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Preview Provision Under Competition

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In certain categories, an important element of competition is the use of previews to signal information to potential consumers about product attributes. For example, the front page of a newspaper provides a preview to potential newspaper buyers before they purchase the product. In this context, a news provider can provide previews that are highly informative about the content of the news product. Conversely, a news provider can utilize a preview that is relatively uninformative. We examine the incentives that firms have to adopt different preview strategies in a context where they do not have complete control of product positioning. Our analysis shows that preview strategy can be a useful source of differentiation. However, when a firm adopts a strategy of providing informative previews, it confers a positive externality on a competitor that utilizes uninformative previews. This reinforces the incentive of the competitor to use uninformative previews and explains why the market landscape in news provision is often characterized by asymmetric competition.

Key words: product positioning; preview design; information goods; information revelation; product differentiation
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1. Introduction

An important task faced by firms is that of providing information to consumers about their products. The standard assumption is that firms have detailed information about the attributes of their products, and consumers need this information to make decisions. In general, firms transmit this information to consumers through advertising, samples, and trials. However, in some circumstances, firms do not have complete control of the attributes of their products.

A prototypical example of a product where the firm does not fully control the attributes of its product is found in the news industry. News providers are in the business of reporting significant events, but typically, the specific events that happen, their timing, and their geographic location are not controlled by the news provider. For example, a major explosion in Iraq needs to be reported, and this explosion is obviously not controlled by CNN. In other words, CNN faces daily uncertainty regarding the content of its news programs. This type of uncertainty also exists in other categories. Wine producers face uncertain weather conditions. Each year, the precise characteristics of a brand of wine (in a given quality tier) are a function of the rainfall, the average temperature each day over the growing season, and the amount of sunlight. These change from year to year and are not controlled by the wine producer. These factors affect the wine in terms of its colour, the amount of tannin, the relative amount of fruitiness in the taste, and a host of other attributes. Ski resorts do not control the amount of snowfall and other weather conditions. The whale-watching industry and many national parks around the world (Denali in Alaska, Kruger in South Africa, and many other game reserves in Africa) do not have control over the types and quantity of wild animals that will be observed by any given tourist group.

Because of this uncertainty, consumers do not know the exact content of the product prior to making a purchase decision. Firms have the opportunity to provide information/signals about their products in advance. This can be done through the front page of a newspaper, the cover page of a magazine, or a brief preview of an upcoming TV program. Wine producers have a choice of how precisely to reveal the characteristics of their wine to consumers through previews. In France, a wine producer can restrict distribution to standard retail channels (e.g., Carrefour, Leclerc, Auchan, and Cora), or it can also make its wine available on specialized websites that provide a full preview of the wine, including a complete description of the vineyard, the wine's performance in tasting, and an evaluation of which types of foods and cheeses it is best to be consumed with.[1] Ski resorts and national parks can provide live webcams on their websites. Wildlife game reserves such as MalaMala cannot guarantee the sighting of wildlife to potential visitors, yet they can provide detailed information about when and which wild animals were encountered in past tours. These actions provide a preview of the experience consumers should have even though the firm does not have full control over the product/service attributes.

Intuitively, the purpose of the previews is to inform consumers so that they can make a better decision with information garnered through the previews. As a result, firms can adopt a variety of preview strategies to influence consumer screening. By providing information about what is "inside," companies can reveal the attributes of their products and facilitate consumer screening. Some newspapers such as the *Toronto Sun* or the *New York Post* provide simplified front pages telling news consumers what they will find inside. One can think of these newspapers as providing more distilled previews that are easier to screen than traditional newspapers (for example, the *New York Times*). Webcams provide real-time images about what it is like skiing at certain resorts or what animals might be encountered in game viewing parks. In fact, we observe different practices with respect to preview provision. Newspapers adopt different styles in terms of the readability and impact of their front pages. Some newspapers start in-depth reports directly on their front pages, whereas others provide a brief but impactful overview of the stories inside.

The objectives of this paper are to examine how the nature of previews is affected by the presence of competition and to better understand how people perceive and process preview information. In particular, we seek to understand why there exist qualitatively different previews, some of which are quite informative about the content and others that are generic and provide less information. Our approach to understanding these trends is based on the assumption that consumers screen products to the extent possible prior to buying them. In the context of news products, this means that consumers will examine (or screen) the front page or listen to or watch a preview to assess whether a news product is one that they wish to consume. Screening is costly for consumers. When it is difficult to determine the "nature" of a product in advance, a consumer will make her purchase decision based on her expectations about its content.

[1] Examples of such websites include http://blog.midi-vin.com (which specializes in wines from the Rhône valley and Midi region of France) and http://www.bienmanger.com (which covers wines from multiple regions).

We show that these simple observations about the markets with production uncertainty explain why firms that compete for the same segment of consumers may employ different strategies for the previews they provide about their products.

2. Related Literature

The role of previews is to provide information about products to potential consumers. In this sense, the model we develop is related to the literature on informative advertising (Butters 1977, Grossman and Shapiro 1984). However, in the informative advertising literature, consumers are potential buyers if and only if they are reached by advertising. In contrast, consumers in our model may buy even if they have not been exposed to precise information about a product's attributes.

From the consumer's perspective, previews are useful because they help consumers find products that are preferred and also because they help consumers avoid products that are undesirable. Thus, the precision of information within a preview is an important aspect of preview strategy. Little or no revelation may result in low attraction, whereas too much information might increase the likelihood of a poor perceived fit between the product and the consumer. In this sense, our model is related to recent literature on advertising content (Anderson and Renault 2006, Mayzlin and Shin 2009). Whereas these papers study the signalling effect of advertising content, our model focuses on the competitive implications of preview strategies. There is limited empirical research on the role and impact of previews in product markets. Anand and Shachar (2011) examine the impact of TV show previews on the audience size. They treat previews as a source of information about the content of the TV shows and suggest that the media firms use the previews to attract potential viewers who might find the show interesting. Abernethy and Franke (1996) use "content analysis" to study the information contained in advertisements across media.

An important aspect that further differentiates this paper from the literature on informative advertising (Grossman and Shapiro 1984, Robert and Stahl 1993) and advertising content (Anderson and Renault 2006) is that the firms do not have full control over the content (or positioning) of products. In contrast, the literature on advertising is based on firms being endowed with positions and then making advertising and pricing decisions that maximize profit taking the positions as given.

Uncertainty in product attributes is not solely a factor that affects the decisions of firms. Consumers are also uninformed about the precise characteristics of products prior to purchase. However, consumers can use information from previews to better understand the content of the products and reach a more informed decision.

When a preview provides imperfect (or incomplete) information about the product, consumers will form expectations about the product's characteristics and will use these expectations in their decision making. Based on their beliefs or knowledge, consumers choose a product that maximizes expected utility. Our paper differs from traditional information-screening literature in that the effectiveness of consumer screening is directly influenced by firms' preview strategy (Van Zandt 2004). Our paper is also related to the research on information revelation (Jovanovic 1982, Shavell 1994, Chen and Xie 2005). The major difference is that we treat the design of previews (such as the style of the front page of a newspaper) as a long-term strategic decision. In the news market, the content of newspapers and TV news programs changes frequently while the style and the format of the news product remain relatively stable. Our base model considers the situation in which the firms do not alter their preview strategy as a function of the product attributes. We also explore two alternative timings where preview decisions are made with firms knowing their product attributes.

Uncertain product content is prominent in news markets. An endemic feature of the subjects in news stories is their uncertainty. Media firms do not manufacture information but simply collect and package it to deliver it to the public. In a sense, media firms wait for the information to materialize and do not have control over its content. This implies that our model utilizes an approach similar to Mullainathan and Shleifer (2005) and Xiang and Sarvary (2007) with regard to the treatment of uncertainty in product positioning.

3. The Model

The fundamental elements of the model are described in the following section. In particular, we describe the nature of the products we model, how consumers screen using the previews, and the choice of preview precision by the firms.

3.1. Production Uncertainty

Our model is based on the idea that firms do not have full control over the content or the attributes of their products. Many producers of experience goods face uncertainty in their production functions. As noted earlier, production uncertainty is present in many sectors including the wine, the ski tourism, and the news industries. More specifically, the precise characteristics of a brand of wine in a given year (and quality tier) are a function of the rainfall, the average temperature each day over the growing season, and the amount of sunlight. These change from year to year and are not controlled by the wine producer.

In the news industry, the exogeneity of news implies that news providers are in the business of informing news consumers about significant events. These events are not controlled by news providers. Most importantly, the information collected is based on (a) what happens on a given day and (b) where the news provider has posted journalists.

We conceptualize uncertain product content as a random draw from a continuum of product attributes, and we assume that this content is uniformly distributed along the continuum. More precisely, we assume that the product, denoted by y, is uniformly distributed from zero to one and that the marginal production cost is zero. In the context of news, y represents the set of news stories that a news provider has to report. Its random nature reflects two important aspects of news: (1) the uncertainty of significant events and (2) that each news provider has its own set of information to report (there is significant overlap but also differences). In addition, individual providers may have their own criteria regarding the "news value" of different events and may choose to report different events. Because there are differences in the information that each news provider decides to publish, this explains why the draws of each news provider from the continuum are different (this implies that the degree of differentiation between each news provider's draw is also random).

The critical aspect of this uncertainty is the exogeneity of the random draw; i.e., firms do not control the location of y. It is true that the content of products may not be fully exogenous; for example, news providers may choose to focus on specific types of news stories: *L'Equipe* in France is entirely focused on sports. However, our objective is to better understand how firms who focus on the same segment compete.

Indeed, a key assumption of our analysis is the focus of competing firms on a common segment. This segment can be the wine consumers who prefer wines from a certain region (and have similar budgets) or skiers with similar preferences in terms of the types of resorts they prefer (a small family resort, a high profile mega-resort, a resort for the adventurous who like off-piste skiing, or a challenging resort for experts).

In the case of news, segmentation may be a function of the theme of the news product (for example, international news, local news, or finance). On the one hand, the *Daily News* of New York will tend to have different news stories than the *Wall Street Journal*; however, these two publications target different segments of the news market (local news versus financial market news). Both newspapers face uncertainty in the news that they report each day, but the overlap in the news stories that they publish is relatively low. On the other hand, there is significantly more overlap in the stories that the *New York Post* and the *Daily News* might report. These papers both target consumers who are interested in local New York City events and news. Similarly, CNN International is a direct competitor with BBC World for English-speaking news consumers who reside outside the United States and the United Kingdom. In contrast, CNBC is targeted more to people who are interested in financial news.

3.2. Consumer Screening and the Preview

Consumers are assumed to be uninformed about the precise content of products before buying, but they do know that the content is drawn from a uniform distribution between zero and one. Consumers can screen the products by processing information that firms provide through previews. We assume that the quality of each consumer's screening is a function of the precision of the previews provided by the firms. If the preview is highly informative, then consumers will have accurate information about the product's location. When the preview is not informative, it is difficult for the consumer to assess the content/attributes from the preview. We define a variable q where $q \in [0, 1]$. This variable represents the degree to which the preview is precise: $q = 0$ means the firm's preview is uninformative, and $q = 1$ means the preview is precise and provides a perfect signal about the product attributes.[2] For consumers, $q = 0$ indicates that they cannot discern the content of the product prior to purchase (and consumption), and $q = 1$ implies that it is costless for consumers to assess the content of the product prior to purchase. To simplify our analysis without loss of generality, we assume that with probability q consumers know the precise content of the product, and with probability $1 - q$ consumers are uninformed about the attribute's location.

In a base model (with discrete preview decisions), we assume that the cost a firm incurs to create previews of any precision are identical and zero. Later in this paper, we discuss a situation in which the firm incurs a cost that is increasing and convex in the level of precision chosen; i.e., the cost for a given level of q is assumed to be αq^2.

Notice that consumers do not need to know the value of q to conduct screening. They simply observe the preview. From the precision of the previews, consumers can certainly infer q although q itself does not play a role in the consumer's decision process.[3]

On another note, we assume that the competing firms know the level of q chosen by the competitor when they set the price and the market opens. In essense, this implies that both firms announce the style of their preview prior to selling the product in the marketplace. For example, newspapers need to attract advertisers in advance of publication in order to be viable. As a result, the newspapers expose their format to potential advertisers long before the products actually are made available for sale (this ensures that news providers are informed of the competitor's q prior to the market opening).

We assume that consumers are uniformly distributed in terms of their preferences along the continuum of potential product content/attributes. In other words, the downstream market for the products consists of one unit of consumers who are distributed along the continuum of product content from zero to one.

