Supermarket Competition: The Case of Every Day Low Pricing

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Abstract

Every Day Low Pricing (EDLP) strategy has proved to be a successful innovation resulting in higher profits to supermarkets adopting it in competition with Promotional Pricing (PROMO). Conventional wisdom attributes this success either to lower costs or to EDLP better serving time constrained consumers, while discouraging cherry pickers who seek promotions. However, it is unclear that such cost savings are being fully realized since EDLP stores also engage in price promotions. Also, continued existence of PROMO stores means that costs are not the only factor, and they compete effectively without relying just on the cherry pickers. Furthermore, experimental evidence suggests that a supermarket cannot obtain higher profits by merely setting constant low prices, leading to the question: exactly what makes EDLP successful? This question is of particular relevance to both academics and practitioners who have been intrigued by the success of this retailing strategy. More generally, the retailing issues addressed in this paper, the economic analysis of competition, and the empirical findings should be of interest to the broader community of researchers and managers.

We investigate the factors contributing to EDLP's success by analyzing the competition between supermarkets through a game theoretic analysis of a market consisting of both time constrained consumers and cherry pickers. Key features of our model are: consumers shop and purchase a basket of goods based on price announcements by stores and rational expectations of unannounced prices; stores carry more than one good and compete through prices, service, convenience, and appropriate communication strategies; and no exogenous cost asymmetries. We derive the conditions under which retailers choosing different strategies (EDLP and PROMO) is a perfect Nash equilibrium.

Our analysis shows that the EDLP store's offering of constant every day low prices is an equilibrium outcome, endogenously determined. Successful implementation of the EDLP strategy involves communication of relative basket prices, implying that merely setting constant low prices is not viable. We further demonstrate that while time constrained consumers find every day low prices at EDLP attractive and cherry pickers the promotions at PROMO, clientele effects are in fact more complicated. Specifically, in equilibrium the PROMO store offers a higher service level as desired by time constrained consumers and the EDLP store a lower service level in keeping with the needs of cherry pickers. This choice of service by the two stores results in a cleaner segmentation of the market. The higher relative basket price and service at the PROMO store results in a larger base of time constrained consumers to shop at the PROMO store and a larger base of cherry pickers to shop at the EDLP store, even though some cherry pickers continue to visit the PROMO store to avail of the price specials. In this way, our results contradict the conventional wisdom on EDLP strategy as being mainly geared towards time constrained consumers. Finally, industry profits are higher in an EDLP-PROMO equilibrium than when stores adopt identical strategies.

Our analysis and results also offer a more complete characterization of the EDLP and PROMO strategies. Indeed, we show that EDLP and PROMO strategies are positioning strategies, rather than merely pricing strategies, with different elements: price/promotions, service, and communications. While the EDLP store uses basket prices to attract both segments, the PROMO store uses service and price specials to compete in the time constrained and cherry picking segment, respectively. Given these different approaches of the two stores, the communication strategies of the EDLP and the PROMO stores emphasize these differences as well. In this way we show, as suggested by Corstjens and Corstjens (1994), that positioning in a retail context involves developing multidimensional strategies appealing to all segments, while each element of the strategy may focus on a different consumer segment. This is in contrast to the traditional view of segmentation in which different products in a product line, for example, are designed to appeal to different segments.

We complete the analysis by examining the data from the trade press and a survey conducted in a major metropolitan area. These data, while limited in scope, support our theoretical results.

(*Retail Competition; Every Day Low Pricing; Segmentation and Positioning; Consumer Expectations; Game Theory*)

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1. Introduction

The phenomenal success of retailers like Wal-Mart, Home Depot and Toys R Us has drawn the attention of practitioners and researchers alike to innovations in retail management. In particular, an innovation which is believed to have proved successful, both in department stores and supermarkets, is Every Day Low Pricing (EDLP). Every Day Low Pricing strategy is thought to differ from a Promotional Pricing strategy (PROMO or Hi-Lo) by not emphasizing price specials on individual goods but instead focusing consumer attention on good value on a regular basis.

The success of EDLP strategy is often attributed to a variety of cost savings on the supply side and "restoring credibility to retail pricing on the demand side" (Ortmeyer, Quelch, and Salmon 1991). These authors argue that on the supply side EDLP leads to lower operating costs through better inventory control and warehouse handling due to more predictable demand; lower personnel costs since the Hi-Lo strategy often requires hiring temporary salespeople at significant costs; and lower advertising expenses by focusing on image rather than price. However, these cost savings are not being fully realized since EDLP stores also engage in price promotions supported by the attractive trade deals offered by the manufacturers. Indeed, Progressive Grocer (1994) reports that ". . . this year, as every year, every day low pricing ranks as the top pricing strategy in chain stores. Except this year, more than one-fifth of managers describe their strategy as every day low pricing mixed with specials .... Industry observers say there are few if any companies running pure EDLP programs anymore, and most mix in specials to make for a better merchandising appeal to their shoppers . . ." Furthermore, if the only advantage of EDLP is lower costs, we should expect all stores to adopt the EDLP strategy. Here again, operators like A & P, Dominick's, Jewel, Safeway, Tom Thumb and Vons have continued with their Hi-Lo strategy and are successful (Hoch et al. 1993, Zweibach and Merrefield 1989). In other words the critical question remains: can an EDLP strategy be viable even when there are no cost advantages to it?

On the demand side, it has been argued that the appeal of EDLP is due to consumers' disenchantment with constantly changing shelf prices and the ensuing skepticism about regular prices. Hoch, Dreze, and Purk (1993) investigated this proposition in two field experiments where prices were varied on over 7,500 items in 25 categories. It is, however, unclear as to how these price reductions were communicated to consumers. They found that a 10% decrease in EDLP category price led to only a 3% increase in sales volume, not sufficient to recover the lost margins. In contrast, the profits were 35% greater in the case of a Hi-Lo strategy. They suggest that in light of this experimental evidence, ". . . the truth is, it's hard to imagine how every day low pricing could ever work for a typical grocery store . . . ." However, other published reports on the profitability of EDLP and Hi-Lo supermarkets such as Albertson's, Food Lion, Vons, and Safeway indicate higher profitability for the EDLP chains (see Table 1). How can these findings be reconciled?

Our goal in this paper is to offer an explanation for these stylized facts. We accomplish this by analyzing the competition between supermarkets pursuing EDLP and Hi-Lo strategies. We explain the viability of the EDLP strategy in the absence of cost advantages by showing that if one supermarket adopts an EDLP strategy while the other uses a Hi-Lo strategy, their pricing,

Table 1 Net Profit for Top-Five Supermarket Chains Whose Pricing Strategy is EDLP and High/Low, 1992

Company	Net Profit
EDLP	
Albertson's	2.7%
Food Lion	2.5
Hannaford	2.4
Bruno's	2.2
Winn Dixie	2.1
High/Low	
Giant Foods	2.0%
Vons	1.3
American Stores	1.2
Safeway	0.7
Kroger	0.5

Source: Business Reports, American Demographics, p. 12.

communication, and service strategies lead to a segmentation of the consumer market that is beneficial to both. Second, given the importance of the communication and service elements of the EDLP strategy, our analysis shows that the EDLP strategy can reap the benefits of segmentation if it is implemented as a positioning strategy (which involves choosing prices, how to communicate them to consumers, and service levels), rather than a mere pricing strategy. In this way, we are able to offer a reason for the low profitability of the EDLP strategy implemented merely as a pricing strategy by Hoch et al.

Our analysis also yields the following insights and take aways. First, in contrast to the conventional wisdom that EDLP stores cater to the greater service needs of "one stop shoppers" (time constrained consumers) and their Hi-Lo competitors target "cherry pickers," we show that both formats attempt to attract both kinds of customers, albeit through different elements of the marketing mix (price, service, and communication strategy).

Second, we show that if the willingness to pay for service by the time constrained consumers is sufficiently high, the clientele of the PROMO store consists of more time constrained consumers, relative to the EDLP store. Said differently, while an EDLP store makes itself attractive to "one stop shoppers" through convenience and lower prices on the basket, the Hi-Lo attacks the same segment via convenience and service. On the other hand, the cherry pickers are attracted to the Hi-Lo store because of lower prices on certain items, and to the EDLP store by lower prices on other items. We offer limited empirical support for these insights.

Another take away of our work relates to the role of promotions in retailing. While the extant literature has focused on manufacturer supported promotions, our analysis identifies a unique role for retailer promotions in the context of a retail pricing strategy where stores sell an assortment of goods. In our model, promotions at the Hi-Lo store take the form of a mixed strategy across the product assortment so as to make it costly for an EDLP retailer to offer better prices on all items in the assortment.

Finally, we attempt to provide answers to some managerially relevant questions. Should an EDLP store have a service level higher than its Hi-Lo competitor? Should a Hi-Lo store increase/decrease/retain its service level when its Hi-Lo competitor switches to an EDLP strategy? How does a retailer implement an EDLP strategy when it is not based on a better cost structure?

The rest of the paper is organized as follows. Section 2 develops the model and describes the specific assumptions. The next section presents an analysis and characterizes the equilibrium strategies for the different types of stores. In §4 we discuss our results. Section 5 extends the analysis to include choice of service by competing stores. Section 6 presents some empirical evidence in support of our conclusions, and we conclude with a summary and directions for future research.

2. Model

In this section we first describe the general problem of a customer choosing between stores and potentially purchasing various items at different stores. Next, we describe the two most commonly used strategies by supermarkets to attract consumers to their stores. Subsequently, we outline the structure of the game to analyze the competition between stores and specify the assumptions of our model. We also state how our model captures some of the essential features of consumer behavior and firm strategies.

A consumer's store choice may depend on four things: (a) purpose of the trip, (b) the attributes that characterize the attractiveness of stores on a given purchase occasion, (c) consumer characteristics, and (d) the price information available. More specifically, the purpose of the trip can be classified as major or minor depending on the size of the basket bought (see Bell 1995). The attractiveness of a store is influenced by its convenience, service, assortment, and price. Consumer characteristics affect store choice because some consumers may value convenience over service while others may value service more than convenience. Similarly, depending on their reservation prices different consumers may derive different levels of consumer surplus from shopping at the two stores. Moreover, some consumers may be willing to make several trips to a store while others may restrict their number of trips in a given time period. Finally, consumers are not informed of all prices at all stores. This could be because stores choose not to communicate all prices or alternatively, consumers choose not to incur the cost of becoming aware of all advertised prices. All these factors affect the initial choice of a consumer to visit a store. A fully informed consumer has no need to alter this initial decision after arriving at a store. However, since consumers may not be aware of all prices, they may decide to visit other stores after visiting the first store.

