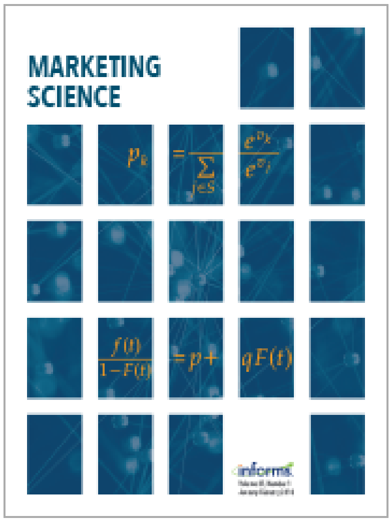

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Asymmetric Store Positioning and Promotional Advertising Strategies: Theory and Evidence

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Abstract

Asymmetrically positioned retailers, who vary in the quality/in-store service offered, are increasingly using promotional advertising—the practice of advertising sale prices on familiar merchandise lines—to compete for customers who are willing to comparison shop. The objective of this paper is to examine the role of promotional advertising for stores that vary in their quality positioning in competing for customers using a game-theoretic model. Our focus is on two key retail promotional advertising decisions: the frequency with which to advertise price reductions and the accompanying depth of discount.

We consider a stylized duopolistic retail market with the two stores that differ in their service positioning. We assume that each store enjoys a relative advantage in serving a subset or segment of customers who regularly visit it and whom we call ''patrons'' of the store. We assume that it costs more to shop at the less-frequented store. We further assume that consumers are only partially informed about the prevailing retail prices—while they perfectly know the posted price at the store that they patronize, they are uncertain about the price at the other store and have rational expectations about these prices. Consumers in this market differ on three dimensions: preference for service, shopping costs, and store switching costs. We explicitly consider two consumer segments differing in their willingness to pay for service. Furthermore, we assume store switching is more costly for the high-valuation segment. We allow for within-segment heterogeneity by assuming that consumers differ in their shopping costs.

Our analysis shows that if promotional advertising is not ''too costly,'' the equilibrium strategies of the competing retailers entail occasionally posting its ''regular'' price but not advertising that price and on other occasions posting its ''sale'' price and advertising that price. The analysis also suggests that promotional advertising is driven by ''offensive'' (traffic-building) as well as ''defensive'' (consumer-retention) considerations. Furthermore, the relative importance of offensive and defensive considerations is influenced by the service positioning of the stores. Specifically, relative to the low-service store, promotional advertising by the high-service store is driven more by offensive consideration than defensive consideration. Finally, a store's service positioning impacts its frequency of promotional advertising and the depth of discount that it offers during ''sale.'' Specifically, relative to the low-service store, the high-service store offers advertised sales more frequently but with shallower discounts.

These results follow from the fact that differences in service positioning lead to a natural consumer ''self-selection.'' Specifically, the consumer-mix of the high-service store comprises a higher fraction of the high-valuation consumers who are less sensitive to promotional advertising due to their higher store switching costs. Thus, if the low-service retailer were to build store traffic by targeting the customer mix of the high-service retailer (motivated by offensive consideration), it has to offer deeper discounts; yet the demand enhancement is lower. Thus, relative to the high-service store, promotional advertising is not that attractive for the low-service store. However, the low-service store still relies on offering discounted prices occasionally to retain its customer base. Thus when using promotional advertising to attract and retain customers, the high-service store should rely more on the ''frequency cue,'' while the low-quality store should rely more on the ''magnitude cue.''

We provide empirical support for the key predictions of our analytical model by collecting and analyzing retail promotional advertisements for stores that vary in their level of in-store service, published in major newspapers in a large U.S. metropolitan city. We collected data from 813 advertisements across 14 different product groups in the men's and women's categories. The data are consistent with the model's predictions. Our theory and empirical analysis should be of interest to both academics and practitioners, particularly those in the area of channel management and promotional advertising.

(*Retail Competition; Store Positioning; Promotional Advertising; Shopping Cost; Traffic Building; Customer Retention*)

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TABLE 1 Mean Time Interval and Depth of Discount for High- and Low-Service Stores for Men's Dress Shirts

	High-Service Stores∗	Low-Service Stores∗∗
Average interval between sales (days)	5.62	12.24
Averge depth of discount (%)	31%	56%

∗High-service stores include Marshall Field's, Bloomingdale's, Carson Pirie Scott, and Lord & Taylor.
∗∗Low-service stores include Filene's Basement and T.J. Maxx.

1. Introduction

In many retail markets, asymmetrically positioned stores provide different levels of service, store ambience, and convenience while competing for customers who comparison shop for similar merchandise offered by these stores; e.g., Marshall Field's and Filene's Basement in the apparel market and Workbench and Door Store in the furniture market (Berman and Evans 1995, Lewison 1997, Ortmeyer and Salmon 1989). These asymmetrically positioned stores primarily use promotional advertising—the practice of advertising sale prices on familiar merchandise lines—to attract customers. For instance, in 1990, retailers spent at least 70% of the total \$20 billion media expenditures on promotional advertising (Berman and Evans 1995). Most of these advertising dollars are used for newspaper advertising (approximately 75%) that is also rated by consumers to be the most important source of information for retail prices (Kopp et al. 1989, Newspaper Advertising Bureau 1990).

The two key decisions in retail promotional planning are the frequency of advertised sales and the depth of discount offered (Stern et al. 1995). A natural question that arises is whether the positioning of the store is related to its advertising frequency and depth of discount decisions? Table 1 below reports the average time interval between advertised sales and the average depth of discount advertised on men's dress shirts by both high- and low-service stores.[1] These data are collected from an overall total of 813 newspaper advertisements over a 6-month period in a major metropolitan city in the United States, out of which 133 advertisements related to men's dress shirts. Based on these data, we observe that the high-service stores advertise sales more frequently but offer lower depths of discount than the low-service stores. This pattern is observed for other product groups as well (data for 14 different product groups in both the men's and women's departments are reported in Table 3).

This empirical observation is particularly intriguing because neither conventional wisdom nor previous related theoretical research can readily explain this phenomenon. For instance, conventional wisdom based on the differences in consumers that these stores serve would suggest that high-service stores should advertise sales less frequently as well as offer a lower depth of discount than low-service stores because high-service stores serve consumers who are less price sensitive than low-service stores. Similarly, these differences in the promotional advertising strategies for high- versus low-service stores cannot be explained by the differences in their merchandise margins. Because high-service stores have higher margins and therefore a higher promotional budget, they may have a greater ability both to advertise sales more frequently and to offer higher depths of discount than low-service stores.

The observed empirical differences in the frequency and depth of discount decisions for high- versus low-service stores are also inconsistent with the predictions for strong versus weak brands in previous pioneering research on price promotions (Narasimhan 1988, Raju et al. 1990). Specifically, Narasimhan (1988) and Raju et al. (1990) predict that a brand with a higher loyal share/strong brand will promote less often than a brand with a lower loyal share/weak brand. Also, while Narasimhan (1988) predicts that both the strong and weak brand will offer the same expected discount, Raju et al. (1990) predict that the strong brand will offer a higher average depth of discount than the weak brand.[2] In a seminal work, Blatt-

[1]In the rest of the paper, we will refer to *quality* and *in-store service* interchangeably.

[2]A few caveats apply to this statement. Both of these papers model interbrand promotional competition. Hence, the above is based on interpreting high- (low-) service store as being the analog of strong (weak) brand in these papers. Furthermore, this statement applies only to the insights from the base models considered in these papers. Both Narasimhan (1988) and Raju et al. (1990) also consider several model extensions that yield different insights.

berg and Wisniewski (1989) present a rationale for the empirically observed asymmetry in cross-price elasticities for high- versus low-price-tier brands. This observed asymmetry implies that higher price-tier brands benefit from offering price cuts, because it takes away sales from lower price-tier brands. In contrast, lower price-tier brands will not take away sales from higher price-tier brands by offering similar price cuts. These findings suggest that higher price-tier brands derive a higher benefit by offering price cuts relative to lower price-tier brands. However, it is not immediately obvious as to why this higher benefit for high-service stores should imply only a higher frequency and not a higher depth of discount as well.

Our objective in this paper is to develop a game-theoretic framework to examine how the competition between retailers who differ in their level of quality/in-store service influences their promotional advertising decisions. Our analysis focuses on two key aspects of promotional advertising: (a) the frequency with which sales are advertised and (b) the advertised depth of discount. In particular, we are interested in answering the following questions:

1. What are the strategic considerations that underlie a retailer's decision on the frequency and depth-of-discount aspects of its promotional advertising strategy?
2. How do differences in the quality positioning of competing stores influence a retailer's decisions on the frequency of advertised sales and the depth of discount offered?
3. How do consumer characteristics influence the stores' promotional advertising decisions?

To address these issues, we consider a stylized duopolistic retail market with the two stores that differ in their service positioning. We assume that each store enjoys a relative advantage in serving a subset or segment of customers who regularly visit it and whom we call ''patrons'' of the store. It is assumed that it costs more to shop at the less-frequented store. We further assume that consumers are only partially informed about the prevailing retail prices—while they perfectly know the posted price at the store that they patronize, they are uncertain about the price at the other store and have rational expectations about these prices. This feature captures the fact that consumers have better price information about stores that they frequently visit, whereas they have less precise price information about stores visited only occasionally (say, during advertised sale events). Consumers in this market differ on three dimensions: preference for service, shopping costs, and store switching costs. We explicitly consider two consumer segments differing in their willingness to pay for service. Furthermore, we assume store switching is more costly for the high-valuation segment. We allow for within-segment heterogeneity by assuming that consumers differ in their shopping costs. These assumptions imply that segment-level demand is finitely elastic.

Our analysis shows that if promotional advertising its not ''too costly,'' the equilibrium strategies of the competing retailers entail occasionally posting its ''regular'' price (not advertised) and on other occasions positing its ''sale'' price (advertised). In addition, the analysis yields the following key insights:

- Promotional advertising is driven by both ''offensive,'' or traffic-building, and ''defensive,'' or consumer-retention, considerations.
- A store's quality positioning impacts the relative importance of offensive and defensive considerations as drivers of promotional advertising. Specifically, relative to defensive consideration, offensive consideration plays a more prominent role for the high-service store than for the low-service store.
- A store's service positioning impacts its frequency of promotional advertising and the depth of discount that it offers during ''sale.'' Specifically, relative to the low-service store, the high-service store offers advertised sales more frequently but with shallower discounts.

These results follow from the fact that differences in service positioning leads to a natural consumer ''self-selection.'' Specifically, the consumer mix of the high-service store comprises a higher fraction of the high-valuation consumers who are less sensitive to promotional advertising because of their higher store switching costs. Thus, if the low-service retailer were to build store traffic by targeting the customer mix of the high-service retailer (motivated by offensive consideration), it has to offer deeper discounts, and yet the demand enhancement is lower. Thus, relative to the high-service store, promotional advertising is not that attractive for the low-service store. However, the low-service store still relies on offering discounted prices occasionally to retain its customer base.