Each consumer is identified by an ideal point along the attribute that corresponds to her preference. She is assumed to consume a maximum of one product and places a value v on her ideal product. The utility of a consumer located at x follows the standard differentiation model with a linear loss function. The utility for a consumer located at x of consuming product i located at y_i is given by $u_i = v - t\,|\,x - y_i\,| - p_i$. In this expression, t is the "preference" cost per unit distance, and p_i is the price charged for product i.[4] It is important to notice that consumers do not know the exact value of y_i prior to the preview. Their knowledge of y_i depends on the previews from the firm. A consumer only buys if she knows of a product for which the expected surplus is positive; i.e., $E(v - t\,|\,x - y_i\,| - p_i) > 0$. If there is more than one product in the market that offers positive surplus, the consumer will buy the product that offers the greatest surplus. It is not uncommon for people to buy multiple items in different situations. However, our model is designed to represent a situation in which people make choices (either between publications or between wines). Even multiple product buyers do not necessarily buy all the options available, and our model is a parsimonious representation of a situation where a buyer makes choices.

3.3. Firm Decisions

The firms are assumed to make two sequential decisions. Because the decision to produce precise

[2] When $q = 0$, this can also be interpreted as a situation in which the firm does not provide a preview prior to purchase.

[3] In the news market, when $q = 1$, consumers are costlessly informed about the content of the news product (i.e., the location of y), but this does not mean that consumers are magically informed about the details of the news product. For example, knowing that the subject of a special feature is "the quest of Tiger Woods to win more majors than Jack Nicklaus" does not deter the consumer's desire to read the feature. People do obtain a rough idea of what is going to be reported by watching the headlines, but more information is needed to get "full value" from the product.

[4] We assume that $v > 3t/2$. This allows full-market coverage under both monopoly and duopoly conditions.

previews involves long-term commitment, the first decision the firm makes is the degree to which the previews provide precise information to potential consumers (q_i). This decision is a choice of how much information the firm reveals to consumers prior to purchase. In industries such as newspapers, TV news, and Internet news, this decision relates to the style, the structure, and the length of the previews that are employed. The style of a newspaper's front page or the length of previews used for TV news determines how much information is revealed to consumers before they make a decision whether or not to consume the news product.[5] Similarly, skiing resorts and many national parks (e.g., Denali in Alaska and Kruger in South Africa) provide real-time webcams on their websites. These webcams provide direct information about the snow conditions and the types of wild animals roaming the parks, respectively.

The second decision that firms make is the prices for the products, p_i $(i = 1, 2)$. The firms' profit is equal to the product of demand and price: $\pi_i = p_i D_i$. In the news industry, while this function is consistent with a pay-per-use news product (such as a daily newspaper that is purchased from a newsstand), it is possible to interpret the function more broadly. Demand can be any metric that reflects audience size, the circulation, or the number of subscriptions for a news product. Price can be thought of as the actual price paid by the news consumer plus the consumer's opportunity cost of consuming news (Gabszewicz et al. 2001, Mullainathan and Shleifer 2005, Xiang and Sarvary 2007). For example, broadcast consumers incur little financial cost for watching news programs, yet they spend time watching commercials. Following household production theory (Becker 1965), one can think of the price consumers pay as the time they spend watching/reading/listening to advertisements. This is important because 80% of newspaper revenue comes from advertising, and many TV news networks rely solely on advertising revenue. In these industries, the news provider's decision is not the "price" per se, but rather the quantity of advertising that consumers will tolerate during the news broadcast. The opportunity cost of time on the part of news consumers does not enter the news provider's profit function directly, yet it contributes to the news provider's advertising revenue. Therefore, the firm's profit function can be thought of as representing the stream of revenue generated by both advertising and receipts from news consumers who purchase a news product.

[5] It is important to note that informative previews do not necessarily crowd out other types of communication in news products. For example, uninformative previews need to be entertaining. As such, they often require as much time (or space) as a preview that provides sharp information.

Notice that both decisions are made prior to the realization of y. This timing of the events applies to situations where the product changes more frequently than the preview and pricing strategies of firms. In the news industry, events that have news value occur every day or hour. Thus, the nature and content of news products change frequently. Meanwhile, decisions regarding the format and the price of the news product (or the fraction of the product allocated to advertising) do not change daily. This justifies the assumption that preview and pricing decisions are made prior to the news content being revealed to news providers.[6] In ski resorts, the snow condition and the weather (wind, humidity, etc.) change daily, but the ticket prices are usually set at the beginning of each season. Many experiential services share similar frequent changes and uncertainty in their products/services. The sequence of events described above implies that firms do not know the content/attributes of their products when they determine their preview strategy and set prices.[7] In general, news providers do not know what the key news stories (of the future) will be when they choose a preview style and set prices. Similarly, ski resorts do not know the snow conditions when setting prices and putting the webcam online.

We recognize that this sequence of events may not be representative of all industries in which there is production uncertainty. For example, wine producers can choose their preview strategy and set prices *after* they know the specific characteristics of their wine for a given year. Later in this paper, we explore alternative sequences of events.

In the base model of our analysis, the game has five stages:

1. The firms simultaneously choose the preview precision "q," and after the decisions, these choices become common knowledge.
2. Prices "p" are announced simultaneously.
3. Product content or attributes, denoted y, is realized randomly between zero and one.
4. Consumers screen products—with probability q, they know perfectly the location of the product; with probability $1 - q$, they do not know.
5. Consumers choose products based on the screening results.

[6] Admittedly, there are situations where a news provider will modulate its preview strategy after the revelation of the story itself. However, this generally occurs when a story has high impact (or shock value). Our model is one in which the heterogeneity of news stories is horizontal and not based on the "impact" of the story.

[7] Indeed, there may be situations where a news provider modulates its preview strategy (or price) as a function of the horizontal location of its primary news story. We examine this alternate perspective in two extensions of the base model.

In the following section, we consider the case of a monopolist. We then move to the case of a competitive market with two competing firms. Two extensions of the model are provided to analyze whether alternative sequences of the product attribute revelation, preview design, and pricing affect the basic insight of our analysis.

4. Analysis

We start by examining the case of a monopolist selling one product in the market. The monopolist first makes a decision about the precision of its previews. It then sets a price for its product. After this, the monopolist realizes a random draw from the continuum of product attributes. The preview decision q_m influences consumers' knowledge about attributes of the product before they make purchase decisions.

With probability $1-q_m$, consumers do not know the location of the product, e.g., the subject of the news or the nature of the product. Thus, consumers base their decisions on the expected location; i.e., $E(y) = 1/2$. This implies that $E(v-t|x-y|-p) = v-t|x-1/2| - p$. With probability q_m, consumers know the location, $E(v-t|x-y|p) = v-t|x-y|-p$. When consumers know the location, their purchase decision depends on both the price and the attribute of the product (y). Because price is set before the realization of y, the monopolist faces uncertain demand when making its pricing decisions. Our first proposition summarizes the optimal preview precision for a monopolist.

Proposition 1. *When consumers' reservation price v is high enough, the monopolist will cover the market and will not provide previews for its product ($q_m = 0$).*[8]

The key insight provided by Proposition 1 is that the monopolist benefits from consumers' inability to correctly assess the attribute/content (e.g., the subject of the news) that is contained in the products. The expected location of the product (in the middle of the continuum) allows the monopolist to maximize the price that is charged for the product while at the same time ensuring that the optimal fraction of consumers buy. We now consider the case where two firms compete against each other in the same market.

4.1. Preview Precision Under Duopoly

Under duopoly, two firms ($i = 1, 2$) compete in the downstream market after making preview precision and pricing decisions sequentially. The firms choose the precision of their previews simultaneously and then make the pricing decisions simultaneously. The objective is to identify the equilibrium preview and pricing strategies for the two firms given that each firm obtains an independent draw from the continuum of potential product locations. In other words, y_1 and y_2 are independent and identically distributed (i.i.d.) on $[0, 1]$.

We start with a base model where the preview decisions are discrete; i.e., the firm either chooses fully informative previews ($q = 1$) or does not provide any information through previews ($q = 0$). To simplify the analysis, we assume that the cost of providing a precise preview in the discrete model is zero. Later in this paper, we examine the robustness of the findings by considering a model where the precision of previews is both a costly and continuous decision, i.e., $q \in [0, 1]$.

4.1.1. Base Model with Discrete Preview Decisions. With discrete preview decisions, the first stage of the game can be represented as shown in Table 1. Different preview decisions lead to different levels of consumer knowledge about the products, which then influence the purchase decisions of consumers. We first derive the product choice for each consumer as a function of the prices under different preview scenarios. We then calculate the expected demand for the competing firms as a function of these choices. The pricing equilibrium is then calculated. To determine the equilibrium outcome, we compare the subgame equilibrium profits $\pi_i(q_1, q_2)$ of Table 1.

A consumer, located at $x \in [0, 1]$, has the utility function $u_i = v - t \mid x - y_i \mid -p_i$. Her expected utility depends on whether she knows the location of the product or not. After screening, a consumer forms an estimate of the content/attribute of the product, denoted by $\hat{y}_i$. Depending on the preview precision, this estimate $\hat{y}_i$ may or may not reflect the true location of the product. If $q_i = 1$, then her estimate is perfect, and she knows y_i; i.e., $\hat{y}_i = y_i$. If $q_i = 0$, then she does not know, and $\hat{y}_i = 1/2$.

Given the precision of the previews provided by the firms, there are four potential scenarios. The first is when $q_1 = q_2 = 1$, and consumers know y_1 and y_2 perfectly. In the second and third scenarios (when $q_1 = 1$, $q_2 = 0$ and $q_1 = 0$, $q_2 = 1$), consumers know y_1 but not y_2, or vice versa. Finally, we have the case where $q_1 = 0$, $q_2 = 0$, and consumers are uninformed about the content/attribute of either product. We first calculate the location of the indifferent consumer (x_I) in each of these situations. Naturally, x_I is a function of prices, preview precision, and consumers' estimate

Table 1 Firm 1's Payoff with Discrete Preview Decisions

	$q_2 = 0$	$q_2 = 1$
$q_1 = 0$	$\pi_1(q_1 = 0,\ q_2 = 0)$	$\pi_1(q_1 = 0,\ q_2 = 1)$
$q_1 = 1$	$\pi_1(q_1 = 1,\ q_2 = 0)$	$\pi_1(q_1 = 1,\ q_2 = 1)$

[8] When $v > 3t$, the monopolist covers the entire market. When $3t/2 < v < 3t$, the monopolist may price such that remotely located consumers do not buy. Even here, the monopolist does not have an incentive to provide precise previews.

of the content of each product. Based on the location of the indifferent consumer, we then calculate the expected demand for each firm. The detailed calculation is provided in the appendix.

The expected demand for each firm depends on how much consumers know about the products as a result of screening: a firm's expected demand is a function of consumers' estimate of its position ($\hat{y}_i$). Because the location y_i is realized after firms' pricing decisions, a firm's expected demand also depends on the location of the competing product. Define

$$f_i(x_I) \equiv \begin{cases} x_I & \text{if } \hat{y}_i < \hat{y}_j, \\ 1 - x_I & \text{if } \hat{y}_i \le \hat{y}_j. \end{cases} \quad (1)$$

We can then write firm i's expected demand as

$$E(D_i(q_i, p_i)) = \int_{y_j} \int_{y_i} f_i(x_I). \quad (2)$$

Because the firms' profits are continuous functions of prices, the first-order conditions allow us to identify the best responses in prices as a function of the preview decisions that are made in the first stage of the game. The best-response functions are then used to calculate the equilibrium prices and hence profits under each preview scenario. We summarize these profits in Table 2.

Because the payoffs for both firms in the off-diagonal squares are strictly higher than the payoffs along the diagonal, there are two pure-strategy equilibria for the preview decisions in the first stage of the game (recall the assumption that the cost of previews is negligible): $[q_1 = 1, q_2 = 0]$ and $[q_1 = 0, q_2 = 1]$. This stands in contrast to the case of a monopolistic firm that does not have incentives to provide informative previews to consumers.

This finding highlights an important characteristic of previews. On the one hand, competition creates an incentive for a firm to provide a preview of its product so that it can be evaluated by potential buyers. In fact, preview strategy provides a vehicle through which competing firms differentiate themselves from each other. On the other hand, a firm that does not provide previews of its product benefits from a positive externality created by the competitor's decision to provide one. This obtains because the expected location of a "no-preview" firm is 1/2, and this dominates the position of a firm that provides a preview; i.e., ceteris paribus, the location of a preview firm is preferred by consumers in less than half of the market. As a result, competition leads to products with asymmetric preview strategies.

Table 2 Firms' Expected Payoffs with Discrete Preview Decisions

	$q_2 = 0$	$q_2 = 1$
$q_1 = 0$	0, 0	$\frac{169t}{288}, \frac{121t}{288}$
$q_1 = 1$	$\frac{121t}{288}, \frac{169t}{288}$	$\frac{t}{2}, \frac{t}{2}$

4.1.2. Duopoly Where the Precision of Previews Is a Continuous Decision. When the preview decisions are continuous between zero and one, consumers' knowledge about the products depends on the precise values of q_1 and q_2.[9] We first calculate firm 1's expected demand building on the calculations developed in the previous section. Similar to §4.1.1, firm 1's demand has four possibilities given the locations y_1 and y_2 of the firms' products:

1. With probability $q_1 q_2$, consumers know both y_1 and y_2. Corresponding to the first scenario in the appendix, firm 1 has a demand of D_{11}.[10]
2. With probability $q_1(1-q_2)$, consumers know the content of firm 1 but not firm 2 ($\hat{y}_1 = y_1$ and $\hat{y}_2 = 1/2$). In this segment, firm 1 has a demand of D_{12}.
3. With probability $(1-q_1)q_2$, consumers know the content of firm 2 but not firm 1 ($\hat{y}_1 = 1/2$ and $\hat{y}_2 = y_2$). In this segment, firm 1's demand is D_{13}.
4. With probability $(1-q_1)(1-q_2)$, consumers do not know anything ($\hat{y}_1 = \hat{y}_2 = 1/2$). In this segment, firm 1 has a demand of D_{14}.

