Selecting a category captain: The impact on manufacturers, retailers, and consumers

Kanishka Misra\textsuperscript{1}  Vincent Nijs\textsuperscript{2}  Karsten Hansen\textsuperscript{3}

October 14, 2009

\textsuperscript{1}Assistant Professor of Marketing, London Business School, Regent’s Park, London NW1 4SA, United Kingdom, Phone: +44 (0)20 7000 8619, Email: kmisra@london.edu
\textsuperscript{2}Assistant Professor of Marketing, Kellogg School of Management, Northwestern University, Evanston, Illinois 60208, Phone: +1 (847) 491 4574, Email: v-nijs@kellogg.northwestern.edu
\textsuperscript{3}Associate Professor of Marketing, Rady School of Management, University of California, San Diego, La Jolla, California 92093, Phone: +1 (858) 822-7462, Email: k4hansen@ucsd.edu
Abstract

It has been argued that many retailers lack not only the resources but also the capabilities to maximize category performance. Retailers may seek category management advice from a manufacturer, referred to as category captain (CC). In the limit, retailer and CC act as a vertically integrated firm; the CC’s recommendations affect all brands in the category, not just her own. We use analytical methods to investigate which manufacturer, if any, a retailer should choose as CC in various conditions. In our empirical application we develop a structural model to both evaluate competing retailers’ CC selection decisions and to quantify their impact on retailers, manufacturers, and consumers.

Key words: Category captains, Category management, Pricing, Consumer welfare, Competition, Public policy.
1 Introduction

Category management (CM) is used to manage product categories as individual business units to enhance consumer benefits (Blattberg and Fox 1995). It shifts retailers’ focus from brand to category-level goals. Both retailers and manufacturers involved in CM expect improved trading relationships and profitability (Dewsnap and Hart 2004). Even though CM has been practiced for well over a decade by companies large and small, it is still often employed inefficiently (Hofstetter 2006, Armstrong 2008). “Win-win-win” scenarios in which retailers, manufacturers, and consumers all benefit have proven hard to realize in practice (Lindblom and Olkkonen 2008).

Coordinating pricing tactics across all products in a category, a key component of CM, requires significant retailer investment. Changing prices is costly (Zbaracki et al. 2004, Srinivasan et al. 2008) and with the ever increasing number of UPCs retailers may simply lack the resources to apply CM principles in every single category (Kurtulus and Toktay 2007, Dhar et al. 2009). In fact, Morgan et al. (2007) argue that most retailers not only lack the resources but also the capabilities to maximize category performance.

The FTC (2001) suggests that even the most successful retailers may not be fully informed about particular product categories and could benefit from manufacturers’ expertise. Consistent with ideas espoused in relational exchange theory retailers can leverage suppliers’ resources and capabilities (Morgan et al. 2007) by seeking CM advice from a manufacturer referred to as a category captain (CC) (Kurtulus and Toktay 2004, 2007). The CC has “joint responsibility with the retailer for category development and growth, providing product trend information and recommending prices and shelf-space allocations for both its own products and those of its competitors” (Desrochers et al. 2003). In addition, the CC may be asked to analyze category-level data, assist in setting category goals, and develop and implement category plans (Basuroy et al. 2001, Dussart 1998). Retailers should only select a CC when the collaboration’s costs and benefits outweigh those of retailer-implemented CM (Kurtulus and Toktay 2007). Due to the level of coordination involved, retailers generally
choose a single CC with superior resources and consumer insights (Webster 1992, Lindblom and Olkkonen 2008). In the limit, retailer and CC act as a vertically integrated firm and the CC’s recommendations affect all brands in the category, not just her own (Dhar et al. 2009).

Industry reports (e.g., Progressive Grocer 2008) suggest that both manufacturers and retailers attribute substantial growth to CC arrangements. Successful management of categories depends on effective retailer-supplier collaboration; when data, insights, and knowledge are pooled both parties benefit (Blattberg and Fox 1995). For example, J.M. Smucker’s CM experts assist retail partners in setting optimal price gaps for all products, including private label brands, in the peanut butter and fruit spread categories. Kellogg Co. offers its retail partners pricing tools to calculate the impact of UPC-level price changes on category sales and profitability (Progressive Grocer 2008). Although a CC is not paid to manage a category, suppliers compete aggressively for the position to increase their influence on category decisions (Business 2.0 2003) and offset the perceived power imbalance between retailers and manufacturers (Corstjens and Corstjens 1995).

Even though Dhar et al. (2009) suggest CC collaborations are increasing, many retailers, concerned about latent manufacturer opportunism (Morgan et al. 2007), doubt that successful alliances can be forged. Desrochers et al. (2003) argue that CC arrangements limits smaller suppliers’ ability to compete, leading to higher prices and reduced consumer welfare. Others are concerned that CCs may promote anti-competitive behavior such as collusion between retailers (FTC 2001, Desrochers et al. 2003, Competition-Commission 2006). Government agencies recommend CCs establish so-called “Chinese walls” or information firewalls within their firms to prevent improper use of information gathered from one retailer to support pricing decisions for other retailers in the market (FTC 2001, Competition-Commission 2006).

Deciding which manufacturer, if any, to choose as CC is crucial. While it has been argued that retailers will select the largest manufacturer in the category (FTC 2001, Kurtulus and Toktay 2004), Progressive Grocer listings indicate that (Progressive Grocer 2008, 2007) small
suppliers have also been appointed. Analytical work in this area is scarce and does not address CC selection (Kurtulus and Toktay 2007, Dhar et al. 2009). Moreover, since extant empirical research is survey based, the costs and benefits of CC arrangements have not been quantified (Kurtulus and Toktay 2004, 2007, Morgan et al. 2007, Lindblom and Olkkonen 2008). Our study is the first, to the best of our knowledge, to analyze retailers’ CC selection both analytically and empirically. Even though a CC may perform various functions, we focus on category pricing.

We develop a set of predictions using an analytical framework and build an econometric model to examine retailers’ CC selections and their implications. We demonstrate in a monopoly as well as an oligopoly environment that appointing a category’s market leader may not be optimal for the retailer. In our empirical application we study a large CPG category in a Mid-Western market. The information on wholesale prices charged by a supplier, one of our data’s unique features, allows us to distinguish retailing from manufacturing costs. We develop a structural model and use policy simulations to both evaluate competing retailers’ CC selections and to quantify their impact on manufacturers, retailers, and consumers.

The remainder of this paper is organized as follows. In Section 2 we discuss the analytical model and results. In Section 3 we describe the data used in the empirical analyses. Sections 4 and 5 address the econometric models and results. Finally, Section 6 offers conclusions and directions for future research.

2 Predictions

Our objective in this paper is to quantify the impact of CC arrangements on prices, profits, and consumer welfare. Before we describe our econometric model we develop the intuition for a retailer’s CC choice and its impact on market participants in a simple analytical context. These insights will, in part, serve as predictions for our empirical application. In Section 2.1

---

1 *Progressive Grocer* CC listings include e.g., General Electric in lighting or Procter & Gamble in the soap and detergent category as well as smaller manufacturers such as Cadbury Schweppes Americas Beverages in carbonated soft drinks or E&J Gallo in wines and spirits.
we assume a monopoly retailer and in Section 2.2 we generalize the results to a setting with retail competition.

2.1 Monopoly Retailer

Consider a market with two manufacturers (1 and 2), each producing a single product with zero marginal cost. For the retailer, demand is given by

\[ q_1 = 1 - p_1 + \beta_{12} p_2, \] (1)
\[ q_2 = \alpha - p_2 + \beta_{21} p_1, \] (2)

where \( \alpha \) represents consumers’ relative preference for product 2 versus product 1 and the \( \beta \) parameters capture product substitutability. We assume manufacturers charge a linear wholesale price (i.e., no quantity discounts) and the CC advises the retailer on how to set prices that will maximize joint profits. If the retailer has sufficient power in the channel, she could negotiate a wholesale price for the CC’s products that will just satisfy the CC’s incentive rationality constraint by keeping her profits at the same level as before the CC arrangement was put in place. The retailer’s profit increase in this setting could be viewed as an upper bound on the benefits from using a CC.