Our analysis thus suggests that in using promotional advertising to attract and retain customers, the high-quality store should rely more on the ''frequency cue,'' whereas the low-quality store should rely more on the ''magnitude cue.'' It further shows that the high-service store's reliance on frequency versus magnitude cues depends on its positional strength on the service dimension as well as customer segmentation characteristics. We offer empirical evidence in support of these findings.

1.1. Literature Review and Research Contributions

This paper builds on and contributes to three research streams. The first stream (e.g., Shilony 1977, Narasimhan 1988, Raju et al. 1990) examines the phenomena of price promotions, in the context of both brand-level and (grocery) retail-level competition. Assuming perfect consumer knowledge about prevailing prices of the competing brands/retailers, these papers show that a pure strategy equilibrium in which manufacturers charge a single price for their brands does not exist because of incentives to undercut the competitor's price. The second stream (e.g., Varian 1980, Banks and Moorthy 1996) investigates a market where consumers are uninformed about prevailing prices of all the brands/retailers. They show that if valuation and search costs are positively correlated, price promotions can be used as a mechanism to implement price discrimination.[3] We contribute to these research streams by examining a retail market where consumers have imperfect price knowledge (i.e., they know about prevailing prices at certain outlets better than others) and highlight the role of promotional advertising as a competitive tool.

[3]Note in Narasimhan (1988), we can also interpret ''loyal'' consumers as those who lack information on prices of the competing brand. Similarly, Varian (1980) can be interpreted as a model with perfectly informed loyals and switchers. We thank an anonymous reviewer for this interpretation.

The third stream (e.g., Blattberg and Wisniewski 1989, Allenby and Rossi 1991) empirically examines the impact of price promotions on the sales of brands asymmetrically positioned in terms of quality. It finds evidence of asymmetric price elasticity. We contribute to this stream by highlighting the strategic implications of this asymmetry for retail promotional advertising decisions.

In contrast, a recent set of marketing papers has incorporated varying roles for price advertising in different retailing contexts. Lal and Matutes (1994), in the context of multiproduct retailers (grocery stores), highlight the commitment role of price advertising. Lal and Rao (1997), again in the context of multiproduct retailers, investigate the role of two different formats of price advertising (namely, EDLP and Hi-Lo formats) and highlight the dependence between stores' positioning and pricing strategies. Simester (1995) investigates the role of advertised prices in influencing consumers' expectations about the unadvertised prices, thus highlighting the signaling role of price advertisements. We contribute to this stream by highlighting the informational role of promotional advertising.

The rest of the paper is organized as follows. In §2, we present the basic assumptions of our model and derive analytical expressions for the retail demand. We present the equilibrium analysis in §3 and characterize the optimal retail promotional advertising strategies. We also highlight the differences in the optimal strategies of the high- and low-quality stores. We discuss the data, empirical model formulations, and results of our empirical analysis in detail in §4. In §5, we discuss the conclusions and managerial implications and provide directions for future research.

2. The Model

Retail Structure

We consider a retail market with two competing stores: store H and store L. We further assume that the two stores differ in their positioning on the quality dimension: the quality of store H is q_H, whereas that of store L is q_L with $q_H > q_L > 0$. This captures the *vertical differentiation* in the retail market. The difference in quality could arise from differences in the level of in-store service, store ambience, shopping convenience, etc. (Stern et al. 1995). For instance, retail chains in the apparel market can be classified into two major retailer groups: Traditional department stores such as Carson Pirie Scott and Marshall Field's offer higher in-store service than full-line discount stores such as Filene's Basement and T.J. Maxx. We assume that each store enjoys a relative advantage in serving a subset or segment of customers in this market who regularly visit it and whom we call ''patrons'' of the store. This captures the *horizontal differentiation* in the retail market. A store may enjoy this relative advantage among patrons for several reasons: (a) their familiarity with the store in terms of its layout (stores have very different layouts with several departments spread over multiple floors); (b) knowledge of how to shop at the store based on their prior experiences (e.g., from whom to obtain in-store assistance); (c) familiarity with the price levels and merchandise sold by the store; (d) geographic proximity with the store, etc. We assume that in the face of uncertainty about prevailing store prices and the absence of a sale from either store, *H*-patrons will visit store *H* and *L*-patrons visit store *L*. However, when a sale is offered each store may also attract the other store's patrons. These assumptions are consistent with findings based on a survey conducted with retail managers in the apparel market (Kopp et al. 1989). The stores are assumed to sell comparable merchandise that can be considered imperfect substitutes.[4] We assume that stores have an identical marginal cost of c which, without loss of generality, is set to zero (we discuss this assumption in §2.1). This characterization is similar to that of Shilony (1977) and Bester and Petrakis (1995).

Consumer Characteristics and Shopping Behavior
We assume a unit mass of *H*-patrons and *L*-patrons. Furthermore, we assume that a fraction, $\rho \in [0, 1]$, of both *H*-patrons and *L*-patrons have a higher valuation (preference) for quality, whereas the remaining consumers have a lower-quality valuation (we discuss this assumption in §2.1). We label the former as the *HV* consumer segment, whereas the latter is referred to as the *LV* consumer segment. This captures the *vertical heterogeneity* across the customers. The consumer valuations assumed in the analysis are as below.[5]

	Buying at Store *L*	Buying at Store *H*
Valuation of *LV* consumers	$v_L^{LV} = v > 0$	$v_H^{LV} = \theta v > 0$, $\theta > 1$
Valuation of *HV* consumers	$v_L^{HV} = \alpha v > 0$, $\alpha > 1$	$v_H^{HV} = \alpha\theta v > 0$

The parameter θ captures the extent of vertical differentiation in the retail market so that $\theta = 1$ denotes either a symmetric positioning of stores on the quality dimension or that consumers do not value the quality differentials across stores. It is instructive to view v as representing the core product valuation, whereas α represents the extent of heterogeneity in consumers' preference for in-store service.

We capture the heterogeneity in consumer (unit) shopping costs through the parameter s that is assumed to be uniformly distributed, i.e., $s \sim U[0, \bar{s}]$. This captures the *horizontal heterogeneity* across customers. Furthermore, we assume that a store's patrons incur a higher shopping cost while visiting the competing store. This is represented by a scaling factor, β, $\beta > 1$. We also assume that *HV* consumers incur higher shopping costs than *LV* consumers. We rep-

[4]In a survey conducted with high- and low-service stores in our empirical study, we found that for the categories studied, the mix of products—in terms of both breadth of product line and depth of assortment—across different price points are comparable. For instance, both Marshall Field's (a high-service store) and T.J. Maxx (a low-service store) have roughly a 30:70 mix of ''better'' and ''moderate''-priced merchandise. Also, while Marshall Field's has approximately 40,000 SKUs, T.J. Maxx has about 37,500 SKUs in men's categories.

[5]Note that in this formulation, $v_H^{HV}/v_L^{HV} = v_H^{LV}/v_L^{LV} = \theta$ while $v_H^{HV}/v_H^{LV} = v_L^{HV}/v_L^{LV} = \alpha$. These valuations are implied by the valuation-for-quality function of the form $u_{ij}(\gamma_i, q_j) = \gamma_i q_j$, where γ_i stands for the marginal willingness to pay for quality for consumer i with $\gamma_{HV} > \gamma_{LV} > 0$ and q_j is the quality of the ''augmented'' product (base product + shopping experience) at store j with $q_H > q_L > 0$ (Moorthy 1988, Bagwell and Riordan 1991).

resent this higher cost by a scaling factor, τ, $\tau > 1$.[6] Thus, an *L*-patron belonging to the *LV* segment with a unit shopping cost of $s \in [0, \bar{s}]$ incurs a shopping cost of s to visit store *L,* whereas she incurs a shopping cost of βs *to visit store H,* and vice versa, for *H*-patrons. On the other hand, an *L*-patron belonging to the *HV* segment with a unit shopping cost of $s \in [0, \bar{s}]$ incurs a shopping cost of τs to visit store *L,* while she incurs a shopping cost of $\beta\tau s$ to visit store *H.* Note that the parameters $\bar{s}$ and β capture two distinct aspects of horizontal differentiation. While $\bar{s}$ represents the extent of consumer heterogeneity in shopping costs, β captures the magnitude of the switching cost from the store that the consumer patronizes (Berman and Evans 1995, Stern et al. 1995).[7] Under this interpretation, a larger value of $\bar{s}$ would signify greater variations in consumer shopping costs. Similarly, a larger value of β would imply a higher extent of store loyalty.

Therefore, the consumer surplus function (i.e., valuation less shopping cost and price) is given by

$$CS_j^i = v_j^i - \beta_j^i \tau^i s_i - p_j, \tag{1}$$

with

$$v_j^i = \text{gross willingness to pay of consumer } i, \quad i \in \{HV, LV\}, \quad \text{at store } j, \quad j \in \{H, L\},$$

$$\beta_j^i = \begin{cases} \beta > 1 & \text{if consumer } i \text{ is not store } j\text{'s patron;} \\ 1 & \text{if consumer } i \text{ is not store } j\text{'s patron,} \end{cases}$$

$$\tau^i = \begin{cases} \tau > 1 & \text{if consumer } i \text{ belongs to the } HV \text{ segment;} \\ 1 & \text{if consumer } i \text{ belongs to the } LV \text{ segment.} \end{cases}$$

[6]Note that our assumption of a positive correlation between consumer valuation for quality and shopping costs (being implied by $\theta > 1$ and $\tau > 1$) is consistent with the literature (Salop and Stiglitz 1977, Tellis and Wernerfelt 1987, Banks and Moorthy 1996, Lal and Rao 1997) and is justifiable on the ground that consumers with higher valuation for in-store service and ambience, being higher income consumers, also have a higher opportunity cost of time and hence higher shopping costs (Becker 1965).

[7]An alternative interpretation is based on consumers' preference for proximity/convenience in the spirit of Hotelling-type locational models (e.g., Lal and Rao 1997). If $\beta = 1$, there is no store loyalty or switching cost and the set-up reduces to a pure vertical differentiation model. If both $\beta = 1$ and $\theta = 1$, the retail competition reduces to undifferentiated Bertrand competition.

2.1. Discussion of Key Model Assumptions

1. *Similar Cost Structure.* We assume that stores have an identical marginal cost for model parsimony. The net effect of this assumption (coupled with the fact that consumers have higher willingness to pay while buying at the high-service store) is that the high-service store enjoys a higher margin. As we discuss in §3.2, this higher margin forms the basis for the high-service store to offer advertised sales with a higher frequency than the low-service store. Therefore, even if we allow the high-service store to have a higher cost, as long as it continues to enjoy a higher margin this result will continue to hold.[8]

2. *Same Mix of High- and Low-Valuation Consumers.* We assume that the mix of high- vs. low-valuation customers is the same among the patrons of the high- and low-service stores. This is not a critical assumption for our analysis and is made for analytical simplicity. Allowing the high-service store to have a higher fraction of high-valuation customers will only strengthen our results.

