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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. We show that the cherry-picker segment plays a key role behind these results. Our analysis not only provides a justification of warehouse club membership fees by discovering its duality with the cherry-picker segment but also gives managers several guidelines on yearly fee and retail price decisions.

Keywords: Retailing; Retail formats; Warehouse club; Price competition

Introduction

The core of the warehouse club concept is *membership*.[2] 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 percent of the US households shopped at the retail format, and according to a survey, 30 percent of shoppers who have not joined a membership warehouse club cite the annual membership fee as the reason.[3] 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 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

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[1] Tel.: +82 2 880 6934.
[2] "Wholesale Club Industry", Harvard Business School, Case 9-594-035, p. 4.
[3] *DNS Retailing Today*, May 5, 2003, 42 (9), p. 6; *Stores*, July 1993, p. 6.

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customer base by simply getting rid of the membership policy. A different answer provided in the frequently asked questions (FAQ) section of the previous Costco/Price Club's Web site is the following.[4]

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

This does not 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 (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 do not. 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 high-cost (i.e., light users, among members) segment (Nagle and Holden 1995; Blattberg and Neslin 1990, pp. 95–102). In a related study by Fruchter and Rao (2001), the membership fee is justified for maximizing discounted profit in a *growing* service market in which the average usage (such as internet service provider's service) declines with the number of customers.

Though these claims provide valuable insights, they do not provide a complete story since they view the warehouse club as a profit-maximizing *monopolist*. The purpose of the current research is to expand our understanding of the practice of the warehouse club membership fees to a more general setting (i.e., competition). 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).[5] Accordingly, a competition between a supermarket and a warehouse club becomes the basic setting of our model.

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 does not 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. This connection provides another explanation for the existence of the membership fee: a mechanism to limit the size of a market segment, called the "cherry pickers," members of which pay the membership fee but purchase at a supermarket whenever there is a promotional discount. Without the membership fee, the majority of consumers would switch between the stores freely, thereby intensifying price competition. They are different from our definition of cherry pickers because there is no membership issue from the start. Combined with lower unit prices, the membership fee allows the warehouse to keep its loyal consumers as well as part of cherry pickers' purchases when there is no supermarket promotion. 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 to create its own "back-yard" customer base. We found that the larger the price discount, the higher is the membership fee; whereas the more frequent the supermarket promotions, the lower is the membership fee. The retail price of the warehouse club moves in the opposite direction from the membership fee.

We present the consumer decision model as well as the firms' profit models in the following section. The next section derives a set of reaction functions and the equilibrium solution. Then we employ 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 the discussion section, and the last section concludes the paper with delineating future research topics.

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. Although there are several other factors affecting consumer choice between retail formats such as assortment, service, and brand consistency (Messinger and Narasimhan 1997; Krishnan et al. 2002), we limit our scope to the pricing aspect in a competitive setting.

[4] 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.

[5] 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.

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),[6] 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 that the promotional depth is fixed in advance, and that the supermarket's promotion frequency (λ, $0 \le \lambda \le 1$) is determined by external factors such as manufacturer's trade promotions or the retailer's category management strategy.[7] For each unit stored, there is a cost of inventory (denoted by h) representing the storage space and the opportunity costs. With a constant consumption rate q, the supermarket customer, who buys one unit at each shopping trip, incurs an inventory cost for storing an average of $\frac{1}{2}$ unit throughout the period. Then her total cost at the supermarket is the average retail price times the quantity:

$$\mathrm{TC}_s = (P_s - \lambda\Delta)q + \tfrac{1}{2}h. \qquad (1)$$

Now consider a consumer whose purchase is only from the warehouse club, which involves a larger inventory-holding cost. A typical product in a warehouse club is bulk-packaged (let k denote the bulk size), and with an average inventory of $k/2$, the annual inventory cost becomes $hk/2$.[8] Another implicit cost component is the extra travel cost to the warehouse club. Recall the above discussion of number of SKUs in the two retail formats. Even if a consumer is a member of the warehouse club, she would need to visit the supermarket to buy items not found in the warehouse club. Thus the trip to the warehouse club incurs an "extra transportation cost." Considering relatively easy access to a warehouse club (e.g., via highway),[9] 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. With retail price (P_w) and the annual fee (F), a consumer who buys the focal product only at the warehouse club spends the total cost of:

$$\mathrm{TC}_w = P_w q + \frac{cq}{k} + \frac{hk}{2} + F, \qquad (2)$$

where q/k represents the total number of extra shopping trips to the warehouse club. Note that the membership fee in our context is a normalized one to reflect the single product in focus.

