

The Role of Warehouse Club Membership Fee in Retail Competition

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ABSTRACT

There are several explanations as to why warehouse clubs charge membership fees and how the fees play a role in the competitive landscape of the retail grocery market. We provide another insight into the nature of the membership fee using a model of price competition between a warehouse club and a supermarket. We show that the warehouse club's membership fee is an optimal competitive reaction to the supermarket's promotional activity. The more frequent the promotion is, the lower is the membership fee. However, the larger the promotion depth is, the higher is the fee. Our analysis not only provides a justification of warehouse club membership fees but also gives managers several guidelines on yearly fee and retail price decisions.

Keywords: Retailing, Retail Formats, Warehouse Club, Price Competition

1. INTRODUCTION

The core of the warehouse club concept is *membership*.¹ As of this writing, all three major warehouse clubs in the U.S.—Costco, Sam’s Club, and BJ’s—charge members annual membership fees, ranging between \$35 and \$45. In 2002, 52% of the US households shopped at the retail format, and according to a survey, 30% of shoppers who have not joined a membership warehouse club cite the annual membership fee as the reason.² Taking their high penetration rate into account, warehouse clubs may now be able to dismiss the complaint by getting rid of the fee policy especially since annual fees account for about 2 percent of their average revenue. Besides, as competition heats up, it has become a big issue whether no-fee format will be a better solution. Despite a 20-year history of warehouse club industry in the U.S., rare attempt has been made to explain the true motivation of the membership policy by warehouse clubs.

Why do they charge a membership fee? There seem to be many possible explanations on this industry practice. On the wall of a Costco store in Mountain View, California, the chain itself puts the following statement, trying to explain their membership fee policy:

“Costco’s membership fee provides a means of covering part of our operating costs and overheads, thereby reducing our prices on the products we sell. This way, the more

¹ “Wholesale Club Industry”, Harvard Business School, Case 9-594-035, p.4

² *DNS Retailing Today*, May 5, 2003, 42 (9), p. 6; *Stores*, July 1993, p.6

members we have, the lower our prices - and the more you buy, the more you save!”

Sam’s Club also offers an explanation on their web site:

“Because members pay a yearly fee, Sam’s Club consistently works to meet their expectations by operating in a cost-effective manner offering big deals on general consumer merchandise and other services.”

These represent the so-called “value marketing through cost advantage” argument that the sellers have made. The cost argument, however, does not solve the puzzle, because cost sharing could better be sought if they broadened the customer base by simply getting rid of the membership policy. A different answer provided in the FAQ (Frequently Asked Questions) section of the previous Costco/Price Club's Web site is the following³.

“Membership gives our members a sense of ownership and instills loyalty.”

This doesn't account for the phenomenon, either. If that is the reason, why do other retailer formats not adopt the same membership policy? Therefore, exclusive membership policy has to have other rationale if it is to be explained satisfactorily.

One plausible answer comes from the area of nonlinear pricing. As a special case of two-part tariff, a fixed fee structure can be explained by the retailer's profit maximizing behavior

³ Costco and Price Club merged in 1993, and as resuming the Costco name in 1997, the company removed this statement from its revamped web page.

(Wilson 1993). More specifically, with the existence of fixed fee, heavy buyers pay less than do light buyers for the same product, since the fixed fee is spread over more units. With that, membership fee policy can be used to have consumers self-select in such a way that heavy buyers join the club membership while light buyers don't. This exclusive membership helps warehouse clubs realize superior operating efficiency through narrow product depth, special bulk packaging, fast turnover, and so on. This segmented pricing is profitable as well because it enables a retailer to remain competitive in serving low-cost customers (i.e. heavy users) while still profitably serving the higher-cost (i.e. light users, among members) segment (Nagle and Holden 1995; Blattberg and Neslin 1990, pp 95-102).

Though this claim provides a valuable insight, it doesn't provide a complete story since it views the warehouse club as a profit-maximizing *monopolist*. Contributing to the understanding of the practice in a more general setting (i.e., competition) and providing a richer implication are the purposes of the current research. Although warehouse clubs compete with many different formats (e.g., category killers such as Home Depot and Office Max), supermarkets are considered their prime competitor (*Harvard Case 9-594-035 "Wholesale Club Industry,"* p.13).⁴ Accordingly, a competition between a supermarket and a warehouse club becomes the basic setting of our model.

⁴ For tractability, we do not model the competition among supermarkets and among warehouse clubs. Incorporating it would be a challenging but meaningful future research direction.

