Should retailers outsource Category Management to a Category Captain?

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Abstract

It has been argued that many retailers lack both the resources and capabilities to maximize category performance. Retailers may seek category management (CM) advice from a manufacturer, referred to as category captain (CC). A CC’s recommendations affect all brands in the category, not just her own. Although the number of CC-collaborations is increasing, many retailers are concerned about manufacturer opportunism and militant behavior by competing manufacturers, while government agencies are worried about anti-competitive behavior that could harm consumers. In this study we develop an empirical model to evaluate competing retailers’ CC selection decisions and to quantify the impact of CC-arrangements and retailer-implemented CM on retailers, manufacturers, and consumer welfare.

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 in order 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 (Dewsnup 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). In fact, Basu Roy et al. (2001) not only show that manufacturers and consumers may be worse off with CM but that even the benefits to retailers are unclear.

Coordinating prices 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 2011, Subramanian et al. 2010). 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, 2011). A CC may be asked to analyze category-level data, assist in setting category goals, and develop and implement category plans (Basu Roy et al. 2001, Dussart 1998). Due to the level of coordination involved retailers generally choose a single CC (Webster 1992, Lindblom and Olkkonen 2008), whose recommendations affect all brands in the category, not just her own (Subramanian et al. (2010)).
Industry reports (e.g., Progressive Grocer 2008) suggest that both manufacturers and retailers attribute substantial growth to CC-arrangements. For example, Gooner et al. (2011) interviewed retailers and found that expanding the size of the “category pie” is a key benefit retailers expect from a CC-relationship. When data, insights, and knowledge are pooled in an effective retailer-supplier collaboration both parties can 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 the 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 Subramanian et al. (2010) suggest the number of CC-collaborations is increasing, many retailers are concerned about latent manufacturer opportunism and doubt successful alliances can be forged (Morgan et al. 2007). Also, one retailer’s choice of CC can impact other players in the market. Desrochers et al. (2003) argue that CC-arrangements may limit other suppliers’ ability to compete, resulting in 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 information firewalls within their firms to prevent improper use of data gathered from one retailer to support pricing decisions for other retailers in the market (FTC 2001, Competition-Commission 2006). Finally, opportunistic behavior on the part of the CC may lead to militant behavior by the non-CC manufacturers that could hurt retailers and manufacturers alike (Gooner et al. 2011).

The existing literature on CC-arrangements is scarce. A few papers have sought to develop predictions from theoretical models (e.g., Kurtulus and Toktay 2011), Subramanian
et al. (2010)). However, tools for weighing the costs and benefits of CCs are missing and the empirical consequences of CC-arrangements are unknown (Kurtulus and Toktay 2004, 2011, Morgan et al. 2007, Lindblom and Olkkonen 2008). While retailers often select the largest manufacturer in the category (FTC 2001, Kurtulus and Toktay 2004), *Progressive Grocer* listings indicate that smaller suppliers have also been appointed (Progressive Grocer 2008, 2007).\(^1\) Retailer CC-choice in a setting with retail competition has neither been studied empirically nor analytically.

In this paper we quantify the impact of CC-arrangements on consumer welfare and market participants’ prices and profits. As, due to anti-trust concerns, data on CC-arrangements are not available, 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. While CCs can be assigned different roles we focus on the effects of using a CC to support retailer category-pricing decisions.

Our empirical results indicate that a move from UPC profit maximization to coordinated category pricing may not be profitable to retailers when manufacturers increase wholesale prices. We demonstrate that not only retailers but also manufacturers and consumers are worse off when retailers implement CM without support from a manufacturer. In contrast, retailer profitability can be substantially enhanced through a CC-arrangement particularly when choosing the leading manufacturer as CC. We find that consumer prices for the CC’s products go down while prices for competing manufacturers’ products go up. Furthermore, we show that CC-arrangements can improve consumer welfare, in contrast to concerns commonly expressed by policy makers. Manufacturers not selected as CC, however, could see a significant drop in profitability. Finally, we demonstrate that information firewalls are needed to ensure the consumer welfare benefits of CC-arrangements are fully realized. However, CC-collusion across retailers can still enhance consumer welfare compared to retailer

\(^1\) *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.
implemented CM.

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

2 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 2003-2004. We observe both weekly wholesale prices charged to retailers for every UPC sold by one manufacturer and retail transactions for all UPCs sold in a major product category in a Midwest market. Whereas these data are generally not available to researchers, they are accessible to manufacturers in the industry.

Our dataset allows us to contribute to the limited extant literature in three distinct ways. First, as our data covers transactions from competing supermarket chains in the market we are able to address the impact of retail competition on CC-selection, 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 2007), 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). Nijs et al. (2010) have shown that AAC introduces both an endogeneity problem (see also Peltzman 2000) and a significant bias in trade deal pass-through estimates. Our cost data help us to determine if our model can accurately uncover retailer and manufacturer margins. Finally, we estimate the implications of CC-relationships at the chain level. None of the
publicly available datasets contain accurate chain level information. Our chain-level data, on the other hand, is derived from a census of stores in a market. Publicly available sources such as the academic IRI dataset (Bronnenberg et al. 2008) provide information on a sample of stores in each chain. The induced sampling variability could lead to under- or overestimation of the true effects of CC-arrangements. As an illustration, we calculated chain-level market shares for the leading manufacturers in a geographical market covered by both the IRI dataset and our own. While the smallest differences are only a single share point, the average difference across brands and chains was equal to 4.7% market share points. As, to date, IRI has not made projection tools available to researchers, the large sampling variability in the IRI data would make it inappropriate for the purpose of estimating the effects of CC-arrangements at the chain level.

We have access to data from two major supermarket chains (R1 and R2) in a large midwestern market. These retailers account for 60% of dollar volume sales in supermarkets and drugstores in this market. The top 14 brands in the category represent 80% of dollar volume in the geographical market. These brands are owned by the top three players in the category (M1, M2, M3). We focus on a set of 48 UPCs, which cover 95% of brand sales.