Because y_2 is a uniformly distributed random variable, firm 1's expected demand is calculated by integrating the demand associated with y_2 over the allowable range:

$$\begin{aligned} E(D_1) = \int_0^{1/2} & q_1 q_2 D_{11} + q_1(1-q_2)D_{12} + (1-q_1)q_2 D_{13} \\ & + (1-q_1)(1-q_2)D_{14}\, dy_2 + \int_{1/2}^{1} q_1 q_2 D_{11} \\ & + q_1(1-q_2)D_{12} + (1-q_1)q_2 D_{13} \\ & + (1-q_1)(1-q_2)D_{14}\, dy_2. \end{aligned}$$

Simplification yields $E(D_1) = A + (1-q_1)(1-q_2)D_{14}$, where

$$A = \frac{4(p_1 - p_2)[q_1(q_2 - 1) - q_2] + [q_1(3 - 4q_2) + 5q_2]t}{8t}.$$

Similarly, we have $E(D_2) = B + (1-q_1)(1-q_2)D_{14}$, where

$$B = \frac{4(p_2 - p_1)[q_1(q_2 - 1) - q_2] + [q_1(5 - 4q_2) + 3q_2]t}{8t}.$$

These expressions form the basis for constructing the objective functions for each firm. In the following

[9] Notice that consumers need not know the value of q_i, although their estimates from screening depend the value of q for each product.

[10] See the appendix for the detailed calculations of D_{11}, D_{12}, D_{13}, and D_{14}.

section, we use these objective functions to calculate the price equilibrium as a function of the levels of q chosen by each firm.

Price Equilibrium. To identify the price equilibrium, we start by deriving each firm's best-response price function. Notice that only D_{14} is a discrete segment whose optimal decision is to buy the product with the lowest price. Moreover, when $q_i = 1$ ($i = 1$ or 2), $(1-q_1)(1-q_2)D_{14} = 0$. Thus the price responses are calculated in two cases:

1. At least one $q_i = 1$;
2. Both q_1 and q_2 are strictly less than one: $q_1 < 1$ and $q_2 < 1$.

When at least one $q_i = 1$, all consumers can assess the content of at least one product, so $(1-q_1)(1-q_2) \cdot D_{14} = 0$. This implies that the profit functions are continuous, and $E(D_1) = A$ and $E(D_2) = 1 - A$. The first-order conditions lead to the following equilibrium prices as a function of the preview precision chosen by each firm:

$$\begin{cases} p_1^* = \dfrac{t(8+5q_2+3q_1-4q_1q_2)}{12(q_1+q_2-q_1q_2)}, \\[2ex] p_2^* = \dfrac{t(16-3q_1-5q_2+4q_1q_2)}{12(q_1+q_2-q_1q_2)}. \end{cases} \tag{3}$$

When both $q_1 < 1$ and $q_2 < 1$, we know that $(1-q_1)(1-q_2) > 0$. As noted earlier, this implies a discrete segment of consumers that will buy from the firm that offers its product at the lowest price. Said differently, demand depends discontinuously on whether $p_1 \gtreqless p_2$.

In the appendix, we show that the best response of Firm i is as follows:

$$p_i = \begin{cases} \dfrac{1}{8}(4p_j + b_i) & \text{if } p_j \le \beta_j, \\[2ex] p_j - \epsilon & \text{if } \beta_j < p_j \le \dfrac{a_i}{4}, \\[2ex] \dfrac{1}{8}(4p_j + a_i) & \text{if } p_j > \dfrac{a_i}{4}. \end{cases} \tag{4}$$

To simplify our presentation, we define variables from the preceding expressions as follows:

$$a_i = \frac{t\psi_i}{\omega}, \quad b_i = \frac{t(5q_j + q_i(3-4q_j))}{\omega},$$

$$\beta_i = \frac{t(\mu_j - \sqrt{8(1-\omega)\psi_j})}{4\omega},$$

given that $\omega = q_i + q_j - q_iq_j$, $\psi_i = 8 - 3q_j + q_i(4q_j - 5)$, and $\mu_i = 16 - 11q_j + q_i(12q_j - 13)$, $i = 1, 2$.

The best-response functions of p_2 and p_1 share a key property related to the complementarity of prices: they are increasing functions of each other when $p_j \notin (\beta_j, a_i/4]$.[11] Moreover, in this parameter range, because the best-response function of each firm consists of two parallel linear segments, and because $p_i < p_j$ when $p_j > a_i/4$, there can be at most one point of intersection. In other words, if a pure-strategy fixed point exists, it is unique.

When $p_j \in (\beta_j, a_i/4]$, Firm i has an incentive to undercut firm j to capture the segment D_{13}, i.e., the segment of consumers who do not know the precise location of either of the two products. This implies that when $p_1 \in (\beta_1, a_2/4]$ or $p_2 \in (\beta_2, a_1/4]$, a pure-strategy equilibrium in prices does not exist. In fact, the kinks at $p_1 = \beta_2$ and $p_2 = \beta_1$ imply that the equilibrium may be in mixed strategies for certain combinations of q_1 and q_2.

In what follows, we characterize the equilibrium pricing strategies throughout the parameter range. We start by identifying the range for which pure pricing strategies are the equilibrium. To compute the conditions, we rewrite the best-response functions as follows:

$$\text{when} \quad p_i < p_j, \begin{cases} p_i = \frac{1}{8}(4p_j + a_i), \\ p_j = \frac{1}{8}(4p_i + b_j). \end{cases} \tag{5}$$

If an equilibrium (p_1^*, p_2^*) exists in (5), then the condition $p_1^* < p_2^*$ needs to be checked. Computing the p_1^* and p_2^* in (5), we derive Lemma 1.

Lemma 1. *When* $\max\{q_1, q_2\} < 1$ *and* $q_i > (4-3q_j) \cdot (5-4q_j)$, *the pure-strategy equilibrium prices are*

$$p_i = \frac{[q_i(5-4q_j)+3q_j-16]t}{12(q_iq_j - q_i - q_j)}, \quad \textit{and}$$

$$p_j = \frac{[q_i(4q_j-5)-3q_j-8]t}{12(q_iq_j - q_i - q_j)}.$$

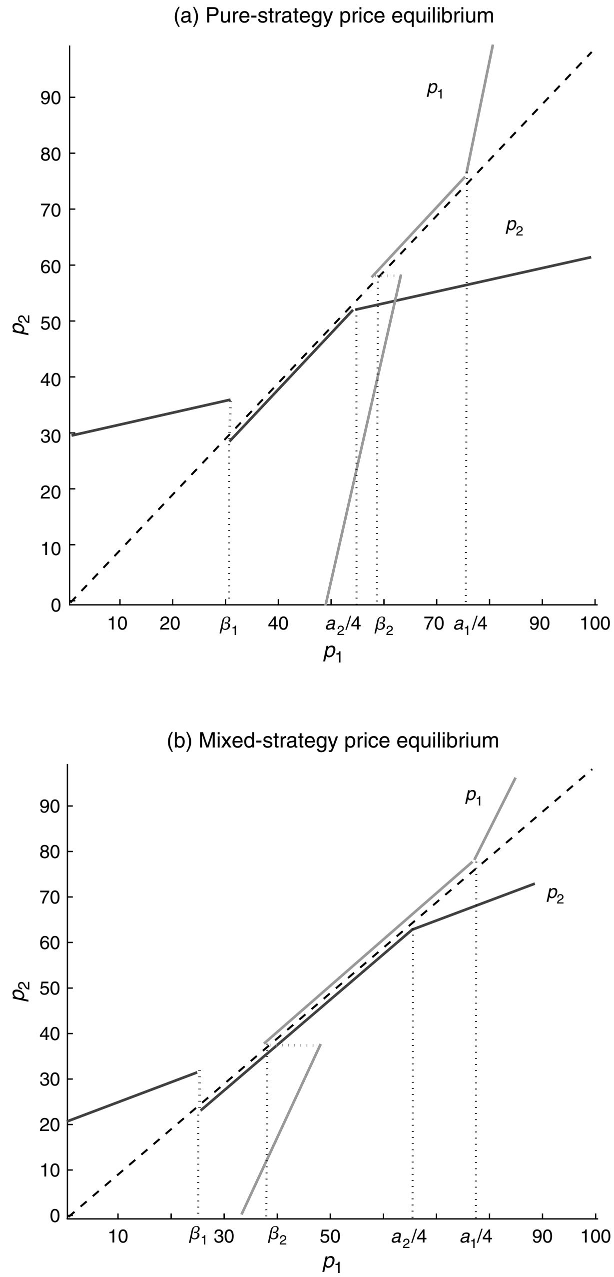
When $q_i \le (4-3q_j)/(5-4q_j)$, *the equilibrium is in mixed pricing strategies.*

An example of the situation described in Lemma 1 is shown in Figure 1(a).

Note that when $q_i \le (4-3q_j)(5-4q_j)$, the response functions do not have a single point of intersection. They are, in fact, concurrent along the $p_1 = p_2$ axis. This intersection implies that if one firm, say, firm 2, chooses a price p_2 that lies in the region where the response functions are concurrent, firm 1's best response is to set a price of $p_2 - \epsilon$, where ϵ is an arbitrarily small number. With such a price, firm 1 undercuts firm 2 and attracts consumers who have not seen an informative preview from either firm, i.e., D_{14}. However, when firm 1 sets a price of $p_2 - \epsilon$, the best response of firm 2 is to choose a price of $p_2 - 2\epsilon$, and

[11] We show in the appendix that $a_i > b_i$ for $i = 1, 2$.

Figure 1 **Illustration of the Price Responses and Possible Price Equilibrium**



so on. In these conditions, the price equilibrium (if it exists) is in mixed strategies (Varian 1980). The existence of mixed-strategy equilibria follows from the conditions of Dasgupta and Maskin (1986).[12] Similar to Narasimhan (1988), Varian (1980), and Salop and Stiglitz (1982), we compute the guaranteed profits for the firms when they employ mixed strategies. To simplify the exposition, we focus on the situation where $q_1 \leq q_2$ (firm 2 provides more precise previews of its news product than does firm 1). In the appendix, we show that $q_1 \leq q_2$ implies that $\beta_1 \leq \beta_2$. The case of $q_1 > q_2$ is analogous. To determine the guaranteed profits of both firms, we start by calculating the guaranteed profits of firm 1.

In Figure 1(b), the lower endpoint of the line segment where the reaction functions are concurrent (along the $p_1 = p_2$ axis) is the point where $p_1 = p_2 = \beta_2$. At this point, firm 1 is indifferent between $p_1^* = (4p_2 + b_1)/8$ and β_2 (as long as $p_1 < p_2$). However, firm 2's best response to $p_1 = \beta_2$, is $p_2 = \beta_2 - \epsilon$. As a result, firm 1's guaranteed profits are given by the profits earned when $p_1 = (4\beta_2 + b_1)/8$, and it captures no demand from the consumers who are uninformed about the location of both products (D_{14}). When firm 1 charges $p_1 = (4\beta_2 + b_1)/8$, firm 2 captures 100% of the segment of consumers who are uninformed about the location of both products. It follows that firm 2's guaranteed profit is given by the profit earned when $p_2 = \beta_2$, and it captures 100% of the segment of uninformed consumers in addition to sales from informed and partially informed consumers.[13]

At the upper end of the line segment where the reaction functions are concurrent (along the $p_1 = p_2$ axis), the reaction functions diverge. Firm 2's best response is to set a price of $p_2 = (1/8)(4p_1 + a_2)$ when $p_1 > a_2/4$ (Equation (4)). Notice that the slope of the reaction function of p_2 is less than one, which means that firm 2's best response is strictly less than p_1. As a result, prices greater than $a_2/4$ do not form part of the support for the mixed pricing strategy. Said differently, if firm 2 mixes over its best responses to firm 1's prices, firm 1 will earn strictly less that its guaranteed profit by choosing a price greater than $a_2/4$. This reasoning leads to Lemma 2.

Lemma 2. *When*

$$\max\{q_1, q_2\} < 1 \quad \text{and} \quad q_2 \in \left[q_1, \frac{4 - 3q_1}{5 - 4q_1}\right],$$

there exists an equilibrium in mixed pricing strategies with p_1 and $p_2 \in (\beta_2, a_2/4)$, and firms 1 and 2 earn profits of

$$\frac{t(\psi_1 - \sqrt{8(1-\omega)\psi_1})^2}{32\omega} \quad \text{and}$$

$$\frac{(8 - \psi_1 + 2\sqrt{2}\sqrt{(1-\omega)\psi_1})(\mu_1 - 4\sqrt{2}\sqrt{(1-\omega)\psi_1})t}{32\omega},$$

respectively.

