The Choice and Consequences of Using a Category Captain for Category Management

Yusong Wang, Jagmohan S. Raju, and Sanjay K. Dhar

This project is funded by the Wharton-SMU Research Center of Singapore Management University
The Choice and Consequences of Using a Category Captain for Category Management

Yusong Wang
Jagmohan S. Raju
Sanjay K. Dhar

January 31, 2003

1Yusong Wang is Assistant Professor of Marketing, School of Business, Singapore Management University, Singapore 259756 (Phone: (65) 6822-0734, Fax: (65) 6822-0777, E-mail: yswang@smu.edu.sg). Jagmohan S. Raju is Joseph J. Aresty Professor of Marketing, The Wharton School, University of Pennsylvania, Philadelphia, PA 19104 (Phone: (215) 898-1114, Fax: (215) 898-2534, E-mail: rajuj@wharton.upenn.edu). Sanjay K. Dhar is Professor of Marketing, Graduate School of Business, University of Chicago, Chicago, IL 60637 (Phone: (773) 702-3005, Fax: (773) 702-0458, E-mail: fsdhar@gsb.uchicago.edu). The authors thank Professors Darryl Banks, David R. Bell, Josh Eliashberg, Ed Fox, Noah Gans, Teck Ho, Steve Hoch, Debu Purohit and Rick Staelin for their helpful comments. The authors thank Wharton-SMU Research Center of Singapore Management University for financial support.
The Choice and Consequences of Using a Category Captain for Category Management

Abstract

The practice of using a category captain for category management involves an alliance between a retailer and a leading national-brand manufacturer, where the retailer delegates considerable decision-making authority over the product category to the manufacturer. This manufacturer is designated as the category captain by the retailer. Facing demanding challenges in the marketplace, retailers have recently adopted this practice for managing their product categories. Our research focuses on the following key questions.

• Is it profitable for the retailer to delegate pricing authority to the category captain?
• What categories are most suitable for using a category captain for category management?
• Which manufacturer should the retailer partner with?

The main results are as follows. Using a category captain for category management is profitable for the retailer and the manufacturer who serves as the captain. Furthermore, this practice has a potential for benefiting all channel members including manufacturers of competing non-captain brands, when the retailer partially delegates pricing authority. The profitability of using a category captain is higher in a product category with fewer national brands, higher price competition among national brands, lower price competition between national brands and a store brand, or lower marginal costs for national-brand manufacturers. It is optimal for the retailer to partner with the national-brand manufacturer who has a higher base level of demand, lower marginal cost, lower own-price sensitivity, or higher cross-price sensitivity. When demand is less sensitive to price changes, the advantage of demand side becomes more important than cost advantage.

Key Words: Category Management, Pricing, Retailing, Distribution Channels, Game Theory
1 Introduction

Traditional retailers are facing demanding challenges stemming from alternative channel formats and fierce price competition in the marketplace. Effective management of the distribution channel is crucial in turning strategic threats into competitive advantages. One important consideration is whether to adopt category management, “a process that involves managing product categories as business units and customizing them on a store-by-store basis to satisfy customer needs” (Nielsen Marketing Research and American Marketing Association 1992). A recent Cannondale’s benchmarking survey indicates that category management is one of the most important industry issues (Valkenburgh 2000). Both researchers and practitioners have realized the growing importance of category management. It is valued as “the current and logical step in the evolution of the retailer buying function”, since categories should be treated as “strategic business units for the purpose of planning and achieving sales and profit goals” (Progressive Grocer 1993).

To implement category management, a retailer often partners with a leading national brand and gives the manufacturer of this brand significant decision-making authority over the product category (Gruen and Shah 2000). This national-brand manufacturer is called the category captain. For example, Warner Home Video is reported to be the category captain for K-Mart in the home-video category (Scally 1998). Stanley is designated as the category captain for Wal-Mart in the hand tool and toolbox categories (PR Newswire 2001). An industry study outlines that Procter & Gamble served as the captain in category management in 55% of retailers surveyed and Kraft as the captain in 31% of the retailers surveyed. Among retailers, Wal-mart and Safeway are the top participants in the practice of category management (Frozen Food Age 2001).

While the practice of using category captains has become popular in the retailing industry, it is not without controversy. On one hand, managerial practice in the grocery industry has shown that using category captains for category management has a potential for achieving higher profits and category sales (Nielsen Marketing Research
and American Marketing Association 1992). For instance, Campbell Soup states that by implementing the practice of category management at retail chains and acting as the category captain, it has seen retailers grow category sales by as much as 18% and profits by as much as 12% over a 52-week period (Supermarket Business 1997). On the other hand, some retailers are uncertain about the effectiveness of using a category captain for category management in helping sales and profits because of the potential downside of “charging manufacturers for the ‘privilege’ of being the category captain, thus completely dismantling the collaborative effort that the category management process was developed to foster in the first place” (Dusek 1999). The objective of this research is to conduct a formal model-based examination on the choice and consequences of having a category captain in category management. A better understanding of this practice can help more retailers successfully implement this important channel innovation.

Prior research (e.g., Basuroy et al 2001, Chen et al 1999, Dhar et al 2001, Zenor 1994) primarily examines category management with respect to the transition from a brand focus to a category focus. Emphasizing this transition highlights the fundamental difference between brand management and category management. In Basuroy et al (2001), a two-retailer two-manufacturer setting is employed to investigate the impact of this transition on retailers’ prices and performance. Chen et al (1999) examine the profit impact cross product categories in a decision support modeling framework. Zenor (1994) examines pricing decisions with respect to the individual manufacturer’s own multi-brand product line. In contrast to Zenor’s work, our focus in this paper is on pricing decisions from the retailer’s viewpoint, which is in line with Basuroy et al (2001). The issue of using a category captain for category management has not been the focus of prior research. ²

More specifically, we are interested in tackling the following critical questions:

- Is it profitable for the retailer to delegate pricing authority to one manufacturer?

²Gruen and Shah (2000) empirically examined antecedents to objectivity and implementation of category management relationship between retailers and category captains.
• What categories are most suitable for using a category captain for category management?

• Which manufacturer should the retailer partner with?

Complementary to the above main questions, the consequences of using a category captain on profits, sales, and share outcomes of the manufacturers, the impact on the retailer’s sales and profits, and the impact on consumers are also examined.


In the context of a multiple-manufacturer single-retailer setting, we develop a stylized Stackelberg model to examine the pricing-authority delegation to a category captain. In a single-manufacturer single-retailer setting, it has been shown in Jeuland and Shugan (1983) that delegating pricing authority to the manufacturer (or the retailer) can result in higher profits for the channel. A potentially important insight from our model (and one that may be counter to conventional wisdom) is that delegating pricing authority to one manufacturer even when a competing manufacturer exists can be profitable for all parties.

The subsequent sections are organized as follows. §2 describes the basic modeling framework. We model the cases before versus after introducing a category captain in category management and solve for the equilibrium solutions. §3 presents the impact of category characteristics on the profitability of having a category captain. §4 presents the impact of having a category captain on various channel members. §5 investigates the issue of which manufacturer is the ideal category captain for the retailer. §6 extends
the modeling framework. §7 summarizes our results, contrasts using a category captain with implementing vertical integration, and outlines the limitations of our study and directions for future research.

2 Modeling Framework

We consider a market consisting of $k$ ($k \geq 2$) competing national brands, NB1, NB2, ..., NB$k$, produced by manufacturers 1, 2, ..., $k$, respectively. The $k$ brands belong to a mature product category. All brands are available to consumers in a common retail outlet. The retailer’s objective is to maximize the total profits from selling the $k$ brands to consumers. Each channel member is an independent profit center. Figure 1 shows the channel structure used in this study.

![Figure 1 About Here](image)

The decision variables are prices. In game-theoretical models, both prices and quantities can be the decision variables. The implications when quantities are the decision variables may be different from those obtained by assuming prices as the decision variables (see Moorthy (1995) for a detailed review). Since the primary concern of our study is to examine pricing decisions, we treat prices as decision variables. Before having a category captain, the retailer maximizes the category profits by choosing retail prices for all brands; and each manufacturer maximizes its own profits by choosing its own wholesale price. After having a category captain, the retailer partners with one manufacturer.

---

3 Competition among retailers is not modeled. The focus of our model is on manufacturer-level competition and retailer-manufacturer relationship. We rule out the retail-level competition as an alternative rationale for introducing a category captain for category management.

4 Our model focuses on one product category. We do not model other product categories in the retail outlet. Substitution and supplementation effects across product categories are assumed to be at a negligible level.
This manufacturer serves as the category captain, who is responsible for making pricing decisions of the category for the retailer. 