In our econometric model consumer choice is specified at the UPC level. We also include an outside good in the model. The consumer chooses the outside good if she does not buy in the category or does not buy any of the products included in our analysis. The mean utility of the outside good is normalized to be constant over time and equal to zero. To calibrate the outside option we need information on the total potential market size. We use the population living in zip-code areas covered by chains R1 and R2 and multiply the number of potential consumers by the consumption rate of a heavy user in the category to determine market potential. The outside good is large in this market with an average share of 92.81%. Table 1 shows the relative shares for the brands and chains studied. Manufacturer M1 is the largest player (66.4%), followed by M2 (29.5%), and M3 (4.1%). Brand 1 has the biggest market share in both chains.
Average brand prices are reported in Table 2.\textsuperscript{2} Brands 6 and 7 are priced highest. M1 and M2 have brands in both the higher and lower price tiers, while M3 only sells products in the highest price tier.

In addition, our database contains information on chain level feature or display support for a UPC in a given week. As category demand may be correlated with temperature, we also gathered weekly weather data for the region. We use instruments for demand estimation that are correlated with price changes but not with demand.\textsuperscript{3} We collected data on possible marginal cost shifters at the national, regional, and local level: Prices for key materials used to manufacture products in this industry, prices for electricity, and prices for gas used in production. In addition, we obtained data on retail prices in cities on the East- and West Coast (Nevo 2001). Any changes in supply conditions should induce a common price shock in multiple cities. In Section 4.1 we use a Sargan test to evaluate whether our instruments adequately address price endogeneity. The test determines if the residuals from our demand model are uncorrelated with the instruments, as they should be.

\textsuperscript{2}For confidentiality reasons prices are standardized by 1/10th of the lowest priced good (brand 12 in chain R2).

\textsuperscript{3}We cannot use wholesale prices since we observe them only for one manufacturer.
In this section we develop a structural model to study retailers’ CC choices and their impact on manufacturers, retailers, and consumers. The ability to estimate the impact of strategic or regulatory changes in the marketplace is an important advantage of using a setup that explicitly models the decisions of the market participants. As Chintagunta and Nair (2011) argue, “The promise of structural models, derived from theoretical micro-foundations of consumer behavior, is built on the premise that these counterfactuals can be more credibly simulated by re-solving the model explicitly for agents’ policies given estimates of policy-invariant parameters that index primitive consumer preferences ... In essence, the approach involves estimating deep parameters indexing consumer behavior and then building up to a ‘new demand’ structure under the counterfactual conditional on these primitives. In some sense, the models use theory to navigate the unknown, and in several contexts they have been shown to provide surprisingly good predictions of radically different counterfactuals and underlying primitives.”

We build a model of competition in vertical channels with incomplete data. Estimating the welfare implications of CC-arrangements requires a system based on individual level

<table>
<thead>
<tr>
<th>Brand</th>
<th>Manufacturer</th>
<th>R1</th>
<th>R2</th>
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</thead>
<tbody>
<tr>
<td>Brand 1</td>
<td>M1</td>
<td>17.33</td>
<td>17.60</td>
</tr>
<tr>
<td>Brand 2</td>
<td>M1</td>
<td>17.22</td>
<td>17.39</td>
</tr>
<tr>
<td>Brand 3</td>
<td>M1</td>
<td>12.83</td>
<td>12.82</td>
</tr>
<tr>
<td>Brand 4</td>
<td>M1</td>
<td>12.84</td>
<td>12.87</td>
</tr>
<tr>
<td>Brand 5</td>
<td>M3</td>
<td>17.09</td>
<td>17.04</td>
</tr>
<tr>
<td>Brand 6</td>
<td>M1</td>
<td>20.06</td>
<td>20.16</td>
</tr>
<tr>
<td>Brand 7</td>
<td>M1</td>
<td>20.06</td>
<td>20.21</td>
</tr>
<tr>
<td>Brand 8</td>
<td>M2</td>
<td>18.26</td>
<td>18.31</td>
</tr>
<tr>
<td>Brand 9</td>
<td>M2</td>
<td>12.35</td>
<td>12.29</td>
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<tr>
<td>Brand 10</td>
<td>M2</td>
<td>17.16</td>
<td>17.35</td>
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<tr>
<td>Brand 11</td>
<td>M2</td>
<td>10.18</td>
<td>10.11</td>
</tr>
<tr>
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<td>M2</td>
<td>10.03</td>
<td>10.00</td>
</tr>
<tr>
<td>Brand 13</td>
<td>M2</td>
<td>10.10</td>
<td>10.09</td>
</tr>
<tr>
<td>Brand 14</td>
<td>M1</td>
<td>11.14</td>
<td>11.13</td>
</tr>
</tbody>
</table>

Table 2: Average retail prices

3 Econometric model
utility. Consistent with previous research on retail pricing, we assume prices result from a weekly game between retailers and manufacturers (e.g., Chintagunta 2002, Chintagunta et al. 2003, Dubé 2004, Villas-Boas 2007). 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 conduct policy simulations using estimated marginal costs for all agents to trace out response functions and quantify the effects of CC-arrangements and retailer implemented CM.

3.1 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 2000). Formally, we assume each consumer $i$ either chooses one UPC ($j \in [1..J]$) from a retail chain ($r \in [1..R]$) or the outside option in each week $t$ ($t \in [1..T]$). Every UPC-retail chain combination $(j,r)$ has characteristics $(x_{jrt}, \xi_{jrt}, p_{jrt})$. $x_{jrt}$ includes (a) UPC fixed effects, (b) retail chain fixed effects, (c) weekly market characteristics, i.e., holidays and temperature, (d) a time trend, and (e) 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 2000, 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:

$$u_{ijrt} = (Y_i - p_{jrt})\beta_i + \alpha_i + X\gamma + \xi_{jrt} + \epsilon_{ijrt},$$

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. \(\alpha_i\) captures the mean preference for the category. \(\gamma\) captures the influence for product characteristics 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

\[
(\beta_i, \alpha_i) \sim N((\beta, \alpha), \Sigma),
\]

The parameters \(\beta\) and \(\alpha\) capture the average marginal utility of income and mean preference for the category. We assume heterogeneity is normally distributed with variance \(\Sigma\). For tractability we assume \(\Sigma\) is a diagonal matrix (Nevo 2000). We further assume inherent preference for the outside option is equal to zero. The utility for the outside option is given by

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

### 3.2 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

\[
P_{ijrt} = \frac{1}{\int_{\epsilon(u_{ijrt} > u_{ij^r't})} dF(\epsilon)},
\]

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

\[
s_{jrt} = \frac{1}{\int_{\epsilon} \int_{\epsilon(u_{ijrt} > u_{ij^r't})} dF(\epsilon)dF(v)}.
\]

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 2000). The linear parameters are estimated by GMM using the instruments described in Section 2. To ensure a global minimum we use 10 random starting points, select the lowest objective function value, and then take 100 random perturbations from this value as a new starting point. We employ the Newey-West algorithm to obtain consistent standard errors of the parameter estimates.