Among the unique characteristics of the warehouse club is its no promotion policy and low merchandise assortment. For example, a typical warehouse club carries 4,000 SKUs, contrasted to 18,000 for a typical supermarket and 45,000 for a discount store. This asymmetry of product assortment gives an important implication to our analysis. That is, in order to buy items that the warehouse club doesn't carry, every consumer must go to a supermarket whether or not she is a warehouse club member. Joining a warehouse club incurs inconvenience, due to *additional trips*, since the consumer could have filled her basket by one time shopping at a supermarket. In addition, purchasing at a warehouse incurs two other cost items: the membership fee and the inventory cost of buying in a bulk quantity. The tradeoff between a lower retail price and the added costs is the key driver of our model.

In this paper, we build a consumer model of store choice and analyze a duopoly model of competition between a warehouse club and a supermarket. Our results indicate, among others, that the membership fee is related with the supermarket's promotional activities. That is, as long as the supermarket has promotions in terms of temporary price reduction, it is optimal for the warehouse club to charge membership fee. Moreover, the deeper the promotion is, the higher is the membership fee. However, the amount of the membership fee is independent of the bulk package size in the warehouse club or the consumer's inventory holding cost.

We present the consumer decision model as well as the firms' profit models in the next section. Section 3 derives a set of reaction functions and the equilibrium solution. Section 4 employs comparative statics of the equilibrium solution to investigate effects of the model parameters on pricing decisions. These findings are summarized and managerial implications are derived in Section 5, and the last section concludes the paper with delineating future research topics.

2. THE MODEL

In this section, we derive demand and profit functions from a distribution of consumer "travel costs." For simplicity, we focus on a single product that is carried by both the supermarket and the warehouse club. In subsection 2.1, three possible shopping options for a representative consumer are examined, and their associated shopping costs are defined. Comparing these costs, subsection 2.2 derives demand and profit for each retail format as functions of price and promotion variables.

2.1. Consumer Costs

Suppose a representative consumer consumes q units of the focal product in a given period (e.g., a year). The consumer's decisions are (i) whether or not to become a warehouse club member by paying the annual fee (denoted by F), and as a member, (ii) whether to buy the

focal product at the supermarket or at the warehouse club. If the customer is a nonmember, her only store choice is the supermarket. However, some warehouse club members can be opportunistic and shop at a supermarket when the store offers a promotional price for the focal product (i.e., “cherry picking”). In our context, this decision is based on the trade off between the supermarket’s price (a higher price with occasional promotions) and that of the warehouse club (a lower price but with the membership fee plus extra costs).

For a consumer whose purchase is only from the supermarket, the annual cost of purchasing the focal product is simple. Let P_s and Δ denote the retail price at the supermarket and the promotional depth, respectively. We assume the promotional depth is fixed in advance, and the supermarket’s promotion decision is mainly on its frequency λ , $0 \leq \lambda \leq 1$.⁵ Then her total cost at the supermarket is the average retail price times the quantity:

$$TC_s = (P_s - \lambda\Delta)q. \tag{1}$$

On the other hand, purchasing at the warehouse club involves two implicit costs in addition to its retail price (denoted by P_w) and the annual fee. The first implicit cost component is the extra travel cost to the warehouse club. Considering relatively easy access to a warehouse

⁵ This assumption is reasonable, since a casual observation indicates that a typical promotion for a consumer product has a fixed “ladder” of price promotion depths, such as 30 or 50 cents off the regular price. Blattberg and Neslin (1990; p. 344) report that the promotional discount is usually in the range of 10%. We later examine the impact of changing the promotion depth.

club (e.g. via highway)⁶, the transportation cost can be better understood as all sorts of inconveniences incurred due to additional shopping trips, such as time cost rather than the distance per se. We assume that consumers are heterogeneous in the extra travel costs per trip (denoted by c), and that these costs are uniformly distributed between 0 and 1.

The second implicit cost component is consumer's inventory-holding cost. A typical product in a warehouse club is bulk-packaged (let k denote the bulk size), so that a consumer usually purchases more than what she can consume in one usage instance. The rest of the purchase ($k - 1$) needs to be stored for future consumption with a constant usage rate. For each unit stored, there is a cost of inventory (denoted by h) representing the storage space and the opportunity costs. It is straightforward to show that the annual inventory cost becomes $h(k - 1)/2$.⁷

Thus, a consumer who buys the focal product only at the warehouse club spends the total cost of:

$$TC_w = P_w q + cq/k + h(k - 1)/2 + F, \quad (2)$$

where q/k represents the total number of extra shopping trips to the warehouse club.

⁶ As a matter of fact, when a new club is constructed, a great deal of attention is paid for site selection. And one of the major concerns is access to major highways.

