



No. 006/2020/MKT

Designing the Content of Advertising in a Differentiated Market

David A. Soberman

Rotman School of Management

University of Toronto

Yi Xiang*

Department of Marketing

China Europe International Business School (CEIBS)

March 2020

* David A. Soberman is a Professor of Marketing at the Rotman School of Management at the University of Toronto, 105 St. George Street, Toronto, Ontario and Yi Xiang is an Associate Professor of Marketing at China Europe International Business School, 699 Hongfeng Road, Pudong, Shanghai 201206, China, Tel: +86-21-2890-5644, Fax: +86-21-2890-5650, e-mail: yixiang@ceibs.edu.

Designing the Content of Advertising in a Differentiated Market

Abstract

In many markets, consumers use detailed attribute information to assess the value they expect from purchasing a product or service. Markets that fit this description include LED monitors, wine, some OTC healthcare products, mattresses and automobile tires. In these markets, quality differences exist yet many differences are horizontal in nature: the consumer is interested in finding a product that meets her unique tastes. Beyond ensuring that consumers know the brand, the category and the price; in these markets, it seems advertising should provide consumers with detailed attribute information. However, a significant proportion of advertising does not provide it. In fact, within the same category, competitors respond to messages that emphasize detailed attribute information with messages that are *devoid* of attribute information. These messages are *uninformative* about product attributes. We explore how competition in a differentiated market is affected by the ability of a firm has to choose uninformative messages. We construct a model to investigate the factors that affect a firm's decision to use advertising with detailed attribute information or advertising that does not provide attribute information. The model demonstrates that content decisions about advertising are affected by the differences between products, the range of heterogeneity in consumer tastes and the degree to which costs increase as a function of the quantity of information in advertising. Surprisingly, even when the cost to increase the quantity of information in advertising is low, uninformative campaigns can be more profitable than campaigns with detailed attribute information. The analysis also demonstrates that firms may be *more* likely to provide detailed attribute information when there are less consumers that are attribute-sensitive. Finally, the model shows that uninformative messages can create "artificial differentiation" in some conditions.

Keywords: Uninformative messages, advertising content, horizontal differentiation, matching

1 Introduction

Marketing managers make choices about how to inform potential consumers about their firm's offer and consumers use this information to assess the value they expect from purchasing a given product or service. Markets that fit this description include LED monitors, wine, some OTC healthcare products, mattresses and automobile tires. In these markets, quality differences exist yet many differences are horizontal in nature: the consumer is interested in finding a product that meets her unique tastes. Here, common sense suggests that advertising should provide consumers with detailed attribute information. Nevertheless, a significant proportion of advertising does not provide such information. Four studies of TV advertising content show that 37.5% of advertising does not contain information about product attributes (Abernethy and Butler 1992).¹ Abernethy and Franke (1996) report that more than 37% and 25% of advertising messages for services and medical products respectively are uninformative. In these categories, a key challenge for the consumer is to find an offer that meets her tastes, a "match" using the terminology of Meurer and Stahl II (1994), yet uninformative advertising does not assist in this regard.

In fact, within the same category, competitors may respond to messages that emphasize detailed attribute information with messages that are *devoid* of attribute information. These messages are *uninformative* about product attributes.² We are interested in learning first, how firms make decisions about the quantity of information to include in their messages and second, how these decisions affect competition in a differentiated market.

To motivate our study, consider the market for LED monitors. It is populated by users of all kinds including videogamers, families and entrepreneurs. Some users want "state of the art" response times, others want monitors that last a long time and others want monitors with close to perfect colour balance. In general, the choices available entail tradeoffs because no product

¹Almost always, marketing ensures that consumers know the brand name, the category and the price before buying.

²In the literature, attribute-free advertising is typically described as *uninformative* despite the fact that it transmits the brand and the product's availability (in the category) to consumers (Milgrom and Roberts 1986, Tirole 1988, Bagwell and Ramey 1994, Bagwell 2007, Mayzlin and Shin 2011).

(within a price range) delivers optimal performance on all criteria.³ A cursory examination of advertising for LED monitors, wine and mattresses reveals significant heterogeneity in the amount of attribute information provided by competing firms.⁴

These observations lead to a set of questions that we seek to address. First, how is competition affected by a firm's willingness to implement uninformative marketing in a differentiated market? Second, is there always an increase in the level of uninformative marketing as firms become more and more undifferentiated? Finally, are there conditions (in terms of customer heterogeneity and the cost of advertising), where uninformative advertising allows undifferentiated firms to generate positive returns. Our objective is to better understand how firms compete when they modulate the amount of attribute information provided through marketing. We construct a model with two competing firms that first make a decision about the level of information to provide to consumers and second, set price to maximize profits. In the model, we consider a) a range of heterogeneity in consumer tastes and b) a range of costs to provide information to consumers.

Our analysis demonstrates that both the range of heterogeneity in consumer tastes and the range of costs to provide information affects firm decisions about how much information to provide. When competing products are different, strong heterogeneity in consumer needs leads to symmetric content-rich advertising. When the range of consumer needs is less heterogeneous, uninformative advertising is attractive as a response to information-rich advertising. In fact, when the heterogeneity in consumer needs is below a threshold, the firm that employs uninformative advertising is more profitable than the information-rich advertiser. However, the likelihood of uninformative marketing does not increase monotonically as the heterogeneity in consumer needs falls; in an intermediate range, firms may be more willing to adopt information-rich strategies. Finally, we find that uninformative advertising can be used to create artificial differentiation when products are functionally identical. There are limits with respect to when "artificial differenti-

³These markets evolve quickly but at the time of writing this paper, organic light emitting diode technology (OLED) provides superior response times to liquid crystal displays (LCD) but has a more limited lifespan and faster degradation with regards to colour balance (Morrison 2017).

⁴Samples of ads in these categories (collected on Google) are available on request from the authors.

ation" is feasible; when it is infeasible, the market is monopolized by one of the two firms. We now move to a discussion of key literature related to this topic.

2 Literature Review

There is a long battle between modelers who claim that advertising is largely uninformative and those who claim its purpose is to provide information to consumers. Empiricists have directed significant effort to distinguish between the persuasive and informative roles of advertising (Akerberg 2001, Hastings et al. 2013, Gurun et al. 2013).

There are two key claims made by people who argue that advertising is uninformative. The first is that the advertising creates an illusory perception of superiority for physically identical products. This is referred to as spurious differentiation and generally reflects a negative view of advertising (Tirole 1988).

The second claim is that uninformative advertising can provide a signal of quality in a vertically differentiated market (Nelson 1974). Here advertising, while uninformative, helps consumers to find products that meet their requirements. The explanation is that the quantity of advertising (not its content) signals quality to consumers (Nelson 1974, Schmalensee 1978, Klein and Leffler 1981, Bagwell and Ramey 1994, Milgrom and Roberts 1986, Feng and Xie 2012). This explanation is known as the money-burning theory of advertising.

The counterpoint to this literature is the partial view of advertising wherein advertising is seen as informative. Here, consumers obtain information that makes them better (and truthfully) informed about products and their unique attributes. This view argues that advertising provides information that allows higher benefits to occur with consumption.⁵ The canonical example of informative advertising adding value for consumers is when advertising provides consumers with

⁵Examples of this include Ehrlich and Fisher (1982) and Becker and Murphy (1993) in which advertising increases demand for a product by reducing the cost of consuming a product or increasing the marginal value of consumption respectively. In contrast to uninformative advertising, the information contained in the messages delivers value.

better pricing information (Telser 1964). This allows consumers to find products that deliver more surplus.

Informative advertising can also provide information on product attributes that are valued by some consumers and not by others (horizontal differentiation). There are numerous studies which demonstrate how informative advertising allows consumers to find products that better meet their needs (Robert and Stahl II 1993, Bester and Petrakis 1995, Grossman and Shapiro 1984, Butters 1977). In particular, exposure to a firm's advertising in Grossman and Shapiro (1984) makes consumers aware of the firm's product and its characteristics (including price) in a horizontally differentiated market. More recently, studies on search advertising examine the optimal strategies in keyword bidding for better match between products and consumer needs (Du et al. 2017).

A number of studies highlight a preponderance of uninformative advertising in markets where informative advertising should dominate (Abernethy and Butler 1992). These are markets where advertising informs consumers about the brand but provides little information on product attributes. In an empirical study, Clark et al. (2009) show that advertising can simply activate brands as alternatives without impacting their quality perceptions.⁶

Mayzlin and Shin (2011) show that uninformative advertising can lead consumers to search for information about products and this can help them to make better decisions. In Mayzlin and Shin (2011), advertising activates interest in the brand similar to Butters (1977) and products can be assessed through inspection.⁷ Importantly, the distinguishing feature between products in Mayzlin and Shin (2011) is quality based. That is, one product is simply better than another. Note that the mechanism in Mayzlin and Shin (2011) is different from the money-burning theory of advertising and the theory of persuasive advertising, both of which are alternative explanations for why high levels of advertising are associated with high priced products.

⁶This reinforces findings in behavioral research showing that brand activation is critical for a product to be included in a consumer's consideration set (Nedungadi 1990, Mitra and Lynch 1995).

⁷The tendency of uninformed consumers to search for product information underlies models that examine how the distribution of information in a population affects firm pricing (Wolinsky 1986, Anderson and Renault 2000).

Abstracting away from vertically differentiated markets (the context where the money-burning theory of advertising and persuasive advertising provide insight), we also observe significant uninformative advertising in horizontally differentiated markets where consumers need information about attributes to assess competing offers (Abernethy and Franke 1996). When a consumer is aware of a brand but she does not have information about its attributes, her only choice is to form expectations about the product characteristics and base her purchase decision on these expectations (Meurer and Stahl II 1994). Our model is designed to explore when (and why) in a horizontally differentiated market, a competitive firm might choose uninformative advertising.⁸

An additional dimension of our study is to understand the role of advertising as a basis for the *perceived* differentiation of products. This issue is fundamental to the analysis of Iyer et al. (2005) who examine how the targeting of advertising through media strategies affects perceived differentiation.⁹ A key insight of Iyer et al. (2005) is that targeted advertising endogenously creates differentiation within a market. We too, seek to understand the link between advertising and perceived differentiation but our focus is markets where media is *not* targeted. That is, advertising is either sent to the entire market or not.

Conversely, we allow firms to modulate the content of the messages sent to the market. To reiterate, the model allows firms to choose advertising that a) is uninformative and does not provide information about product attributes or b) has rich content and provides attribute information. Our interest is to understand how firms respond to each other in equilibrium and ultimately to assess how these choices affect market outcomes.

⁸Anderson and Renault (2006) examine the decision of a monopolist to include pricing information, attribute information or both in its advertising. In contrast, our objective is to examine the message content decision of competitive firms in a context where all ads activate the brand and the category. The question is whether or not the messages also provide detailed attribute information.

⁹Esteban et al. (2001) also examine the targeting of media by allowing different levels of advertising to be directed at different segments (or locations) within a market.

3 The Model

3.1 Model Structure

The market is assumed unitary and each consumer buys (at most) one product from either Firm 1 or Firm 2. Each firm offers one product with distinct attributes and we normalize the marginal cost of the products to 0. For the sake of simplicity, we assume that a product has either a Left attribute or a Right attribute but not both.

Prior to the start of the game, the firms develop products and each firm has a 50% chance of developing a product with a Left attribute and a 50% chance of developing a product with a Right attribute.¹⁰ In other words, there is a 50% chance that the two firms have differentiated products and a 50% chance that the products are identical.¹¹ If a consumer becomes aware of a product, her prior probability of that product having a Left or Right attribute is 50/50. However, if the consumer sees informative advertising about the product (or if she consumes the product), she learns the actual attribute of the product with 100% probability. The assumption that a firm has a 50/50 chance of being Left or Right is important because it implies that consumers cannot infer the attribute of a firm by "knowing" the attribute of the competitor. We assume that each firm knows the attribute of the competitor; the challenge for firms is to manage the information set of consumers.

The vast majority of advertising mentions the brand and the category the brand participates in. Without loss of generality, we assume that all advertising contains the brand name and the category. The difference between uninformative (U) and content-rich advertising (C) is that content-rich advertising also contains information about the product attribute (see Table 1). In all cases, we assume that the information provided by advertising is truthful.¹²

¹⁰This reflects a context where firms conduct market research independently and do not coordinate their offers. In this market, absent coordination, the expected profitability of either attribute is equal.

¹¹To be specific, there is a 25% chance that both products have the Left attribute, a 25% chance that both products have the Right attribute and a 50% chance that one product is Left and the other Right.