### 3.3 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 2007). The retailers studied do not carry a private label product in the category. We assume manufacturers set wholesale prices to maximize profits across their product line jointly for both retail chains. We estimate four sets of objective functions for the retailer which either maximize profits (i) for the category, (ii) per manufacturer, (iii) per brand, or (iv) per UPC (Sudhir 2001, Basuroy et al. 2001).

#### 3.3.1 Retailer pricing

Retailer profits are given by

$$\pi_{rt}(p_r, p) = \sum_{j \in S_{rt}} [p_{jrt} - p^w_{jrt} - c^r_{jrt}] D_{jrt}(p) + C_{rt},$$  \hspace{1cm} (6)$$

where $p_{jrt}$ refers to the price charged by retail chain $r$ for product $j$ in week $t$, $p^w_{jrt}$ refers to the wholesale price charged by the manufacturer to retail chain $r$ for product $j$ in week $t$, $c^r_{jrt}$ 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 $t$. For example, 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 UPC, there will be one profit equation for each UPC. $C_{rt}$ includes all fixed costs that do not change with demand. The retailer sets price to maximize profits

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

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

$$D_{rjt}(p) + \sum_{k \in S_{rt}} [p_{krt} - p_{kr^w} - c_{kr}^r] \frac{\partial D_{rkt}(p)}{\partial p_{jrt}} = 0,$$

which, in matrix notion, simplifies to

$$\beta \sum \begin{pmatrix} \vdots \\ P_t \\ \vdots \end{pmatrix} - \begin{pmatrix} \vdots \\ P_t^w \\ \vdots \end{pmatrix} - \begin{pmatrix} \vdots \\ c_t^r \\ \vdots \end{pmatrix} = - \begin{pmatrix} \vdots \\ \cdots T_r \times \Delta_{rt} \cdots \\ \vdots \end{pmatrix}^{-1} \begin{pmatrix} \vdots \\ D_t \\ \vdots \end{pmatrix},$$

where $P_t$ is a vector of all prices charged to consumers by both retail chains at time $t$, $P_t^w$ is a vector of all wholesale prices charged to the retailers at time $t$, and $c_t^r$ 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. We infer price-cost margins for the retailer using

$$p_t - p_t^w - c_t^r = -(T_r \ast \Delta_{rt})^{-1} D_t.$$
3.3.2 Manufacturer pricing

We assume observed retail prices result from a game with manufacturers as Stackelberg leaders. The profit function for each manufacturer $m$ is

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

(11)

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 $t$. $p(p_{r}^w)$ is the retail price that will be charged to consumers when the manufacturer charges the retailer $p_{r}^w$. We infer price-cost margins for the manufacturer using

$$
p_t^w - c_t^m = -(T_m * \Delta_{mt})^{-1} D_t(p),
$$

(12)

where $T_m$ is an ownership matrix indicating which UPCs are produced by each manufacturer. $T_m(j,k) = 1$ if the same manufacturer sells UPCs $j$ and $k$, and 0 otherwise. $\Delta_{mt}$ is the matrix of own- and cross-price derivatives where element $(j,k)$ is $\frac{\partial D_{kr}}{\partial p_{jrt}}$ as in Villas-Boas (2007). We can simplify this further as $\frac{\partial D_{kr}}{\partial p_{jrt}} = \sum \forall l \frac{\partial D_{kl}}{\partial p_{lrt}} \frac{\partial p_{lrt}}{\partial p_{jrt}}$. In matrix form we have $\Delta_{mt} = \Delta_{pt} \Delta_{rt}$. We know $\Delta_{rt}$, the own- and cross-price demand derivatives with respect to retail price, as used in the retailers’ first order conditions. $\Delta_{pt}$ is the matrix of retailer reaction functions, which we estimate by applying the implicit function theorem to the retailers’ first order conditions. $\Delta_{pt}$ is the matrix of retailer reaction functions, which we estimate by applying the implicit function theorem to the retailers’ first order conditions. If manufacturers are Stackelberg leaders, they know consumer prices are set to satisfy the retailers’ first order conditions, in particular $\forall j$ retailer $r$ will solve $D_{jrt} + \sum_{k \in S_{rt}} [p_{krt}^w - p_{krt}^w - c_{krt}^r] \frac{\partial D_{kr}}{\partial p_{jrt}} = 0$. From the implicit function theorem we get $\Delta_{pt} = -\left( \frac{\partial D_{jrt} + \sum_{k \in S_{rt}} [p_{krt}^w - p_{krt}^w - c_{krt}^r] \frac{\partial D_{kr}}{\partial p_{jrt}}}{\partial P_{rt}} \right)^{-1} \left( \frac{\partial [D_{jrt} + \sum_{k \in S_{rt}} [p_{krt}^w - p_{krt}^w - c_{krt}^r] \frac{\partial D_{kr}}{\partial p_{jrt}}]}{\partial P_{rt}} \right)$. If competition between manufacturers and retailers is Vertical Nash $\Delta_{pt}$ is the identity matrix.
3.4 Simulating the impact of selecting a category captain

3.4.1 Game structure

As described in Section 2, we consider a market with three manufacturers and two retailers. Each manufacturer sells one or more brands and each brand has multiple UPCs. Manufacturers set UPC wholesale prices for both chains and retailers set UPC retail prices. The vertical channel structure is depicted in Figure 3.4.1 below.

To select an appropriate supply model we use price-cost margins recovered from estimates of demand parameters and apply the test of nonnested models proposed by Rivers and Vuong (2002). Specifically, we evaluate eight alternative models; four in which vertical competition is specified as Manufacturer Stackelberg (MS), and four in which it is specified as Vertical Nash (VN). For each structure we then consider a case in which retailers price at either the category (CM), manufacturer (M), brand (B), or UPC (U) level. We empirically determine the most appropriate structure for our data set without a CC. The key benefit of structural models in our application lies in their ability to describe outcomes following changes in the
industry, i.e., a retailer entering into a CC-arrangement.