2.1.1 No Product Differentiation

Consider a case where \( \alpha = 1 \) and \( \beta_{12} = \beta_{21} = \beta \) (Dhar et al. 2009). Equilibrium prices without a CC are

\[ p_1 = p_2 = \frac{2}{3 - 2\beta}, \] (3)
\[ w_1 = w_2 = \frac{1}{3 - 2\beta}, \] (4)
where $p_j, w_j$ are retail and wholesale prices, respectively, for product $j = 1, 2$. With a CC prices are

$$p_{CC} = \frac{1}{2 - 2\beta},$$  \hspace{1cm} (5)

$$p_{NCC} = \frac{4 - \beta}{6(1 - \beta)},$$  \hspace{1cm} (6)

$$w_{NCC} = \frac{1}{3},$$  \hspace{1cm} (7)

where $p_{CC}$ represents the retail price charged for the CC’s product, $p_{NCC}$ is the price charged for the product of the manufacturer not selected as CC and $w_{NCC}$ is the wholesale price set for the NCC’s product.\(^2\) It is easy to show that the retail price charged for the NCC’s product is weakly higher and the wholesale price charged by the NCC is weakly lower in the presence of a CC. In addition, it can be shown that the direction of change in the CC’s retail price depends on the degree of substitution between products: If $\beta > \frac{1}{2}$, the CC’s retail price will increase. Finally, if the retailer negotiates a wholesale price to make the CC indifferent between the current setting and being a CC, her gain in profit is $\frac{1}{2 - 2\beta} - \frac{3}{(3 - 2\beta)^2} - \frac{5}{36}$, which is positive and increasing in $\beta$ for $\beta \in [0, 1]$. The retailer will therefore always prefer to use a CC due to the benefits derived from (1) removing double marginalization on the CC’s products and (2) setting category profit maximizing prices. The benefits from the latter force will increase with product substitutability ($\beta$) (see also Basuroy et al. 2001).

### 2.1.2 Heterogeneous Products

To allow product differentiation we assume $\alpha < 1$, i.e., product 1 is preferred over 2 by consumers and manufacturer 1 is larger than manufacturer 2. In this case the retailer will again always choose to have a CC and will receive positive profits as long as $\beta \in [0, 1]$, but may select either the smaller or the larger manufacturer. As above, if we assume that the retailer negotiates a wholesale price to make the manufacturer indifferent between being CC

\(^2\)Note that since manufacturers are symmetric, the retailer is indifferent between choosing either one as CC.
or not, it can be shown that the retailer’s profit differential from selecting manufacturer 1 versus 2 as CC is\(^3\)

\[
\Pi_{\text{manuf 1 is CC}} - \Pi_{\text{manuf 2 is CC}} = \frac{(1 - \alpha^2)(9 - 20\beta^2)}{36(9 - 4\beta^2)}.
\] (8)

The denominator in this equation is positive for \(\beta \in [0, 1]\) and the first term of the numerator is always positive for \(\alpha \in [0, 1]\). Therefore, if substitutability is high enough \((\beta > \sqrt{\frac{9}{20}})\) the retailer will always appoint the smaller manufacturer as CC. Equation (8) illustrates two key factors influencing the retailer’s choice: (1) the total profit increase and (2) the compensation needed to make the selected manufacturer indifferent to being CC.

The difference in the total profit increase for the retailer without negotiation from using manufacturer 1 rather than 2 as CC, is given by \((\frac{5}{36})(1 - \alpha^2)\), which is positive for \(\alpha \in [0, 1]\) and is decreasing in \(\alpha\). Since both manufacturers, by assumption, are equally adept at managing a category, the discrepancy results from the added benefits of removing double marginalization for the leading manufacturer. The difference in compensation needed to make manufacturers indifferent is given by \(\frac{1 - \alpha^2}{9 - 4\beta^2}\), which is positive for \(\alpha \in [0, 1]\), \(\beta \in [0, 1]\). Stronger product heterogeneity forces the retailer to pay the leading manufacturer more to accept the role of CC. Interestingly, the differential is increasing in \(\beta\) because the profit gap between the leading and smaller manufacturer increases when products are close substitutes. Since the benefits from removing double marginalization depend only on \(\alpha\) and the compensation amount depends on \(\beta\), we see that for a sufficiently high level of substitutability, the retailer would choose the smaller manufacturer as CC.

The implications of CC arrangements on wholesale prices are similar to the homogeneous products model. The NCC will reduce wholesale prices even if the retailer chooses the smaller manufacturer as CC. However, in this model retail prices charged for both the CC’s and NCC’s products could either increase or decrease depending on product substitutability \((\beta)\) and consumers’ relative product preferences \((\alpha)\).

\(^3\)An appendix with derivation details can be obtained from the authors upon request.
2.1.3 Asymmetric substitution

Now consider a monopoly retailer’s CC decision given a demand model with asymmetric product substitution

\begin{align*}
q_1 &= 1 - p_1 + \beta \alpha (p_2 - p_1), \\
q_2 &= \alpha - p_2 + \beta (p_1 - p_2).
\end{align*}

(9) \hspace{0.5cm} (10)

Since \( \alpha < 1 \), product 1 is able to steal more demand from product 2 than product 2 can steal from product 1 (e.g., Blattberg and Wisniewski 1989). As analytical results cannot be derived for this model, we compute the optimal policy for the retailer numerically for different values of \( \alpha \) and \( \beta \). The results are shown in Figure 1 below.

[Insert Figure 1 about here]

The figure demonstrates that a monopolist retailer will choose the smaller manufacturer as CC across a large range of \( \alpha \) and \( \beta \) values. In line with the heterogeneous products model discussed above, the cost of compensating the leading manufacturer will outweigh the benefits from removing double marginalization for sufficiently large values of \( \beta \). A key insight from the monopoly retailer models is that the largest manufacturer will not always be chosen as CC. In fact, when products are sufficiently substitutable the leading manufacturer becomes ‘too expensive’ and the retailer will select a smaller manufacturer as CC. The asymmetric substitution model demonstrates the threshold level of substitutability (\( \beta \)) is decreasing in \( \alpha \), i.e., as the intrinsic preferences for the manufacturers’ products become more similar, the hurdle the smaller manufacturer has to overcome to be selected as CC is reduced. In the next section we argue this result also holds in the presence of retail competition.
2.2 Oligopoly Retailers

Basuroy et al. (2001) show, both analytically and empirically, that intense retail competition reduces retailer benefits from category price coordination. However, their model does not allow for heterogeneity in preferences for products and retailers. We posit a demand system with two retailers (A and B) of the form

\begin{align*}
q_1^A &= 1 - p_1^A + \beta(p_2^A - p_1^A) + \delta[(p_1^B - p_1^A) + \beta(p_2^B - p_1^A)], \quad (11) \\
q_2^A &= \alpha - p_2^A + \beta(p_1^A - p_2^A) + \delta[(p_2^B - p_2^A) + \beta(p_1^B - p_2^A)], \quad (12) \\
q_1^B &= \alpha B - p_2^B + \beta(p_1^B - p_2^B) + \delta[(p_2^A - p_2^B) + \beta(p_1^A - p_2^B)], \quad (13) \\
q_2^B &= \alpha B - p_2^A + \beta(p_1^B - p_2^B) + \delta[(p_2^A - p_2^B) + \beta(p_1^A - p_2^B)], \quad (14)
\end{align*}

where $\delta$ captures intra-store substitution and $\alpha_B$ captures the inherent preference for store B. Without loss of generality, we assume $\alpha_B < 1$. Even though analytical solutions are infeasible, we are able to show numerically that both asymmetric and symmetric equilibria in retailer CC selection can occur. In the asymmetric equilibrium the larger retailer chooses the leading manufacturer while the smaller retailer chooses the smaller manufacturer. In addition, a symmetric equilibrium in which both retailers choose the same CC is more likely for large $\alpha$ (i.e., stronger product heterogeneity) and $\beta$ (i.e., stronger product substitution) values as well as greater discrepancies in consumer preference for retailers (i.e., one strong and one weak retailer). Additional details on the numerical results for the CC selection model with retail competition are available from the authors on request.