¹²False (or misleading) advertising is prohibited by the *Competition Act* in Canada and the guidelines of the

Table 1: Advertising Message Content

Advertising Type	Brand Name	Indication of the Category	The Attributes
Uninformative	✓	✓	
Content-Rich	✓	✓	✓

Similar to Meurer and Stahl II (1994), consumers costlessly learn the price of products for which they have seen advertising. This implies that price information is available when the purchase decision is made (through price boards, printing on the package or shelf signs); information about the key attributes is obtained through advertising.¹³

When a firm chooses content-rich advertising, information about the firm's attribute (Left or Right) is added to the firm's communication. This reflects the idea that each firm makes a conscious (and costly) decision about whether to communicate its attribute to the market. As noted earlier, a product has either a Left attribute or a Right attribute but not both. This represents a typical horizontal attribute where the designer of the product manages a trade-off. Typical examples of such attributes include Big versus Small, Light versus Heavy, Spicy versus Bland, Tight-fitting versus Loose and so on. Absent the possibility where firms have the ability to launch a second product, a manager cannot simultaneously provide Left and Right in the same offer. Moreover, we assume that the Left and Right attributes are equally attractive.¹⁴

The objective is to examine the "information" strategies of firms when their products "match" with the preferences of some consumers and not others. Without marketing, consumers are uninformed about firms and their attributes. As noted earlier, there is heterogeneity in consumer

Federal Trade Commission in the USA.

¹³Alternatively, the model reflects a market where prices are obtained through search and search is costless (price is a search attribute). However, the product is an experience good so without advertising (or experience), knowledge of the attributes is limited.

¹⁴Equally attractive does not mean that each and every consumer is willing to pay the same for Left or Right. It means that the potential demand for each attribute (which in part comes from different consumers) is equivalent. This assumption allows us to analyze the effect of differentiation on advertising strategies (and not the advantage one firm might have over its competitor).

preferences across the market. We assume there are three segments of consumers, denoted by L, R and S. The L and R segments are of equal size. Because of this, the Left and Right attribute are equally attractive. The size of the S segment is s and this implies that both the L and R segments are of size: $\frac{1-s}{2}$.

Consumers in the L segment prefer products with the Left attribute. Similarly, consumers in the R segment prefer products with the Right attribute and dislike products with the Left attribute. Consumers in the third segment S are indifferent between the Left and Right attributes. These are consumers whose enjoyment is not affected by whether the product is Big/Small, Light/Heavy, Spicy/Bland or Tight-fitting/Loose for example. In reality, market segments are not this clean. Nevertheless, this structure allows us to represent a market where a) firms have an incentive to differentiate (homogenous products lead to Bertrand price competition) and b) the incentive to differentiate can be modulated by varying the size of the S segment (the larger the S segment is, the less important the Left and Right attributes are).

We denote by V , the overall benefit that a consumer obtains by consuming a product that meets her preferences. A consumer in either the L or R segment places a value of $V = r$ on the product with preferred features and $V = 0$ otherwise. In contrast, a consumer in segment S buys the least expensive product she knows about and receives a value r from a purchased product.¹⁵

As in Butters (1977) and Grossman and Shapiro (1984), exposure to marketing by a firm means that consumers are aware of a product (as an option within the category) and the price. We further assume that firms cannot target their advertising to specific segments. In other words, if a firm decides to advertise, its advertising reaches everyone.

Without loss of generality, content-rich advertising is assumed to be more expensive than uninformative advertising. It may seem that little cost should be associated with adding an additional piece of information (Left or Right) into advertising. However, the model represents a

¹⁵Conceivably, switchers might have a lower reservation price than loyal segments. Intuitively, a lower reservation value from the switchers makes the segment less attractive so firms should have less incentive to fight for it. The effect of this change is likely to be similar to what happens when the segment of switchers is smaller. Unless the switchers' reservation price is less than $\frac{r}{2}$, this would have limited impact on the results.

context wherein the attribute represents detailed information about the offer (the uninformative ad does not provide this). When considered in this light, the assumption about the difference in the cost for uninformative advertising versus content rich advertising is based on literature starting in the 1970s which shows experimentally (and in the field) that more complexity in a message

1. makes it more difficult for consumers to process.
2. forces the sender to repeat the message more or to lengthen the exposure of the message to effectively transmit the content. These points are highlighted in Kasulis and Zaltman (1977).
3. presents a greater creative challenge (to make the message fluent).

All three of these points are demonstrated experimentally with voice mail in Reinsch Jr. and Beswick (1990) and banner ads in Wang et al. (2013). The bottom line is that with more complex ads, the marketer needs to make the ad easier to process or needs to show it more times to get the same effect (Magrath 1989). In fact, Tellis (1999) argues that effective frequency, the prevailing wisdom for effective media planning, does not depend solely on the number of consumer exposures, but on three factors, namely, brand familiarity, message complexity and message novelty. In this model, all factors are normalized except message complexity (content-rich ads are more complex). The cost of content-rich advertising is assumed to be c_c , the cost of uninformative advertising is assumed to be c_u , and $c_c > c_u$. This implies that more complex messages require the marketer to spend more either in media or in making the message fluent in order for consumers to process the information.¹⁶ Alternatively, one can think of content-rich advertising as communication that entails the transfer of more "bits of information". For example, when a firm desires better matching for its online customers (through search), extra key words lead to higher costs (Du et al. 2017).

¹⁶Some uninformative advertising is of extraordinary quality and is expensive to produce (due to high costs of production and talent). In this model, we assume that the quality of the two types of message are identical in terms of production value and talent. The difference is that content-rich messages need to convey more information.

The prior probability of a firm having either a Left or Right attribute is 50% and consumers know this. We represent the beliefs of consumers about the product attribute as μ_i (i is the subscript for the firm), the probability that product has a Right attribute. Thus, the prior probability for a consumer who sees an uninformative ad for a product is $\mu_i = \frac{1}{2}$.

Suppose a consumer in segment L or R sees an uninformative ad from a firm. She knows that the firm's product is available. Unless she can update her prior, she believes that the product has a 50% chance of meeting her preferences. Following Meurer and Stahl II (1994) and Anderson and Renault (2009), when a consumer is uninformated about a product's attribute, her expected value for the product is $\frac{r}{2}$.¹⁷

In contrast, if a consumer in segment L or R sees a content-rich ad from a firm, she knows whether the firm's product has a Left or a Right attribute. Thus, depending on the match between the product and the consumer's preference, she will expect a value of $V = r$ or $V = 0$ from the product.

A consumer buys the product which maximizes her utility, defined as $u_i = V_i - p_i$, where p_i is the price of the product from firm i . We also assume that $u_i > 0$ ($i = 1, 2$) for a consumer to buy. In other words, the outside option in the model provides 0 utility to consumers. The actual level of utility provided by the outside option does not affect our findings as long as the products provide an incremental benefit. When $u_i = u_j$, the consumer randomly chooses between Firms 1 and 2, and this leads to an even split of demand in that segment.

If a consumer in segment S sees an uninformative ad from a firm, she does not know the attributes of the product but because she is indifferent to the product attribute, her expected value of the product is r . If she is exposed to a content-rich message, her value is also $V = r$.

This underlies a source of tension in the model. The unwillingness of the attribute sensitive segments (L and R) to pay for a product unless it aligns with the segment's preference undermines the ability of firms to extract surplus from the segment of consumers (S) that is not sensitive to product attributes. We now discuss the equilibrium concept used in the game.

¹⁷Implicitly, this assumption means that consumers do not search actively or seek information from past users.

3.2 The Equilibrium Concept

Following Fudenberg and Tirole (1991), the model is solved using the Perfect Bayesian Equilibrium (PBE). The PBE restricts players to choosing strategies that are best responses (**P**) and imposes “logical consistency” on the beliefs of uninformed players (**B**). The beliefs of uninformed players (i.e., consumers) are derived using Bayes’ Rule from the actions of the informed player (the firm knows its attribute) before the uninformed players make decisions. This means that signalling is possible if the actions of the informed player (the firm) transmit information to the uninformed player (the consumer). In summary,

(P) The strategies of the informed player are optimal given the beliefs of the uninformed players.

(B) The beliefs of uninformed players are based on strategies that are consistent with Bayes’ Rule.

As noted earlier, μ_i is the prior belief of consumers about Firm i ’s attribute if Firm i advertises. We let the advertising decision of each firm be represented as a_i where $a_i = 0, U$ or C (no advertising, uninformative advertising or content-rich advertising). Consumers update their prior after observing advertising from one or both firms and we represent the updated "posterior" belief as $\hat{\mu}_i(a_1, a_2)$.¹⁸

The quadruplet $(a_1^*, a_2^*, \hat{\mu}_1, \hat{\mu}_2)$ constitutes a Perfect Bayesian Equilibrium (PBE) if and only if it satisfies the following conditions related to sequential rationality (P) and Bayesian consistency in beliefs (B).

(P) $a_i^*, i = 1, 2 \in \arg \max \pi_i(a_i, a_j, \hat{\mu}_1(a_1^*, a_2^*), \hat{\mu}_2(a_1^*, a_2^*))$.

(B) $(\mu_1, \mu_2) = (\hat{\mu}_1, \hat{\mu}_2)$ given that $(a_1, a_2) = (a_1^*, a_2^*)$

The PBE only imposes logical consistency on the beliefs of uninformed players over actions *on the equilibrium path*. We further restrict the beliefs of uninformed players (consumer) over actions *off*

¹⁸All consumers in the market have identical priors and posteriors because everyone is assumed to see exactly the same marketing from each firm.

the equilibrium path with the Intuitive Criterion (IC) of Cho and Kreps (1987). This eliminates the possibility of multiple equilibria based on consumers believing that firms choose strategies that are equilibrium dominated.¹⁹ In the next section, we present the analysis and equilibrium for the game.

4 Analysis

A firm can choose uninformative advertising independent of which attribute its product has and any equilibrium relies on logically consistent consumer beliefs about the firm's attribute, were it to make such a choice. Said differently, consumer beliefs are important even if uninformative advertising is not chosen in equilibrium: the PBE relies on every player choosing an optimal strategy. In order to ensure that a choice is optimal, we need to know what the firm would earn were it to choose an alternative strategy. We start by discussing the updating process employed by consumers to form posterior beliefs.

4.1 The Updating of Consumer Beliefs

A key requirement to identify the equilibrium when firms advertise is to specify how consumers form beliefs about a firm's attribute. If a firm does not advertise then consumers are unaware of its existence. Hence, the beliefs of consumers about that firm's attribute are moot. Conversely, if a firm chooses content-rich advertising then its type is perfectly known to consumers. Thus, the challenge is to explain how consumers update their beliefs when a firm employs uninformative advertising.

The prior belief (μ_u) about a firm that employs uninformative advertising is $\mu_u = \frac{1}{2}$. When only one firm advertises, independent of whether the firms have the same attribute or not, consumers cannot update their beliefs about the attribute of the advertised firm. The reason is that independent of whether the firms are identical or not, the firm that advertises could be Left

¹⁹An outcome fails the IC if consumers hold beliefs *off* the equilibrium path about a firm that would result in that firm earning less than an alternative strategy.

or Right. The focus of our study is parameter conditions where both firms advertise (at least sometimes).²⁰

When a firm's advertising is content rich, the firm's attribute is known. When a firm's advertising is uninformative, consumers try to infer the firm's attribute from firm actions that precede the buying decision. Here, there are two types of signals that may inform consumers whether the firms are identical or differentiated: price and advertising. When a firm chooses uninformative advertising and the competitor's choice does not reveal its attribute, the pricing strategies of differentiated and undifferentiated firms are identical. Accordingly, our focus is to identify conditions where the advertising decisions of the two firms reveals the uninformative advertiser's attribute.

In a nutshell, the technical challenge is to specify posterior beliefs when one firm employs content-rich advertising and the other employs uninformative advertising. As noted earlier, in a PBE, i) consumer beliefs about the player types are consistent with actions that the players choose and ii) the players' actions are consistent with the beliefs that are held by consumers after observing the players' actions.

We start by assuming the existence of a region where the posterior belief held by consumers (after observing the advertising choices of both firms) is identical to the prior, i.e. $\hat{\mu}_u = \mu_u = \frac{1}{2}$. We then define the parameter space where differentiated (identical) firms exhibit (U, C) as $\Omega_{dif}(U, C)$ given $\hat{\mu}_u = \mu_u$. Similarly, we define the parameter space where identical firms would exhibit (U, C) as $\Omega_{id}(U, C)$ given $\hat{\mu}_u = \mu_u$. Reasoning provided in the appendix leads to Lemma 1.

Lemma 1 $\Omega_{dif}(U, C) \subseteq \Omega_{id}(U, C)$.