We begin with the Stackelberg game in which manufacturers first set wholesale prices simultaneously to maximize the profits from their portfolio of products. In the second stage, retailers simultaneously set retail prices to maximize profits at the category (CM), manufacturer (M), brand (B), or UPC (U) level. Following Kurtulus and Toktay (2011) and Wang et al. (2003) we assume that the CC recommends prices to maximize joint retailer-CC profits and eliminates double marginalization on her products. We build a game structure consistent with Kurtulus and Toktay (2011) as follows:

- **Stage 1 – Select CC**: Each retailer offers a take-it-or-leave-it level of compensation $C$ to one manufacturer (or none) to act as CC. The manufacturer can either accept or reject the offer.

- **Stage 2 – Set wholesale prices**: Manufacturers not selected as CC set their wholesale prices simultaneously to maximize profits for their portfolio of products.

- **Stage 3 – Set retail prices**: In the absence of a CC retailers will set prices as in the pre-CC scenario. Else the CC recommends prices to maximize category profits and eliminates double marginalization for each of her UPCs sold by the retailer.

If the vertical structure in our data is best characterized as Vertical Nash, stages 2 and 3 are combined, i.e., wholesale and retail prices are set simultaneously. We solve the first stage by backward induction. The offer $C$ must satisfy the Incentive Compatibility (IC) condition for the manufacturer chosen as the CC. This can be achieved by offering a level of compensation $C$ that makes the manufacturer indifferent between becoming CC and the pre-CC scenario (see Kurtulus and Toktay 2011). As Kurtulus and Toktay (2011) state “... the alliance profit is shared between the retailer and the category captain through some predetermined mechanism. For example, a fixed fee or the category captain’s wholesale price ... or a combination of the two ...”. If $C$ is below pre-CC profit levels for all manufacturers an agreement will not be reached. All else equal, an offer will only be extended if retailer profit -
$C$ exceeds pre-CC profits. Conditional on the competing retailer’s actions, the manufacturer that can generate the highest level of profits will receive the offer. We solve the 2nd and 3rd stages for 16 scenarios of retailers’ CC decisions in stage 1, i.e., each retailer can pick one of the manufacturers as CC or decide not to select one. Given the retailers’ CC decisions we derive the best price responses for retailers and manufacturers and determine if a unique pure strategy Nash Equilibrium exists.

We empirically evaluate two additional negotiation scenarios. First, although Jeuland and Shugan (1983) argue “Neither the retailer nor the manufacturer would be willing to accept less after coordination were achieved than before it were achieved”, manufacturers not selected as CC may be willing to accept an offer below their pre-CC profit level if they are worse off when a CC-arrangement is put in place. Suppose, manufacturer M1 generates profits $X$ for the retailer as CC, while manufacturer M2 would only generate $X - Y$. If M2 is worse off with M1 as the CC, she may be willing to accept a level of compensation $C'$ equal to $C - Y$ to become CC. If so, the retailer would be indifferent between choosing M1 or M2 as CC. M2 would only accept such an offer, however, if her net profit as CC ($C'$) would exceed her profits as non-CC.

Finally, if manufacturer M1 is selected as CC and recommends prices that would make manufacturers M2 and M3 worse off (i.e., pre-CC profits - $Z$) they have an incentive to displace M1 as the CC. This could initiate a downward spiral in which all manufacturers are worse off. As these scenarios are not observed in practice (Gooner et al. 2011), the CC can avoid this unattractive outcome by setting prices such that manufacturers M2 and M3 are indifferent between being non-CC and becoming the CC. If M1 retains compensation level $C$ this pricing scheme would decrease retailer benefits from the CC-arrangement by $Z$. Despite lower profits the retailer may prefer this scenario as it limits the risk of legal action or militant behavior by the non-CCs. In practice there is little evidence of opportunistic CC behavior and complaints by non-CCs are limited, suggesting this could be a plausible outcome (Gooner et al. 2011).
Note that in the game structure described above we do not assume formal contracts are established. Based on interviews and surveys with managers, Gooner et al. (2011) argue that the CC-retailer relationship is a form of relational governance that allows the CC and the retailer to “cooperate without formal agreements or contracts, which are deliberately avoided because of antitrust concerns”. They explain that partners can develop mutually beneficial relationships “even in a context that our fieldwork revealed uses no formal contracts to safe-guard the ability to claim value from their joint efforts”.

3.4.2 Policy simulations

A key component for our policy simulations is reflected in the level of coordination in retail prices (e.g., UPC versus category level). As discussed in Section 3.3.1 this is achieved by changes to the ownership matrices $T_r$ in equation 9. Specifically, $T_r(i, j) = 1$ if retailer $r$ maximizes joint profits over UPCs $i$ and $j$, and zero otherwise. If the retailer coordinates prices across all UPCs sold $T_r$ is a matrix of ones. In contrast, if the retailers sets prices for each UPC separately $T_r$ is an identity matrix. If a CC suggests prices to the retailer $T_r$ is a matrix of ones. The CC’s wholesale prices are set at cost while the non-CCs set prices either simultaneously with or before the retailer-CC (i.e., Vertical Nash or Manufacturer Stackelberg).

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

$$CV_{it} = \frac{\log(\sum_{j \in [0,J], r \in [1,R]} \exp(V_{jrit}^{S1})) - \log(\sum_{j \in [0,J], r \in [1,R]} \exp(V_{jrit}^{S2}))}{\beta_{it}}, \quad (13)$$

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

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

To derive a pure strategy Nash equilibrium in a setting with retail competition we evaluate the profit implication for all combinations of CC choices and determine each retailer’s best response to the competing chain’s CC decisions.

## 4 Results

### 4.1 Demand results

Estimates from a random coefficients logit model with UPC fixed effects are reported in Table 3 below. The table shows mean effects, standard errors, and heterogeneity coefficients for price and the constant (i.e., standard deviations). For comparison we also include estimates for a homogenous logit with endogenous prices. Except for price and the mean UPC fixed effect, the estimates are quite similar across the two models.

