경영학석사학위논문

Strategic Pricing Behavior of Channel Members Before and After the Horizontal Merger Between Manufacturers

제조업자와 유통업자의 가격책정 행위에 대한 연구: 제조업자의 수평적 합병 전과 후 비교

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Abstract

Strategic Pricing Behavior of Channel Members Before and After the Horizontal Merger Between Manufacturers

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In this research, I study the interactions between several manufacturers and one common retailer, focusing on their pricing behavior. Particularly, I try to uncover the nature of the retailer-manufacturer interaction before and after a horizontal merger between two manufacturers in the toilet tissue market. I take a new empirical industrial organization approach, specifying consumer and firm behaviors and using the notion of equilibrium. For the demand side, I apply the random coefficient logit model. The estimation strategy uses simulation and contraction mapping suggested by Berry, Levinsohn, and Pakes (1995). While they estimated demand and cost equations simultaneously, I follow a two-step approach suggested by

Chintagunta, Bonfrer, and Song (2002). For the supply side, using the estimate results obtained from the demand equation, I recover price-cost margins and estimate cost parameters under three different games—vertical Nash, manufacturer Stackelberg, and retailer Stackelberg—to determine which game fits the data best. Additionally, I introduce a conduct parameter in the model in case the three discrete games are not sufficient to capture a wide enough range of possible interactions. As a result of the nonnested hypothesis test, the conduct parameter model fits the data best. By examining the change in the value of conduct parameters, I find that the merging firm became tougher in its pricing. This implies that the manufacturer priced more competitively trying to increase its price-cost margin. Conversely, the manufacturer whose market share was the lowest behaved in a more accommodating manner toward the retailer resulting in the manufacturer's lower price-cost margin than before the merger. The results suggest that the retailer-manufacturer interaction is heterogeneous across manufacturers. This research shows that channel members are interacting with one another and they devise different strategies depending on the market structure they are confronting.

Keywords: Strategic pricing, channel interaction, horizontal merger, new empirical industrial organization

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1. Introduction

Quite often, we hear on the news that a retailer has asked its manufacturers to reduce the wholesale prices of their products. While small manufacturers are forced to accept the retailer's demand, some big manufacturers have the power to refuse the retailer's unfair demand. Sometimes in the extreme case, manufacturers decide to stop supplying their products to the retailer who asks them for unacceptably low prices. This is especially the case with the consumer goods market. This might be because of a relatively low level of differentiation and fierce competition among manufacturers.

The power game between giant manufacturers and mega-retailers has been one of great interest to both marketing researchers and marketing managers. As retailers become bigger, they have begun to exert influence on the manufacturers who have taken the leadership stemming from their high market shares. Moreover, retailers have attempted to obtain a dominant position by introducing private labels, which fight against national brands with lower prices. Manufacturers have responded through aggressive promotions and new product introduction to defend their profits. For the last few decades, both sides have tried to take the leadership in channel interaction like this. It seems that they have maintained a narrow equilibrium, so the marginal changes in market structure are likely to affect the power balance between manufacturers and retailers. In this sense, the changes in market structure are worthy of investigation to understand the nature of vertical relationship. Thus, I try to uncover the nature of channel interactions in terms of the pricing behavior of retailer and manufacturer before and after an event that seems to have a considerable impact on competition dynamics in the market such as a merger and a new brand entry .

On July 15, 1995, a merger between the Kimberly-Clark Corporation and the Scott Paper Company was announced. Kimberly-Clark was one of the largest consumer products companies in the U.S. The company produces facial tissue, toilet tissue, diapers, and so on. Scott was also one of the leading manufacturers of tissue products, such as toilet tissue, paper towels, and paper napkins. As a result of the merger, a new giant tissue company was born. This company seemed to hold equal power in the market with the other major player, Procter & Gamble (P&G). At the time of the merger, the combined company had approximately half of the facial tissue market and one quarter of the toilet tissue market[1]. Among paper product industries, the toilet paper market was the biggest market in the U.S., amounting to $2.96 billion sales in 1994.

Kimberly had the second highest market share in the toilet tissue market as a result of the merger. Therefore, it is expected that some changes among market participants, both large and small, occurred. For example, Kimberly might behave more aggressively by utilizing more plentiful resources than before, or they might act collusively with other major players. In addition to a change in the relationship among the manufacturers of toilet tissue, Kimberly's stance on their relationship with retailers is also likely to change after the merger.

As noted, the vertical relationship between retailer and manufacturer

1) All the figures (market share and market size) come from the article of July 18, 1995 "Scott's Dunlap: no paper tiger" in The Free Lance-Star.

has been of interest to many marketing researchers. The researchers have approached this issue with the new empirical industrial organization (NEIO) framework. They have modeled consumer and firm behaviors, and tried to figure out how retailer and manufacturer interact in the market. In particular, most studies have concentrated on the pricing behaviors of firms. This might be due to the easily observable characteristics of price and the availability of price data.

In my study, I examine the pricing behaviors of both the retailer and manufacturer in the toilet tissue market, using NEIO approach. What makes this study different from others is that I compare the pricing behaviors in the pre-merger market with those in the post-merger market. There are several possible scenarios. The merger could make the competition between manufactures more intense, which would lead them to behave more cooperatively with retailers. They could lower their wholesale prices, enduring the decline of their margins. Otherwise, the decrease in the number of manufacturers would allow manufactures to have more power against retailers than they had before the merger. The merger could have a different impact on each manufacturer.

My research shows that channel members interact with one another and changes in market structure have an impact on which party seizes the market pricing initiative. I find that the merging firm priced more competitively after the merger while the weakest brand behaved in a more cooperative way toward the retailer.

Many studies have examined the interactions between channel members and the effects of the merger, but this study can contribute to the knowledge on the changes in the relationship between the manufacturer and retailer when the market structure transforms—such as the horizontal merger in this paper.

The rest of this paper is organized as follows. In §2, I discuss the previous studies that analyze interactions between the manufacturer and retailer in different industries, and the studies of horizontal mergers. In the third section, I discuss the model including the demand and supply equations. In §4, I describe the estimation strategy and in §5, I explain the data. Section 6 has the results of the study, and in the last section, I discuss the conclusion and limitations of this research.

2. Literature Review

I investigate the changes in the pricing behaviors of one common retailer and manufacturers within NEIO framework. The NEIO framework gives us methods to evaluate the impact of a firm's strategic marketing mix choices on other market participants' strategic choices as well as on demand and costs (Kadiyali, Sudhir, & Rao, 2001). Traditionally, most marketing researchers have studied the effects of firm's choices on consumer demand. However, the advent of the NEIO approach led many marketing researchers to consider firm's strategic reactions to other firms' behaviors. The researchers began to incorporate a firm's strategic behavior in their models.

The NEIO approach started through advances in game theory in the late seventies (Kadiyali et al., 2001). A large amount of theoretical research has been conducted to study specific industries rather than using cross-sectional data across industries. These theoretical works revealed that market outcomes are affected by industry and firm-specific demand and cost characteristics that are difficult to model in the cross-sectional analysis (Kadiyali et al., 2001). As a result, researchers have focused on studying specific industries. The NEIO literature incorporates more industry- and firm-specific details in modeling demand, cost, and competition to analyzing the relationship between the marketing mix and profits (Kadiyali et al., 2001). Therefore, the NEIO approach can capture heterogeneity across industries.