2.1 Before Using a Category Captain

The retailer and manufacturers play a two-stage Stackelberg price game (e.g., Choi 1991, Coughlan 1985, McGuire and Staelin 1983). The manufacturers are the Stackelberg leaders, and the retailer is the follower. The two-stage game is as follows. In the first stage, the manufacturers choose wholesale prices simultaneously to maximize their own profits, taking into account the response functions of the retailer. In the second stage, given the wholesale prices, the retailer chooses retail prices to maximize the total profits from all brands.

2.1.1 Demand and Cost Structures

In conformity with previous channel research, the market demand of each brand is assumed to be jointly determined by the retail prices of the $k$ national brands:

$$q_i = \frac{1}{k}[1 - p_i + \frac{1}{k-1}\sum_{j \neq i}^{k} \theta(p_j - p_i)]$$ (1)

where $q_i$ and $p_i$ are the demand and retail price of brand $i$, $(i = 1, 2, ..., k)$, respectively. \(\theta \in (0, 1)\) is the cross-price sensitivity or substitutability measure. The demand structure follows the formations in McGuire and Staelin (1983), Choi (1991), Ingene and Parry (1995), and Raju, Sethuraman and Dhar (1995). The demand structure has one term that contains the effect of the price of the focal brand $i$ and another term that captures

---

5The pricing-authority delegation can be full or partial. To begin with, we consider the case of full delegation. Partial delegation is examined as a model extension.

6The formulation of this game rule, that retailer sets retail prices after the manufacturers have chosen wholesale prices, does not assume that manufacturers have dominance over the retailer in the market. This game rule has been widely employed in the literature. Sudhir (2001) finds empirical support for the Manufacturer-Stackelberg rule, which reflects the institutional reality of the timing of the game.
the effect of the price differences between competing brands and the focal brand. One desirable aspect is that such a demand structure is consistent with the individual utility maximization behavior (Shubik and Levitan 1980). It is however possible that different underlying utility functions will have different demand functions (Lee and Staelin 2000).

Here, $\theta$ represents the effect of price differences between brand $i$ and all other $k - 1$ brands on brand $i$’s demand. This parameter captures the intensity of price competition among national brands. The sum of $k - 1$ price difference terms is divided by $k - 1$ to get the average. Although all $k$ national brands belong to the same product category, they are differentiated to a certain degree. The degree of differentiation is characterized by the magnitude of the cross-price sensitivity measure, $\theta$. This measure has been adopted in previous studies as a parsimonious way of incorporating the substitutability between two brands. If $\theta$ equals zero, the demand of NB$i$ is independent of the price of NB$j$, where $j \neq i$. This corresponds to the case where the $k$ brands are entirely differentiated, and there is no price competition among them.\footnote{In Equation (1), both own-price sensitivity and cross-price sensitivity are symmetric across brands. The case involving asymmetric price sensitivity is considered later in this paper.}

The marginal cost of each brand is normalized to zero. This assumption will be relaxed later, when we examine which manufacturer is the ideal category captain for the retailer. The retailer’s marginal cost equals the wholesale price. Fixed cost is zero.\footnote{Fixed cost is relevant to the market entry decision, but irrelevant to the interior solution of a profit maximization problem, provided that the entry decision has been made. Fixed cost is then treated as sunk cost. In order to isolate the impact of pricing decisions from that of other activities, costs associated with inventory, shipping, and assortment are not considered.}

\subsection*{2.1.2 Profit Maximization Problems}

Conditional on the wholesale prices $w_1, w_2, ..., w_k$, the retailer chooses the retail prices $p_1, p_2, ..., p_k$ to maximize the category profits

$$\Pi^b_r = \sum_{i=1}^{k} (p_i - w_i)q_i, \quad (2)$$
where \( r \) represents the retailer, and \( b \) represents before using a category captain for category management. Substitute equation (1) into equation (2), and then the retailer’s category profits become

\[
\Pi^b_r = \frac{1}{k} \sum_{i=1}^{k} (p_i - w_i) [1 - p_i + \frac{\theta}{k-1} \sum_{j \neq i}^{k} (p_j - p_i)],
\]

(3)

which is a function of \( p_1, p_2, ..., p_k \) and \( w_1, w_2, ..., w_k \). First-order conditions are obtained by differentiating equation (3) with respect to \( p_i \) (\( i = 1, 2, ..., k \)), respectively:

\[
\frac{\partial \Pi^b_r}{\partial p_i} = \frac{1}{k} [1 - (2p_i - w_i)(1 + \theta) + \frac{\theta}{k-1} \sum_{j \neq i}^{k} (2p_j - w_j)] = 0.
\]

(4)

Solving the \( k \) first-order conditions simultaneously, we get the retailer’s response functions

\[
\hat{p}_i = \frac{1}{2} + \frac{w_i}{2}.
\]

(5)

Substitute the best response functions into equation (1), and we have the derived demand functions \( \hat{q}_i(w_1, w_2, ..., w_k) \). Each manufacturer chooses its own wholesale price \( w_i \) to maximize its own profit

\[
\Pi_i = w_i \hat{q}_i(w_1, w_2, ..., w_k) = \frac{w_i}{k} [1 - (\frac{1}{2} + \frac{w_i}{2})(1 + \theta) + \frac{\theta}{k-1} \sum_{j \neq i}^{k} (\frac{1}{2} + \frac{w_j}{2})].
\]

(6)

Solving the \( k \) first-order conditions in equation (6) with respect to \( w_i \) (\( i = 1, ..., k \)), we get the equilibrium wholesale prices

\[
w^*_i = \frac{1}{2 + \theta},
\]

(7)

where * denotes the equilibrium solution. The equilibrium wholesale price reaches the maximal value if the national brands do not compete with each other, that is, \( \lim_{\theta \to 0} w^*_i = \frac{1}{2} \). This is consistent with the intuition that as the competition among national brands gets less intense, equilibrium wholesale prices will be driven up. Using \( w^*_i \), we get equilibrium retail prices, demand and profits.
2.2 After Using a Category Captain

Without loss of generality, the manufacturer of NB1 is assumed to be the category captain. The category captain is responsible for choosing the retail prices of the $k$ national brands. The two-stage game is as follows. In the first stage, manufacturers 2, ..., $k$ choose the wholesale price of NB2, ..., NB$k$, respectively, to maximize own profit, taking into account the response functions of the category captain. In the second stage, given the wholesale prices of NB2, ..., NB$k$, the category captain chooses the retail prices for NB1, NB2, ..., NB$k$ to maximize the category profits.

Demand and cost structures are assumed to be the same as before using a category captain. In a mature market, demand and cost structures usually are quite stable. This assumption rules out the impact of structural nonstationarity in demand and cost on pricing decisions. Serving as the category captain for category management, NB1 chooses retail prices $p_1, p_2, ..., p_k$ to maximize joint profits of the product category

$$\Pi_{\text{joint}}^a = p_1 q_1 + \sum_{i=2}^{k} (p_i - w_i) q_i, \tag{8}$$

where “joint” denotes the joint profits of the retailer and the category captain, $a$ denotes after having a category captain, $p_1 q_1$ is the profit from selling NB1, and $(p_i - w_i) q_i$ is the profit from selling NB$i$, where $i = 2, ..., k$. Substitute equation (1) into equation (8), and then the joint profits become

$$\Pi_{\text{joint}}^e = \frac{p_1}{k} [1 - p_1 + \frac{\theta}{k - 1} \sum_{j \neq 1}^k (p_j - p_1)] + \frac{1}{k} \sum_{i=2}^{k} (p_i - w_i) [1 - p_i + \frac{\theta}{k - 1} \sum_{j \neq i}^k (p_j - p_i)]. \tag{9}$$

Differentiating equation (9) with respect to $p_1$ and $p_i$, where $i = 2, ..., k$, we get $k$ first-order conditions

$$\frac{\partial \Pi_{\text{joint}}^e}{\partial p_1} = 1 - 2(1 + \theta)p_1 + \frac{\theta}{k - 1} \sum_{j \neq 1}^k (2p_j - w_j) = 0, \tag{10}$$

$$\frac{\partial \Pi_{\text{joint}}^e}{\partial p_i} = 1 + \frac{\theta}{k - 1} [2p_1 + \sum_{j \neq 1, i}^k (2p_j - w_j)] - (1 + \theta)(2p_i - w_i) = 0. \tag{11}$$
Solving them simultaneously gives the best response functions of the category captain
\[ \hat{p}_1 = \frac{1}{2}, \hat{p}_i = \frac{1}{2} + \frac{w_i}{2}. \quad (12) \]
Substituting the best response functions into equation (1), we then get the derived demand functions, \( \hat{q}_1(w_2, \ldots, w_k) \) and \( \hat{q}_i(w_2, \ldots, w_k) \), where \( i = 2, \ldots, k \). Manufacturer \( i \) \( (i = 2, \ldots, k) \) chooses its wholesale price \( w_i \) to maximize its own profit:
\[ \Pi^o_i = w_i \hat{q}_i(w_2, \ldots, w_k). \quad (13) \]
Solving the \( k - 1 \) first-order conditions of equation (13) with respect to \( w_i \) \( (i = 2, \ldots, k) \), we get the equilibrium wholesale prices
\[ w_i^* = \frac{k - 1}{k(2 + \theta) - 2}. \quad (14) \]
Using \( w_i^* \), we get the equilibrium retail prices, demand, and profits. Table 1 summaries the equilibrium solutions before and after category management.