[12] The two conditions are as follows: First, the sum of the payoff functions needs to be upper hemicontinuous. This implies that the sum of the individual payoffs not jump down in the limit of the equilibrium strategies. When the payoffs are the sum of profits from a Hotelling game and there are discrete segments reserved for each of the players, this property is satisfied. Second, the individual payoff functions need to be weakly semicontinuous. This property is also satisfied.

[13] Following Equation (4), we know that when $p_2 = \beta_2$, firm 1 prefers $p_1 = (1/8)(4p_2 + b_1)$ to $p_1 = p_2 - \epsilon$ (it is willing to forgo demand from uninformed consumers when $p_2 = \beta_2$). Because of this, firm 2 will not price lower than β_2: hence, β_2 is the lower limit of support for the mixed pricing strategy.

The guaranteed profits are the subgame equilibrium profits in the sequential game when

$$q_i \in \left[q_j, \frac{4-3q_j}{5-4q_j}\right].$$

Because our objective is to identify the optimal preview strategy for the competing firms, we proceed to the analysis of the equilibrium preview strategy without fully characterizing the mixed-strategy equilibrium in prices.

Firms' Decisions on Preview Precision. As discussed earlier, we assume that the cost of increasing the precision of a preview is given by a quadratic function: αq_i^2. We first consider a base case of the continuous model in which the preview decision is costless; i.e., $\alpha = 0$. The following proposition summarizes the optimal precision levels for the previews that competing firms choose.

Proposition 2. *The equilibrium product preview precision* (q_i^*) *is* $q_i^* = 1$ *and* $q_j^* = 0$ *when* $\alpha_{i,j} = 0$.

Similar to the discrete case, the equilibrium is asymmetric. Intuitively, one firm needs to differentiate itself by providing signals about the content of its product. By choosing $q = 1$, a firm makes the content of its product easy to assess. When neither firm provides a precise preview, the products are effectively homogeneous, and this leads to a Bertrand outcome. However, in equilibrium only one firm provides a precise preview ($q_i^* = 1$), and the other keeps the content of its product unknown to consumers ($q_j^* = 0$). This obtains because the preview decision of one firm confers a positive externality on the firm that does not provide a preview.

Note that making α costly does not materially affect the findings of Proposition 2. Firms have an incentive to escape the homogeneous trap created when $q_1 = q_2 = 0$. However, as the cost to provide precise previews increases (α is higher), the firm that invests in preview precision will not necessarily invest to the limit of $q = 1$ and provide a perfectly informative preview. It is interesting that the equilibrium is invariably asymmetric. Once a firm has decided to provide an informative preview, the competitor has no incentive to imitate. This obtains because the expected location of 1/2 for a firm that does not provide previews leads to higher perceived differentiation $|y_i - y_j|$ between the two firms versus the case where consumers are informed of the location of both products.

To explain why the asymmetric equilibrium leads to higher perceived differentiation, one needs to examine the mechanism that creates differentiation in a market where the location of each product is uncertain. Recall that the key point is that a firm only reduces price competition if it moves farther away from the competitor (on average). When both firms provide informative previews of their products, half the time the two firms are farther away and half the time they are actually closer to each other. When they are close, there are two disadvantages: (1) the price competition is harsh, and (2) each firm finds itself in a tiny part of the market. For example, if the competitor is at 0.8 and the focal firm is located at 0.9, the focal firm is restricted to competing for 20% of the market. In contrast, when a firm does not provide a preview and its competitor does, the firm's perceived location is 1/2. Because the competitor will be located to either the left or the right of the focal firm, the focal firm enjoys the gift (when the competitor provides a preview) of being able to dominate at least half of the market. Said differently, when a firm is in the middle of the market and the competitor is not, the firm is able to dominate more than half of the market. The next subsection provides more detail on the positive externality and how this affects the perceived differentiation between the firms.

4.1.3. A Comparison of Product Positioning and Preview Precision. To understand the intuition behind the asymmetric equilibrium found in both the discrete and continuous models, we now examine the effectiveness of "preview precision" as a strategy to differentiate competing products. Consider a market where firms need to make a decision (in advance) of where to produce their products. In a simple model, we represent this phenomenon by allowing the firms to focus their production on the left side ($y_i \in [0, 1/2)$) or the right side ($y_i \in [1/2, 1]$) of the $[0, 1]$ continuum. In the news markets, the two options resemble a strategic decision of news focus: for example, should a firm focus its news gathering efforts on the East Coast or the West Coast? In this subsection, we limit our attention to discrete preview precision, i.e., $q_i \in \{0, 1\}$, and assume that preview and location decisions are simultaneous.[14] Table 3 summarizes the payoffs of firm 1 for all strategy combinations that can be chosen by the competing firms.

Straightforward analysis reveals that there are two symmetric Nash equilibria in this game, both of which entail no previews by the firms and the firms choosing different locations for their products ($q_i^* = 0, y_i^* \neq y_j^*$). The value of Table 3 is that it allows us to highlight the forces that lead to an asymmetric outcome when firms cannot choose the location from which their product attributes are realized.

The first column lists firm 1's payoffs when firm 2 chooses the left half of the 0–1 continuum ($y_2 < 1/2$) and does not provide an informative preview ($q_2 = 0$).

[14] This assumption allows us to focus on pure-strategy Nash equilibria without worrying about the mixed-strategies that arise if the location and preview decisions are made sequentially.

Table 3 Firm 1's Expected Payoffs with Discrete Preview and Location Decisions

	Firm 2's decisions			
	$(q_2 = 0, y_2 < 1/2)$	$(q_2 = 0, y_2 \geq 1/2)$	$(q_2 = 1, y_2 < 1/2)$	$(q_2 = 1, y_2 \geq 1/2)$
Firm 1's decisions $(q_1 = 0, y_1 < 1/2)$	0	$\frac{t}{2}$	$\frac{625t}{1152}$	$\frac{t}{2}$
$(q_1 = 0, y_1 \geq 1/2)$	$\frac{t}{2}$	0	$\frac{t}{2}$	$\frac{625t}{1152}$
$(q_1 = 1, y_1 < 1/2)$	$\frac{529t}{1152} - \alpha$	$\frac{t}{2} - \alpha$	$\frac{t}{2} - \alpha$	$\frac{t}{2} - \alpha$
$(q_1 = 1, y_1 \geq 1/2)$	$\frac{t}{2} - \alpha$	$\frac{529t}{1152} - \alpha$	$\frac{t}{2} - \alpha$	$\frac{t}{2} - \alpha$

Obviously, firm 1's best response is to locate in the right half of the 0–1 continuum ($y_1 \geq 1/2$) with no preview of its product ($q_1 = 0$). Moreover, if one compares the second and fourth cells, the common element of the two cells is to locate on the right side of the market ($y_1 \geq 1/2$), and the difference is whether or not firm 1 provides a preview of its product. Interestingly, zero preview (the second cell) yields a higher payoff than the detailed preview (the fourth cell). This means that when firms' products are already differentiated, a preview does not bring an extra benefit; it only generates additional costs. This suggests that the preview is a relatively weak tool for differentiation.

If one looks at the third column (or the fourth column), it is also apparent that firm 1 is better off by not providing the preview of its product given that the competitor provides a precise preview. This obtains by noting that the profits in rows 1 and 2 are strictly greater than the profits in rows 3 and 4. Independent of whether firms locate their products from the same or different sections of the line, the optimal strategy is not to provide an informative preview when the competitor does provide one.

An interesting question that arises regards the source of the externality. Is the externality solely caused by the competitor's decision to provide a preview, or is there an additional factor that creates the externality? To answer this question, we compare the profits of firm 1 across the first row (the same reasoning applies to the second row). When the firms locate in the same section of the market (cells 1 and 3 in row 1), the externality of firm 2's preview decision is evident. Firm 1's profits are strictly higher in cell 3 than in cell 1:

$$\pi_1\left(q_1 = 0, y_1 < \tfrac{1}{2} \,\middle|\, q_2 = 1, y_2 < \tfrac{1}{2}\right) > \pi_1\left(q_1 = 0, y_1 < \tfrac{1}{2} \,\middle|\, q_2 = 0, y_2 < \tfrac{1}{2}\right).$$

Conversely, when the firms choose to focus on different sections of the market (cells 2 and 4 in row 1), firm 1's profits are unaffected by firm 2's preview decision:

$$\pi_1\left(q_1 = 0, y_1 < \tfrac{1}{2} \,\middle|\, q_2 = 0, y_2 \geq \tfrac{1}{2}\right) = \pi_1\left(q_1 = 0, y_1 < \tfrac{1}{2} \,\middle|\, q_2 = 1, y_2 \geq \tfrac{1}{2}\right).$$

This shows that the positive externality generated by firm 2's preview strategy disappears when the location focus of the two firms is different; i.e., the firms focus their products in different sections of the market. The positive externality created by a competitor's preview strategy relies on both firms having common support for their product attributes (i.e., the random variable y_i needs to be drawn from the same piece of the continuum of product content).

In addition, it is interesting to examine firm 1's profits when it does not provide a preview of its product and firm 2 does. Consider the first and second cells in the third column (firm 2 provides a preview for its product and focuses on the left side of the market). Oddly, firm 1 is better off by providing product on the same side as the competitor (the left side) versus the alternative of focusing on the right side of the line. This follows the argument in the previous section that a firm's decision to preview effectively gifts more than half the market to a "nonpreview" competitor.

This submodel highlights the weakness of informative previews as a tool of differentiation and also explains the positive externality that a preview provides to a competitor. These factors explain the asymmetric outcome that results when previews are used as competitive tools by the firms.

5. Extension 1: Pricing After the Realization of y

The base model is based on a situation where product content changes frequently but the preview of the product and its pricing are long-term decisions (hence the realization of product content after both preview and pricing have been chosen). In this extension, we consider a situation where preview design is the first decision but pricing is chosen after the content of the product has been realized. This is a less general situation than the base model but applies to some news products such as the creation of special editions, investigative reports, or commemorative news products where the news provider has the flexibility to adjust the price after the basic content of the news story is known. In this extension, we focus on discrete preview decisions, i.e., $q_i \in \{0, 1\}$. In other words, the duopolists play a game similar to Table 1 except that prices are set after the realization of y_i. First, we consider the case of a monopolist. We then move to the duopoly case (as before) to understand how preview strategies are affected by competition.

5.1. Monopoly

The first decision of the monopolist is to choose a level of preview precision q_m, where $q_m \in \{0, 1\}$. This implies that consumers do not know the location of the product when $q_m = 0$, and they know the location when $q_m = 1$. Similar to the model where the location of the product is revealed after prices are set, when consumers do not know the location of the product, the expected location is $y = 1/2$. This implies that the expected utility from consuming the product when a consumer at x is uninformed is $E(v - t|x - y| - p) = v - tE|x - 1/2| - p$.

The expected distance a consumer finds herself from the monopolist's product, $E|x - 1/2|$, is highest for a consumer located at $x = 0, 1$.

For all *uninformed* consumers to buy, the most distant consumer needs to realize surplus by buying. As a result, the optimal price for the segment of uninformed consumers is $v - t/2$.[15] This implies that the monopolist's profit when $q_m = 0$ is

$$E(\Pi_m) = v - \frac{t}{2}. \tag{6}$$

When $q_m = 1$, consumers know the location of the product. Thus, the surplus realized by a consumer located at y is $v - t|x - y| - p$. To maximize profit, the monopolist sets a price such that $p = v - t|x - y|$ for the consumer who is located farthest from the ideal product. Thus, the optimal price as a function of location will be $v - t(1 - y)$ for $y < 1/2$ and $v - ty$ when $y > 1/2$. As a result, the profits of the monopolist are

$$\begin{cases} \Pi_m = v - t(1 - y) & \text{when } y \le \frac{1}{2}, \\ \Pi_m = v - ty & \text{when } y > \frac{1}{2}. \end{cases} \tag{7}$$

Equation (7) implies that the maximum profit that can be earned when $q_m = 1$ is $v - t/2$. However, this is earned with zero likelihood because of the continuous nature of the distribution for y. In fact, the profits earned when $q_m = 1$ are strictly less than $v - t/2$, with an average profit of $v - 3t/4$. Because preview decisions precede the realization of y, the preview decision is based on expected profit, and this leads to Proposition 3.

[15] This analysis is based on v being greater than $3t/2$, the standard full coverage condition for the Hotelling model.

Proposition 3. *The monopolist will not provide an informative preview of its product as profits are strictly reduced when consumers are informed about the product's location.*

The key observation from this section is that the monopolist benefits from consumers' inability to correctly assess the content of the product that is being offered. In other words, it does not matter whether y_m is realized prior to the setting of p_i; the monopolist always gains when consumers make their decisions based on the expected value of y_m as opposed to the true value of y_m.