3. *Imperfect Price Information.* We assume that *H*-patrons are aware of the prevailing prices at store *H* while they are uncertain about the prevailing prices at store *L.* Similar assumption holds for *L*-patrons. This assumption captures the notion that consumers are better informed about prices at stores that they regularly shop at and are familiar with versus prices at stores that they occasionally visit to take advantage of the sales offered. Furthermore, this assumption is also consistent with that in Gabszewicz and Garella (1987) and Bester and Petrakis (1995).

4. *Rational Expectations.* We assume that consumers form rational expectations about prevailing retail prices that they are unaware of. In the context of the model, this means that when an *H*-patron (*L*-patron)

[8]An industry study done in 1995 by McKinsey Consultants (cited in Stern et al. 1996) suggests that department stores have higher margins than discount stores. In addition, we collected data on retail margins from a sample of both high- and low-service stores. On an average, retail margins were 40–50% higher for the high-service stores than discount stores. For instance, the gross profit margins for Neiman-Marcus over the period from 1991 to 1995 was 35.5%, whereas that for T.J. Maxx over the same period was 23.2%. We thank the editor and the area editor for suggesting this comparison.

does not receive a promotional advertisement from store L (store H), she correctly infers that store L (store H) is not offering a sale. As we discuss in §2.2, this inference is consistent with store L's (store H's) incentives and equilibrium strategies. Furthermore, the rational expectation assumption is consistent with the literature (Lal and Matutes 1994, Bester and Petrakis 1995, Lal and Rao 1997).[9]

2.2. Rational Expectations and Consumer Beliefs About Unadvertised Prices

In this section we discuss the rationale underlying consumer inference about a store's unadvertised price. Recall that as per our assumptions, even when a store does not advertise its posted price, its patrons are aware of it. Thus the problem of inferring the store's unadvertised price is relevant only for the patrons of the competing store.

Let p_H and p_L be the prices of stores H and L, respectively. Furthermore, define indicator variables δ_j, $j \in \{H, L\}$, denoting the advertising decisions of store j such that $\delta_j = 1$ if store j advertises its price p_j while $\delta_j = 0$ otherwise.

Rational Expectation About Store *L*'s Unadvertised Price (p_L^e). Because L-patrons are aware of p_L, we need only consider the case of an H-patron. As per our assumption, this consumer is perfectly informed of store H's posted price p_H irrespective of whether store H advertises this price or not. However, to decide whether to shop at store H or L, she must form an expectation about store L's unadvertised price. What should be her belief about the unadvertised price p_L? She reasons as follows: If store L had posted a ''low'' price, it would have the incentive to advertise its price because by doing so, store L can induce some of the H-patrons (those with low shopping costs) to switch to store L. Thus, if store L has not advertised its price p_L, it must be that the price is ''high'' so that no H-patron would switch even when informed about it. It can be shown that such a ''high'' price satisfies the condition: $p_L^e > p_H - v(\theta - 1)$.[10]

Rational Expectation About Store *H*'s Unadvertised Price (p_H^e). A similar argument indicates that when store H does not advertise its price p_H, the L-patrons should recognize that this price is ''high,'' i.e., $p_H^e > p_L + \alpha v(\theta - 1)$. Under this condition, no L-patron would switch to store H even if the store were to advertise its price.

2.3. Characterization of Retail Demand[11]

We briefly discuss the logic underlying the demand characterization for store H. We need to consider demand in the following two situations: (a) store H charges a ''high'' price, and (b) store H charges a ''low'' price.[12]

(a) *Store H charges a "high" price.* As mentioned earlier, when $p_H > p_L + \alpha v(\theta - 1)$, even if store H were to advertise its price, it will not induce L-patrons to switch stores. Thus, the demand is exclusively derived from high- and low-valuation H-patrons and is independent of store H's promotional advertising. However, if store L advertises its price, some H-patrons (those with low shopping costs) will switch to store L, thereby reducing the demand at store H.[13]

Aggregating demands from high- and low-valua-

[9]Having said that, we recognize that consumer's rational expectation implicitly assumes that consumers are reasonably aware of the pricing pattern in the product category. As such, this assumption may be more applicable to items such as apparel that are commonly advertised by retail stores and whose general price levels consumers are typically familiar with at different stores (e.g., men's white shirts). We thank an anonymous reviewer for alerting us to this issue.

[10]Note that for any H-patron to switch to store L, she must derive a higher surplus at store L: $\theta v - s - p_H < v - \beta s - p_L$. Thus, she will switch to store L only if $s < \{p_H - p_L - v(\theta - 1)\}/(\beta - 1)$, i.e., her shopping cost is ''low enough.'' However, shopping cost must be positive, i.e., $s > 0$. For this condition to hold for any H-patron, we must have $p_L \leq p_H - v(\theta - 1)$. However, when $p_L > p_H - v(\theta - 1)$ no H-patron (with a positive shopping cost) will find it optimal to switch to store L.

[11]The analytical details underlying the demand derivations are given in the Technical Supplement, which is available at http://www.informs.org.

[12]Note that it is not optimal for store H to offer a price in the ''intermediate'' range such that $p_L + \alpha v(\theta - 1) > p_H > p_L + v(\theta - 1)$. The store can always increase its profit by reducing its price further (i.e., to ''low'' price range) and attract low-valuation L-patrons as well.

[13]Specifically, the consumers who switch are low-valuation H-patrons with $s \leq \{p_H - p_L - v(\theta - 1)\}/(\beta - 1)$ and high-valuation H-patrons with $s \leq \{p_H - p_L - \alpha v(\theta - 1)\}/\tau(\beta - 1)$.

tion H-patrons and adjusting for store switching in the event of promotional advertising by store L (cf. footnote 16), the demand at store H is given by

$$\begin{aligned} &D_H(p_H, p_L, \delta_H, \delta_L) \\ &\quad = \frac{\theta v[\alpha\rho + \tau(1-\rho)] - p_H[\rho + \tau(1-\rho)]}{\tau\bar{s}} \\ &\qquad - \delta_L[\{(p_H - p_L)[\rho + \tau(1-\rho)] \\ &\qquad\qquad - v(\theta - 1)[\alpha\rho + \tau(1-\rho)]\}/[(\beta - 1)\tau\bar{s}]], \\ &\qquad \text{if } p_H > p_L + \alpha v(\theta - 1). \end{aligned} \tag{2}$$

(b) *Store H charges a "low" price.* This is the price range when, if store H advertises its price, it attracts both the high- and low-valuation L-patrons who have low shopping costs. Specifically, we have $p_H \le p_L + v(\theta - 1)$.[14] Furthermore, in this range, even if store L were to advertise its price, it would not induce any H-patron to switch to store L. Thus, store H's demand is independent of store L's promotional advertising.

Aggregating demands from the high- and low-valuation H- and L-patrons, the demand at store H is given by

$$\begin{aligned} &D_H(p_H, p_L, \delta_H, \delta_L) \\ &\quad = \frac{\theta v[\alpha\rho + \tau(1-\rho)] - p_H[\rho + \tau(1-\rho)]}{\tau\bar{s}} \\ &\qquad + \delta_H[\{v(\theta - 1)[\alpha\rho + \tau(1-\rho)] \\ &\qquad\qquad + (p_L - p_H)[\rho + \tau(1-\rho)]\}/[(\beta - 1)\tau\bar{s}]], \\ &\qquad \text{if } p_H \le p_L + v(\theta - 1). \end{aligned} \tag{3}$$

Demand at Store *L*. As above, the demand at store L is obtained by aggregating demand from four consumer segments: the high- and low-valuation L-patrons as well as the high- and low-valuation H-patrons. It can be shown that store L's demand when it charges "high" price is given by

$$\begin{aligned} &D_L(p_H, p_L, \delta_H, \delta_L) \\ &\quad = \frac{v[\alpha\rho + \tau(1-\rho)] - p_L[\rho + \tau(1-\rho)]}{\tau\bar{s}} \\ &\qquad - \delta_H[\{v(\theta - 1)[\alpha\rho + \tau(1-\rho)] \\ &\qquad\qquad + (p_L - p_H)[\rho + \tau(1-\rho)]\}/[(\beta - 1)\tau\bar{s}]], \\ &\qquad \text{if } p_L > p_H - v(\theta - 1). \end{aligned} \tag{4}$$

Similarly, store L's demand when it charges "low" price is given by

$$\begin{aligned} &D_L(p_H, p_L, \delta_H, \delta_L) \\ &\quad = \frac{v[\alpha\rho + \tau(1-\rho)] - p_L[\rho + \tau(1-\rho)]}{\tau\bar{s}} \\ &\qquad + \rho_L[\{(p_H - p_L)[\rho + \tau(1-\rho)] \\ &\qquad\qquad - v(\theta - 1)[\alpha\rho + \tau(1-\rho)]\}/[(\beta - 1)\tau\bar{s}]], \\ &\qquad \text{if } p_L \le p_H - \alpha v(\theta - 1). \end{aligned} \tag{5}$$

Properties of Retail Demand Functions. Having characterized the retail demand, it is instructive to investigate the following issues:

(a) How sensitive is a store's demand to its own promotional advertising? Does this own "promotional advertising sensitivity" differ across stores H and L?

(b) How sensitive is a store's demand to its competitor's promotional advertising? Does this cross-promotional advertising sensitivity differ across stores H and L?

Note that answers to these questions shed light on a store's frequency of advertised sales: The higher a store's own promotional advertising sensitivity, the greater is the retailer's incentive to offer more frequent advertised sales motivated by traffic-building considerations. Similarly, the higher a store's cross-promotional advertising sensitivity, the greater is the retailer's incentive to offer more frequent advertised sales motivated by customer-retention considerations.

Now, in Equations (3) and (5), the second term captures the expansion in store H's and L's demand, respectively, as a result of its own promotional adver-

[14]Note that if *LV L*-patrons find it optimal to switch to store H, so will *HV L*-patrons because of store H's higher quality. For any *LV L*-patron to switch to store H, she must derive a higher surplus at store H: $\theta v - \beta s - p_H > v - s - p_L$. Thus, she will switch to store H only if $s < \{v(\theta - 1) + p_L - p_H\}/(\beta - 1)$, i.e., her shopping cost is "low enough." However, shopping cost must be positive, i.e., $\mathbf{s} > 0$. For this condition to hold for any H-patron, we must have $p_H \le p_L + v(\theta - 1)$.

tising. Thus, this captures the ''traffic building'' effect of promotional advertising—the extent to which a store is able to induce store switching by the competing store's patrons. Holding the relative price advantage enjoyed by a store the same across the two stores (i.e., $p_L - p_H$ in case of store H and $p_H - p_L$ in case of store L), we find that by engaging in promotional advertising, store H is able to attract more L-patrons as a result of its superior quality positioning. We summarize this insight in the following lemma.