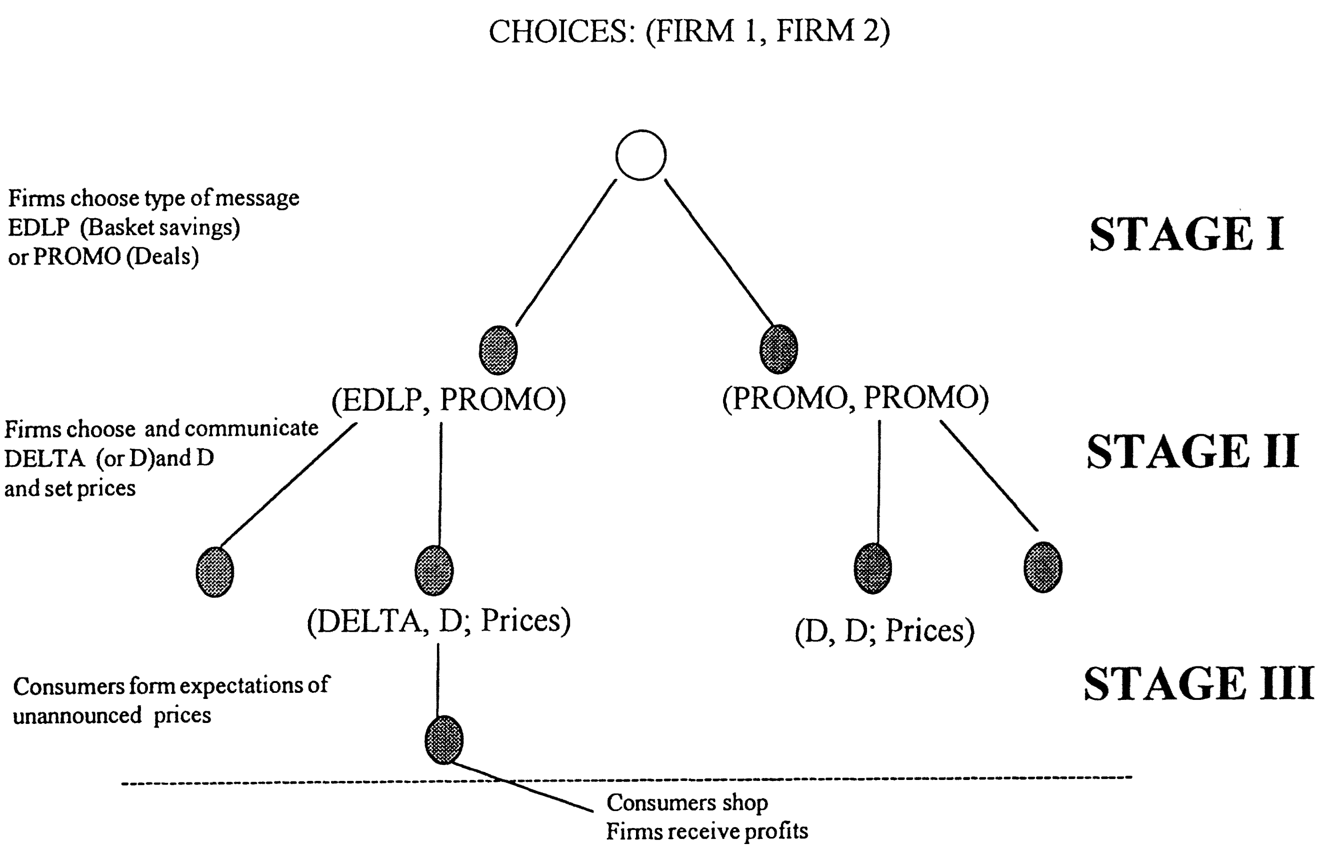
In our model, we capture some of the foregoing features of consumer behavior. We focus only on the major trips which are known to account for a large fraction of the trips and dollars spent (Bell 1995). Although in our model each consumer seeks to purchase an identical basket of goods, we allow consumers to buy only a subset of the basket if the prices are too high or split the basket across stores to benefit from deals offered by different stores. In this way, both the set of items purchased and where they are purchased are endogenously determined in our model. We consider store attractiveness in terms of convenience, service, and price. In order to capture the fact that not all stores are equally convenient to all consumers, we assume that stores are located at the end points of a line and that consumers are located along the line. In this way stores are more convenient to consumers located near the end points and less convenient to those located in the middle. Furthermore, we capture the heterogeneity in consumers' evaluation of convenience through their opportunity cost of travel time. Consumers are classified as "cherry pickers" or "time constrained." Cherry pickers are assumed to have low opportunity cost of time and are therefore willing to search for information on deals and can visit more than one store to benefit from them. In contrast, time constrained consumers only seek to learn basket prices and find it more costly to visit multiple stores. We parsimoniously capture both travel and search related costs, which are likely to be positively correlated in practice, through a single parameter. Finally, we recognize that time constrained consumers have a higher willingness to pay for in-store service as compared to cherry pickers. In this way we model the important characteristics of consumer behavior while fully recognizing the limitations of these choices for implications to be drawn from our model.

With respect to the strategies chosen by retailers, they can be broadly classified as Promotional or Every Day Low Prices. While the definition of a Promotional strategy (PROMO) is reasonably well established, there seems to be more confusion about the characteristics of an EDLP strategy especially since many retailers have their own variation of the EDLP strategy. However, as reported by Hoch et al. on the basis of an IRI study of EDLP pricing using IRI's InfoScan database, the average prices at the EDLP store are lower than at the PROMO store. While these facts focus on the pricing in EDLP stores, it is instructive to consider their advertising messages as well. Examples of EDLP strategy include advertising claims such as "Guaranteed Low Prices Day In, Day Out" by Home Depot (Ortmeyer, Quelch, and Salmon 1991), "We have everything you need in low prices that will save you money" by Albertson's, and advertisements of lower prices relative to competitors for a market basket by Lucky. It is thus clear that the EDLP grocery stores emphasize the savings on a market basket. It is equally important to note that these savings are communicated relative to prices in the PROMO store. Given this description of the EDLP strategy, we model the competition between two grocery stores in the following way.

The Game

Consider a market with two supermarkets each carrying two products. We view the interaction between these stores as a multistage game (as shown in Figure 1) in which each supermarket first chooses to be either an EDLP or PROMO store. This choice implies a specific kind of information to be communicated through the advertising message. For example, the advertising message could focus on good value on the basket or may emphasize the availability of good deals (in general) along with other attributes like service, selection, etc. Note that neither of these advertising messages contain any specific pricing information. In other words, stores first choose the type of advertising message to emphasize savings on a basket of goods or availability of good deals. For expositional purposes, we call the store with the first type of message as EDLP and that with the second type as PROMO or Hi-Lo. In the next stage, stores simultaneously choose prices and implement their communication strategy. The PROMO store's communication strategy involves advertising the specific deals available in its store. The EDLP store, on the other hand,

Figure 1 **The Game**



advertises the specific savings on the basket that a consumer can get relative to the PROMO store. In other words, if both stores choose to be PROMO in the previous stage, they announce the specific deals in the second stage. If one store chooses to be PROMO while the other EDLP, the PROMO store advertises the deals and the EDLP store advertises the savings from buying a basket of goods at the EDLP store. Finally, if both choose to be EDLP, it is easily seen that announcing relative basket prices is not feasible. In other words, it is impossible to have two EDLP stores since both cannot claim a lower basket price.[1] This description of the sequence of decisions which includes the fact that stores simultaneously decide on the advertising message in stage 1 and simultaneously decide and communicate prices in stage 2 implies that the appropriate equilibrium concept is the Nash equilibrium.

In this game, even though consumers can be aware of the specific deals and the basket savings at the EDLP store, they are not fully informed about all prices at the time of store choice. In particular, consumers are uninformed about prices of unadvertised products at the PROMO store, and the individual prices of all products at the EDLP store. This is because consumers know only

[1] Another way to conceptualize the game is to allow the two supermarkets to decide sequentially in stage 1. In this case, if the supermarket that moves first chooses to be EDLP, then the second supermarket can only be a PROMO store. On the other hand, if the supermarket that moves first chooses to be PROMO, the second supermarket can be either an EDLP or a PROMO store. The two game formulations lead to identical results.

the bundle price at the EDLP store relative to its competitor. Following Lal and Matutes (1994), we suppose that consumers have expectations about unadvertised prices, thereby enabling them to make a store choice. We require consumer expectations to be such that given the expectations, stores find it optimal to choose prices of unadvertised products equal to the expectations. Thus consumers' expectations have the desirable property that consumers are not surprised by the equilibrium prices set by the stores. These expectations are also called rational expectations. (Such expectations have been used in the marketing literature; for details, see Lal and Matutes 1994 and Winer 1986.)

The objective of each store is to maximize profits taking into account its competitor's strategy and the behavior of consumers. And, the objective of the consumers is to maximize their utility (surplus). We next elaborate on the specific assumptions of our model.

Assumptions

(1) There are two stores, each carrying two product categories, A and B. In the context of a supermarket, it is best to think of these as branded goods each supplied by a national manufacturer. The advantage of this assumption is that consumers can sensibly compare prices across stores. Thus it excludes products such as produce whose quality may be store dependent, making direct price comparisons less meaningful.

(2) The two stores are located at each end of a straight line of unit length. Without loss of generality, let the PROMO store be located at the left end of the line and the EDLP store at the right end of the line. The convenience of each store will thus depend on a consumer's location relative to each store.

(3) Marginal costs of goods A and B are assumed to be constant, and without loss of generality are specified to be zero. In our one period model, this also implies the absence of trade promotions. Modeling trade promotions has been left to future research, although we conjecture that the presence of trade promotions will result in some promotional activity at the EDLP store, and therefore result in the equilibrium EDLP strategy more closely resembling that observed in practice.

(4) There are two types of consumers: cherry pickers and time constrained, denoted by cp and tc, respectively, and each type is uniformly distributed along the line joining the two stores. As discussed earlier, these two types differ in their travel and search costs. This difference is modeled by assuming that $0.5c_{cp}$ and $0.5c_{tc}$ are the transportation cost per unit distance for the two types, where $c_{cp} < c_{tc}$. Therefore, a person located at a distance g from a store incurs a cost $c_{cp}g$ or $c_{tc}g$ to visit the store and return to her/his location. Finally, we let α denote the number of cherry pickers for every time constrained consumer in the population.

(5) The cost of advertising a price, of the bundle or of a single product, is assumed to be F, and without loss of generality can be set to zero. In modeling the cost of advertising it is useful to understand the context of multi-product retailers. These firms carry a large number of products, and therefore it would be prohibitively expensive to advertise prices of all products in the store. Said differently, it is natural to assume that firms can profitably advertise only a subset of products. In our model, since there are are only two products, we incorporate this reality by restricting advertising to only one price: one product or the bundle. In other words, the PROMO store advertises a deal D on one of the products and the EDLP store advertises the basket savings of δ relative to the PROMO store.

(6) All consumers learn of stores' announcements of D and δ before making store choice. However, only the cherry pickers are assumed to learn through search about the deal/s offered by the PROMO store, i.e., the identity of the good being advertised. This implies that time constrained consumers make store choice decisions only on the basis of basket prices at the two stores.