2.3 The Impact of a Category Captain

We generate five main predictions on the impact of a CC from the models for which we can derive equilibrium prices and profits analytically.

1. Wholesale prices for the NCC’s products decrease.
2. Retail prices for the NCC’s products increase when products are homogeneous.

3. Retail prices for the CC’s products either increase or decrease depending on substitutability ($\beta$).\(^4\)

4. Retailer profits increase.

5. Profits for the NCC decrease.

In the presence of a CC the NCC still faces double marginalization even though the CC has removed it on all her products, forcing the NCC to lower wholesale prices. Moreover, as retail prices are set to maximize category rather than brand-level profits, prices charged for the NCC’s products increase. Retail prices for the CC’s products are influenced by two opposing forces: removing double marginalization drives the retail price down, whereas coordinated category pricing drives them up (Basuoy et al. 2001). While the impact of the second force depends on product substitutability, the impact of the first does not. Therefore, retail price for the CC’s products will increase for sufficiently high values of $\beta$.

We also provide predictions on agents’ profits. CC arrangements (1) increase retailer profits due to removal of double marginalization for the CC’s products, (2) (weakly) lower wholesale prices charged by the NCC, and (3) provide support for the retailer to set prices that maximize category profits. The NCC, however, generates lower profits for non-zero levels of product substitutability.

The predictions outlined above, derived using simple analytical frameworks, demonstrate what could happen in more realistic scenarios. In the following sections we describe our empirical approach to quantifying the impact of a CC. In addition to testing whether our analytical insights hold under more general demand and competition assumptions, we also use the empirical framework to quantify the impact of CC arrangements on consumer welfare.

\(^4\)The critical range for $\beta$ in the heterogeneous model is a function of $\alpha$. 

3 Data

The unique dataset we assembled for this study contains information on quantities, prices, promotions, costs, and other financial flows for the distribution channel in 2004. We observe both weekly wholesale prices charged to retailers for every UPC sold by a manufacturer and retail transactions at the chain level, covering all UPCs in the category. Whereas these data are generally not available to researchers, they are accessible to any manufacturer in the industry.

Our dataset allows us to contribute to extant literature in two distinct ways. First, as our data covers transactions from all supermarket chains in the market we are able to address the impact of retail competition on the selection of a CC, in contrast to prior studies that focus on only one retail chain (e.g., Kadiyali et al. 2000, Choi 1991). Second, whereas researchers previously did not have access to manufacturer data (e.g., Sudhir 2001, Villas-Boas 2006), we observe actual supplier costs and wholesale prices. Empirical work on channel interaction has commonly relied on accounting measures such as Average Acquisition Cost (AAC) as a proxy for wholesale prices (Kadiyali et al. 2000, Chintagunta 2002, Besanko et al. 2005, Meza and Sudhir 2006). Since these measures do not represent economic marginal cost, they have been described as “a limitation to be lived with” (Meza and Sudhir 2006). As Nijs et al. (2010) have shown that AAC introduces both an endogeneity problem (see also Peltzman 2000) and a significant bias in estimates of trade deal pass-through, our dataset offers an important advantage over those used in previous studies in this area.

The two major supermarket chains (R1 and R2) studied have been competitors in a Mid-Western market for over 20 years. Our analysis focuses on the market level, as manufacturers commonly set prices at this level (Nevo 2001).5 We study the top three U.S. based players in the industry (M1, M2, M3), covering nearly 54% of total supermarket volume. The market’s top 4 brands cover 88% of suppliers’ national supermarket volume: M1.1 and M1.2 are produced by manufacturer M1; supplier M2 sells brand M2.1; and M3.1 is manufactured by

---

5 Villas-Boas (2006) studied competition in smaller geographical areas (e.g., zip-code areas).
firm M3. We focus on the top 36 UPCs, which cover over 90% of brand sales.

To calibrate the outside option, which reflects consumers who choose not to buy in the defined market, we use the population living in zip-code areas covered by chains R1 and R2. We multiply the number of potential consumers by the consumption rate of a heavy user in the category to determine market potential.\(^6\) Table 1 shows the relative shares for the brands and chains studied. Manufacturer M1 is clearly the largest player, followed by M2 and M3. Brand M1.1 dominates in both chains, with brand M2.1 a clear second; brands M1.2 and M3.1 are of similar size.

<table>
<thead>
<tr>
<th>Brand/Chain</th>
<th>R1</th>
<th>R2</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>M1.1</td>
<td>48.3%</td>
<td>10.3%</td>
<td>58.6%</td>
</tr>
<tr>
<td>M1.2</td>
<td>6.9%</td>
<td>1.1%</td>
<td>8.0%</td>
</tr>
<tr>
<td>M2.1</td>
<td>21.8%</td>
<td>4.6%</td>
<td>26.4%</td>
</tr>
<tr>
<td>M3.1</td>
<td>4.6%</td>
<td>1.1%</td>
<td>5.7%</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td>81.6%</td>
<td>17.2%</td>
<td></td>
</tr>
</tbody>
</table>

Table 1: Relative brand shares

Prices in Table 2 are standardized relative to the lowest priced good for confidentiality reasons: brand M2.1 in chain R1. Brand M1.2 is priced highest, brand M2.1 lowest, and brands M1.1 and M3.1 are sold at a very similar price.

<table>
<thead>
<tr>
<th>Brand/Chain</th>
<th>R1</th>
<th>R2</th>
</tr>
</thead>
<tbody>
<tr>
<td>M1.1</td>
<td>1.06</td>
<td>1.06</td>
</tr>
<tr>
<td>M1.2</td>
<td>1.25</td>
<td>1.25</td>
</tr>
<tr>
<td>M2.1</td>
<td>1.01</td>
<td>1.01</td>
</tr>
<tr>
<td>M3.1</td>
<td>1.04</td>
<td>1.04</td>
</tr>
</tbody>
</table>

Table 2: Average relative prices

In addition, our database contains information on the number of stores in either chain receiving feature or display support for a particular UPC in a given week. As category demand is likely correlated with temperature, we also collected weekly weather data for the region. UPCs differ in package material, package size, individual unit size, and total volume; we refer to Appendix A.1 for an overview of their characteristics. Retailers carry three main

\(^6\)Our findings are robust to changes in this assumption.
package sizes\textsuperscript{7} in two different packaging materials, of which material 2 is more durable. Component A is considered the category’s main ingredient; component B is expected to have a negative correlation with consumer preference, and some UPCs are marketed as low fat.

We use instruments for demand estimation that are correlated with price changes but not with demand.\textsuperscript{8} First, we obtained data on prices in nearby cities (Nevo 2001). Any changes in supply conditions should induce a common price shock in multiple cities. Second, prices for key materials used to manufacture products in this industry were collected from the department of agriculture. Prices for two types of gasoline (one used for production and the other for transportation) as well as electricity were obtained for regions in which manufacturers’ production plants are located. They are specified at a national, regional, and local level and are intended to capture production and transportation costs on the supply side.

