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Supermarket Pricing and Game Theory: The Presence of Wal-Mart

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Abstract

Wal-Mart is a giant in the grocery industry and its influence is growing at a rapid pace. Despite Wal-Mart's success with Everyday Low Pricing (EDLP), there is little to no evidence to suggest that other supermarket chains wish to follow a similar path. Why? This research addresses this question.

Introduction

Many studies have addressed the growing influence of Wal-Mart in the supermarket industry (Albright, 2003; Advertising Age, 2002; Turner, 2003). According to a recent report, Wal-Mart together with Sam's Club and Neighborhood markets combined to take \$15 to \$17 billion in sales away from supermarkets in 2001 and this vaulted Wal-Mart to the top food retailer in the country (Grant, 2002). At the top, it had 2002 grocery sales of \$51.8 billion, as compared to \$51.4 billion for the number two retailer, Kroger (The Packer, 2004). This elevated economic muscle for Wal-Mart played a role in precipitating a strike among grocery workers at three of Wal-Mart's largest competitors. Albertsons, Kroger and Safeway, in anticipation of Wal-Mart's entry into the southern California grocery market, joined together to try and negotiate wages and health benefits with the United Food and Commercial Workers (UFCW) that were more competitive with and comparable to those of Wal-Mart. And because of Wal-Mart's lower wages and limited health benefits, these negotiations involved reduced benefits in the form of a proposed two-year freeze on wages and an increase in employees' contributions for health benefits (New York Times, 2003). A strike developed as workers viewed the offer as an attempt to push them from the middle class into a poverty class (Los Angeles Times, 2003).

A factor driving the success of Wal-Mart is cost. Innovations in supply chain management, transportation logistics and technology diffusion are credited with wringing down costs and positioning the company as a formidable competitor. By some accounts, Wal-Mart is so cost-driven and efficient that it alone accounted for 4 percent of the productivity growth in the U.S. economy during 1995-99 (Goldman and Cleeland, 2003). Indeed the success of Wal-Mart suggests that it is likely to have a growing influence on pricing behavior in the supermarket industry. Given its Everyday Low Pricing (EDLP) format coupled with its glowing market

success, one would be inclined to hypothesize a change in pricing format for its competitors to try and emulate Wal-Mart. Yet, there is little evidence to suggest that its competitors are contemplating a switch from promotional or High-Low Pricing (HLP) to EDLP. Instead, the limited evidence we do have show supermarkets switching from an EDLP format to a HLP format. Recently, Shaw's, the second largest supermarket chain in New England, abandoned EDLP in favor of HLP to try and become more competitive with Stop & Shop, the largest chain in New England (Mohl, 2000). How does one explain a switch from EDLP to HLP when Wal-Mart has clearly demonstrated the success of EDLP? Is it possible that supermarket managers at HLP chains are irrational and unaware of the profit opportunities of an EDLP format? Or, are there potential revenue gains from an HLP format that exceed those of an EDLP format? This paper addresses these issues, developing a game-theoretic framework to explain the existence of HLP stores, despite glowing success for Wal-Mart. A general conclusion of the paper is that Wal-Mart constrains price-cost margins among HLP supermarkets, but it provides little to no incentives for HLP supermarkets to emulate or duplicate its format.

Game Theory

Game theory is a field of study that focuses on human interactions within specified rules of play and alternative choices. Its language includes concepts such as coalitions, markets, payoffs and votes and these are concepts that permeate our everyday lives and help shape our "real world" experiences. Yet, the mathematical rigor of game theory together with its many solution notions has limited its appeal to mainstream economists and caused some critics to question the ability of game theory to identify a solution notion that "truly" describes human behavior (Aumann, 1985; Goeree and Holt, 2001). Indeed one of these solution notions is a Nash equilibrium, a payoff point in which firms reach and maintain their position. This position

can be illustrated by deriving a series of mathematical equations and proofs, or it can be demonstrated with a model structure known as the normal or strategic form. This paper will employ the latter approach and derive a game-theoretic framework that captures the basic structure of the U.S. supermarket industry and then illustrate observed behavior for supermarket chains within this industry. First, a discussion of the supermarket industry is provided to help focus this discussion.

A fair amount of literature has developed which suggests that Everyday Low Pricing (EDLP) supermarkets enjoy lower costs and higher profit rates than promotional or High-Low Pricing supermarkets (HLP). Lal and Rao (1997) cite an *American Demographics* report showing the top 5 EDLP supermarket chains realizing net profit rates in 1992 ranging from 2.1% to 2.7%, whereas the top 5 HLP chains had profit rates ranging from .5% to 2.0%. Much of the literature also suggests that an EDLP format better meets the needs of an ever-growing population of time-constrained consumers (Lal and Rao, 1997; Corstjens and Corstjens, 1994). As further evidence of the advantages of EDLP, some authors point to the success of chains like Wal-Mart and Home Depot (Kotler and Armstrong, 2000; Ortmeyer, Quelch, and Salmon, 1991). Given the identified advantages of EDLP, one would expect to see supermarkets switching from a HLP format to an EDLP format. Instead, more frequently, we see EDLP chains adopting many of the attributes of HLP chains (Hoch, et al., 1994). Such observations are puzzling and this paper attempts to provide some insight into the riddle of this puzzle.