(7) Consumers need one unit of each good. In other words, we capture the presence of goods like paper products, beverages, cereals, or canned meats in a weekly basket since the demand for one good is independent of the demand for the other. Moreover, they are willing to pay a maximum of R dollars for each good. Although the reservation price for the two goods is likely to be different, we make this assumption for the sake of expositional simplicity.

(8) Consumers decide whether to visit one/both/no stores based on their information and expectations about prices. On visiting a store, consumers gather additional information about prices in that store only and decide whether or not to buy any of the products at that

store. Once at the store, they may also decide to visit and buy some of the goods at the other store. Finally, they may even decide to return to the store visited first. All these decisions are made to maximize total surplus.

3. Analysis

We begin our analysis by characterizing the equilibrium for the case in which one store, denoted by E, pursues the EDLP strategy while the other, denoted by P, pursues the PROMO strategy. Later we identify conditions for such strategies to constitute a perfect Nash equilibrium, i.e., if one store adopts a PROMO strategy (EDLP), it is indeed optimal for the competing store to adopt an EDLP strategy (PROMO). We develop the EDLP-PROMO equilibrium in four steps. Table 2 provides a summary of the notation used in the paper.

First, we derive the demand at the two stores. This demand depends on the PROMO and EDLP stores' choices of $D \geq 0$ and $\delta \geq 0$, and rational consumer expectations of unadvertised prices.[2] Second, in Lemma 1, we identify a set of consumer expectations that are rational. Lemma 1 also establishes the equilibrium prices of the unadvertised good at the PROMO store, and the prices of individual goods at the EDLP store as a function of D and δ. Third we characterize the equilibrium announcements D and δ by the two competing stores. This result is stated in Proposition 1. The final step establishes the conditions for the EDLP-PROMO structure to be a perfect equilibrium, and they are described in Proposition 2.

Table 2 Notations

Superscript e	Expected
index A	good A
index B	good B
index P	Promotional Store (PROMO)
index E	Every Day Low Pricing Store (EDLP)
t_{tc}	transportation cost for time constrained consumers
t_{cp}	transportation cost for cherry pickers
α	number of cherry pickers for every time constrained consumer
D	deal advertised by PROMO store
δ	basket savings advertised by EDLP store
R	Reservation price for each good
x^e	price deal expected on the unadvertised good at the PROMO store
k^e	fraction of discount at the EDLP store expected to be applied to good A
μ	probability of advertising good A
β	$\frac{\alpha C_{tc}}{C_{cp}}$
s	service level
$t(s)$	willingness to pay for service by time constrained consumers
$v(s)$	cost of providing a level of service, s

3.1. Demand at the Two Stores

The demand at each store is determined by aggregating the demand in the two segments. First consider the time constrained (tc) consumers. These consumers are assumed to buy both goods at the same store due to their time constraint, if they buy at all. Their choice of store depends on their location relative to the two stores and the price of the basket of two goods at these two stores. Note that these consumers need not form expectations of prices of each good at the two stores since they are only interested in the basket price. The demand at the PROMO store is $0.5 - \delta/2c_{tc}$ and that for the EDLP store is $0.5 + \delta/2c_{tc}$, assuming that all consumers buy at either store. This is determined by identifying the consumer who is indifferent between the two stores and trades off the savings of δ at the EDLP store with the increase in cost of shopping at the EDLP store. It is easily seen that such a customer is located at a distance $0.5 - \delta/2c_{tc}$ from the PROMO store.[3]

Next consider the cherry pickers. Store choice by these consumers requires them to either know, or have expectations of, prices of each good at the two stores. Let $\mathcal{P}_i^j$ and $\mathcal{E}\mathcal{P}_i^j$ be the known and expected prices of good i at store j; where $i = A$, B and $j = P(PROMO)$, $E(EDLP)$. Suppose that the PROMO store announces a price which implies a discount D relative to the reservation price, R, for good A, i.e., $\mathcal{P}_A^P = R - D$. Moreover, since the price of good B at store P is not announced,

[2] Note that δ less than zero is not feasible since the EDLP store seeks to deliver savings on the basket.

[3] It is possible to allow a demand specification such that some type tc consumers do not buy at all. For purpose of expositional simplicity, we focus on the case where all consumers buy both goods.

the consumer needs to form expectations about this price. Let this be $\mathcal{E}\mathcal{P}_B^P = R - x^e$, where $x^e \geq 0$ and represents the expected discount on the unadvertised good. Similarly, the expected prices at the EDLP store can be derived by noting that the expected bundle price is $2R - D - \delta - x^e$. Therefore, if k^e represents the consumer's expectation about the fraction of the discount applied to good A, then $\mathcal{E}\mathcal{P}_A^E = R - k^e(D + \delta + x^e)$ and $\mathcal{E}\mathcal{P}_B^E = R - (1 - k^e)(D + \delta + x^e)$, where $D > x^e \geq 0$, and $0 \leq k^e \leq 1$. Given these prices and expectations, one can derive the store choice of each cherry picker. Like time constrained consumers, some cherry pickers may buy both goods at either store P or E, but unlike them, other cherry pickers may indeed cherry pick from both stores. Such consumers cherry pick the lower priced good, good A, in store P and good B in store E. It can be shown that all cherry pickers located at $0 \leq g \leq \min\{g_s^e, \bar{g}^e\}$, where $\bar{g}^e = (c_{cp} - \delta)/2c_{cp}$, $g_s^e = 1/c_{cp} \times \{c_{cp} + x^e - (1 - k^e)(D + x^e + \delta)\}$, buy both goods at store P. Similarly, it can be shown that all cherry pickers located at g such that $1 \geq g \geq \max\{h_s^e, \bar{g}^e\}$, where $h_s^e = 1/c_{cp} \times \{D - k^e(D + x^e + \delta)\}$, buy both goods at store E. Cherry pickers in the middle cherry pick at both stores.

3.2. Rational Expectations

We now focus on rational expectations in our model. In order to do so, we must understand three components of consumer behavior: (i) given all the prices that are advertised and the derived consumer expectations, how consumers choose a store to visit; (ii) once at a store, they learn about prices at that store and may reconsider their shopping decision; and (iii) consumers find that their expectations are fulfilled. These considerations allow us to characterize rational expectations about unadvertised prices based on the announcements of D and δ. We recognize that the PROMO store may offer the discount D on good A or good B as part of a pure strategy Nash equilibrium; or alternatively offer the discount D randomly across the two goods as part of a mixed strategy Nash equilibrium. Lemma 1 establishes the rational expectations for both these cases and further demonstrates that the PROMO store is better off using the mixed strategy.

LEMMA 1. *Let c_{cp} and α be sufficiently small. If store P restricts itself to a pure strategy, the following expectations are rational:*

(i) *if $D + \delta < R$, $x^e = 0$ and $k^e = 1$*
(ii) *if $D + \delta \geq R$, $x^e = 0$ and $k^e = D/D + \delta$.*

If store P adopts a mixed strategy of advertising good A with probability $\mu = 0.5$ and good B with probability $1 - \mu = 0.5$, the following expectations are rational. Consumer expectations $x^e = 0$ and $k^e = 0.5$ are rational for all $D + \delta < 2R$. The EDLP store makes positive profits only when $D + \delta < 2R$. The mixed strategy dominates the pure strategy for the PROMO store.

PROOF. See Appendix I.

The conditions in Lemma 1 have an intuitive interpretation. Recall that time constrained consumers are assumed not to search for deals and therefore make store choice on the basis of basket prices. Similarly, the assumption that c_{cp} is sufficiently low enables us to appropriately model the cherry pickers such that some of them, in equilibrium, cherry pick at both stores. Finally, if α is high, the above described expectations are not rational. This is because the PROMO store finds it profitable to deviate by reducing the price of the unadvertised good. The deviation is profitable because some of the cherry pickers who had planned to visit the EDLP store also, end up buying both goods at the PROMO store.

3.3. Characterization of the EDLP-PROMO Equilibrium

PROPOSITION 1. *If α and c_{cp} are sufficiently small, $c_{tc}^* < c_{tc} < c_{tc}^{**}$, and the parameters of the model satisfy the conditions A(1)–A(3) identified in Appendix II, the following pricing-advertising strategies and consumer expectations constitute a rational expectations Nash equilibrium:*

$$\mu^* = 0.5, \quad D^* = \frac{\beta R - c_{tc} + (1 + \beta)\delta^*}{2\beta},$$

$$\delta^* = \frac{R(2 + \beta) - D^* + (1 + 2\alpha)c_{tc}}{(2 + \beta)},$$

$$x^e = 0 \quad \text{and} \quad k^e = 0.5 \quad \text{where} \quad \beta = \alpha c_{tc}/c_{cp}.$$

PROOF. See Appendix II.

The equilibrium can be described as follows. In stage 1 each store simultaneously chooses a communication strategy. The difference in the communication strategies can be characterized by the focus on specials at the PROMO store and relative basket savings at the EDLP store. In stage 2, stores simultaneously set prices and implement their communication strategies by advertising prices of goods at the store. The PROMO store announces a discount of D^* on good A with probability 0.5 (and on good B with probability 0.5); simultaneously, the EDLP store announces that its basket price is lower than that at the PROMO store by δ^*. Moreover, the PROMO store sets the price of the unadvertised good at the reservation price and the EDLP store sets the price of both goods to be equal.

On hearing these announcements, consumers form the following expectations. At the PROMO store, the price of the unadvertised good is equal to the reservation price R (i.e., $x^e = 0$). Similarly, the expectations at the EDLP store are that the total difference in basket prices is split equally across the two goods (i.e., $k^e = 0.5$). As stated above, these strategies and expectations constitute a rational expectations Nash equilibrium.

3.4. EDLP-PROMO or PROMO-PROMO

Until now we have identified the restrictions on the parameter space for which an EDLP-PROMO equilibrium exists. However, for one store to adopt an EDLP strategy in competition with the PROMO store, in equilibrium, it must be the case that the profits from the EDLP strategy should be higher than those from using a PROMO strategy in competition with a PROMO store. We therefore next characterize the equilibrium strategies when a store uses a PROMO strategy as identified above to compete with another store using a similar strategy. Note that in the above described equilibrium, a PROMO strategy results in a store using a mixed strategy of offering the same discount across the two products. The mixed strategy across products results in the price of any particular good to be R or $R - D^*$ at any given time. In other words, both goods are promoted and, as in our EDLP-PROMO equilibrium, they are promoted equally often. We therefore next characterize the equilibrium pricing strategies for a PROMO-PROMO game.

LEMMA 2. *If $\alpha R \geq c_{cp}(3 + 2\alpha)$, the following pricing-advertising strategies and consumer expectations constitute a rational expectations Nash equilibrium:*

$$\mu^* = 0.5, \quad D^* = 2R - c_{tc}\frac{2 + 3\alpha}{2 + \alpha}, \quad \textit{and} \quad x^e = 0.$$

PROOF. See Appendix III.