Finally, we can think of two scenarios when a consumer cherry picks between the two retail formats to pick a lower price at the time of each purchase. She may use the supermarket (a) *whenever* there is a promotional sale regardless of her inventory status, or (b) only when she runs out of the product inventory *and* there is a promotional sale. For tractability, we consider the former scenario in this paper.[10] Even though she shops at the warehouse club only some parts of the time, she will still have to pay the annual membership fee to the warehouse club. Thus she incurs a total cost of

$$\mathrm{TC}_c = \lambda(P_s - \Delta)q + (1-\lambda)P_w q + \frac{c(1-\lambda)q}{k} + \frac{hk}{2} + F. \qquad (3)$$

The details of the inventory cost derivation are presented in the Appendix.

Given these three shopping choice options with respective costs, the consumer is expected to choose a shopping strategy by comparing these three purchase costs, from which the demand functions are derived as follows.

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

[6] In reality, the annual membership fee is spread across all product purchases from the warehouse club. In our simplified version which considers only one product, F can be thought of as a prorated portion of the annual fee that can be attributed towards the expected purchase of the focal product.

[7] 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%. Also, the frequency of supermarket promotion is generally initiated by the manufacturer aiming to attract brand switchers (Sun et al. 2003). Bolton and Shankar (2003) empirically derive multiple dimensions as the basis of retail promotion including the manufacturer's deal and product category management.

[8] Bell et al. (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 the existence of inventory does not induce additional consumption.

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

[10] We appreciate the Associate Editor for suggesting this assumption and for deriving its cost function that follows.

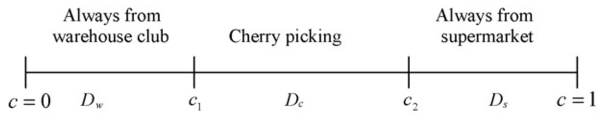


Fig. 1. Travel cost and store choice.

choices: warehouse club only, supermarket only, and cherry picking. Consumers with low travel costs (c) would find it cheaper to buy the focal product 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.[11] These three consumer segments can be presented in the linear space of the travel cost as in Fig. 1.

In Fig. 1, a consumer whose travel cost is c_1 would be indifferent between always buying the 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 always from the supermarket. c_1 and c_2 can be derived by setting $TC_w = TC_c$ and $TC_c = TC_s$, respectively:

$$c_1 = k(P_s - P_w - \Delta), \tag{4}$$

and

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

Notice that in order for the warehouse club-only segment to be positive ($c_1 > 0$), the supermarket's promotion price P_s–Δ has to be no less than the warehouse club's price P_w. Otherwise, all warehouse club members will also be cherry pickers. Also, the cherry picker segment is defined only if $c_1 \leq c_2$, or $F + h(k-1)/2 \leq \Delta q(1-\lambda)$. It implies that the cherry pickers are more likely to exist as the supermarket discount gets deeper, the shoppers consume more units (q) per period, and the inventory holding cost is smaller. As the supermarket promotion becomes more frequent, cherry picking becomes less attractive than patronizing a single retail format. In Fig. 1, this is equivalent to moving the point c_2 leftwards.

There are three regions of λ resulting in three different demand scenarios:

- The "normal case": when $0 < \lambda \leq 1 - [h(k-1)+F]/2\Delta q \leq 1$ (derived from the cherry picker's nonnegativity condition above), the market has three segments as in Fig. 1.
- No promotion: when $\lambda = 0$, there is practically no cherry picking because there is no supermarket promotion. The cherry pickers wait for supermarket promotion that never occurs, and end up buying always at the warehouse club. Hence, all cherry pickers are by definition warehouse club-only shoppers, hence the market has two segments.
- Too frequent promotion: when there are too frequent promotions (i.e., $1 - h[(k-1)] + F]/2\Delta q < \lambda \leq 1$), the cherry picker segment vanishes, and c_2 moves to left of where c_1 used to be, resulting in two buyer segments.

[11] In Krishnan et al.'s (2002) model which focuses on brand consistency and service levels of retail formats, the consumers are segmented in predetermined "types." So is the approach of Lal and Rao (1997). However, our model assumes that the segments are formed endogenously in a continuum of the transportation cost parameter.