<table>
<thead>
<tr>
<th>Table 1 About Here</th>
</tr>
</thead>
</table>

### 2.3 Is It Profitable to Use a Category Captain?

Denote the gain in joint profits for the retailer and the category captain (NB1) as \( \Delta \Pi_{\text{joint}}^* = \Pi_{\text{joint}}^{a*} - \Pi_{\text{joint}}^{b*} \), where \( \Pi_{\text{joint}}^{a*} \) and \( \Pi_{\text{joint}}^{b*} \) represent the equilibrium joint profits after and before using a category captain, respectively. From Table 1 we have
\[ \Delta \Pi_{\text{joint}}^* = \frac{4(k - 1)^2 + 4(k - 1)(3k - 2)\theta + (7 - 17k + 11k^2)\theta^2 + (k - 1)(3k - 1)\theta^3}{4k(2 + \theta)^2(2k + k\theta - 2)^2}, \quad (15) \]
which is strictly positive, \( \forall k \geq 2 \) and \( \theta \in (0, 1) \). Hence, we have Proposition 1.
Proposition 1 Using a category captain for category management increases the joint profits of the product category for the retailer and the category captain.

The incremental joint profits come from two sources: the joint profit gain from the category captain’s brand (denoted as $G_{captain} > 0$), and the joint profit loss from selling other national brands (denoted as $L_{others} < 0$). That is, $\Delta \Pi_{joint} = G_{captain} + L_{others}$. Because $G_{captain} > |L_{others}|$, $\Delta \Pi_{joint} > 0$. In words, since the gain from the category captain’s brand is sufficient to compensate for the loss from other national brands, the overall joint profit gain is positive.

Combining Channel Coordination and Competition Effects: A more intuitive approach to look at Proposition 1 is to separate out the profit impact of using a category captain into two effects:

- The channel coordination effect, and
- The competition effect.

The retailer and the category captain are influenced by competition from other brands. If there are no other brands, the profit gain comes entirely from the gain from the captain’s brand. That is, the profit gain is only influenced by the coordination between the retailer and the captain (e.g., Jeuland and Shugan 1983). In the presence of other brands, the profit gain is influenced by both channel coordination and competition.

The joint profit gain with only the coordination effect is derived by holding other brands’ retail prices ($p_2, ..., p_k$) and wholesale prices ($w_2, ..., w_k$) the same as before having a category captain. It can be shown that the profit gain for the retailer and the category

\[ G_{captain} = p_{a1}q_{a1} - p_{b1}q_{b1} > 0, \]

\[ L_{others} = \sum_{i=2}^{k} [(p_{ai} - w_{ai})q_{ai} - (p_{bi} - w_{bi})q_{bi}] < 0, \]

where $a$ and $b$ denote after and before having a category captain, respectively.
captain is positive when there is only the coordination effect. The retailer and the category captain however would have a greater gain for the captain’s brand but also have a greater loss from other brands, when there is only the coordination effect (for details see Appendix A). The intuition is that, competition among manufacturers makes it more difficult for the retailer and the category captain to gain profits from the captain’s brand, while mitigating the loss from other brands. Furthermore, the loss mitigated from other brands is more than the gain reduced from the captain’s brand, and as a result the overall effect of competition is an increase in the joint profit gain for the retailer and the category captain. Thus, both the channel coordination effect and the competition effect have a positive impact on the joint profit gain. Consequently, combining the two channel effects leads to the proposition that the joint profit gain for the retailer and the category captain is positive.

2.4 Identifying Characteristics of Categories that are Most Suitable for Using a Category Captain

In this section, we examine why certain categories may be more conducive to the use of a category captain for category management. The category characteristics we study include the number of national brands, cross-price sensitivity, marginal costs of national brands, and the presence of a store brand.

**Number of National Brands:** The joint profit gain is plotted in Figure 2. For a fixed level of $\theta$, Figure 2 suggests that the joint profit gain becomes smaller as $k$ increases. We show analytically that $\frac{\partial (\Delta \Pi^*_{\text{joint}})}{\partial k} < 0$. The result leads to Proposition 2.
**Proposition 2** Other things being equal, the profitability of using a category captain for category management is higher if the product category has fewer national brands.

The joint profit gain from selling the category captain’s brand decreases as \( k \) increases \((\partial G_{\text{captain}}/\partial k < 0)\). The joint profit loss from selling other national brands also decreases as \( k \) increases \((\partial |L_{\text{others}}|/\partial k < 0)\). Because the decrease in the gain is greater than the decrease in the loss \((|\partial G_{\text{captain}}/\partial k| > |\partial |L_{\text{others}}|/\partial k|)\), the joint profit gain of the entire category goes down as \( k \) increases. The intuition behind this result is that the category captain has limited power to influence a market consisting of a large number of competing brands.

**Cross-Price Sensitivity:** Figure 2 also suggests that the joint profit gain generally becomes larger as \( \theta \) increases, given a fixed \( k \). Specifically, higher \( \theta \) leads to a higher joint profit gain when the cross-price sensitivity is below a critical level \( \overline{\theta} \), if \( k = 2, 3 \); higher \( \theta \) leads to a higher joint profit gain, if \( k \geq 4 \). The critical level of cross-price sensitivity is approximately 0.58 for \( k = 2 \), and 0.89 for \( k = 3 \). The result is summarized in Proposition 3.

**Proposition 3** Other things being equal, the profitability of using a category captain for category management is higher if the product category has a higher cross-price sensitivity among national brands when \( k = 2, 3 \) and \( \theta < \overline{\theta} \) or when \( k \geq 4 \).

The joint profit gain from selling the category captain’s brand increases as \( \theta \) increases \((\partial G_{\text{captain}}/\partial \theta > 0)\). The joint loss from selling other national brands also increases as \( \theta \) increases \((|\partial L_{\text{others}}|/\partial \theta > 0)\). When \( k = 2, 3 \) and \( \theta < \overline{\theta} \), the increase in the gain is more than the increase in the loss. The increase in the gain is not enough to compensate for the increase in the loss, if \( \theta \) is above the critical level when \( k = 2, 3 \). Joint profit gain always increases as \( \theta \) increases when \( k \geq 4 \). This means that the category captain has
a stronger leverage over other national brands as the competition among them becomes intense. However, if the competition is too intense for a very small set of competitors, the profitability becomes lower as \( \theta \) increases (due to an overwhelming loss from selling other brands).

**Marginal Costs:** In the above analysis, the marginal cost of each national brand is assumed to be zero. If the marginal cost \( c \) is greater than zero and is not prohibitively high such that the demand is always positive, we obtain the following proposition.

**Proposition 4** When the marginal cost of national brands is lower, using a category captain for category management is more profitable.

The intuition is as follows. When the marginal cost of national brands is lower, it is less difficult for national-brand manufacturers to cut wholesale prices. This helps widen retail margins and increase joint profits for the retailer and the category captain. In other words, joint profit gain for the retailer and the category captain would be limited if the national-brand manufacturers are constrained in wholesale margins.