A general premise of this paper is that, in an all-EDLP world, it is conceivable that consumers could realize lower food expenditures and supermarket chains could realize higher profit rates. An implicit assumption here is that advertising and merchandising costs impact food prices and the operating costs of supermarkets (Hoch, et al., 1994). However, an EDLP world

cannot possibly represent an equilibrium state, since any departure from it would result in one chain gaining an advantage over another one. That is, in the absence of uniform consumer preferences and opportunity costs, a chain could adopt a HLP format and increase its sales and profits (Hoch, et al., 1994; Mulhern and Leone, 1990).¹ Moreover, such a change would place competitive pressure on all remaining chains and perhaps cause them to consider a similar format. To increase their competitiveness under this scenario, EDLP supermarket chains tend to adopt some of the attributes of a HLP format. Some common features of this format include week-to-week price promotions, media advertising, and in-store advertising/merchandising. In the nomenclature of game theory, this process is best described as a non-cooperative game that is played among competing chains. Each chain selects its advertising, price promotions, and in-store advertising/merchandising simultaneously and independently. However, the nature of the supermarket industry is such that the chains are involved in a dynamic game of “almost perfect” information.² To operationalize this game, this paper follows an approach suggested by Aumann (1985) in which a model is developed to provide an understanding of the strategies supermarket chains engage in to try and increase their sales and profitability. Specifically, a framework is developed that shows consumers and retailers reaching equilibrium through a market structure of many HLP chains and a limited number of EDLP chains.³

Model Development

Following the lead of Lal and Rao (1997), it seems reasonable to segment food shoppers into two categories: cherry pickers and time-constrained. Time-constrained consumers have

¹ In a series of field experiments with 86 stores, Hoch, et al., concluded that a 10% price increase at HLP stores leads to a 15% increase in profits; by contrast, a 10% decrease in prices at EDLP stores leads to an 18% decrease in profits. This suggests profitable opportunities for a departure from EDLP formats.

² According to Tirole, the games are dynamic because each chain chooses an action after observing the actions of his opponents; they are games of “almost perfect” information because each chain knows the actions of other chains for periods 1 through $t-1$, but simply makes simultaneous decisions at period t .

³ Everyday low price chains are constrained by the difficulty of any two chains positioning themselves as the lowest-price alternative for a market basket of goods.

been characterized as the largest segment of the American population and, assuming search costs play a major role in determining shoppers' store selections, this population segment is likely to provide a ready clientele for EDLP supermarkets. Cherry pickers are considered to have lower opportunity costs and a strong preference for low prices. These attributes define a population segment that is likely to search between EDLP and HLP chains for the best purchases. That is, these shoppers are likely to be attracted to the every day low prices of EDLP chains as well as to the advertised deals of HLP chains. Manufacturers influence the group of products that are selected for advertising and promotion, but each supermarket chain combines manufacturers' incentives with its own marketing strategies to project a favorable store image and pricing strategy to consumers (Lal and Rao, 1997). Since a typical supermarket carries over 40,000 products, search costs would prohibit a consumer from gaining complete information on pricing. Yet, with respect to HLP chains, consumers are believed to make their shopping decisions based on advertised prices and some rational expectations about unadvertised prices.

One of the competitive disadvantages of an EDLP chain is believed to be its inability to offset the highly visible pricing strategies of HLP chains. A typical EDLP store projects itself as having the lowest prices for a market basket of goods, but consumers, given limited ability to process price information across a wide array of products, will sometimes make cost comparisons among stores based on a selected set of advertised prices across a few product categories. As such, EDLP supermarkets feel competitive pressure to develop a communication mechanism for informing consumers of the cost savings on a market basket of goods. These communication costs, since they are not product and price specific, receive limited levels of compensation from food manufacturers. Indeed this differential in promotion compensation partly explains the motivation for EDLP chains to adopt attributes of HLP chains.

A fundamental assumption of game theory is that all players are rational and intelligent (Moorthy, 1985). Further, each player is assumed to pursue a set of actions or strategies that leads, in the long run, to a point of equilibrium. At this equilibrium, no player desires to deviate from its chosen strategy. Within the supermarket industry, these strategies are played on a weekly basis among HLP chains, but less frequently and less directly among HLP and EDLP chains.⁴ More specifically, both EDLP and HLP chains attempt to maximize their sales and profits (payoffs), but HLP chains pursue a more transparent and explicit strategy. HLP chains' weekly strategies consist of a combination of price reductions, in-store advertising/merchandising and media advertising. EDLP chains, by contrast, make limited use of all three. EDLP chains use price reductions and in-store advertising/merchandising to stimulate sales, but such strategies are generally communicated to consumers on a monthly basis through media advertising (especially circulars or free-standing inserts). For all practical purposes, the game-theoretic framework for supermarket competition is most applicable for HLP chains, with each chain implementing strategies that are cognizant of the positioning image and prices of EDLP chains. As a matter of approach, chains are assumed to focus on sales and margins in the short run, while recognizing the contribution of each to long-run profit objectives. Specifically, chains are hypothesized to develop long-run sales and profit objectives, but then use short-run sales changes to develop their game strategies.