Another distinct characteristic of NEIO is to use structural econometric models. According to Chintagunta, Erdem, Rossi and Wedel (2006), the structural models rely on economic and/or marketing theories of consumer or firm behavior to derive the econometric specification that can be taken to data. In particular, structural models are typically derived based on optimizing behavior of agents, for example, utility maximizing by consumers, profit maximizing by firms. In contrast to the structural consumer choices which do not incorporate any strategic behavior, NEIO models of firms account for the interdependency of one firm from the choices of other firm (Kadiyali et al., 2001). For instance, a change in retail prices causes manufacturers to react.

In the NEIO framework, there are two methods for modeling competitive interactions among firms; one is the menu approach, and the other is the conjectural variation approach (conduct parameter approach[2)]). In the menu approach, researchers literally test several

2) In the study of Kadiyali et al. (2001), they introduce the conjectural variations approach and the conduct parameter approach separately, but I think they are

menus—equilibrium interactions—to find the equilibrium that best fits the data. The most widely tested equilibrium is the Bertrand, the Stackelberg leader-follower, and collusion. On the other hand, one parameter, called either conjectural variation or conduct parameter, is estimated in the conjectural variation approach. This parameter represents the interactions between firms. Typically, this parameter equal zero when the game is Nash. Positive or negative values of this parameter imply that the competition is more competitive than in the Nash equilibrium or less intense. Conjectural variations capture the equilibria that cannot be captured by the menu approach because estimating them is the same as testing thousands of different equilibria. However, some equilibria, such as Stackelberg, are not nested in the models that adopt the conjectural variations approach.

Many marketing researches that have studied the interactions between channel members also have inherited this tradition; they have followed the menu approach or the conjectural variations approach (conduct parameter approach). First I discuss some literature that adopts the menu approach, and then review the literature that follows the conjectural variation approach.

Choi (1991) is the first researcher who investigated the price competition in a market with a common retailer. Before this, most studies assumed a channel structure, which consists of two retailers who sells one manufacturer's product exclusively. Choi's assumption seems more realistic because most retailers carry products from several manufacturers. In his study, he followed the menu approach. Choi

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fundamentally not different in the sense that one parameter captures different types of equilibrium. Thus, I do not draw a line between them.

studied three noncooperative games of different power structures—vertical Nash, manufacturer Stackelberg, and retailer Stackelberg—and he assumed that competition between manufacturers is Bertrand Nash. The demand function he used was not structural. He did not incorporate the optimal behavior of consumers. Conversely, it was assumed that the retailer chooses the retail margin that maximizes its category profit and the manufacturers determine the wholesale price that maximizes their profits. He concluded that when the demand function is nonlinear, the price of the manufacturer and retailer is highest in a vertical Nash arrangement, profit of the former is largest in retailer Stackelberg, and that of the latter is largest in manufacturer Stackelberg[3].

Applying Choi's work, Besanko, Gupta, and Jain (1998) empirically studied the pricing behaviors of retailers and manufacturers. They use the vertical Nash model among the three scenarios of Choi to describe the noncooperative interactions between oligopolistic manufacturers and the common retailer. Their work did not compare one type of equilibrium with another, but rather they assumed the vertical Nash to see the endogeneity of price by estimating the demand side and supply side simultaneously. Besanko et al. used the logit model for the demand function and the linear function for the cost function. For the retailer pricing rule, they adopted category profit maximization. The categories they studied was ketchup and yogurt. The conclusion of thier work is that incorporating the endogeneity of price is essential because assuming exogeneity causes price sensitivity to be estimated

3) He employed both linear and nonlinear demand function, and the result from the linear demand function is contrary to that from the nonlinear.

downward.

Like Choi, Sudhir (2001) used the menu the approach in his study of manufacturer pricing in the presence of a strategic retailer. He assumed two scenarios—vertical Nash and manufacturer Stackelberg. Unlike other vertical relationship studies, Sudhir considered different interactions between manufacturers as well as manufacturer-retailer interaction. For interactions between manufacturers, he tested not only Bertrand competition but also tacit collusion scenario. In addition, he tested various retailer pricing rules and demand functional forms, which previous studies had not taken into account. For the retailer pricing rule, two behaviors of the retailer were assumed; one is category profit maximization and the other is brand profit maximization. Sudhir also used two demand specifications, logit model and the multiplicative model. The cost function was assumed to be linear. When both the demand equation and the pricing equations are estimated, the logit fits the data better than the multiplicative model[4]. Sudhir used the data from the yogurt and peanut butter categories. His results supported the category profit maximizing behavior of the retailer. In terms of interactions between manufacturers and retailer, manufacturer Stackelberg game best fits the data, and the manufacturer pricing is tacitly collusive. According to Sudhir's interpretation, the categories he studied are highly concentrated markets, so a cooperative outcome can be achieved in noncooperative game becaues it is easy to punish the firm that deviates from cooperative behavior.

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4) When only demand equations are estimated, the multiplicative model has a smaller sum of squared error.

The most recent work that used the menu approach is the study of Villas-Boas (2007). She investigated the vertical relationship between manufacturer and retailer. She assumed seven different scenarios, including manufacturer-Stackelberg, manufacturer collusion, and retailer collusion. The demand side followed the logit model. The biggest difference from other studies was that Villas-Boas' study allowed for multiple retailers who played Bertrand game. Villas-Boas used yogurt data. She concluded that the models assuming zero wholesale margin, in which retailers make pricing decisions, were supported by data and revealed that the retail pricing may lie between Bertrand Nash and collusive retail pricing. This result is consistent with the high bargaining power of retailers that forces wholesale prices down to marginal cost (Villas-Boas, 2007).

Kadiyali, Chintagunta, and Vilcassim (2000) employed the conduct parameter approach, extending Choi's model in three ways. First, they introduced a more general model of interactions between manufacturers instead of assuming Bertrand Nash game. Second, the researchers allowed for heterogeneity in manufacturer-retailer interaction while Choi implicitly assumed that all manufacturers follow the same game rule. For instance, depending on the channel power and pricing strategies, some manufacturers might be Stackelberg leaders whereas other manufacturers are Stackelberg followers. Finally, Kadiyali et al. thought that Choi's three games were not adequate enough to reflect all possible interactions. According to Folk theorem, there are infinite feasible solutions other than the three games analyzed in Choi. Accordingly, they introduced a conduct parameter which captures thousands of equilibria. A conduct parameter represents pricing behavior other than vertical Nash. As noted, the two Stackelberg games are not nested in the conduct parameter model, whereas Nash is nested. In addition, Kadiyali et al. measured pricing power by estimating the price-cost margin and by computing how channel profits are divided between manufacturers and retailer. The categories analyzed were refrigerated juice and tuna. In both categories, they found that the retailer had pricing power. They attributed this result to the commodity image of these two categories.

Another study that used a conduct parameter investigated the effects of store-brand introduction on retailer demand and pricing behavior. Unlike the research of Kadiyali et al. (2000), Chintagunta, Bonfrer, and Song (2002) estimated only the retailer's pricing equation. They examined whether manufacturer-retailer interaction changed after the introduction of a store-brand by estimating demand and pricing equations twice—before and after store-brand entry. Chintagunta et al. investigated two categories—oats and frozen pasta. The results of the parameter estimates implied that the national-brand manufacturers appear to behave in a more accommodating manner after the introduction of store-brand.