Lemma 1 implies that parameter conditions where differentiated firms employ asymmetric advertising strategies (U, C) also lead identical firms to exhibit (U, C) . But the reverse is not true. In fact, both identical firms advertise *if and only if* differentiated firms exhibit (U, C) in equilibrium. Within $\Omega_{id}(U, C)$, there are conditions where differentiated firms prefer advertising

²⁰These conditions are derived in the course of solving the game.

strategies (C, C) . In this region, (U, C) is not sustainable as an outcome for identical firms because (U, C) is equilibrium dominated for differentiated firms when $\hat{\mu}_u = \mu_u$. The intuitive criterion implies that consumers update their beliefs in this region such that $\hat{\mu}_u = 1$ if the content-rich advertiser is Right and $\hat{\mu}_u = 0$ if the content-rich advertiser is Left (the firms are identical).²¹

Accordingly, we first examine the sub-game equilibrium for the case when the firms are differentiated. Both the (U, C) and (C, C) are viable outcomes for differentiated firms. We then move to the sub-game equilibrium when the firms are identical. If there are conditions where differentiated firms exhibit (U, C) , we know that identical firms choose the same strategies. In these conditions, the posterior belief about the firm that employs uninformative advertising $\hat{\mu}_u$ is identical to the prior. This process allows the identification of a PBE for identical firms where both advertise.

This pre-amble provides a basis to solve the two-stage game. In the first stage, the firms simultaneously decide whether to advertise using uninformative or content-rich advertising and consumers are exposed to the advertising. In the second stage, the firms simultaneously set prices and consumers decide which product to buy.

4.2 The Case when Firms are Differentiated

For differentiated firms, we first examine the outcome when there is no S segment ($s = 0$). This reflects a market where consumer heterogeneity is at a maximum. We then examine conditions where $s > 0$. To facilitate exposition of the differentiated case, we assume that Firm 1 has the Left attribute and Firm 2 has the Right attribute.

4.2.1 No S Segment

When all consumers are sensitive to product attributes ($s=0$), the conditions reflect maximum consumer heterogeneity because every consumer likes the product of Firm 1 or Firm 2 and not

²¹When consumers have beliefs that the firms are identical, price competition leads to zero profits in the (U, C) pricing subgame for both firms.

both. Here, we consider the pricing equilibria and corresponding firm profits under different advertising scenarios.

When neither firm advertises, consumers in the market are not aware of the products so nobody buys and both firms earn zero profits. When only one firm chooses uninformative advertising, say Firm 1, consumers cannot update their prior beliefs and all consumers expect a value of $\frac{r}{2}$ (when $s = 0$, all consumers in the market are attribute sensitive). As long as the price is lower than $\frac{r}{2}$, all consumers buy from Firm 1. Consequently, Firm 1 charges the monopoly price of $\frac{r}{2}$ and earns a profit of $\frac{r}{2} - c_u$.

When both firms choose uninformative advertising, consumers do not know the attributes of either product. Consequently, they expect a value of $\frac{r}{2}$ from the two choices and consumers perceive the products to be identical. As a result, the firms engage in Bertrand-like price competition in the second stage of the game. This leads to an equilibrium price of zero ($p_1 = p_2 = 0$) and the firms earn negative profits because the cost of advertising is sunk: $\pi_1 = \pi_2 = -c_u$.

Alternatively, consider what happens when both firms employ content-rich advertising and consumers are informed about the attributes of both products. Here, consumers in the L and R segments only buy from Firms 1 and 2 respectively, because the product from the other firm provides them with zero value. In this situation, each firm spends c_c to be a *de facto* monopolist in its corresponding segment. A monopoly price of r is charged and each firm earns a profit of $\pi_1 = \pi_2 = \frac{r}{2} - c_c$

In the final advertising scenario, one firm uses uninformative advertising and the other firm employs content-rich advertising. For ease of exposition, Firm 1 is the uninformative advertiser and Firm 2 is the content-rich advertiser. The prior beliefs of consumers about Firm 1 are that it is 50/50 Left/Right. Following the discussion in Section 4.1, we know that identical firms will exhibit U,C whenever differentiated firms exhibit U,C. Hence, the posterior belief for Firm 1 is also 50/50 Left/Right. As a result, if consumers observe U,C, they are willing to pay $\frac{r}{2}$ for Product 1. Furthermore, because Firm 2's advertising provides truthful information about its product attribute, consumers in the L segment will not buy from Firm 2 while those in the R

segment are willing to pay r . In other words, Firm 1 has monopoly power in the L segment and can compete with Firm 2 in the R segment. To compete for the R segment, Firm 1 has to charge a price that is $\frac{r}{2}$ less than the price of Firm 2.

This gives rise to an equilibrium in mixed pricing strategies (Varian 1980). Here, Firm 1 can focus on the L segment, charge the monopoly price (given that its advertising is uninformative) and earn guaranteed profit of $\frac{1}{2} \frac{r}{2} = \frac{r}{4}$ (net of advertising costs). Firm 1 can also choose to compete for the R segment and if successful, its demand is 1 and its profit is p_1 . Because Firm 1 can earn $\frac{r}{4}$ by focussing on the L segment, it will not charge a price less than $\frac{r}{4}$. Understanding this, Firm 2 does not price less than $\frac{r}{2} + \frac{r}{4} = \frac{3r}{4}$ (consumers in the R segment will pay $\frac{r}{2}$ more for Firm 2's product than for Firm 1's product). This implies that Firm 2's guaranteed profit is $\frac{3r}{8}$ i.e., the product of the minimum price needed to guarantee sales from the R segment $\frac{3r}{4}$ and the size of the R segment. The price support for Firm 1's mixed pricing strategy is therefore $[\frac{r}{4}, \frac{r}{2}]$. The price support for Firm 2's mixed pricing strategy is $[\frac{3r}{4}, r]$.²²

Here, the equilibrium entails Firm 1 choosing a price of $\frac{r}{2}$ with positive probability z . We define $F_1(p)$ as the cumulative distribution function of Firm 1's price conditional on Firm 2 not setting $p = \frac{r}{2}$ and $F_2(p)$ is the cumulative distribution of Firm 2's price. We now write the profit functions for Firms 1 and 2.

$$\pi_1 = \frac{p}{2} + (1 - F_2(p + \frac{r}{2})) \frac{p}{2} = \frac{r}{4} \quad (1)$$

$$\pi_2 = z \frac{p}{2} + (1 - z)(1 - F_1(p - \frac{r}{2})) \frac{1}{2} p = \frac{3r}{8} \quad (2)$$

Because Firm 1 does not charge a price higher than $\frac{r}{2}$, we know that $F_1(p - \frac{r}{2}) = 1$ at $p = r$. This implies that $z = \frac{3}{4}$, i.e. Firm 1's mass point at $\frac{r}{2}$ occurs with probability $\frac{3}{4}$. The cumulative distribution functions for each firm's pricing strategy satisfy equations 1 and 2.

When the firms choose different advertising strategies, the sub-game profits of the content-rich advertiser (Firm 2) are higher than the sub-game profits of the firm that uses uninformative advertising. This comes from the pricing power that the content-rich advertiser exercises over

²²Firm 2's price support does not include the end point r because r is not a best response to any price charged by Firm 1.

the segment for which its product attributes are a match. Whether this is attractive depends on the cost of content-rich advertising, c_c . Throughout the paper, we focus on parameter conditions where both firms have an incentive to advertise. In the absence of attribute insensitive consumers, the relevant condition is $c_u < c_c < \frac{3r}{8}$.²³

Using the equilibrium profits in the sub-games, we evaluate the first decision of the firms, whether to implement uninformative or content-rich advertising. Table 2 presents the normal form for the first stage of the game (and the profits for each firm).

Table 2: Advertising game without S segment

	No Advertising	Uninformative	Content-Rich
No Advertising	$0, 0$	$0, \frac{r}{2} - c_u$	$0, \frac{r}{2} - c_c$
Uninformative	$\frac{r}{2} - c_u, 0$	$-c_u, -c_u$	$\frac{r}{4} - c_u, \frac{3r}{8} - c_c$
Content-rich	$\frac{r}{2} - c_c, 0$	$\frac{3r}{8} - c_c, \frac{r}{4} - c_u$	$\frac{r}{2} - c_c, \frac{r}{2} - c_c$

The equilibrium advertising strategy is found by determining the strategy combination that is a best response for both firms. This is summarized in Proposition 1 (proofs for all propositions are provided in the appendix).

Proposition 1 *When there is no S segment, if $c_c - c_u \leq \frac{r}{4}$, then both firms engage in content-rich advertising. If $c_c - c_u > r/4$ one firm chooses content-rich advertising and the other implements uninformative advertising.*

Proposition 1 underlines the role of advertising cost as a basis for determining the equilibrium. As expected, when the incremental cost of content-rich advertising is sufficiently high, one of the

²³When $c_c > \frac{3r}{8}$, there are two possible equilibria, one of which is a degenerate outcome where only one firm employs uninformative advertising. Our goal is to examine markets where given r and s , consumers observe firms competing with each other, i.e. we focus our attention on values where content-rich advertising is feasible. In Section 4.3, we examine conditions where the firms are identical. There, despite the feasibility of advertising, one firm may choose to not advertise.

firms has an incentive to use uninformative advertising in response to content-rich advertising.²⁴

When this happens, two points are worth noting. First, the profits earned by the content-rich advertiser (Firm 2) are reduced because the content-rich advertiser faces competition in the segment that prefers its attribute (in this case the Right attribute). When both firms employ content-rich advertising, they are fully differentiated and *de facto* monopolists in their respective segments.

A second important point is that when $c_c - c_u > \frac{r}{4}$, the uninformative advertiser earns a minimum of $\frac{r}{8}$ more profit than the content-rich advertiser. When there is no S segment, the relative profitability of the firms when they employ different advertising strategies is primarily driven by the higher cost of content-rich advertising. In other words, even though content rich advertising provides more pricing power and higher sub-game profit (i.e., profit excluding advertising cost), its competitive advantage is offset by the higher cost. Interestingly, even in a highly heterogeneous market (i.e., without a switcher segment), uninformative advertising can be attractive.

We now proceed to the analysis of a market with consumers who are not sensitive to attributes.

4.2.2 With an attribute insensitive segment

Here, we examine the firms' optimal strategies when there is a segment of consumers (size s) who are not sensitive to product attributes. Similar to the previous section, we determine the pricing equilibrium under different advertising scenarios.

As before, when neither firm advertises, both firms earn zero profit. Consider a situation where only one firm advertises. In one case, the firm chooses to employ uninformative advertising and in the second case, the firm implements content-rich advertising. In Table 3, the willingness to pay of each segment for the advertised product is shown ($i, j = L$ or R and $i \neq j$). For the ease of exposition, we assume that the content-rich advertising indicates a fit with segment i and a mismatch with segment j .

²⁴In the equilibrium, consumers believe that Firm 1 is 50/50 Left/Right because identical firms exhibit the same outcome.

Table 3: Consumers' willingness to pay

	i	S	j
Uninformative Advertising	$\frac{r}{2}$	r	$\frac{r}{2}$
Content-rich Advertising	r	r	0

When a firm engages in uninformative advertising and the other firm does not advertise, consumers in segment S have an expected value of r from the firm that advertises and consumers in segments i and j have a willingness to pay of $r/2$. In this situation, the firm compares the profit associated with selling to everyone $\frac{r}{2} - c_u$ with the profit earned by selling to the S segment alone, i.e. $sr - c_u$. As a result, the uninformative advertiser's optimal price depends on the size of the attribute insensitive segment. When one firm engages in content-rich advertising and the other firm does not advertise, consumers in segment S and the segment for which the firm's attribute is a match i buy as long the price is less than or equal to r . Consequently, the content-rich advertiser charges a price of r and realizes profit of $\frac{r(1+s)}{2} - c_c$.

When both firms choose uninformative advertising, the products are perceived as homogeneous. This leads to profits of zero in the pricing sub-game because of Bertrand competition.²⁵

When both firms choose content-rich advertising, consumers in the L segment only buy from the firm that offers an L attribute (and as before, we assume that the L attribute is offered by Firm 1 and the R attribute is offered by Firm 2) and those in R segment only buy from the firm that offers an R attribute. The attribute insensitive consumers simply choose the least expensive product. This resembles a special case of Narasimhan (1988). The pricing equilibrium is in mixed strategies and each firm earns guaranteed profit of $\pi_1^* = \pi_2^* = \frac{r(1-s)}{2} - c_c$. Because of symmetry, there is no mass point in the price support; profit from serving the attribute insensitive segment is competed away.

²⁵When both firms choose uninformative advertising, consumers' posterior beliefs are the same as their priors. As a result, consumers in the L and R segments are willing to pay $r/2$ while attribute insensitive consumers are willing to pay r . The incentive of firms to undercut each other is unaffected by the difference in reservation prices across segments. Therefore, the firms undercut each other on price until prices and profits are zero.