As an illustration of the process chains use to develop their promotional strategies, consider the illustration in Figure 1 for September/October 2002. Chains receive reports for the week of 9/8 – 9/15 on 9/16 and these reports include information of their sales as well as the sales of their competitors. Each chain assesses its relative performance and plans a strategy for a

⁴ It should be emphasized that some of the discussion in this paper is based on the author's experience with the supermarket industry.

subsequent period. Because retailers' promotions are linked to manufacturers' incentives, a lag period of approximately three weeks are required to properly coordinate strategies of retailers with the incentives of manufacturers. Thus, as shown in Figure 1, strategies that are planned during week 9/15 – 9/21 are implemented on 10/6. Strategies utilized in a supermarket game are shown in Table 1 and these strategies consist of a combination of price reductions, in-store advertising/merchandising and media advertising. In the nomenclature of game theory, this table represents the normal or strategic form of a game.⁵ Critical elements of this form of the game are: (1) the players of the game; (2) the strategies available to each player; and (3) the payoff received by each player for each combination of strategies that could be chosen by the players. As illustrated here, strategies α_i , δ_i , or γ_i are available to player i and α_j , δ_j , or γ_j are available to player j . These promotional strategies can be set and implemented independently by each player. Yet, past observations on supermarkets' behavior show that all three of these promotional efforts are used concurrently.

Although the parameters α , δ , and γ of the bi-matrix in Table 1⁶ can take on many values, it is useful to place some constraints on these parameters. To this end, assume that each player has played the game frequently enough to recognize three separate components of his competitors' strategies. For example, chain 1 knows that chain 2 is likely to use one of three levels of price reductions, one of three levels of in-store advertising/merchandising, and one of three levels of media advertising. Similarly, chain 2 has comparable knowledge about chain 1. Within this framework, there are nine strategies for each player and we assume that each play of

⁵ Strictly speaking, a normal form of a game shows the strategies available to each player along the top and left side of the bi-matrix and the payoffs in each cell. This matrix is modified slightly to show varying levels of the strategies in each cell. A precise form of a normal form game is shown within the bi-matrix in Table 2.

⁶ Even though this Table shows a bi-matrix, it is useful to think of this game as Player i against Player j , where j represents all other players. Also, the term "bi" does not define the number of columns and rows, but refers to the fact that there are two payoffs in each cell.

the game requires a combination of three strategies. In sum, there are a total of twenty-seven possible payoffs ($3*3*3$) for this game. With such a large number of payoffs, illustrating a Nash equilibrium⁷ becomes quite challenging. Yet, Nash (1951) has shown that an equilibrium point does exist for every game with a finite number of strategies.⁸ To illustrate an equilibrium point for the supermarket chains, this paper will present a payoff matrix that is derived from a subset of the many strategies shown in Table 1.

The model is developed around the basic assumption that chains are far more observant of week-to-week sales and product margins than they are of direct profit rates. Indeed much of the literature on the supermarket industry shows that profit rates tend to decrease as sales increase. For example, the Food Marketing Institute reported a 1990-98 decline in the profit rate of supermarket chains with sales over \$100 million, but an increase in profit rates for supermarket chains with sales under \$100 million (Natural Foods Merchandiser, 1999). This result seems to support the notion that sales represent a major focus of supermarket chains. A useful way to illustrate the relationship between sales and profits is shown in Figure 2. Chains develop long-term sales and profit objectives, as illustrated by the straight lines from the origin. These lines can represent alternative sales and profit objectives for a single firm, or they can represent different sales and profit objectives for three different firms. As shown, sales changes of 2, 4 and 6 percents are desired over some time period, typically a year (profits are assumed to be imbedded in sales). Regardless of which long-term objective is pursued by a firm, consumer responsiveness to promotions and the strategies of competitors lead to fluctuations around long-term objectives. As the game is played, each supermarket chain (player) assesses the band of

⁷ For a dynamic game with “near perfect” information, the equilibrium is technically known as a Bayesian equilibrium. The term Nash equilibrium is more widely recognized and it is therefore used in this paper.