LEMMA 1. *Because of its superior quality positioning, promotional advertising by store H induces more L-patrons to switch to store H. Thus, relative to store L, store H enjoys more "clout."*

This suggests that from a purely offensive or traffic-building consideration, store H would have a higher incentive to engage in promotional advertising relative to store L.

Also note that in Equations (2) and (4), the second term captures the reduction in store H's and L's demand, respectively, as a result of promotional advertising by the competing store. Thus, this captures the ''lost customer'' effect of competitive promotional advertising—the extent to which a store stands to lose its own patrons from store switching induced by promotional advertising by the competing store. Holding the relative price disadvantage the same across the two stores ($p_L - p_H$ in case of store H and $p_H - p_L$ in case of store L), we find that store L's demand is more susceptible to promotional advertising by store H. This reflects the inferior quality positioning of store L. We summarize this insight in the following lemma.

LEMMA 2. *Because of its inferior quality positioning, store L stands to lose more of its patrons in the event of promotional advertising by store H. Thus, relative to store H, store L is more "vulnerable" to competitive promotional advertising.*

This suggests that, relative to store H, defensive or customer-retention consideration would be more salient for store L while deciding on its promotional advertising strategy.

We now investigate the ''promotional price elasticity'' of retail demand by addressing the following issues:

(a) Given that a store has decided to advertise its ''low'' price to attract the competing store's patrons, how elastic is this incremental demand to changes in its (advertised) discounted price? Does this ''own promotional price elasticity'' differ across the two stores?

(b) Given that a store has decided to advertise its ''low'' price to attract the competing store's patrons, how do changes in its (advertised) discounted price affect the competitor's demand? Does this ''cross-promotional price elasticity'' differ across the two stores?

Observe that answers to these questions shed light on the depth-of-discount decision of a retailer: The higher a store's own promotional elasticity, the greater is the retailer's incentive to offer deeper price discounts motivated by traffic-building considerations. Similarly, the higher a store's cross promotional elasticity, the greater is the retailer's incentive to offer deeper price discounts motivated by customer-retention considerations.

Comparing Equations (3) and (5), we observe that the incremental change in retail demand from price change is the same for both stores H and L, i.e.,

$$\left.\frac{\partial D_H(\cdot)}{\partial p_H}\right|_{\delta_H=1} = \left.\frac{\partial D_L(\cdot)}{\partial p_L}\right|_{\delta_L=1} = -\frac{\beta[\rho + \tau(1 - \rho)]}{(\beta - 1)\tau\bar{s}}. \quad (6)$$

This is the incremental effect on the retail demand from the patrons of the competing store from an increase in the advertised depth of discount offered by the store. However, as noted earlier, the incremental store traffic (the competing store's patrons who switch) because of promotional advertising is more for store H than store L (cf. Lemma 1).[15] Thus, the percentage change in retail demand is more for store L than store H, thereby implying a higher ''own promotional price elasticity.'' We summarize this conclusion in the following lemma.

[15]It is important to note that incremental traffic at store H depends on both its promotional advertising (i.e., whether δ_H is 0 or 1) and the level of advertised discounted price (p_H given that it is ''low,'' i.e., $p_H \leq p_L + v(\theta - 1)$ and it is advertised, i.e., $\delta_H = 1$).

LEMMA 3. *The "own promotional price elasticity"—incremental percentage change in retail demand from change in (advertised) depth of discount (originating from the patrons who switch from competing store)—is higher for store L than store H.*

This suggests that, relative to store *H*, during advertised sales store *L* will tend to offer deeper discounts purely from offensive considerations.

Finally, comparing Equations (3) and (5), we observe that the incremental change in retail demand due to changes in the (advertised) depth of discount offered by the competing store is the same for both stores *H* and *L*, i.e.,

$$\left.\frac{\partial D_H(\cdot)}{\partial p_L}\right|_{\delta_L=1} = \left.\frac{\partial D_L(\cdot)}{\partial p_H}\right|_{\delta_H=1} = \frac{\beta[\rho + \tau(1-\rho)]}{(\beta-1)\tau\bar{s}}. \quad (7)$$

Thus, the sensitivity of retail demand to competitor's price (slope) is the same across the stores. However, as noted earlier, the reduction in store traffic from promotional advertising (because of the store's patrons switching to its competitor) is less for store *H* than store *L* (cf. Lemma 2). Thus, the percentage change in retail demand as a result of competitive price cut is more for store *L* than store *H*, thereby implying a higher ''cross-promotional price elasticity.'' We summarize this conclusion in the following lemma.

LEMMA 4. *The "cross-promotional price elasticity"—incremental percentage change in retail demand due to change in (advertised) depth of discount offered by the competing store (resulting from its patrons switching to the competing store)—is higher for store L than store H.*

This suggests that, relative to store *H*, during advertised sales store *L* will tend to offer deeper discounts motivated by defensive considerations.

To ensure that the demand functions facing stores *H* and *L* is elastic even for low prices, in the following analysis we assume that the parameters satisfy the following conditions: $v < \bar{s}$ and $\beta > \theta$. The first condition implies that some consumers will derive negative surplus even at very low prices so that a price cut will have a demand expansion effect for all positive prices. Similarly, the second condition ensures that store *H* (with higher quality) cannot force store *L* to exit by undercutting.

3. Analysis

As mentioned earlier, a store's equilibrium promotional advertising strategy is driven both by offensive or traffic building and defensive or customer retention motivations. Before analyzing the equilibrium promotional strategies, we first analyze a store's incentive to initiate price promotion (i.e., discount and advertise its sale price even when its competitor is charging an unadvertised ''high'' price). We then characterize the mixed strategy promotional pricing equilibrium.

3.1. Stores' Incentives to Initiate Promotional Advertising

As noted earlier, when consumers are imperfectly informed about retail prices, if store *H* (store *L*) does not advertise its price, it would attract *H*-patrons (*L*-patrons) alone. As such, in the absence of advertising, the two stores would be localized monopolies. Now, if stores *H* and *L* were to serve only their own patrons, it can be shown that the optimal monopoly prices, retail demand and profits for the two stores are as given in Table 2.

Consider the incentive of the two stores to unilaterally offer a price discount and advertise it in order to induce store switching from the patrons of the competing store. The optimal prices, retail demand, and profits for the two stores are as given in Table 2, where *k* refers to the advertising cost.

Comparing the monopoly profits of the two stores with their corresponding profit when they initiate price promotion, we find the incremental profits from advertised promotion to be more for store *H* because

$$\begin{aligned}\Delta\Pi_H &\equiv \frac{v^2(4\theta^2\beta - 4\theta\beta + 1)[\alpha\rho + \tau(1-\rho)]^2}{16\beta(\beta-1)\tau\bar{s}[\rho + \tau(1-\rho)]} - k \\ &> \Delta\Pi_L \\ &\equiv \frac{v^2(\theta^2 - 4\theta\beta + 4\beta)[\alpha\rho + \tau(1-\rho)]^2}{16\beta(\beta-1)\tau\bar{s}[\rho + \tau(1-\rho)]} - k. \quad (8)\end{aligned}$$

This is because relative to store *L*, store *H* generates

Table 2 Retail Equilibrium With and Without Advertising

	Store H	Store L
No advertising		
Optimal price	$p_H^m = \frac{\theta v[\alpha\rho + \tau(1-\rho)]}{2[\rho + \tau(1-\rho)]}$	$p_L^m = \frac{v[\alpha\rho + \tau(1-\rho)]}{2[\rho + \tau(1-\rho)]}$
Equilibrium demand	$D_H^m = \frac{\theta v[\alpha\rho + \tau(1-\rho)]}{2\tau\bar{s}}$	$D_L^m = \frac{v[\alpha\rho + \tau(1-\rho)]}{2\tau\bar{s}}$
Optimal profit	$\Pi_H^m = \frac{\theta^2 v^2[\alpha\rho + \tau(1-\rho)]^2}{4\tau\bar{s}[\rho + \tau(1-\rho)]}$	$\Pi_L^m = \frac{v^2[\alpha\rho + \tau(1-\rho)]^2}{4\tau\bar{s}[\rho + \tau(1-\rho)]}$
Unilateral price advertising		
Optimal price	$p_H^{\%} = \frac{v(2\theta\beta - 1)[\alpha\rho + \tau(1-\rho)]}{4\beta[\rho + \tau(1-\rho)]}$	$p_L^{\%} = \frac{v(2\beta - \theta)[\alpha\rho + \tau(1-\rho)]}{4\beta[\rho + \tau(1-\rho)]}$
Equilibrium demand	$D_H^{\%} = \frac{v(2\theta\beta - 1)[\alpha\rho + \tau(1-\rho)]}{4(\beta - 1)\tau\bar{s}}$	$D_L^{\%} = \frac{v(2\beta - \theta)[\alpha\rho + \tau(1-\rho)]}{4\beta\tau\bar{s}}$
Optimal profit	$\Pi_H^{\%} = \frac{v^2(2\theta\beta - 1)^2[\alpha\rho + \tau(1-\rho)]^2}{16\beta(\beta - 1)\tau\bar{s}[\rho + \tau(1-\rho)]} - k$	$\Pi_L^{\%} = \frac{v^2(2\beta - \theta)^2[\alpha\rho + \tau(1-\rho)]^2}{16\beta(\beta - 1)\tau\bar{s}[\rho + \tau(1-\rho)]} - k$

higher incremental sales due to the advertised price cut, while at the same time it does not need to offer as deep a discount as store L (cf. Lemmas 1 and 3). This suggests that from a purely offensive consideration, store H has an incentive to offer more frequent advertised sales.

We summarize these insights in the following lemma.

LEMMA 5. *The potential gains from attracting the competing store's customers through promotional advertising are higher for store H than for store L. Furthermore, store L needs to offer a steeper discount to attract store H's patrons.*

From Equation (8), it is evident that if advertising is "too costly," i.e., if

$$\Delta\Pi_L < \Delta\Pi_H < 0$$

$$\Leftrightarrow k > k_H^{\%} \equiv \frac{v^2(4\theta^2\beta - 4\theta\beta + 1)[\alpha\rho + \tau(1-\rho)]^2}{16\beta(\beta - 1)\tau\bar{s}[\rho + \tau(1-\rho)]}, \tag{9}$$

neither of the stores will offer advertised discounted price. However, if the advertising cost is sufficiently "low," i.e.,

$$\Delta\Pi_H > \Delta\Pi_L > 0$$

$$\Leftrightarrow k < k_L^{\%} \equiv \frac{v^2(\theta^2 - 4\theta\beta + 4\beta)[\alpha\rho + \tau(1-\rho)]^2}{16\beta(\beta - 1)\tau\bar{s}[\rho + \tau(1-\rho)]}, \tag{10}$$

both of the stores will have an incentive to advertise. Finally, in the case when $k_L^{\%} < k < k_H^{\%}$, store H alone has the incentive to offer advertised promotion.