4 Econometric model

In this section we develop an empirical model to study retailers’ CC choices and their impact on manufacturers, retailers, and consumers. We build on the work of various researchers that have studied manufacturer-retailer interactions using structural models. The ability to estimate the impact of economic or strategic changes in the marketplace is an important advantage of structural models (e.g., Dubé et al. 2003). In our data we observe both prices from multiple retailers and wholesale prices charged by one manufacturer, allowing us to estimate competing manufacturers’ wholesale prices and analyze horizontal retailer competition as well as the equilibria between retailers and manufacturers. We conduct "what-if" analyses of industry effects of retailers’ CC selection.\textsuperscript{9}

\textsuperscript{7}Although we cannot provide the actual size identifiers, the numbers in Appendix A.1 are in increasing order.
\textsuperscript{8}We cannot use wholesale prices since we observe them for one manufacturer.
\textsuperscript{9}Although in theory experiments could be used to investigate retailer CC selection, they are infeasible in practice.
We build a model of horizontal competition in vertical channels with incomplete data. Estimating changes in welfare following a CC arrangement requires a system based on individual level utility. Consistent with previous research on supermarket pricing we assume prices result from a weekly game between retailers and manufacturers (e.g., Dubé 2004, Chintagunta 2002, Chintagunta et al. 2003, Villas-Boas 2006). Since we do not observe individual consumer choices, we parameterize unobserved heterogeneity. From the utility model we derive an aggregate demand system (Berry et al. 1995) and impose a supply side model to infer cost-price margins. We run policy simulations using estimated marginal costs for all agents to trace out response functions and quantify the effects of CC arrangements. We describe each of these steps in detail below.

4.1 Individual utility

We use a random coefficient logit model (Berry et al. 1995) of weekly discrete choice in which consumers either select a UPC in the category or the outside option. As we do not observe individual level choices, we estimate the model on aggregate data (Nevo 2000a). Our specification eliminates the Independence of Irrelevant Alternatives (IIA) property, allowing for more flexible cross-price elasticities.

Formally, we assume each consumer \( i \) either chooses one UPC \( (j \in [1..J]) \) from one retail chain \( (r \in [1..R]) \) in every week \( t \ (t \in [1..T]) \) or the outside option. Every UPC and retail chain combination \( (j,r) \) has attributes \( (x_{jrt}, \xi_{jrt}, p_{jrt}) \). \( x_{jrt} \) includes (a) UPC characteristics that do not vary over time or chain e.g., package size, (b) retail chain fixed effects, (c) weekly market characteristics, e.g., weeks of high demand, and (d) attributes that vary by brand, UPC, and time - e.g., feature advertising. \( \xi_{jrt} \) are weekly product characteristics that are observable to consumers and firms though unobservable to the researcher, e.g., shelf-space and coupons (Berry et al. 1995, Nevo 2000a, Chintagunta et al. 2003). \( p_{jrt} \) denotes the price.
for UPC \( j \) at chain \( r \) in week \( t \). The individual utility specification is as follows:

\[
    u_{ijrt} = (Y_i - p_{jrt})\beta_i + X_{jrt}\gamma_i + \xi_{jrt} + \epsilon_{ijrt},
\]

where \( i \) refers to the consumer, \( j \) the product (including the outside option), \( r \) the supermarket chain, and \( t \) the time period or market. In this formulation, \( Y_i \) is the income of consumer \( i \) and \( \beta_i \) is the marginal utility of income. \( \gamma_i \) captures the taste for measured product attributes and the intrinsic preference for a retail chain. \( \epsilon_{ijrt} \), which is distributed IID extreme value, captures consumer \( i \)'s idiosyncratic utility for each alternative. We assume consumer preferences are distributed normally across the population.

\[
    \beta_i \sim N(\beta, \sigma^2),
\]

\[
    \gamma_i \sim N(\gamma, \Sigma_\gamma).
\]

The parameters \( \beta \) and \( \gamma \) capture the average marginal utility of income and average taste for measured product attributes, respectively. Unlike Nevo (2000a), we consider only unobserved heterogeneity because our data do not contain information on changes in demographics. We assume heterogeneity is normally distributed with variance \( \sigma^2 \) and \( \Sigma_\gamma \). For tractability we assume \( \Sigma_\gamma \) is a diagonal matrix (Nevo 2000a). We further assume inherent preference for the outside option is equal to zero, common in discrete choice models, and the utility for the outside option is given by

\[
    u_{i0t} = Y_i\beta_i + \epsilon_{i0t}.
\]

We also assume that a consumer will buy no more than one item from the category in a given week (Chintagunta 2002, Villas-Boas 2006). For convenience we rewrite the utility model separating the mean effects that are common across all individuals and terms that vary by
individual

\[ u_{ijrt} = \delta_{jrt} + \nu_{ijrt}p_{jrt} + \mu_{ijrt}X_{jrt} + \epsilon_{ijrt}, \]  

where \( \delta_{jrt} \) represents the common utility across all consumers, which is equal to \( p_{jrt}\beta + X_{jrt}\gamma + \xi_{jrt} \) and is often referred to as the linear part of the utility function (Nevo 2000a). \( \nu_{ijrt} \) and \( \mu_{ijrt} \) are variations from the mean for each consumer, referred to as the non-linear parts of utility (Nevo 2000a). We express consumer heterogeneity as

\[ \beta_i = \beta + \sigma_{\beta}v, \]  
\[ \gamma_i = \gamma + \sum\gamma v, \]  
\[ v \sim N(0, 1). \]

### 4.2 Demand side

Next we build an aggregate from the consumer utility model described above. We assume consumer \( i \) chooses UPC \( j \) at retail chain \( r \) at time \( t \), if and only if \( u_{ijrt} > u_{ij'r't} \). The choice probability is given by

\[ P_{ijrt} = \int_{\epsilon|u_{ijrt}>u_{ij'r't}} dF(\epsilon), \]

which simplifies to a standard logit form with an appropriate assumption about the distribution of \( \epsilon \). Since individual choices are not observed, we parameterize the distribution of heterogeneity across consumers as

\[ s_{jrt} = \int_{v} \int_{\epsilon|u_{ijrt}>u_{ij'r't}} dF(\epsilon)dF(v), \]

where \( s_{jrt} \) is the share of UPC \( j \) in chain \( r \) in market \( t \).

We use simulated method of moments to integrate over the distribution of \( v \) (Berry et al. 1995, Nevo 2000a). The linear parameters are estimated by contraction mapping and 2SLS using the instruments described in Section 3. To ensure a global minimum we use 10
random starting points, select the lowest objective function value, and then take 20 random perturbations from this value as a new starting point to locate the global optimum. We employ the Newey-West algorithm to obtain consistent standard errors of the parameter estimates.

4.3 Supply side

In line with a large body of research on weekly price setting in supermarkets we assume a static Bertrand pricing game for both manufacturers and retailers and include information on feature and display activity as control variables (e.g., Chintagunta 2002, Dubé 2005, Villas-Boas 2006). The retailers studied do not carry a private label product in the category. Consistent with the models developed in Section 2 we select a retailer objective function that results in a set of prices that maximize profits from manufacturers’ product line separately (Sudhir 2001). In Section 5 we provide empirical evidence that this structure fits the data better than one in which retailers set prices to optimize category profits. We assume manufacturers set wholesale prices to maximize profits across their product line jointly for both retail chains.