⁸ To be certain, a pure strategy equilibrium will not always exist. However, there will always be a mixed strategy equilibrium. This simply means that each strategy is played with an identifiable level of probability.

fluctuations around its long-term objective to determine its strategy or plan of action for the following week. Narrow bands of fluctuations that keep sales and profits on target with the long-term objectives lead to a particular strategy. Three possible scenarios are illustrated in Figure 3. Assuming a long-run sales and profit objective of 6 percent for a given firm, a narrow band of fluctuations, as shown by f_1 , would lead to a particular strategy. As short-run sales show greater fluctuations around the long-run objective, as illustrated by f_2 , a more progressive strategy is implemented. Finally, as fluctuations widen to a level shown by f_3 , a firm responds by implementing its most progressive strategy.

The Game-Theoretic Framework

For a market consisting of two supermarkets and each carrying two products, Lal and Rao (1997) have shown that a Nash equilibrium exists for this market and profit maximization is derived from a format of one EDLP and one HLP store. Moreover, this equilibrium is reached with each store serving both cherry pickers and time-constrained consumers. Time constrained consumers are attracted to the HLP store because of greater service and larger product assortment and cherry pickers are attracted because of product promotions. For the EDLP store, time-constrained consumers are attracted by the lower basket prices and convenient locations. Cherry pickers, with a lower opportunity cost of time, are also attracted by the lower basket prices and the limited need for a high level of service. These conclusions are reached with the aid of several propositions, many mathematical equations and related proofs. The game developed in this paper is far less abstract and quantitative. A simple model is developed that captures the existing structure of the supermarket industry and this model describes the interaction among chains that leads to an equilibrium state.

One noticeable observation about supermarket chains in a given market is that there is almost complete uniformity in their promotion periods. For example, promotions in a Oregon market might run from Saturday to Friday, while those in a Utah market might run from Sunday through Saturday. Moreover, freestanding inserts of promotions for any chain will generally appear in the Saturday or Sunday edition of major newspapers. While promotions are run simultaneously and developed independently, each chain gets to assess the positioning and pricing strategies of its competitors on a weekly basis. Moreover, each competitor has information about the deals received by its competitors and this information can then be used to help determine margins and profit rates earned by competitors. Further, each chain receives weekly reports on its market share gains and/or losses. This information can then be used to help craft a marketing strategy and game play for the following week. Indeed the game involves each chain trying to out perform its competitors by attracting the most shoppers and dollar expenditures through a combination of consumer benefits consisting of manufacturers' deals, retailers' deals, and in-store advertising/merchandising. Even though EDLP and HLP supermarkets compete for shoppers, the number of HLP relative to EDLP chains determines the speed of adjustment toward equilibrium. This paper illustrates a Nash equilibrium for a more restricted market of two chains, but additional quantitative analyses can be employed to extend the model to a larger number of chains.

As shown in Table 1, two supermarket chains engage in price reductions, in-store advertising/merchandising and media advertising to try and maximize their weekly sales and profits. Sales receive the primary focus because many chains adopt the view that increased sales and market shares will lead to increased profits (Hoch, et al., 1994). Since supermarket chains engage in weekly competition and receive weekly information on the performance of their

competitors, the game illustrated in Table 1 is best characterized as a dynamic game with “almost perfect” information. Since EDLP chains do not engage in week-to-week price promotions, both players *i* and *j* represent HLP chains (Hoch, et al., 1994). Yet, the strategies of both players *i* and *j* are influenced by the strategies of EDLP chains because consumers’ store selections are influenced by price perceptions that are derived from all promotions. From a practical perspective, it seems reasonable to assume that each HLP chain, in an effort to attract both cherry pickers and time-constrained consumers, attempts to project an overall price level of *x* percent of a given EDLP chain. For example, given the higher service demands of time-constrained consumers, a HLP chain may reason that prices within 10% of an EDLP competitor is sufficient to offset the tradeoffs consumers make in their store selections.

As illustrated in Table 1, player *j* has no way of knowing what level of price reductions, in-store advertising/merchandising and media advertising player *i* will select in response to any of its actions. Yet, because the game is played weekly and intelligent players learn from experience, it seems reasonable to assume that player *j* can assign some probabilities to a range of strategies available to player *i*. Specifically, each player will play mixed strategies. To keep the game tractable, assume that three levels of price reductions, three levels of in-store advertising/merchandising and three levels of media advertising are available to each player. Each of these levels can be classified respectively as aggressive, moderate, and passive. Since each player (chain) is more likely to maximize sales and profits by utilizing all three, each player selects its game strategy by assigning probabilities to the combination of strategies available to its competitor. Given this scenario, 27 strategies are available to each player and the game is played with each player assigning a probability between 0 and 1 to each strategy. Influencing each probability assignment, of course, is the strategies of EDLP chains. If EDLP chains are

gaining sales and market shares at the expense of HLP chains, then each HLP chain is likely to assign a higher probability to an aggressive reaction than to a moderate or passive one.

Similarly, if a HLP chain is gaining sales and market shares at the expense of another HLP chain, then the winning chain is likely to assign a higher probability to an aggressive reaction than to a moderate or passive one. Of course, one of the primary objectives of game theory is to show that this interaction among the players will lead to a Nash equilibrium.