There is extensive literature on the topic of horizontal mergers in the field of in economics. Many studies have focused on dealing with antitrust issues resulting from merger. Some papers, however, investigated horizontal merger from different points of view. Salant, Switzer, and Reynolds (1983) studied losses from horizontal mergers, assuming a Cournot equilibrium. They argued that there is the possibility that mergers reduce the joint profits of the merging parties because merging firms contract their output while other firms in the market expand. Contrary to their research, Perry, and Porter (1985) discussed the incentives for horizontal merger in an oligopolistic industry, and they claimed that since new firms have access to the combined resources of both firms, mergers can be profitable in many circumstances. The goal of the present paper is not to investigate the general effects of a merger, so I do not go further into researches on horizontal mergers.

In addition, There are studies analyzing Kimberly-Scott merger case. The study of Hausman and Leonard (1997) is one of them. Like other papers, they focused on the effect of the merger on price which is closely related to the issue of antitrust. Hausman et al. tried to find whether unilateral effects arise after merger. Unilateral effects arise when the products of the merging parties place significant competitive constraints on each other prior to the merger. The merged firm may then be able to raise prices post-merger. They concluded that no unilateral effects arose after Kimberly bought Scott, which means that there was no price increase after the merger.

3. The Model

The main issue of this paper is to investigate pricing behavior of channel members before and after horizontal mergers between manufacturers. In the case I deal with, the horizontal merger occurred between two manufacturers. The essential idea is to estimate the parameters of demand equation first, and then use these parameters to recover price-cost margin from pricing equation under the different scenarios. I use the same scenarios with Choi—vertical Nash, manufacturer Stackelberg, and retailer Stackelberg. In addition to these three scenarios, I also incorporate conduct parameters into the model and estimate them because there is a possibility that the three discrete games are not sufficient to capture a wide enough range of possible interactions. I estimate cost coefficients and conduct parameters twice with pre-merger data and post-merger data (Chintagunta et al., 2002). However, I do not divide the data into two parts to estimate demand parameters because consumer behavior is unlikely to be influenced by the merger between manufacturers. This particularly makes sense because Kimberly decided to maintain the brand "Scott", so there was no outward change in the toilet tissue market after the merger in consumer's point of view.

Demand Equations

The first step in examining the channel interaction is to estimate the demand equation. The demand model used in this paper is almost same as that of Chintagunta et al. (2002). The specification of demand is at the store level, although the specification is based on individual level utilities aggregated across heterogeneous consumers within a given store (Chintagunta et al., 2002). The indirect utility of consumer i from choosing brand j at time t is

$$u_{ijt} = \alpha_{ij} + \beta_i p_{jt} + \gamma d_{jt} + \mu_{jt} + \epsilon_{ijt}, \quad (1)$$

where p_{jt} is the price of brand j at time t, d_{jt} is a dummy variable which equals one if brand j is sold on a promotion—coupon, bonus buy, and price reduction—at time t, β_i is price sensitivity, α_{ij} is a brand-specific preference parameter, and γ is the sensitivity to the retailer's deal activity. μ_{jt} is a mean zero demand shock. This demand shock is specific to each store, each brand, and each time period. Since it comes from factors such as changes in shelf location and other unobserved promotions than ones included in d_{jt}, μ_{jt} can be correlated with the prices. ϵ_{ijt} indicates the consumer-, brand-, and time-specific error term that is observed by consumer, but not by researchers. I also include a time dummy for every three month that can capture overall demand shock affecting all the stores.

Besides error term ϵ_{ijt}, I allow for consumer heterogeneity with respect to intrinsic brand preferences and price sensitivity by introducing random coefficients for intrinsic brand preferences (α_i) and for price sensitivity (β_i). I model the distribution of these parameters as multivariate normal. However, I impose some restrictions on parameterizing the heterogeneity distribution because unconstrained variance-covariance matrix requires the estimation of 28 parameters. I assume independence between heterogeneity parameters. The structure I use is

$$\begin{aligned} &\alpha_{ij} = \alpha_j + \rho_j \nu_{ij} \\ &\beta_i = \beta + \rho_\beta \nu_{i\beta} \\ &where\, \nu_{ij}, \nu_{i\beta} \sim N(0,1) \end{aligned} \tag{2}$$

α_j is the mean value of preference of brand j, ν_{ij} is a variance component that varies by both consumers and brands, β is the mean value of price sensitivity, and $\nu_{i\beta}$ is a variance component that varies by consumers. α_j, β, ρ_j, and ρ_β are parameters to be estimated. Consequently, the implied variance of α_{ij} is ρ_j^2 and that of β is ρ_β^2. With this heterogeneity distribution, I estimate seven mean parameters and seven covariance parameters. Substituting equation (1) with equation (2) makes the indirect utility function divided by two parts like the below equation.

$$u_{ijt} = \delta_{jt} + \rho_j \nu_{ij} + \rho_\beta \nu_{i\beta} + \epsilon_{ijt}. \quad (3)$$

δ_{jt} is the utility common to all consumers, and the remaining terms reflect individual taste.

Specification of the demand system is completed with the option of an "outside good". The introduction of an outside good allows consumers to decide not purchase any of the brands which are included in the data. The indirect utility for the outside good is

$$u_{i0t} = \alpha_{i0} + \epsilon_{i0t}, \quad (4)$$

where α_{i0} is set to zero. The mean utilities of included brands can be identified and estimated relative to the mean utilities of the outside good.

In terms of the distribution of idiosyncratic error term ϵ_{ijt} and ϵ_{i0t}, I assume they are identically and independently distributed with a Type I extreme value distribution. Given this assumption, the probability of consumer i purchasing brand j at time t takes a closed form and is given by multinomial logit model:

$$P_{ijt} = \frac{\exp(V_{ijt})}{1 + \sum_{k=1}^{J} \exp(V_{ikt})}, \quad (5)$$

where $V_{ijt} = \alpha_{ij} + \beta_i p_{jt} + \gamma d_{jt} + \mu_{jt}$ and J is the number of brands included in the analysis. Predicted market shares are obtained by aggregating the individual-level choice probabilities over all consumers in a given time t. The logit model is known for suffering from *independence of irrelevant alternatives* (IIA) property. However, I avoid the IIA property by modeling consumer taste parameter as a function of random component, ν_{ij} and $\nu_{i\beta}$. This model results in more flexible substitution patterns between brands than homogeneous logit model.

Pricing Equations

The supply side problem involves the pricing decision of retailer and manufacturer. The retailer chooses retail price which maximizes its category profit, and each manufacturer picks the profit maximizing wholesale price of its own products. I investigate how channel members interacted with one another before the merger and after the merger respectively. I apply both the menu approach and the conduct parameter approach discussed in section two.

First, I examine three possible scenarios—vertical Nash, manufacturer Stackelberg, and retailer Stackelberg. Interactions between manufacturers are assumed to be Bertrand Nash.

Vertical Nash(VN). In vertical Nash game, each manufacturer chooses its wholesale price conditional on both the retailer's margin on its own product and the observed retail prices of the competing brands. The retailer determines the margin of each brand conditional on the respective wholesale prices (Choi 1991).