4.3.1 Retailer pricing

Retailer profits are given by

\[
\pi_{rt}(p_r, p) = \sum_{j \in S_{rt}} [p_{jrt} - p_{jrt}^{w} - c_{jrt}^r] D_{jrt}(p) + C_{rt},
\]

(25)

where \( p_{jrt} \) refers to the price charged by retail chain \( r \) for product \( j \) in week \( t \), \( p_{jrt}^{w} \) refers to the wholesale price charged by the manufacturer to retail chain \( r \) for product \( j \) in week \( t \), \( c_{jrt}^r \) is the marginal cost for chain \( r \) to store product \( j \) in week \( t \), and \( D_{jrt}(p) \) is the demand for UPC \( j \) at chain \( r \) in week \( t \) as a function of all prices in the time period. \( S_{rt} \) defines the set of products that retailer \( r \) takes into consideration when setting prices to
maximize profits in week $t$. If the retailer maximizes category profits, $S_{rt}$ is the set of all UPCs sold. On the other hand, if the retailer maximizes profits per manufacturer, there will be as many profit equations as there are manufacturers and $S_{rt}$ represents a manufacturer’s UPC’s. $C_{rt}$ includes all fixed costs that do not change with demand. If the retailer sets price to maximizes profits

$$p^*_r = \arg \max_{p} \pi_{rt}(p_r, p),$$

where $p^*_r$ is the vector of optimal prices charged by retail chain $r$. The first order condition of the maximization for $\forall j$ is given by

$$D_{rjt}(p) + \sum_{k \in S_{rt}} [p_{kr} - p^w_{kr} - c^r_{kt}] \frac{\partial D_{rkt}(p)}{\partial p_{jrt}} = 0,$$

which, in matrix notion, simplifies to

$$
\begin{pmatrix}
\vdots \\
P_t \\
\vdots
\end{pmatrix}
- 

\begin{pmatrix}
\vdots \\
P^w_t \\
\vdots
\end{pmatrix}
- 

\begin{pmatrix}
\vdots \\
c^r_t \\
\vdots
\end{pmatrix}
= - 

\begin{pmatrix}
\vdots \\
\cdots T_r \times \Delta_{rt} \cdots \\
\vdots
\end{pmatrix}
^{-1}

\begin{pmatrix}
\vdots \\
D_t \\
\vdots
\end{pmatrix},
$$

where $P_t$ is a vector of all prices charged to consumers by both retail chains at time $t$, $P^w_t$ is a vector of all prices charged to retail chains at time $t$, $c^r_t$ is a vector of marginal costs for both chains at time $t$. $\Delta_{rt}$ is the matrix of own and cross price demand derivatives where

$$\Delta_{rt}(j, k) = \frac{\partial D_{rkt}}{\partial p_{jrt}},$$

$T_r(i, j) = 1$ if retailer $r$ maximizes joint profits over UPCs $i$ and $j$, and zero otherwise. Changes in the assumption about the retailer’s profit maximizing behavior result in changes to the ownership matrix $T_r$. $D_t$ is a vector of demand (shares) across the retail chains. Henceforth we will write this equation as

$$p_t - p^w_t - c^r_t = -(T_r \times \Delta_{rt})^{-1} D_t.$$
From Equation (29) we can infer price-cost margins for the retailer. We evaluate relative model fit by comparing the implied costs derived from our models \(c_{rt}^r\) for our manufacturing partner’s UPCs to observed data on \(p_{jrt}^w\).

### 4.3.2 Manufacturer pricing

We assume observed retail prices result from a Nash game in which retailers and manufacturers set price simultaneously. The profit function for each manufacturer \(m\) is

\[
\pi_{mt}(p^w) = \sum_{j,r \in S_{mt}} [p_{jrt}^w - c_{jrt}^m]D_{jrt}(p(p^w)),
\]

where \(c_{jrt}^m\) is the marginal cost for the manufacturer to produce product \(j\) and deliver it to retailer \(r\). \(S_{mt}\) defines the set of products that manufacturer \(m\) sells to the retailers at time \(t\). \(p(p^w)\) is the retail price that will be charged to consumers when the manufacturer charges the retailer \(p_r^w\). The first order conditions for profit maximizing manufacturers are given by

\[
p_t^w - c_t^m = -(T_m \ast \Delta_{mt})^{-1}D_t(p),
\]

where \(T_m(j, k) = 1\) if a manufacturer sells both UPC’s \(j\) and \(k\) (and 0 otherwise). \(\Delta_{mt}\) is the matrix of own- and cross-price derivatives where element \((j, k)\) is \(\frac{\partial D_{jrt}}{\partial p_{jrt}}\), as in Villas-Boas (2006). In matrix form we have \(\Delta_{mt} = \Delta_{pt} \Delta_{rt}\). \(\Delta_{rt}\) captures the own- and cross-price demand derivatives with respect to retail price used in the retailers first order conditions. \(\Delta_{pt}\) is the matrix of the retailer’s reaction functions and in a Nash game we have \(\Delta_{pt} = I\).

### 4.3.3 Inferring marginal costs

To infer retailer and manufacturer marginal costs we assume the retailer’s marginal cost of holding an item can be described as an affine map of the observable product characteristics with an unobservable shock. In particular, we assume there are no brand specific cost effects, e.g., it is equally costly for the retailer to stock either brand M1.1 or brand M2.1. The
retailer’s variable costs include storage and shelf space allocation, which are not expected to vary across brands. Agents’ marginal costs are inferred in five steps. First, we derive retailer marginal cost for the UPCs sold by our manufacturing partner. Using these products’ retail prices, wholesale prices, and estimated retail margins we can recover marginal costs for the retailer. Second, we estimate the effect of observable product characteristics, such as package size and unit size, on retailer costs. Third, we calculate the retailer’s marginal cost for other manufacturer’s products. Forth, from the retailer’s price-cost margin, the observed retail prices, and estimated marginal costs we estimate wholesale prices charged by other manufacturers. Finally, we calculate the marginal costs for other manufacturers in the industry.

Our five-step procedure is an extension of the one suggested by Nevo (2000b). Since, managers commonly have access to data similar to ours (see Section 3), the suggested methodology would allow them to estimate wholesale prices charged by competing manufacturers.

4.3.4 Model validity

As we observe true wholesale prices $p^w$ in our data for a manufacturer, we are able to both establish an upper bound on a retailers’ price-cost margins and evaluate alternative retailer supply side models. To check the validity of the manufacturer supply side model we use production and delivery cost data from our manufacturing partner. Although these may not exactly equal economic marginal costs, they provide an upper bound on the estimates recovered by manufacturer supply side models. We also estimate the correlation between recovered economic marginal costs and production and delivery costs. A strong positive correlation would suggest changes in manufacturer marginal costs are appropriately estimated by the empirical model.
4.4 Simulating the impact of selecting a category captain

The key benefit of structural models lies in their ability to describe equilibrium outcomes following changes in the industry. We use policy simulations to derive equilibrium outcomes for various CC choices in a setting with and without retail competition. In our model the CC provides the retailer with the expertise to manage prices for a category. In addition to increasing joint retailer-CC profits, double marginalization is removed as the CC eliminates supplier margins for each of the products sold to the retailer. In this paper we assume the retailer provides the selected manufacturer just enough compensation to be indifferent between being CC and the status quo. We also assume Chinese walls are in place to prevent the CC from jointly optimizing profits across both stores.

Our model is built upon a consumer utility formulation, enabling us to derive consumer welfare implications of industry structure changes. Previous literature (e.g., Small and Rosen. 1981, Chintagunta et al. 2003, Dubé 2005) has shown that the welfare differential for consumer \( i \) between two scenarios (S1 and S2) can be calculated as

\[
CV_{it} = \frac{\log(\sum_{j \in [0,J], r \in [1,R]} \exp(V_{jrit}^{S1})) - \log(\sum_{j \in [0,J], r \in [1,R]} \exp(V_{jrit}^{S2}))}{\beta_{it}},
\]

where \( V_{jrit} \) is the expected utility for consumer \( i \) from UPC \( j \) in store \( r \) at time \( t \). Intuitively the numerator specifies the difference in expected utility for the two scenarios. The denominator captures the marginal utility of income and therefore converts utils to a dollar measure. The total effect on consumer welfare can be estimated by integrating over heterogeneous consumers

\[
\Delta CS_t = M_s \int CV_{it} dF(v),
\]

where \( M_s \) is the market size. To derive the equilibrium in a setting with retail competition we evaluate the profit implication for every possible mix of CC choices and determine each retailer’s best response.
5 Results

5.1 Demand results

Results for the random coefficients logit model with UPC fixed effects are reported in Table 3. Coefficients for the product characteristics (marked by $^a$) are estimated from a second stage regression on the UPC fixed effects parameters (Nevo 2001). The table shows the estimate and standard error of the mean coefficients $\beta$ and $\gamma$ as well as the estimate and standard error of the heterogeneity coefficients $\sigma_\beta$ and $\Sigma_\gamma$. Even though in theory heterogeneity can be estimated for all parameters, in practice it is often infeasible (Nevo 2001, Chintagunta et al. 2003).

