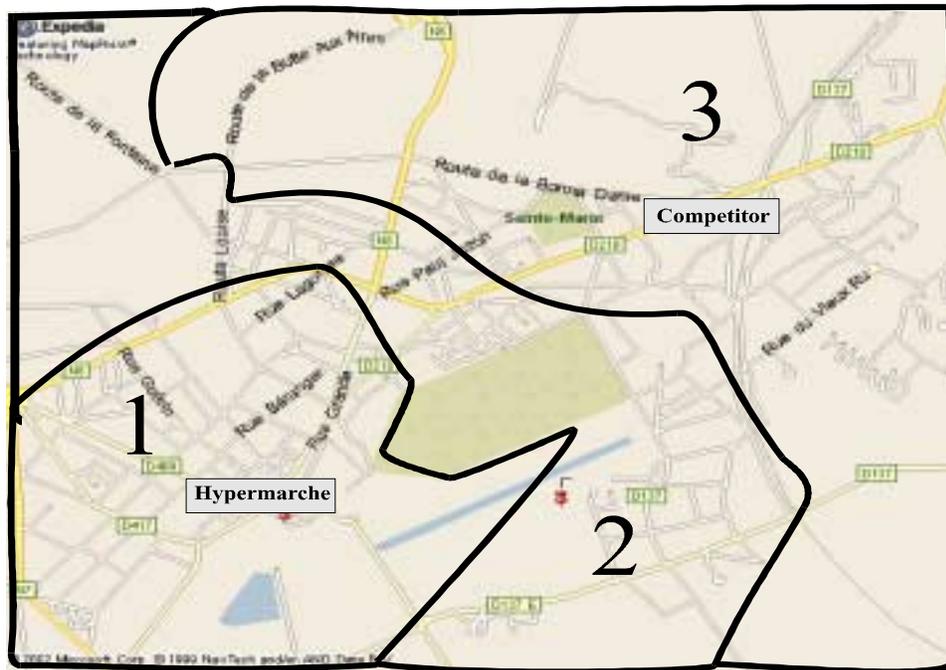
Theme Type	Primary	Secondary	Tertiary
Regular Weekly Specials	yes	no	no
Seasonal Events	yes	yes	no
Special Events	yes	yes	no
Shock Specials	yes	yes	yes
Total	100%	50%	>10%

Source: Interviews by the authors Jan-April 2002

Figure 1: Normal Form of Decision to Invest to Obtain Targeting Capability.

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

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



## APPENDIX

### THE TARGETING OF ADVERTISING

#### Proof of Lemma 1

The profit of firms when they do not advertise is given by  $\pi = \delta hp + \delta sp(1 - G(p))$ . Let  $p = r$  to derive the guaranteed profit i.e.,  $\pi_{gu} = \delta hr$ . Therefore  $\delta hp + \delta sp(1 - G(p)) = \delta hr$  implying that the c.d.f. of the pricing strategy is  $G(p) = 1 - \frac{r-p}{p} \frac{h}{1-2h}$ . This further implies that the lowest price in the support of the mixed pricing strategy is  $\underline{p} = \frac{hr}{1-h}$ .

#### Proof of Lemma 2

When both firms advertise then the guaranteed profit of a firm is  $hr - A$ . When neither firm advertises, each firm earns  $\delta hr$ . This implies that if  $hr - A > \delta hr$ , the firms will always advertise. When  $hr - A < \delta hr$ , a firm will lose profits if it advertises with probability one. Thus for  $hr(1 - \delta) - A \leq 0$ , a firm can increase profit by advertising with probability less than one.

#### 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  $\alpha$ . Then when a firm advertises the guaranteed profit of a firm from charging the reservation price  $r$  will be  $hr + (1 - \delta)(1 - \alpha)sr - A$ . Equating this to the profits when the firm does not advertise we have the equilibrium of  $\alpha^* = 1 - \frac{A - (1 - \delta)hr}{(1 - \delta)sr}$ .

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  $\alpha^*$  into the firms indifference condition to obtain  $F(p) = 1 - \frac{r-p}{p} \frac{A + \delta hr}{r[1 - h(1 + \delta)] - A}$ . To identify the minimum price in the distribution, note that when a firm charges the minimum price we have  $\pi(z) = z(h + s) - A = \delta hr$ . From this the minimum price can be derived to be  $z = \frac{A + \delta hr}{1 - h}$  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  $\beta$  is presented 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

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

From this the equilibrium probability of advertising to the comparison shoppers can be derived to be  $\beta^* = 1 - \frac{A}{r(1-\delta)}$ . 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

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 2, an equilibrium where both firms employ pure advertising strategies to comparison shoppers does not exist. Thus, the equilibrium condition for comparison shoppers shown in the text. 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 to obtain  $\gamma_t = 1 - \frac{A}{r}$ . Substitute back into the indifference equation for the prices for the comparison shoppers 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  $z = A$ .

### Proof of Lemma 3

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 4

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  $\pi_2(p) = hp + (1 - \beta_1)sp + \beta_1spW_1(p) - A$ . 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  $\pi_1(p) = hp + \alpha_2spW_2(p) + (1 - \alpha_2)sp - A(h + s)$ . This means that  $\pi_1(z) = (h + s)z - A(h + s) = A - A(h + s)$ . To derive the equilibrium  $\alpha_2$ , 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  $\pi_1(p) = hp + \alpha_2spW_2(p) + (1 - \alpha_2)sp - A(h + s)$ . 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  $\pi_2 = hp + \beta_1spW_1(p) + (1 - \beta_1)sp - A$ . 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	Targeting/Uniform		Both Targeted
	$\pi_u$	$\pi_a - f$	$\pi_d$	$\pi_t - f$
$0 < A < \frac{r}{2}$	$hr - A$	$h(r - A) - f$	$hr - A(1 - s)$	$h(r - A) - f$
$\frac{r}{2} < A < r(h + s)$	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.