Let there be one retailer and N_m multi-brand manufacturers competing in the market. The retailer's profit function in time t is given by

$$\pi_t = \sum_{j=1}^{J} [p_{jst} - w_{jt} - c^r_{jst}] s_{jst} M_{st}, \tag{6}$$

where p_{jst} is retail price of brand j at store s at time t, w_{jt} is wholesale price of brand j, c^r_{jst} is the retailer's marginal cost of brand j at store s at time t, s_{jst} is the market share of brand j, and M_{st} is market size of store s at time t. Since the data I use include the sales records of individual stores that cover the local market, I assume that each store determines its own retail price. Thus, I use subscript "s" for store-specific variable. The first order conditions, assuming vertical Nash equilibrium in price, are

$$s_{jst} + \sum_{k=1}^{J} [p_{kst} - w_{kt} - c^r_{kst}] \frac{\partial s_{kst}}{\partial p_{jst}} = 0 \qquad \forall j \in \{1, 2, \cdots, J\}. \tag{7}$$

In vector notation, the first-order conditions become

$$s - \Omega(p - w - c^r) = 0,$$

where s, p, w and c^r are J×1 vectors of market shares, retail prices, wholesale prices, and marginal costs of retailer respectively. And I define $\Omega_{jk} = -\frac{\partial s_{ks}}{\partial p_{js}}$, resulting in J×J matrix. Rearranging this equation, I obtain a retailer's markup equation.

$$p - w - c^r = \Omega^{-1} s. \tag{8}$$

Using estimates of the demand parameters, I can compute price-cost margin of retailer. The marginal cost of retailer is defined as $c^r_{jst} = \lambda^r_j + \psi^r_s + \tau^r l^r_t + \omega^r_{jst}$ where λ^r_j is brand-specific marginal cost, ψ^r_s is store-specific marginal cost, l^r_t is labor cost of retailing at time t, τ^r is coefficient of the cost variable, and w^r_{jst} is an error term that is the marginal cost unobserved by the researcher, but observed by the retailer.

Obtaining a manufacturer's markup follows a similar process. Each manufacturer chooses the wholesale prices that maximize its profit. There are M manufacturer profit functions

$$\pi_{mt} = \sum_{j \in S_m} [w_{jt} - c_{jt}^m] s_{jt} M_t. \qquad (9)$$

In the above equation, S_m denotes the set of products that manufacturer m owns, and c_{jt}^m denotes manufacturer's marginal cost of brand j. Unlike the retailer, manufacturers set equal price across stores, so I drop subscript s. Market shares in manufacturer's pricing equation are ones which are weighted by market size in each store. Each brand has its first-order condition.

$$s_{jt} + \sum_{k \in S_m} [w_{kt} - c_{kt}^m] \frac{\partial s_{kt}}{\partial w_{jt}} = 0 \qquad \forall j = \{1, 2, \cdots, J\}. \qquad (10)$$

In vertical Nash game, manufacturers take as given the competing brands' retail prices and the retailer's margin on its own brand, thus $\frac{\partial s_{kt}}{\partial w_{jt}} = \frac{\partial s_{kt}}{\partial p_{jt}}$. This leads to manufacturer's markup equation as follow:

$$w - c^m = (T_m .* \Omega)^{-1} s. \qquad (11)$$

In the above expression, I define T_m as the manufacturer m's ownership matrix with the element $T_m(i,j)$ that equals 1 when both brand i and j are produced by manufacturer m and 0 otherwise (Villas-Boas, 2007). '.*' means element by element multiplication.

I define the manufacturer's marginal cost of brand j as $c_{jt}^m = \lambda_j^m + \tau_1^m l_t^m + \tau_2^m ppi_t^m + \omega_{jt}^m$, where λ_j^m is brand-specific marginal cost, l_t^m is labor cost of manufacturing at time t, ppi_t^m is the Producer Price Index of pulp at time t, τ_1^m and τ_2^m is coefficient of cost variables, and

w_{jt}^{m} is an error term that is unobservable to the researcher, but observable to the manufacturers.

Manufacturer-Stackelberg(MS). Manufacturer-Stackelberg scenario models a market in which each manufacturer chooses the wholesale price using the response function of the retailer, conditional on the observed wholesale price of the competitor's product. The retailer determines the price of each product given the respective wholesale prices (Choi, 1991).

In terms of retailer's margins in MS game, it is the same as those in VS case because retailer's strategy is to choose the best price in response to wholesale prices set by manufacturers in MS games as well as in VN game. Manufacturers do not change their wholesale prices in response to retailer's price setting behavior.

On the other hand, the manufacturers' markups change. Each manufacturer decides its wholesale price to maximize profit from all the products that it possesses, knowing that retailer behaves according to equation (7). The first-order condition of each brand is as follows:

$$\sum_{s} M_{st} s_{jst} + \sum_{k \in S_m} \left\{ \left[w_{kt} - c_{kt}^{m} \right] \sum_{s} M_{st} \frac{\partial s_{kst}}{\partial w_{jt}} \right\} = 0 \qquad \forall j = \{1, 2, \cdots, J\}. \tag{12}$$

The derivatives of the market shares of all brands with respect to all wholesale prices, $\frac{\partial s_{kst}}{\partial w_{jt}}$, contain the cross price elasticities of demand and the effects of cost pass-through (Villas-Boas, 2007). In other words, $\frac{\partial s_{kst}}{\partial w_{jt}} = \frac{\partial s_{kst}}{\partial p_{lst}} \frac{\partial p_{lst}}{\partial w_{jt}}$. To compute $\frac{\partial s_{kst}}{\partial w_{jt}}$, I need to compute $\frac{\partial p_{lst}}{\partial w_{jt}}$ first. The first-order conditions of retailer's maximization functions are

$$FOC_r = s_{jst} + \sum_{k=1}^{J} [p_{kst} - w_{kst} - c^r_{kst}] \frac{\partial s_{kst}}{\partial p_{jst}} = 0 \tag{13}$$
$$F_{JS}(p_{1s}(w_1, \cdots w_J), \cdots, p_{Js}(w_1, \cdots w_J), w_1, \cdots w_J) = 0$$

They are a function of retail prices and wholesale prices. Thus, I can get the below equation by implicit function theorem.

$$\sum_{k=1}^{J} \frac{\partial F_{js}}{\partial p_{ks}} \frac{\partial p_{ks}}{\partial w_j} + \frac{\partial F_{js}}{\partial w_j} = 0 \quad \begin{cases} j = 1, 2, \cdots, J \\ s = 1, 2, \cdots, S \end{cases}, \tag{14}$$

where J is the number of brands and S is the number of stores. The left-side of this equation can be rewritten as follows:

$$\begin{bmatrix} \sum_{k=1}^{J} \frac{\partial s_{1s}}{\partial p_{ks}} \frac{\partial p_{ks}}{\partial w_j} - \frac{\partial s_{js}}{\partial p_{1s}} + \sum_{k=1}^{J} \frac{\partial s_{ks}}{\partial p_{1s}} \frac{\partial p_{ks}}{\partial w_j} + \sum_{k=1}^{J} \left[(p_{ks} - w_k - c^r_{ks}) \sum_{l=1}^{J} \frac{\partial^2 s_{ks}}{\partial p_{1s} \partial p_{ls}} \frac{\partial p_{ls}}{\partial w_j} \right] \\ \vdots \\ \sum_{k=1}^{J} \frac{\partial s_{Js}}{\partial p_{ks}} \frac{\partial p_{ks}}{\partial w_j} - \frac{\partial s_{js}}{\partial p_{Js}} + \sum_{k=1}^{J} \frac{\partial s_{ks}}{\partial p_{Js}} \frac{\partial p_{ks}}{\partial w_j} + \sum_{k=1}^{J} \left[(p_{ks} - w_k - c^r_{ks}) \sum_{l=1}^{J} \frac{\partial^2 s_{ks}}{\partial p_{Js} \partial p_{ls}} \frac{\partial p_{ls}}{\partial w_j} \right] \end{bmatrix}$$

.