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Mean</th>
<th>S.e.</th>
<th>Heterogeneity</th>
<th>S.e.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Constant$^a$</td>
<td>-19.14**</td>
<td>2.58</td>
<td>0.36**</td>
<td>0.18</td>
</tr>
<tr>
<td>Price</td>
<td>-1.49**</td>
<td>0.27</td>
<td>0.27**</td>
<td>0.13</td>
</tr>
<tr>
<td>Feature/Display</td>
<td>0.51**</td>
<td>0.11</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Temperature</td>
<td>0.006*</td>
<td>0.003</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Holiday</td>
<td>0.68**</td>
<td>0.26</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Chain R1</td>
<td>1.59**</td>
<td>0.06</td>
<td>0.36</td>
<td>0.41</td>
</tr>
<tr>
<td>Brand M1.1$^a$</td>
<td>-0.72**</td>
<td>0.35</td>
<td>1.52**</td>
<td>0.53</td>
</tr>
<tr>
<td>Brand M2.1$^a$</td>
<td>-0.46*</td>
<td>0.27</td>
<td>0.94**</td>
<td>0.47</td>
</tr>
<tr>
<td>Brand M3.1$^a$</td>
<td>-1.11**</td>
<td>0.29</td>
<td>0.35</td>
<td>1.10</td>
</tr>
<tr>
<td>Package size 1$^a$</td>
<td>-3.07**</td>
<td>0.22</td>
<td>1.65</td>
<td>1.08</td>
</tr>
<tr>
<td>Package size 3$^a$</td>
<td>-0.59**</td>
<td>0.05</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Package material 2$^a$</td>
<td>0.23</td>
<td>0.21</td>
<td>1.21**</td>
<td>0.40</td>
</tr>
<tr>
<td>Low fat$^a$</td>
<td>3.35**</td>
<td>0.56</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Component A$^a$</td>
<td>3.35**</td>
<td>0.69</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Component B$^a$</td>
<td>-0.17**</td>
<td>0.02</td>
<td>0.10**</td>
<td>0.03</td>
</tr>
</tbody>
</table>

** p < .05, * p < .10, $^a$ effect estimated in second stage model

Table 3: Random coefficients logit demand parameter estimates

Figure 2 depicts variation in the price coefficient across consumers. Although the mean is -1.49, the distribution does have support below -2 and above -1. Although the large, negative constant suggests many consumers do not buy in the category, there is strong heterogeneity in preference. Demand increases with feature and display support, during the holiday season, and with higher temperatures, consistent with our expectations. The positive coefficient for
R1, the market leading retailer, confirms that consumers prefer to shop at this chain. The heterogeneity in this preference estimate could be linked to the consumers’ proximity to stores.

Figure 3 shows the distribution of consumer brand preferences. The mean estimates show consumers prefer M2.1, which is the most expensive brand (see Table 2), followed by M1.1, M2.1 and M3.1 respectively. Heterogeneity estimates suggest consumer preference for brand M3.1 varies less compared to brands M1.1 and M2.1. The estimated coefficients for low fat, component A, and component B all have the expected sign. Package material 2 has a positive mean preference with a large variance and Package size 2 is preferred over the smaller package size 1 and the larger package size 3.

Table 4 shows own- and cross-price elasticities for each brand’s top UPC. The numbers represent the change in share for a product listed in a column following a price change for the product listed in a row. For example, a 1% change in price for brand M1.2’s top UPC in chain R1 will result in a 0.129% decrease in share for brand M1.1’s top UPC in chain R2. The own-price elasticities (i.e., the diagonal elements in the table) are between -5.3 and -6.6. Previous studies implementing similar demand models either report own-price elasticities in this range (Villas-Boas 2006) or higher (Kadiyali et al. 1999). Note that UPC level own-price elasticities tend to be higher (Bijmolt et al. 2006) than brand level elasticities (e.g., Nevo 2001). The cross-price elasticities (i.e., the off-diagonal elements) not only vary by UPC, suggesting the IIA property does not hold in our data, but also by brand and retail chain.

5.2 Supply side results

A supply side model in which retailers maximize profit across their entire product portfolio in a category produces negative cost estimates in 41% of cases. This number reduces by
Table 4: Sample own- and cross-price elasticities - effect of a change in price for the row product on share for the column product

9% for a model in which retailers maximize profits for each brand separately, suggesting this structure is more consistent with our market data. Predicted values from a model that imposes two-part pricing are well below production and distribution costs data provided by the manufacturer. Therefore, the model that best fits our data is one in which manufacturers charge one-part prices and retailers set prices to optimize profits for each brand separately. Our manufacturer and retailer margin estimates are consistent with benchmarks provided by previous survey based research (Farms and Ailawadi 1992, Messinger and Narasimhan 1995).\textsuperscript{10} To further test the supply model’s validity we calculate the correlation between estimated costs and cost data provided by our manufacturing partner. As the correlation coefficient is 0.51 and significant ($p < .05$), we conclude that our model is able to correctly trace changes in manufacturer’s costs.

We assume a retailer’s marginal cost for a product can be described by its attributes. We first regress estimated retailer costs for our manufacturing partner’s products on package material and package size, allowing for chain and week fixed effects. We then use the regression results to predict retailer costs for the chains’ other products and estimate competitive wholesale prices charged in the industry.

\textsuperscript{10}For reasons of confidentiality we cannot provide the estimated retailer and manufacturer profit margins for this industry.
5.3 Selecting a category captain

To evaluate the impact of retailer CC selection we simulate the effect of retailer $i$ appointing manufacturer $j$ as CC. We calculate equilibrium retail prices for all products and wholesale prices for each manufacturer except $j$, assuming the retailer negotiates a wholesale price that will make manufacturer $j$ indifferent between being CC and the status quo.

5.3.1 Monopoly retailers

In line with the structure used in Section 2, we first view each retailer as a monopolist selecting a CC among competing manufacturers. Table 5 below shows the impact of different choices on retailers’ profits. Remember that M1 is the largest and M3 the smallest player in both chains in our application (see Table 1). We find that the optimal CC selection is chain specific: the large chain (R1) will select the smallest manufacturer (M3) and the small chain (R2) will select the largest manufacturer (M1). All else equal, the retailer will benefit most from removal of double marginalization for the largest manufacturer. However, as demonstrated in Section 2.1.2, when product substitution (i.e., cross-price elasticities) is sufficiently strong, the retailer will select the smaller manufacturer as CC. Cross-price elasticities for chain R1 are 96% higher than those in chain R2.\footnote{We estimate brand level cross-price elasticity within a chain as the 1% change in overall share for a brand following a 1% change in price for all UPCs of a competing brand. This measure is calculated for each brand combination in both chains.} As markets with strong product substitution generate more profits for the leading than the smaller manufacturer, the former would require a greater level of compensation from the retailer to convince her to accept the CC position. Our empirical results demonstrate retailers may indeed choose not to select the leading manufacturer as CC.

<table>
<thead>
<tr>
<th>Retailer/Manufacturer</th>
<th>M1</th>
<th>M2</th>
<th>M3</th>
<th>Optimal decision</th>
</tr>
</thead>
<tbody>
<tr>
<td>R1</td>
<td>-406.00</td>
<td>-69.03</td>
<td>40.27</td>
<td>M3</td>
</tr>
<tr>
<td>R2</td>
<td>55.02</td>
<td>22.46</td>
<td>5.01</td>
<td>M1</td>
</tr>
</tbody>
</table>

Table 5: Estimates of additional retailer profits from selecting each manufacturer as their CC
Interestingly, Table 5 shows that it would be unprofitable for chain R1 to select either M1 or M2 as CC. If the retailer would choose one of these manufacturers, the benefits from category price coordination and removal of double marginalization would not outweigh the compensation the supplier would require to achieve status quo profits.