The two-segment cases result in straightforward Hotelling-type price competition scenarios, in which the two retail formats compete in a linear market. We show in the Appendix that membership fee is linearly dependent on the warehouse club's price, and consequently the membership fee cannot be justified without using other standard two-part tariff arguments (e.g., Dolan 1987). Since our objective is to provide another explanation of membership fee, we focus on the "normal case" in which the cherry-picker segment plays a key role in justifying a positive membership fee.

When there are three nonnegative market segments, their demands can be derived as follows:

$$D_w = c_1 = k(P_s - P_w - \Delta), \tag{6}$$

$$D_c = c_2 - c_1 = k\left(\Delta - \frac{h(k-1)+2F}{2q(1-\lambda)}\right), \tag{7}$$

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

Note that the demand for warehouse club-only segment does not depend on λ, indicating that more frequent supermarket promotion attracts only the cherry pickers into the supermarket-only shoppers. The promotion frequency should not affect the warehouse club-only shoppers as long as the depth of the promotion is not sufficient to make P_s undercut P_w, which was one of the conditions derived above for the existence of cherry pickers.

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 (Appendix shows that the total warehouse club purchase by the cherry pickers is $q(1-\lambda)D_c$), while that for the supermarket comes from a portion 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 quantity they buy from the warehouse club. Accordingly, the profit functions are derived as follows:

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

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

The warehouse club is assumed to make the pricing decisions in two stages. Since the membership fee F applies to all other products in the store, it is considered a long-term decision and is set in the first stage with the subsequent retail price competition in sight. Then the two retail formats compete in a Nash game by respectively choosing P_w and P_s. As discussed above, the supermarket's promotion depth and its frequency are assumed exogenous. It is straightforward to show that the second-order conditions for optimal profits are all satisfied. Hence the solution from the first-order conditions in the next section is a Nash equilibrium.

Analysis

In this section, we seek an equilibrium solution between the two retailer formats in terms of their respective price strategies. Throughout the analysis, we assume that the manufacturer's wholesale price to both retailers are the same and are set to be zero without loss of generality. An optimal two-stage decision for the warehouse club can be found by first deriving the Nash equilibrium retail prices between the two formats for any given membership fee. Solving the two first-order conditions of (9) and (10) simultaneously, we obtain the following price equilibrium solution conditional on the membership fee[12]:

$$P_w = \frac{1}{3k} - \frac{F}{q} - \frac{h(k-1)}{6q}, \tag{11}$$

$$P_s^* = \frac{2}{3k} + \lambda\Delta + \frac{h(k-1)}{6q}. \tag{12}$$

It is natural that the equilibrium retail price of the supermarket is not dependent on the warehouse club's membership fee, while the warehouse club's own retail price is. This result is not surprising when we consider the two *best reaction functions*:

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

$$P_s = \frac{P_w}{2} + \frac{F}{2q} + \frac{h(k-1)}{4q} + \frac{1}{2k} + \lambda\Delta. \tag{14}$$

We observe that the supermarket's *direct* reaction to a decreased membership fee is to decrease its retail price (P_s), but the effect is cancelled out by the opportunity to raise the price due to a higher price (P_w) of the warehouse club. As we have seen from demand Eqs. (6) to (8), the warehouse club-only segment size is independent of F, while a reduced membership fee expands the cherry picker segment at the expense of the supermarket-only shoppers.[13] The warehouse club's myopic view (i.e., without considering other product categories) of the relationship between the retail price and membership fee is a simple trade off between them. That is, when the membership fee increases, its retail price needs to decrease in a linear fashion. We also 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, and vice versa. This is a property that guarantees the existence of an equilibrium.

Substituting (11) and (12) into the warehouse club's profit (Eq. (9)), and solving for the optimal membership fee, we have the optimal membership fee:

$$F^* = \frac{(1-\lambda)q\Delta}{2} - \frac{h(k-1)}{4}. \tag{15}$$

For the fixed cost to be positive, we have the following condition on the frequency of supermarket promotion: $0 < \lambda < 1 - h(k^- 1)/2q\Delta$. Below, we show that this is the same condition as that guarantees a positive cherry picker segment. This implies that the existence of cherry pickers is a key factor (at least in our limited scope) for a positive membership fee. Substituting (15) into (11), the warehouse club's equilibrium retail price (11) can be written as

$$P_w^* = \frac{1}{3k} + \frac{h(k-1)}{12q} - \frac{\Delta(1-\lambda)}{2}, \tag{16}$$