5.2. Duopoly

As noted earlier, with discrete preview decisions, the duopolists play a game similar to Table 1. However, prices are set *after* the firms become informed about their y_is. This game structure implies that firms set prices that depend on the realizations of y_i. Accordingly, the preview decisions of firms depend on the expected payoffs integrated across all possible realizations of y_i.

When the duopolists do not provide previews, consumers do not know the content of the product. Thus they assume that $y_i = 1/2$. This implies that both firms are assumed to be at the same location. From the perspective of consumers, the two products appear homogenous, so Bertrand price competition reduces the price to zero, and the duopolists make no profit.

When both firms provide previews of their products, consumers know the exact locations of y_1 and y_2. Therefore, the location of the indifferent consumer is the same as in Scenario 1 described in the appendix. We can easily calculate the equilibrium prices for firms 1 and 2:

$$p_i^* = \begin{cases} \dfrac{t(y_i + y_j + 2)}{3} & \text{if } y_i < y_j, \\ \dfrac{t(4 - y_i - y_j)}{3} & \text{if } y_i \ge y_j. \end{cases} \tag{8}$$

With the equilibrium prices, we can also calculate the payoff $\pi_i(y_1, y_2)$ for each realization of y_i. Integrating $\pi_i(y_1, y_2)$ over $[0, 1]$ with respect to y_1 and y_2, we have the firms' expected payoffs after preview decisions and before the realization of y_i:

$$E(\pi_i) = \iint_y \pi_i(y_1, y_2) = \frac{55t}{108}, \quad \text{where } y = \{y_1, y_2\} \text{ and } i = 1, 2. \tag{9}$$

Thus, when both news providers provide previews for their products, they earn $55t/108$ and avoid the trap of Bertrand competition. When only one firm provides a preview of its product, say, firm i, consumers know y_i perfectly through screening and they assume $y_j = 1/2$. Following the same logic as in the above calculations, the expected payoffs are

$$\begin{cases} E(\pi_i) = \dfrac{91t}{216}, \\ E(\pi_j) = \dfrac{127t}{216}. \end{cases} \tag{10}$$

This leads to the following proposition regarding equilibrium preview strategies.

Proposition 4. *When the prices are set after the realization of product content y_i, only one firm has an incentive to provide an informative preview of the product, whereas the other will not provide one.*

This proposition shows that informative previews allow competing firms to escape the trap of Bertrand competition. However, similar to the model where the location of the product is revealed after the pricing decision, only one firm has an incentive to provide a preview of its product.

6. Extension 2: Preview Decisions After the Realization of y

In this section, we examine another alternative for the sequence of the key decisions/events that constitute our game. To be specific, we consider a game where the firms are informed about the location (or content) of the product they will offer before making a decision about how precise a preview to provide to the market. As in the base case, we assume that the pricing decision is made last (after the firms have chosen their preview decisions). Similar to Extension 1, we focus on the case of discrete preview precision, i.e., $q \in \{0, 1\}$. This timing is perhaps inapplicable to daily newspapers, broadcasting news programs, and Internet news; however, it is certainly applicable to product markets where manufacturers face uncertainty in the characteristics of their products and the manufacturers do not control the uncertainty. The previously mentioned wine example fits this description, as do a number of categories where manufacturers face uncertainty in the ultimate performance of their products (e.g., whiskey and cognac production, and the production of certain cheeses). In the case of a big story, news providers may also change their preview strategies for that particular event.

We assume that firms are informed of their own location but not the competitor's location when product location is revealed to firms, i.e., y_i $(i = 1, 2)$. In other words, when the firms choose the precision of their preview, they do not know their competitor's product location (y_j). Similar to the base model and Extension 1, the preview precision of each firm becomes public knowledge after firms have made their choices.[16] Firms then announce their prices with the knowledge of both y_i.

We directly explore the case of duopoly competition and examine the robustness of the asymmetric equilibrium outcome found in the previous models. Again, the two competing firms play a game similar to Table 1, with the noticeable difference being that each firm is informed about its own y_i but not the competitor's. We also assume that consumers are naive and do not form beliefs about the location of the firm as a function of the observed preview strategy.[17]

As in Extension 1, we calculate the firms' expected payoffs. Obviously, when both firms do not provide previews, their products are regarded by consumers as perfect substitutes, and they consequently engage in Bertrand price competition, resulting in a profit of zero for both firms.

When both firms provide detailed previews ($q_1 = q_2 = 1$), consumers have perfect knowledge of the competing products after screening. In this case, the pricing equilibrium is identical to that of Extension 1 (Equation (8)): at the time of pricing decision, both firms have exactly the same information as in Extension 1. However, the firms' expected profits are different because each knows its own realization of y_i but not that of the competitor. Accordingly, the expected profit of firm i is calculated by integrating $\pi_i(y_i, y_j)$ over y_j:

$$E(\pi_i) = \int_{y_j} \pi_i(y_i, y_j) = \frac{t(19 + 51y_i - 51y_i^2)}{54}. \tag{11}$$

Similarly, we calculate the expected profit of each firm when only one firm provides a precise preview and the other firms provides an uninformative preview. Suppose only firm i provides a preview of its product. We then have

$$\begin{cases} E(\pi_i) = \begin{cases} \dfrac{t(5 + 2y_i)^2}{72} & \text{if } y_i < 1/2, \\ \dfrac{t(7 - 2y_i)^2}{72} & \text{if } y_i \geq 1/2, \end{cases} \\ E(\pi_j) = \dfrac{127t}{216}. \end{cases} \tag{12}$$

[16] Firms are assumed to be aware of the competitor's location after the preview decision. This assumption allows us to focus on the impact of preview precision without worrying about the potential signalling impact of preview precision.

[17] If consumers were to form beliefs about firm location as a function of the preview strategy selected by the firm, one would have to identify a perfect Bayesian equilibrium. However, with reasonable refinements and the precondition that a firm does not receive a draw at $y = 1/2$, the preview strategy will not be informative. That obtains because the dominant strategy for a firm is to play the opposite strategy to its competitor independent of its location.

Comparing the expected profits in the above two equations, we have

$$E(\pi_i(q_i = q_j = 1)) - E(\pi_i(q_i = 0, q_j = 1)) = \frac{-17t(1-2y_j)^2}{72} < 0. \quad (13)$$

This means that when one firm provides a precise preview of its product, the other is better off providing an uninformative preview.

Proposition 5. *When the precision of previews is decided after the realization of the product location y_i, only one firm has an incentive to provide a precise preview of its product, whereas the other will not.*

This proposition highlights the robustness of the model to different assumptions about the timing of the game. It essentially points to the positive externality generated by a competitor that provides an informative preview of its product.

7. Conclusion

7.1. Key Insight

Many firms provide previews for experiential products. Such a preview can be the front page of a newspaper, information on specialty websites for wine, or webcams for ski resorts and national parks. A common feature of these experience goods is that firms do not have full control of the precise characteristics of their products. News providers collect information and report significant events, the taste of a wine is heavily influenced by the local weather, snow conditions at a ski resort vary from day to day, and tourist encounters with wild animals in a national park are a matter of luck. Our objective is to understand the motivation that firms have to employ different preview strategies when product content is not fully controlled. Why is it that some newspapers have front pages that efficiently tell potential buyers what is inside, whereas others have a format that makes it difficult to know what is inside without inspecting the product in detail?

Our model shows that competition provides an incentive for firms to make the content of a product easier to assess. In fact, previews are a vehicle to create perceived differentiation between experiential products. However, in contrast to the literature on differentiation (Hotelling 1929), where firms choose "positions," the question here is whether to "reveal" a location that has been chosen by nature. Interestingly, when a firm enjoys a relative monopoly, it has no incentive to provide informative previews. A monopoly-like firm can benefit from consumers' inability to determine the content of its product.

However, in a competitive context, when one firm provides an informative preview, both firms realize a significant benefit. Surprisingly, the firm that benefits the most is the one that does not provide informative previews: it benefits from a positive externality. This positive externality makes asymmetry in the precision of previews the equilibrium outcome. We believe that the incentive to invest (or to implement informative previews), leading to greater benefit for the competitor than the implementing firm, is indeed driven by Bertrand-like competition that results in the (no preview, no preview) case. Similar to Cooper and John (1988), the model is an interesting example of a classical coordination problem that may exist when firms have strategic complementarities. It is useful to note that the insights provided by the model relate to a situation where the only driver of profits is the perceived location of the products that *can be* communicated to consumers through the preview strategy. In reality, there are a number of factors that might affect profits. For example, an "investing firm" may be more profitable than its competitor in a market where the density of consumers is not uniform. However, that does not negate the insight the model provides regarding the positive externality the investing firm confers upon its competitor.

Our findings can be used to understand certain empirical observations regarding the nature of competition between news providers. For example, in cities where more than one local newspaper is in operation, the competition is nearly always between a traditional broadsheet and a tabloid (Picard and Brody 1997, Picard 2003).[18] Moreover, well-known publications are known to change format in order to manage competition. Recently, the *Wall Street Journal Europe* (the version of the *Wall Street Journal* sold to English-speaking business readers in Europe, also known as the *WSJE*) changed formats to compete with the *Financial Times*. On May 12, 2005, the *WSJE* moved to tabloid format because "(it) will give our readers a more convenient and useful global business daily briefing package ... more themed and regionally relevant content" (see *Business Wire* 2005). Interestingly, the *Financial Times* is a broadsheet (the former format of the *WSJE*), and it is more difficult to assess from the front page. Famous wildlife game reserves adopt different preview strategies. The MalaMala Game Reserve at the Kruger National Park in South Africa provides detailed dates when lions, leopards, and other animals were sighted in the past year. Right beside MalaMala is another famous game

[18] Picard and Brody (1997) show that although the majority of local newspaper markets in the United States are characterized by local monopoly, the markets with local competition mostly consist of one broadsheet and one tabloid.

reserve, Sabi Sand. There, the competing reserve simply advertises that there is an excellent chance of wildlife encounters without providing data on past game-viewing experiences. We now highlight the limitations that apply to our analysis.

7.2. Limitations

Similar to any analytical model, our model is based on assumptions that may limit the generalizability of the findings. First, our analysis is restricted to contexts where previews only affect how consumers choose between competing products. In some cases, previews may be effective at attracting new consumers who are not currently active within a market. For example, an attractive front page for a newspaper may cause a commuter who does not generally buy newspapers to buy one. Our model does not address situations such as this.

Second, the model's insights extend to situations where consumers do not pay directly for each issue of the news product. However, there are a number of news products where consumers pay a long-term subscription fee well in advance of consumption. In these cases, the timing and impact of preview strategies would be different than those reflected in our model. On another note, our model still provides insights into this issue. Notice that newsstand sales are more lucrative than subscription sales.[19] Moreover, subscription customers eventually let their subscriptions lapse, so it is important to generate trials with people who do not have subscriptions to maintain business (people do not generally sample a publication by taking out a subscription). This underlines the importance of attracting a consumer before she becomes loyal (or a subscriber). This is akin to the problem faced by beer companies. Not only are beer companies interested in switchers, but they are also interested in generating trials before a beer drinker becomes loyal. Thus, the issue of how to attract customers at the newsstand (for example, when they are on a business trip) is important. The main effect of subscription or loyal customers would be to weaken the effects identified in our model but not to eliminate them. In other words, loyal customers are effectively a barrier to change.

Third, the preview for news products can be thought of as the front page of a newspaper or the preview of a TV news program. Whereas these previews function to reveal information about the news stories inside a publication or a news program, they also signal the type of events covered. Chan and Goldthorpe (2007) found that the choice of newspaper format, i.e., tabloid or broadsheet, is associated with a person's social status. In fact, many tabloids are known to provide sensational stories instead of serious reports and analytics. Moreover, using educational level as a proxy to consumer information processing capacity, Chan and Goldthorpe find significant correlation between the choice of newspaper format and education level. This suggests that the design of the front page of a newspaper might reflect a decision to provide news in an easy-to-process fashion (targeted to those with less information processing capacity), as opposed to being the execution of a carefully chosen preview strategy.[20] Although there might be a link between the type of news stories and the newspaper format, we also observe serious publications such as the *Wall Street Journal Europe* in tabloid format.

Fourth, our model applies to the role of previews in a context where the uncertainty is about the attributes of horizontally differentiated products. An interesting extension to this work would be to examine the effect of previews in a context where the primary differences between products are vertical in nature (quality-based). For example, hotels possess horizontal attributes (near the airport or near downtown), yet a significant aspect of the consumer experience relates to the overall quality of the hotel (the hotel star level). The role of previews cannot be understated for products such as hotels. There are many websites that provide previews to potential customers before they book. It would be useful to understand how our findings extend to a context such as this.

Finally, when repeat purchasing or consumption is a key characteristic of the category (as is the case with news products), the consumption experience is an important aspect of product evaluation. Our model implicitly assumes that the quality of the consumption experience of the competing products is entirely based on the product's attribute location. If some consumers developed a certain degree of loyalty to a particular product and rely less on the previews to evaluate the product, then the impact of the informative preview would be reduced. In other words, as long as the consumer heterogeneity in screening propensity is uniformly distributed along the market, the results of the model would be weakened but not eliminated. In reality, there are many dimensions that contribute to the quality of the consumption experience, and some of these are affected by the design of the product itself. Our model does not address these issues, and this is an important topic for further research.