Comparing the profits to the EDLP store in the EDLP-PROMO equilibrium to those to the PROMO store in the PROMO-PROMO equilibrium leads to the next proposition.

PROPOSITION 2. *If, in addition to the conditions identified in Proposition 1 and Lemma 2, the profits to the EDLP store in the EDLP-PROMO equilibrium are greater than those to the PROMO store in the PROMO-PROMO equilibrium, the equilibrium identified in Proposition 1 is indeed a perfect Nash equilibrium.*

To investigate the feasibility and robustness of the conditions identified in Propositions 1 and 2, we present a numerical example next. Let the reservation price of each good be R for all consumers. Also assume that the unit transportation cost for the time constrained (type tc) consumer is $c_{tc} = R = 1$ and that for the cherry picker (type cp) is $c_{cp} = 0.2$. Finally let α, the ratio of cherry pickers to time constrained consumers, be 0.5. For these parameter values, the following pricing strategies and consumer expectations constitute a rational expectations Nash equilibrium[4]:

$$\mu^* = 0.5, \quad D^* = 0.596, \quad \delta^* = 0.423,$$
$$x^e = 0 \quad \text{and} \quad k^e = 0.5.$$

We also verified the sensitivity of the existence of this equilibrium by varying the parameters α, c_{cp} and c_{tc} and find that the equilibrium exists for a range of values for each of these parameters. Furthermore, we found that both D^* and $D^* + \delta^*$ decrease with increase in c_{tc} and c_{cp} and with decrease in α. This makes intuitive sense since an increase in c_{tc} or c_{cp}, ceteris paribus makes the market less price sensitive and therefore results in reduced price competition in the form of lower discounts.

[4] Note that in this equilibrium, no cherry picker buys both products at the PROMO store since their transportation costs are sufficiently low.

Similarly, a decrease in the proportion of cherry pickers leads to lower discounts as reported above.

It can also be shown that for the parameter values used, the profits in the PROMO-PROMO equilibrium are lower than those for the EDLP store in the EDLP-PROMO equilibrium. Hence we can conclude that the EDLP-PROMO is indeed the Nash equilibrium.

4. Discussion

It is useful to summarize the main findings from the analysis presented in §3. If we examine the pricing strategies of the EDLP and PROMO stores, we find that in equilibrium not only is the basket price at the EDLP lower than at the PROMO store (consistent with the advertising strategy), but we also find that the price of individual goods has lower variance at the EDLP store. This latter result is important for two reasons. First, it is an endogenous outcome in our model and therefore can serve as a basis for testing the empirical validity of our model. The constant equilibrium price is optimal for the EDLP store because of the promotions at the PROMO store. In other words, while the *low price* of the EDLP strategy is part of the communication strategy, the *every day* (constant prices) part of the strategy is a response to promotions by the PROMO store. Secondly, the EDLP store sets a constant price on each good but does not offer prices lower than at the PROMO store on both goods. Note that if the basket price at EDLP is sufficiently lower than at the PROMO store, the prices at the EDLP store could still be constant for each good and lower for both goods. This does not occur in our model since such sufficiently lower prices are not profitable and more importantly, the optimal strategy of the PROMO store would not involve promotions if the EDLP prices were lower on both goods.

The pricing strategy of the PROMO store also displays an interesting feature. The mixed strategy by the PROMO store is also endogenous in our model, since we allow it to pursue pure strategies. The intuition behind the mixed strategy is easily understood as a response to the EDLP promise of lower basket prices since the mixed strategy ensures that the EDLP promise does not result in lower prices on both goods. Moreover, we find that mixing, or randomizing, is over products rather than depth of price discounts. Past research on promotions has focused on promotion depths, given the emphasis on single product marketing (Narasimhan 1988; Raju, Srinivasan, and Lal 1990; and Rao 1990, 1991). In the retail context, multi-product marketing is an essential feature, and this leads to randomized promotions across products. In this way, we provide a different motivation for retail promotions.

In our model, equilibrium profits are higher for the EDLP store than for the PROMO store. Of course, this is consistent with reports in the trade press which attest to EDLP's higher profitability (see Table 1). But our analysis allows us to gain insights into why this is the case. Since we do not assume any exogenous cost asymmetries, the outcome is a result of the particular strategies. The intuition can be followed by imagining a market served by two PROMO stores. When one of them adopts the EDLP strategy, it changes both its pricing and communications strategy. The pricing strategy may actually result in lower margins on the basket, but be offset by higher market shares. The communication strategy, however, makes it difficult for the PROMO store to compete effectively on prices. It is the combination of these two that results in higher profits to the EDLP store. In this way we can conjecture why the EDLP strategy (lower prices) implemented by Hoch et al. did not result in increased profits. Our analysis would suggest that the lower prices should have been communicated in a particular way, i.e., as lower basket prices relative to the PROMO store.

Lastly, our model offers insights into consumer behavior and clientele effects. Time constrained consumers find the EDLP store attractive due to its lower basket prices, and cherry pickers the PROMO store due to its promotions. This is consistent with conventional wisdom and the arguments in Ortmeyer, Quelch, and Salmon. However, in our equilibrium, both types of consumers visit both stores, albeit in different proportions, and buy different goods in each store. Thus the EDLP strategy does not lead to a clear segmentation in which its clientele consists of mainly time constrained consumers. In other words, while the implications of our model with respect to store price attractiveness are consistent with conventional wisdom, implications for store targeting and market segmentation are somewhat different. In fact, in the next section, we show that when stores include service as a means for competition, segmentation becomes clearer, and in the direction opposite to price attractiveness of the two stores.

5. Competition with Service

As discussed in Betancourt and Gautschi (1990), supermarkets typically compete on various nonprice factors such as fast check-out, adequate parking space, courteous in-store help, enhanced assortment, quality of produce and meats, quality of store brands, quality of specialty foods such as delicatessens, etc. In this way we can think of supermarkets positioning themselves by suitable choice of these individual factors.

Our discussion until now suggests that the EDLP strategy seeks to take advantage of the needs of the time constrained consumers by offering savings from one stop shopping; however, it does not completely give up the cherry picking segment. Most marketing texts would suggest that given two types of consumers, each store may be better off targeting a unique segment. Said differently, it may be worthwhile for the EDLP store to focus on the time constrained segment and the PROMO store to focus on the cherry pickers. To investigate this issue further, we consider other decisions of a store, specifically, service. The idea being that if the EDLP store indeed wishes to cater to the needs of the time constrained consumers, then the EDLP store might also offer better service if the marginal willingness to pay for service is higher for the time constrained consumers.

In modeling these factors, it is important to recognize that some of these factors contribute to a consumer's utility whenever he/she visits the store, e.g., parking space, check-out counters and in-store help, while other factors affect a consumer's utility depending upon what he/she buys at the store. An important distinction between these two sets of factors is that while a store can set prices of meats, produce, fish and deli in such a way that only those who consume it have to pay for it, all consumers pay the same price for the above mentioned services as reflected in the price of other goods. From a consumer's point of view, the nonprice factors influence store choice because consumers have different willingness to pay for better parking space and speedier check-out counters. In contrast, the price of meat and produce not only affects store choice but also allows the consumer to decide what goods to buy at each store, based on the prices. In the following analysis we focus on the nonprice factors to keep the model tractable.

5.1. Modeling Nonprice Factors

To model the nonprice factors such as in-store service, we make two specific assumptions. First, we suppose that a level of service s can be provided at a cost of $v(s)$ **per customer** visiting the store, where $v'(s) > 0$ and $v'' > 0$. Second, we assume that the cherry pickers (type cp customers) who are willing to shop around in many stores are not willing to pay for any service level beyond a minimum, denoted as 0. Moreover, it is assumed that the time constrained consumers (type tc consumers), for whom the costs of search and travel are high, are willing to pay $t(s)$ for service level s, where $t(0) = 0$, $t'(s) > 0$ and $t'' < 0$. Thus a type tc consumer located g from the PROMO store incurs a transaction cost of $c_{tc}g - t(s^P)$ if he shops there; and incurs a transaction cost $c_{tc}(1 - g) - t(s^E)$ if he shops at the EDLP store. In contrast, since it is assumed that cherry pickers do not get any value from the provision of service, a type cp consumer located g from the PROMO store incurs a transaction cost of $c_{cp}g$ and $c_{cp}(1 - g)$ in shopping at the PROMO and EDLP stores, respectively. Thus, in our model the willingness to pay for service and travel and search costs are correlated. This assumption follows Becker (1965), since both factors are influenced by income and the opportunity cost of time. We assume that the choice of service is made so as to maximize profits of each store and consumers are assumed to be aware of the service levels offered by the two stores. Since the in-store service decision is not as permanent as other service decisions, a store is assumed to make this decision along with the pricing decision for each product; consequently, we seek a Nash equilibrium in service as well.

As in §3, we continue to assume that c_{cp} and α are sufficiently small. As before, this implies that while a fraction of cherry pickers buy only one good at the PROMO and EDLP store, the rest buy both goods only at the EDLP store. The profit functions for EDLP and

PROMO stores can now be specified by describing the market shares and margins for each store from the two consumer segments.

First consider the time constrained consumers. Assuming that all such customers buy from at least one store, the fraction of these that buy at the PROMO store is given by $1/2c_{tc} \times \{c_{tc} - \delta + t(s_P) - t(s_E)\}$. The profit margin from each of these customers is $2R - D - v(s_P)$. Next consider the cherry pickers. Since these customers do not value service, the fraction that buys one good at the PROMO store is $(D - \delta)/2c_{cp}$, and the profit margin from each of these customers is $R - D - v(s_P)$. Hence the profit function for the PROMO store can now be written as:

$$(1 + \alpha)\pi^P = (2R - D - v(s_P))\frac{1}{2c_{tc}}\{c_{tc} - \delta + t(s_P) - t(s_E)\} + \alpha(R - D - v(s_P))\frac{D - \delta}{2c_{cp}}.$$

These profits are maximized by appropriate choices of D and s_P. Differentiating with respect to D and s_P, respectively, and setting equal to zero, we get

$$2\beta D = \beta(R - v(s_P)) - c_{tc} - t(s_P) + t(s_E) + \delta(1 + \beta) \quad \text{and}$$

$$\frac{v'(s_P)}{t'(s_P)} = \frac{2R - D - v(s_P)}{c_{tc} - \delta + t(s_P) - t(s_E) + \beta(D - \delta)}.$$

Similarly, the profit function for the EDLP store can now be written as:

$$(1 + \alpha)\pi^E = (2R - D - \delta - v(s_E))\frac{1}{2c_{tc}}\{c_{tc} + \delta - t(s_P) + t(s_E)\} + 0.5\alpha(2R - D - \delta - 2v(s_E))\frac{D - \delta}{2c_{cp}} + \alpha(2R - D - \delta - v(s_E))\left(1 - \frac{D - \delta}{2c_{cp}}\right).$$

Differentiating with respect to δ and s_E, respectively, and setting equal to zero, we get

$$(2 + \beta)\delta = (2 + \beta)R - v(s_E) - c_{tc}(1 + 2\alpha) - t(s_E) + t(s_P) - D \quad \text{and}$$

$$\frac{v'(s_E)}{t'(s_E)} = \frac{2R - D - \delta\, v(s_E)}{c_{tc} + \delta - t(s_P) + t(s_E) + 2\beta c_{cp}}.$$

These first order conditions can be solved simultaneously to determine the equilibrium values of D, δ, s_P and s_E.