and (12) is by itself the supermarket's retail price (repeated here for easier reference):

$$P_s^* = \frac{2}{3k} + \lambda\Delta + \frac{h(k-1)}{6q}. \tag{12}$$

Eqs. (12), (15) and (16) represent the equilibrium prices of the two retail formats. It is easy to verify that the warehouse club's retail price is lower than that of the supermarket: $P_w^* < P_s^*$. Furthermore, setting manufacturer costs of both at zero, we observe that the retail price (which is to be interpreted as retailer margin) at the warehouse club is less than half the discounted retail price at the supermarket. A casual observation of grocery prices between the two retail formats confirms that this is roughly the case for most items.

The resulting equilibrium profit functions are complex and tedious, and are presented in the Appendix. On the other hand, the equilibrium demands are:

$$D_w^* = \frac{1}{3} - \frac{k\Delta(1-\lambda)}{2} + \frac{hk(k-1)}{12q}, \tag{17}$$

$$D_c^* = \frac{k\Delta}{2} - \frac{hk(k-1)}{4q(1-\lambda)}, \tag{18}$$

$$D_s^* = \frac{2}{3} - \frac{k\lambda\Delta}{2} + \frac{hk(k-1)(2+\lambda)}{12q(1-\lambda)}. \tag{19}$$

One can easily verify that the sum of the three segment demands is one. The condition for the existence of cherry pickers can be derived from (18) such that $0 < \lambda < 1 - h(k-1)/2q\Delta$, which is equivalent to the condition derived in the previous section. Again, when the supermarket's promotion frequency is excessive, all cherry pickers will abandon the membership and become supermarket-only buyers. Notice that this is exactly the same condition that also guarantees a positive membership fee (via Eq. (15)). Thus,

[12] The second-order derivatives are both negatives, satisfying the optimality conditions.

[13] $\partial D_w/\partial F = 0$, $\partial D_c/\partial F = -k/q(1-\lambda) < 0$, and $\partial D_s/\partial F = k/q(1-\lambda) > 0$.

as the following key proposition summarizes, the warehouse club optimally charges a nonzero membership fee as long as there are positive, but not excessive, supermarket promotion activities:

Proposition 1. *Suppose the supermarket promotion frequency is within the range of* $0 < \lambda < 1 - h(k-1)/2q\Delta$. *Then there exists a positive cherry-picker segment, and it is optimal for the warehouse club to charge a positive membership fee.*

The duality of the membership fee and the cherry-picker segment can be explained more intuitively. From the warehouse club's point of view, the cherry pickers are a buffer zone that shields its hinterland (warehouse club-only segment) from the supermarket's promotional discounts. The warehouse club has revenue guaranteed from the membership fee in both segments. However, as the promotion frequency becomes excessive ($\lambda > 1 - h(k-1)/2q\Delta$), the buffer zone vanishes and the direct competition lures the club-only customers into abandoning the membership. At that point, the warehouse club would better drop the membership fee and compete only in retail price.

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 promotion frequency (λ) and its depth (Δ), and bulk package size (k), which are at least partly controllable variables by the respective retailers, and holding cost (h) and demand quantity (q), which are external parameters.

Effects of supermarket promotion depth (Δ) and frequency (λ)

The warehouse club's optimal reaction to a larger promotional depth (Δ) is to increase the membership fee while decreasing its retail price. On the other hand, its optimal reaction to a more frequent promotion (λ) is to decrease the membership fee while increasing 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 expands the cherry picker segment ($\partial D_c/\partial\Delta > 0$) at the expense of the warehouse club-only segment ($\partial D_c/\partial\Delta < 0$). The size of the supermarket-only segment does not change ($\partial D_s/\partial\Delta = 0$) because the expected savings ($\lambda\Delta q$) from the supermarket promotion are the same between cherry picking and buying only at the supermarket. However, increasing the promotion frequency expands the supermarket-only segment ($\partial D_s/\partial\lambda > 0$) at the expense of the cherry picker segment ($\partial D_c/\partial\Delta < 0$). 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 and inventory costs.

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 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.

On the other hand, when the supermarket increases either promotional depth or frequency, its own price needs to be increased to compensate the lost revenue from the deeper or more frequent discounts, unless the promotion is supported by the manufacturer.