### 5.3.2 Oligopoly retailers

In this section we report equilibrium results for two retailers making simultaneous CC selections. Table 6 below shows the impact of various retailer decision scenarios on profits. Interestingly, the large chain (R1) would select M3, the smallest manufacturer, as CC, regardless of the decision made by chain R2. The small chain’s (R2) best choice, on the other hand, does depend on R1’s choice. If chain R1 selects either M1 or M3, R2 should choose M3 as CC. However, if R1 selects M2, the medium size manufacturer, chain R2 should also select M2. Consistent with our earlier predictions, a unique pure strategy Nash Equilibrium exists in which both chains select the smallest manufacturer (M3) as their CC. In Section 2.1 we showed that in markets with strong product heterogeneity, such as in the market studied, retailers will more likely choose the smaller manufacturer as CC (see Table 1). In Section 2.2 we argued that in competitive retail markets with strong product heterogeneity and divergence in consumers’ retailer preference symmetric equilibria in which both retailers appoint the same CC become more likely. Interestingly, both our analytical and empirical results contradict the widely held belief that retailers choose the largest manufacturer as CC.

<table>
<thead>
<tr>
<th>Chain R1’s CC decision</th>
<th>M1</th>
<th>M2</th>
<th>M3</th>
</tr>
</thead>
<tbody>
<tr>
<td>Chain R2’s CC decision</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>M1</td>
<td>-636</td>
<td>-145</td>
<td>-575</td>
</tr>
<tr>
<td>M2</td>
<td>-344</td>
<td>-361</td>
<td>-154</td>
</tr>
<tr>
<td>M3</td>
<td>-220</td>
<td>-185</td>
<td>-52</td>
</tr>
</tbody>
</table>

The first (second) number in each cell represents the payoff to chain R1 (R2).

Table 6: Changes in profits following CC selection in a market with retailer competition
5.4 The impact of a category captain

Our results demonstrate that manufacturers not selected as CC reduce their wholesale prices between 0.03% and 0.20%, consistent with findings outlined in Section 2.3. However, compared to the impact on retail prices these effects are small; whereas retailers increase prices for the other manufacturer’s items between 0.09% and 2.64%, retail prices for the CC’s products’ are reduced between 12% and 14%.12

As retailers’ CC selection will impact consumers, retailers, manufacturers, and social welfare, it has important policy implications. The results of our welfare analysis are reported in Table 7 below. With Chinese walls in place the equilibrium in which both retailers select M3 as CC results in higher retailer profits and improved consumer and social welfare. The increase in consumer welfare is attributable to the removal of double marginalization which, in turn, results in a reduction in prices charged to consumers. Although both retailers are better off choosing the smaller manufacturer, manufacturers M1 and M2 are significantly worse off (-124K), and profits across all firms combined are negative (38K-124K = -86K).

Without Chinese walls to restrict information flow across retail accounts the CC could joint optimize profits across chains. We estimate the implications of a CC arrangement without information firewalls to quantify their importance. When M3, acting as CC to both retailers, recommends prices that would result in joint profit optimization across chains, consumer welfare would be reduced (-146K) due to the increased retail prices resulting from the elimination of retail competition. Interestingly, competing manufacturers are even worse off than consumers in this scenario as their combined profits drop by 181K.

<table>
<thead>
<tr>
<th>Scenario</th>
<th>Consumer welfare</th>
<th>Retailer/CC profit</th>
<th>Competitor profit</th>
<th>Social welfare</th>
</tr>
</thead>
<tbody>
<tr>
<td>CC with Chinese walls</td>
<td>189</td>
<td>38</td>
<td>-124</td>
<td>103</td>
</tr>
<tr>
<td>CC without Chinese walls</td>
<td>-146</td>
<td>180</td>
<td>-181</td>
<td>-147</td>
</tr>
</tbody>
</table>

Table 7: Weekly welfare implications ($000) of equilibrium CC choice with and without information firewalls

12 Results derived from a model without retail competition are similar.
6 Conclusions and further research

Our study is the first to quantify the costs and benefits of CC arrangements for retailers, manufacturers, and consumers. Below we discuss our research’s implications for all market players as well as public policy.

Retailers - It has been argued repeatedly in the literature that retailers lack both the resources and capabilities to effectively implement CM. CC arrangements allow retailers to achieve the benefits of CM when unable to implement it themselves. Retailers appear to set prices to maximize brand rather than category profits in our empirical application, suggesting that implementing CM is indeed costly.

Although it is generally assumed that retailers should select the largest manufacturer as CC, we show doing so is actually not always in their best interest. We demonstrate analytically that the retailers’ decision will depend on the level of heterogeneity between products and retailers as well as the degree of substitutability between products. Our empirical application’s policy simulations demonstrate that in the absence of retail competition the largest chain should select the smallest manufacturer while the smaller chain should select the largest manufacturer as their CC. In a competitive retail market, however, both retailers benefit most by appointing the smallest manufacturer as CC.

Even though CC collaborations are increasing, many retailers are still concerned about opportunistic behavior (Morgan et al. 2007). Manufacturers who serve as CCs walk a fine line between optimizing their own and the retailer’s performance. Retailers can use models such as ours as a device to detect undesirable CC behavior. The need to monitor CC’s recommendations may diminish retailer’s gains from CC-arrangements. Our estimates of the monetary benefits from CC arrangements can be viewed as an upper bound on the warranted level of retailer investment in monitoring manufacturer behavior.

In addition, when weighing the pros and cons of CC arrangements retailers should consider their long-term implications. Managing a category requires comprehensive insight into purchasing patterns and consumers’ preferences. By outsourcing more and more CM com-
ponents to their suppliers, retailers not only risk losing touch with consumers, which may be hard to regain (Kurtulus and Toktay 2004), but also power in the channel. These long-term implications of CC arrangements for retailers warrant further study.

Manufacturers - How much should manufacturers be willing to invest in CC capabilities? Our research has quantified the size of the profit pie that the retailer and CC may share when the latter supports the retailer’s pricing decisions. Even though a manufacturer may not share greatly in the spoils when the retailer has significant channel power, we showed that the profit implications of missing out on the CC job can be substantial. However, manufacturers are not motivated by potential profit losses; they compete for the CC job to increase their influence retailer decision making (Kurtulus and Toktay 2007). In fact, companies such as Total Floral, LLC envision vendor managed stores in which manufacturers manage product mix, pricing, ad profiles, and even in-store labor. More research is needed to establish which manufacturer investments in CC capabilities are most beneficial for both retailers and manufacturers.

Consumers - We show that CC arrangements can result in sizable benefits for consumers. However, information firewalls within the CC’s firm are critical for achieving welfare increases. Without these explicit restrictions, CC arrangements could result in a reduction, or even elimination, of retail competition in the market, which would, in turn, significantly harm consumers. Interestingly, as Basuroy et al. (2001) have shown that retailer implemented CM can cause social welfare loses, consumers may be better off when retailers outsource CM to their suppliers.

Public policy - Our findings have important implications for public policy. Even though Desrochers et al. (2003) argued that CC arrangements can limit smaller suppliers’ ability to compete, lead to higher prices, and reduce consumer welfare, our study is the first to quantify the impact of a CC for market participants. First of all, while CC arrangements may hurt manufacturers that are not selected as CC, in practice manufacturers compete for the job. Moreover, since we show it may be optimal for the retailer to choose either
a small or a large manufacturer, depending on market characteristics, it remains unclear whether or not a CC’s actions’ impact on other manufacturers should be considered anti-competitive, particularly since consumers may benefit from such arrangements. Regulations for CC arrangements should not be so onerous that only large (or small) firms could possibly comply, or the costs of implementing and monitoring them would eliminate benefits for all parties involved. Models such as ours could be used by policy makers to assess the impact of various regulation alternatives such as Chinese walls.