Analysis and Discussion

As described in Table 1, each player seeks to maximize its sales and profit, but focuses week-to-week on sales. As each chain receives a report on its sales for a given week, it then assesses its performance relative to that of its HLP competitors and its EDLP competitors. If sales changes for player *i* are in line with long-run profit objectives and competitors are pursuing passive strategies, then player *i* has a higher probability of pursuing a passive strategy than a moderate or aggressive one. Likewise, if sales changes for player *i* are below long-run profit objectives and competitors are pursuing aggressive strategies, then player *i* has a higher probability of pursuing an aggressive strategy than a moderate or passive one. Within this game structure, costs are likely to be lower and profits higher when all players pursue passive strategies (Lal and Rao, 1997). From a practical viewpoint, it is useful to think of this scenario of passive strategies as representing an all EDLP world. Yet, this world cannot represent a Nash equilibrium because one or more players can be made better off by pursuing alternative strategies. As an illustration of this process, consider the payoff matrix in Table 2 that represents nine of the twenty-seven strategies that are implicit within Table 1.

As shown in Table 2, each cell represents the payoffs to each player (chain) from playing aggressive, moderate and passive strategies. For example, TPE_A represents total promotional

effort that consists of aggressive price reductions, aggressive in-store advertising/merchandising and aggressive media advertising. TPE_M and TPE_P are defined similarly. Under collusive or cooperative behavior, these two chains would reach equilibrium at $B_{pp} (40, 40)$ and maximize profits for each chain. This profit point, however, cannot represent an equilibrium because player i can increase his profit by playing strategy TPE_m if he is convinced that player j is going to play strategy, TPE_p . Even at $B_{mp} (50, 24)$, a Nash equilibrium is not established because player i has a desire to play strategy TPE_A if he is convinced that player j will play TPE_p . Indeed a stable equilibrium is not reached until both players implement aggressive strategies with payoffs $B_{AA} (26, 26)$. At this equilibrium, both firms are worse off than at point $B_{pp} (40, 40)$, but neither firm has an incentive to move from $B_{AA} (26, 26)$. This conclusion is reasonable, despite the fact that this is a dynamic game with each player assumed to be rational and intelligent. With promotions being driven by deals from manufacturers, each chain recognizes the inevitability of promotions as well as the self-inflicted wounds that result from a non-retaliatory strategy.

The movement of firms away from the maximum profit level of $B_{pp} (40, 40)$ can also be explained with the aid of Figure 3. As a particular firm (say firm 1) plays a passive strategy as shown by the f_1 fluctuations around the straight-line profit objective, another firm (firm 2) has an incentive to play a more progressive strategy and therefore cause firm 1's profits to fall. This decline in profits can be illustrated by the f_2 fluctuations for firm 1, as firm 2 implements a more progressive strategy. Likewise, firm 1 becomes more progressive and firm 2 reacts to this progressive behavior. Profits falls more for firm 1 as illustrated by f_3 and firm 1 further reacts to this behavior. After maximizing deals from manufacturers and reaching minimum levels of acceptable margins, the two firms eventually reach equilibrium and this is shown in Table 2 as $B_{AA} (26, 26)$. For the supermarket industry, this stable equilibrium develops as HLP chains use

week-to-week promotional circulars, radio, newspapers, and television advertising, and in-store advertising/merchandising. Further, EDLP chains are engaged in a limited number of these activities on a less frequent basis, but these chains are constantly engaged in an effort to position themselves as the lowest-price alternative for a market basket of goods.

It might seem counter intuitive that a dynamic game with rational and intelligent firms would not lead to the equilibrium, $B_{pp(40,40)}$. Manufacturers could perhaps facilitate this equilibrium point by reducing deals and incentives to chains. However, once a manufacturer offers deals to one chain and this chain engages in promotions at the expense of other chains, all chains have an incentive and a reason to react. In the absence of deals, the rationality and intelligence assumption should lead firms to recognize the interdependency of their actions and allow them to reach equilibrium at $B_{pp(40,40)}$. However, even this level of profit is not likely to represent a stable equilibrium because, as described in this paper, it represents a low level of promotion by the HLP chains and such promotion makes it more difficult for HLP chains to distinguish themselves from EDLP chains. In other words, it is very difficult for any two chains to position themselves as the lowest price alternative for a market basket of goods.

Conclusions

This paper has noted the growing success of Wal-Mart in the grocery industry, particular its success with supply chain management, transportation logistics and technology diffusion. The confluence of these factors has lowered Wal-Mart's cost and positioned it as a formidable competitor in the supermarket industry. Indeed its Everyday Low Pricing (EDLP) format has catapulted it into the leading grocery chain in the U.S. With such success with EDLP, the question arises as to why competitors continue to follow a High-Low Pricing (HLP) format? The answer revolves around the fact that supermarket chains are engaged in a competitive game

and this game cannot be played in an environment of complete EDLP. That is, any departure from this environment leads to gains for the departing chain. As a result, the supermarket industry is characterized by a host of HLP chains and a limited number of EDLP chains.