Proposition 2. *As the supermarket's promotion depth increases, the warehouse club's membership fee increases. Furthermore, the warehouse club's retail price decreases, while the supermarket's retail price increases. However, as the promotion frequency increases, the membership fee decreases, while retail prices of both retail formats increase.*

It is interesting to note that, under the same condition as in Proposition 1 (i.e., positive cherry-picker segment), a deeper promotion discount increases the warehouse club's profit while it decreases the supermarket's: $\partial\Pi_w^*/\partial\Delta > 0$ and $\partial\Pi_s^*/\partial\Delta < 0$. This is because only the cherry-picker segment expands at the price equilibrium, while the other two segments contract: $\partial D_w^*/\partial\Delta < 0$, $\partial D_c^*/\partial\Delta > 0$, $\partial D_s^*/\partial\Delta < 0$. Moreover, since all cherry pickers pay the membership fee, the warehouse club's profit increases as Δ increases. On the other hand, the supermarket-only demand decreases at the equilibrium due to the increased retail price.

Proposition 3. *Suppose* $0 < \lambda < 1 - h(k-1)/2q\Delta$. *As the supermarket's promotion depth increases, the warehouse club's profit increases while that of the supermarket decreases.*

Table 1
Comparative statics of the equilibrium solution

θ	Warehouse club		Supermarket
	$\partial P_w^*/\partial\theta$	$\partial F^*/\partial\theta$	$\partial P_s^*/\partial\theta$
Δ	−	+	+
λ	+	−	+
k	− ➔ +[a]	−	− ➔ +[a]
h	+	−	+
q	−	+	−

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

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. However, the effects of the promotion frequency on profits are very difficult to verify due to the multiple parameters and polynomial functions, and we leave them for future research.

Effects of the warehouse club's bulk package size (k)

The warehouse club's package size is determined by many external factors such as cost savings in transaction and handling, possibility of locking in consumer consumptions, and the specific agreements with the manufacturers. Here we examine the impact of the bulk package size on the membership fee and retail prices in the absence of those external factors. Table 1 shows that membership fee decreases as the bulk package size increases. Also, the two retail prices initially decrease as the package size increases. A larger package size increases the consumer's inventory cost only for the warehouse club-only and the cherry picker segments. Without corresponding price adjustments, the warehouse club would lose its market share to the supermarket. Apparently, the increased consumer cost of holding inventory needs to be compensated by the lower warehouse club prices, while the supermarket needs to follow the price cut. But when $k > 2\sqrt{q/h}$, both retail prices increase in k. Due to the complexity of the derivatives with multiple parameters, we were unable to determine the property of the right-hand side of this inequality. However, we speculate the eventual raise in retail prices occurs because the falling membership fee needs to be compensated for profitability. Likewise, the signs of the derivatives of the profit functions with respect to k are very difficult to determine, and we could not derive any meaningful implications on the optimal package size. We leave this analysis to future research.

Proposition 4. *As the warehouse club's bulk package size increase, the membership fee decreases.*

Effects of consumer inventory holding cost (h)

Table 1 also shows that, the warehouse membership fee decreases as the consumer inventory holding cost increases, while retail prices at both retail formats increase. In fact, the warehouse-only and the supermarket-only segments expand at the expense of the cherry-picker segment: $\partial D_{\mathrm{w}}^*/\partial h > 0$, $\partial D_{\mathrm{c}}^*/\partial h < 0$, and $\partial D_{\mathrm{s}}^*/\partial h > 0$. This is because, under our assumption that the cherry picker buys an item whenever there is a supermarket promotion regardless of her inventory level (see Appendix), the cost of cherry pickers increases more quickly than that of single retail patrons as the inventory holding cost goes up. In order to provide the shrinking cherry picker segment a justification to pay the membership fee, the warehouse club needs to lower the fee, which can be partially recovered by a higher retail price.

The impact of h on the warehouse club's profit is not easy to verify. Intuitively, the warehouse club would not benefit from increased inventory holding cost of the consumer, but we were not able to prove it due to the complexity of the derivatives. On the other hand, we were able to determine the sign the derivative of the supermarket's profit ($\partial \Pi_{\mathrm{s}}^*/\partial h > 0$), and we know that the supermarket never loses when the inventory cost goes up.