I express the above equations as vector notation and rearrange them, and then they become

$$\frac{\partial p_{Js}}{\partial w_j} = (-\Omega_{JS} - \Omega'_{JS} + Z_{JS})^{-1} \left[(-\Omega')_j \right]. \tag{15}$$

where $$Z_{JS} = \begin{bmatrix} \sum_k (p_{ks} - w_k - c^r_{ks}) \frac{\partial s^2_{ks}}{\partial p_{1s} \partial p_{1s}} & \cdots\cdots & \sum_k (p_{ks} - w_k - c^r_{ks}) \frac{\partial s^2_{ks}}{\partial p_{1s} \partial p_{Js}} \\ \vdots & \ddots & \vdots \\ \sum_k (p_{ks} - w_k - c^r_{ks}) \frac{\partial s^2_{ks}}{\partial p_{Js} \partial p_{1s}} & \cdots\cdots & \sum_k (p_{ks} - w_k - c^r_{ks}) \frac{\partial s^2_{ks}}{\partial p_{Js} \partial p_{Js}} \end{bmatrix}$$

and $(-\Omega')_j$ is jth column of $-\Omega'$. Now define $\Omega^m_{ij} = -\left(\sum_{k=1}^{J} \frac{\partial s_{js}}{\partial p_{ks}} \frac{\partial p_{ks}}{\partial w_i} \right)_{ij}$.

Collecting terms and solving for the manufacturers' price-cost margin yields

$$w - c^m = \left(T_m . * \Omega^m\right)^{-1} s. \tag{16}$$

Retailer-Stackelberg(RS). If I assume that market structure is retailer-Stackelberg, each manufacturer chooses its wholesale price conditional on both the retailer's margin on its own brands and the observed retail prices of the competing brands. The retailer chooses the margin of each brand using the reaction functions of all manufacturers (Choi, 1991).

In opposition to MS game, manufacturer's markup is the same as one in VN game in retailer-Stackelberg game, and retailer's markup is different from one in VN scenario. The method to get the derivatives of market shares of all brands with respect to retail prices, $\frac{\partial s_{kst}}{\partial p_{jst}}$, is same as what I do in the MS game. Since $\frac{\partial s_{kt}}{\partial p_{jst}} = \frac{\partial s_{kst}}{\partial w_{lt}} \frac{\partial w_{lt}}{\partial p_{jst}}$, I need to compute $\frac{\partial w_{lt}}{\partial p_{jst}}$. When I differentiate the first order conditions of manufacturer with respect to retail price of brand j at store r, I obtain the equation (17) by implicit function theorem.

$$\sum_{k=1}^{J} \frac{\partial F_m}{\partial w_k} \frac{\partial w_k}{\partial p_{jr}} + \frac{\partial F_m}{\partial p_{jr}} = 0, \quad m = 1, \cdots, M. \tag{17}$$

If I develop the derivative of the first manufacturer's first order condition with respect to p_{jr}, then it becomes

$$\left[\begin{array}{l} \sum_{l=1}^{J} \sum_{s} M_s \frac{\partial s_{1s}}{\partial w_l} \frac{\partial w_l}{\partial p_{jr}} + M_r \frac{\partial s_{1r}}{\partial p_{jr}} + \sum_{k \in S_m} \sum_{s} M_s \frac{\partial s_{ks}}{\partial p_{1s}} \frac{\partial w_k}{\partial p_{jr}} \\ + \sum_{l=1}^{J} \left[\sum_{k \in S_m} (w_k - c_k^m) \sum_{s} M_s \frac{\partial^2 s_{ks}}{\partial p_{1s} \partial w_l} \frac{\partial w_l}{\partial p_{jr}} \right] + \sum_{k \in S_m} (w_k - c_k^m) \sum_{s} M_s \frac{\partial^2 s_{ks}}{\partial p_{1s} \partial p_{jr}} \end{array} \right]$$

From the above equation, I obtain $\frac{\partial w_{lt}}{\partial p_{jst}}$ and use these to solve the retailer's margin. The equation (18) is retailer's price-cost margin.

$$p - w - c^r = (\Omega^r + H)^{-1} s \tag{18}$$

where $\Omega^r = \begin{bmatrix} M_1\Omega_1 & 0 & \cdots & 0 \\ \vdots & \ddots & & \vdots \\ \vdots & & \ddots & \vdots \\ 0 & \cdots & \cdots & M_S\Omega_S \end{bmatrix}$ is a block diagonal matrix in which

$$\Omega_s = \begin{bmatrix} \frac{\partial s_{1s}}{\partial p_{1s}} & \frac{\partial s_{2s}}{\partial p_{1s}} & \cdots & \frac{\partial s_{Js}}{\partial p_{1s}} \\ \vdots & \ddots & & \vdots \\ \vdots & & \ddots & \vdots \\ \frac{\partial s_{Js}}{\partial p_{1s}} & \cdots & \cdots & \frac{\partial s_{Js}}{\partial p_{Js}} \end{bmatrix}, \text{ and } H = \begin{bmatrix} \sum_l \frac{\partial s_{11}}{\partial w_l}\frac{\partial w_l}{\partial p_{11}} & \cdots & \sum_l \frac{\partial s_{JS}}{\partial w_l}\frac{\partial w_l}{\partial p_{11}} \\ \sum_l \frac{\partial s_{11}}{\partial w_l}\frac{\partial w_l}{\partial p_{21}} & \ddots & \sum_l \frac{\partial s_{JS}}{\partial w_l}\frac{\partial w_l}{\partial p_{21}} \\ \vdots & \ddots & \vdots \\ \sum_l \frac{\partial s_{11}}{\partial w_l}\frac{\partial w_l}{\partial p_{JS}} & \cdots & \sum_l \frac{\partial s_{JS}}{\partial w_l}\frac{\partial w_l}{\partial p_{JS}} \end{bmatrix}.$$

Conjectural Variation Approach. Introducing a conduct parameter makes the pricing equation different. The first-order condition of retailer's pricing equation is

$$s_{jst} + \sum_{k=1}^{J} \left[p_{kst} - w_{ks} - c^r_{kst}\right] \frac{\partial s_{kst}}{\partial p_{jst}} \left[1 + \theta(w_j, r_j)\right] = 0 \tag{19}$$

where $r_{jst} = p_{jst} - w_{jt} - c^r_{jst}$ and $\theta(w_j, r_j) = \frac{\partial w_j}{\partial r_j}$. $\theta(w_j, r_j)$ is called as a "conduct parameter". This parameter represents how manufacturers respond to the change in retailer margin. When vertical Nash is assumed, these parameters equal zero, and equation (19) becomes same with equation (7). In the study of Kadiyali et al. (2001), they estimates the conduct parameters that capture the response of manufacturer in response to changes in *other* brands' retail margin, $\frac{\partial w_j}{\partial r_k}(k \neq j)$, as well as those that capture the response of manufacturer in response to changes in retail margin of *own* products. However, I assume those conduct parameters to be zero for the sake of simplicity because I have six brands, which requires estimation of 36 conduct parameters whereas Kadiyali et al. analyze only three brands. This assumption suggests that manufacturers do not react to the changes in other brands' retailer margins.