Competition in the supermarket industry can be described by the HLP chains engaging in week-to-week game play and the EDLP chains having a constraining impact on the variability of price changes and the flexibility of price levels. As the game is played among HLP chains, equilibrium is reached that maximizes profits for none of the chains. Intuition and deductive logic are used to derive this equilibrium and the lower profits associated with it can be attributed to higher inventory and promotion costs. For example, inventory buildups before a promotion can add to labor and storage costs and decrease the overall profitability of promotions. Additionally, higher labor costs are often associated with planning and executing promotions. Despite these higher costs, HLP promotional strategies are considered imperative because, once a competitor decides to engage in promotion, it can increase its profits at the expense of other chains. To guard against lost sales and profits, all chains simultaneously engage in promotional activities. Everyday low price chains, while not engaged in promotions on a week-to-week basis, do incur some adverse impacts from the week-to-week promotions of HLP chains. To minimize these effects, EDLP chains react by taking on some of the promotional attributes of HLP chains.

Figure 1.

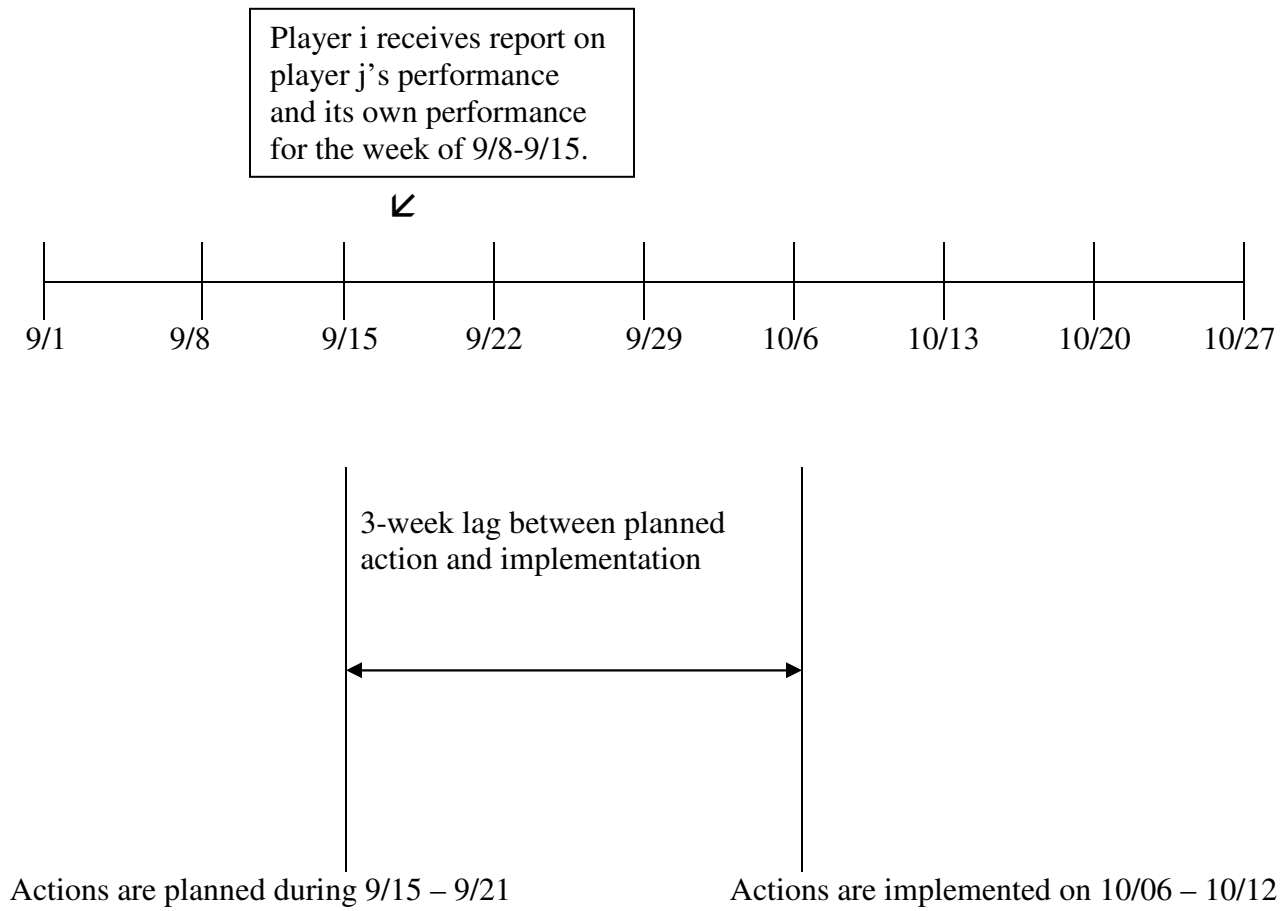


Table 1.