Proposition 5. *As the consumer inventory holding cost increases, the membership fee decreases, while the retail prices increase for both retail formats.*

Effects of consumption quantity (q)

Table 1 shows that as the individual consumption quantity (q) increases, the membership fee rises while the retail prices decrease. This can easily be understood by the fact that the membership fee per unit becomes smaller as the consumption quantity increases. Spreading the membership fee across a larger yearly consumption makes cherry picking more affordable. The result is that the cherry-picker segment expands at the expense of the warehouse club-only and the supermarket-only segments: $\partial D_{\mathrm{w}}^*/\partial q < 0$, $\partial D_{\mathrm{c}}^*/\partial q > 0$, and $\partial D_{\mathrm{s}}^*/\partial q < 0$. However, the expanded membership base makes the warehouse club more competitive in retail pricing, and accordingly both retail prices decrease. On the other hand, comparative statics of the equilibrium profits are very difficult to characterize due to many polynomial parameters, and the profit implications are left for future research.

Proposition 6. *As the individual consumption q increases, the warehouse club's membership fee increases. However, both retail formats' retail prices decrease.*

Discussion

This paper examines the nature of competition between two retail formats: the warehouse club and the supermarket. In particular, we provide a complementary explanation for the existence of the warehouse club membership fee. 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. We assume that the supermarket's promotion depth and frequency are externalities. 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.

In our framework, the warehouse club's membership fee is an optimal competitive reaction to the supermarket's promotional activity. That is, when the supermarket offers positive, but not excessive, promotional discounts, the warehouse club finds it optimal to charge a positive membership fee. Moreover, the condition for a positive membership fee is also the condition that results in a positive cherry-picker segment. The membership fee creates the "back-yard" customer segment for the warehouse as well as the cherry-picker segment. Our model shows that the paid membership is justified only when the supermarket adopts a promotion policy. The fee becomes zero when either $\Delta = 0$ or $\lambda = 1 - h(k-1)/2q\Delta$ (Eq. (15)). $\Delta = 0$ indicates no promotion policy by the supermarket, and $\lambda = 1 - h(k-1)/2q\Delta$ implies too frequent promotion approaching the "every day low pricing (EDLP)" policy. Trade literature, however, reports that every supermarket somehow needs to offer a degree of promotion activities. 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, therefore, we assume that both the promotional depth (Δ) and its frequency (λ) are fixed. After all, our focus is to provide an alternative explanation for the membership fee.

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. However, it decreases with the promotional frequency, bulk package size, and the consumer inventory holding cost. Second, the warehouse club should lower its retail price for more frequent supermarket promotion and a larger consumer inventory cost. However, its retail price decreases for greater promotion depth and higher demand. The supermarket's retail price generally moves in the opposite direction, except for the promotional depth.

Lastly, we can think of an issue of why supermarkets do not 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,* January 1993). 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, that is, 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 would not 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.

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 activities and the average consumer's annual consumption rate. Interestingly, the effects of promotional depth and frequency are not always identical.

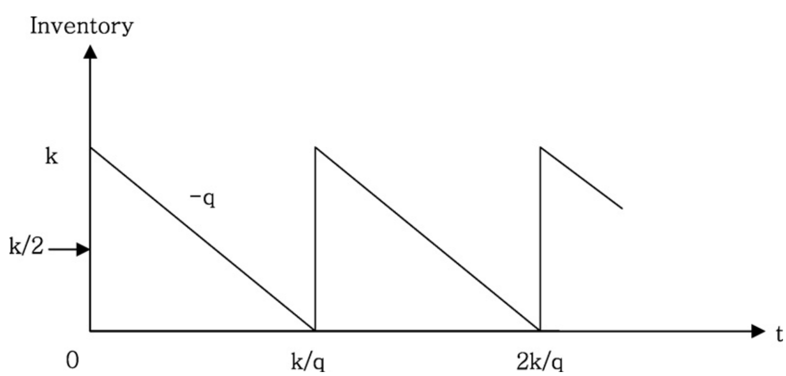
To get closer to realism, the next step of this paper should be to develop a more comprehensive model that incorporates the following elements and see how our intuition holds (or changes) under a more general scenario. The first venue in which we may extend the current study is to allow the consumption rate to vary across consumers. In fact, a dichotomy between heavy versus light users or a distributional assumption would not only make the analysis more realistic but also allow us 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.