**Effects of the Presence of a Store Brand:** Many retailers have store brands in a number of product categories. In the model analyzed above, only national brands are considered. When a store brand is incorporated, the demand of national brands \( q_i \) \((i = 1, 2, \ldots, k)\) and the demand of store brand \( q_s \) are assumed to be as follows:

\[
q_i = \frac{1}{k+1} \left[ 1 - p_i + \frac{1}{k} \sum_{j \neq i} \left[ \theta(p_j - p_i) + \delta(p_s - p_i) \right] \right], \tag{16}
\]

\[
q_s = \frac{1}{k+1} \left[ 1 - p_s + \frac{1}{k} \sum_{j=1}^{k} \delta(p_j - p_s) \right], \tag{17}
\]

where \( p_s \) is the price of the store brand, and \( \delta \in (0, 1) \) is a measure of cross-price sensitivity between national brand \( i \) and store brand \( s \). A high sensitivity indicates a higher degree
of competition between national brands and the store brand. The store-brand national-brand relationship is allowed to be different from the national-brand national-brand relationship. Without loss of generality, NB1 is assumed to be the category captain who is responsible for choosing the retail prices of $k$ national brands and the store brand $(p_1, p_2, ..., p_k, p_s)$ to maximize the joint profits

$$\Pi_{\text{joint}}^n = p_1 q_1 + \sum_{i=2}^{k} (p_i - w_i) q_i + p_s q_s.$$  \hspace{1cm} (18)

Other manufacturers have the same profit maximization problems as stated earlier. We use the analytical method of the previous section to obtain the equilibrium solutions before and after having a category captain (for details see Appendix B). \textit{With a store brand}, the gain in joint profits for the retailer and NB1 is

$$\Delta \Pi_{\text{joint}}^* = k[4(k+\delta)^3 + 4(3k-2)(k+\delta)^2\theta + (7 - 17k + 11k^2)(k + \delta)\theta^2 + (k - 1)^2(3k - 1)\theta^3]/[4(1 + k)(2k + 2\delta + k\theta)(2k + 2\delta - \theta + k\theta)^2].$$ \hspace{1cm} (19)

Propositions 1 and 2 still hold in the presence of a store brand. It is easy to show that with a store brand, a higher cross-price sensitivity among national brands leads to a higher joint profit gain, and thus Proposition 3 becomes stronger. The intuition is that the presence of the store brand mitigates the competition among national brands, and the overwhelming loss from selling other brands is reduced. We also show that lower cross-sensitivity between national brands and the store brand leads to a higher joint profit gain ($\partial \Delta \Pi_{\text{joint}}^*/\partial \delta < 0$). Hence, we have Proposition 5.

**PROPOSITION 5** Other things being equal, the profitability of using a category captain for management is higher if the product category has a lower cross-price sensitivity between national brands and the store brand.

The incremental joint profits come from three sources: the joint profit gain from selling category captain’s brand ($G_{\text{captain}} > 0$), the joint profit loss from selling other national
brands($L_{\text{others}} < 0$), and the joint profit loss from selling the store brand ($L_{\text{storebrand}} < 0$).
We can show that $G_{\text{captain}}$, $|L_{\text{others}}|$, and $|L_{\text{storebrand}}|$ increase as $\delta$ increases. The intuition is that when price competition between national brands and the store brand intensifies, using a category captain for category management more significantly influences these brands. The increase in the gain is not sufficient to compensate for the increase in the two losses combined, thus the entire joint profit gain becomes smaller as $\delta$ increases.

Further, we show that joint profit gain from using a category captain without a store brand is greater than the joint profit gain from using a captain with a store brand.  
This leads to the following proposition.

**Proposition 6** The profitability of using a category captain is lower for a product category with a store brand than one without a store brand.

The joint profit gain from selling the category captain’s brand has to sufficiently compensate for the loss from selling other national brands and the loss from selling store brand. Intuitively, a product category without a store brand has a wider space to introduce a category captain. This implies that having store brands is a substitute for using category captains. Furthermore, it is potentially interesting to consider a case where the retailer has to either use a category captain or introduce a store brand. We can show that it is more profitable to use a category captain than to introduce a store brand for categories having higher competition among national brands, lower competition between national brands and the store brand, and fewer national brands (see Figure 3).

---

**Figure 3 About Here**

---

\(^{10}\)The result remains the same, if there are $k - 1$ national brands and one store brand (to allow for the number of brands in the category to be unchanged).
3 Consequences of Using a Category Captain on Channel Members

Table 2 presents changes in retail and wholesale prices, retail margins, demand at the brand and category levels, market shares, and profits.

**Category Captain’s Brand:** NB1 benefits from serving as the category captain. Although NB1’s retail price decreases, NB1 achieves higher demand. The increase in NB1’s demand is negatively associated with the number of brands in the product category, and positively associated with cross-price sensitivity $\theta$. In other words, NB1’s market share increases more when NB1 is facing a smaller set of competitors, and when national brands are more substitutable. When a store brand is introduced, NB1’s demand increases more if the cross-price sensitivity between national brands and the store brand is low. This means that NB1’s demand is likely to increase more significantly, if retailer’s store brand is positioned away from national brands. NB1’s market share increases after using a category captain for category management, and its profit increases under a feasible profit-sharing plan.

**Other Brands:** Generally, using a category captain does not benefit the national brands other than the category captain’s brand (NB$i$, $i = 2, ..., k$). NB$i$’s wholesale price, demand, market share, and its manufacturer’s profit decrease, while its retail margin goes up. This implies that other brands are under increased pressure from the channel. Later in this paper we will show that under certain conditions non-captain brands can benefit from using a competing brand as the category captain.
**Retailer and Consumers:** The retailer benefits from using a category captain for category management. Category demand increases and the retailer and the category captain’s joint profits are higher than before. Since retail prices of all brands go down, consumers as a whole are better off. The consumers purchase more units of the product category at lower prices. This is conducive to an increase in store patronage and consumer loyalty, and as a result it helps strengthen the retailer’s competitive power in the market. Thus, using a category captain for category management potentially provides an opportunity for the retailer to improve its channel position.

In summary, *using a category captain for category management benefits the category captain, retailer, and consumers. This practice generally does not benefit the manufacturers who are not designated as the category captain, but can benefit them under certain conditions. Retail prices of all brands decrease, while category demand goes up. Demand and market share for the category captain’s brand increase, while demand and market shares of non-captain brands go down.*

### 4 Who is the Ideal Category Captain?

It is important for the retailer to carefully decide which manufacturer should become the category captain. For example, K-Mart has many options. It could use Warner Home Video or partner with Sony. What makes one manufacturer more attractive than another? This issue is examined in the following general model that incorporates asymmetric sensitivity and asymmetric marginal cost for the two-brand case.

Two national-brand manufacturers differ in the base level of demand ($\alpha$ versus $1 - \alpha$), marginal cost ($c_1$ versus $c_2$), own-price sensitivity ($\eta_1$ versus $\eta_2$), and cross-price sensitivity ($\theta_1$ versus $\theta_2$). The demand structure is:

$$
q_1 = \alpha - \eta_1 p_1 + \theta_1 (p_2 - p_1),
$$

$$
q_2 = (1 - \alpha) - \eta_2 p_2 + \theta_2 (p_1 - p_2),
$$
where parameters $\alpha, \eta_1, \eta_2, \theta_1, \theta_2, c_1$ and $c_2 \in (0, 1)$. The modeling approach is the same as before.

**Choosing a Category Captain:** Either NB1 or NB2 is assumed to be the category captain. The optimal policy is obtained by comparing the joint profit gains under different category captains. The underlying premise is that the retailer should choose the category captain who has a better potential for increasing joint profits. Under a same division of the joint profit gain, *ceteris paribus*, the optimal policy for the retailer is to partner with the manufacturer who has\(^\text{11}\):

1. Higher base level of demand,
2. Lower marginal cost,
3. Lower own-price sensitivity, or

The first three rules are held for any values of the parameters under the modeling specification. The last rule is held under the sufficient condition that the own-price sensitivity is greater than the cross-price sensitivity. Overall, the optimal policy indicates that a stronger manufacturer generally is the ideal category captain.

The only surprising aspect is that the manufacturer with a higher cross-price sensitivity is more desirable. At an immediate glance, this means that it is more attractive for the retailer to partner with a national-brand manufacturer whose demand is more influenced by competing brands. The intuition behind this seemingly counterintuitive result is that the higher cross-price sensitivity conversely serves as a leverage point through which the category captain influences the market to its advantage. Specifically, before having a category captain, there exists a demand gap: the brand with a higher cross-price sensitivity

\(^{11}\text{The proofs are given in Appendix C.}\)
has a higher demand than the other brand has. If the brand with a higher cross-price sensitivity serves as the category captain, the demand of this brand is enhanced while the demand of the other brand is pressed down. This widens the demand gap. However, if the brand with a lower cross-price sensitivity serves as the captain, the demand gap tends to become smaller. The shrinkage of the demand gap is less in its magnitude than the widening of the gap. A larger demand gap adds a relative advantage to the brand with a higher cross-price sensitivity, as a change in demand is the major force that determines the profit impact of having a category captain. As a result, partnering with the brand with a higher cross-price sensitivity leads to a higher joint profit gain for the retailer and the category captain.