⁷ Bell, Chiang, and Padmanabhan (1999) report that in product categories such as bacon and soft drinks, consumer inventory spurs higher consumption rate. For model tractability, however, we assume that consumers do not stockpile inventories due to supermarket promotion, that inventory arises only from the bulk packaging of the warehouse club, and that the existence of inventory does not induce additional consumption.

Lastly, when a consumer cherry picks between the two retail formats to pick a lower price at the time of each purchase, she will choose the supermarket with a probability of λ and the rest of the time, $(1 - \lambda)$, the warehouse club. However, she will still have to pay the annual membership fee to the warehouse club. Thus she incurs a total cost of

$$TC_c = \lambda(P_s - \Delta)q + (1 - \lambda)(P_w q + cq/k + h(k - 1)/2) + F. \quad (3)$$

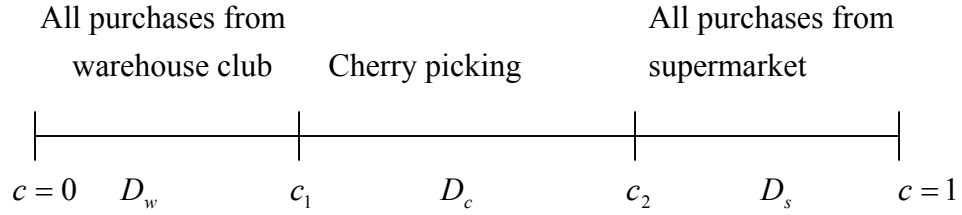
The consumer is expected to choose a store by comparing these three purchase costs, from which the demand functions are derived as follows.

2.2. Demand and Profit Functions

Based on the assumption that consumers are heterogeneous in their travel costs, we can derive demand functions for the two retailers. In choosing between the two stores, consumers are assumed to have perfect information on the respective prices and on the nature of the supermarket promotion. By comparing the total annual costs of buying the focal product, a consumer chooses among the three shopping choices: warehouse club only, supermarket only, and cherry picking. Consumers with low travel costs (c) would find it cheaper to buy only at the warehouse club. Consumers with high travel costs, on the other hand, will find that the lower retail price at the warehouse club cannot justify the extra travel, and they will shop only at the supermarket. However, consumers whose travel costs are in the mid-range will find cherry

picking more attractive than patronizing either store. These three consumer segments can be presented in the linear space of the travel cost as in Figure 1.

Figure 1. Travel Cost and Store Choice



In the figure, a consumer whose travel cost is c_1 would be indifferent between buying all focal product from the warehouse club and cherry picking. On the other hand, a consumer whose travel cost is c_2 would be indifferent between cherry picking and buying all from the supermarket. c_1 and c_2 can be derived by setting $TC_w = TC_c$ and $TC_c = TC_s$, respectively:

$$c_1 = k \left((P_s - P_w - \Delta) - \frac{h(k-1)}{2q} \right), \text{ and} \quad (4)$$

$$c_2 = k \left((P_s - P_w) - \frac{h(k-1)}{2q} - \frac{F}{q(1-\lambda)} \right). \quad (5)$$

It is straightforward to derive a parameter condition that guarantees the existence of the cherry pickers. Since we require $c_1 \leq c_2$, it follows that $F/q \leq \Delta(1-\lambda)$. It implies that the cherry pickers are more likely to exist as the supermarket discount gets deeper and/or the shoppers consume more units (q) per period. On the other hand, as the membership fee gets relatively larger and/or the supermarket promotion is more frequent, cherry picking becomes less attractive

than patronizing a single retail format. In the next section, we shall see that the equilibrium solution satisfies this condition.

The size of the three store-choice segments are derived as follows:

$$D_w = c_1 = k \left((P_s - P_w - \Delta) - \frac{h(k-1)}{2q} \right), \quad (6)$$

$$D_c = c_2 - c_1 = k \left(\Delta - \frac{F}{q(1-\lambda)} \right), \quad (7)$$

$$D_s = 1 - c_2 = 1 - k \left((P_s - P_w) - \frac{h(k-1)}{2q} - \frac{F}{q(1-\lambda)} \right). \quad (8)$$

Profit for the warehouse club comes from the entire warehouse-only segment D_w and a portion $(1-\lambda)$ of the cherry picker segment D_c , while that for the supermarket comes from λ of the cherry pickers and the entire supermarket-only segment D_s . Note that all cherry pickers must pay the membership fee regardless of the quantities they buy from the warehouse club.