[19] See *New York Times* (2008).

[20] Clearly, the number of stories and the design of a newspaper's front page affect how easily consumers can process it. This is an interesting area for future research.

7.3. Summary

To conclude, our analysis shows why a firm might employ previews that quickly inform potential consumers about the content of a product. However, the analysis also explains why a firm might avoid previews altogether when it competes with another firm that provides informative previews. This obtains because previews are a tool that simultaneously differentiates a product but also confers a positive externality on a competitor that is less explicit about its content.

Our analysis applies to a context where firms do not have full control over the content of their products. We show that the model's findings are robust to alternate timing in the ordering of the firms' decisions. Nevertheless, previews are but one element that firms employ to market their products. We hope this study serves as an impetus for further research to better understand the many elements that the sellers of experience goods use to compete.

Appendix

Proof of Proposition 1. The demand depends on both price and consumers' knowledge about the content of the product. In the following analysis, we will call those who know the product content through screening informed consumers and those who do not, uninformed consumers.

Let us start from the demand from the informed consumers. Because these consumers know the realized location of y perfectly, the demand then depends on y. When $y \le \min\{1-(v-p)/t, (v-p)/t\}$, the demand from informed consumers is $(v-p)/t + y$. When

$$\max\left\{1-\frac{v-p}{t}, \frac{v-p}{t}\right\} \ge y > \min\left\{1-\frac{v-p}{t}, \frac{v-p}{t}\right\},$$

it is $\min\{2(v-p)/t, 1\}$. When $1 \ge y > \max\{1-(v-p)/t, (v-p)/t\}$, it becomes $1-y+(v-p)/t$.

From uninformed consumers, the demand is $2(v-p)/t$ if $p \ge v-t/2$ and 1 if $p < v-t/2$.

Thus the price range can be divided into three regions: $[0, v-t)$, $[v-t, v-t/2)$, and $[v-t/2, v]$, each leading to a different but continuous demand function. For each demand function within the corresponding price region, there is a locally optimal price p^*. Notice that the equilibrium price must be one of the three local optima. If we show that the monopolist prefers not to provide previews of its product for any locally optimal p^*, then in equilibrium the monopolist will not provide any preview.

If the monopolist set a price $p \in [v-t/2, v]$, we have $(v-p)/t \le 1-(v-p)/t$. Thus the demand is

$$D_m(q_m, p) = q_m\left(\int_0^{(v-p)/t}\left(\frac{v-p}{t}+y\right)dy + \int_{(v-p)/t}^{1-(v-p)/t} 2\frac{v-p}{t}\,dy + \int_{1-(v-p)/t}^{1}\left(1-\frac{v-p}{t}+y\right)dy\right) + (1-q_m)2\frac{v-p}{t} = \frac{(v-p)(pq_m+2t-q_m v)}{t^2}. \quad (14)$$

In this expression, the item within the parentheses after q_m is the demand from informed consumers, and the item within the parentheses after $(1-q_m)$ is the demand from uninformed consumers. Profit is simply the product of demand and price: $\pi_m = D_m p$.

Because $p \in [v-t/2, v]$, we have

$$\frac{\partial^2 \pi_m}{\partial p^2} = \frac{-6pq_m - 4t + 4q_m v}{t^2} \le \frac{-6(v-t/2)q_m - 4t + 4q_m v}{t^2} = -2vq_m - 4t + 3tq_m < 0 \quad \text{if } v \text{ is large enough.} \quad (15)$$

Based on the constraint that $v - t/2 \le p < v$, we can derive the optimal price:

$$p^* = \min\left\{v-t/2, \frac{-2t+2q_m v+\sqrt{4t^2-2q_m tv+q_m^2 v^2}}{3q_m}\right\}.$$

Substituting p^* into the profit function, one can easily check that $\partial\pi_m/\partial q_m < 0$ and $\partial^2\pi_m/\partial q_m^2 \ge 0$. Thus, it is optimal for the monopolist to choose a precision level of $q_m = 0$ if the equilibrium price is between v and $v-t/2$.

Similarly, when $p \in [v-t, v-t/2)$, calculation gives us $D_m = 1-q_m-(q_m(p-v)(p+2t-v))/t^2$. Given the constraint of p, we have

$$p^* = \max\left\{v-t, \min\left\{v-t/2-\epsilon, \frac{2q_m(v-t)+\sqrt{q_m((3+q_m)t^2-2q_m tv+q_m v^2)}}{3q_m}\right\}\right\}.$$

It is easily checked that $\partial\pi_m/\partial q_m < 0$. This means if the equilibrium price $p^* \in [v-t, v-t/2)$, the monopolist will not provide a preview for its products; i.e., $q_m^* = 0$.

So far, we have shown that the monopolist will not provide previews for its product if the price is higher than $v-t$. Next, we show that a price lower than $v-t$ cannot be optimal.

If the monopolist sets a price $p < v-t$, then all consumers in the market will buy independent of q_m (this obtains because even the maximum distance a consumer can be from the realized location of the news context is one). With a price marginally less than $v-t$, the monopoly firm will earn a profit of $v-t$. However, the monopolist can always set $q_m = 0$ and $p = v-t/2$, which leads to full market coverage and a profit of $v-t/2$. This is strictly higher than the profit that can be realized by providing a more precise preview and charging $p = v-t$. Therefore, $p < v-t$ can never be the optimal price. Q.E.D.

Calculation of Firms' Expected Demand for the Discrete Base Model

We first calculate the location of the indifferent consumers in the four scenarios.

Scenario 1: Consumers know both y_1 and y_2. In this case, $\hat{y}_1 = y_1$ and $\hat{y}_2 = y_2$. The location of the indifferent consumer can be easily calculated:

$$x_I = \begin{cases} x_{I10} \equiv \dfrac{p_1 - p_2 + t(y_1+y_2)}{2t} & \text{if } y_1 < y_2, \\ x_{I11} \equiv \dfrac{p_2 - p_1 + t(y_1+y_2)}{2t} & \text{if } y_1 \ge y_2. \end{cases} \quad (16)$$

Scenario 2: Consumers know y_1 but not y_2. Because here $\hat{y}_2 = 1/2$, the location of the indifferent consumer depends on whether $y_1 > 1/2$. We have

$$x_I = \begin{cases} x_{I20} \equiv \dfrac{2p_2 - 2p_1 + t + 2ty_1}{4t} & \text{if} y_1 < 1/2, \\ x_{I21} \equiv \dfrac{2p_1 - 2p_2 + t + 2ty_1}{4t} & \text{if } y_1 \geq 1/2. \end{cases} \quad (17)$$

Scenario 3: Consumers know y_2 but not y_1. This case is similar to Scenario 2:

$$x_I = \begin{cases} x_{I30} \equiv \dfrac{2p_1 - 2p_2 + t + 2ty_2}{4t} & \text{if } y_2 < 1/2, \\ x_{I31} \equiv \dfrac{2p_2 - 2p_1 + t + 2ty_2}{4t} & \text{if } y_2 \geq 1/2. \end{cases} \quad (18)$$

Scenario 4: Consumers are uninformed regarding the content of each product. In this case, since $\hat{y}_1 = \hat{y}_2 = 1/2$, consumers consider the two products perfect substitutes. They will buy whichever is cheaper.

We now calculate the firms' expected demand. We start by considering firm 1's expected demand when $q_1 = q_2 = 1$ and firm 2's product is y_2. When $q_1 = q_2 = 1$, all consumers know both y_1 and y_2. This corresponds to the first case in the previous section, when $y_1 < y_2$ and firm 1's demand is x_{I10}. When $y_1 \geq y_2$, firm 1's demand is $1 - x_{I11}$. Thus, firm 1 has a demand of

$$D_{11} \equiv \int_0^{y_2} x_{I10}\, dy_1 + \int_{y_2}^{1} (1 - x_{I11})\, dy_1 = \frac{2(p_2 - p_1) + 3t(1 - 2y_2 + 2y_2^2)}{4t}.$$

Because y_2 is a random variable between zero and one, we integrate $D_{11}(y_2)$ over the distribution of y_2 to determine the expected demand for firm 1:

$$E(D_1(q_1 = q_2 = 1)) = \int_0^1 D_{11}\, dy_2 = \frac{1}{2} + \frac{p_2 - p_1}{2t}. \quad (19)$$

When $q_1 = 1$ and $q_2 = 0$, consumers know that $\hat{y}_1 = y_1$ and $\hat{y}_2 = 1/2$. Thus when $y_1 < 1/2$, firm 1 has a demand of x_{I20} and when $y_1 \geq 1/2$, firm 1 has a demand of $1 - x_{I21}$. We have

$$D_{12} \equiv \int_0^{1/2} x_{I20}\, dy_1 + \int_{1/2}^{1} (1 - x_{I21})\, dy_1 = \frac{3}{8} + \frac{p_2 - p_1}{2t}.$$

Because D_{12} does not depend on y_2, we have

$$E(D_1(q_1 = 1, q_2 = 0)) = \frac{3}{8} + \frac{p_2 - p_1}{2t}. \quad (20)$$

Similarly, when $q_1 = 0$, $q_2 = 1$, consumers know $\hat{y}_1 = 1/2$ and $\hat{y}_2 = y_2$. Thus, firm 1's demand depends on the value of y_2 that is revealed to consumers. This implies that:

$$D_{13} \equiv \begin{cases} 1 - x_{I30} & \text{if } y_2 < 1/2, \\ x_{I31} & \text{if } y_2 \geq 1/2. \end{cases} \quad (21)$$

Similar to the previous case, firm 1's expected demand is

$$E(D_1(q_1 = 0, q_2 = 1)) = \frac{5}{8} + \frac{p_2 - p_1}{2t}. \quad (22)$$

When $q_1 = 0$, $q_2 = 0$, consumers know $\hat{y}_1 = \hat{y}_2 = 1/2$. Firm 1 has a demand of

$$E(D_1(q_1 = q_2 = 0)) = D_{14} \equiv \begin{cases} 1 & \text{if } p_1 < p_2, \\ 0 & \text{if } p_1 > p_2, \\ 1/2 & \text{if } p_1 = p_2. \end{cases} \quad (23)$$

Equation (23) is based on the assumption that the market is split equally between the two competing firms in the case of identical prices.

Derivation of Best-Response Functions When q_1 and q_2 Are Less Than 1

Start with firm 1's best response. Given $(1 - q_1)(1 - q_2) > 0$ and $\pi_1 = p_1 D_1$, we have $E(\pi_1) = p_1 E(D_1) = p_1[A + (1 - q_1) \cdot (1 - q_2) D_{14}]$. Given the discrete nature of D_{14} as specified in Equation (23), firm 1's best response directly depends on whether $p_1 \gtreqless p_2$. When $p_1 = p_2$, firm 1 will undercut firm 2. When $p_1 \neq p_2$, firm 1 sets a locally optimal price based on a first-order condition. Therefore, we have

$$p_1 = \begin{cases} \dfrac{1}{8}\left(4p_2 + \dfrac{t(8 - 3q_2 + q_1(4q_2 - 5))}{q_1 + q_2 - q_1 q_2}\right) & \text{if } p_1 < p_2, \\ p_2 - \epsilon & \text{if } p_1 = p_2, \\ \dfrac{1}{8}\left(4p_2 + \dfrac{t(5q_2 + q_1(3 - 4q_2))}{q_1 + q_2 - q_1 q_2}\right) & \text{if } p_1 > p_2. \end{cases} \quad (24)$$

We need to remove p_1 from the "if" conditions. First, we remove the p_1 in the first and third items in Equation (24) by substituting p_1 into the if conditions. Let

$$a_1 \equiv \frac{t(8 - 3q_2 + q_1(4q_2 - 5))}{q_1 + q_2 - q_1 q_2} \quad \text{and}$$

$$b_1 \equiv \frac{t(5q_2 + q_1(3 - 4q_2))}{q_1 + q_2 - q_1 q_2};$$

it is easily checked that

$$a_1 - b_1 = \frac{(1 - q_1)(1 - q_2)t}{q_1 + q_2 - q_1 q_2} > 0.$$

Now we have

$$p_1 = \begin{cases} \dfrac{1}{8}(4p_2 + b_1) & \text{if } p_2 < \dfrac{b_1}{4}, \\ p_2 - \epsilon & \text{if } p_2 = p_1 \\ \dfrac{1}{8}(4p_2 + a_1) & \text{if } p_2 > \dfrac{a_1}{4}. \end{cases} \quad (25)$$

Each item in the above equation is a valid candidate for firm 1's best response. However, the partitions of p_2 in the if conditions are overlapping because of the "$p_1 = p_2$" specification (a constraint in the second item). To reach a mutually exclusive partition in the parameter range of p_2, we need to compare the corresponding profit of each price candidate.