Alternatively, since the profit of the manufacturer of the non-captain brand is lower than before having a category captain, a category captain’s outside option may be assumed to be the profit level after using the competing brand as the captain. When NB1 is the captain, denote the joint profits of NB1 and the retailer by $\Pi_{\text{joint}}^{\text{captain}1}$, and denote the profit of NB2 by $\Pi_{\text{captain}1}^{\text{joint}}$. When NB2 is the captain, denote the joint profits of NB2 and the retailer by $\Pi_{\text{joint}}^{\text{captain}2}$ and denote the profit of NB1 by $\Pi_{\text{captain}2}^{\text{joint}}$. If the retailer has the full bargaining power, the ideal category captain is NB1, under the condition that $\Pi_{\text{joint}}^{\text{captain}1} - \Pi_{\text{captain}2}^{\text{joint}} > \Pi_{\text{joint}}^{\text{captain}1} - \Pi_{\text{captain}2}^{\text{joint}}$, where $\Pi_{\text{captain}2}^{\text{joint}}$ represents NB1’s outside option if NB2 is the captain, and $\Pi_{\text{captain}1}^{\text{joint}}$ represents NB2’s outside option if NB1 is the captain. It can be shown that the optimal policy remains the same when the retailer has the full bargaining power and category captain’s outside option is the profit level after using the competing brand as the captain.

**Demand Advantage versus Cost Advantage:** The above optimal policy gives a directional suggestion for a retailer facing two brands that differ in a single dimension. If the brands differ in more than one dimension, the optimal policy generally becomes mathematically more complicated. Here we consider one important case in more detail where the two brands differ in two dimensions: NB1 has an advantage in the base level of
demand (i.e., $\alpha > \frac{1}{2}$), and NB2 has an advantage in the marginal cost (i.e., $c_1 > c_2$). The two brands are symmetric in price sensitivity. The parameter $\alpha$ is replaced by $\frac{1}{2} + \Delta \alpha$, and the parameter $c_2$ by $c_1 - \Delta c$, where $\Delta \alpha \in (0, \frac{1}{2})$ represents NB1’s advantage in the base level of demand (or NB2’s disadvantage in the base level of demand), and $\Delta c \in (0, c_1)$ represents NB2’s advantage in the marginal cost (or NB1’s disadvantage in the marginal cost). It can be shown that NB1 is the ideal category captain if and only if

$$\Delta \alpha > (\theta + \frac{1}{2} \eta) \Delta c$$

is satisfied (for details see Appendix C). Inequality (22) shows that the advantage in the base level of demand is more important when price sensitivity is low, whereas the advantage in the marginal cost is more important when price sensitivity is high.  

In summary, the ideal category captain is the manufacturer who has a higher base level of demand, a lower marginal cost, a lower own-price sensitivity, or a higher cross-price sensitivity. When demand is less responsive to changes in price, the demand side advantage is more pronounced than cost side advantage.

5 Model Extensions

The model is extended along the following two axes:

1. The Completeness of Delegation. The retailer delegates pricing authority either fully or partially to the category captain. Under full delegation, the category captain has the authority to choose retail prices for the entire product category. Under partial delegation, the captain has the authority to choose the retail price for its own brand only.  

---

12 Inequality (22) can be shown to be the same when the retailer is assumed to have the full bargaining power and category captain’s outside option is assumed to be the profit level after using the competing brand as the category captain.

13 The retailer may be unwilling to hand over too much authority to the category captain. Alternatively, there may exist a rigid contract between the non-captain brand and the retailer such that the non-captain brand’s retail price is unchangeable.
2. The Behavior of the Non-captain Brand. The non-captain brand either behaves strategically or non-strategically. It behaves strategically if it adjusts its own wholesale price to the use of a category captain in the channel, and non-strategically if its wholesale price remains unchanged.  

We consider the two-brand case with an asymmetric base level of demand as follows

\[ q_1 = \alpha - p_1 + \theta(p_2 - p_1), \]
\[ q_2 = (1 - \alpha) - p_2 + \theta(p_1 - p_2), \]

where parameters \( \alpha, \theta \in (0, 1) \) and marginal costs are normalized to zero \( c_1 = c_2 = 0 \). NB1 is assumed to be the category captain. There are four scenarios corresponding to the four quadrants defined by the two axes (see Table 3).

**Table 3 About Here**

Scenario I: NB2 chooses \( w_2 \), taking into account the response function of NB1. Conditional on \( w_2 \), NB1 chooses \( p_1 \) and \( p_2 \) to maximize joint profits \( p_1 q_1 + (p_2 - w_2)q_2 \).

Scenario II: NB2 chooses \( w_2 \), taking into account the response function of NB1. Conditional on \( w_2 \), NB1 chooses \( p_1 \) to maximize joint profits \( p_1 q_1 + (p_2 - w_2)q_2 \), while \( p_2 \) is fixed to be the same as before having a category captain.

Scenario III: NB1 chooses \( p_1 \) to maximize joint profits \( p_1 q_1 + (p_2 - w_2)q_2 \), while \( p_2 \) and \( w_2 \) are fixed to be the same as before having a category captain.

Scenario IV: NB1 chooses \( p_1 \) and \( p_2 \) to maximize joint profits \( p_1 q_1 + (p_2 - w_2)q_2 \), while \( w_2 \) is fixed to be the same as before having a category captain.  

---

14The manufacturer of non-captain brand may be uninformed of the use of a category captain. Alternatively, there may exist a rigid contract between the non-captain’ brand and the retailer such that this brand’s wholesale price is unchanged.

15In light of the optimal response function for the category captain, having NB2’s wholesale price fixed implies that NB2’s retail price is also fixed. Scenario IV is equivalent to III in terms of market outcomes, while the two scenarios correspond to restrictions from different channel members and are institutionally distinct.
The scenario with full delegation and strategic non-captain brand is the case we modeled previously. The same modeling approach is applied to the other three scenarios. The results are summarized in Table 3. We find that using a category captain in category management is profitable under the scenarios that involve full delegation, regardless of the behavior of the non-captain brand. It is profitable with partial delegation and non-strategic non-captain brand. *It is not always profitable when the pricing authority delegation is partial and the non-captain brand is strategic* (Scenario II). This scenario is the only case where the retailer and NB1’s joint profit gain may be negative. The intuition is that the partial delegation gives less pricing authority to the category captain, whereas NB2 being strategic puts more competitive pressure on the category captain.

**Figure 4 About Here**

Figure 4 shows the contour plot of the retailer and NB1’s joint profit gain under Scenario II. It indicates that if \( \alpha < 0.5 \) and \( \theta < 0.5 \), the joint profit gain will be negative. In words, when NB1’s base level of demand does not dominate the market, and when cross-price sensitivity is moderate, using a category captain in category management will not benefit NB1 and the retailer. If NB1 has a base-level-demand dominance over NB2 (i.e., \( \alpha > 0.5 \)), using a category captain will show a positive joint profit gain, provided that cross-price sensitivity is sufficiently high.

**The Possibility of Benefiting All Parties:** As shown in Figure 5(A), the non-captain brand may benefit from using a category captain in category management under Scenario II. If the cross-price sensitivity is not sufficiently high, the manufacturer outside the category alliance (NB2) achieves a higher profit. The intuition is that if the retail price of NB2 is not under the control of the category captain and if the category captain does not have a sufficiently strong leverage over the market, NB2 can strategically choose
an optimal wholesale price to benefit even when the competing brand is designated as the category captain. As shown in Figure 5(B), there exists a region denoted by (++) where the retailer and NB1’s joint profit gain and NB2’s profit gain are positive.

\[ \text{Figure 5 About Here} \]

In summary, using a category captain in category management achieves higher joint profits with full delegation (regardless of the behavior of the non-captain brand) or with partial delegation when the non-captain brand is non-strategic. When the non-captain brand is strategic, using a category captain is not always profitable with partial delegation. There exists a parametric region where all parties including the competing non-captain brand achieve higher profits.

6 Summary, Discussion, Limitations and Future Research

We proposed a model-based framework that allows retailers gain a better understanding of the practice of using category captains. Our analysis suggests that this practice can in fact benefit retailers and those who they choose to be category captains. We also identified situations where the practice can benefit all parties. Our model allows retailers to explore what categories are most suitable for adoption of this practice and also what makes one manufacturer a better channel captain than the other. One of the main insights is that using a category captain allows for better channel coordination and also allows the retailer to take advantage of competition effects thereby enhancing the overall profitability.
We have not directly addressed the issue of how precisely the gains from the using a category captain will be split between the category captain and the retailer. Theoretically, the possible ways of dividing joint profits are infinite, depending on the bargaining power of players (Nash 1950). Researchers can draw upon the work of Jeuland and Shugan (1983) on specific ways to share the gains that keep in mind the relative strengths of the two parties.