An immediate and important result that can be easily established is that $s_P^* > s_E^*$. To see this, we evaluate the first order condition for service by the EDLP store at $s_E = s_P^*$. It can be easily shown that the profits to the EDLP store are declining for $s_E \geq s_P^*$. Hence, we conclude that $s_P^* > s_E^*$. To understand this result, it is important to recognize that if both stores were to offer the same service levels, the margins at the PROMO store are higher than at the EDLP store and yet the marginal cost of offering any given level of service is higher at the EDLP store. The latter is true because the marginal cost of providing any given level of service depends on the number of customers visiting the store and is higher for the EDLP store since the fraction of cherry pickers visiting the PROMO store is no greater than that visiting the EDLP store. Hence a marginal cost-benefit analysis will suggest that the service at the PROMO store is higher than at the EDLP store, in equilibrium. This result is in direct contrast to the arguments presented in the literature. For example, Ortmeyer, Quelch, and Salmon (1991) argue that since EDLP is attractive to high income households, the EDLP store can satisfy their needs by offering better assortment and exceptional service. Similarly, Lattin and Ortmeyer (1991) argue that the EDLP strategy is more appropriate as the number of time constrained consumers increase in the total population.

We next re-visit the numerical example discussed in §3 to illustrate several other important features of the competition between PROMO and EDLP stores, in presence of service.

5.2. Example Revisited

As in §3, we let $c_{tc} = R = 1$, $c_{cp} = 0.2R$ and $\alpha = 0.5$. Moreover, suppose the cost of providing service per customer visiting the store is $v(s) = 0.5\eta s^2$ and the willingness to pay for service by type tc customer is given by and $t(s) = \tau s$. We let $\eta = 1$ and vary τ over (0, 1.2)

Table 3(a) PROMO-EDLP Competition

Willingness to Pay for Service (τ)	Discount by PROMO Store (D^*)	Difference in Basket Prices (δ^*)	Service Provided by PROMO (Sp)	Service Provided by EDLP (S_E)	EDLP's Share of Customers		Profits	
					Time Constrained	Cherry Pickers	PROMO	EDLP
0.0	0.596	0.423	0.0	0.0	71.7	56.7	0.328	0.721
0.1	0.595	0.426	0.14	0.043	70.8	57.7	0.327	0.720
0.2	0.593	0.435	0.28	0.085	69.8	60.6	0.323	0.714
0.5	0.585	0.488	0.63	0.200	63.6	75.6	0.312	0.676
0.8	0.589	0.548	0.85	0.310	55.8	89.6	0.310	0.624
1.0	0.602	0.580	0.93	0.314	51.0	94.6	0.314	0.586
1.2	0.616	0.607	0.99	0.317	46.8	98.2	0.317	0.558

to capture varying effectiveness of service. Of course $\tau = 0$ corresponds to the case of no service (§3). Table 3a shows the equilibrium values of D, δ, s_P and s_E. In addition we display the share of each type of customer visiting the EDLP store. As expected $s_P > s_E$. We also see that as expected, both stores offer higher levels of service with higher willingness to pay for service by the time constrained consumers.

What is more interesting is that δ increases as service becomes more desirable. In contrast, D decreases and then increases as service becomes more desirable. The intuition for these results is as follows. Since the EDLP store attracts a larger share of cherry pickers, the total cost of offering any given level of service ends up being higher for the EDLP store; therefore, it competes for the time constrained consumers by lowering price. Of course, benefits from lowering price not only accrue from the time constrained consumers but also from the cherry pickers. In contrast, since the EDLP store offers a discount on the bundle in addition to that offered by the PROMO store, the PROMO store is better of reducing promotions and emphasizing service. However, once the level of service offered by the PROMO store reaches a certain level and the marginal cost of offering service is sufficiently high, it responds to lower prices at the EDLP store by offering lower prices in the form of higher D.

We now turn to the customer mix at the EDLP store. We find that as service becomes more desirable by the time constrained consumers, the market share of the PROMO store increases in the time constrained segment but decreases in the cherry picking segment. In other words, as the PROMO store provides more service, an increasingly higher fraction of time constrained consumers buy both goods in the PROMO store while an increasingly smaller fraction of cherry pickers buy at the

Table 3(b) PROMO-PROMO Competition and Service Comparisons

Willingness to Pay for Service (τ)	PROMO-PROMO Comparisons			Service Comparisons		
	Discount D^*	Service S^*	Profits π^{p-p}	Service under PROMO-PROMO	Service by PROMO under EDLP-PROMO	Service by EDLP under EDLP-PROMO
0.0	1.222	0.0	0.324	0.0	0.000	0.000
0.1	1.221	0.044	0.323	0.044	0.140	0.043
0.2	1.218	0.089	0.322	0.089	0.280	0.085
0.5	1.197	0.222	0.314	0.222	0.630	0.200
0.8	1.159	0.356	0.297	0.356	0.850	0.310
1.0	1.123	0.444	0.283	0.444	0.930	0.370
1.2	1.080	0.533	0.265	0.533	0.990	0.430

PROMO store. Said differently, the service offered by the two stores leads to a cleaner segmentation of the market: the PROMO store is able to focus more on the time constrained consumer and allows the cherry pickers to shop at the EDLP store with the result that the PROMO store's clientele is characterized by a higher fraction of time constrained consumers, relative to the EDLP store. Thus although the EDLP store offers a lower basket price, the PROMO store is better able to compete for the time constrained consumers if service is sufficiently desirable. We believe it to be an important consequence of the EDLP strategy.

Finally, we consider the question about service levels in different competitive environments, as posed in the introduction: Should a Hi-Lo retailer increase/decrease or retain its service level when its Hi-Lo competitor shifts to an EDLP strategy? The above discussion may suggest that since the EDLP store offers lower service, the competition on service may be more intense among two Hi-Lo stores than between a Hi-Lo and an EDLP store. To address this question we next characterize the equilibrium pricing and service strategies for the case when two PROMO stores compete with each other.

5.3. PROMO-PROMO Equilibrium with Service

As before, let store i offer a discount D_i on each good with probability 0.5. Moreover, let each store's choice of service be denoted by s_i. Then the profits to store i are[5]:

$$\frac{(2R - D_i - v(s_i))}{1 + \alpha} \left\{ \frac{c_{tc} + D_i - D_j + t(s_i) - t(s_j)}{2c_{tc}} + 0.5\alpha \left(\frac{c_{cp} + D_i - D_j}{2c_{cp}} \right) \right\} + 0.5\alpha \frac{(R - D_i - v(s_i))}{1 + \alpha}.$$

Differentiating these profits with respect to D_i and s_i, setting equal to zero and invoking symmetry, we obtain

$$2R - D - v(s) = \frac{c_{tc}(2 + 3\alpha)}{2 + \beta} \quad \text{and}$$

$$\frac{v'(s)}{t'(s)} = \frac{2(2R - D - v(s))}{c_{tc}(2 + 3\alpha)}.$$

For the specific case in the example, we get

$$D^* = 2R - \frac{2\tau^2}{\eta(2 + \beta)^2} - \frac{c_{tc}(2 + 3\alpha)}{2 + \beta} \quad \text{and}$$

$$s^* = \frac{2\tau}{\eta(2 + \beta)}.$$

Table 3b provides a comparison of the service levels under PROMO-PROMO equilibrium, and EDLP-PROMO equilibrium for different values of τ for the numerical example. We also display the discount under the PROMO-PROMO equilibrium, and the profits under each scenario. The first point to note is that in all cases, the EDLP-PROMO equilibrium results in higher profits than the PROMO-PROMO equilibrium to at least one store. Thus the EDLP-PROMO structure is a perfect Nash equilibrium. Finally, the most interesting observation regards the fact that the service level provided under PROMO-PROMO equilibrium lies between the levels provided by the EDLP and PROMO stores under the EDLP-PROMO equilibrium. Thus we see that when a Hi-Lo store's competition changes from Hi-Lo to an EDLP store, it improves its service level even though the competing store now offers a lower service level. This is a direct consequence of the fact that in case of PROMO-PROMO competition, there is complete symmetry in the strategy of the two stores while the competition between EDLP-PROMO allows for a better segmentation and higher profits for the retailers. These conclusions have been drawn under the assumption that the EDLP store does not enjoy sufficiently large cost advantages from adopting the EDLP strategy. However our conclusions should be modified if the implementation of the EDLP strategy results in significant cost advantages, as discussed below.

Until now we have assumed that the marginal costs to both stores are identical. However, if one takes into account the cost savings identified by Ortmeyer, Quelch and Salmon (1991) for an EDLP store, the above results can be reversed only if these cost savings are sufficiently high. In other words, if the contribution margin for the EDLP store is sufficiently higher, i.e., higher than a critical value, due to savings in operating costs, personnel costs and advertising expense, the above arguments imply that the EDLP store will find it profitable to offer a higher level of service as compared to the PROMO

[5] These profits imply that all cherry pickers buy the lower priced good at each store, when the two supermarkets promote different goods. For this to be an equilibrium, we have checked that a deviation such that some cherry pickers buy both goods at one store is not profitable.

store. Said differently, if an EDLP store can improve its operations sufficiently, it can dominate (have higher market share) the PROMO store in both segments. Of course, achieving these cost savings is easier said than done.

5.4. Take Aways

The most important take away from our analysis is the segmentation and positioning aspects of EDLP-PROMO competition. Our results are consistent with the conventional wisdom if one were to focus only on pricing. As suggested by Ortmeyer, Quelch, and Salmon (1991), the EDLP store basket price attracts time constrained consumers, and the PROMO store's deals attract the potential cherry pickers. However, positioning involves more than pricing. When service is incorporated in our analysis, we find that the PROMO store offers a higher level of service to attract the time constrained consumers while the EDLP store offers a lower level of service. The equilibrium strategies of the two stores lead to a segmentation resulting in the following differences in the clientele at the two stores. If service is sufficiently valued by the time constrained consumers, the PROMO store's clientele consists of more time constrained consumers who have a higher opportunity cost for shopping and searching for deals. In contrast, while EDLP shoppers also include the time constrained consumers who are attracted by its convenience and lower basket price, the EDLP store's clientele consists of more cherry pickers due to its significantly lower prices.