		Player j		
		Price Reduction (α_j)	In-Store Advertising/ Merchandising (δ_j)	Media Advertising -- FSI, R, T.V. & NP* (γ_j)
Player i	Price Reduction (α_i)	(α_i, α_j) $(\alpha_i \geq \alpha_j) \text{ or } (\alpha_i < \alpha_j)$	(α_i, δ_j) $(\alpha_i \geq \delta_j) \text{ or } (\alpha_i < \delta_j)$	(α_i, γ_j) $(\alpha_i \geq \gamma_j) \text{ or } (\alpha_i < \gamma_j)$
	In-Store Advertising/ Merchandising (δ_i)	(δ_i, α_j) $(\delta_i \geq \alpha_j) \text{ or } (\delta_i < \alpha_j)$	(δ_i, δ_j) $(\delta_i \geq \delta_j) \text{ or } (\delta_i < \delta_j)$	(δ_i, γ_j) $(\delta_i \geq \gamma_j) \text{ or } (\delta_i < \gamma_j)$
	Media Advertising -- FSI, R, T.V. & NP* (γ_i)	(γ_i, α_j) $(\gamma_i \geq \alpha_j) \text{ or } (\gamma_i < \alpha_j)$	(γ_i, δ_j) $(\gamma_i \geq \delta_j) \text{ or } (\gamma_i < \delta_j)$	(γ_i, γ_j) $(\gamma_i \geq \gamma_j) \text{ or } (\gamma_i < \gamma_j)$

*FSI is Free-Standing Inserts; R is radio; T.V. is television; and NP is newspaper.