Using a category captain for category management bears some resemblance to vertical integration: both imply that two parties join hands together to increase profits. If there is only one national brand, using a category captain in our model is mathematically equivalent to vertical integration. They are not strategically equivalent, however. First, using a category captain in category management focuses on the alliance at the product category level. A product category is only a fraction of the whole business. Integration focuses on merging at the level of the entire business operation. Second, after having a category captain, the competing national brands are still available in the store, although the manufacturers of these brands are outside of the category-level alliance. Third, using a category captain is likely to be more flexible in authority delegation formats. Fourth, since the use of a category captain benefits consumers, antitrust concerns become less serious here than in the case of vertical integration.

While the demand functions used in our research have some basis in utility theory, and the implications based on these demand functions seem to be consistent with market data in other studies, it is important to recognize that the assumed demand equations are linear, deterministic and time-invariant. Our main consideration lies in the simplicity of showing the key idea of using a category captain for category management. Linear demand functions have been used extensively in the literature. They often capture the gist of a bigger picture in a parsimonious way and give tractable insights that are directionally meaningful, and the deterministic, time-invariant demand equations are more suitable for

---

16See Coughlan (1985) and Choi (1991) for examples of using nonlinear demand functions in distribution channels.
mature product categories. Future research can examine cases involving random demand and random price sensitivity. Second, marginal cost is assumed to be constant. If there exist economies of scale or scope, the cost structures should be modified accordingly. Numerical methods can be used to derive equilibrium solutions. Third, the decision variables are prices. Category management involves decisions on multiple dimensions such as advertising, self-space allocation, and product quality control. Our model does not incorporate these considerations that constitute promising future research opportunities.

While we do not claim that our model and results offer the answer to all questions related to using a category captain for category management, we do believe that our approach has adequately captured the central idea of the managerial practice, and the results can be relevant to the academic and managerial communities.
References


Appendices

A Coordination and Competition Effects

The joint profit gain with only coordination effect is derived by holding other brands’ retail prices \((p_2, \ldots, p_k)\) and wholesale prices \((w_2, \ldots, w_k)\) the same as before having a category captain. First, we show that the demand of the category captain’s brand would be higher if there is no competition effect. The NB 1’s demand with only coordination effect is

\[
q_{1}^{\text{coor}} = \frac{1}{k}[1 - p_1^a + \frac{1}{k-1} \sum_{j \neq 1} \theta(p_j - p_1^a)]
\]  

(25)

where superscript \(\text{coor}\) denotes with only coordination effect. Since \(p_1^a > p_j^a\) \((j \neq 1)\), \(q_{1}^{\text{coor}} > q_{1}^a = \frac{1}{k}[1 - p_1^a + \frac{1}{k-1} \sum_{j \neq 1} \theta(p_j - p_1^a)]\). Second, we show that the demand of other brands would be lower if there is no competition effect. The demand for national brand \(j\) (where \(j = 2, \ldots, k\)) with only coordination effect is

\[
q_{j}^{\text{coor}} = \frac{1}{k}[1 - p_j^b + \frac{1}{k-1}(\theta(p_1^j - p_j^b) + \sum_{j' \neq j} \theta(p_{j'} - p_j^b)))]
\]  

(26)

where \(j' \neq j\) and \(j' \neq 1\) represents all other national brands other than the focal brand \(j\) and NB1. Since \(p_j^b > p_j^a\), \(p_j^b = p_j^a\) and \(p_j^b = p_1^a\), \(q_{2}^{\text{coor}} < q_{1}^a = \frac{1}{k}[1 - p_j^a + \frac{1}{k-1}(\theta(p_1^j - p_j^a) + \sum_{j' \neq j} \theta(p_{j'} - p_j^a)))]\). Third, we show that the retailer and the category captain would have a greater gain for the captain’s brand but also have a greater loss from other brands, when there is no competition effect. The retailer and NB1’s joint profit with only coordination effect is

\[
\Pi_{\text{joint}}^{\text{coor}} = q_{1}^{\text{coor}}p_1^a + \sum_{j=2}^{k} q_{j}^{\text{coor}}(p_j^b - w_j^b).
\]  

(27)

Since \(q_{1}^{\text{coor}} > q_{1}^a\), \(q_{1}^{\text{coor}}p_1^a > q_{1}^ap_1^a\), that is, the captain’s will generate higher profits if there is only coordination effect. Since \(p_j^b - w_j^b < p_j^a - w_j^a\) and \(q_{j}^{\text{coor}} < q_{j}^a\), \(\sum_{j=2}^{k} q_{j}^{\text{coor}}(p_j^b - w_j^b) < \sum_{j=2}^{k} q_{j}^a(p_j^a - w_j^a)\), which shows that the joint profits from other brands are lower with only coordination effect. Therefore, we have \(G_{\text{captain}}^{\text{coor}} > G_{\text{captain}}\) and \(|L_{\text{captain}}^{\text{coor}}| > |L_{\text{captain}}|\).

Denote \(\Delta_{\text{captain}}^{\text{comp}} = G_{\text{captain}}^{\text{coor}} - G_{\text{captain}} > 0\) and \(\Delta_{\text{other}}^{\text{comp}} = |L_{\text{other}}^{\text{coor}}| - |L_{\text{other}}| > 0\). \(\Delta_{\text{captain}}^{\text{comp}}\) represents the deduction of profit gain from the captain’s brand due to competition effect. \(\Delta_{\text{other}}^{\text{comp}}\) represents the loss mitigated from other brands due to competition effect. Thus, we can decompose the total joint profit gain \(\Delta \Pi_{\text{joint}}\) as

\[
\Delta \Pi_{\text{joint}} = G_{\text{captain}} + L_{\text{other}} = (G_{\text{captain}}^{\text{coor}} - \Delta_{\text{captain}}^{\text{comp}}) + (L_{\text{other}}^{\text{coor}} + \Delta_{\text{other}}^{\text{comp}})
\]

\[
= (G_{\text{captain}}^{\text{coor}} + L_{\text{other}}^{\text{coor}}) + (\Delta_{\text{other}}^{\text{comp}} - \Delta_{\text{captain}}^{\text{comp}})
\]

\[
= \text{Coordination gain} + \text{competition gain}.
\]  

(28)
where it can be shown that both $G_{\text{coor}}^{\text{captain}} + L_{\text{others}}^{\text{coor}}$ and $\Delta_{\text{others}}^{\text{comp}} - \Delta_{\text{captain}}^{\text{comp}}$ are greater than zero. Thus, the overall joint profit gain when there is only coordination (i.e., $(G_{\text{coor}}^{\text{captain}} + L_{\text{others}}^{\text{coor}})$ will be less than that the gain when there exist both coordination and competition effects (i.e., $\Delta \Pi_{\text{joint}}$). The fact that the competition gain is positive implies that the competition from other brands is beneficial for the retailer and the category captain.

B  Effects of the Presence of a Store Brand

B.1 Before Using a Category Captain

Conditional on the wholesale prices, the retailer chooses the retail prices $p_1, p_2, ..., p_k$, and $p_s$ to maximize the category profits

$$\Pi^b_r = \sum_{i=1}^{k} (p_i - w_i)q_i + p_s q_s.$$  \hfill (29)

Substitute equations (16) and (17) into equation (29), and then the retailers category profits become

$$\Pi^b_r = \frac{1}{k+1} \sum_{i=1}^{k} (p_i - w_i)[1 - p_i + \frac{1}{k} \sum_{j \neq i}^k \theta(p_j - p_i) + \delta(p_s - p_i)] + \frac{p_s}{k+1} [1 - p_s + \frac{1}{k} \sum_{j=1}^{k} \delta(p_j - p_s)].$$ \hfill (30)

First-order conditions are obtained by differentiating equation (30) with respect to $p_i$ ($i = 1, 2, ..., k$) and $p_s$, respectively. Solving the $k+1$ first-order conditions simultaneously, we get the retailer’s response functions $\hat{p}_i = \frac{1}{2} + \frac{w_i}{2}$, and $\hat{p}_s = \frac{1}{2}$, which lead to the derived demand functions $\hat{q}_i(w_1, w_2, ..., w_k)$. Each manufacturer chooses its own wholesale price $w_i$ to maximize its own profit $\Pi_i = w_i \hat{q}_i(w_1, w_2, ..., w_k)$. Solving the $k$ first-order conditions with respect to $w_i$ ($i = 1, ..., k$), we get the equilibrium wholesale prices $w_i^* = \frac{k}{k(2+\theta)+2\delta-\theta}$. Using $w_i^*$, we get equilibrium retail prices, demand and profits.