When $p_2 > a_1/4$, both $(1/8)(4p_2 + a_1)$ and $p_2 - \epsilon$ are candidates. Notice that under either price, firm 1 will have an expected demand of $E(D_1) = A + (1 - q_1)(1 - q_2)$. Because $(1/8)(4p_2 + a_1)$ is a local optimum, it dominates $p_2 - \epsilon$ when $p_2 > a_1/4$. In other words, $p_1 = (1/8)(4p_2 + a_1)$ is the best response when $p_2 > a_1/4$.

When $b_1/4 \le p_2 \le a_1/4$, because $p_1 = p_2 - \epsilon$ is the only candidate, firm 1's best response is $p_2 - \epsilon$.

When $p_2 < b_1/4$, $(1/8)(4p_2 + b_1)$ and $p_2 - \epsilon$ are the candidates. These two prices lead to different demand functions, and we need to compare the corresponding expected profits.

Let

$$K \equiv E\left(\pi_1 | p_1 = \frac{1}{8}(4p_2 + b_1)\right) - E(\pi_1 | p_1 = p_2 - \epsilon)$$
$$= \frac{1}{8} p_2(3q_2 - 8 + q_1(5 - 4q_2)) + \frac{(4p_2(q_1 + q_2 - q_1 q_2) + (q_1(3 - 4q_2) + 5q_2)t)^2}{128(q_1 + q_2 - q_1 q_2)t}. \quad (26)$$

It is straightforward to show that $\partial^2 K/\partial p_2^2 = (q_1 + q_2 - q_1 q_2)/4t > 0$. Solving $K = 0$ with respect to p_2, we have the two roots:

$$\begin{cases} \beta_2 \equiv \dfrac{t(\mu_1 - \sqrt{8(1-\omega)\psi_1})}{4\omega}, \\ \beta_2' \equiv \dfrac{t(\mu_1 + \sqrt{8(1-\omega)\psi_1})}{4\omega}, \end{cases} \quad (27)$$

where $\omega = q_1 + q_2 - q_1 q_2$, $\psi_1 = 8 - 3q_2 + q_1(4q_2 - 5)$, and $\mu_1 = 16 - 11q_2 + q_1(12q_2 - 13)$. It is easily checked that $0 < \beta_2 < b_1/4 < \beta_2'$. Together with the fact that $\partial^2 K/\partial p_2^2 > 0$, we have

$$\begin{cases} E\left(\pi_1 \middle| p_1 = \dfrac{1}{8}(4p_2 + b_1)\right) \ge E(\pi_1 \mid p_1 = p_2 - \epsilon) \\ \quad \text{if } p_2 \in (0, \beta_2], \\ E\left(\pi_1 \middle| p_1 = \dfrac{1}{8}(4p_2 + b_1)\right) < E(\pi_1 \mid p_1 = p_2 - \epsilon) \\ \quad \text{if } p_2 \in \left(\beta_2, \dfrac{b_1}{4}\right). \end{cases} \quad (28)$$

Equation (28) tells us that $(1/8)(4p_2 + b_1)$ is the best response when $p_2 \le \beta_2$, and $p_2 - \epsilon$ is the best response when $\beta_2 < p_2 \le b_1/4$.

Now we can write down firm 1's best response:

$$p_1 = \begin{cases} \dfrac{1}{8}(4p_2 + b_1) & \text{if } p_2 \le \beta_2, \\ p_2 - \epsilon & \text{if } \beta_2 < p_2 \le \dfrac{a_1}{4}, \\ \dfrac{1}{8}(4p_2 + a_1) & \text{if } p_2 > \dfrac{a_1}{4}. \end{cases} \quad (29)$$

Similarly, we can calculate the best response for firm 2:

$$p_2 = \begin{cases} \dfrac{1}{8}(4p_1 + b_2) & \text{if } p_1 \le \beta_1, \\ p_1 - \epsilon & \text{if } \beta_1 < p_1 \le \dfrac{a_2}{4}, \\ \dfrac{1}{8}(4p_1 + a_2) & \text{if } p_1 > \dfrac{a_2}{4}, \end{cases} \quad (30)$$

where

$$a_2 = \frac{t(8 - 5q_2 + q_1(4q_2 - 3))}{q_1 + q_2 - q_1 q_2}, \quad b_2 = \frac{t(3q_2 + q_1(5 - 4q_2))}{q_1 + q_2 - q_1 q_2},$$
$$\beta_1 = \frac{t(\mu_2 - \sqrt{8(1-\omega)\psi_2})}{4\omega},$$

and $\omega = q_1 + q_2 - q_1 q_2$, $\psi_2 = 8 - 3q_1 + q_2(4q_1 - 5)$, and $\mu_2 = 16 - 11q_1 + q_2(12q_1 - 13)$. Q.E.D.

Proof of Lemma 1. From Equation (5), using the best-response functions and substituting the result into the condition of $p_1 < p_2$, we have

$$\text{When } q_1 > \frac{4 - 3q_2}{5 - 4q_2}, \begin{cases} p_1^* = \dfrac{[q_1(5 - 4q_2) + 3q_2 - 16]t}{12(q_1 q_2 - q_1 - q_2)}, \\ p_2^* = \dfrac{[q_1(4q_2 - 5) - 3q_2 - 8]t}{12(q_1 q_2 - q_1 - q_2)}. \end{cases} \quad (31)$$

By the same logic, we have

$$\text{When } q_2 > \frac{4 - 3q_1}{5 - 4q_1}, \begin{cases} p_1^* = \dfrac{[q_1(4q_2 - 3) - 5q_2 - 8]t}{12(q_1 q_2 - q_1 - q_2)}, \\ p_2^* = \dfrac{[q_1(3 - 4q_2) + 5q_2 - 16]t}{12(q_1 q_2 - q_1 - q_2)}. \end{cases} \quad (32)$$

The above two equations tell us that when $q_i \le (4 - 3q_j)/(5 - 4q_j)$, there does not exist a pure-strategy equilibrium in pricing. Q.E.D.

Proof of Lemma 2. First we show than when $q_1 \le q_2$ the lower limit of the profit of price dispersion is β_2; i.e., $\beta_1 \le \beta_2$. Simplifying $\beta_1 - \beta_2$, we have

$$\beta_1 - \beta_2 = \frac{-t}{2\omega}\left[q_2 - q_1 + 2\sqrt{2}\left(\sqrt{(1-\omega)\psi_2} - \sqrt{(1-\omega)\psi_1}\right)\right]. \quad (33)$$

Because $1 > q_i \ge 0$, we have $\omega \ge 0$; thus $-t/2\omega \le 0$. Now we need to prove that

$$\left[q_2 - q_1 + 2\sqrt{2}\left(\sqrt{(1-\omega)\psi_2} - \sqrt{(1-\omega)\psi_1}\right)\right] \ge 0 \quad \text{if } q_1 \le q_2.$$

We have

$$q_2 - q_1 + 2\sqrt{2}(\sqrt{(1-\omega)\psi_2} - \sqrt{(1-\omega)\psi_1}) \ge 0$$
$$\iff 2\sqrt{2}(\sqrt{(1-\omega)\psi_2} - \sqrt{(1-\omega)\psi_1}) \ge q_1 - q_2$$
$$\iff \frac{4\sqrt{2}(1-\omega)(q_1 - q_2)}{\sqrt{(1-\omega)\psi_2} + \sqrt{(1-\omega)\psi_1}} \ge q_1 - q_2.$$

Because $1 > q_2 \ge q_1 \ge 0$, canceling out the $q_1 - q_2$ on both sides of the inequality and $\sqrt{1-\omega}$ in the fraction, we have

$$\iff 4\sqrt{2}\sqrt{1-\omega} \le \sqrt{\psi_2} + \sqrt{\psi_1}$$
$$\iff 32(1-\omega) \le 8 + 8(1-\omega) + 2\sqrt{\psi_1 \psi_2}$$
$$\iff \sqrt{\psi_1 \psi_2} \ge 8 - 12\omega.$$

Because $q_2 \ge q_1$, we have

$$\sqrt{\psi_1 \psi_2} = \sqrt{(8 - 3q_1 - 5q_2 + 4q_1 q_2)(8 - 3q_2 - 5q_1 + 4q_1 q_2)}$$
$$\ge 8 - 3q_1 - 5q_2 + 4q_1 q_2 = \psi_2.$$

Furthermore, $\psi_2 - (8 - 12\omega) = 7q_2 + 9q_1 - 8q_1 q_2 = 7q_2 + q_1 + 8q_1(1 - q_2) \ge 0$. Thus we have $\sqrt{\psi_1 \psi_2} \ge 8 - 12\omega$.

Given that $q_1 \le q_2$, we have $\beta_1 \le \beta_2$. Because when $p_2 < \beta_2$, firm 1 has $E(\pi_1 \mid p_1 = (1/8)(4p_2 + b_1)) > E(\pi_1 \mid p_1 = p_2 - \epsilon)$; it is then clear that Firm 1 will never set its price lower than $(1/8)(4\beta_2+b_1)$. Therefore, we can calculate firm 1's guaranteed profit:

$$\begin{aligned}\pi_1(\text{guaranteed}) &= Ap_1 = A\left(\frac{1}{8}(4\beta_2+b_1)\right)\\ &= \frac{t}{32(q_1+q_2-q_1q2)}[(8-3q_2+q_1(-5+4q_2))\\ &\quad -2\sqrt{2}\sqrt{(-1+q_1)(-1+q_2)(8-3q_2+q_1(-5+4q_2))}]^2\\ &= \frac{t(\psi_1-\sqrt{8(1-\omega)\psi_1})^2}{32\omega}. \end{aligned} \tag{34}$$

For firm 2, it knows firm 1 will never set a price lower than $1/8(4\beta_2+b_1)$. Thus it will never set a price p_2 lower than β_2. Then we have

$$\begin{aligned}\pi_2(\text{guaranteed}) &= Bp_2 = B\beta_2\\ &= \frac{((5q_1+3q_2-4q_1q_2)+2\sqrt{2}\sqrt{(-1+q_1)(-1+q_2)(8-3q_2+q_1(-5+4q_2))})}{32(q_1(-1+q_2)-q2)}\\ &\quad\times((-16+q_1(13-12q_2)+11q_2)t\\ &\quad\quad +4\sqrt{2}\sqrt{(-1+q_1)(-1+q_2)(8-3q_2+q_1(-5+4q_2))t^2})\\ &= \frac{(8-\psi_1+2\sqrt{2}\sqrt{(1-\omega)\psi_1})(\mu_1-4\sqrt{2}\sqrt{(1-\omega)\psi_1})t}{32\omega}.\quad \text{Q.E.D.}\end{aligned} \tag{35}$$

Proof of Proposition 2. For ease of exposition, we focus on the case of $q_1 \le q_2$. We know that when $\max\{q_1,q_2\}=1$, or when $\max\{q_1,q_2\}<1$ and $q_2>(4-3q_1)/(5-4q_1)$, there is a unique pure-strategy equilibrium in pricing. We also know that when $\max\{q_1,q_2\}<1$ and $q_2\le(4-3q_1)/(5-4q_1)$, there exists a mixed-strategy equilibrium in pricing. With this knowledge in mind, we proceed with the proof in five steps.

1. We show that, under a pure-strategy pricing equilibrium, both firms' profits are convex with respect to their decision about the precision of the previews q_i ($\partial^2\pi_i/\partial q_i^2>0$ if $\max\{q_1,q_2\}=1$, or if $\max\{q_1,q_2\}<1$ and $q_2>(4-3q_1)/(5-4q_1)$.
2. We show that under a mixed-strategy pricing equilibrium, firm 1's profit is also convex with respect to q_1 ($\partial^2\pi_1/\partial q_1^2>0$ if $\max\{q_1,q_2\}<1$ and $q_2\le(4-3q_1)/(5-4q_1)$). Together with Step 1, we then know that firm 1's optimal precision decision $q_1^*\in\{0,1-\epsilon,1\}$.
3. Given that $q_1^*=0$ or $1-\epsilon$ under a mixed-strategy equilibrium in pricing, we show that firm 2's profit is nondecreasing in q_2.
4. Given that $q_1^*\in\{0,1-\epsilon,1\}$, we show that firm 2's optimal strategy is $q_2^*=1$.
5. Given that $q_2^*=1$, we show $q_1^*=0$.

Step 1. Comparing Equation (3) with Equation (32), it is straightforward to see that the equilibrium price when $\max\{q_1,q_2\}=1$ is identical to the equilibrium price when $\max\{q_1,q_2\}<1$ and $q_2>(4-3q_1)/(5-4q_1)$. Substituting Equation (32) into the profit function $E(\pi_i)=p_i^*E[D_i(p_i^*)]$, one can easily check that

$$\begin{cases}\dfrac{\partial^2E(\pi_1)}{q_1^2}=\dfrac{[q_2(q_2+6)-8]^2t}{144[q_1(1-q_2)+q_2]^3}>0,\\[2ex] \dfrac{\partial^2E(\pi_2)}{q_2^2}=\dfrac{[q_1(14+q_1)-16]^2t}{144[q_1(1-q_2)+q_2]^3}>0.\end{cases} \tag{36}$$

Step 2. In the mixed-strategy pricing equilibrium, we can state the following. Assuming $q_1\le q_2$, we claim that firm 1's guaranteed profit from the mixed-strategy pricing equilibrium is convex with respect to its decision about the precision of its preview q_1.