When one firm chooses uninformative advertising (Firm 1) and the other chooses content-rich advertising (Firm 2), the pricing equilibrium depends on the size of the attribute insensitive segment. Obviously, Firm 1 can capture the L segment as long as its price is lower than $r/2$.²⁶ Therefore, Firm 1's pricing decision depends on whether it wants to compete for the S-segment or both the S and R segments. When Firm 1 chooses to compete only for the S segment, its price is $p_1 = p_2 - \epsilon$. If Firm 1 competes for the S and R segments $p_1 < p_2 - \frac{r}{2}$ is necessary and this implies that Firm 1 captures the entire market and earns profit of $\pi_1 = p_2 - \frac{r}{2}$. When $p_2 \leq \frac{r}{2}$, Firm 1 is restricted to competing for the S segment because its price needs to be $\frac{r}{2}$ less than p_2 to compete for the R segment and this implies a negative price. When $p_2 > \frac{r}{2}$, Firm 1 can compete for the R segment but the profit needs to be higher than the profit that would result by capturing only segments L and S.

In the asymmetric advertising scenario, the challenge is to identify the pricing equilibrium and the equilibrium profit.

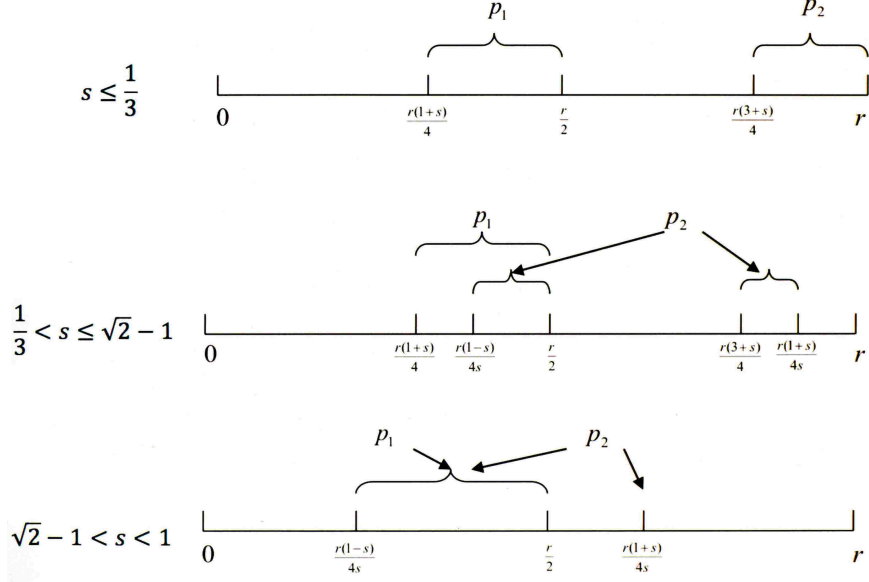
Proposition 2 *When one firm chooses uninformative advertising and the other chooses content-rich advertising, the firms play mixed strategies in prices and their profits are:*

$$\left\{ \begin{array}{l} \pi^*(\text{uninformative advertiser}) = \begin{cases} \frac{(1+s)r}{4} & \text{if } 0 < s \leq 1/3, \\ \frac{(1+s)(1-s)r}{8s} & \text{if } 1/3 < s < 1, \end{cases} \\ \pi^*(\text{content rich advertiser}) = \begin{cases} \frac{(3+s)(1-s)r}{8} & \text{if } 0 < s \leq \sqrt{2}-1, \\ \frac{(1+s)(1-s)r}{8s} & \text{if } \sqrt{2}-1 < s < 1. \end{cases} \end{array} \right. \quad (3)$$

Under asymmetric advertising, the sub-game pricing behavior of the firms depends on the size of the switcher segment. To be specific, there are three cases, each entailing a different mixed

²⁶Throughout the analysis of the differentiated case, we assume that consumers' posterior about Firm 1 is identical to the prior since identical firms will exhibit the same outcome if it is optimal for differentiated firms.

Figure 1: Sub-game price support under asymmetric advertising



pricing equilibrium. Figure 1 illustrates the support of the mixed pricing equilibrium.

When s is small ($s \leq 1/3$), the pricing equilibrium is similar to the case with no attribute insensitive consumers. In fact, as $s \rightarrow 0$, the price support approaches the price support derived in Section 4.2.1. Firm 1 has a mass point at $r/2$ and it captures both the L and S segments (for expositional purposes of the differentiated case, Firm 1's product has the L attribute and Firm 2 the R attribute). Here, Firm 2's equilibrium profit is equal to its lowest price times the size of R segment.

When s is medium ($1/3 < s \leq \sqrt{2} - 1$), Firm 1 still prices below $r/2$, but Firm 2 (the content-rich advertiser) gradually reduces its price to compete with Firm 1 for the switcher segment. Notice that the maximum price in Firm 2's price support (the content-rich advertiser) is substantially less than the reservation price r (the maximum price that the R segment is willing to pay for Firm 2's product). This stands in contrast to the pricing behaviour of the content-rich advertiser when the S segment is small ($s < \frac{1}{3}$). When the S segment is small, the content-rich advertiser randomizes its price over a range that approaches r at its upper limit. Furthermore, the lower section of Firm 2's price support overlaps with Firm 1's upper part. Firm 1 has two

mass points: one at $\frac{r(1-s)}{4s}$ and the other at $r/2$. Firm 2 has a mass point at $\frac{r(3+s)}{4}$.

When the S segment is large ($s > \sqrt{2} - 1$), the firms share a continuous price support in the region $[\frac{r(1-s)}{4s}, \frac{r}{2}]$ and they both have mass points: Firm 1 at the upper end of the range $[\frac{r(1-s)}{4s}, \frac{r}{2}]$ and Firm 2 at a price of $\frac{r(1+s)}{4s}$ which is higher than the maximum price in the range $[\frac{r(1-s)}{4s}, \frac{r}{2}]$.

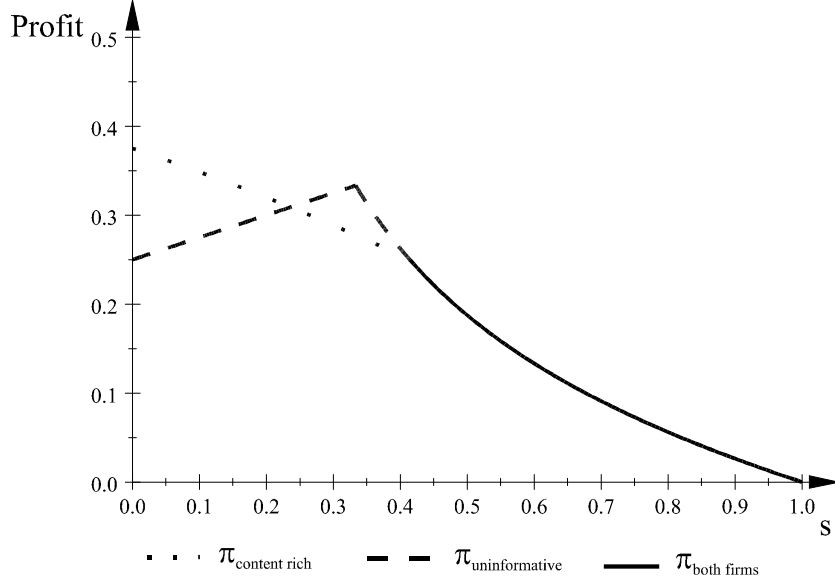
In this pricing equilibrium, there are two forces at work. On the one hand, the content-rich advertiser (Firm 2) can charge a high price to the R segment because these consumers obtain $\frac{r}{2}$ more utility from Firm 2's product than from Firm 1's product. The implication of this for Firm 2 is that if it wishes to compete for the attribute insensitive segment by choosing a price less than Firm 1, it walks away from at least $\frac{r}{2}$ of margin that can be earned on product sold to the R segment. As a result, Firm 2 (the content-rich advertiser) has limited willingness to undercut Firm 1 to capture business from the attribute insensitive segment.

On the other hand, the uninformative advertiser, Firm 1, is simultaneously in a weak position to compete for the R segment and in a strong position to compete for the attribute insensitive segment. As a result, Firm 1 competes aggressively for the attribute insensitive segment and this limits the degree to which Firm 2 can set a high price for the R segment. This explains why Firm 2 has a mass point in the support for its mixed pricing strategy at the limit price where it captures the R segment 100% of the time (recall that Firm 2 has the R-attribute). Were Firm 2 to price higher than $\frac{r(1+s)}{4s}$ and Firm 1 to randomize its price between $[\frac{r(1-s)}{4s}, \frac{r}{2}]$, at times Firm 1 would capture the R segment.

Notice that as $s \rightarrow 1$, the mass point of the content-rich advertiser decreases towards the upper boundary of the continuous price support $(\frac{r(1+s)}{4s} \rightarrow \frac{r}{2})$. Not surprisingly, the probability masses for both firms approach zero as $s \rightarrow 1$, i.e., $\frac{(1-s)^2}{2s^2} \rightarrow 0$ and $\frac{2(1-s)^2}{7s^2+2s-1} \rightarrow 0$. This happens because as $s \rightarrow 1$, the two firms become increasingly undifferentiated: most consumers are attribute insensitive and are willing to pay r for the products of either firm.

As shown in Figure 2, when s is small, the content rich advertiser earns higher subgame profit than the uninformative advertiser. In the interval $s \in (\sqrt{5} - 2, \sqrt{2} - 1)$, this changes and the uninformative advertiser earns higher subgame profit than the content-rich advertiser. Once $s >$

Figure 2: Sub-game profits under asymmetric advertising



$\sqrt{2} - 1$, both firms earn identical profit in the pricing subgame. The explanation for this is as follows. Firm 1 (the uninformative advertiser) always captures the L segment for prices less than $\frac{\tau}{2}$: Firm 2's product is unacceptable to the L segment because, from Firm 2's advertising, they know that it has the R attribute. To ensure that the L segment buys, Firm 1 anchors its prices in a range less than $\frac{\tau}{2}$.

When s is small, both firms have significant loyal segments and the content-rich advertiser prices to protect demand from the R segment. This allows the uninformative advertiser (Firm 1) to focus on capturing the S and the L segments. In fact, Firm 1 needs to keep its price less than $\frac{\tau}{2}$ (so that the L segment buys). This appears to be a weakness yet as s increases it becomes a strength. Firm 1 has its price anchored in a range where it always competes for a fraction $\frac{1+s}{2}$ of the market (the L segment and the S segment). This explains why the uninformative advertiser earns more profit than the content-rich advertiser when the S segment is in an intermediate range.

When s is sufficiently large ($s > \frac{1}{3}$), the switcher segment is attractive enough such that both firms compete for it. As a result, their pricing behaviors are more homogenous. While both firms have an incentive to focus on their loyal segment, as $s \rightarrow 1$, that incentive shrinks to a mass point.

The similarity in the pricing strategies of the firms leads to both firms earning equal profits in the subgame.

We now solve the game of advertising choice, as represented by the normal form shown in Table 4.

Table 4: Advertising game with S segment

	No Advertising	Uninformative	Content-rich
No Advertising	$0, 0$	$0, \frac{r}{2} - c_u$	$0, \frac{r(1+s)}{2} - c_c$
Uninformative	$\frac{r}{2} - c_u, 0$	$-c_u, -c_u$	$\pi_{uc} - c_u, \pi_{cu} - c_c$
Content-rich	$\frac{r(1+s)}{2} - c_c, 0$	$\pi_{cu} - c_c, \pi_{uc} - c_u$	$\pi_{cc} - c_c, \pi_{cc} - c_c$

Proposition 3 summarizes the equilibrium in the first stage.