Addendum to The Targeting of Advertising: The Case of  
Continuous Advertising

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## The Case of 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  $\phi$  of a segment between 0 and 1. For any given advertising intensity  $\phi$ , if there is targeting, every consumer within the targeted segment sees the advertising with a probability of  $\phi$ . 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  $A = \frac{k}{2}\phi^2$ .

### 1. Uniform Advertising and Uniform Pricing

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:

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

The full solution is provided in the Appendix. Here, 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

$\frac{kr^2}{2} \frac{(h+s)^2}{(k+rs)^2}$ . 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.

## 2. Targeted Advertising and Uniform Pricing

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.<sup>1</sup> 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:

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

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

Proposition 1: In equilibrium,

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. 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 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

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<sup>1</sup>Unless  $\phi_s = 0$ , 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.

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 also obtain another result that is analogous to the result generated in the model with discrete advertising: Firms advertise more to consumers who prefer their product 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.

## APPENDIX

### 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  $\phi$  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  $\phi$ , 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  $\phi$  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 1

The first order condition for  $\phi_h$  is:

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

The first order condition for  $\phi_s$  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:

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

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  $\phi_h$ ),  $\phi_h$  must also be a mixed strategy. Then equation (i) 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 (i) implies that  $\phi_h(p)$  and  $\phi_s(p)$  are negatively correlated. This proves the first part of Proposition 1.

Because  $\phi_h(p) = \frac{p}{k}$ , we substitute into equation (i) 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  $\pi$  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,  $\pi$  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  $\pi$  (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:

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

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:

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

The two equations (ii) and (iii) can be solved for the two unknowns  $\pi$  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  $h=1/3$

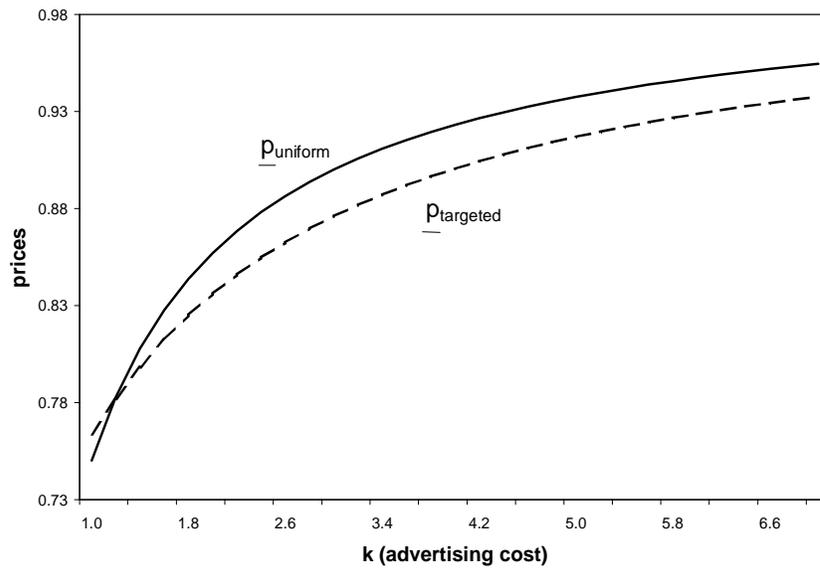


Figure A2: Profit Levels as a Function of the High Preference Segment Size (for  $k = 1$ )

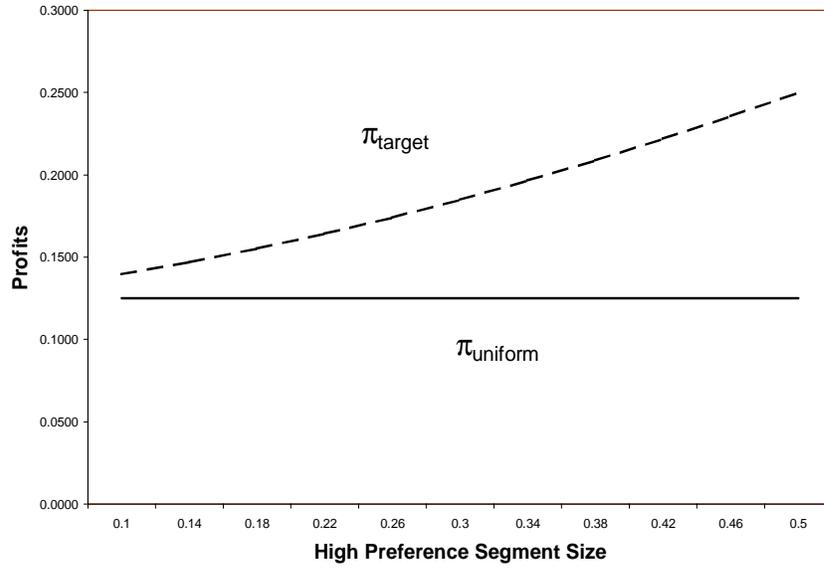


Figure A3: Profit Levels as a Function of the High Preference Segment Size (for  $k = 5$ )