6. Empirical Evidence

To recapitulate, our analysis provides three testable implications. The first prediction relates to difference in the variance in prices at the two stores. The second is related to the service levels offered by the two stores and the third predicts the differences in the clienteles of the two stores. We now turn to some evidence to support these conclusions.

Our results have some face validity. One implication of our analysis concerns the price dispersion at the two stores. Clearly, the EDLP store's prices are the same across the two identical products. Moreover, the price lies between the prices charged by the PROMO store. This can be interpreted to mean that over time PROMO store prices on individual goods will vary more than the corresponding prices at the EDLP store. These implications are consistent with the findings in the IRI study based on 3,000 stores, "it is seen that EDLP store prices are on average 9% below Hi-Lo stores and percentage price reduction is less deep in EDLP stores (see Hoch et al. 1993)."

Similarly, a survey in Grocery Marketing (April 1994) of supercenters like Wal-Mart practicing EDLP and supermarkets typically practicing PROMO strategies offers support to our second prediction. This survey reveals that ". . . supermarkets edged out supercenters on overall quality, as well as the quality of meat and produce, but were beaten on every day low price and sale price; supermarkets also maintained the lead in convenient location, store layout, good checkouts, friendly atmosphere and well trained employees, but were split with supercenters on cleanliness and were topped by them in pleasing decor; noting the high marks for meat and produce, . . . , perishables are the bright spot for supermarkets. This is where they have the competitive advantage. . . . most supermarkets are making the most of this by increasing the size of the perishables departments and improving quality and diversity of product . . . ."

We offer further evidence regarding the difference in clienteles of the PROMO and EDLP stores based on a survey of shoppers conducted in the Dallas area. To capture the competition in a specific market, we chose a small geographic region in North Dallas where four supermarkets are located along a surface road. At one end there is a Kroger while at the other end, a little over two miles, is an Albertson's store. Midway between the two is a Tom Thumb store, and a mile south of it is a Skaggs Alpha Beta store. This area is residential with single family housing surrounding the stores. There are also many multi-family housing units and apartment buildings in the area.

We used a survey instrument to gather data both on consumer perceptions and their shopping behavior. In addition, we obtained demographic data. The survey was administered over the telephone after extensive pretesting and modification. The sample was randomly drawn using a criss-cross directory and produced a usable sample of 71. Each respondent was asked to identify the grocery store of their choice. They were asked to classify the above identified store as either an EDLP

Table 4 EDLP/PROMO Classification

First Choice Store	% Classifying as EDLP	PROMO	Total
Albertsons	100	0	20
Kroger	57	43	7
Skaggs	20	80	15
Tom Thumb	7	93	29

Table 5 Shopping Other Stores vs. First Choice

First Choice Store		# of Other Stores Shopped				Total
Type	Name	0	1	2	3	#
EDLP	Albertson's	10%	20%	50%	20%	20
EDLP	Kroger	0%	43%	57%	0%	7
PROMO	Tom Thumb	3.5%	86%	10.5%	0%	29
PROMO	Skaggs	10.3%	53%	20%	6.7%	15

or PROMO store. The results of the classification are displayed in Table 4. We can see that while Albertson's is perceived as an EDLP store, Tom Thumb is perceived to be a PROMO store. This is consistent with the published reports in the trade press (*Progressive Grocer* (March 1995) and *Business Editor* (Aug 29, 1994)).

To understand the clientele at each of these stores, we asked the respondent for the number of other stores visited over the preceding three months. Results are displayed in Table 5. It is interesting to note that while 90% of Tom Thumb's clientele visit no more than one other store, 70% of Albertson's clientele visited two or more other stores during the same period.[6] We therefore conclude that Tom Thumb's clientele seems to be more time constrained than Albertson's. In this way the PROMO store's clientele consists of more time constrained consumers, as suggested by our model. In order to further investigate the differences in the clienteles at the two stores with respect to time constraints, we compare its demographics at the two stores. In particular, we report data on income, age, and the presence of an unemployed spouse in the household. These results are presented in Table 6. We observe that Tom Thumb's clientele, on average, has higher income, is younger and has fewer households with unemployed spouses, as compared to Albertson's clientele. In this way, we conclude that the PROMO store indeed attracts more time constrained consumers than the EDLP store.

In summary, our analysis shows that contrary to the notion that an EDLP store's success is based on consumers who are time constrained, it is the PROMO store's strategies that are more geared towards satisfying the needs of these consumers. Moreover, another important message of our analysis is that the PROMO store can compete more effectively against the EDLP store by finding other goods and services that will provide a higher value to the time constrained consumers. Thus expanding the assortment desired by the time constrained consumers to include items such as fresh produce and fruits, higher quality meats and fish, delis and other specialty goods is the likely reason why we see many PROMO stores offering these goods and services.

[6] A store's clientele consists of all respondents who identified the store as their first choice.

7. Summary and Conclusions

In this paper we have studied the competition between two supermarkets to investigate the phenomenon of Every Day Low Pricing. The two stores compete for two types of customers through their choices of advertising, price, and service. Consumers buy a basket of two products at one or both stores depending on the advertised and expected prices at the two stores. Consumer

Table 6 Clientele at Different Stores*

Type of Customer	Albertson	Tom Thumb	Kroger	Skaggs
Low Income	40%	21.5%	43%	23%
Older	30%	18%	13%	35%
Spouse Unemployed	60%	46%	60%	75%

* The table should be read as follows. The clientele of store consists of those consumers who expressed the store to be their first choice. Among those who stated Albertson to be their first choice, for example, 40% (8/19) are classified as low income with the remaining 60% as high income. Similarly, while only 18% (5/28) of Tom Thumb's clientele is classified as older consumers, the rest, 82%, is classified as younger. Similarly, each store's clientele is classified by whether or not one spouse is unemployed.

expectations about the unadvertised prices are rational, and therefore fulfilled in equilibrium. We show that, under certain conditions, one firm adopting a PROMO strategy and the other adopting an EDLP strategy is an equilibrium even when the EDLP store does not have a cost advantage over the PROMO store.

The key to our result is understanding the scope of these strategies which are not merely pricing strategies but in fact positioning strategies. We demonstrate that pursuing either of these strategies implies a unique combination of advertising, pricing, and service. The EDLP store advertises the price of the bundle, prices its products such that they are always between the promoted and regular prices at the PROMO store, and offers a lower level of service. In contrast, the PROMO store advertises the price of the promoted good such that the pricing strategy, and therefore the advertised deals are randomized across the basket of goods. It also offers a higher level of service. In this way, our results offer a different point of view as compared to those in Hoch et al. (1993), where price reductions were insufficient to generate the additional volume for the EDLP strategy to be more profitable than the Hi-Lo strategy.

A direct consequence of these positioning strategies is segmentation of the two types of consumers. Specifically, it results in the PROMO store targeting time constrained consumers who also have a higher willingness to pay for service. In contrast, the EDLP store finds it more profitable to adopt strategies that satisfy the needs of the cherry pickers. Segmentation in the retail context has been argued to be different from that of a market being segmented through a product line as noted by Corstjens and Corstjens (1994). They suggest that while product line segmentation is geared towards offering a different product for each segment, retailers cannot implement this policy in a way that results in the exclusion of certain types of consumers. In other words, retailers try to attract all type of customers into the store, but different types of consumers buy different goods at the store. Our explanation of the EDLP-PROMO phenomenon is consistent with this view. For example, we see that although the PROMO store offers a higher level of service to attract the time constrained consumers, it does not forego the cherry pickers; in fact, it uses randomized promotions to attract them. On the other hand, the EDLP store offers a lower level of service consistent with the needs of cherry pickers but attracts the other type through the offer of lower bundle price. Thus we see that the services offered by the two stores lead to improved profitability for the two stores through a better segmentation of the market, i.e., higher industry profitability when stores adopt different rather than similar strategies. Finally, the design of advertising strategies depends on the choice of price and service, and is used to communicate the positioning strategy to the consumers. In summary, the role of service and its implications for positioning is critical to understanding Every Day Low Pricing in the grocery industry.

Another contribution of our work involves a different perspective on the role of promotions. Most of the marketing literature focusing on single product pricing has interpreted mixed strategies as promotions. By capturing competition for a basket of goods, our analysis sheds new light on the phenomenon of retail promotions. We find that from a retailer's perspective, it is equally important to decide on which products to promote as it is to decide on the depth of promotion. This allows a retailer to pursue a mixed strategy by promoting different products even if the depth of promotion remains the same across products. Our characterization of the equilibrium demonstrates that the PROMO store indeed uses such a mixed strategy so as to ensure that the EDLP store does not have a lower price on all goods. This motivation for retail promotion is novel since it is used by the retailer to maintain its customer base.

Finally, it is important to realize that we are able to obtain these results only because our model explicitly includes decisions about a market basket both from the retailers' and the consumers' points of view. Moreover, as emphasized in Lal and Matutes (1994), the role of expectations about unadvertised prices is central in understanding the positioning strategies of the retailers.

With respect to directions for future research, we believe that including the cost considerations and allowing for different reservation prices for different goods and across consumer segments would yield a more complete model of competition. Similarly, it will be useful to incorporate the availability of trade promotions and stockpiling by consumers so that the equilibrium EDLP strategies may include some promotions and an extended time horizon. Another extension might involve the study of competition to include stores with formats different from EDLP and PROMO stores. This would naturally raise the issue of market baskets not being identical for all purchase occasions. We believe that these investigations hold significant promise and offer potential for exciting research. Our game theoretic framework presented herein should be useful in analyzing these issues.[7]

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Appendix I

We offer a proof of Lemma 1 in this appendix.

PROOF. First consider the case where the PROMO store adopts a pure strategy. Given these expectations, all consumers plan to buy both goods at the EDLP store or the PROMO store. Once consumers arrive at the EDLP store and since the bundle price is fixed, it cannot increase its profits by setting $k \neq k^e$. Setting $k \neq k^e$ could only result in some consumers buying good A at the PROMO store. Now consider consumers visiting the PROMO store. By setting $x > x^e$, the PROMO store reduces the price of the unadvertised good without gaining any new customers. Hence the optimal value of $x = x^e$.

Next consider the case where the PROMO store adopts a mixed strategy. In this case the proof consists of three parts. We first offer a proof for the case where $D < R$ and $\delta < R$. This is followed by a proof for the case where $D > R$ and $\delta < R$. The proof of the case $D < R$ and $\delta > R$ completes the proof.

Case (a): $D < R$ and $\delta < R$.

We first prove that $x^e = 0$ is rational. We know that all type tc consumers buy only at one store. Consider those who arrive at the PROMO store. If the PROMO store chooses $x > x^e$, these consumers will not change their buying decision, but the store will make less profits from sales to them. The type tc consumers who arrive at the EDLP store will be unaffected by choice of x. Thus, for $\alpha = 0$ $x^e = 0$ is rational. Also note that if $\alpha > 0$, and $D \leq \delta$, all type cp consumers also plan to buy both goods at only one store and the above argument continues to apply.