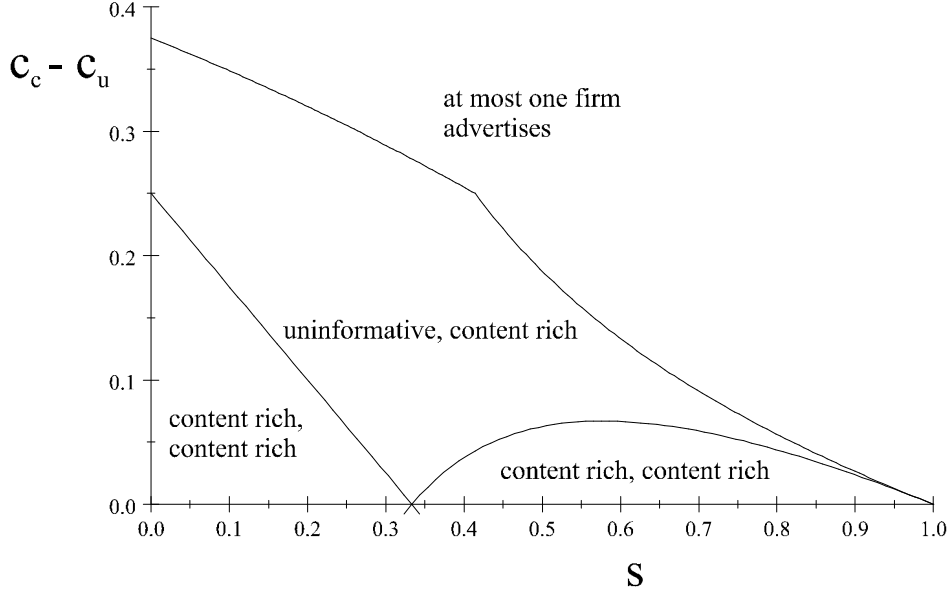
Proposition 3 *Let $f(s)$ be a function of s , when $c_c - c_u < f(s)$, both firms engage in content rich advertising; when $c_c - c_u \geq f(s)$, firms engage in asymmetric advertising, where $f(s)$ is described below:*

$$f(s) = \begin{cases} \frac{(1-3s)r}{4} & \text{if } s \leq 1/3, \\ \frac{(4s-3s^2-1)r}{8s} & \text{if } 1/3 < s < 1. \end{cases} \quad (4)$$

Figure 3 summarizes the equilibrium advertising strategies in the feasible parameter space. In the figure, the Y axis is the cost difference between content-rich and uninformative advertising $c_c - c_u$. The function $f(s)$ is what defines the boundary between (Content-rich, Content-rich) and (Content-rich, Uninformative) as an outcome.

Notice that when $s < 1/3$, the first derivative of the threshold in Proposition 3 with respect to s is negative: $\frac{\partial \frac{r(1-3s)}{4}}{\partial s} = \frac{-3r}{4}$. This means that as s increases, the threshold decreases implying that the likelihood of an asymmetric outcome increases. As a result, the market is likely to move

Figure 3: Advertising equilibrium when firms are differentiated



from a (Content-rich, Content-rich) outcome to a (Uninformative, Content-rich) outcome as s increases. This is explained by the cumulative distribution of the pricing strategies employed by the firms in the asymmetric sub-game (equation i in the Appendix). Prices increase with s in the asymmetric subgame meaning that decreases in differentiation lead to higher (and not lower) prices.²⁷ This unusual dynamic is explained by recognizing that sometimes Firm 1, the uninformative advertiser, captures business from the R segment. This happens because Firm 2 is motivated to set high prices to capitalize on the high willingness to pay of the R segment for its product. However, as s increases (the level of differentiation in the market decreases), Firm 1 has less incentive to discount to attract the R segment because it is smaller. This relaxes price competition and ultimately, has a positive effect on Firm 1's profits. As noted earlier, when $\sqrt{5} - 2 < s < \sqrt{2} - 1$, the subgame profit of the uninformative advertiser is higher than that of the content-rich advertiser. This dynamic explains the primary insight of advertising choice with a small switcher segment. As s increases, the probability of a firm choosing uninformative

²⁷Recall that s is inversely related to differentiation in this model.

advertising in response to a competitor that employs content-rich advertising increases.

When s is closer to 1, the firms are more likely to engage in asymmetric advertising as s increases. However, the motivation for asymmetric advertising is different from the case of $s < 1/3$ where the uninformative advertiser enjoys a higher sub-game profit. Here, both firms earn equal profit in the pricing game. In the asymmetric outcome, one firm is motivated to differentiate itself by providing detailed product information while the other is motivated by the lower costs associated with uninformative advertising. As s increases, increased differentiation does not deliver sufficient profit. At high levels of s , the lower cost of uninformative advertising makes it more attractive to one of the firms.

When $s > 1/3$, an important point emerges, related to the likelihood of observing uninformative advertising. As s increases (differentiation in the market is lower), it seems that detailed product information (through content-rich advertising) should be less valuable. In other words, a symmetric (Content-rich, Content-rich) equilibrium should be less likely as s increases. This is true when s is small or closer to 1. However, when s is in an intermediate range, this is not the case. Proposition 4 relates to the likelihood of seeing uninformative advertising i.e. it summarizes the shape of the boundary where at least one firm engages in uninformative advertising.

Proposition 4 *When $1/3 < s < 1/\sqrt{3}$, firms are more likely to both employ content-rich advertising as s increases.*

Proposition 4 shows that when $1/3 < s < 1/\sqrt{3}$, increases in s lead to an increase in the amount of content-rich advertising. Consider the boundary in Figure 3 between (Uninformative, Content-rich) and (Content-rich, Content-rich) for $s > \frac{1}{3}$.²⁸ The positive slope of the boundary in $s \in (1/3, 1/\sqrt{3})$, implies that the equilibrium changes from (Uninformative, Content-rich) to (Content-rich, Content-rich) as s increases. Therefore, in this range, increases in s (less differentiation) lead to an increase in the amount of content-rich advertising.

To understand why increases in s lead to more content-rich advertising in this range, recall the effect of increases in s when $s \leq \frac{1}{3}$. When $s \leq \frac{1}{3}$, expansion of the S segment lowers the incentive

²⁸In Figure 3, the scale on the y-axis is units of r .

of the uninformative advertiser to reduce price to capture the competitor's loyal segment. This leads to higher profits for the uninformative advertiser (in the asymmetric outcome). As a result, the asymmetric advertising outcome is more likely when s increases.

In contrast, when $s > 1/3$, there is a significant difference in how increases in s affect firm profits. In this range, the comparative statics on subgame profits for each firm highlight the difference. An increase in s reduces profits for both firms in the symmetric (Content-rich, Content-rich) outcome ($\frac{\partial \pi_{cc}}{\partial s} < 0$) and the asymmetric (Uninformative, Content-Rich) outcome ($\frac{\partial \pi_{uc}}{\partial s} < 0$ and $\frac{\partial \pi_{cu}}{\partial s} < 0$). In contrast, when $s \leq \frac{1}{3}$, $\frac{\partial \pi_{uc}}{\partial s} > 0$. The difference between the ranges for s comes from the distinct pricing equilibria that occur in each range. Average prices are positively related to s when $s \leq \frac{1}{3}$. In contrast, average prices are negatively related to s when s is large.

This observation alone does not explain Proposition 4. To understand why there is an increase in content-rich advertising, we make a detailed comparison of the profit associated with an uninformative response (π_{uc}) and a content-rich response (π_{cc}) to a content-rich advertiser. This is the comparison a firm makes to determine its best response to a competitor that employs content-rich advertising. To compare the shape of π_{uc} and π_{cc} as function of s (holding r constant), we examine the second order derivatives of π_{uc} and π_{cc} and find that $\frac{\partial^2 \pi_{uc}}{\partial s^2} > 0$ and $\frac{\partial^2 \pi_{cc}}{\partial s^2} = 0$. This means that s has a negative and convex impact on the profit associated with an uninformative response to a content-rich advertiser. In contrast, the relationship of s to the profits associated with a content-rich response to a content-rich advertiser is negative and linear. Because of the convexity of π_{uc} , in $[1/3, 1/\sqrt{3}]$, π_{uc} declines faster than π_{cc} as a function of s . In $[1/\sqrt{3}, 1]$, the reverse is true.

Why does π_{uc} decrease faster than π_{cc} as a function of s in the interval $[1/3, 1/\sqrt{3}]$? The explanation is that the S segment is large enough to attract the attention of the content-rich advertiser (who prices aggressively to capture it from time to time). This makes price competition intense when the firms use different advertising strategies. Understanding this, a firm relaxes the intensity of price competition for the S segment by employing content-rich advertising. It is

also important that the attribute sensitive segments (L and R) remain significant in $[1/3, 1/\sqrt{3}]$. Consequently, as s increases, a firm is more willing to pay the incremental cost of content-rich advertising to achieve a less damaging outcome in the pricing sub-game.

This dynamic applies as long as the attribute sensitive segments remain significant. When $s > 1/\sqrt{3}$, the market approaches a condition of no differentiation and the firms become more homogenous. Here, the attribute sensitive segments are small so the advantage of content-rich advertising (allowing a high price to be charged to the attribute sensitive segment from time to time) diminishes. This reverses the trend observed when $s < 1/\sqrt{3}$ and makes uninformative advertising a more attractive response to content-rich advertising. In particular, the rapid decline in π_{uc} as a function of s when $s < 1/\sqrt{3}$ is muted and π_{cc} declines more rapidly in the upper part of the interval.

4.2.3 Summary for Differentiated Firms

When consumer needs are highly differentiated, the most likely outcome is that differentiated firms employ content-rich advertising. As the level of differentiation decreases (s increases), the likelihood of uninformative advertising being a best response to content-rich advertising increases. The intuition is that reduced differentiation in consumer taste increases the strength of a generic appeal (uninformative advertising) and decreases the strength of a differentiated appeal (content-rich advertising). In fact, when $s > \approx 0.23607$, the uninformative advertiser earns more than the content-rich advertiser. However, the analysis of Proposition 4 shows that the trend of uninformative advertising becoming more likely as a response to content-rich advertising reverses when $s > 1/3$. The reason is that the equilibrium changes: when $s > 1/3$, the S segment is big enough to attract the attention of the content-rich advertiser who prices more aggressively. This intensifies competition and reduces the attractiveness of the uninformative response. However, as s continues to increase, the level of differentiation between the firms becomes less important and the relative attractiveness of uninformative advertising as a response to content-rich advertising returns. This means that the likelihood of a firm responding to a competitor's content-rich adver-

tising with uninformative advertising is non-monotonically related to the level of differentiation in the market. The non-monotonicity of the advertising equilibrium is the combined result of providing information to market and alleviating price competition through advertising.

4.3 The Equilibrium when Firms are Undifferentiated

As noted earlier, it is equally likely that the firms develop identical products and differentiated products. Here, we analyze the equilibrium when the firms have identical products (both possess the L attribute or both possess the R attribute). Before presenting the analysis, it is useful to highlight two points.

First, symmetric strategies where firms with identical products both advertise result in negative profits. Symmetric strategies cause consumers to perceive the products as identical. This leads to Bertrand competition in the sub-game and losses related to the expenditure on advertising (either c_u or c_c). Indeed, the key difference with Section 4.2 is that the (Content-rich, Content-rich) outcome leads to negative profits because the products *are* identical.

Second, there are only two ways for positive profits to be earned when firms are identical. The first is that only one firm advertises. The second is if consumers *perceive* two advertised products to be different. Following Section 4.1, the only outcome that allows two advertised product to be perceived as different entails one firm using content-rich advertising and the other using uninformative advertising. This outcome is only possible in conditions where $\hat{\mu}_i = \frac{1}{2}$ where i is the firm that uses uninformative advertising (the posterior belief for Firm i equals the prior belief). This is the case whenever U, C is the chosen strategy of differentiated firms.²⁹ In parameter conditions (c_c, c_u, s, r) where differentiated firms exhibit C, C , the outcome for identical firms entails only one active firm. With $f(s)$ as defined in Proposition 3, this reasoning leads to Proposition 5:

²⁹The parameters c_c, c_u, s and r are common knowledge for all players in the game.