Accordingly, the profit functions are derived as follows:

$$\Pi_w = (P_w q + F)D_w + ((1-\lambda)P_w q + F)D_c, \quad (9)$$

$$\Pi_s = (1-\lambda)P_s q D_s + \lambda(P_s - \Delta)q D_s + \lambda(P_s - \Delta)q D_c. \quad (10)$$

It is straightforward to show that the Hessian matrices of Π_w and Π_s are negative (semi-) definite in their respective decision variables, hence the solution from the first order conditions

in the next section is a Nash equilibrium.⁸

3. ANALYSIS

In this section, we seek a Nash equilibrium solution between the two retailer formats in terms of their respective price strategies. The warehouse club decides its retail price as well as the membership fee. The supermarket decides its own retail price and the frequency of price promotion. Throughout the analysis, we assume that the product's manufacturer price for both retailers are set to be zero without loss of generality.

From the first order conditions for the warehouse club's profit maximization, we obtain its reaction functions:

$$P_w = \frac{P_s - \Delta}{2} - \frac{h(k-1)}{4q}, \quad (11)$$

$$F = (1/2)(1 - \lambda)\Delta q. \quad (12)$$

Equation (11) indicates that the retail price (or retailer margin) at the warehouse club is less than half the retail price at the supermarket. A casual observation of grocery prices in the East Coast between the two retail formats confirms that this is generally the case for most items.

⁸ A symmetric real matrix A is negative definite if (i) $a_{ii} < 0$, for all i , (ii) $a_{ii}a_{jj} > |a_{ij}|^2$ for $i \neq j$, (iii) the element with largest modulus lies on the main diagonal, and (iv) $\det(A) < 0$.

Examining equation (12), we find that the warehouse club's optimal reaction to a more frequent (λ) supermarket promotion is to *decrease* its membership fee (F) while leaving its price (P_w) the same. On the other hand, the warehouse club's optimal reaction to a larger promotional depth (Δ) is to *increase* the membership fee while decreasing its retail price. This may sound contradictory, since the promotional depth and frequency seem different sides of the same price reduction. In our demand model, however, they have different impact on the sizes of the three segments. That is, increasing the promotion depth (Δ) expands the cherry picker segment at the expense of the warehouse club-only segment. The size of the supermarket-only segment does not change because the expected savings ($\lambda\Delta q$) from the supermarket promotion are the same between cherry picking and buying only at the supermarket.⁹ However, increasing the promotion frequency (λ) expands the supermarket-only segment at the expense of the cherry pickers. The size of the warehouse club-only segment is unaffected as long as the promotion depth stays the same, because the frequency alone does not offset the transportation cost.¹⁰

In sum, an increase in the promotion depth tends to convert some club members into cherry pickers. Since both segment customers would pay the full membership fee, the

⁹ $\frac{\partial D_w}{\partial \Delta} = -k$, $\frac{\partial D_c}{\partial \Delta} = k$, and $\frac{\partial D_s}{\partial \Delta} = 0$.

¹⁰ $\frac{\partial D_w}{\partial \lambda} = 0$, $\frac{\partial D_c}{\partial \lambda} = -\frac{Fk}{(1-\lambda)^2 q}$, and $\frac{\partial D_s}{\partial \lambda} = \frac{Fk}{(1-\lambda)^2 q}$.

optimal reaction of the warehouse club is to lower its retail price but to recover the loss by raising the annual fee. On the other hand, the increased promotion frequency would switch some cherry pickers to supermarket-only shoppers, thereby reducing the fee base of the warehouse club. In this case, the warehouse club would want to respond by decreasing the annual fee to make cherry picking more attractive than buying only at the supermarket. These asymmetrical effects of promotion depth and frequency are one of the unique features in our model. It is straightforward to show that equation (12) is sufficient to satisfy the condition that guarantees the existence of cherry pickers as discussed in the previous section.

Similarly, the supermarket's reaction functions are obtained as

$$P_s = \frac{P_w + \Delta}{2} + \frac{h(k-1)}{4q} + \frac{1}{2k}, \quad (13)$$

$$\lambda = \frac{1}{2} - \frac{F}{2\Delta q}. \quad (14)$$

We notice that the supermarket's best price reaction to the warehouse club's price change is to reflect only a half the changes into its own price. Also, the supermarket's best reaction to reduced membership fee (F) is to increase its promotion frequency (λ). The reduced membership club fee expands the cherry picker segment at the expense of the supermarket-only shoppers.¹¹

Therefore, the supermarket needs to increase the deal frequency to gain more store visits of

¹¹ $\frac{\partial D_w}{\partial F} = 0$, $\frac{\partial D_c}{\partial F} = -\frac{k}{q(1-\lambda)} < 0$, and $\frac{\partial D_s}{\partial F} = \frac{k}{q(1-\lambda)} > 0$.

cherry pickers.