However, when $k < \tilde{k}_L$ it is easy to see that an equilibrium wherein both the stores always advertise their prices to attract the competing store's patrons can never arise. The rationale is as follows. Because store H advertises its price to attract L-patrons, it must be that its equilibrium price is "low enough," i.e., $p_H^{**} \le p_L^{**} + v(\theta - 1)$, where p_H^{**} and p_L^{**} are the equilibrium prices for stores H and L, respectively. However, this implies $p_L^{**} > p_H^{**} - v(\theta - 1)$, i.e., store L's equilibrium price is "too high," and it will not advertise its price, thereby leading to a contradiction. We summarize this insight in the following proposition.[16]

[16]The rationale for the nonexistence of an equilibrium wherein the stores charge "low" price and always promote is that the profit functions of stores H and L are not jointly concave in (p_j, δ_j).

PROPOSITION 1. *If the marginal cost of advertising is not "too high," i.e., $k < \tilde{k}_L < \tilde{k}_H$, a pure strategy equilibrium in which both stores either always post "high" prices and not advertise or always post and advertise "low" prices does not exist. Thus, the only equilibrium when $k < \tilde{k}_L$ must entail random promotional advertising by the competing stores, i.e., store j randomizes between posting a nondiscounted price (and not advertising it) and posting a discounted price (and advertising it).*[17]

The proof is given in the Technical Supplement. In the subsequent analysis, we characterize the promotional advertising equilibrium under the assumption that $k < \tilde{k}_L$.

3.2. Characterization of the Promotional Advertising Retail Equilibrium

The unique mixed strategy equilibrium of the pricing game entails store j, $j \in \{H, L\}$, randomizing between its ''sale'' (discounted) price, p_j^s, (with probability f_j) and its ''regular'' (nondiscounted) price, p_j^r (with probability $1 - f_j$). Consistent with the literature (Shilony 1977, Rao 1991, Raju et al. 1990), we interpret the mixed strategy equilibrium in a temporal context so that f_j denotes store j's frequency of advertising sale prices.[18]

The promotional advertising (PA) equilibrium is a two-support-point mixed strategy equilibrium. This is distinct from the mixed strategy equilibria in Narasimhan (1988) and Raju et al. (1990), which entail a continuous distribution over a range of prices. The difference arises because in Narasimhan (1988) and Raju et al. (1990), all the switchers have an identical valuation for the product, while in the proposed framework consumers are heterogeneous in their willingness-to-pay (due to heterogeneity in their shopping costs).[19] Our discrete two-price mixed strategy equilibrium is consistent with prior research in economics and marketing (Salop and Stiglitz 1982, Banks and Moorthy 1996, Bester and Petrakis 1995).

Solution Procedure to Derive Promotional Advertising Equilibrium. Our approach to solving the discrete two-point equilibrium differs from the ''textbook'' approach in one important way. In the standard approach, the support points (i.e., the underlying pure strategies) are exogenously given. In our setting, this would imply that the stores do not select their ''regular'' and ''sale'' price but choose only their promotional frequencies. In contrast, our analysis requires characterizing both the support points (which determine the depth of discount) and the mixing distribution (which determines the frequency of advertised sale). This poses an additional challenge because in our formulation the support points (i.e., the ''regular'' and ''sale'' prices) are dependent on the mixing distribution and thus have to be derived simultaneously.

The Appendix gives an outline of the solution procedure. This essentially entails three steps:

Step 1. Characterizing the support points of the discrete distribution for both stores H and L, given the support points and the mixing distribution of the other store, i.e., $\langle \hat{p}_H^r, \hat{p}_H^s \rangle$ and $\langle \hat{p}_L^r, \hat{p}_L^s \rangle$.[20]

Step 2. Deriving the stores' reaction functions for frequency of promotional advertising (i.e., $f_H(f_L)$ for store H and $f_L(f_H)$ for store L), recognizing that the store must earn the same profits when charging unadvertised ''regular'' price and advertised ''sale'' price.

Step 3. Simultaneously solving the two reaction functions to obtain the Nash Promotional Advertising equilibrium $\{f_H^*, f_L^*\}$.

[17]The continuity of the retail profit functions ensures the existence of a mixed strategy equilibrium in which stores randomly offer and advertise ''sale'' prices (Dasgupta and Maskin 1986). Please see Raju et al. (1990) for a detailed discussion on this issue.

[18]This temporal interpretation is based on a result due to Benoit and Krishna (1985) that states that a unique Nash equilibrium of a constituent subgame is also a unique subgame perfect equilibrium of the (finitely repeated) supergame. See Raju et al. (1990) for additional details.

[19]In fact, if all consumers had identical shopping costs, the mixed strategy equilibrium in our framework would also have a continuous distribution over a range of prices. While a continuous mixed strategy equilibrium allows for a range of depths of discount, it comes at the cost of a more restrictive consumer model.

[20]This is analogous to deriving the support of the continuous distribution in Narasimhan (1988) and Raju et al. (1990). However, in their model, the support is independent of the mixing distribution.

Features of the Promotional Advertising Equilibrium. As mentioned earlier, the interdependence of the support points and the mixing distribution makes our computation task harder, unlike previous formulations. While we are unable to obtain closed form expressions for the equilibrium promotional advertising frequencies, we verified through extensive simulations that for a wide range of parameters[21]:

- NE frequencies lie in the unit simplex, i.e., $\{f_H^*, f_L^*\} \in [0, 1] \times [0, 1]$.
- Store H's promotional frequency is higher than that of store L, i.e., $f_H^* > f_L^*$.

Furthermore, we analytically demonstrate that if $f_H > f_L$, the percentage depth of discount offered by store L is higher. We illustrate the property of the promotional advertising equilibrium through a numerical example with the following parameter values, namely, $v = 1$; $\theta = 1.1$; $\alpha = 1.5$; $\tau = 1.5$; $\beta = 1.25$; $\bar{s} = 1$; $\rho = 0.4$. For these parameter values, the cost-of-advertising thresholds for stores H and L are: $\tilde{k}_H = 0.3577$ and $\tilde{k}_L = 0.1637$ (cf. Proposition 1). We let $k = 0.05$ so that both stores have the incentive to advertise.

We find that f_H^* and f_L^* are 0.3796 and 0.1550, respectively; i.e., in equilibrium store H offers an advertised sale with probability 0.38 while store L offers an advertised sale with probability 0.16. Thus, we find $f_H^* > f_L^*$. Furthermore, at these equilibrium frequencies, the optimal regular and sale prices of store H are $\hat{p}_H^r = 0.5077$ and $\hat{p}_H^s = 0.3438$, while the corresponding prices for store L are $\hat{p}_L^r = 0.4447$ and $\hat{p}_L^s = 0.2658$. Thus, the equilibrium percentage depth of discount offered by store H is $\%\Delta_H \equiv (\hat{p}_H^r - \hat{p}_H^s)/\hat{p}_H^r = 32.29\%$. In contrast, the percentage depth of discount for store L is $\%\Delta_L = 40.23\%$. Therefore, we find that $\%\Delta_H < \%\Delta_L$. These findings reinforce the intuition from Lemma 5.

We summarize this discussion in the following proposition.

PROPOSITION 2. *The optimal frequency of advertised sales is higher for store H than for store L. However, the optimal depth of discount (expressed as a percentage of regular price) offered by store H is lower than that for store L.*

Relative Drivers of Promotional Advertising. Because the equilibrium promotional strategies are driven by both traffic building (offensive) and customer retention (defensive) considerations, we attempt to disentangle the relative impact of the two effects and assess any systematic differences across the stores. To do so, we compare a store's equilibrium frequency with the frequency it would choose if its competitor were not to promote.

We find that when $f_L = 0$, the frequency of store H, $f_H^{**}(f_L = 0)$, is 0.2705. Said differently, even if store L were not to offer advertised sales, store H will offer an advertised sale with probability 0.27 driven by traffic-building motivation alone. Recall that store H's equilibrium frequency is 0.38. Thus, store H's promotional advertising is mainly motivated by traffic-building considerations (i.e., 71% (0.27/0.38) versus the balance 29% for customer-retention consideration). In contrast, for store L, the customer-retention consideration is relatively more important (i.e., 53% (0.08/0.15) accounted for by traffic-building motivation versus the balance 47% for customer-retention consideration).

The intuition for this finding follows directly from Lemmas 1 and 2, where we note that the own promotional advertising elasticity is higher for store H, its cross-promotional advertising elasticity is lower than that for store L.

We summarize this intuition in the following lemma.

LEMMA 6. *Relative to store L, promotional advertising by store H is influenced more by traffic building than customer retention considerations.*

Intuition for Results.[22] Recall that relative to LV consumers, HV consumers incur a higher cost to

[21]We have done extensive simulations over the entire parameter space where prices are positive.

[22]Even though the model structure appears complex because of three sources of consumer heterogeneity and two sources of retail differentiation, they constitute the minimal sufficient set of assumptions needed to obtain these results. The parameters characterizing vertical heterogeneity (namely, α and ρ) and differentiation (θ) are necessary for consumer "self-selection." As stated earlier, it is horizontal heterogeneity ($\bar{s}$) that results in a two-support-point mixed

switch stores ($\tau\beta s$ for *HV* consumers vs. βs for *LV* consumers). Thus, the *HV* segment is less sensitive to promotional advertising. Because the retailers draw both the *HV* and the *LV* consumers, the effective ''promotional advertising sensitivity'' of retail demand depends on the mix of customers that a retailer draws. Because of asymmetric quality positioning, consumer ''self-selection'' implies that under competitive promotional advertising, relative to store *L*, store *H* draws a higher fraction of *HV* consumers. This implies that while store *H*'s demand is less vulnerable to store *L*'s promotional advertising (cf. Lemma 2), store *H* stands to attract more customers were it to advertise its ''sale'' targeted at store *L*'s customers (cf. Lemma 1). Thus, defensive or customer-retention considerations is more salient for store *L*, while store *H* is driven primarily by offensive or traffic-building considerations.

The aforementioned difference in the store's promotional advertising sensitivities also explains why store *H* offers more frequent advertised sales. Note that the higher the promotional advertising sensitivity of the target customers (i.e., the competing store's customer mix), the greater is the incentive to offer such advertised sales. Because the target customers of store *H* are more sensitive to promotional advertising, store *H* has incentive to offer advertised sale more frequently.