Proposition 5 *When the firms are identical and*

1. $s < \frac{1}{5}$, *the advertising outcome is*

$$\left\{ \begin{array}{l} \text{one firm employs content-rich advertising when } c_c - c_u \in \left(0, \frac{rs}{2}\right) \\ \text{one firm employs uninformative advertising when } c_c - c_u \in \left(\frac{rs}{2}, f(s)\right) \\ \text{the firms exhibit asymmetric advertising when } c_c - c_u \geq f(s). \end{array} \right.$$

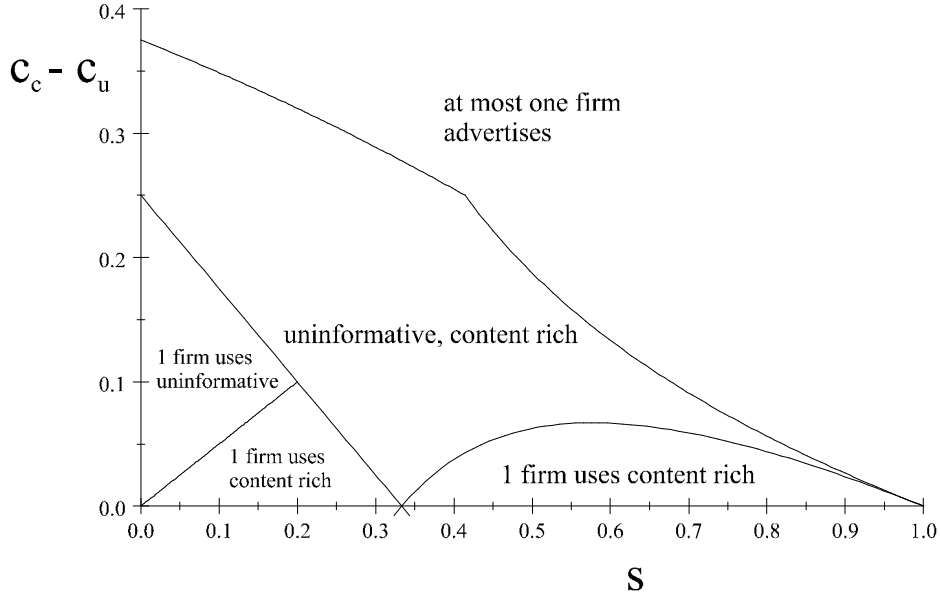
2. $s > \frac{1}{5}$, *the advertising outcome is*

$$\left\{ \begin{array}{l} \text{one firm employs content-rich advertising when } c_c - c_u \in (0, f(s)) \\ \text{the firms exhibit asymmetric advertising when } c_c - c_u \geq f(s). \end{array} \right.$$

Proposition 5 shows that firms use advertising content to create "artificial differentiation" when the difference in cost between content-rich and uninformative advertising exceeds a threshold. For "artificial differentiation" to take place, the symmetric content-rich advertising is unstable were firms differentiated. Another insight from Proposition 5 is that when the difference in cost between content-rich and uninformative advertising is small, only one firm operates when the firms have identical products.

The equilibrium outcomes are illustrated in Figure 4. The observation that uninformative advertising can be used to create perceived differentiation between identical products is important; it echoes the accusation of advertising critics who claim that advertising leads to spurious differentiation (Chamberlin 1933, Galbraith 1967, Comanor and Wilson 1974). However, the mechanisms suggested by these critics entail advertising that misrepresents the benefits of a brand or that creates "valueless" positive emotional associations for brands. In contrast, this analysis shows that perceived (or spurious) differentiation comes from using advertising that is *truly uninformative*. The advertising provides no attribute information to consumers and it allows a firm to capitalize on how consumers form expectations about attributes.

Figure 4: Advertising equilibrium when firms are identical



5 Conclusion

The objective of this study is to understand how competitive firms choose between content-rich advertising and uninformative advertising. Our focus is goods where consumers need information (from advertising) or consumption experience, to know a product's attribute. The model includes the assumption that advertising which transmits information about product attributes (content-rich) costs more than uninformative advertising. As expected, this assumption leads to an asymmetric outcome when the cost of content-rich advertising is sufficiently high. However, the model goes further than this. It provides an explanation for the preponderance of uninformative advertising that is not cost-based.

The key model parameter we vary is the degree to which consumer preferences are differentiated. We start from a situation of maximum differentiation in the market: in a 2 segment market, one segment wants one thing and the other segment wants another. At the other extreme, we consider a situation where there is no heterogeneity in consumer needs: consumers are happy with the product of either firm. We examine cases between the extremes by using a third segment

of attribute insensitive consumers. We progressively increase the fraction of attribute insensitive consumers until the entire market is comprised of attribute insensitive consumers.

The analysis is based on the firms developing products independently and as a result, the products are differentiated or identical with 50/50 probability. First, we discuss the findings when the firms have differentiated products.

Not surprisingly, in conditions where consumer tastes are maximally differentiated, content-rich advertising is optimal. It facilitates perfect matching of consumers to products. Here, despite the effectiveness of content-rich advertising, a firm may choose uninformative advertising as a response to content-rich advertising if content-rich advertising is sufficiently expensive.

For intermediate levels of differentiation, one of the firms also chooses uninformative advertising when content-rich advertising is sufficiently expensive but two distinct pricing regimes arise: one when the attribute insensitive fraction of the market is small (the level of differentiation in consumer preferences is high) and another, when the attribute insensitive fraction of the market is large (the level of differentiation in consumer preferences is low).

When the fraction of attribute insensitive consumers is small, the firms choose different advertising strategies when the incremental cost of content-rich advertising exceeds a threshold. Here, the content-rich advertiser sets high prices to capture surplus from the segment of consumers whose preferences are aligned with its product. These prices allow the uninformative advertiser can attract this segment with low prices. Unusually, as the attribute insensitive fraction of the market increases, average prices *increase*. As a result, prices and the uninformative advertiser's profits increase in the fraction of the market that is attribute insensitive. This dynamic means that when the fraction of attribute insensitive consumers in the market is small, the likelihood of an asymmetric outcome increases in the fraction of attribute insensitive consumers.

When the fraction of attribute insensitive consumers is large and asymmetric advertising strategies are observed, the firm engaging in content-rich advertising refocuses its attention. In contrast to conditions of high differentiation ($s < \frac{1}{3}$), the content-rich advertiser strives to capture demand from attribute insensitive consumers as well from the segment that has needs aligned

with its attribute. As a result, price competition is fierce. Moreover, it intensifies as the fraction of attribute insensitive consumers increases. This is the typical relationship between prices and differentiation; the exact opposite of what is observed when the fraction of attribute insensitive consumers is small. This change means that increases in the fraction of attribute insensitive consumers reduces the profits of both firms. But at intermediate levels of s , the profits of the uninformative advertiser decline faster. As a result, the asymmetric advertising outcome becomes less likely at intermediate levels of s . Then, as we continue to increase s (and the market approaches a state of minimal differentiation), uninformative advertising becomes more likely because the profits of the symmetric content-rich advertising outcome decline quickly when there are few attribute sensitive consumers.

When the firms have identical products, the only feasible outcomes are that one firm operates by itself or that two firms employ asymmetric advertising strategies. In fact, when the firms employ different advertising strategies, advertising creates "artificial differentiation" between identical products. However, identical firms are constrained by how consumers update their beliefs in a PBE. As a result, identical firms both advertise whenever differentiated firms would themselves exhibit a (U, C) outcome. Indeed, the likelihood of observing a (U, C) outcome is unaffected by whether firms are differentiated or not. The primary difference between outcomes when firms are differentiated versus identical is that markets with identical firms are more likely to be dominated by a single firm.

Finally, the likelihood of observing uninformative advertising as a response to content-rich advertising is non-monotonically related to the degree by which consumer preferences are differentiated (independent of whether the firms have different products). As discussed, this arises because, when consumer tastes are highly differentiated, the natural outcome is for differentiated firms to employ content-rich advertising to maximize efficient matching. However, as the fraction of the market that is attribute insensitive increases, the likelihood of an asymmetric outcome increases, then decreases and then increases as we approach a fully undifferentiated market.

In sum, the impact of changes in the level of customer heterogeneity on advertising strategies

depends strongly on the initial level of customer heterogeneity. The model shows that decreases in differentiation can lead to increases or decreases in the occurrence of asymmetric advertising strategies. The model also provides an explanation for why firms opt for uninformative advertising in categories where consumers have heterogeneous preferences. At times, firms sacrifice the strength of preference delivered by content-rich advertising for the breadth of preference provided by uninformative advertising.

A Appendix

Proof of Lemma 1

We start by considering the case where the firms are identical and one firm employs content-rich advertising and the other employs uninformative advertising. Here, consumers learn the attribute of the firm that employs content rich advertising through the advertising. In Table A.1, the key question is "can consumers deduce the attribute of uninformative advertiser?"

Table A.1: The Updating of Consumer Beliefs when Firms are Identical

	Beliefs about the firm that employs U	Updated beliefs	Profits of identical firms	Best response of identical firms
Consumers observe U and C	If identical & differentiated firms choose the same strategy, 50/50 Left/Right	Same as prior	U, C profits where U firm is believed to be 50% Left and 50% Right	Identical firms will employ U, C if profits positive
	If differentiated firms choose C,C or U,U, identical to C	Identical to C	$(-c_u, -c_c)^*$	If firms are identical only one firm advertises

* When firms are perceived identical, Bertrand competition reduces profit to zero in Stage 2 of the game.

It is clear that identical firms will exhibit U and C anytime differentiated firms exhibit the same strategies (the first row of Table A.1). The explanation is that the only profitable strategy for identical firms where both advertise is U and C.³⁰ However, a requirement for this outcome is that consumers do not update their beliefs.

We now move to the case where the firms are differentiated and one firm employs content-rich advertising and the other employs uninformative advertising. As before, the key question in Table A.2 is "can consumers deduce the attribute of the uninformative advertiser?"

³⁰In the first row of Table 1, an outcome where only one firm advertises is not stable because the non-advertising firm has a profitable deviation.

Table A.2: The Updating of Consumer Beliefs when Firms are Differentiated

	Beliefs about the firm that employs U	Updated beliefs	Profits of differentiated firms	Best response of differentiated firms
Consumers observe U and C	If identical & differentiated firms choose the same strategy, 50/50 Left/Right	Same as prior	U, C profits where U firm is believed to be 50% Left and 50% Right	U,C if U firm increases profit from C,C
	If identical firms choose C,C or U,U, the opposite of C	The opposite of C	U, C profits where U firm is believed to be the opposite of C	U,C in all cases because $c_c > c_u$

From Row 1 of Table A.2, we see that in conditions where identical firms choose U,C, differentiated firms will choose U,C if a firm increases profit from the profits earned in the C,C outcome by choosing U. Conversely, in Row 2 of Table A.2, whenever a differentiated firm perfectly identifies itself as having the opposite attribute to its competitor by choosing U in response to C, U is dominant because identical Stage 2 profits are earned but with less expensive advertising.

Row 2 provides the starting point to solve the game. Previewing what we explain later, we do not observe the conditions of Row 2 in equilibrium. Identical firms never exhibit either a C,C or U,U outcome because both outcomes lead to negative profits (consumers perceive the products as identical).

In summary, Table A.1 implies that parameter conditions which lead differentiated firms to exhibit U,C as an outcome, also lead identical firms to exhibit U,C as an outcome. In fact, the *only* time identical firms both advertise is when U,C is the outcome. This obtains because the posterior beliefs of consumers are the same as the priors. Table A.2 is a guide for when differentiated firms might exhibit U,C as an outcome. It occurs if a firm increases profit from the profits earned in the C,C outcome by choosing U.

Pricing Equilibrium in the Asymmetric Advertising Sub-game

Under asymmetric advertising, firms' pricing behaviours depend on the size of the switcher segment s . In particular, there are three cases: $s \leq 1/3$, $1/3 < s \leq \sqrt{2} - 1$, and $s > \sqrt{2} - 1$,

each entailing different pricing equilibrium. We provided detailed proof for the case of $s \leq 1/3$ and $s > \sqrt{2} - 1$. For the case of $1/3 < s \leq \sqrt{2} - 1$, because the firms' response functions are not upper-hemicontinuous, we characterize the equilibrium and provide proof that no firm will deviate from the equilibrium. The following Lemmas summarise the price equilibria.

Lemma A.1 $s \leq 1/3$, Firm 1 randomises its price on $\left[\frac{r(1+s)}{4}, r/2\right]$, with a mass point at $r/2$, and Firm 2 randomises its prices on $\left[\frac{r(3+s)}{4}, r\right)$, the density functions for the mixed pricing equilibrium are described by:

$$\left\{ \begin{array}{l} F_1(p) = \begin{cases} \frac{4p - r - rs}{4p + 2r}, & \frac{r(1+s)}{4} \leq p < r/2, \\ \frac{3+s}{4}, & p = \frac{r}{2}, \end{cases} \\ F_2(p) = \frac{4p - 3r - rs}{(1-s)(2p - r)}. \end{array} \right. \quad (\text{i})$$

Proof: To identify the pricing equilibrium, we start by examining Firm 1's price response. Depending on p_2 , Firm 1 can choose to: compete for the attribute insensitive segment ($p_1 = p_2 - \epsilon$), compete for R and S segment ($p_1 = p_2 - r/2 - \epsilon$), or restrict its attention to the L segment ($p_1 = r/2$).³¹ The corresponding profits are:

$$\left\{ \begin{array}{l} \text{if } p_2 > r/2 \left\{ \begin{array}{l} p_1 = p_2 - \epsilon \implies \pi_1 = p_2 s, \\ p_1 = p_2 - r/2 - \epsilon \implies \pi_1' = p_2 - r/2, \\ p_1 = r/2 \implies \pi_1'' = \frac{r(1+s)}{4}, \end{array} \right. \\ \text{if } p_2 < r/2 \left\{ \begin{array}{l} p_1 = p_2 - \epsilon \implies \pi_1 = p_2 \frac{1+s}{2}, \\ p_1 = r/2 \implies \pi_1'' = \frac{r(1-s)}{4}. \end{array} \right. \end{array} \right. \quad (\text{ii})$$

³¹Throughout these proofs, we assume that $\mu_i = \frac{1}{2}$ in the asymmetric advertising outcome (i is the firm that employs uninformative advertising) This follows from the reasoning of Section 4.1.