B.2 After Using a Category Captain

The category captain chooses $p_1, p_2, ..., p_k$, and $p_s$ to maximize the joint profits

$$\Pi^a_{\text{joint}} = p_1 q_1 + \sum_{i=2}^{k} (p_i - w_i)q_i + p_s q_s.$$ \hfill (31)
Substitute equations (16) and (17) into equation (31), and then the joint profits become

\[
\Pi_{\text{joint}}^a = \frac{p_1}{k+1}[1-p_1 + \frac{1}{k} \sum_{j \neq 1} [\theta(p_j - p_1) + \delta(p_s - p_1)]] \\
+ \frac{1}{k+1} \sum_{i=2}^{k} (p_i - w_i)[1-p_i + \frac{1}{k} \sum_{j \neq i} [\theta(p_j - p_i) + \delta(p_s - p_i)]] \\
+ \frac{p_s}{k+1}[1-p_s + \frac{1}{k} \sum_{j=1}^{k} \delta(p_j - p_s)].
\]  
(32)

First-order conditions are obtained by differentiating equation (30) with respect to \( p_1, p_i \) (\( i = 2, \ldots, k \)) and \( p_s \), respectively:

\[
\frac{\partial \Pi_{\text{joint}}^a}{\partial p_1} = k - 2(k + \delta - \theta + \theta k)p_1 + 2\delta p_s + \theta \sum_{j=2}^{k} (2p_j - w_j) = 0,  
\]  
(33)

\[
\frac{\partial \Pi_{\text{joint}}^a}{\partial p_i} = k + 2\theta p_1 - (k + \delta - \theta + \theta k)(2p_i - w_i) + 2\delta p_s + \theta \sum_{j \neq 1, i}^{k} (2p_j - w_j) = 0 ,  
\]  
(34)

\[
\frac{\partial \Pi_{\text{joint}}^a}{\partial p_s} = k - 2k(1 + \delta)p_s + 2\delta p_1 + \delta \sum_{j=2}^{k} (2p_j - w_j) = 0.  
\]  
(35)

Solving the \( k + 1 \) first-order conditions simultaneously, we get the retailer’s response functions \( \hat{p}_1 = \frac{1}{2}, \hat{p}_i = \frac{1}{2} + \frac{w_i}{2}, (i = 2, \ldots, k), \) and \( \hat{p}_s = \frac{1}{2} \), which lead to the derived demand functions. Each manufacturer \( i \) (\( i = 2, \ldots, k \)) chooses its own wholesale price \( w_i \) to maximize its own profit \( \Pi_i = w_i \hat{q}_i(w_2, \ldots, w_k) \). Solving the \( k - 1 \) first-order conditions with respect to \( w_i \) (\( i = 2, \ldots, k \)), we get the equilibrium wholesale prices \( w_i^* = \frac{k}{k(2+\theta)+2\delta} \). Using \( w_i^* \), we get equilibrium retail prices, demand and profits.

**C  Who is the Ideal Category Captain?**

Let the joint profit gain when NB1 is the category captain be \( \Delta \Pi_{\text{joint}}^{\text{captain}1} \), and the joint profit gain when NB2 is the category captain be \( \Delta \Pi_{\text{joint}}^{\text{captain}2} \).

**Case 1: NB1 has a higher base level of demand.**

If \( \alpha > \frac{1}{2}, \theta_1 = \theta_2 = \theta, \eta_1 = \eta_2 = \eta, c_1 = c_2 = c \), we can show \( \Delta \Pi_{\text{joint}}^{\text{captain}1} - \Delta \Pi_{\text{joint}}^{\text{captain}2} = \frac{3(2\alpha - 1)(1 - 2c\eta)(\eta + \theta)}{16(\eta + \theta)^2} \). Notice that category sales before having a category captain \( = \frac{(1 - 2c\eta)(\eta + \theta)}{2(\eta + \theta)^2} \), which is strictly positive, and this implies that \( 1 - 2c\eta > 0 \). Since \( \alpha > \frac{1}{2} \), we have
\(\Delta \Pi_{\text{captain}} - \Delta \Pi_{\text{junior}} > 0\). Thus, if NB1 has a higher base level of demand, NB1 should be the category captain.

**Case 2: NB1 has a higher marginal cost.**

If \(c_1 > c_2, \theta_1 = \theta_2 = \theta, \eta_1 = \eta_2 = \eta, \alpha = \frac{1}{2}\), we can show that \(\Delta \Pi_{\text{captain}} - \Delta \Pi_{\text{junior}} = -\frac{(\eta + \theta)(c_1 - c_2)(1 - \eta c_1 - \eta c_2)}{2(\eta + \theta)}\). Notice that the category sales before having a category captain is \(\frac{(\eta + \theta)(1 - \eta c_1 - \eta c_2)}{2(\eta + \theta)}\), which is strictly positive, and this implies that \(1 - \eta c_1 - \eta c_2 > 0\). Since \(c_1 > c_2\), we have \(\Delta \Pi_{\text{captain}} - \Delta \Pi_{\text{junior}} < 0\). Thus, if NB1 has a higher marginal cost, NB2 should be the category captain.

**Case 3: NB1 has a higher own-price sensitivity.**

If \(\eta_1 > \eta_2, \theta_1 = \theta_2 = \theta, c_1 = c_2 = c, \alpha = \frac{1}{2}\), we can show that \(\Delta \Pi_{\text{captain}} - \Delta \Pi_{\text{junior}} = -\frac{(\eta_1 - \eta_2)(1 + 4c_\theta - 4c_\theta^2(\eta_1 + \eta_2 + \eta_1 \eta_2))}{64(\theta + \eta_1)(\theta + \eta_2)}\). Solving \(1 + 4c_\theta - 4c_\theta^2(\eta_1 + \eta_2 + \eta_1 \eta_2) = 0\), we have

\[c = \frac{\theta + \sqrt{\theta + \eta_1 \sqrt{\theta + \eta_2}}}{2(\eta_1 + \eta_2 + \eta_1 \eta_2)}, \text{ and } \frac{\theta - \sqrt{\theta + \eta_1 \sqrt{\theta + \eta_2}}}{2(\eta_1 + \eta_2 + \eta_1 \eta_2)}.\]

Thus, we only need to consider \(\frac{\theta + \sqrt{\theta + \eta_1 \sqrt{\theta + \eta_2}}}{2(\eta_1 + \eta_2 + \eta_1 \eta_2)}\). Notice that NB2’s wholesale price when NB2 is the category captain is \(\frac{1 + 4c_\theta - 2c_\theta \eta_1}{4(\theta + \eta_1)}\), which must be greater than \(c\), and this implies that \(c < \frac{1}{2\eta_1}\). Since \(\eta_1 > \eta_2\),

\[\frac{\theta + \sqrt{\theta + \eta_1 \sqrt{\theta + \eta_2}}}{2(\eta_1 + \eta_2 + \eta_1 \eta_2)} - \frac{1}{2\eta_1} = \frac{-\theta \eta_2 - \eta_1 \eta_2 + \eta_1 \sqrt{\theta + \eta_1 \sqrt{\theta + \eta_2}}}{2\eta_1(\theta + \eta_2 + \eta_1 \eta_2)} > \frac{-\theta \eta_2 - \eta_1 \eta_2 + \eta_1 \sqrt{\theta + \eta_1 \sqrt{\theta + \eta_2}}}{2\eta_1(\theta + \eta_2 + \eta_1 \eta_2)} > 0.\]

Thus, we have \(c < \frac{1}{2\eta_1} < \frac{\theta + \sqrt{\theta + \eta_1 \sqrt{\theta + \eta_2}}}{2(\eta_1 + \eta_2 + \eta_1 \eta_2)}\). Consequently, \(\Delta \Pi_{\text{captain}} - \Delta \Pi_{\text{junior}} < 0\). Thus, if NB1 has a higher own-price sensitivity, NB2 should be the category captain.

**Case 4: NB1 has a higher cross-price sensitivity.**

If \(\theta_1 > \theta_2, \eta_1 = \eta_2 = \eta, c_1 = c_2 = c, \alpha = \frac{1}{2}\), we can show \(\Delta \Pi_{\text{captain}} - \Delta \Pi_{\text{junior}} = \frac{(1 - 2\eta c_\theta)(\theta_1 - \theta_2)(\eta_1 + \theta_1 + \eta_2)}{64(\eta + \theta_1)(\eta + \theta_2)} > 0\). If \(\eta > \theta_1\) and \(\eta > \theta_2\), demand is positive. This sufficient condition means that the own-price sensitivity is greater than the cross-price sensitivity. Under this condition, NB1 should be the category captain if NB1 has a higher cross-price sensitivity.