<table>
<thead>
<tr>
<th></th>
<th>Logit IV Estimate</th>
<th>s.e.</th>
<th>RC Logit IV Estimate</th>
<th>s.e.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mean UPC fixed effect</td>
<td>-6.92*</td>
<td>-</td>
<td>-5.170*</td>
<td>-</td>
</tr>
<tr>
<td>Price</td>
<td>-0.409*</td>
<td>0.127</td>
<td>-0.872*</td>
<td>0.208</td>
</tr>
<tr>
<td>Chain R1</td>
<td>1.831*</td>
<td>0.010</td>
<td>1.824*</td>
<td>0.010</td>
</tr>
<tr>
<td>Feature/Display</td>
<td>0.705*</td>
<td>0.046</td>
<td>0.630*</td>
<td>0.053</td>
</tr>
<tr>
<td>Holiday</td>
<td>0.210*</td>
<td>0.013</td>
<td>0.279*</td>
<td>0.028</td>
</tr>
<tr>
<td>Temperature</td>
<td>0.002*</td>
<td>0.000</td>
<td>0.001*</td>
<td>0.000</td>
</tr>
<tr>
<td>Trend</td>
<td>0.001*</td>
<td>0.000</td>
<td>0.003*</td>
<td>0.001</td>
</tr>
<tr>
<td>Standard deviation price</td>
<td>0.180*</td>
<td>0.038</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Standard deviation constant</td>
<td>0.750*</td>
<td>0.208</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

* p < .01

Table 3: Demand estimates

On average, price has a negative effect on utility and price sensitivity varies significantly
across consumers. Although the mean of the UPC fixed effects suggests some consumers do not buy in the category, there is strong heterogeneity in preferences. The positive coefficient for R1, the market leader, confirms consumers prefer to shop at this chain. As expected, we find that demand increases with feature and display support, during the holiday season, and with higher temperatures. There is also a slight positive trend in demand. We used a Sargan test to evaluate the instruments used in estimation (see Section 2). The $p$-value for the test was equal to .36, suggesting our instruments adequately address price endogeneity for the random coefficients logit model.

Table 4 shows mean own- and cross-price elasticities by manufacturer. The average own-price elasticities vary from -3.35 for manufacturer M2 and -4.12 for manufacturer M3. Previous studies implementing similar demand models report own-price elasticities in the same range (Nevo 2001) or higher (Villas-Boas 2009, Bonnet and Dubois 2010). Manufacturer M3 has the most elastic demand but also the most limited ability to draw demand from manufacturers M1 and M2. M1 has the highest cross-price elasticity.

<table>
<thead>
<tr>
<th>Manufacturer</th>
<th>Mean own</th>
<th>Mean cross</th>
</tr>
</thead>
<tbody>
<tr>
<td>M1</td>
<td>-3.90</td>
<td>0.42</td>
</tr>
<tr>
<td>M2</td>
<td>-3.35</td>
<td>0.14</td>
</tr>
<tr>
<td>M3</td>
<td>-4.12</td>
<td>0.02</td>
</tr>
</tbody>
</table>

Table 4: Mean price elasticities by manufacturer

Table 5 reports mean own- and cross-price elasticities by retailer. The retailers’ average own-price elasticities are very similar. Furthermore, the within and across store cross-price elasticities are virtually identical (see Villas-Boas 2009 for a similar result).

<table>
<thead>
<tr>
<th>Retailer</th>
<th>Mean own</th>
<th>Mean cross</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Within stores</td>
</tr>
<tr>
<td>R1</td>
<td>-3.69</td>
<td>0.48</td>
</tr>
<tr>
<td>R2</td>
<td>-3.71</td>
<td>0.10</td>
</tr>
</tbody>
</table>

Table 5: Mean price elasticities by retail chain
4.2 Supply side results

Recall we use Rivers and Vuong (2002)’s nonnested model specification test to determine the best fitting channel cost model for our data set without a CC. Specifically, we evaluate eight alternative models; four in which vertical competition is specified as Manufacturer Stackelberg (MS), and four in which it is specified as Vertical Nash (VN). For each structure we then consider a case in which retailers price at either the category (CM), manufacturer (M), brand (B), or UPC (U) level. Our testing procedure follows Bonnet and Dubois (2010).

For the best fitting model the estimated marginal costs should be most strongly correlated with variables that affect marginal costs. The test determines which cost equation has the best statistical fit given the observed cost shifters $W_{jt}$, which are independent of the conjectured supply model. For each model $h$ we use nonlinear least squares to minimize the lack-of-fit

$$Q^h_t = \sum_{j,r} [\log(p_{jrt} - \Gamma^h_{jrt} - \gamma^h_{jrt}) - \omega^h_{jr} - W_{jt}\lambda_h]^2,$$

where $p_{jrt}$ is the retail price for product $j$ in retail chain $r$ at time $t$, $\Gamma^h_{jrt}$ is the manufacturer price-cost margin for model $h$, $\gamma^h_{jrt}$ is the retailer price-cost margin, $\omega^h_{jr}$ is an unknown product and chain specific parameter, and $W_{jt}$ are observable shocks to the marginal cost of product $j$ at time $t$. Two competing models $h$ and $h'$ are asymptotically equivalent if

$$H_0 : \lim_{T \to \infty} \{\hat{Q}^h - \hat{Q}^{h'}\} = 0,$$

where $\hat{Q}^h$ ($\hat{Q}^{h'}$) is the expectation of the lack-of-fit measure $Q^h_t$ ($Q^{h'}_t$) for model $h$ ($h'$). We consider two alternative hypotheses

$$H_1 : \lim_{T \to \infty} \{\hat{Q}^h - \hat{Q}^{h'}\} < 0,$$

$$H_2 : \lim_{T \to \infty} \{\hat{Q}^h - \hat{Q}^{h'}\} > 0.$$
where in $H_1$ model $h$ is asymptotically better than model $h'$ while $H_2$ indicates $h'$ is asymptotically better than $h$. The test statistic of interest is $Z_{hh'} = \frac{\sqrt{T}}{\hat{\sigma}_{hh'}} \sum_t (\hat{Q}_t^h - \hat{Q}_t^{h'})$ where $\hat{\sigma}_{hh'}$ is the estimated variance of the difference in lack-of-fit. Values of $Z_{hh'}$ are compared to critical values of the standard normal distribution to determine statistical significance. Results are reported in Table 6 below. A significantly negative (positive) value indicates the column (row) model has a higher lack-of-fit. As all values of $Z_{hh'}$ in row MS-U are significantly smaller than zero, we find empirical support for a supply-side model with UPC level price setting by the retailer and manufacturers as Stackelberg leaders. Using the identified specification to predict wholesale and retail prices we find that the correlation between estimated and actual wholesale prices is .90. The correlation between estimated and actual total manufacturing and distribution costs is .91.