Solving the system of equations (11) through (14), we obtain the following equilibrium solution:

$$P_w^* = \frac{1 - \Delta k}{3k} - \frac{h(k-1)}{6q}, \quad (15)$$

$$F^* = \Delta q / 3, \quad (16)$$

$$P_s^* = \frac{2 + \Delta k}{3k} + \frac{h(k-1)}{6q}, \quad (17)$$

$$\lambda^* = 1/3. \quad (18)$$

It is easy to verify that the warehouse club's retail price is lower than that of the supermarket:

$P_w^* < P_s^*$. The corresponding equilibrium profits are

$$\Pi_w^* = \frac{h^2 k^2 (k-1)^2 + 2(k^2 \Delta^2 + 2)q^2 - 4hk(k-1)q}{36kq}, \text{ and} \quad (19)$$

$$\Pi_s^* = \frac{h^2 k^2 (k-1)^2 - 4(k^2 \Delta^2 - 4)q^2 + 8hk(k-1)q}{36kq}. \quad (20)$$

The sizes of the three market segments in Figure 1 in equilibrium are

$$D_w^* = \frac{2(1 - \Delta k)q - h(k-1)k}{6q}, \quad D_c^* = \frac{\Delta k}{2}, \text{ and} \quad D_s^* = \frac{(4 - \Delta k)q + h(k-1)k}{6q}. \quad \text{One can easily}$$

check the sum of these three demand segments is one. This equilibrium solution satisfies the

condition for existence of the cherry picker and the supermarket-only segments. For the

warehouse club-only segment to be nonnegative, however, we require $\Delta k \leq 1$ and

$q/h \geq (k-1)k/(2(1-\Delta k))$. That is, the supermarket promotion depth and the warehouse club's bulk size cannot be excessively high, and the consumer's inventory holding cost cannot be excessively high for the demand level. Thus, as the following proposition summarizes, in equilibrium, the warehouse club charges a nonzero membership fee that is related with the depth of supermarket promotion, but not with the frequency of it.

Proposition 1. In Nash equilibrium, both supermarket promotion frequency and warehouse club membership fee are positive.

In the equilibrium solution, it is interesting to note that the promotion frequency (λ) of the supermarket is a constant! At the equilibrium, the supermarket promotes the focal product 1/3 of the time. In our demand scenario of equations (6) to (8), this is the optimal balance between attracting more cherry pickers and the lost sales revenue due to the promotional discount. Since our model does not consider other external factors of supermarket promotion, we do not claim this result represents the actual retail market. However, it can be compared with actual levels of price promotion frequency reported in empirical studies. For example, Blattberg and Neslin (1990; p. 344) report that a prominent bathroom tissue brand (i.e., Northern) is promoted every three to four weeks, and Bell et al. (1999) report an estimated frequency of 0.419 (see a further discussion in Section 5).

Proposition 2: Under our scenario, the retailer's equilibrium promotion frequency is fixed at 1/3.

4. COMPARATIVE STATICS OF THE EQUILIBRIUM SOLUTION

In this section, we examine the properties of the equilibrium solution. Table 1 presents comparative statics of the equilibrium solution with respect to bulk package size (k) and promotion depth (Δ), which are at least partly controllable variables by the respective retailers, and holding cost (h) and demand quantity (q), which are external parameters.

Table 1. Comparative Statics of the Equilibrium Solution

	Warehouse Club		Supermarket	
θ	$\frac{\partial P_w}{\partial \theta}$	$\frac{\partial F}{\partial \theta}$	$\frac{\partial P_s}{\partial \theta}$	$\frac{\partial \lambda}{\partial \theta}$
Δ	-	+	+	0
k	-	0	- ^a	0
h	-	0	+	0
q	+	+	-	0

^a Negative when k is within $1 \leq k < 2\sqrt{q/h}$, and positive when k is above $2\sqrt{q/h}$.

However, one can easily verify that the conditions for a positive segment size discussed above imply $k < 2\sqrt{q/h}$ as long as $k \geq 2$.

4.1. Effects of Supermarket Promotion Depth (Δ)

As the supermarket's promotional depth increases, the warehouse club's price decreases in order to compete for the cherry pickers, while its membership fee is increased to make up for some of its loss from the lower margin (as discussed in the previous section equation 12).

However, the supermarket's own price needs to be increased to compensate the lost revenue from the deeper discount. Note that because the equilibrium promotion frequency is constant, its depth does not affect the optimal frequency.

Proposition 3: As the supermarket's promotion depth increases, the warehouse club's price decreases, its membership fee increases, and the supermarket's price increases.