Finally, the intuition behind differences in the depth of discount is as follows. As mentioned earlier, store *H*'s customer mix comprises a higher fraction of *HV* customers relative to that for store *L*. Given the higher store switching costs for *HV* consumers, store *L* needs to offer deeper discounts to overcome this (cf. Lemma 3). This difference in customer mix also implies that store *L* needs to offer deeper discounts to retain its customer (cf. Lemma 4).

Comparison with Prior Models. Note that findings in Proposition 2 are distinct from those in Narasimhan (1988) and Raju et al. (1990). Both models imply a lower promotional frequency for the high-quality store.[23] While the former predicts that the two stores should offer the same depth of discount, the latter suggests the high-quality store should offer deeper discounts.

The intuition for the contrasting results is as follow. In both models, the incremental traffic is the same across the two stores because of identical consumer valuation. Furthermore, in both these models, the losses occurring from subsidizing ''loyal'' customers are higher for the high-quality store. Thus, the net gains to the low-quality store from price promotions are higher than that for the high-quality store. In contrast, in our model the net gains to high-quality store from promotional advertising are higher (cf. Lemma 5).

3.3. Consumer Characteristics, Store Positioning, and Reliance on Frequency Cues

In the previous section, we showed that in using promotional advertising, the high-quality store relies more on the ''frequency cue'' while the low-quality store relies more on the ''magnitude cue.'' We discuss below how this relative emphasis is influenced by consumer characteristics and store's positioning.

To do so, we focus on the difference in the frequency of advertised promotions across the two stores (i.e., $\Delta f^* \equiv f_H^* - f_L^*$). Note that as Δf^* increases, store *H* relies increasingly on the frequency cue, while store *L* relies increasingly on the magnitude

strategy equilibrium. This also leads to market expansion as a result of price promotions (unlike, e.g., Narasimhan 1988, Raju et al. 1990). Furthermore, unlike the extant models, it also implies differential expansion in retail demand across the two stores. The horizontal differentiation (β) parameter corresponding to switching costs makes it imperative for the stores to offer price cuts for traffic building. In technical terms, $\beta > 1$ creates the requisite discontinuity in a store's profit function to have a mixed strategy NE. Finally, the second source of vertical heterogeneity (τ) leads to differential switching costs across *HV* and *LV* segments and is necessary for differences in store's promotional frequencies and depths of discount offered.

[23]Note both Narasimhan (1988) and Raju et al. (1990) deal with manufacturer/brand-level competition between ''strong'' and ''weak'' brands. In this comparison, we consider ''strong'' and ''weak'' brands as analog of high- and low-service stores, respectively. Furthermore, this section compares our results to insights from the base models considered in these papers. In addition, both these models assume that consumers are perfectly aware of the posted prices; as such, there is no role of price advertising in these models.

cue. The following proposition summarizes the key comparative statics results.

PROPOSITION 3. *The difference in the frequency of advertised sales across the high- and low-quality stores increases with increase in* α, θ *and* ρ *while it decreases with increase in* β *and* $\bar{s}$.

The intuition behind these results is as follows. As noted above, it is consumer ''self-selection'' that leads to differences in the store's promotional advertising strategies. Increases in either vertical differentiation (θ) or vertical heterogeneity (α) as well as the relative size of the *HV* segment (ρ) leads to sharper consumer ''self-selection.'' Note that the sharper the consumer ''self-selection,'' the greater is the difference in the customer mix across the two stores. Specifically, store *H* predominantly attracts *HV* customers while store *L* mainly serves *LV* customers. Because the switching costs of the *LV* customers is lower, this mix implies that store *H* can attract these customers even by offering a shallower discount, thereby making promotions more attractive. This accounts for store *H* placing a higher emphasis on frequency cue than magnitude cue. In contrast, an increase either in horizontal heterogeneity (β) or horizontal differentiation ($\bar{s}$) blurs this process, thereby reducing the differences across the two stores in their strategic orientation.

4. Empirical Validation

In this section, we examine whether market data are consistent with our model's key predictions. However, because secondary data were not available, we collected our own data by coding information from newspaper price advertisements for both high- and low-service level stores in product groups that mirror our model assumptions. To test whether the model predictions are consistent with empirical observations, we focus on the following model predictions:

1. Other things being equal, the frequency of advertised sales increases with the service positioning of a store.

2. Other things being equal, the depth of discount decreases with the service positioning of a store.

4.1. Description of the Data Set

Our empirical analysis focuses on the apparel market. Traditional department stores and off-price discount stores are the two major retailer groups in this market. Mirroring our model assumptions, stores across these two groups differ in their quality positioning providing customers with different levels of in-store service, sales assistance, and shopping convenience. Similar to our model, stores in both these groups periodically advertise sales in newspaper advertisements in order to compete for customers (Kopp et al. 1989). A sale advertisement typically features several product groups including discount information on each of these groups. To determine the appropriate unit of analysis, i.e., the level at which to code the sale information from these advertisements, we conducted interviews with approximately 50 shoppers, asking them how they made their store selection decision. Consumers stated that in deciding among competing stores, promotional advertisement was an important factor, and they evaluated and compared savings at the product group level (e.g., men's dress shirts).

Using information obtained from interviews conducted with 10 retail managers, we selected only those product groups in which (a) comparable product lines were both stocked and advertised by the two store groups, and (b) items did not have a fashion orientation so that they did not have any temporal variation in prices. This led to a total of 14 product groups—7 of them were men's products (dress shirts, sports shirts, neck ties, casual pant, boxer shorts, tee shirts, and shorts), and the other 7 were women's products (tee shirts/tank tops, knit top vests, blouses, knit separates, shorts, shoes, bras). Because stores typically advertised chain-wide sales in a given geographic area, we focus our study on a major metropolitan city in the United States.

In this market, traditional department stores and off-price discount stores comprise about 76% of the apparel market. We included the following four leading (in terms of market share) department store chains—Carson Pirie Scott, Marshall Field's, Lord & Taylor, and Bloomingdale's—accounting for about 85% of the department store market; and the two leading discount store chains—Filene's Basement and T.J. Maxx—accounting for about 80% of the discount store market. By collecting data from multiple chains in each of the two retailer groups, we minimize the impact of retailer-specific effects in our analysis. Newspaper advertising accounts for about 75% of the total advertising dollars spent on promotional advertising for the chains included in our analysis. Furthermore, by restricting our analysis to retailers in the same geographic area, we ensure that the same retail advertising regulations govern the advertising practices for our sample of retailers (Ortmeyer 1991).

We obtained data from two different sources. First, for the retail chains included in our analysis, we collected all promotional advertisements published in the two leading newspapers in the city over a 6-month period. This led to a total of 813 promotional advertisements across the six stores from which we coded information on the 14 product groups that were included in our study. In addition, we obtained consumer ratings data on in-store service and sales assistance for each of the six chains from a survey published in *Consumer Reports* (1994).

4.2. Variable Operationalization

(a) *Frequency of Advertised Sales (TDAYS).* This refers to the time interval in days (*TDAYS*) from the last promotional advertisement in the product category. The longer the time interval, the lower the frequency of advertised sales.

(b) *Depth of Promotional Discount (DISCOUNT).* This measure represents the percentage reduction in price offered on the advertised merchandise. We computed this by determining the fraction of the advertised regular price that the offered price reduction (difference in advertised regular and sale prices) represented. While the FTC guidelines and state statutes/regulations prevent retailers from artificially inflating the "regular" price, we also use actual transacted prices (both "observed" regular and sale) to develop an alternate measure of the depth of discount offered.[24]

For each of the product groups included in our study, we tracked the actual transacted prices for identical merchandise sold by a high-service store (Marshall Field's) and a low-service store (Filene's Basement) for a 6-week period. By tracking specific items that both stores sell, we are able to ensure that we have the same basis of comparison in terms of the specific brands and type of merchandise sold by the two stores. This provides a robustness check of our results independent of the operationalization of "regular" price. This also helps to directly eliminate any items where we observe any temporal variation in regular prices (as seen for fashion items).

(c) *In-Store Service (SERV).* This measure is based on an article in *Consumer Reports* (1994), which provides summary consumer ratings on in-store service and sales assistance for different chains based on a survey of 50,000 consumers. In this survey, respondents rated each store on a five-point scale, with 1 being "excellent sales help" and 5 being "poor sales help." Both Filene's Basement and T.J. Maxx were given a rating of 5; Carson Pirie Scott and Lord & Taylor were given a rating of 3; and Bloomingdale's and Marshall Field's a rating of 2.

4.3. Empirical Analysis at the Product Group Level

For each of the 14 product groups, Table 3 reports the mean values of *DISCOUNT* and *TDAYS* for the high-service traditional department stores (Marshall Field's, Carson Pirie Scott, Lord & Taylor, Bloomingdale's; Mean *SERV* = 2.5) and the low-service off-price discount stores (Filene's Basement and T.J. Maxx; Mean *SERV* = 5). First, we individually compare the mean values of the variables across the two types of stores separately for each product group.

Comparing the differences in the mean values of *DISCOUNT* across the two store types for each product group, we find that in all the 14 product groups, the low-service stores offer a higher advertised depth of discount than the high-service stores (all p values < 0.01). The results are similar when we use the actual depth of discount computed from transacted prices for the identical merchandise sold by the two store types. Also, for each product group we find that the mean time interval between advertisements is higher for high-service stores than low-service stores

[24]We thank the area editor for this suggestion.

TABLE 3 Comparison of Mean *DISCOUNT* and *TDAYS* for High- and Low-Service Stores[26]

	Mean Discount (%)			Mean *TDAYS* (days)		
Product Group	High-Service	Low-Service	*t*-Statistics	High-Service	Low-Service	*t*-Statistics
Men						
1. Dress shirts	31	56	7.554	5.62	12.24	2.989
2. Sport shirts	32	59	7.549	6.17	17.75	2.393
3. Neck ties	34	72	7.757	7.71	18.71	1.794
4. Casual pants	28	49	4.712	6.69	16.27	2.540
5. Boxer shorts	27	50	7.066	8.76	19.75	2.122
6. Tee shirts	30	57	7.991	7.30	25.57	3.241
7. Shorts	28	48	5.021	9.71	32.00	3.541
Women						
1.Tee shirts/tank tops	33	58	7.042	6.15	19.89	4.039
2. Knit top vests	33	54	4.893	5.82	19.89	3.660
3. Blouses	35	67	6.623	6.42	22.38	3.814
4. Knit separates	34	52	2.884	4.93	20.29	4.245
5. Shorts	31	59	5.983	8.88	15.78	2.253
6. Shoes	35	52	4.535	5.66	20.29	3.177
7. Bras	30	59	4.215	6.10	19.89	2.581

(in 12 of the 14 product groups, $p < 0.01$; in the remaining 2, $p < 0.05$). These findings provide support for Proposition 2.