There are several interesting topics for future research on CC selection and its implications for manufacturers, retailers, and consumers. Although we studied CCs’ influence on retailer pricing, they may also be asked to support assortment decisions (Kurtulus and Toktay 2007), which could have important legal implications. For example, the FTC (2001) is concerned CC arrangements may result in strategic exclusion of rival products (e.g., Conwood vs United States Tobacco Co. and R.J. Reynolds Tobacco Co. vs Philip Morris). Furthermore, Kurtulus and Toktay (2007) suggest that CCs may push for increased diversity in retailers’ assortment in order to limit competition, even though retailers may benefit from lower levels of differentiation, if it increases manufacturer competition and drives down wholesale prices. Additional research on CC participation in various aspects of retail decision making could produce important insights for both managers and policy makers.
## Appendix

### A.1 UPC characteristics

<table>
<thead>
<tr>
<th>UPC</th>
<th>Brand</th>
<th>Package size</th>
<th>Package material</th>
<th>Low fat</th>
<th>Component A*</th>
<th>Component B*</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>M1.1</td>
<td>1</td>
<td>2</td>
<td>0</td>
<td>111.9</td>
<td>142.6</td>
</tr>
<tr>
<td>2</td>
<td>M1.1</td>
<td>1</td>
<td>2</td>
<td>1</td>
<td>94.0</td>
<td>88.8</td>
</tr>
<tr>
<td>3</td>
<td>M1.1</td>
<td>2</td>
<td>1</td>
<td>1</td>
<td>94.0</td>
<td>88.8</td>
</tr>
<tr>
<td>4</td>
<td>M1.1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>94.0</td>
<td>88.8</td>
</tr>
<tr>
<td>5</td>
<td>M1.1</td>
<td>2</td>
<td>1</td>
<td>0</td>
<td>111.9</td>
<td>142.6</td>
</tr>
<tr>
<td>6</td>
<td>M1.1</td>
<td>1</td>
<td>1</td>
<td>0</td>
<td>111.9</td>
<td>142.6</td>
</tr>
<tr>
<td>7</td>
<td>M1.1</td>
<td>3</td>
<td>2</td>
<td>0</td>
<td>111.9</td>
<td>142.6</td>
</tr>
<tr>
<td>8</td>
<td>M1.1</td>
<td>3</td>
<td>1</td>
<td>0</td>
<td>111.9</td>
<td>142.6</td>
</tr>
<tr>
<td>9</td>
<td>M1.1</td>
<td>2</td>
<td>2</td>
<td>0</td>
<td>111.9</td>
<td>142.6</td>
</tr>
<tr>
<td>10</td>
<td>M1.1</td>
<td>3</td>
<td>1</td>
<td>1</td>
<td>94.0</td>
<td>88.8</td>
</tr>
<tr>
<td>11</td>
<td>M1.1</td>
<td>2</td>
<td>2</td>
<td>1</td>
<td>94.0</td>
<td>88.8</td>
</tr>
<tr>
<td>12</td>
<td>M1.1</td>
<td>3</td>
<td>2</td>
<td>1</td>
<td>94.0</td>
<td>88.8</td>
</tr>
<tr>
<td>13</td>
<td>M1.2</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>91.8</td>
<td>35.0</td>
</tr>
<tr>
<td>14</td>
<td>M1.2</td>
<td>2</td>
<td>1</td>
<td>1</td>
<td>91.8</td>
<td>35.0</td>
</tr>
<tr>
<td>15</td>
<td>M1.2</td>
<td>2</td>
<td>2</td>
<td>1</td>
<td>91.8</td>
<td>35.0</td>
</tr>
<tr>
<td>16</td>
<td>M1.2</td>
<td>3</td>
<td>1</td>
<td>1</td>
<td>91.8</td>
<td>35.0</td>
</tr>
<tr>
<td>17</td>
<td>M2.1</td>
<td>1</td>
<td>2</td>
<td>1</td>
<td>94.0</td>
<td>43.0</td>
</tr>
<tr>
<td>18</td>
<td>M2.1</td>
<td>3</td>
<td>2</td>
<td>0</td>
<td>105.2</td>
<td>176.2</td>
</tr>
<tr>
<td>19</td>
<td>M2.1</td>
<td>1</td>
<td>1</td>
<td>0</td>
<td>105.2</td>
<td>176.2</td>
</tr>
<tr>
<td>20</td>
<td>M2.1</td>
<td>2</td>
<td>1</td>
<td>0</td>
<td>105.2</td>
<td>176.2</td>
</tr>
<tr>
<td>21</td>
<td>M2.1</td>
<td>2</td>
<td>2</td>
<td>0</td>
<td>105.2</td>
<td>176.2</td>
</tr>
<tr>
<td>22</td>
<td>M2.1</td>
<td>3</td>
<td>2</td>
<td>0</td>
<td>111.9</td>
<td>176.2</td>
</tr>
<tr>
<td>23</td>
<td>M2.1</td>
<td>1</td>
<td>1</td>
<td>0</td>
<td>111.9</td>
<td>176.2</td>
</tr>
<tr>
<td>24</td>
<td>M2.1</td>
<td>2</td>
<td>1</td>
<td>0</td>
<td>111.9</td>
<td>176.2</td>
</tr>
<tr>
<td>25</td>
<td>M2.1</td>
<td>2</td>
<td>2</td>
<td>0</td>
<td>111.9</td>
<td>176.2</td>
</tr>
<tr>
<td>26</td>
<td>M2.1</td>
<td>3</td>
<td>1</td>
<td>1</td>
<td>94.0</td>
<td>43.0</td>
</tr>
<tr>
<td>27</td>
<td>M2.1</td>
<td>3</td>
<td>2</td>
<td>1</td>
<td>94.0</td>
<td>43.0</td>
</tr>
<tr>
<td>28</td>
<td>M2.1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>94.0</td>
<td>43.0</td>
</tr>
<tr>
<td>29</td>
<td>M2.1</td>
<td>2</td>
<td>1</td>
<td>1</td>
<td>94.0</td>
<td>43.0</td>
</tr>
<tr>
<td>30</td>
<td>M2.1</td>
<td>2</td>
<td>2</td>
<td>1</td>
<td>94.0</td>
<td>43.0</td>
</tr>
<tr>
<td>31</td>
<td>M3.1</td>
<td>1</td>
<td>2</td>
<td>1</td>
<td>94.0</td>
<td>67.3</td>
</tr>
<tr>
<td>32</td>
<td>M3.1</td>
<td>2</td>
<td>2</td>
<td>1</td>
<td>94.0</td>
<td>67.3</td>
</tr>
<tr>
<td>33</td>
<td>M3.1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>94.0</td>
<td>67.3</td>
</tr>
<tr>
<td>34</td>
<td>M3.1</td>
<td>3</td>
<td>1</td>
<td>1</td>
<td>94.0</td>
<td>67.3</td>
</tr>
<tr>
<td>35</td>
<td>M3.1</td>
<td>2</td>
<td>1</td>
<td>1</td>
<td>94.0</td>
<td>67.3</td>
</tr>
<tr>
<td>36</td>
<td>M3.1</td>
<td>3</td>
<td>2</td>
<td>1</td>
<td>94.0</td>
<td>67.3</td>
</tr>
</tbody>
</table>

* variable has been scaled for reasons of confidentiality.

Table 8: UPC characteristics
References


Competition-Commission. Working paper on category management. *Competition Commis-
sion, UK*, 2006.


C. Dussart. Category management: Strengths, limits and developments. *European Manage-


34
Figure 1: Optimal monopolist retailer policy as a function of model parameters
Figure 2: Distribution of the price parameter in the random coefficient logit model
Figure 3: Distribution of the brand parameters in the random coefficient logit model