Interestingly, as the promotion depth increases, the warehouse club's profit increases while that of the supermarket decreases: $\frac{\partial \Pi_w^*}{\partial \Delta} > 0$ and $\frac{\partial \Pi_s^*}{\partial \Delta} < 0$. This is because only the cherry-picker segment is expanded while the other two segments decrease:

$\frac{\partial D_w^*}{\partial \Delta} < 0$, $\frac{\partial D_c^*}{\partial \Delta} > 0$, $\frac{\partial D_s^*}{\partial \Delta} < 0$, and all cherry pickers pay the membership fee, which also increases as Δ increases. On the other hand, the supermarket-only demand decreases due to the increased retail price.

Proposition 4: As the supermarket's promotion depth increases, the warehouse club's profit increases while that of the supermarket decreases.

Therefore, in the absence of other sales effects such as loss-leader or product assortment, the supermarket's profit from the focal product decreases as it promotes more deeply.

4.2. Effects of the Warehouse Club's Bulk Package Size (k)

Here we examine the impact of the bulk package size in the absence of other factors such as transaction and handling cost savings by the warehouse club. Table 1 shows that when the bulk package size increases, both stores' retail prices decrease in competition while the membership fee and the promotion frequency stay the same. Apparently, the increased consumer cost needs to be compensated by the lower warehouse clubs retail price, while the supermarket needs to follow the price cut.

The first order derivative of Π_w^* with respect to k is not straightforward to sign due to its polynomial nature, and our numerical examination indicates that the profit can increase or decrease depending on the relative parameter values. Instead, we provide limited insights of the impact of k on profits. First, we examine the segment demands when k changes: $\frac{\partial D_w^*}{\partial k} < 0$, $\frac{\partial D_c^*}{\partial k} > 0$, and $\frac{\partial D_s^*}{\partial k} \sim 0$. The last quantity depends on the level of k : the derivative is positive when k is large and negative otherwise. That is, as the bulk package size increase, the warehouse club-only segment gets smaller, and the cherry picker segment grows. The

supermarket-only segment shrinks in k if its initial value is small, and grows otherwise.¹² An increased cherry picker segment with constant membership fee and promotion frequency means that price competition would be more intense, and the retail prices decrease as discussed above.

Next, we examine changes in profits when the bulk size is one by examining: the sign of

$\partial \Pi_w^* / \partial k$ at $k = 1$:

$$\Pi_w^* \Big|_{k=1} = \frac{1}{18}(2 + \Delta^2)q \quad \text{and} \quad \frac{\partial \Pi_w^*}{\partial k} \Big|_{k=1} = -\frac{1}{18}(2h + (2 - \Delta^2)q). \quad (21)$$

For the supermarket, the corresponding quantities are

$$\Pi_s^* \Big|_{k=1} = \frac{1}{9}(4 - \Delta^2)q \quad \text{and} \quad \frac{\partial \Pi_s^*}{\partial k} \Big|_{k=1} = \frac{1}{9}(2h - (4 + \Delta^2)q). \quad (22)$$

The signs of the above equations depend on the magnitude of the cost of inventory (h).

We note from equation (15) that $\Delta \leq 1$ for the warehouse club's price to be positive at any k .

Therefore, the first-order derivative in equation (21) is negative. This means that, in the absence of other cost-saving features of bulk packaging, the warehouse club would not have any incentive to use the package size greater than $k = 1$. However, this result would undoubtedly change when we consider the warehouse club's savings in operating costs by using bulk packaging, or when the initial value of k is large.

¹² The critical value is $k = 1 + \Delta q / h$, but we were not able to determine where the initial value of k should lie.

On the other hand, the supermarket's first-order derivative in equation (22) becomes positive when $h > \frac{(\Delta^2 + 4)q}{2}$, and negative otherwise. That is, the effect of warehouse club's bulk packaging depends on the size of customer holding costs. When the holding cost is low, the supermarket's profit decreases in k . This is because more consumers would find it more attractive to buy in bulk at the warehouse club whose equilibrium retail price decreases in k (see Table 1).

Proposition 5: Suppose there is no cost savings or external gains due to bulk packaging. As the bulk package size increase, (a) both retail prices decrease, and (b) warehouse club's profit initially decreases whereas the supermarket's profit depends on the level of consumer holding cost: it decreases when the holding cost is low, and increases otherwise. (c) The package size does not affect the optimal membership fee or promotion frequency.

4.3. Effects of Consumption Quantity (q)

Table 1 also shows that as the individual consumption quantity (q) increases, the membership fee rises while the promotion frequency stays the same. This can easily be understood by the fact that the membership fee per unit becomes smaller as the consumption quantity increases. The result is that the warehouse club-only segment expands at the expense of the supermarket-only segment: $\frac{\partial D_w^*}{\partial q} > 0$, $\frac{\partial D_c^*}{\partial q} = 0$, and $\frac{\partial D_s^*}{\partial q} < 0$. At the same time, the

warehouse club can raise its retail price while the supermarket finds it needs to lower its own.