<table>
<thead>
<tr>
<th>$H_1 \setminus H_2$</th>
<th>MS-CM</th>
<th>MS-M</th>
<th>MS-B</th>
<th>MS-U</th>
<th>VN-CM</th>
<th>VN-M</th>
<th>VN-B</th>
<th>VN-U</th>
</tr>
</thead>
<tbody>
<tr>
<td>MS-CM</td>
<td>11.81</td>
<td>11.94</td>
<td><strong>12.09</strong></td>
<td>-2.16</td>
<td>4.15</td>
<td>6.19</td>
<td>6.43</td>
<td></td>
</tr>
<tr>
<td>MS-M</td>
<td>-11.81</td>
<td>-10.19</td>
<td>-10.56</td>
<td><strong>-4.74</strong></td>
<td>-1.77</td>
<td>0.48</td>
<td>0.76</td>
<td></td>
</tr>
<tr>
<td>MS-B</td>
<td>-11.94</td>
<td>-10.19</td>
<td><strong>13.64</strong></td>
<td>-6.81</td>
<td>-7.24</td>
<td>-6.13</td>
<td>-5.93</td>
<td></td>
</tr>
<tr>
<td>MS-U</td>
<td><strong>-12.09</strong></td>
<td><strong>-10.56</strong></td>
<td><strong>-13.64</strong></td>
<td><strong>-6.98</strong></td>
<td><strong>-7.63</strong></td>
<td><strong>-6.64</strong></td>
<td><strong>-6.45</strong></td>
<td></td>
</tr>
<tr>
<td>VN-CM</td>
<td>2.16</td>
<td>4.74</td>
<td>6.81</td>
<td><strong>6.98</strong></td>
<td>5.87</td>
<td>6.53</td>
<td>6.63</td>
<td></td>
</tr>
<tr>
<td>VN-M</td>
<td>-4.15</td>
<td>1.77</td>
<td>7.24</td>
<td><strong>7.63</strong></td>
<td>-5.87</td>
<td>10.32</td>
<td>10.63</td>
<td></td>
</tr>
<tr>
<td>VN-B</td>
<td>-6.19</td>
<td>-0.48</td>
<td>-13.64</td>
<td><strong>6.64</strong></td>
<td>-6.53</td>
<td>-10.32</td>
<td>12.61</td>
<td></td>
</tr>
<tr>
<td>VN-U</td>
<td>-6.43</td>
<td>-0.76</td>
<td>5.93</td>
<td><strong>6.45</strong></td>
<td>-6.63</td>
<td>-10.63</td>
<td>-12.61</td>
<td></td>
</tr>
</tbody>
</table>

Vertical competition: MS - Manufacturer Stackelberg, VN - Vertical Nash
Retailer pricing level: CM - Category Management, M - Manufacturer, B - Brand, U - UPC
Cells values are estimates of $Z_{hh'}$

Table 6: Nonnested model comparisons

As our model is static, we try to determine empirically whether omitting dynamics is likely to affect our results. Villas-Boas (2009) states that “The implications of assuming a static framework are shown in Nevo and Hendel (2006): ignoring dynamic demand stockpiling behavior results in upward-biased own price elasticities and, thus, in estimated price-cost margins that are too low.” Since our data contains the actual manufacturer and retailer price-cost margins for the UPCs produced by one manufacturer, we are able to evaluate if the margins are indeed too low as argued by Nevo and Hendel (2006). Using the best-fitting
supply model (MS-U), we find our estimated margins are, on average, the same size as the margins observed in the data.

### 4.3 Impact of a category captain

To evaluate the impact of a retailer’s CC decision we simulate the effect of retailer $r$ selecting manufacturer $m$ as CC and calculate equilibrium prices and profits.

#### 4.3.1 Monopoly retailers

We first view each retailer as a monopolist selecting a CC among the competing manufacturers. Table 7 below shows the impact of different choices on retailer profits. Remember that M1 is the largest and M3 the smallest player in both chains (see Table 1). We find that both chains’ optimal CC is M1. All else equal, the retailer will benefit most from removal of double marginalization for largest manufacturer, as it would result in lower retail prices for the most preferred products. Interestingly, selecting M3 as CC would be unprofitable for chain R1.

<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>103</td>
<td>35</td>
<td>-9</td>
<td>M1</td>
</tr>
<tr>
<td>R2</td>
<td>32</td>
<td>12</td>
<td>2</td>
<td>M1</td>
</tr>
</tbody>
</table>

Table 7: Difference in profits for monopoly retailers from using a CC compared to UPC level retailer price setting

#### 4.3.2 Oligopoly retailers

In this section we report profit implications for two competing retailers making simultaneous CC selections. Table 8 below shows the impact of various retailer decision scenarios on profits. Both retailers would choose to use a CC even if the other retailer does not. A unique pure strategy Nash equilibrium exists in which both chains select M1 as their CC. As in the monopoly scenario, our empirical results confirm that retailers may indeed be better off choosing the largest manufacturer as CC.
The first (second) number in each cell represents the payoff to chain R1 (R2).

Numbers in bold represent the best response for R1 (first number) or R2 (second number).

Table 8: Difference in profits for oligopoly retailers from using a CC compared to UPC level retailer price setting

As mentioned in the introduction, retailers expect CC-arrangements to boost the size of the ‘category pie’. We estimate whether or not category demand increases when M1 is the CC in both chains. We find that with a CC the share of the inside option could be increased by 75.8%, suggesting CC-arrangements can indeed drive category growth (Wang et al. 2003, Gooner et al. 2011).

In the presence of a CC the non-CCs still face double marginalization, which forces them to lower wholesale prices. Moreover, as retail prices are set to maximize category profits, prices charged for non-CCs’ products should increase due to coordinated category pricing (Basuroy et al. 2001). Retail prices for the CC’s products are influenced by two opposing forces: removing double marginalization drives retail prices down, whereas coordinated category pricing drives them up. Our results demonstrate that manufacturers not selected as CC reduce their wholesale prices between 0.09% and 0.70%. As one might expect, in equilibrium, M2 and M3’s retail prices increase in both retail chains (between +0.74% and +6.80%). As a result market shares for the non-CC’s go down between 15% and 30%. In contrast, retail prices for CCs products’ are reduced substantially due to the removal of double marginalization: -22.95% in R1 and -27.29% in R2. Consequently, the market share for M1 increases by 120.7% in R1 and 165.5% in R2 (Wang et al. 2003).