Appendix A. Inventory cost derivation

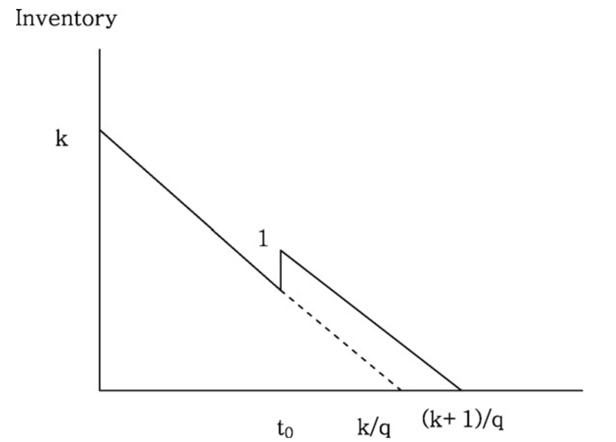
Suppose that consumption of the product is continuous at a rate of q per period. A consumer who makes purchases only from the warehouse (with package size k) would hold an average inventory of $k/2$. Mathematically, the average inventory is computed as the area divided by the corresponding time period: $\left(\frac{k\cdot k/q}{2}\right)/(k/q) = k/2$.



Now suppose that a supermarket offers a *single* promotional discount during one inventory cycle, and that the promotion limits one unit per customer. This promotion attracts the cherry-pickers, who are assumed to purchase one unit *whenever* the item is on promotion.[14] The consumer's inventory cycle is then extended by $1/q$ after the promotional purchase, so the inventory cycle becomes the interval of $[0,(k+1)/q]$. Suppose that the promotion takes place at time $t_0 \in [0,(k+1)/q]$. The average inventory is computed as the area under the solid lines divided by the time:

$$\frac{(1/2)(k+1)(k+1)/q - t_0}{(k+1)/q} = \frac{(k+1)^2 - 2qt_0}{2(k+1)} \quad \text{or} \quad \frac{k+1}{2} - \frac{qt_0}{k+1},$$

which depends on the timing t_0 of the one-time promotional discount. If the time of the supermarket promotion is equally likely to occur during the inventory cycle $[0,(k+1)/q]$, then the expected time of the event is $E[t_0] = (k+1)/(2q)$, and the expected inventory is $k/2$.[15]



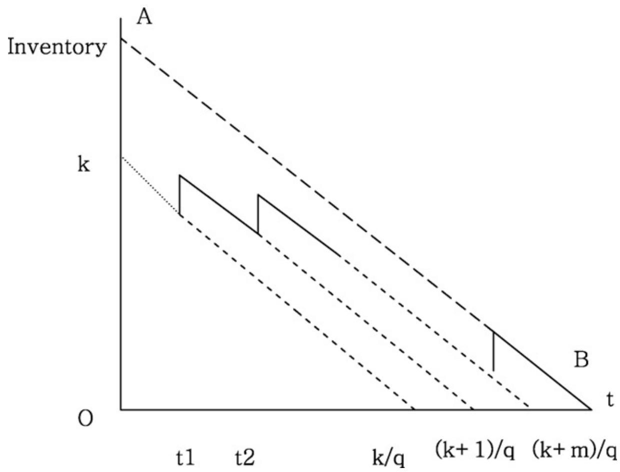
Now we extend the inventory cost derivation to a more general case. Suppose there are m promotions (uniformly distributed) within one inventory cycle. Then the average value for the discounting time is $(k+m)/(2q)$, and there are m of these discounts. The area under the solid line can be computed as the large triangle (AOB), which is $(k+m)^2/2q$, minus the portion of the triangle above the solid lines, $m(k+m)/2q$. Dividing the inventory area by the inventory cycle $(k+m)/q$, we have

$$\frac{(k+m)(k+m)/2q - m(k+m)/2q}{(k+m)/q} = \frac{k}{2},$$

which is same as the inventory level of just buying only from the warehouse.

[14] In the next section, we show that the model becomes very complicated when we assume that the consumer waits until her inventory depletes before the next purchase.

[15] An alternative range for the promotion timing would be $[0,k/q]$, if we require that the promotion take place before the inventory is depleted. This adds a term, $1/2(k+1)$, to the expected mean inventory for the single promotion case. In the multiple promotions case, the same requirement (i.e., all m promotions take place within the range of $[0,(k+m-1/q])$ adds a term, $m/2(k+m)$, to the average inventory. However, the resulting complexity makes the equilibrium model extremely difficult to analyze.