In other words, the increased individual consumption gives the warehouse club more advantage over the supermarket.

Comparative statics of the equilibrium profits are very difficult to characterize due to many polynomial parameters, but based on these results, the warehouse club's profit should increase in q due to increased demand and price. However, the supermarket's profit depends on the balance between the individual consumption gain and the loss of market share with decreased price. Our numerical probe confirms that the supermarket's profit can indeed decrease when individual consumption increases.¹³

Proposition 6: As the individual consumption q increases, the warehouse club benefits from the expanded demand, higher retail price and membership fee. However, the supermarket's retail price and demand decrease, and its profit can increase or decrease depending on other parameter values.

4.4. Effects of Consumer Inventory Holding Cost (h)

Table 1 also shows that, as the consumer inventory holding cost increases, the warehouse club's retail price decreases while the supermarket's retail price increases. In

¹³ Interested readers may contact the authors for numerical exercise that shows profit implication. (Technical Appendix A)

addition, the size for the supermarket-only segment increases at the expense of the warehouse

club-only segment: $\frac{\partial D_w^*}{\partial h} < 0$, $\frac{\partial D_c^*}{\partial h} = 0$, and $\frac{\partial D_s^*}{\partial h} > 0$. For some consumers, the increased

holding cost does not justify the lower price of the warehouse club. As a result, the warehouse

club's profit decreases and the supermarket's profit increases: $\frac{\partial \Pi_w^*}{\partial h} < 0$ and $\frac{\partial \Pi_s^*}{\partial h} > 0$.

Proposition 7: As the consumer inventory holding cost increases, the warehouse's retail price, market share, and profit decreases, while the supermarket's retail price, market share, and profit increases. However, the membership fee and the promotion frequency stay the same.

5. DISCUSSION

This paper examines the nature of competition between two retail formats: the warehouse club and the supermarket. In our duopoly model, the “extra travel cost” to a warehouse club by consumers is assumed heterogeneous. The consumer trade-off between extra costs of shopping at the warehouse club (which include inventory holding cost from the bulk purchase and the membership fee) and its lower retail price is the key driver of our demand function. The warehouse club determines its retail price and membership fee, whereas the supermarket determines its own retail price and the promotional frequency. Among the warehouse club members are the “cherry pickers” who will buy at the supermarket when the item is on sale.

However, nonmembers do not have such option, and they must make all purchases at the supermarket.

From the analysis, we find that the warehouse club's membership fee is an optimal competitive reaction to the supermarket's promotional activity. Both the size of the membership fee and the promotion depth influence the behavior of opportunistic buyers (the "cherry-pickers") and subsequently the segment size. More specifically, the supermarket discount converts some club members into cherry pickers, while the membership fee discourages cherry picking. Under the scenario of retail competition, our model shows that the paid membership is justified only when the supermarket adopts a promotion policy. From the warehouse club's reaction function (equation 12), we see that the fee becomes zero when either $\Delta=0$ or $\lambda=1$. $\Delta=0$ indicates no promotion policy by the supermarket, and $\lambda=1$ implies so-called "every day low pricing (EDLP)" policy. Trade literature, however, reports that every supermarket somehow needs to offer promotions. According to Progressive Grocer (1994), even EDLP supermarkets cannot avoid promotion to vie with other retailers.

"Industry observers say there are few if any companies running pure EDLP programs anymore, and most mix in special to make for a better merchandising appeal to their shoppers..."

In deriving the equilibrium solution, we assume that the promotional depth (Δ) is fixed and that the supermarket's promotion decision is mainly on its frequency (λ). Though it is pragmatic to assume both of the two parameters don't move freely and we believe fixing one variable should not make our analysis be too deviant from realism, it might be a challenging but worthy move to try relaxing the assumption. An interesting result we obtained is that the supermarket optimally promotes the focal product a third of the time. Though we don't claim it to be a rule to be obeyed, it is somewhat consistent with the empirical findings as discussed below.