We examine these three profit possibilities to determine Firm 1's best price response. When $p_2 > r/2$, $\pi'_1 > \pi_1 \iff p_2 > \frac{r}{2(1-s)}$. Therefore, when $p_2 > \frac{r}{2(1-s)}$, we just compare π'_1 and π''_1 (we have: $\pi'_1 > \pi''_1 \iff p_2 > \frac{r(3+s)}{4}$). When $\frac{r}{2(1-s)} > p_2 > r/2$ so we compare π_1 and π''_1 . In this case, $\pi_1 > \pi''_1 \iff p_2 > \frac{r(1+s)}{4s}$.

When $p_2 < r/2$, the calculation is straightforward. $\pi_1 > \pi''_1 \iff p_2 > \frac{r(1-s)}{2(1+s)}$. It is straightforward to show that:

$$s > \sqrt{2} - 1 \iff \frac{1+s}{4s} < \frac{3+s}{4} < \frac{1}{2(1-s)} \quad (\text{iii})$$

$$s < \sqrt{2} - 1 \iff \frac{1+s}{4s} > \frac{3+s}{4} > \frac{1}{2(1-s)}. \quad (\text{iv})$$

We now have Firm 1's price response:

$$\left\{ \begin{array}{l} \text{when } s \leq \sqrt{2} - 1 \left\{ \begin{array}{ll} p_1 = p_2 - r/2 - \epsilon & \text{if } p_2 > \frac{r(3+s)}{4}, \\ p_1 = r/2 & \text{if } \frac{r(3+s)}{4} \geq p_2 > r/2, \\ p_1 = p_2 - \epsilon & \text{if } r/2 \geq p_2 > \frac{r(1-s)}{2(1+s)}, \\ p_1 = r/2 & \text{if } p_2 \leq \frac{r(1-s)}{2(1+s)}, \end{array} \right. \\ \\ \text{when } 1/2 > s > \sqrt{2} - 1 \left\{ \begin{array}{ll} p_1 = p_2 - r/2 - \epsilon & \text{if } p_2 > \frac{r}{2(1-s)}, \\ p_1 = p_2 - \epsilon & \text{if } \frac{r}{2(1-s)} \geq p_2 > \frac{r(3+s)}{4}, \\ p_1 = r/2 & \text{if } \frac{r(3+s)}{4} \geq p_2 > r/2, \\ p_1 = p_2 - \epsilon & \text{if } r/2 \geq p_2 > \frac{r(1-s)}{2(1+s)}, \\ p_1 = r/2 & \text{if } p_2 \leq \frac{r(1-s)}{2(1+s)}, \end{array} \right. \end{array} \right. \quad (\text{v})$$

Now we look at Firm 2. Similar calculations imply that Firm 2's best response is:

$$\left\{ \begin{array}{ll} p_2 = p_1 - \epsilon & \text{if } p_1 > \frac{r(1-s)}{4s}, \\ p_2 = p_1 + r/2 - \epsilon & \text{if } p_1 \leq \frac{r(1-s)}{4s}. \end{array} \right. \quad (\text{vi})$$

From Equation (v), we know that when $s \leq \sqrt{2} - 1$, Firm 1 does not set price greater than $r/2$. Notice that when $s \leq 1/3$, $\frac{r(1-s)}{4s} \geq r/2$. Because $1/3 < \sqrt{2} - 1$, we know that if $s \leq 1/3$, $p_1 \leq \frac{r(1-s)}{4s}$. From Equation (vi), we conclude that when $s \leq 1/3$, Firm 2's best response is $p_2 = p_1 + r/2 - \epsilon$.

From Equation (ii), we know that Firm 1 will not lower its price below $\frac{r(1+s)}{4}$. As a result, Firm 2's lowest price is $p_2 = \frac{r(3+s)}{4}$. This leads straightforwardly to the support for the mixed pricing strategy when $s \leq 1/3$:

$$\begin{cases} p_1 \in [\frac{r(1+s)}{4}, r/2], \\ p_2 \in [\frac{r(3+s)}{4}, r]. \end{cases} \quad (\text{vii})$$

The response functions are not upper hemi-continuous (a condition that ensures the existence of an equilibrium). However, when $s \leq 1/3$, the game has a unique equilibrium. Firm 1 has a mass point at $r/2$ and captures both the L and the attribute insensitive segment. Firm 2's equilibrium profit is its lowest price times the size of R segment. The equilibrium profits net of advertising expenditures are:

$$\begin{cases} \pi_{uc}^* = \pi_1^* = \frac{r}{2} \frac{1+s}{2}, \\ \pi_{cu}^* = \pi_2^* = \frac{r(3+s)(1-s)}{8}. \end{cases} \quad (\text{viii})$$

The cumulative density function for the price distribution is obtained by solving the equal profit equation:

$$\begin{cases} F_1(p)(p + \frac{r}{2}) \cdot 0 + (1 - F_1(p))(p + \frac{r}{2}) \frac{1-s}{2} = \frac{r(3+s)(1-s)}{8}, \\ F_2(p)(p - \frac{r}{2}) \frac{1+s}{2} + (1 - F_2(p))(p - \frac{r}{2}) = \frac{r}{2} \frac{1+s}{2}. \end{cases} \quad (\text{ix})$$

Q.E.D.

Lemma A.2 $s > \sqrt{2} - 1$, Firm 1 randomises its price on $\left(\frac{r(1-s)}{4s}, r/2\right]$, with a mass point at $r/2$, and Firm 2 randomises its prices on $\left[\frac{r(1-s)}{4s}, r/2\right)$, with a mass point at $\frac{r(1+s)}{4s}$, and

the density functions for the mixed pricing equilibrium are described by:

$$\left\{ \begin{array}{l} F_1(p) = \begin{cases} \frac{(1+s)(4ps-r+rs)}{8ps^2}, & p \in (\frac{r(1-s)}{4s}, \frac{r}{2}), \\ \frac{(1-s)^2}{4s^2}, & p = \frac{r}{2}, \end{cases} \\ F_2(p) = \begin{cases} \frac{(1+s)(4ps-r+rs)}{8ps^2}, & p \in [\frac{r(1-s)}{4s}, \frac{r}{2}), \\ \frac{(1-s)^2}{4s^2}, & p = \frac{r(1+s)}{4s}. \end{cases} \end{array} \right. \quad (\text{x})$$

Proof: We start with Firm 1's (the uninformative advertiser) price response. Since it will not compete for the R segment, it has two options in pricing: $p_1 = p_2 - \epsilon$ or $p_1 = \frac{r}{2}$. The first option leads to two possible profits:

$$\pi_1 = \begin{cases} sp_2 & \text{if } p_2 > \frac{r}{2}, \\ (s + \frac{1-s}{2})p_2 & \text{if } p_2 \leq \frac{r}{2}. \end{cases} \quad (\text{xi})$$

The second pricing option also leads to two possible profits:

$$\pi_1'' = \begin{cases} (s + \frac{1-s}{2})\frac{r}{2} & \text{if } p_2 > r/2, \\ \frac{1-s}{2}\frac{r}{2} & \text{if } p_2 \leq r/2. \end{cases} \quad (\text{xii})$$

Firm 1 compares the choices:

$$\pi_1 - \pi_1'' = \begin{cases} sp_2 - \frac{r(1+s)}{4} & \text{if } p_2 > r/2, \\ \frac{p_2(1+s)}{2} - \frac{r(1-s)}{4} & \text{if } p_2 \leq r/2. \end{cases} \quad (\text{xiii})$$

We solve the above equation to obtain:³²

$$\begin{cases} \pi_1 > \pi_1'' & \text{if } p_2 > \frac{r(1+s)}{4s}, \\ \pi_1 < \pi_1'' & \text{if } \frac{r}{2} < p_2 \leq \frac{r(1+s)}{4s}, \\ \pi_1 > \pi_1'' & \text{if } \frac{r}{2} \geq p_2 > \frac{r(1-s)}{2(1+s)}, \\ \pi_1 < \pi_1'' & \text{if } p_2 \leq \frac{r(1-s)}{2(1+s)}. \end{cases} \quad (\text{xiv})$$

We know that Firm 2 has a guaranteed profit of $\frac{r(1-s)}{4}$ if it charges a price of $r/2$. Therefore it will not lower its price below $\frac{(1-s)r}{2(1+s)}$. Therefore, the last case in equation (xiv) is not feasible.

This allows us to write Firm 1's best response function:

$$\begin{cases} p_1 = p_2 - \epsilon & \text{if } p_2 > \frac{r(1+s)}{4s}, \\ p_1 = r/2 & \text{if } \frac{r}{2} < p_2 \leq \frac{r(1+s)}{4s}, \\ p_1 = p_2 - \epsilon & \text{if } p_2 \leq \frac{r}{2}. \end{cases} \quad (\text{xv})$$

Understanding that Firm 1 will not undercut when $\frac{r}{2} < p_2 \leq \frac{r(1+s)}{4s}$, Firm 2 will not charge a price between $\left[\frac{r}{2}, \frac{r(1+s)}{4s}\right]$. In other words, there is a hole in its price support between $\left[\frac{r}{2}, \frac{r(1+s)}{4s}\right]$.

Next we examine Firm 2's price response. Given any p_1 , Firm 2 has two options: undercut Firm 1 ($p_2 = p_1 - \epsilon$) or charge a price of $p_2 = p_1 + r/2 - \epsilon$. The latter case means that Firm 2 does not compete with Firm 1 for the attribute insensitive segment and focuses on the R segment.

Comparing the profit of the two price options, we have:

$$\pi_2(p_2 = p_1 - \epsilon) - \pi_2(p_2 = p_1 + \frac{r}{2} - \epsilon) = p_1 \frac{1+s}{2} - (p_1 + \frac{r}{2}) \frac{1-s}{2} = p_1 s - \frac{r(1-s)}{4}. \quad (\text{xvi})$$

Therefore, when $p_1 \leq \frac{r(1-s)}{4s}$, Firm 2 will not undercut Firm 1. Instead, it will raise its price to $p_1 + \frac{r}{2}$ and focus on the R segment. In other words, Firm 2 will not lower its price below

³²Note that $\frac{r(1+s)}{4s} > \frac{r}{2}$ for all $s \in (0, 1)$.

$\frac{r(1-s)}{4s}$. Notice that when $s > 1/3 \iff \frac{r(1-s)}{4s} < \frac{1}{2}$. This leads to Firm 2's options in terms of price response:

$$\begin{cases} p_2 = p_1 - \epsilon & \text{if } p_1 > \frac{r(1-s)}{4s}, \\ p_2 = p_1 + r/2 - \epsilon & \text{if } p_1 \leq \frac{r(1-s)}{4s}. \end{cases} \quad (\text{xvii})$$

From the above equation, we know that when Firm 1 prices at $p_1 = \frac{r(1-s)}{4s}$, Firm 2 will increase its price by $\frac{r}{2}$. In other words, Firm 2 never prices below $\frac{r(1-s)}{4s}$. Understanding this, Firm 1 will not price less than $\frac{r(1-s)}{4s}$ either. Therefore the price support for the mixed pricing strategy lies "within" $[\frac{r(1-s)}{4s}, \frac{r}{2}] \cup [\frac{r(1+s)}{4s}, r]$. However, not all prices in this parameter region are included in the price support for the mixed pricing equilibrium. In fact, consider Firm 1 choosing a price of r . In that situation, Firm 2's best response is to undercut Firm 1. The price undercutting continues until the price reaches $\frac{r(1+s)}{4s}$. At that point, Firm 1 dramatically drops its price to $r/2$, and Firm 2 again undercuts at $r/2$. The price undercutting resumes until the price reaches $\frac{r(1-s)}{4s}$. At this point, Firm 2 stops undercutting and dramatically raises its price by $r/2$ to $\frac{r(1+s)}{4s}$ and then, the price undercutting resumes. The above strategic tournament implies that no firm chooses a price greater than $\frac{r(1+s)}{4s}$ in the equilibrium. It can be easily checked that if Firm 1 randomizes its price over $\left(\frac{r(1-s)}{4s}, r/2\right]$, for Firm 2, any positive probability allocated to a price greater than $\frac{r(1+s)}{4s}$ is dominated by the mass point at $\frac{r(1+s)}{4s}$. Similarly, if Firm 2 randomizes on $\left[\frac{r(1-s)}{4s}, \frac{r}{2}\right)$ with a mass point at $\frac{r(1+s)}{4s}$, Firm 1's incentive to choose a price greater than $\frac{r}{2}$ is dominated by a mass point at $\frac{r}{2}$. In equilibrium, each firm has equal profit at any price in the support. Denote by α the probability mass for Firm 1 at $r/2$, and by β the probability mass at $\frac{r(1+s)}{4s}$ for Firm 2. Calculating the profit for Firms 1 and 2 at prices of $\frac{r(1-s)}{4s}$ and at $r/2$ respectively, we can write the equal profit conditions for both firms as functions of α and β .

$$\text{Firm 1: } \frac{r(1-s)}{4s} \frac{1+s}{2} = \frac{r}{2} \left((1-\beta) \frac{1-s}{2} + \beta \frac{1+s}{2} \right), \quad (\text{xviii})$$

$$\text{Firm 2: } \frac{r(1-s)}{4s} \frac{1+s}{2} = \frac{r}{2} \left((1-\alpha) \frac{1-s}{2} + \alpha \frac{1+s}{2} \right), \quad (\text{xix})$$

These conditions allows us to determine the equilibrium mass point probabilities:

$$\begin{cases} \alpha &= \frac{(1-s)^2}{4s^2}, \\ \beta &= \frac{(1-s)^2}{4s^2}. \end{cases} \quad (\text{xx})$$

The equilibrium profits are determined by using the probability masses.

$$\begin{cases} \pi_1^* &= \frac{(1+s)(1-s)r}{8s}, \\ \pi_2^* &= \frac{(1+s)(1-s)r}{8s}. \end{cases} \quad (\text{xxi})$$

The cumulative density functions are obtained by solving the equal profit condition.