Figure 2

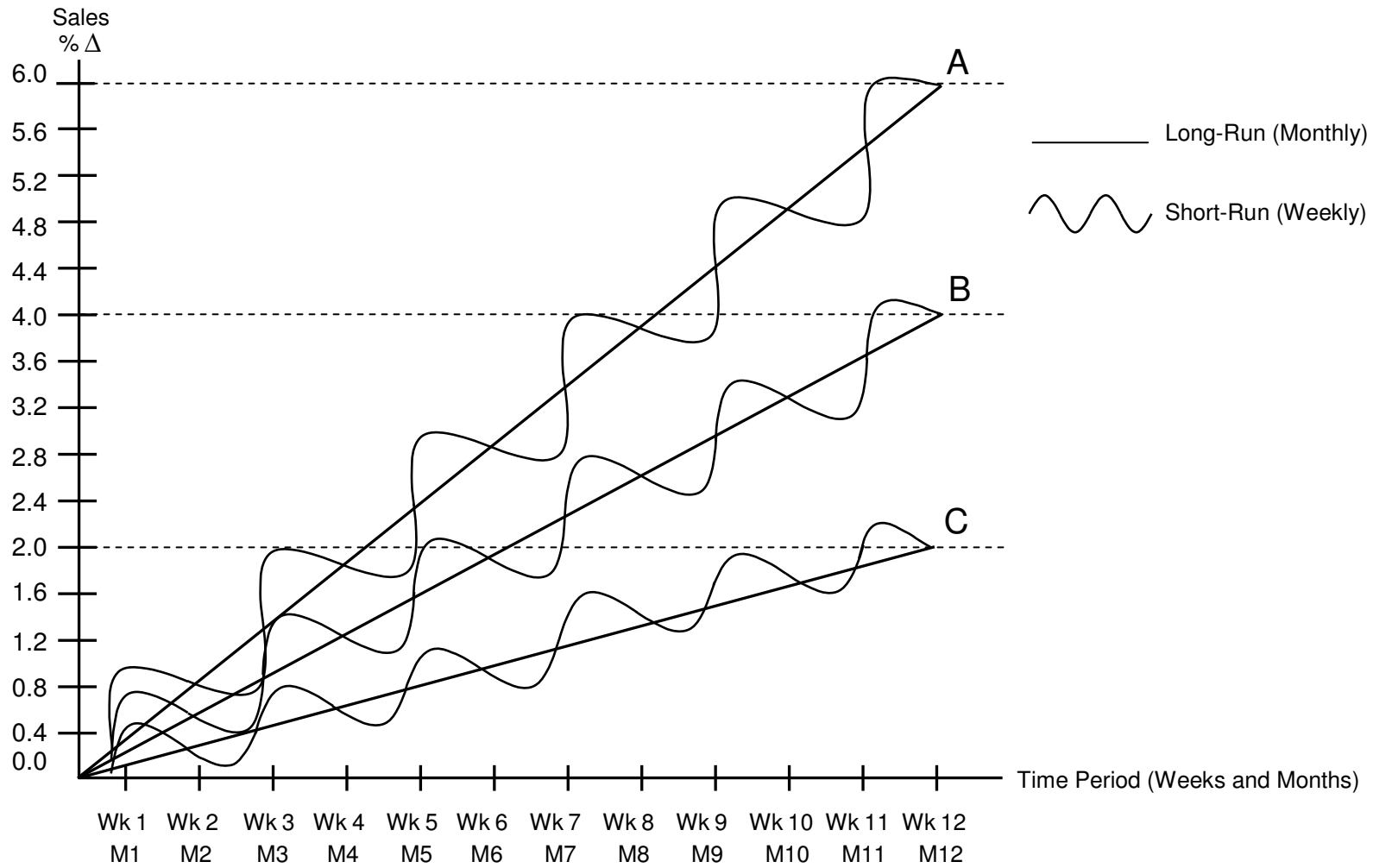


Figure 3

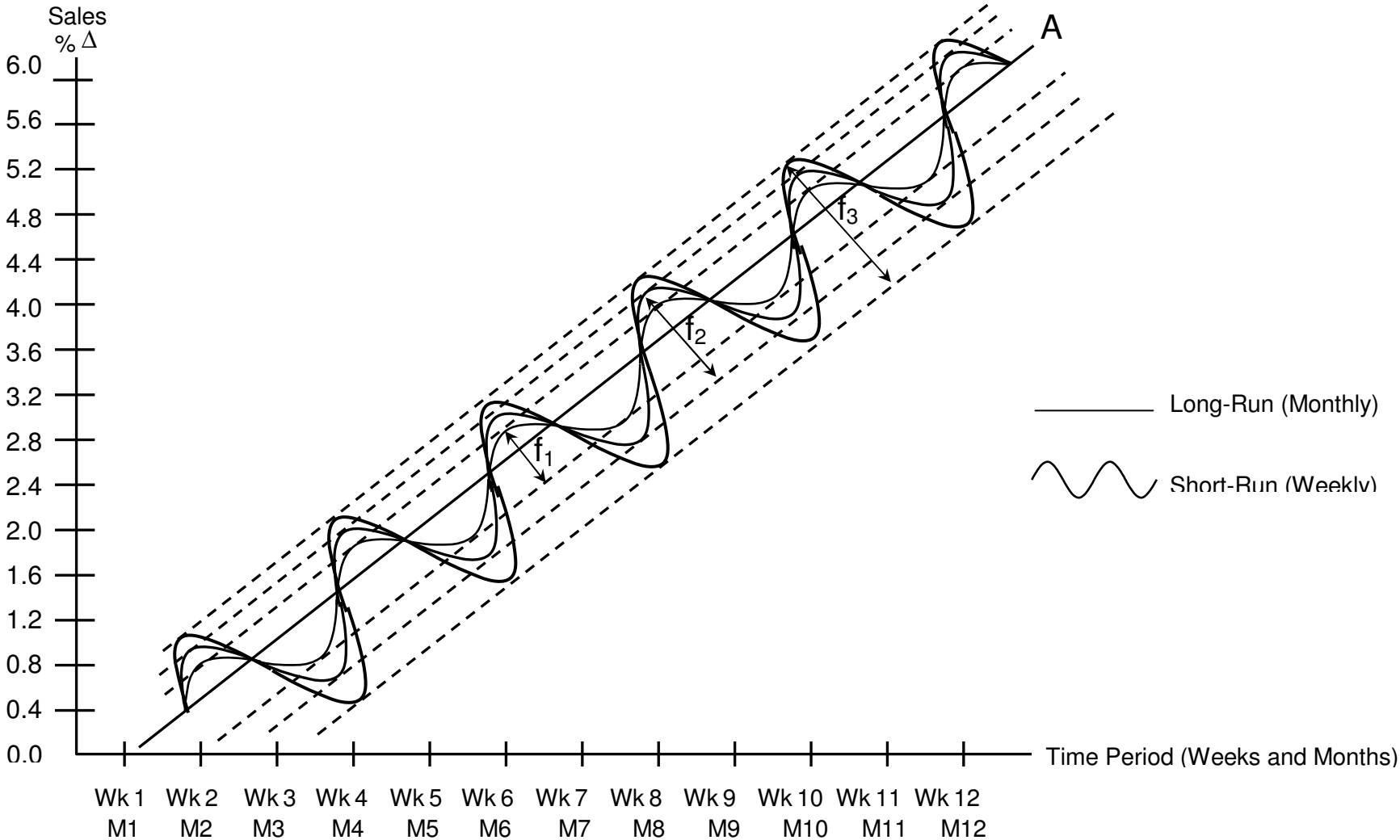


Table 2. Total Promotional Effort (Price Reductions, In-Store advertising/Merchandising and Media Advertising)

		Player j		
		TPE_A	TPE_M	TPE_P
Player i	TPE_A	$B_{A,A}$ (26, 26)	$B_{A,M}$ (32, 24)	$B_{A,P}$ (60, 16)
	TPE_M	$B_{M,A}$ (24, 32)	$B_{M,M}$ (28, 28)	$B_{M,P}$ (50, 24)
	TPE_P	$B_{P,A}$ (16, 60)	$B_{P,M}$ (24, 50)	$B_{P,P}$ (40, 40)

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