4.4. Empirical Analysis with Data Pooled Across Product Groups

We also conduct a pooled analysis of the observations across the 6 stores and the 14 product groups by relating the two dependent variables (*DISCOUNT* and *TDAYS*) to *SERV* separately while controlling for the confounding effect of covariates. To include covariates, we need to conduct the analysis at the disaggregate level with a store's promotional advertisement at the product group level being the unit of analysis. Pooling observations across product groups, as well as across stores, also helps us improve the statistical efficiency of the parameter estimates.

In conducting the disaggregate analysis, we need to be careful about a few important econometric issues. Because we have multiple observations for a store in a product category, there could be a possibility of serial correlation. However, the conceptualization of sales promotions as mixed strategies (e.g., Narasimhan 1988, Raju et al. 1990) implies that different observations from a store correspond to the store independently drawing from its equilibrium promotional strategies. Empirical support for the lack of serial correlation among posted prices was shown in Rao et al. (1995). It is important to point out that serial correlation could still exist because of store-specific unobserved factors that are not explicitly modeled in our analysis. Because we are also pooling data across product groups, we need to also control for product group-specific unobserved heterogeneity. To account for unobserved heterogeneity on two dimensions—namely, store and product group—we use the latent class approach (Kamakura and Russell 1989).[25] We also recognize that while the frequency of a promotional advertisement (*TDAYS*) and the depth of discount (*DISCOUNT*) are jointly determined and ideally should be estimated in the context of SUR system, because of the discrete/continuous nature of the dependent variables and the nonlinearity of the model specification, we are unable to implement this and recognize it as a potential limitation of our analysis.

[25]We thank the editor, the area editor, and an anonymous reviewer for alerting us to this concern.

[26]The comparison of mean uses pooled variance. In effect, it is assumed that the variance of *TDAYS* and *DISCOUNT* is the same for all six stores.

4.4.1. Covariates Operationalization. We used the following two covariates in our analysis.

(a) *National Brand Advertised (NAME).* Based on findings in previous research (e.g., Gupta and Cooper 1992), consumers do not discount advertised savings for name brands as much as for store brands. Consequently, offering the same discount on a name brand has more impact on consumers' intention to buy than a similar discount on a store brand. This may lead retailers to offer lower depth of discounts when advertising name brands. To control for the possibility, we included an indicator variable, *NAME,* with $NAME = 1$ when national brands are advertised for the product group; $NAME = 0$ otherwise. Furthermore, the lower average discount when name brands are advertised may make it optimal for retailers to reduce the time between advertised sales, thereby increasing the frequency (Achabal et al. 1990).

(b) *Special Sale (SALE).* Retailers hold special holiday sales (e.g., Memorial Day sale; Fourth of July sale) or limited-time sales (e.g., 13-Hour sale, 2-Day sale). During these sales, retailers may be more likely to offer a higher depth of discount to build traffic. To control for these effects, we include an indicator variable, *SALE,* with $SALE = 1$ when the advertisement is for a special holiday or limited-time sale; $SALE = 0$ otherwise. Furthermore, the incidence of a special holiday may reduce the normal time interval between consecutive promotions for retailers.

4.4.2. Modeling Relationship Between *TDAYS* and *SERV.* Because the variable *TDAYS* can take only positive values, using a linear model is inappropriate; hence we use the proportional hazard function approach (e.g., Jain and Vilcassim 1991) with a baseline exponential hazard. To control for unobserved heterogeneity, we use the latent class random effects specification (Kamakura and Russell 1989).

The sample likelihood is given by[27]

$$L = \prod_{i=1}^{i=6} \left\{ \sum_{\eta_l \in S} \left(\prod_{j=1}^{j=14} \sum_{\zeta_m \in P} \left[\prod_{k=1}^{k=K_{ij}} (\eta_l + \zeta_m) g(X_{ijk}) \exp\{-(\eta_i + \zeta_j) g(X_{ijk}) TDAYS_{ijk}\} \right] \omega_m \right) \gamma_l \right\}, \tag{11}$$

where subscripts i, j, and k stand for store, product group, and promotional advertisement, respectively. K_{ij} denotes the number of promotional advertisements for product group j, $j = 1, \ldots, 14$, and store i, $i = 1, \ldots, 6$. We define η_l and ζ_m to represent the support points for the store-specific (set S) and product group-specific (set P) random component, respectively, with corresponding probability masses of γ_l and ω_m. The proportionality function $g(X_{ijk})$ is given by

$$g(X_{ijk}) = \exp(\alpha_1 \times SERV_{ijk} + \alpha_2 \times NAME_{ijk} + \alpha_3 \times SALE_{ijk}). \tag{12}$$

The results for the ML estimation of the hazard function with two-support distribution for store- and product-specific random heterogeneity components are reported in Table 4. Likelihood ratio tests failed to reject the two-support model in favor of three-support models. *SERV* was negative and statistically significant ($p < 0.01$).

This is consistent with the prediction of our analytical model that the time between advertised sales is shorter for high-quality stores than for lower-quality stores (note that the *SERV* variable is reverse coded with higher *SERV* ratings for lower service stores and vice versa). In addition, the parameter for *NAME* is significant ($p < 0.01$), but the direction is contrary to our hypothesis. We conjecture that it could be due to the fact that stores in our sample seem to mainly

[27]To test for temporal dependence in the frequency of promotion (*TDAYS*), we also estimated the model with baseline Weibull hazard. However, the likelihood ratio test failed to reject the nested exponential hazard specification (Equation (11)), thus suggesting lack of duration dependence. We thank an anonymous reviewer for alerting us to this issue. Details of the hazard function model along with a description of our approach for incorporating unobserved store- and product-specific heterogeneity components are given in the Technical Supplement.

TABLE 4 Empirical Results—Time Between Advertised Sales

Variable	Coefficient	Standard Error
SERV (α_1)	−0.2135	0.0298**
NAME (α_2)	−0.1157	0.0437**
SALE (α_3)	0.3281	0.0915**
Store-specific random error		
1st support (η_1)	1.2281	0.1352**
2nd support (η_2)	0.7513	0.0984**
Probability mass point at 1st support (γ)	0.8117	0.1483**
Product-specific random error		
1st support (ζ_1)	0.4215	0.1955***
2nd support (ζ_2)	0.7332	0.0812**
Probability mass point at 1st support (ω)	0.6194	0.1126**
Log likelihood	−783.47	
χ^2statistic for LRT	310.4**	

**Significant at $\alpha = 0.01$.
***Significant at $\alpha = 0.05$.

TABLE 5 Empirical Results—Depth of Discount

Variable	Coefficient	Standard Error
SERV (β_1)	0.0896	0.0040**
NAME (β_2)	−0.0146	0.0085***
SALE (β_3)	0.0611	0.0126**
Store-specific random error		
1st support (η_1)	0.0521	0.0163**
2nd support (η_2)	0.0376	0.0097**
Probability mass point at 1st support (γ)	0.6182	0.1337**
Product-specific random error		
1st support (ζ_1)	0.0271	0.0108**
2nd support (ζ_2)	0.0618	0.0188**
Probability mass point at 1st support (ω)	0.3822	0.1325**
Log likelihood	589.29	
χ^2 statistic for LRT	271.1**	

**Significant at $\alpha = 0.01$
***Significant at $\alpha = 0.05$.

use name brands during major holiday seasons, offering deep advertised discounts to build traffic. In any event, it does not invalidate our main prediction. The parameter for *SALE* is significant ($p < 0.01$) and in the expected direction.

4.4.3. Modeling Relationship Between *DISCOUNT* and *SERV.* Because the variable *DISCOUNT* can only take values between 0 and 1, using a linear model is inappropriate; hence we use the two-limit probit approach. Note that the two-limit probit model represents a generalization of the Tobit model (Heckmann 1979) and controls for both upper and lower truncation of the dependent variable (for additional details, see Datar et al. 1997). To account for unobserved store- and product-specific heterogeneity, we develop the sample likelihood function using an approach analogous to that for modeling *TDAYS.*

The relationship between the (latent) depth of discount offered is given by[28]

$$y^*_{ijk} = \beta_0 + \beta_1 \times SERV_{ijk} + \beta_2 \times NAME_{ijk} + \beta_3 \times SALE_{ijk} + \epsilon_{ijk}, \quad (13)$$

where subscripts i, j and k are as defined in Equation (11) above.

The results for the ML estimation of the two-limit probit model with two-support distribution for store- and product-specific random heterogeneity components are reported in Table 5. Likelihood ratio tests failed to reject the two-support model in favor of three-support models. The coefficient for *SERV* was positive and statistically significant ($p < 0.01$). This is consistent with the prediction of our analytical model that lower quality stores offer a higher discount than higher quality stores. In addition, the average depth of discount (a) is lower when advertisements include name brands ($p < 0.05$), and (b) is

[28]We acknowledge that, while the equilibrium is a two-support-point discrete mixing distribution, the two-limit probit corresponds to a continuous mixing distribution. To test if the depth of discount in the current period k depends on the past realizations, we added lagged depth of discount (during the $k - 1$th sale) as an additional covariate in Equation (13). However, likelihood ratio test failed to reject the nested specification (Equation (13)), thereby suggesting a lack of temporal dependence. We thank an anonymous reviewer for alerting us to these issues. Details of the two-limit probit model are given in the Technical Supplement.

higher when the advertisement is for a special sale ($p < 0.01$).

5. Conclusions and Managerial Insights

In this paper, we examined the strategic considerations underlying a retailer's promotional advertising decisions—the frequency of advertised sales and the depth of the discount offered. Our analysis suggests promotional advertising is motivated by both traffic-building and customer-retention considerations. The relative importance of these considerations is related to the store's service positioning. Our analysis indicates that compared to the low-service store, the high-service store offers more frequent advertised sales, albeit with shallower discounts. We provide empirical support for the key predictions of our analytical model by collecting and analyzing data from retail promotional advertisements for stores (which vary in their level of in-store service) published in major newspapers in a large U.S. metropolitan city.

Our analysis thus suggests that in using promotional advertising to attract and retain customers, the high-quality store should rely more on the ''frequency cue'' while the low-quality store should rely more on the ''magnitude cue.'' Furthermore, these actions by the high-service store are motivated mainly by traffic-building consideration. In contrast, the customer-retention considerations are relatively more salient for the low-service store.

Our results further suggest that the high-service store's reliance on frequency versus magnitude cues depends on its positional strength on the service dimension as well as customer segmentation characteristics. Specifically, the high-service store needs to consider the consumer heterogeneity in (a) willingness to pay for service (mix of high- and low-valuation consumers, as well as differences in their intensity of preference for service) and (b) shopping costs.

The key managerial insights from our analysis are summarized in Figure 1 below. While designing their promotional advertising strategy, key questions for the high-service store to resolve are: Who are the customers being served at regular price? Who are the customers being targeted through advertised sales?