As discussed in Section 3.4.1, M2 and M3 may compete aggressively for the CC position in an attempt to limit profit and market share losses if M1 is selected as CC. As the producer of the most preferred products M1 has an inherent advantage as CC as it generates the largest
benefit for the retailer from double-marginalization removal. Therefore, to make retailers at least indifferent between choosing M1 and M2 or M3 as CC, the latter manufacturers would have to accept lower profits compared to the pre-CC state (i.e., $C' < 0$). Specifically, if we assume R2 selects M1 as her CC, M2 would have to accept a value of $C'$ equal to -$61K ($27K - $88K). M3 would have to settle for even less: -$102K ($27K - $88K). Similarly, if we assume R1 selects M2 as her CC, M2 would have to accept $C' = -$13K ($7K - $20K), while M3 would take $C' = -$21K ($1K - $20K). As we discuss in the next section, both M2 and M3 should prefer the non-CC position rather than accept such low values of $C'$.

4.4 Retailer category management or category captain?

As a retailer’s decision to implement CM or select a CC will impact consumers, competing retailers, manufacturers, and social welfare, it has important policy implications. The results of our welfare analysis are reported in Table 9 below. With information firewalls in place, the equilibrium in which both R1 and R2 select M1 not only results in higher profits for both chains, but also improved consumer and social welfare. The removal of double marginalization drives the retail price reductions for the CC’s products, which, in turn, increase consumer welfare. In equilibrium, M1’s profit level is unaffected as she is made indifferent by both retailers. M2 and M3 are not chosen as CC in either chain and thus experience lower profit levels. The change in total social welfare is positive due to the increase in both consumer welfare and industry profits. Importantly, the benefits to the retailer exceed the losses incurred by manufacturers M2 and M3. Making the non-CCs indifferent between the scenario with M1 as the CC and the pre-CC state would induce a 34% drop in profits for R1 (from $88K to $58K). For R2 the drop in profits would be smaller: 16.1% ($20K to $16K). As discussed in Section 3.4.1, despite lower profits the retailer may prefer this scenario, as it limits the risk of legal action or militant behavior by the non-CCs.

Both R1 and R2 would be substantially worse off with CM than the status-quo (i.e., UPC level retail pricing). The two chains combined would lose, on average, $18K in profits per
week. It has been argued that retailers will not attempt to coordinate category prices if (1) the costs of implementing CM are higher than the estimated benefits and/or (2) they lack the resources and capabilities to set category profit maximizing prices for all products over an extended period of time (Kurtulus and Toktay (2011), Morgan et al. (2007), Subramanian et al. (2010)). Our results suggest an additional explanation for the growing popularity of CC-arrangements in practice compared to retailer implemented CM: If retailer implemented CM results in wholesale price increases (+2.8% on average in our policy simulations), her overall profitability may be lower compared to a scenario in which she uses UPC level pricing.\(^4\) The intuition for this result is as follows: Moving from UPC level retailer pricing to CM increases the total price-cost margin in the channel and provides the manufacturer with an opportunity to increase prices. Furthermore, a move from UPC pricing to CM would decrease competition between products at the retail level. This effect ’feeds up’ to manufacturers that coordinate price-setting for multiple products allowing them to increasing wholesale prices. A move in the opposite direction, i.e., from CM to UPC level, would increase competition among the manufacturer’s products. This effect can again ’feed up’ as manufacturers lose some of the benefits of price coordination for their products and decrease wholesale prices. These findings are in line with Cottrell (1995): “It is still not clear that those [retailers] who don’t practice [CM] find themselves at any competitive disadvantage. In fact, the study found many [retailers] to be performing better than those competitors who were practicing it”. While CM purports to strive for win-win-win outcomes for manufacturers, retailers, and consumers, our findings suggest lose-lose-lose may be a more likely outcome.

We find that manufacturers are on average slightly better off in the CC than the CM scenario. Under retailer implemented CM wholesale prices for all goods are higher compared to the equilibrium CC setup. Perhaps the most important distinction, however, is the large difference in consumer welfare. While consumers are substantially better off when a CC supports retailers’ pricing decisions, they are worse off if retailers manage category pricing

\(^4\)In a technical appendix, available from the authors upon request, we demonstrate numerically that for a logit demand function a transition to CM can lead to a decrease in retailer profits.
themselves. To understand the forces driving these results, we first isolate the impact of price coordination (i.e., category level retail pricing) by setting retail prices to their equilibrium levels while maintaining wholesale prices at pre-CC levels. As expected, we see in row 3 in Table 9 that price coordination across all UPCs in the category will benefit the retailer when wholesale prices are left unchanged. Comparing rows 2 (CM) and 3 (Price coordination) illustrates that each manufacturer can ward off some of the losses from retail price coordination and the associated retail price increases by charging higher wholesale prices. Consumer and social welfare benefits are equal in rows 2 and 3 as manufacturers transfer some of their losses to retailers. The last row in Table 9 isolates retailers and consumer benefits resulting from double marginalization removal for the CC’s products. In this simulation prices for the CC’s products are set at equilibrium levels, while wholesale and retail prices for all other goods are at pre-CC levels. Clearly removal of double marginalization is the primary driver of the consumer welfare boost.