The pricing equations of manufacturers which contain conduct parameters are as follows:

$$s_{jt} + \sum_{k \in S_m} \left[w_k - c_k^m \right] \frac{\partial s_{kt}}{\partial p_{jt}} \left[1 + \theta(r_j, w_j) \right] = 0 \tag{20}$$

where $\theta(r_j, w_j) = \frac{\partial r_j}{\partial w_j}$. This parameter indicates how retailer behaves in response to the change in wholesale price. Like the assumption that the conduct parameters which capture the response of manufacturer in response to changes in the other brands' retail margins are zero, I assume that the conduct parameters which represent the reaction of retailer and manufacturers in response to changes in the *other* brands' wholesale prices equal zero, $\frac{\partial p_j}{\partial w_k} = 0, (k \neq j)$. Therefore, I estimate only six conduct parameters.

As noted above, the conduct parameters are zero in vertical Nash scenario. For values of θ between 0 and -1, the retailer and manufacturers make higher margins than those under VN game and for values greater than 0, the margins are below those corresponding to VN.

4. Estimation Procedure

The general idea behind my estimation procedure is identical to those by Berry, Levinsohn, and Pakes (1995) and Nevo (2001). I follow a two-step approach taken by Chintagunta et al. (2002) rather than the approach of Berry et al. In the study of Berry et al. (1995), they estimate the parameters of demand and pricing equations simultaneously. In contrast, Chintagunta et al. (2002) employ a two-step approach; the first step is to estimate the parameters of demand equation, and then using these estimated parameters, they estimate parameters in pricing equation. This procedure makes the estimation procedure simple because demand equation is not needed to be re-estimated whenever different market structures are tested. Villas-Boas (2007) also use the two-step approach.

In the first step, I estimate the parameters of demand equation. In the second step, using these estimated parameters, I compute margins of the retailer and the manufacturers and estimate coefficients of cost and conduct parameters. There is one issue in estimating parameters. The data that I have is market-level data that contain brand shares, price, and promotion activities at store-level. I do not observe individual brand choices. Thus, the aggregation of individual choice probabilities across all consumers has to be computed by simulation using the method that Berry et al. (1995) and Nevo (2000) suggest. The detailed demand estimation procedure is as follows:

Step 1. Pick starting values for the set of parameters $\theta_2 = \{\rho_j, \rho_\beta\}$.

These parameters enter in the demand equation nonlinearly, so I distinguish these from the linear parameters by making set θ_2 that contains only nonlinear parameters.

Step 2. Make R draws from distribution of $\nu = \{\nu_{ij}, \nu_{i\beta}\} \sim N(0,1)$.

Step 3. Given the values of θ_2, numerically compute δ that equates observed brand shares to predicted shares. Use the contraction mapping suggested by Berry et al. (1995). In the contraction mapping, the delta is updated until the differences between observed market shares and predicted ones fall within a pre-determined threshold.

Step 4. Estimate parameters included in δ_{jt}, $\theta_1 = \{\alpha_j, \beta, \gamma\}$. These parameters enters into the equation linearly. μ_{jt} is an error term and correlated with prices, so use Two-stage Least Square (Instrumental variables are introduced in section five).

Step 5. Make moment conditions with the error term, μ_{jt}, and instrumental variables. Compute the Generalized Method of Moments objective function. The objective function is given by

$$\hat{\theta}_{GMM} = \arg min(Z'\mu(\theta))' A Z'\mu(\theta) \qquad (21)$$

Z is instrumental variables, and A is the weighted matrix given by $A = (Z'Z)^{-1}$.

Following Chintagunta et al. (2002), I adjust the demand equation based on the information on average demographics for each store in order to allow for systematic store-level differences in brand preferences and price sensitivity. Specifically, the brand preferences and price sensitivities for consumer i at store s are given by

$$\begin{aligned} \alpha_{ijs} &= \alpha_j + X_s \phi_j + \rho_j \nu_{ij} \\ \beta_{is} &= \beta + X_s \phi_\beta + \rho_\beta \nu_{i\beta} \end{aligned} \qquad (22)$$

where X_s indicates the average demographics for store s, and ϕ_j and ϕ_β represent coefficient of interactions between brand preferences and price sensitivity with store-level demographics.

Using the values of parameters estimated in the first step, I compute price-cost margins of retailer and manufacturers under three assumed market structures. The markups are easily computed with estimated market shares and the first derivatives of shares with respect to retail prices. Next, subtracting these markups from the observed retail (wholesale) prices generates marginal costs of the retailer (manufacturers), c^r (c^m). And then I estimate parameters in cost equations, $\lambda_j^r, \psi_s^r, \tau^r, \lambda_j^m,$ and τ^m with ordinary least square, assuming that the error terms in cost equations are not correlated with brand and store dummies, and other cost variables.

In terms of the estimation of conduct parameter, I employ nonlinear least squares. Since the conduct parameters enter nonlinearly in the pricing equations, I cannot apply ordinary least squares. The estimation strategy is to minimize the sum of squares, $E(\omega'\omega)$. The logic used to obtain the estimates of the conduct parameters are similar to that applied to estimate demand parameters; linear parameters and nonlinear parameters are estimated separately. The first- order condition of the minimization problem with respect to $\lambda_j^r, \psi_s^r, \tau^r, \lambda_j^m,$ and τ^m are linear in these parameters. Thus, these linear parameters can be solved as a function of the conduct parameters with ordinary least square and plugged into the rest of the first-order conditions, limiting the nonlinear search to the conduct parameters only.

I use the likelihood-ratio test for nested hypothesis and Vuong

(1989) test for nonnested hypothesis to infer which game fits the data best.

5. Data

I used scanner data from a large supermarket chain, Dominick's Finer Foods[5]. This chain has 96 stores around Chicago, Illinois, and is one of the two largest supermarket chains in the area (Chintagunta et al., 2002). The scanner panel data provided a number of variables including units sales at the UPC level, retail and wholesale prices, promotion activities, store traffic for each store, and some demographics of households for each store. All these variables are available on a weekly-basis from each store.

Of the 399 weeks of available data, I chose two sets of 46-week data; one is set for the pre-merger estimation from 06/30/94 to 06/28/95, and the other is for post-merger from 01/04/96 to 01/01/97. The data was supposed to include 102 weeks, but 10 weeks are missing, resulting in 92 weeks of data. The data was chosen near the announcement date of the merger, July 15, 1995. The pre-merger sample contains the data from one year before the merger and the post-merger sample starts six months after the announcement of merger. The actual date the merger was finalized is December 12, 1995. Nevertheless, during six months after the announcement, the market had time to recover to equilibrium. All market participants such as retailers, competing firms, and consumers knew that the two

5) I get the data from University of Chicago Booth School of Business webpage. I acknowledge the James M. Kilts Center, University of Chicago Booth School of Business

companies would merge from the date of the announcement. Thus, I chose data just after the finalization of the merger contract.