Within one inventory cycle $(k+m)/q$, the promotion occurs with a frequency of λ $(0 \leq \lambda \leq 1)$ of the time, and the promotional purchase volume during that period is $\lambda q[(k+m)/q]$ which needs to be equal to m. Solving for m yields $m = k\lambda/(1-\lambda)$, and substituting into the cycle length, we have $(k+m)/q = k/q(1-\lambda)$. Therefore it follows that there are $q(1-\lambda)/k$ cycles in a year, which is equivalent to the number of warehouse purchases. When the cherry picker segment size is D_c, their warehouse purchase volume is $q(1-\lambda)D_c$.

Therefore, the cherry picker's travel and inventory costs per year are $cq(1-\lambda)/k$ and $hk/2$, respectively.

Appendix B. An alternative inventory model

We derive an alternative mean inventory model under the assumption that a cherry-picker waits until he/she inventory runs out before initiating the next purchase (i.e., no stock piling). Under this assumption, even if the consumer is fully aware that there would be no supermarket promotion with a probability of $(1-\lambda)$, he/she passes any supermarket promotion while there is a positive inventory.

The consumer purchases k units from the warehouse club with a probability of $(1-\lambda)$ and one unit from the supermarket with a probability of λ. Therefore the total inventory during an inventory cycle is $(1/2)(k\cdot k/q)(1-\lambda) + (1/2)(1/q)\lambda$. On the other hand, an inventory cycle can be derived as $(k/q)(1-\lambda) + (1/q)\lambda$. Therefore, the average inventory becomes, after a simplification:

$$\text{Inv} = \frac{k^2(1-\lambda)+\lambda}{2(k(1-\lambda)+\lambda)}$$

This inventory formula, when applied to our cost function for the cherry-pickers (3), produces a set of complex profit functions. Although we were able to derive closed-form equilibrium solutions equivalent to Eqs. (15) through (19), they are extremely complex to be examined analytically for their qualitative properties. To analyze them, it is necessary to apply a numerical analysis. However, we determined that, for the underlying behavioral assumption, the benefit from an extensive numerical exercise would be very limited.

Appendix C. The case of zero promotion

In the zero-promotion case, the market has two segments: warehouse-only and supermarket-only segments. Their boundary is defined by setting $\lambda = 0$ and solving $TC_w = TC_s$ for c: $c_2 = k[(P_s - P_w) - (h(k-1) + 2F)/2q]$. Thus, their respective segments sizes are

$$D_w = c_2 = k[(P_s - P_w) - (h(k-1) + 2F)/2q],$$

$$D_s = 1 - c_2 = 1 - k[(P_s - P_w) - (h(k-1) + 2F)/2q].$$

For the warehouse club's demand to be positive the warehouse club's price needs to be sufficiently lower than the supermarket's price to offset the membership fee and the increased inventory cost. The corresponding profits are derived as follows:

$$\Pi_w = (P_w q + F)D_w,$$

$$\Pi_s = P_s q D_s.$$

It is easy to verify that P_w and F are linearly dependent, and the existence of the membership fee cannot be justified within out context.

Appendix D. The case of too frequent promotion

If there are too frequent supermarket promotions, all cherry pickers will drop the warehouse membership and become the supermarket-only segment. Moreover, some warehouse-only customers will convert to the other segment. Their boundary is defined by solving $TC_w = TC_s$ for c: $c_2 = k[(P_s - P_w - \Delta\lambda) - (h(k-1) + 2F)/2q]$. Thus, their respective segments sizes are

$$D_w = c_2 = k[(P_s - P_w - \Delta\lambda) - (h(k-1) + 2F)/2q],$$

$$D_s = 1 - c_2 = 1 - k[(P_s - P_w - \Delta\lambda) - (h(k-1) + 2F)/2q].$$

The corresponding profits are derived as follows:

$$\Pi_w = (P_w q + F)D_w,$$

$$\Pi_s = (P_s - \lambda\Delta)qD_s.$$

Again, it is easy to verify that P_w and F are linearly dependent, and the existence of the membership fee cannot be justified within out context.

Appendix E. Equilibrium profits

The equilibrium profits based on the solution (12), (15), and (16) are

$$\Pi_w^* = \frac{h^2(k-1)^2k(4+5\lambda)}{144q(1-\lambda)} - \frac{h(k-1)(4+9\lambda\Delta k)}{36} + \frac{q(4+9k^2\Delta^2(1-\lambda)\lambda)}{36k},$$

$$\Pi_s^* = \frac{h(k-1)(8+9k\lambda\Delta)}{36} + \frac{h^2(k-1)^2k}{36q} + \frac{2q(8-9k^2\Delta^2\lambda(1-\lambda))}{36k}.$$

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