Note that our model assumes asymmetric competition between a warehouse club and a supermarket without the flexible consumption effect. Bell, Iyer and Padmanabhan (2002), on the other hand, analyze a symmetric competition setting, in which consumption rate increases with stockpiling and show that the increased consumption rate increases equilibrium promotion frequency. Their equilibrium promotion frequency depends on two parameters—reservation utility and consumer inventory holding cost.¹⁴ It would be an interesting future extension to see if the same result could be obtained in our model setting when the consumption rate change is considered. Bell et al. (2002) report that the promotion frequency of $\lambda = 0.419$ for the items

¹⁴ Under their competition scenario only with stockpiling, the equilibrium promotion frequency in our notation is $(1 - \lambda) = 2h / (u - h)$, where u is the reservation utility for the product. When $u = 4h$, i.e., the inventory holding cost is 1/4 of the product utility, $\lambda = 1/3$. (Their λ is the frequency of proportion of high price, i.e. non-promotion frequency.)

that consumers can stockpile without increased consumption, and $\lambda = 0.498$ for the items with increased consumption. It is expected that when consumer stockpiling is not considered, the promotion frequency would naturally be lower, closer to our solution.

Our analysis not only provides a good explanation on why warehouse clubs charge membership fees but also gives managers several guidelines on yearly fee and retail price decisions. The results of comparative statics tell us the following. First, the optimal yearly fee increases with the supermarket's promotion depth, and with the buyer's annual consumption. Second, the warehouse club should lower its retail price for larger consumer inventory cost, bigger package size, greater promotion depth, and higher demand. The supermarket's retail price should move in the opposite direction, except for the package size. Third, the profit impact of bulk packaging on the two retailer formats depends on the size of consumer inventory cost. With smaller inventory cost, a larger package size works for the warehouse club and against the supermarket, and vice versa.

Lastly, we can think of an issue of why supermarkets don't imitate the fee policy. In fact, many supermarkets have fought back with membership club concept. For example, H.E. Butt, the dominant supermarket chain in south-central Texas, introduced a club-like format called Bodego, which features institutional sizes of grocery items and a frozen-food locker in 1992. In

1993, another club-like format supermarket called PriceRite was introduced by Big V supermarkets in Fishkill, N.Y. Megafood Stores, based in Mesa, Ariz., also competes against clubs by maintaining large sections of club-pack items (Chain Store Age Executives, 1/93). However, the common denominator of these club-like supermarkets is that they do not charge an annual fee. Very recent Californian examples of Lucky Reward membership and Safeway club membership confirm the fact that supermarkets cannot afford to introduce a positive annual membership fee though they can imitate the club-like format such as bulk packaging, wider store, and less assortment.

One of the inherent problems with supermarkets is that they cannot target only part of customers in their limited business region. Rather, they should develop hyper-segmentation schemes that can address different segments with different marketing mix elements. As Lal and Rao (1997) pointed out, both EDLP and Hi-Lo supermarkets attempt to attract time constrained consumers and cherry pickers alike, though using different elements of the marketing mix, i.e. price and service. Therefore, from a supermarket's point of view, giving away a customer segment (especially when it is of substantial size) by charging a fixed fee won't be justified, whereas a warehouse club that covers much broader area needs to do so in order to collect the huge capital investment in its early stage.

6. FURTHER MODELING ISSUES

In this article, we have modeled competition between a warehouse club and a supermarket and shown why a warehouse club needs to charge a fixed annual fee instead of broadening its customer base by getting rid of it. The analytic results imply that their fee policy can be explained as a competitive reaction to promotion practice by supermarkets and that there exists an optimal level of the fee determined by the supermarket's promotion depth and the average consumer's annual consumption rate.

To get closer to realism, the next step of this paper should be to develop a more comprehensive model that incorporates the following elements and see how our intuition holds (or changes) under more general scenario. The first venue in which we may extend the current study is to allow the consumption rate to vary across consumers. In fact, a dichotomy between heavy vs. light users or a distributional assumption would not only make the analysis more realistic but also allow to bring the nonlinear pricing argument into our modeling framework. The current study attests that one of the key roles that a membership fee plays is to discourage light buyers from cherry picking. In other words, with the certain annual fee, cherry picking would be no longer a feasible shopping strategy for light buyers.

The second parameter that we may consider adding to the analysis is *search cost*. As

travel cost affects consumers' shopping strategy decision, difference in search cost will also influence the buyer's shopping alternatives under consideration. That is, while those who have very low search cost will always be willing to seek for opportunities of cherry picking, high search cost people will restrict their attention only on membership decision and never cherry pick.

Thirdly, from the retailer's point of view, a *service cost* may play an important role in their pricing strategy. For example, if service cost for light users is too high, the warehouse club might be better off by focusing only on heavy user segment. A longer queue is an example of degraded service level (which is costly) due to cherry pickers. And in that case, according to our intuition from the model analyzed, the club may want to discourage the light users further by raising the membership fee and offering a very low retail price to the members. As a matter of fact, warehouse clubs tend not to install express lanes.

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