Q.E.D.

Lemma A.3 $1/3 < s \leq \sqrt{2} - 1$, Firm 1 randomises its price on $\left(\frac{r(1+s)}{4}, r/2 \right]$, with a mass point at $\frac{r(1-s)}{4s}$ and another mass point at $r/2$, and Firm 2 randomises its prices on $\left(\frac{r(1-s)}{4s}, r/2 \right) \cup \left[\frac{r(3+s)}{4}, \frac{r(1+s)}{4s} \right)$, with a mass point at $\frac{r(3+s)}{4}$, and the density functions

for the mixed pricing equilibrium are described by:

$$\left. \begin{aligned}
 F_1(p) = \begin{cases} \frac{4p - r - rs}{4p + 2r}, & p \in \left(\frac{r(1+s)}{4}, \frac{r(1-s)}{4s}\right), \\ \frac{(s^3 + s^2 - 3s + 1)}{2s(1+s)}, & p = \frac{r(1-s)}{4s}, \\ \frac{4p(1+s) - r(1-s)(3+s)}{8ps}, & p \in \left(\frac{r(1-s)}{4s}, \frac{r}{2}\right), \\ \frac{1-s^2}{4s}, & p = \frac{r}{2}, \end{cases} \\
 \\
 F_2(p) = \begin{cases} \frac{(1+s)(4ps - r + rs)}{8ps^2}, & p \in \left(\frac{r(1-s)}{4s}, r/2\right), \\ \frac{(3s-1)(s^2 + 4s - 1)}{4s^2(1-s)}, & p = \frac{r(3+s)}{4}, \\ \frac{8ps - r(1+4s - s^2)}{2s(1-s)(2p-r)}, & p \in \left(\frac{r(3+s)}{4}, \frac{r(1+s)}{4s}\right) \end{cases}
 \end{aligned} \right\} \quad (\text{xxii})$$

Proof: The search for the pricing equilibrium for this case largely follows that of Lemma A.2. Let $\phi = Prob(p_1 = \frac{(1-s)r}{s})$, $\gamma = Prob(p_1 = r/2)$, $\omega = F_1(p_1 < \frac{(1-s)r}{4s})$. We have: $\pi_2(p_2 = \frac{(1+s)r}{4s}) = (1-\omega)(1-s)p_2/2$, $\pi_2(p_2 = \frac{(3+s)r}{4}) = p_2(1-s)/2$, $\pi_2(p_2 = r/2) = \gamma p_2(1+s)/2 + (1-\gamma)p_2(1-s)/2$, $\pi_2(p_2 = \frac{(1-s)r}{4s}) = (\omega + \phi)p_2(1-s)/2 + (1-\omega - \phi)p_2(1+s)/2$. Applying equal profit condition to the above profit equations, we can have the probability masses for the two mass points of Firm 1. This gives us the equilibrium profit: $\pi_1^* = \frac{r(1-s)(1+s)}{8s}$. Follow the similar process, we have the equilibrium profit of Firm 2: $\pi_2^* = \frac{r(1-s)(3+s)}{8}$. The cumulative density functions are obtained through the equal profit condition. One can check the the density functions reach 0 and 1 at the upper and lower end of the price support.

Q.E.D.

Proof of Proposition 2

The proof is straight forward following the above Lemmas. The equilibrium profits are also provided in the proofs of the Lemmas.

Q.E.D.

Proof of Proposition 3

The threshold $f(s)$ in the proposition obtains by comparing the profits earned by a firm that responds to content-rich advertising with uninformative advertising to the profits earned by a firm that responds to content-rich advertising with content-rich advertising. If $\pi_{uc} - c_u > \pi_{cc} - c_c$, the best response is uninformative advertising, resulting an asymmetric advertising equilibrium.

Q.E.D.

Proof of Proposition 4:

When $s > 1/3$, take the derivative of $f(s)$ with respect to s , we obtain

$\frac{\partial f(s)}{\partial s} = \frac{r}{8} \frac{1-3s^2}{s^2}$. Obviously, when $s < \frac{1}{\sqrt{3}}$, $\frac{\partial f(s)}{\partial s} > 0$ and $f(s)$ is increasing in s . Recall that when $c_c - c_u < f(s) = \pi_{cc} - \pi_{uc}$, the equilibrium in advertising is (Content-rich, Content-rich). Therefore, holding $c_c - c_u$ constant, as s increases, a higher $f(s)$ means the equilibrium moves from (Uninformative, Content-rich) to (Content-rich, Content-rich), i.e., more firms are willing to do content-rich advertising.

Q.E.D.

References

- Avery M. Abernethy and Daniel D. Butler. Advertising information: Services versus products. *Journal of Retailing*, 68(4):398–419, 1992.
- Avery M. Abernethy and George R. Franke. The information content of advertising; a meta-analysis. *Journal of Advertising*, 25(2):1–17, 1996.
- D. Akerberg. Empirically distinguishing informative and prestige effects of advertising. *Rand Journal of Economics*, 32:316–333, 2001.
- Simon P. Anderson and Régis Renault. Consumer information and firm pricing: Negative externalities from improved information. *International Economic Review*, 41(3):721–742, 2000.
- Simon P. Anderson and Régis Renault. Advertising content. *The American Economic Review*, 96(1): 93–112, 2006.
- Simon P. Anderson and Régis Renault. Comparative advertising: disclosing horizontal match information. *The Rand Journal of Economics*, 40(3):558–581, 2009.
- Kyle Bagwell. The economic analysis of advertising. In M. Armstrong and R.H. Porter, editors, *Handbook of Industrial Organization*, pages 1701–1844. North-Holland, Amsterdam, 2007.
- Kyle Bagwell and Garey Ramey. Coordination economies, advertising, and search behavior in retail markets. *American Economic Review*, 84(3):498–517, 1994.
- Gary S. Becker and Kevin M. Murphy. A simple theory of advertising as a good or a bad. *Quarterly Journal of Economics*, 108(4):941–964, 1993.
- H. Bester and E. Petrakis. Price competition and advertising in oligopoly. *European Economic Review*, 39:1075–1088, 1995.
- Gerard R. Butters. Equilibrium distributions of sales and advertising prices. *Review of Economics and Statistics*, 44:465–491, May 1977.
- Edward H. Chamberlin. *Theory of Monopolistic Competition*. Harvard University Press., Cambridge, MA, 1933.
- In-Koo Cho and David Kreps. Signaling games and stable equilibria. *Quarterly Journal of Economics*, 102 (2):179–221, 1987.
- R. Clark, U. Doraszelski, and M. Draganska. The effect of advertising on brand awareness and perceived

- quality: An empirical investigation using panel data. *Quantitative Marketing and Economics*, 7: 207–236, 2009.
- William S. Comanor and Thomas A. Wilson, editors. *Advertising and Market Power*. Harvard University Press, Cambridge, Mass., 1974.
- Xiaomeng Du, Meng Su, Xiaoquan(Michael) Zhang, and Xiaona Zheng. Bidding for multiple keywords in sponsored search advertising: Keyword categories and match types. *Information System Research*, 28(4):711–722, 2017.
- Issac Ehrlich and Lawrence Fisher. The derived demand for advertising: A theoretical and empirical investigation. *American Economic Review*, 72(3):366–388, 1982.
- L. Esteban, A. Gil, and J.M. Hernández. Informative advertising and optimal targeting in a monopoly. *Journal of Industrial Economics*, 49:161–180, 2001.
- Juan Feng and Jinhong Xie. Research note - performance-based advertising: Advertising as signals of product quality. *Information System Research*, 23(3):1030–1041, 2012.
- Drew Fudenberg and Jean Tirole. *Game Theory*. MIT Press, Cambridge, MA, 1991.
- J. K. Galbraith. *The New Industrial State*. Houghton-Mifflin Co., Boston, MA, 1967.
- Gene M. Grossman and Carl Shapiro. Informative advertising with differentiated products. *Review of Economic Studies*, 51(1):63–81, January 1984.
- U. Gurun, G. Matvos, and A. Seru. Advertising expensive mortgages. Working Paper, NBER, 2013.
- J. Hastings, Ali Hortaçsu, and Chad Syverson. Advertising and competition in privatized social security: The case of mexico. Working Paper, NBER, 2013.
- Ganesh Iyer, David Soberman, and J. Miguel Villas-Boas. The targeting of advertising. *Marketing Science*, 24(3):461–476, Summer 2005.
- Jack Kasulis and Gerald Zaltman. Message reception and cognitive complexity. *Advances in Consumer Research*, 4(1):93–97, 1977.
- Benjamin Klein and Keith B. Leffler. The role of market forces in assuring contractual performance. *Journal of Political Economy*, 89(4):615–641, 1981.
- Alan Magrath. Don’t complexify the situation more. *Marketing News*, 20(20):15, 1989.
- Dina Mayzlin and Jiwoong Shin. Uninformative advertising as an invitation to search. *Marketing Science*, 30(4):666–685, 2011.

- Michael Meurer and Dale O. Stahl II. Informative advertising and product match. *International Journal of Industrial Organization*, 12(1):1–19, 1994.
- Paul R. Milgrom and John Roberts. Price and advertising signals of product quality. *Journal of Political Economy*, 94(4):796–821, 1986.
- Anusree Mitra and John G. Lynch. Toward a reconciliation of market power and information theories of advertising effects on price elasticity. *Journal of Consumer Research*, 21(3):644–659, 1995.
- Geoffrey Morrison. LED LCD VS. OLED: TV display technologies compared. *Cnet.com*, April 12: <https://www.cnet.com/how-to/led-lcd-vs-oled/>, 2017.
- Chakravarthi Narasimhan. Competitive promotional strategies. *Journal of Business*, 61(4):427–449, 1988.
- Prakash Nedungadi. Recall and consumer consideration sets: Influencing choice without altering brand evaluations. *Journal of Consumer Research*, 17(3):263–376, 1990.
- Philip Nelson. Advertising as information. *Journal of Political Economy*, 81:729–754, 1974.
- N.L. Reinsch Jr. and Raymond Beswick. Voice mail versus conventional channels: a cost minimization analysis of individuals’ preferences. *Academy of Management Journal*, 33(4):801–816, 1990.
- Jacques Robert and Dale O. Stahl II. Informative price advertising in a sequential search model. *Econometrica*, 61(3):657–686, May 1993.
- Richard Schmalensee. A model of advertising and product quality. *Journal of Political Economy*, 88: 485–500, 1978.
- Gerald Tellis. Effective frequency: one exposure or three factors? *Journal of Advertising Research*, 37(4): 75, 1999.
- Lester G. Telser. Advertising and competition. *Journal of Political Economy*, 72:537–562, 1964.
- Jean Tirole. *The Theory of Industrial Organization*. The MIT Press, Cambridge, MA, 1988.
- Hal R. Varian. A model of sales. *The American Economic Review*, 70(4):651–659, 1980.
- Kai-Yu Wang, Eric Shi, and Laura Perrachio. How banner ads can be effective: Investigating the influences of exposure duration and banner ad complexity. *International Journal of Advertising*, 32(1):121–141, 2013.
- Asher Wolinsky. True monopolistic informatioun as a result of imperfect information. *Quarterly Journal of Economics*, 51(1):53–61, 1986.