Proof. We know the following:

$$\pi_1(\text{guaranteed})=\frac{t(\psi_1-\sqrt{8(1-\omega)\psi_1})^2}{32\omega}.$$

Let

$$\begin{aligned}f_1(q_1) &\equiv \frac{1}{\omega}=\frac{1}{(q_1+q_2-q_1q_2)},\\ f_2(q_1) &\equiv \psi_1-\sqrt{8(1-\omega)\psi_1}\\ &= (8-3q_2+q_1(-5+4q_2))\\ &\quad -2\sqrt{2}\sqrt{(1-q_1)(1-q_2)(8-3q_2+q_1(-5+4q_2))}.\end{aligned}$$

We have $\pi_1=t/32f_1f_2^2$. To facilitate the proof, we establish the following facts:

(1) $f_2\ge 0$ for all possible q_1,q_2.

This is easy to prove:

$$\begin{aligned}&(8-3q_2+q_1(-5+4q_2))^2-8(-1+q_1)(-1+q_2)\\ &\quad\cdot(8-3q_2+q_1(-5+4q_2))\\ &\quad=(8-3q_2-5q_1+4q_1q_2)(5q_2+3q_1-4q_1q_2)\ge 0\\ &\quad\Longrightarrow\ (8-3q_2+q_1(-5+4q_2))\\ &\quad\ge 2\sqrt{2}\sqrt{(-1+q_1)(-1+q_2)(8-3q_2+q_1(-5+4q_2))}.\end{aligned} \tag{37}$$

(2)

$$\frac{\partial^2 f_1}{\partial q_1^2}=\frac{2(1-q_2)^2}{\omega^3}\ge 0.$$

(3)

$$\frac{\partial^2 f_2}{\partial q_1^2}=\frac{(1-q_2)^2(3+q_2)^2}{\sqrt{2[(1-q_1)(1-q_2)(8-3q_2+q_1(-5+4q_2))]^3}}\ge 0.$$

With those facts established, we now calculate the second derivative of π_1:

$$\begin{aligned}\frac{\partial^2\pi_1}{\partial q_1^2} &= \frac{t}{32}\bigg(\frac{\partial^2 f_1}{\partial q_1^2}f_2^2+4f_2\frac{\partial f_1}{\partial q_1}\frac{\partial f_2}{\partial q_1}\\ &\quad +2f_1\left(\frac{\partial f_2}{\partial q_1}\right)^2+2f_1f_2\frac{\partial^2 f_2}{\partial q_1^2}\bigg).\end{aligned} \tag{38}$$

Take $4f_2(\partial f_1/\partial q_1)(\partial f_2/\partial q_1)+2f_1(\partial f_2/\partial q_1)^2$ as a quadratic function of $\partial f_2/\partial q_1$, and when $\partial f_2/\partial q_1=-f_2(\partial f_1)/(\partial q_1)/f_1$, the above function reaches its minimum:

$$\frac{\partial^2\pi_1}{\partial q_1^2}\ge\frac{t}{32}\left(\frac{\partial^2 f_1}{\partial q_1^2}f_2^2-2\left(f_2\frac{\partial f_1}{\partial q_1}\right)^2\Big/ f_1+2f_1f_2\frac{\partial^2 f_2}{\partial q_1^2}\right). \tag{39}$$

Because $f_1 \geq 0$ and $f_2 \geq 0$, multiplying f_1 and dividing by f_2 in the left-hand side of the above inequality, we have

$$\frac{\partial^2 f_1}{\partial q_1^2} f_2^2 - 2\left(f_2 \frac{\partial f_1}{\partial q_1}\right)^2 \Big/ f_1 + 2 f_1 f_2 \frac{\partial^2 f_2}{\partial q_1^2} \geq 0$$
$$\iff \frac{\partial^2 f_1}{\partial q_1^2} f_2 f_1 - 2 f_2 \left(\frac{\partial f_1}{\partial q_1}\right)^2 + 2 f_1^2 \frac{\partial^2 f_2}{\partial q_1^2} \geq 0. \quad (40)$$

Notice that

$$f_1 \frac{\partial^2 f_1}{\partial q_1^2} = \frac{2(1-q_2)^2}{(q_1+q_2-q_1 q_2)^4} = 2\left(\frac{\partial f_1}{\partial q_1}\right)^2; \quad (41)$$

we have

$$\frac{\partial^2 f_1}{\partial q_1^2} f_2 f_1 - 2 f_2 \left(\frac{\partial f_1}{\partial q_1}\right)^2 + 2 f_1^2 \frac{\partial^2 f_2}{\partial q_1^2} = 2 f_1^2 \frac{\partial^2 f_2}{\partial q_1^2} \geq 0.$$

Hence $\partial^2 \pi_1 / \partial q_1^2 \geq 0$. Q.E.D.

Combining Steps 1 and 2, we know that, for $\max\{q_1, q_2\} < 1$, firm 1's optimal precision decision has $q_1^* \in \{0, 1-\epsilon\}$, and for $\max\{q_1, q_2\} = 1$, firm 1 has $q_1^* \in \{0, 1\}$. □

Step 3. Note that mixed-strategy pricing equilibrium only exists when $\max\{q_1, q_2\} < 1$. Thus firm 2 understands that $q_1^* \in \{0, 1-\epsilon\}$ if $\max\{q_1, q_2\} < 1$. Therefore, firm 2 will optimize the precision of its previews q_2, assuming $q_1 = 0$ or $1-\epsilon$. Assuming $q_1 \leq q_2$, when either $q_1 = 1-\epsilon$ or $q_1 = 0$, we now show that firm 2's guaranteed profit is nondecreasing in the precision of its previews q_2.

When $q_1 = 1$, it is easily checked that

$$\lim_{q_1 \to 1} \frac{\partial \pi_2(\text{guaranteed})}{\partial q_2} = \frac{(1-q_2)t}{16} \geq 0.$$

When $q_1 = 0$,

$$\frac{\partial \pi_2(\text{guaranteed})}{\partial q_2} = \frac{t((128-81q_2^2)\sqrt{(1-q_2)(8-3q_2)} + \sqrt{2}(q_2(176+17q_2(11-6q_2))-256))}{32 q_2^2 \sqrt{(1-q_2)(8-3q_2)}}.$$

It can be easily checked that the numerator reaches its minimum of 0 when $q_2 \to 0$. Thus we have

$$\frac{\partial \pi_2(\text{guaranteed})}{\partial q_2} \geq 0. \quad \text{Q.E.D.}$$

Step 4. In Step 1, we know that under pure-strategy pricing equilibrium, firm 2's profit is convex with respect to precision of its previews q_2. This leads to $q_2^* \in \{0, 1\}$ under pure-strategy pricing equilibrium. In Step 3, we know that under mixed-strategy pricing equilibrium, firm 1's profit is nondecreasing in precision of its previews, q_2, given that $q_1^* \in \{0, 1-\epsilon\}$. This leads to $q_2^* = (4-3q_1^*)/(5-4q_1^*)$.

With the knowledge that firm 1's optimal precision of its previews $q_1^* \in \{0, 1-\epsilon, 1\}$, we examine firm 2's optimal precision of its previews.

(1) If $q_1^* = 0$, then firm 2 has three options: $q_2 = 0$, $q_2 = (4-3q_1)/(5-4q_1) = 4/5$, and $q_2 = 1$. Comparing the corresponding profit of firm 2, we have

$$\begin{cases} \pi_2(q_1 = 0, q_2 = 0) = 0, \\ \quad \text{play pure-strategy pricing equilibrium;} \\ \pi_2(q_1 = 0, q_2 = 4/5) = \dfrac{(3\sqrt{14}-1)t}{40} \\ \quad \text{play mixed-strategy pricing equilibrium;} \\ \pi_2(q_1 = 0, q_2 = 1) = \dfrac{121t}{288} \\ \quad \text{play pure-strategy pricing equilibrium.} \end{cases} \quad (42)$$

It is obvious that if $q_1^* = 0$, then $q_2^* = 1$.

(2) If $q_1^* = 1-\epsilon$, then firm 2 has two options: $q_2 = (4-3q_1)/(5-4q_1) = (1+3\epsilon)/(1+4\epsilon)$ with mixed pricing equilibrium, and $q_2 = 1$ with pure-strategy pricing equilibrium. Simple calculation gives us:

$$\pi_1\left(\text{guaranteed} \mid q_1 = 1-\epsilon,\ q_2 = \frac{1+3\epsilon}{1+4\epsilon}\right)$$
$$\longrightarrow \quad \pi_1(q_1 = 1, q_2 = 1) = \frac{t}{2}.$$

This shows that if $q_1^* = 1$, then $q_2^* = 1$.

(3) If $q_1^* = 1$, obviously, $q_2^* = 1$ because $q_2 \geq q_1$.

With the above analysis, we can claim that, given $q_1^* \in \{0, 1-\epsilon, 1\}$, firm 2's optimal precision of its previews is $q_2^* = 1$.

Step 5. Given that $q_1^* \in \{0, 1-\epsilon, 1\}$, from Table 2, we know if $q_2^* = 1$, then firm 1's optimal precision of its previews is $q_1^* = 0$. Q.E.D.

References

Abernethy, A. M., G. R. Franke. 1996. The information content of advertising: A meta-analysis. *J. Advertising* **25**(2) 1–17.

Anand, B. N., R. Shachar. 2011. Advertising, the matchmaker. *RAND J. Econom*. Forthcoming.

Anderson, S. P., R. Renault. 2006. Advertising content. *Amer. Econom. Rev.* **96**(1) 93–113.

Becker, G. S. 1965. A theory of the allocation of time. *Econom. J.* **75**(299) 493–517.

Business Wire. 2005. The *Wall Street Journal* strengthens its international editions; repositions to better serve global business leaders and advertisers. (May 8).

Butters, G. R. 1977. Equilibrium distributions of sales and advertising prices. *Rev. Econom. Statist.* **44**(3) 465–491.

Chan, T. W., J. H. Goldthorpe. 2007. Social status and newspaper readership. *Amer. J. Sociol.* **112**(4) 1095–1134.

Chen, Y., J. Xie. 2005. Third-party product review and firm marketing strategy. *Marketing Sci.* **24**(2) 218–240.

Cooper, R., A. John. 1988. Coordinating coordination failures in Keynesian models. *Quart. J. Econom.* **103**(3) 441–463.

Dasgupta, P., E. Maskin. 1986. The existence of equilibrium in discontinuous economic games, I: Theory. *Rev. Econom. Stud.* **53**(1) 1–26.

Gabszewicz, J. J., D. Laussel, N. Sonnac. 2001. Press advertising and the ascent of the "pensée unique." *Eur. Econom. Rev.* **45**(4–6) 641–651.

Grossman, G. M., C. Shapiro. 1984. Informative advertising with differentiated products. *Rev. Econom. Stud.* **51**(1) 63–81.

Hotelling, H. 1929. Stability in competition. *Econom. J.* **39**(153) 41–57.

Jovanovic, B. 1982. Truthful disclosure of information. *Bell J. Econom.* **13**(1) 36–44.

Mayzlin, D., J. Shin. 2009. Uninformative advertising as an invitation to search. Working paper, Yale University, New Haven, CT.

Mullainathan, S., A. Shleifer. 2005. The market for news. *Amer. Econom. Rev.* **95**(4) 1031–1053.

Narasimhan, C. 1988. Competitive promotional strategies. *J. Bus.* **61**(4) 427–449.

New York Times. 2008. Magazine sales fall 6.3% at newsstands. (August 11), http://www.nytimes.com/2008/08/12/business/media/12magazine.html.

Picard, R. G. 2003. The economics of the daily newspaper industry. A. Alexander, J. Owers, R. Carveth, C. A. Hollifield, A. N. Greco, eds. *Media Economics: Theory and Practice*. Lawrence Erlbaum Associates, Mahwah, NJ, 109–126.

Picard, R. G., J. H. Brody. 1997. *The Newspaper Publishing Industry*. Allyn & Bacon, Boston.

Robert, J., D. O. Stahl II. 1993. Informative price advertising in a sequential search model. *Econometrica* **61**(3) 657–686.

Salop, S., J. E. Stiglitz. 1982. The theory of sales: A simple model of equilibrium price dispersion with identical agents. *Amer. Econom. Rev.* **72**(5) 1121–1130.

Shavell, S. 1994. Acquisition and disclosure of information prior to sale. *RAND J. Econom.* **25**(1) 20–36.

Van Zandt, T. 2004. Information overload in a network of targeted communication. *RAND J. Econom.* **35**(3) 542–560.

Varian, H. R. 1980. A model of sales. *Amer. Econom. Rev.* **70**(4) 651–659.

Xiang, Y., M. Sarvary. 2007. News consumption and media bias. *Marketing Sci.* **26**(5) 611–628.