The toilet tissue data have sales records from 93 stores. However, only the data of 73 stores were available for all the brands that I wanted to analyze for the entire sample period. Moreover, the store demographic data are missing for three stores among 73. Thus, I have to exclude a total 23 stores, and 70 stores remain for analysis. There was no entry or exit of any brands during the estimation period.

In the toilet tissue market, there were six major national brands, one store-brand, and other small brands. The two of six national brands—Scott and Cottonelle—were produced by Scott Paper Company. The remaining four brands were manufactured by different firms. I could not use Cottonelle sales data because many stores do not have sales records for this brand. In addition, combining Kleenex with Cottonelle in March 1996, Kimberly made new brand "Kleenex Cottonelle". It was a combination that relied heavily on the Kleenex name, however[6]. Thus, I left Cottonelle out of analysis, and included only five national brands and one store-brand in the estimation.

I aggregated the sales data at UPC level across both size (e.g., 4 rolls and 12 rolls) and brand variant (e.g., Charmin White is combined with Charmin Ultra White). When aggregating data across the UPC level, I substituted UPC-level prices and promotion dummies with brand-level ones that were weighted by quantity sold each week at each store. All the analysis is carried out on a unit-basis, i.e. one roll of toilet tissue.

6) "Kleenex, Cottonelle to ply the market together", Chicago Tribune, Mar 1, 1996

As noted, the outside good is incorporated. Therefore, I needed to compute the size of the outside good. The size of the outside good is defined as the total market size less the total quantity sold in the category in a given week. Using the store traffic data and assuming that every customer visiting the store purchases four rolls of toilet tissue which is the average package size of toilet tissue, I calculated total market size as M_{st} (market size at store s at week t) = store traffic at store s during week t × average package size of toilet tissue. The observed market shares are obtained as well as the size of outside good with computed market size by dividing brand sales by the market size.

As mentioned in the section four, I included information on the market characteristics for each of the 70 stores. For each store, I used the averages for the following five variables: (a) the fraction of the population that is educated, (b) the median income, (c) the average household size, (d) the fraction of the population that is unemployed, and (e) the average driving time to the store. I choose these variables based on the results of the Hoch, Kim, Mongomery, and Rossi (1995) study. The average driving time proxies for the level of retail competition and is negatively correlated with it (Hoch et al., 1995). Note that these variables are mean-centered to ensure that the main effects of the preferences and price sensitivities are easy to interpret.

I need some exogenous variables to the estimate parameters in the demand equation since price is correlated with demand shock. The instruments I chose for price are lagged retail price, lagged wholesale price, current values of the producer price indices (PPI) for the product category that was analyzed, and the average retail price of other stores. Lagged retail price is unlikely correlated with the current demand shock. Sudhir (2001) also used lagged retail price as an instrument. Since lagged wholesale price and PPI reflect the costs of manufacturers, they are likely to be correlated with retail price, but uncorrelated with demand shock. Variables related to the manufacturer's costs are widely used as an instrument for retail price (e.g. Chintagunta et al. 2002, Villas-Boas 2007). According to the study of Walters and MacKenzie (1998), loss leader promotion or in-store price specials in paper product categories (e.g., paper towels, toilet tissue) have no effect on store traffic. The stores are unlikely to respond to the activities of other stores because customers do not go to other stores due to the promotions. Thus, the demand shock in one specific store does not seem to affect the retail prices of the rest of the other stores. I interacted with brand dummies to generate brand specific instruments (Chintagunta et al., 2002). In addition to these four variables, I also include all other exogenous variables as instruments.

For the variables included in the cost function, I use hourly wages of retailing for retailer's cost function and those of manufacturing for manufacturers' cost functions. These data gathered from Current Employment Statistics (CES) surveyed by Bureau of Labor Statistics in the U.S. In addition to the hourly wages, the PPI for pulp are used as a cost variables in the cost function of manufacturer because the pulp is the main raw material for producing tissue.

6. Results

I first discuss descriptive statistics of some variables. Next, I compare the model fits for the four models proposed, and then discuss the parameter estimates obtained from the best-fitting model.

Descriptive

Table 1 provides descriptive statistics for the data with a comparison of before and after the merger. The mean and standard deviation of the following variables are summarized: (a) sales, (b) retail price, (c) wholesale price, (d) retailer margin, (e) promotion, and (f) market share. I find some interesting facts about these summary statistics. First, although Scott is classified as an economy brand (Hausman et al., 1997), its unit price is the highest among the six brands. This may be attributed to Scott's package size. The package size of the other brands is normally four whereas Scott's products consist of one roll. The more rolls one product consists of, the cheaper the unit price is likely to be. This makes Scott's unit price higher than that of the other brands.

Second, after the merger the retail and wholesale price of Kleenex went down while all the other brands' retail and wholesale prices rose. In addition, Kleenex's promotion activities increased by 69% post-merger. This may imply that Kleenex marketed its products aggressively to expand its market share. Its strategies seem successful. The quantity sold grew by 130%, and the market share doubled. At the same time, after the merger the retail price for Kleenex dropped more than the decrease of the wholesale price. Scott, Kimberly's another brand, shows records opposite of Kleenex's. Not only sales but market share fell by 30%. The standard deviation of sales decreased sharply. I assume that Kimberly focused on boosting the sales of

Table 1 Descriptive Statistics

		Sales (roll)	Retail price ($/roll)	Wholesale price ($/roll)	Retailer margin (%)	Promotion	Share
A. Before							
Angel Soft	Mean	413	0.250	0.201	19.60	0.551	0.004
	S.D	1253	0.025	0.030		0.498	0.012
Kleenex	Mean	465	0.577	0.490	15.08	0.175	0.005
	S.D	273	0.023	0.016		0.283	0.003
Charmin	Mean	2256	0.354	0.305	13.84	0.178	0.023
	S.D	2635	0.057	0.042		0.252	0.029
Store brand	Mean	646	0.266	0.187	29.70	0.060	0.006
	S.D	585	0.034	0.018		0.153	0.005
Quilted Northern	Mean	1788	0.303	0.255	15.84	0.172	0.018
	S.D	2406	0.028	0.019		0.256	0.024
Scott	Mean	1010	0.581	0.511	12.05	0.171	0.010
	S.D	1511	0.050	0.038		0.288	0.012
B. After							
Angel Soft	Mean	573	0.294	0.231	21.43	0.391	0.003
	S.D	1376	0.028	0.020		0.474	0.014
Kleenex	Mean	1070	0.528	0.463	12.31	0.296	0.011
	S.D	1132	0.080	0.073		0.353	0.012
Charmin	Mean	1641	0.400	0.335	16.25	0.110	0.018
	S.D	1369	0.050	0.038		0.266	0.012
Store brand	Mean	503	0.365	0.296	18.90	0.153	0.005
	S.D	225	0.040	0.030		0.244	0.002
Quilted Northern	Mean	2216	0.381	0.270	29.13	0.241	0.021
	S.D	2415	0.038	0.018		0.364	0.022
Scott	Mean	710	0.645	0.548	15.04	0.210	0.007
	S.D	447	0.045	0.047		0.342	0.004

Note. Retailer margins are calculated by subtracting wholesale price from retail price and dividing by retail price. These do not take into account retailer's other costs than wholesale price such as labor cost.