Now, if $D > \delta > 0$, $\alpha > 0$, consumers who plan to buy from both stores are located in the segment $(\max\{0, g_s^e\}, h_s^e)$. Let $\max\{0, g_s^e\} = 0$ and consider those who arrive at the PROMO store. Given that $k^e = 0.5$, they expect the price of good A and B, respectively, to be $\mathcal{E}\mathcal{P}_A^E = R - 0.5(D + \delta) > R - D = \mathcal{E}\mathcal{P}_A^P$, and $\mathcal{E}\mathcal{P}_B^E = R - 0.5(D + \delta) < R - x^e = \mathcal{E}\mathcal{P}_B^P$. The PROMO store can obtain additional profits of $R - x$ per person from these consumers if $x \geq (D + \delta - 2c_{cp})/2$. The cost of this strategy would be a loss of $(D + \delta - 2c_{cp})/2$ from sales to type tc consumers. For sufficiently small α this would not be profitable. Therefore $x = x^e = 0$, i.e., consumer expectation that $x^e = 0$ is rational. A similar argument can be constructed for $g_s^e > 0$.

We next prove that $k^e = 0.5$ is rational. Note that for any δ, the choice of k does not affect the bundle price. Hence if $\alpha = 0$, $k^e = 0.5$ is rational. Next, if $\alpha > 0$ and $\delta > D$, all type cp consumers also plan to buy at only one store, and their decision is either unaffected by the choice of k or some are induced to buy the advertised good at the PROMO store. Hence $k^e = 0.5$ is rational even if $\alpha > 0$ and $\delta > D$.

We complete the proof by analyzing the case where $\alpha > 0$ and $\delta < D$. If $\mu = 0.5$, then the following prices are expected with probability 0.5: $\mathcal{E}\mathcal{P}_A^P = R - D$, $\mathcal{E}\mathcal{P}_B^P = R$, $\mathcal{E}\mathcal{P}_A^E = R - k^e(D + \delta)$, and $\mathcal{E}\mathcal{P}_B^E = R - (1 - k^e)(D + \delta)$. At these expected prices, the EDLP store can potentially increase its profits by setting $k > k^e = 0.5$ and inducing some of the type cp consumers who plan to buy only good B at the EDLP store to also buy good A at the EDLP store. Let half of the consumers located in (g_s^e, h_s^e) come to the EDLP store with the intention to buy good B at the EDLP store and those located in $(h_s^e, 1)$ with the intention to buy both goods at the EDLP store. Once at the EDLP store, $k > 0.5$ induces the consumers who plan to buy only good B to buy both goods. Let the consumer located at z decide to buy both goods at the EDLP store. Then it must be that

$$2R - (D + \delta) + 0.5c_{cp}(1 - z)$$
$$\leq R - D + R - (1 - k)(D + \delta) + 0.5c_{cp} + 0.5c_{cp}z,$$
$$\text{i.e., } c_{cp}z \leq (1 - k)(D + \delta) - \delta.$$

Hence consumers located in (z, h_s^e) buy both goods at the EDLP store, bringing in an incremental profit of $0.5[(k - 0.5)(D + \delta)]/c_{cp} \times \{R - k(D + \delta)\}$.

Recall that since the PROMO store is following a randomized strategy, setting $k > 0.5$ also implies that the following set of prices are expected with probability 0.5: $\mathcal{E}\mathcal{P}_A^P = R$, $\mathcal{E}\mathcal{P}_B^P = R - D$, $\mathcal{E}\mathcal{P}_A^E = R - k^e(D + \delta)$, and $\mathcal{E}\mathcal{P}_B^E = R - (1 - k^e)(D + \delta)$. We next examine how $k > 0.5$ affects profits of the EDLP store under this scenario. In this case, among the people who come to the EDLP store with the intention of buying both goods at the EDLP store, some of them are induced to buy from both stores. In particular, all consumers located in $(h_s^e, \bar{z})$, will buy only good A at the EDLP store, where $\bar{z} = k(D + \delta)/c_{cp}$. This results in a loss of $[(k - 0.5)(D + \delta)]/c_{cp} \times \{R - (1 - k)(D + \delta)\}$. Furthermore, consumers who plan to buy only good A at the EDLP store, i.e., those in (g_s^e, h_s^e), are also better off. This results in a loss of $(k - 0.5)(D + \delta)(D - c_{cp})/c_{cp}\}$. Hence if $k > 0.5$, the incremental profits are

$$\mu\left[\frac{(k - 0.5)(D + \delta)}{2c_{cp}}\{R - k(D + \delta)\}\right]$$
$$- (1 - \mu)\left[\frac{(k - 0.5)(D + \delta)}{c_{cp}}\{R - (1 - k)(D + \delta)\} + (k - 0.5)(D + \delta)\left\{\frac{D - c_{cp}}{c_{cp}}\right\}\right].$$

If $\mu = 0.5$, the above terms can be rewritten as

$$\left\{\frac{(k-0.5)(D+\delta)}{4c_{cp}}\right\}$$
$$\times\{R-k(D+\delta)-2R+2(1-k)(D+\delta)-2(D-c_{cp})\}.$$

Differentiating with respect to k, it is easily seen that profits are decreasing for all $k > 0.5$ when $\mu = 0.5$. Hence, the EDLP store has no incentive to deviate from $k = k^e = 0.5$. Similar arguments can be constructed for $g_s^e < 0$ and $h_s^e > 1$. The proof for the other two cases can be derived in a similar manner and are available from the authors on request. QED.

Appendix II

In this appendix we offer a proof for Proposition 1.

PROOF. We construct this proof by identifying the set of conditions under which no deviation is profitable by either the PROMO or the EDLP store.

(i) The argument is identical to that presented in the numerical example.

(ii) Consider this type of deviation by the PROMO store. If the PROMO store sets a price $R - x^e$ where $x^e > 0$, the change in profits can be computed by recognizing that some cherry pickers may buy both goods at the PROMO store and therefore decide to not visit the EDLP store as planned. The change in profits if $x^e \geq [(D^* + \delta^* - 2c_{cp})]/2$ are

$$(1+\alpha)\Delta\pi^P = 0.5\alpha(R-x^e)\left\{1-\frac{D^*+\delta^*}{2c_{cp}}+\frac{x^e}{c_{cp}}\right\}-x^e\left\{\frac{c_{tc}-\delta}{2c_{tc}}\right\}$$

and 0, otherwise. These changes are optimized at $x^e = 0.5\{R - c_{cp} + 0.5(D^* + \delta^*) - (c_{tc} - \delta)/\beta\}$. However, this deviation is not profitable if

$$0.5\{R-c_{cp}+0.5(D^*+\delta^*)-(c_{tc}-\delta)/\beta\} \leq \frac{(D^*+\delta^*-2c_{cp})}{2}.$$

It is easily seen that this, indeed, is the case for sufficiently small values of α.

Next consider a deviation by the EDLP store to discourage cherry pickers from visiting the PROMO store, once they are at the EDLP store. Since the PROMO store uses a mixed strategy, this can be accomplished only by lowering the price of both goods. Let ϵ be the additional price cut on both goods. The consequent change in EDLP store's profits are:

$$(1+\alpha)\Delta\pi^E = -2\epsilon\left\{\frac{c_{tc}+\delta^*}{2c_{tc}}+\alpha\left(1-\frac{D^*-\delta^*}{2c_{cp}}\right)\right\}$$
$$-\epsilon\alpha\frac{D^*-\delta^*}{2c_{cp}}+\frac{0.5\alpha\epsilon}{c_{cp}}(R-\epsilon-0.5(D^*+\delta^*)).$$

The optimal value of ϵ can be shown to be

$$\epsilon^* = 0.5R + 0.25(D^* - 3\delta^*) - 2c_{cp} - (c_{tc} + \delta^*)/\beta.$$

However, $\epsilon^* \leq 0$, for sufficiently small values of α. Hence this deviation is not profitable.

(iii) Now consider deviations by either store such that not all time constrained consumers shop at either store, i.e., some time constrained consumers do not find it worthwhile to buy at either store. If the PROMO store sets a D such that $D < 0.5(c_{tc} - \delta^*)$, some time constrained consumers do not buy at all. The profits to the PROMO store in this case are:

$$(1+\alpha)\pi^P = (2R-D)\frac{D}{c_{tc}}+\alpha(2R-D)\frac{c_{cp}-\delta^*}{2c_{cp}} \quad \text{if } D \leq c_{cp}$$
$$= (2R-D)\frac{D}{c_{tc}}+\alpha(2R-D)\left\{1-\frac{D+\delta^*}{2c_{cp}}\right\}$$
$$+\alpha(R-D)\frac{D-c_{cp}}{c_{cp}} \quad \text{if } c_{cp} \leq D \leq 2c_{cp}-\delta^*$$
$$= (2R-D)\frac{D}{c_{tc}}+\alpha(R-D)\frac{D-\delta^*}{2c_{cp}}$$
$$\text{if } 2c_{cp}-\delta^* \leq D \leq 2c_{cp}+\delta^*$$
$$= (2R-D)\frac{D}{c_{tc}}+\alpha(R-D)$$
$$\text{if } 2c_{cp}+\delta^* \leq D \leq 0.5(c_{tc}-\delta^*). \quad (1)$$

It is seen that as α goes to zero, these profits are increasing for all $D \leq R$. Hence if $R \geq 0.5c_{tc}$, the profits are increasing for all $D \leq 0.5(c_{tc} - \delta^*)$. Thus for α sufficiently small and c_{tc} sufficiently small, this deviation is not profitable.

Let us now consider the case where the EDLP store sets a δ such that not all time constrained consumers buy both goods at either store. We know that in the proposed equilibrium $2D^* + \delta^* \geq c_{tc}$ and $\delta^* < D^*$. Therefore, this deviation is feasible only if $\delta < D^*$. Profits to the EDLP store for these values of δ are:

$$(1+\alpha)\pi^E = (2R-D^*-\delta)\frac{(D+\delta)}{c_{tc}}$$
$$+0.5\alpha(2R-D^*-\delta)\left\{1+1-\frac{D^*-\delta}{2c_{cp}}\right\}$$
$$\text{if } D^*-2c_{cp} \leq \delta \leq D^*, \quad \text{and}$$
$$(1+\alpha)\pi^E = (2R-D^*-\delta)\frac{(D+\delta)}{c_{tc}}+0.5\alpha(2R-D^*-\delta)$$
$$\text{if } \delta \leq D^*-2c_{cp}.$$

It should be noted that δ^* approaches $R - D^*$ as α approaches zero. However, for some time constrained consumers to not buy at all, $2D^* + \delta$ should be less than c_{tc}. Hence if α is sufficiently small and $c_{tc} \leq R$, this deviation is not profitable.