<table>
<thead>
<tr>
<th>Scenario</th>
<th>Consumer welfare</th>
<th>R1 profit</th>
<th>R2 profit</th>
<th>M1 profit</th>
<th>M2 profit</th>
<th>M3 profit</th>
<th>Social welfare</th>
</tr>
</thead>
<tbody>
<tr>
<td>CC</td>
<td>22</td>
<td>88</td>
<td>20</td>
<td>0</td>
<td>-29</td>
<td>-4</td>
<td>97</td>
</tr>
<tr>
<td>CM</td>
<td>-7</td>
<td>-17</td>
<td>-1</td>
<td>-26</td>
<td>-9</td>
<td>-1</td>
<td>-60</td>
</tr>
<tr>
<td>Price coordination</td>
<td>-7</td>
<td>3</td>
<td>2</td>
<td>-45</td>
<td>-11</td>
<td>-1</td>
<td>-60</td>
</tr>
<tr>
<td>DM removal</td>
<td>25</td>
<td>85</td>
<td>19</td>
<td>0</td>
<td>-13</td>
<td>-2</td>
<td>113</td>
</tr>
</tbody>
</table>

Table 9: Weekly welfare and profit implications ($000) of equilibrium CC choice and retailer implemented CM

4.5 Category captain collusion

Without information firewalls to restrict flow of information across retail accounts a CC could coordinate retail prices across chains. To investigate the effects of collusion on welfare we use the equilibrium solution reported in Table 9 above as the starting point and compare the performance outcomes with and without information firewalls in place (i.e., with and without collusion). The results are shown in Table 10 below. With firewalls in place the results are as reported in Table 9. By comparison, we find that when a manufacturer, acting as CC to
both retailers, recommends prices that would lead to joint profit optimization across chains, consumer welfare is reduced by -$7K ($15K - $22K) due to retail price increases resulting from the elimination of retail competition (Desrochers et al. 2003). As expected, retailers are better off overall under a collusion scenario due to the absence of retail competition ($5K - $2K = $3K) even though this benefit is not equally divided. While the non-CC firms are worse off, overall social welfare is still substantially above pre-CC levels (+$87K).

### 5 Conclusions and further research

Our study is, to the best of our knowledge, the first to quantify the costs and benefits of CC-arrangements for retailers, manufacturers, and consumers. Below we discuss the implications of our results for market participants and public policy.

*Retailers* - It has been argued that many retailers lack both the resources and capabilities to effectively implement CM. Our research provides an additional explanation for retailer outsourcing of CM: Manufacturers may increase wholesale prices when a retailer implements CM, leading to a reduction in retail profitability. CC-arrangements can provide retailers the benefits of CM when unable to implement it profitably themselves. Using policy simulations we demonstrate that in the absence of retail competition both retailers should select the leading manufacturer as CC. In a competitive retail market, a unique pure strategy equilibrium exists in which retailers also pick the largest manufacturer as CC. Even though CC-collaborations are increasing, many retailers remain concerned about opportunistic behavior (Morgan et al. 2007). Manufacturers who serve as CC walk a fine line

<table>
<thead>
<tr>
<th>Scenario</th>
<th>Consumer welfare</th>
<th>R1 profit</th>
<th>R2 profit</th>
<th>M1 profit</th>
<th>M2 profit</th>
<th>M3 profit</th>
<th>Social welfare</th>
</tr>
</thead>
<tbody>
<tr>
<td>with information firewalls</td>
<td>22</td>
<td>88</td>
<td>20</td>
<td>0</td>
<td>-29</td>
<td>-4</td>
<td>97</td>
</tr>
<tr>
<td>without information firewalls</td>
<td>15</td>
<td>93</td>
<td>18</td>
<td>0</td>
<td>-34</td>
<td>-5</td>
<td>87</td>
</tr>
<tr>
<td>difference</td>
<td>-7</td>
<td>5</td>
<td>-2</td>
<td>0</td>
<td>-5</td>
<td>-1</td>
<td>-9</td>
</tr>
</tbody>
</table>

Table 10: Weekly welfare implications ($000) of CC choice with and without information firewalls
between optimizing their own and the retailer’s performance. Retailers could use models like ours to detect undesirable CC behavior. However, monitoring a CC’s recommendations may increase costs and diminish gains. Our estimates of the potential monetary benefits from CC-arrangements can be viewed as an upper bound on the warranted level of retailer investment in monitoring CC’s recommendations. Retailers are also concerned about legal action and militant behavior by non-CCs who’s performance declines when a CC-arrangement is in place. We find that even if non-CCs are made indifferent between being CC and not, retailer benefits are substantial.

In addition, retailers should consider long-term implications when weighing the pros and cons of CC-arrangements. Managing a category requires comprehensive insight into consumer preferences and purchasing patterns. By outsourcing CM components to 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 invest in developing 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 show that the profit implications of missing out on the CC job can be substantial. However, in practice manufacturers compete for the CC job not merely to avoid potential profit losses; instead they aim to gain influence on retailer decision making (Kurtulus and Toktay 2011). 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 Progressive Grocer (2007). 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, in contrast to retailer implemented CM, can result in sizable benefits for consumers. However, information firewalls within the CC’s
firm may be needed to protect the welfare increases. The importance of establishing information firewalls will depend, among other things, on the extent of retail competition in a particular market. In highly competitive markets consumer welfare could be harmed significantly without these explicit restrictions. Interestingly, since we find that retailer implemented CM can cause welfare losses, consumers may be better off when retailers outsource CM to a supplier.

Public policy - Our findings also 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. Our findings show that prices for the CC’s products will go down while prices for non-CC’s products go up. Although CC-arrangements can hurt competitors’ performance, in practice manufacturers compete for the job. Moreover, it is not clear whether the impact of a CC’s actions on other manufacturers should be considered anti-competitive, particularly since consumers can benefit from CC-arrangements. Despite retailers’ and policy makers’ concerns about CC opportunism, we show that social welfare benefits of CC-arrangements can exceed those of retailer implemented CM. Regulations imposed on CC-arrangements should not be so onerous that the costs of implementing and monitoring them would eliminate the benefits for all parties involved. Policy makers could assess the potential impact of alternative regulations, such as information firewalls, using models like ours.

To date, researchers have not had access to detailed data on CC-arrangements due to anti-trust concerns. As a result, we are unable to quantify how the gains from using a CC are split between the retailer and the manufacturers. Theoretically the options are infinite and depend on the bargaining power of retailer and manufacturer (Wang et al. 2003). Future research with detailed data on CC activities could attempt to address this issue empirically.

There are several interesting topics for future research on CC selection and its implications for manufacturers, retailers, and consumers. Although we studied their influence
on retailer pricing, a CC may also be asked to support assortment decisions (Kurtulus and Toktay 2011), 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. or R.J. Reynolds Tobacco Co. vs Philip Morris). Furthermore, Kurtulus and Toktay (2011) suggest that CCs may push for increased diversity in retailers’ assortments in order to limit competition, even though retailers may benefit from lower levels of differentiation as it increases manufacturer competition and drives down wholesale prices. Additional empirical research on CC participation in various aspects of retail decision making, such as category planning, shelf-space allocation, etc., could produce important insights for both managers and policy makers (Subramanian et al. 2010).
References


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