Figure 1A Promotional Advertising Strategy for High-Service Store

		Heterogeneity in Shopping Costs ($\bar{s}$): High	Heterogeneity in Shopping Costs ($\bar{s}$): Low
Positional Strength on Service (θ)	High	Moderate Frequency; Moderate Discount	High Frequency; Shallow Discount
	Low	Low Frequency; Deep Discount	Moderate Frequency; Moderate Discount

Figure 1B Promotional Advertising Strategy for High-Service Store

		Heterogeneity in Preference for Service (α): High	Heterogeneity in Preference for Service (α): Low
Positional Strength on Service (θ)	High	High Frequency; Shallow Discount	Moderate Frequency; Moderate Discount
	Low	Moderate Frequency; Moderate Discount	Low Frequency; Deep Discount

Figure 1A shows how the design of its promotional advertising strategy is influenced by the positional advantage enjoyed by the high-service store as well as consumer shopping costs. The store needs to recognize that when its positional advantage is high and consumers do not differ substantially in their shopping costs, it predominantly serves the high-valuation customers with its regular price while attracting primarily the low-valuation customers through advertised sales. In this situation, the store is better off relying mainly on the frequency cue. In contrast, when its positioning is not distinct and consumer heterogeneity is substantial, it is difficult to use the regular and advertised sales to distinctly target the different segments. In this case, the store should rely more on the magnitude cue.

Similarly, Figure 1B shows how the high-service store's promotional advertising strategy is influenced by its positional advantage as well as customers' preference for service. The store needs to recognize that a high positional advantage coupled with substantial differences in consumers' preference for service allows it to achieve distinct targeting through its regular and sale prices. Specifically, its regular price primarily caters to the high-valuation segment, while its advertised sales are meant to attract mainly low-valuation customers. In this situation, the store is better off relying mainly on the frequency cue.

We consider this paper an important first attempt to study the effect of promotional advertising on retail competition between stores that differ in their positioning. Having said that, we realize the limitations of the theoretical and empirical components of our analysis. For instance, our analysis does not relate to fashion-oriented products, for which the dynamics of competition between the two kinds of stores may be somewhat different from that in our model. We also recognize the shortcomings of our empirical analysis, primarily because of data limitations. For instance, being limited to data coded from advertisement, we were not able to identify exogenous variables to control for potential endogeneity among the covariates and the dependent variables.

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Appendix

Derivation of Promotional Advertising Equilibrium[29]

We follow a 3-step procedure:

Step 1. Derivation of Support Points of the Mixing Distributions $\langle \hat{p}^r_H, \hat{p}^s_H\rangle$ *and* $\langle \hat{p}^r_L, \hat{p}^s_L\rangle$. Program 1 characterizes store H's choice of "regular" and "sale" prices, i.e., $\langle \hat{p}^r_H, \hat{p}^s_H\rangle$, given that store L follows its NE strategy $\langle \hat{p}^r_L, \hat{p}^s_L, f_L\rangle$.

$$\text{P1:}\quad \hat{p}^r_H \in \underset{p^r_H}{\operatorname{argmax}}\ \Psi^r_H(p^r_H)$$

$$\equiv p^r_H[f_L D_H(p^r_H, p^s_L, 0, 1) + (1 - f_L) D_H(p^r_H, p^r_L, 0, 0)], \quad \text{(P1.1)}$$

$$\check{p}^s_H \in \underset{p^s_H}{\operatorname{argmax}}\ \Psi^s_H(p^s_H)$$

$$\equiv p^s_H[f_L D_H(p^s_H, p^s_L, 1, 1) + (1 - f_L) D_H(p^s_H, p^r_L, 1, 0)]. \quad \text{(P1.2)}$$

Above, $D_H(p^s_H, \hat{p}^s_L, \delta_H = 1, \delta_L = 1)$ refers to store H's demand when both stores advertise and can be obtained from Equation (3). Similar interpretations hold for $D_H(p^r_H, p^s_L, 0, 1)$, $D_H(p^r_H, p^s_L, 0, 0)$ and $D_H(p^r_H, p^s_L, 1, 0)$. The implied optimality conditions are

$$v[f_L(\theta - 1) + \theta(\beta - 1)]\{\alpha\rho + \tau(1 - \rho)\} + f_L p^s_L\{\rho + \tau(1 - \rho)\}$$
$$- 2p^r_H(\beta - 1 + f_L)\{\rho + \tau(1 - \rho)\} = 0, \quad \text{(A.1)}$$

$$v(\theta\beta - 1)\{\alpha\rho + \tau(1 - \rho)\}$$
$$- [2\beta p^s_H - f_L p^s_L - (1 - f_L)p^r_L]\{\rho + \tau(1 - \rho)\} = 0. \quad \text{(A.2)}$$

Similarly, the pricing problem faced by store L is modeled as program P2 below:

$$\text{P2:}\quad \check{p}^r_L \in \underset{p^r_L}{\operatorname{argmax}}\ \Psi^r_L(p^r_L)$$

$$\equiv p^r_L[f_H D_L(p^s_H, p^r_L, 1, 0) + (1 - f_H) D_L(p^r_H, p^r_L, 0, 0)], \quad \text{(P2.1)}$$

$$\check{p}^s_L \in \underset{p^s_L}{\operatorname{argmax}}\ \Psi^s_L(p^s_L)$$

$$\equiv p^s_L[f_H D_L(p^s_H, p^s_L, 1, 1) + (1 - f_H) D_L(p^r_H, p^s_L, 0, 1)]. \quad \text{(P2.2)}$$

The implied optimality conditions are

$$[\beta - 1 - f_H(\theta - 1)]\{\alpha\rho + \tau(1 - \rho)\} + f_H p^s_H\{\rho + \tau(1 - \rho)\}$$
$$- 2p^r_L(\beta - 1 + f_L)H\{\rho + \tau(1 - \rho)\} = 0, \quad \text{(A.3)}$$

$$v(\beta - \theta)\{\alpha\rho + \tau(1 - \rho)\}$$
$$- [2\beta p^s_L - f_H p^s_H - (1 - f_H)p^r_H]\{\rho + \tau(1 - \rho)\} = 0. \quad \text{(A.4)}$$

Simultaneously solving Equations (A.1)–(A.4), the support points of the mixing distributions are obtained as

[29]Additional details are given in the Technical Supplement.

$$\check{p}_H^r = \frac{v\eta\{2\beta(\beta - 1)\theta[2(\beta - 1)(2\beta + f_L) + f_H(4\beta + 3f_L - 1)] + f_L(\theta - 1)[4\beta^3 - (1 - f_H)\{4\beta^2 + f_H(1 - f_L)\}]\}}{[4\beta(\beta + f_L - 1) - f_L(1 - f_H)][4\beta(\beta + f_H - 1) - f_H(1 - f_L)] - 4f_Hf_L(\beta + f_L - 1)(\beta + f_H - 1)},$$

$$\begin{aligned}\check{p}_H^s = \{&v\eta[(\beta - 1)[4(2\beta + f_L)(\beta + f_L - 1)(\beta + f_H - 1) + (1 - f_L)\{4\beta(\beta + f_L - 1) - \theta f_L(1 - f_H)\}]\\ &+ (\theta - 1)[4(2\beta^2 - f_L)(\beta + f_L - 1)(\beta + f_H - 1) - (1 - f_L)\{4\beta f_H(\beta + f_L - 1) + f_L(1 - f_H)(\beta + f_H - 1)\}]]\}\\ &\div \{[4\beta(\beta + f_L - 1) - f_L(1 - f_H)][4\beta(\beta + f_H - 1) - f_H(1 - f_L)] - 4f_Hf_L(\beta + f_L - 1)(\beta + f_H - 1)\},\end{aligned}$$

$$\check{p}_L^r = \frac{v\eta\{2\beta(\beta - 1)[2(\beta - 1)(2\beta + f_H) + f_L(4\beta + 3f_H - 1)] - f_H(\theta - 1)[4\beta^3 - (1 - f_L)\{4\beta^2 + f_L(1 - f_H)\}]\}}{[4\beta(\beta + f_L - 1) - f_L(1 - f_H)][4\beta(\beta + f_H - 1) - f_H(1 - f_L)] - 4f_Hf_L(\beta + f_L - 1)(\beta + f_H - 1)},$$

$$\begin{aligned}\check{p}_L^s = \{&v\eta[(\beta - 1)[4(2\beta + f_H)(\beta + f_L - 1)(\beta + f_H - 1) + \theta(1 - f_H)\{4\beta(\beta + f_H - 1) - f_H(1 - f_L)\}]\\ &- (\theta - 1)[4\beta(2 - f_H)(\beta + f_L - 1)(\beta + f_H - 1) - (1 - f_H)\{4\beta f_L(\beta + f_H - 1) + f_H(1 - f_L)(2\beta + f_L - 2)\}]]\}\\ &\div \{[4\beta(\beta + f_L - 1) - f_L(1 - f_H)][4\beta(\beta + f_H - 1) - f_H(1 - f_L)] - 4f_Hf_L(\beta + f_L - 1)(\beta + f_H - 1)\},\end{aligned}$$

where $\eta = [\alpha\rho + \tau(1 - \rho)]/[\rho + \tau(1 - \rho)]$.

Step 2. Derivation of Stores' Reaction Functions $f_H(f_L)$ and $f_L(f_H)$. For store H to randomize between posting an unadvertised "regular" price and an advertised "sale" price, i.e., $\langle \hat{p}_H^r, \delta_H = 0\rangle$ and $\langle \hat{p}_H^s, \delta_H = 1\rangle$, its profits at the "regular" price must be the same as its profits at the "sale" price (net of advertising costs):

$$\check{\Psi}_H^r(f_H, f_L) = \check{\Psi}_H^s(f_H, f_L) - k, \tag{A.5}$$

where k is the marginal cost of advertising. Substituting from support points above, we obtain store H's (implicit) reaction function $F_H(f_H, f_L) = 0$.

Similarly, for store L, the requisite randomization condition is

$$\check{\Psi}_L^r(f_H, f_L) = \check{\Psi}_L^s(f_H, f_L) - k. \tag{A.6}$$

As above, substitution from support points above yields store L's (implicit) reaction function $F_L(f_H, f_L) = 0$.

Step 3. Derivation of Promotional Advertising Nash Equilibrium $\{f_H^*, f_L^*\}$. The NE is obtained by simultaneously solving the two (implicit) reaction functions $F_H(f_H, f_L) = 0$ and $F_L(f_H, f_L) = 0$ given in Equations (A.5)–(A.6).

Because of the high-order polynomials, we are unable to obtain closed expressions for the promotional frequencies. However, we ran extensive simulations over a range of parameter values for which the support points were positive (i.e., $\hat{p}_j^r \geq 0$, $\hat{p}_j^s \geq 0$ for $j \in \{H, L\}$. For all these values, results enumerated in the Proposition 2 hold. Details of the numerical simulations are given in the Technical Supplement.

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