**Case 5: NB1 has a higher base level of demand, and NB2 has a lower marginal cost.**

If \(\alpha = \frac{1}{2} + \Delta \alpha, c_2 = c_1 - \Delta c, \eta_1 = \eta_2 = \eta, \theta_1 = \theta_2 = \theta, \) we can show \(\Delta \Pi_{\text{captain}} - \Delta \Pi_{\text{junior}} = \frac{3(2\Delta \alpha - \Delta \eta - 2\Delta c)(1 - \eta c_1 + c_2)}{16(\eta + \theta)} > 0\), if and only if \(\Delta \alpha > \frac{(\eta + \theta)\Delta c}{2}\). Notice that category sales before having a category captain is \(\frac{(\eta + \theta)(1 - \eta c_1 - \eta c_2)}{2(\eta + \theta)}\), which is strictly positive, and this implies that \(1 - \eta c_1 - \eta c_2 > 0\).
Figure 1  The Channel Structure

National Brand One (NB1)  National Brand Two (NB2)  \[ \ldots \]  National Brand k (NB k)

Retailer
Figure 2  Retailer and NB1’s Joint Profit Gain

Joint Profit Gain

k = 2

k = 3

k = 4

k = 5
Figure 3   Using a Category Captain versus Introducing a Store Brand

The bottom right region is optimal for the retailer to use a category captain.
Figure 4  Retailer and NB1’s Joint Profit Gain with Partial Delegation and Strategic Non-Captain Brand
Figure 5  The Possibility of Benefiting All Channel Members with Partial Delegation and Strategic Non-Captain’s Brand

(A) NB2’s profit gain

(B) The area denoted by (+ +) is the region where NB1 and retailer’s joint profit gain and NB2’s profit gain both are positive.
### Table 1: Before and After Using a Category Captain for Category Management

<table>
<thead>
<tr>
<th></th>
<th>Before Using a Category Captain</th>
<th>Using a Category Captain</th>
<th>After Using a Category Captain</th>
</tr>
</thead>
<tbody>
<tr>
<td>Retail Price of NB1</td>
<td>$p_1^*$</td>
<td>$\frac{1}{2(2\theta)}$</td>
<td>$\frac{1}{2}$</td>
</tr>
<tr>
<td>Wholesale Price of NB1</td>
<td>$w_i^*$</td>
<td>$\frac{1}{(2\theta)}$</td>
<td>N/A a</td>
</tr>
<tr>
<td>Retail Margin of NB1</td>
<td>$p_1^* - w_1^*$</td>
<td>$\frac{1}{2(2\theta)}$</td>
<td>N/A a</td>
</tr>
<tr>
<td>Retail Price of NBi, $i=2,\ldots,k$</td>
<td>$p_i^*$</td>
<td>$\frac{3 + \theta}{2(2\theta)}$</td>
<td>$\frac{k(3 + \theta) - 3}{2(k(2\theta) - 2)}$</td>
</tr>
<tr>
<td>Wholesale Price of NBi, $i=2,\ldots,k$</td>
<td>$w_i^*$</td>
<td>$\frac{1}{(2\theta)}$</td>
<td>$\frac{k - 1}{k(2\theta) - 2}$</td>
</tr>
<tr>
<td>Retail Margin of NBi, $i=2,\ldots,k$</td>
<td>$p_i^* - w_i^*$</td>
<td>$\frac{1}{2(2\theta)}$</td>
<td>$\frac{k(1 + \theta) - 1}{2(k(2\theta) - 2)}$</td>
</tr>
<tr>
<td>Demand of NB1</td>
<td>$q_1$</td>
<td>$\frac{1 + \theta}{2k(2\theta)}$</td>
<td>$\frac{2k(1 + \theta) - (2 + \theta)}{2k(k(2\theta) - 2)}$</td>
</tr>
<tr>
<td>Demand of NBi, $i=2,\ldots,k$</td>
<td>$q_i$</td>
<td>$\frac{1 + \theta}{2k(2\theta)}$</td>
<td>$\frac{(k - 1)(1 + \theta)}{2k(2\theta) - 2}$</td>
</tr>
<tr>
<td>Category Demand</td>
<td>$Q^*$</td>
<td>$\frac{(1 + \theta)}{2(2\theta)}$</td>
<td>$\frac{k^2(1 + \theta) - 1}{2k(k(2\theta) - 2)}$</td>
</tr>
<tr>
<td>Market Share of NB1</td>
<td>$MS_1^*$</td>
<td>$\frac{1}{k}$</td>
<td>$\frac{2k(1 + \theta) - (2 - \theta)}{k^2(1 + \theta) - 1}$</td>
</tr>
<tr>
<td>Market Share of NBi, $i=2,\ldots,k$</td>
<td>$MS_i^*$</td>
<td>$\frac{1}{k}$</td>
<td>$\frac{(k - 1)(1 + \theta)}{k^2(1 + \theta) - 1}$</td>
</tr>
<tr>
<td>NB1’s Profit</td>
<td>$\Pi_1^*$</td>
<td>$\frac{1 + \theta}{2k(2\theta)^2}$</td>
<td>N/A b</td>
</tr>
<tr>
<td>NBi’s Profit, $i=2,\ldots,k$</td>
<td>$\Pi_i^*$</td>
<td>$\frac{1 + \theta}{2k(2\theta)^2}$</td>
<td>$\frac{(k - 1)^2(1 + \theta)}{2k(k(2\theta) - 2)^2}$</td>
</tr>
<tr>
<td>Retailer’s Profit</td>
<td>$\Pi_r^*$</td>
<td>$\frac{(1 + \theta)^2}{4(2\theta)^2}$</td>
<td>N/A b</td>
</tr>
<tr>
<td>NB1 and Retailer’s Joint Profits</td>
<td>$\Pi_{joint}^*$</td>
<td>$\frac{(1 + \theta)^2 + \frac{1 + \theta}{2k(2\theta)^2}}{4(2\theta)^2}$</td>
<td>$\frac{k^2(1 + \theta)^2 + k^2(1 + \theta) - k(5 + 4\theta) + 3 + \theta}{4k(k(2\theta) - 2)^2}$</td>
</tr>
</tbody>
</table>

a: NB1’s wholesale price is not a decision variable, since NB1 is the category captain.

b: The division of joint profits depends on specific profit-sharing plans.
### Table 2  The Consequences of Using a Category Captain on Channel Members a

<table>
<thead>
<tr>
<th>Variable</th>
<th>Symbol</th>
<th>Change</th>
</tr>
</thead>
<tbody>
<tr>
<td>Retail Price of NB1</td>
<td>$p_1^*$</td>
<td>Decrease</td>
</tr>
<tr>
<td>Retail Price of NB$i$, $i=2, ..., k$</td>
<td>$p_i^*$</td>
<td>Decrease</td>
</tr>
<tr>
<td>Wholesale Price of NB$i$, $i=2, ..., k$</td>
<td>$w_i^*$</td>
<td>Decrease</td>
</tr>
<tr>
<td>Retail Margin of NB$i$, $i=2, ..., k$</td>
<td>$p_i^* - w_i^*$</td>
<td>Increase</td>
</tr>
<tr>
<td>Demand of NB1</td>
<td>$q_1^*$</td>
<td>Increase</td>
</tr>
<tr>
<td>Demand of NB$i$, $i=2, ..., k$</td>
<td>$q_i^*$</td>
<td>Decrease</td>
</tr>
<tr>
<td>Category Demand</td>
<td>$Q^*$</td>
<td>Increase</td>
</tr>
<tr>
<td>Market Share of NB1</td>
<td>$MS_1^*$</td>
<td>Increase</td>
</tr>
<tr>
<td>Market Share of NB$i$, $i=2, ..., k$</td>
<td>$MS_i^*$</td>
<td>Decrease</td>
</tr>
<tr>
<td>NB$i$’s Profit, $i=2, ..., k$</td>
<td>$\Pi_i^*$</td>
<td>Decrease</td>
</tr>
<tr>
<td>Retailer and NB1’s Joint Profits</td>
<td>$\Pi_{\text{joint}}^*$</td>
<td>Increase</td>
</tr>
</tbody>
</table>

a: NB1 is the category captain.

### Table 3  Model Extensions

<table>
<thead>
<tr>
<th>Non-captain Brand</th>
<th>Partial Delegation</th>
<th>Full Delegation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Strategic</td>
<td>(Scenario II) Not always</td>
<td>(Scenario I) Profitable</td>
</tr>
<tr>
<td>Non-Strategic</td>
<td>(Scenario III) Profitable</td>
<td>(Scenario IV) Profitable</td>
</tr>
</tbody>
</table>