(iv) Next consider strategies for the PROMO store that result in some cherry pickers buying both goods at the PROMO store. Since $\delta^* > c_{cp}$, this strategy is infeasible.

(v) We now consider a deviation by the EDLP store such that all cherry pickers buy only one good at the EDLP store. This can be achieved in two ways: (a) with all time constrained consumers buying at either store, or (b) with some time constrained consumers not buying at all. First consider the case where all time constrained consumers buy at either store and all cherry pickers buy only one good at the EDLP store. In this situation the profits to the EDLP store are

$$(1 + \alpha)\pi^E = (2R - D^* - \delta)\left\{\frac{c_{tc} + \delta}{2c_{tc}} + 0.5\alpha\right\}.$$

Moreover all cherry pickers buy only one good at the EDLP store only if $0 < \delta \le D - 2c_{cp}$. It is easily seen that these profits are increasing for $0 \le \delta \le D^* - 2c_{cp}$, if $D^* \le \frac{1}{3}\{2R + 4c_{cp} - c_{tc}(1 + \alpha)\}$. However, if $D^* \ge \frac{1}{3}\{2R + 4c_{cp} - c_{tc}(1 + \alpha)\}$, the optimal value of δ is $R - 0.5(D^* + c_{tc}(1 + \alpha))$. At this value of δ the profits to the EDLP store are $(1/2c_{tc})\{R - 0.5(D^* - c_{tc}(1 + \alpha))\}^2$. Hence this deviation is not profitable if either $D^* \le \frac{1}{3}\{2R + 4c_{cp} - c_{tc}(1 + \alpha)\}$ or

$$\frac{1}{2c_{tc}}\{R - 0.5(D^* - c_{tc}(1 + \alpha))\}^2 \le \Pi^E_{eq}(1 + \alpha);$$

where Π^E_{eq} are the profits to the EDLP store in the proposed equilibrium.

We know that if some time constrained consumers do not buy at all, the profits to the EDLP store are

$$(1 + \alpha)\pi^E = (2R - D^* - \delta)\left\{0.5\alpha + \frac{(D^* + \delta)}{c_{tc}}\right\}.$$

Moreover, we know that all cherry pickers buy both goods at the EDLP store only if $\delta \le D^* - 2c_{cp}$. Therefore the profits to the EDLP are store increasing for all $\delta \le D^* - 2c_{cp}$ if $D^* \le 0.5R + c_{cp} - 0.125\alpha c_{tc}$. However, if $D^* \ge 0.5R + c_{cp} - 0.125\alpha c_{tc}$, the optimal value of δ is $R - D^* - 0.25\alpha c_{tc}$. Here again, for sufficiently small values of α and $c_{tc} \le R$, it is better to set δ such that all time constrained consumers buy at either store.

(vi) We now consider a deviation by the EDLP store such that all cherry pickers buy both goods at the EDLP store. This can be achieved in two ways: (a) all time constrained consumers buy at either store, or (b) some time constrained consumers do not buy at all. First consider the case where all time constrained consumers buy at either store and all cherry pickers buy both goods at the EDLP store. In this situation the profits to the EDLP store are

$$(1 + \alpha)\pi^E = (2R - D^* - \delta)\left\{\frac{c_{tc} + \delta}{2c_{tc}} + \alpha\right\}.$$

Moreover all cherry pickers buy at the EDLP store only if $\delta \ge D^*$; It is easily seen that these profits are decreasing for $\delta \ge D^*$, if $D^* \ge (\frac{1}{3})(2R - c_{tc}(1 + 2\alpha))$. However, if $D^* \le (\frac{1}{3})(2R - c_{tc}(1 + 2\alpha))$, the optimal value of δ is $R - 0.5(D^* + c_{tc}(1 + 2\alpha))$. At this value of δ all time constrained consumers do not buy if $R + 1.5D^* - 0.5c_{tc}(1 + 2\alpha) < c_{tc}$. If $D^* \le (\frac{1}{3})(2R - c_{tc}(1 + 2\alpha))$, this is indeed true if $c_{tc}(1 + \alpha) \ge R$. Therefore this deviation is not profitable if either $D^* \ge (\frac{1}{3})(2R - c_{tc}(1 + 2\alpha))$ or $c_{tc}(1 + \alpha) \ge R$.

We know that if some time constrained consumers do not buy at all, the profits to the EDLP store are

$$\pi^E = (2R - D^* - \delta)\left\{\alpha + \frac{(D^* + \delta)}{c_{tc}}\right\}.$$

Moreover, we know that all cherry pickers buy at EDLP store only if $\delta \ge D^*$. Therefore the profits to the EDLP are store decreasing for all $\delta > D^*$ if $D^* > 0.5R - 0.25\alpha c_{tc}$. However, if $D^* \le 0.R - 0.25\alpha c_{tc}$, the optimal deviation is $\tilde{\delta} = R - D^* - 0.5\alpha c_{tc}$. As before, for sufficiently small α and $c_{tc} \le R$, this deviation is not profitable because $2D^* + \tilde{\delta} \ge c_{tc}$.

Collecting all the conditions we get:

$$\alpha,\ c_{cp} \text{ are sufficiently small,} \quad c_{tc} \le R,$$

$$D^* \le \tfrac{1}{3}\{2R + 4c_{cp} - c_{tc}(1 + \alpha)\}$$

$$\text{or } \frac{1}{2c_{tc}(1 + \alpha)}\{R - 0.5(D^* - c_{tc}(1 + \alpha))\}^2 \le \Pi^E_{eq},$$

$$\text{and} \quad D^* \ge (\tfrac{1}{3})(2R - c_{tc}(1 + 2\alpha)) \quad \text{or } c_{tc}(1 + \alpha) \ge R.$$

Appendix III

In this appendix we provide a proof for the PROMO-PROMO equilibrium identified in Lemma 2.

PROOF. It should be first noted that any probability of promotion μ other than 0.5 cannot be an equilibrium. This is because if one store promotes one product more often, the competition is better off promoting the same good all the time. Next if a store promotes the products evenly, it is also easily seen that the best response for the competing store is to promote the products evenly also. Hence if store 1 offers a discount of D_1 and the other a discount D_2, the profits to store 1 are:

$$\begin{aligned}(1 + \alpha)\Pi^1_{P-P} &= (2R - D_1)\left\{\frac{c_{tc} + D_1 - D_2}{2c_{tc}} + \frac{0.5\alpha(c_{cp} + D_1 - D_2)}{2c_{cp}}\right\} \\ &\quad + 0.5\alpha(R - D_1).\end{aligned}$$

Optimizing with respect to D_1 and exploiting symmetry we get the optimal discount to be $2R - c_{tc}(2 + 3\alpha)/(2 + \beta)$ and the equilibrium profits are:

$$c_{tc} = \frac{(2 + 3\alpha)^2}{4(2 + \beta)} - \frac{\alpha R}{2}$$

finally, we need to consider a deviation by the PROMO store away from rational expectations about the unadvertised good. If the PROMO store sets a price to induce some consumers (who come to buy only one good) to not visit the other store, it can do so only by setting a lower price for both goods, because of the mixed strategy employed by the competing store. Let the price be ϵ_1 below the expected price. The change in profits are:

$$(1 + \alpha)\Delta\Pi_1 = -0.5*0.5(1 + \alpha)2\epsilon_1 - \epsilon_1 - 0.5\alpha\epsilon_1 + 0.5\alpha(R - \epsilon_1)\frac{\epsilon_1}{c_{cp}}.$$

We see that profits are decreasing for all $\epsilon_1 \ge 0$ if $\alpha R \le c_{cp}(3 + 2\alpha)$. However, if $\alpha R \ge c_{cp}(3 + 2\alpha)$ the change in profits is always positive. Hence, the pricing strategies described in Lemma 2 are an equilibrium if and only if $\alpha R \le c_{cp}(3 + 2\alpha)$. QED.

References

Becker, Gary S. (1965), "A Theory of Allocation of Time," *Economic Journal* (September), 493–517.

Bell, David (1995), "Grocery Shopping Behavior and Consumer Response to Retail Price Formats," Unpublished Dissertation, Stanford University, Stanford, CA.

Betancourt, R. and David Gautschi (1990), "Demand Complimentarities, Household Production, and Retail Assortments," *Marketing Science*, 9 (Spring), 146–161.

Business Editor (1994), "Albertson's Inc. Reports Record Sales and Earnings for the Second Quarter of 1994" (August 29).

Corstjens, Marcel and Judy Corstjens (1994), *Store Wars*, New York: John Wiley.

Coughlan, Anne T. and Naufel Vilcassim (1990), "Retail Marketing Strategies: An Investigation of Every Day Low Pricing vs. Promotional Pricing Strategies," Unpublished Working Paper, Northwestern University, Evanston, IL.

Grocery Marketing (1994), "Formidable Formats," 60(4), 20, Delta Communications Inc.

Hoch, Stephen, Xavier Dreze, and Mary Purk (1994), "EDLP, Hi-Lo, and Margin Arithmetic," *Journal of Marketing*, 58 (October), 16–29.

Lal, Rajiv and Carmen Matutes (1994), "Retail Pricing and Advertising Strategies," *Journal of Business*, 67 (July), 345–370.

Lattin, James and Gwen Ortmeyer (1991), "A Theoretical Rationale for Every Day Low Pricing by Grocery Retailers," Working Paper, Graduate School of Business, Stanford University, Stanford, CA.

Narasimhan, Chakravarthi (1988), "Competitive Promotional Strategies," *Journal of Business*, Vol. 61(4), 427–449.

Ortmeyer, Gwen, John Quelch, and Walter Salmon (1991), "Restoring Credibility to Retail Pricing," *Sloan Management Review* (Fall), 55–66.

Progressive Grocer (1994), "61st Annual Report of the Grocery Industry," 73, 4 (April), 28, Maclean Hunter Media Inc.

—— (1995), "Tom Thumb's New Generation, Store of the Month Company Profile," 74, 3 (March), 44, Maclean Hunter Media Inc.

Raju, Jagmohan, V. Srinivasan, and Rajiv Lal (1990), "The Effects of Brand Loyalty on Competitive Price Promotional Strategies," *Management Science*, 36 (March), 276–304.

Rao, Ram C. (1990), Pricing and Promotions in Asymmetric Duopolies," *Marketing Science*, 10 (Spring), 131–144.

—— (1991), "Promoting to Strategic Consumers," *Managerial and Decision Economics*, 13 (May–June), 215–222.

Supermarket News (1994), "Value Foods Shifts HBC to High-Low Pricing," 44, 12 (March 21), 31, Capital Cities Media Inc.

Winer, Russell S. (1986), "A Reference Price Model of Brand Choice for Frequently Purchased Products," *Journal of Consumer Research*, 13, 250–256.

Zweibach, Elliot and David Merrefield (1989), "EDLP Gains Momentum," *Supermarket News* (Oct. 9), 1ff.

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