Kleenex. Consequently Scott's sales dropped. However, Scott's sales stabilized because regular consumers who liked Scott continuously bought Scott's products.

Finally, I evaluate the statistics for Kimberly's competitors; I find two brands that display the opposite direction of changes in some variables—Charmin and Quilted Northern. Charmin manufactured by P&G was the pre-merger market leader while Quilted Northern produced by James River Corporation (acquired by Georgia-Pacific in 2000) was the post-merger leader. It appears that Quilted Northern acted more competitively and took a softer stance towards the retailer in response to the merger between its rivals. Quilted Northern provided the retailer with a much greater margin compared to Charmin. Moreover, the former increased promotions by 40% whereas the latter cut promotions by 38%. Another aggressive brand is a private label, Dominick's. The retailer enjoyed a much higher margin from its private label—almost 30%—than the national brands, but the margin shrank considerably after the merger. Also, the promotion for the store brand soared by 155%. It seems that the retailer marketed its store-brand aggressively at the expense of its margin.

Demand parameter estimates

In table 2, I present the parameter estimates and the standard errors for the mean effects of brand preferences, price sensitivity, and deal sensitivity. I find the price and deal sensitivity to have an expected sign—negative and positive, respectively—and have statistically significant effects at the 5% level of significance. Further, some of the interaction terms are statistically significantly different from zero.

Table 2 Mean Preference and Response Parameter Estimates

Variable	Parameter estimate	Standard error
Angel Soft	-2.442*	0.242
Angel Soft × Fraction educated	1.113*	0.478
Angel Soft × Median income	-1.102*	0.337
Angel Soft × Family size	0.421*	0.192
Angel Soft × Fraction unemployed	-5.736*	2.251
Angel Soft × Driving time	-0.016	0.054
Kleenex	1.114*	0.225
Kleenex × Fraction educated	-0.294	0.866
Kleenex × Median income	-0.361	0.626
Kleenex × Family size	-0.026	0.352
Kleenex × Fraction unemployed	-7.066	4.156
Kleenex × Driving time	-0.049	0.091
Charmin	0.632*	0.219
Charmin × Fraction educated	0.080	0.617
Charmin × Median income	-0.022	0.465
Charmin × Family size	-0.020	0.257
Charmin × Fraction unemployed	-4.642	2.965
Charmin × Driving time	-0.039	0.063
Store brand	-0.784*	0.232
Store × Fraction educated	-0.802	0.512
Store × Median income	-1.123*	0.347
Store × Family size	0.229	0.194
Store × Fraction unemployed	-4.471	2.356
Store × Driving time	-0.032	0.053
Quilted Northern	0.116	0.141
Quilted Northern × Fraction educated	0.442	0.508
Quilted Northern × Median income	0.073	0.394
Quilted Northern × Family size	-0.030	0.229
Quilted Northern × Fraction unemployed	-4.347	2.696
Quilted Northern × Driving time	-0.039	0.054
Scott	1.412	0.735
Scott × Fraction educated	-1.542	0.997

Scott × Median income	-1.535	0.817
Scott × Family size	0.140	0.408
Scott × Fraction unemployed	-7.233	4.598
Scott × Driving time	-0.102	0.099
Price	-0.188*	0.010
Price × Fraction educated	0.008	0.016
Price × Median income	0.025*	0.012
Price × Family size	-0.006	0.007
Price × Fraction unemployed	0.157*	0.076
Price × Driving time	0.001	0.002
Promotion	0.598*	0.022

Note. Estimates of time dummies are not reported. All seven dummies are statistically significant at the 5% level of significance.
* Significant at the 5% level of significance

Specifically, the direction of interactions between income and the store brand preference is predictable. The estimates for the interactions between income and the private label is -1.123. This means that the preference for this brand is higher in the areas with lower incomes. It makes sense that consumers with lower than average income prefer the store brand to national brands. The interaction between income and price sensitivity is also statistically significantly different from zero, and the sign of this term is positive as expected. It is a reasonable result that consumers residing in the higher-than-average are less sensitive to price.

Table 3 reports the estimates and the standard errors for the heterogeneity parameters. The figures in the table are directly interpretable as a standard deviation of preferences and price sensitivity because I assume independence between them. Only two estimates—brand preference for Charmin and price sensitivity—are statistically significant at the 5% level of significance. The remaining five insignificant heterogeneity parameter estimates indicate that consumers do not have different tastes in corresponding brands. Consumers have the same order of brand preference, other things being equal. This might be because toilet tissue is a commodity. In other words, the level of differentiation appears low in this market, and each brand does not seem to give a distinct value to consumers.

Table 3 Heterogeneity Parameter Estimates

Variable	Parameter estimate	Standard error
$\rho_{AngelSoft}$	-0.070	3.073
$\rho_{Kleenex}$	0.243	1.041
$\rho_{Charmin}$	0.804*	0.381
ρ_{Store}	-0.054	4.545
$\rho_{QuiltedNorthern}$	0.070	1.928
ρ_{Scott}	-0.928	1.279
$\rho_{\mathrm{P}rice}$	0.068*	0.005

* Significant at the 5% level of significance

Instead, consumers are likely to habitually purchase the same brand as one they purchased previously. This is consistent with the fact that the ranking of brands in market share was stable over the estimation period. There is, however, an exception; Kleenex ranked the third after the merger, rising from the fifth before the merger.

The rise of Kleenex's market share is ascribed to the decrease in its retail price. Note that only Kleenex's average retail price declined after the merger whereas that of the other brands rose. Thus, some consumers who liked Kleenex, but did not buy it due to its high price were likely to switch to Kleenex. This idea seems to be supported by the results of the price elasticity estimates. In Table 4, I provide the cross-price elasticity matrix. The elasticities were computed for each store week and then averaged across store week. The post-merger elasticities of other brands with respect to Kleenex's price are all statistically significant at the 5% level of significance. That is, some consumers who used to buy other brands switched to Kleenex after the merger.

Turning to the results in Table 3, the statistically significant estimate for price sensitivity suggests that consumers are considerably heterogeneous in price sensitivities. While some consumers are likely to buy products without discount, others tend to purchase products when they are discounted. Some of these price-sensitive consumers probably switch to Kleenex after the merger.

Table 4 reports estimates of pre-merger and post-merger elasticities. I computed the standard errors of the elasticity estimates using a bootstrap procedure. That is, I drew values from the estimated variance-covariance matrix of the parameter estimates and computed the implied variances of the elasticity estimates (Song et al., 2006). All the estimates have the expected sign—negative for own-elasticities and positive for cross-elasticities. In addition, all the own-elasticities have absolute values greater than 1 and are statistically significant, a condition for profit-maximizing behavior. Compared with the pre-merger elasticities, many of the post-merger own- and cross-elasticities increased. This result indicates that consumers became more sensitive to prices after the merger. It might be because the retail prices of the majority of brands fluctuated more after the merger. Consequently, consumers might wait until the prices are discounted. Particularly, all the cross-elasticities of other brands with respect to

Table 4 Price Elasticities

	Angel Soft	Kleenex	Charmin	Store	Quilted Northern	Scott
	A. Before					
Angel Soft	-2.870*	0.022	0.025	0.027	0.027	0.021
	(0.705)	(0.032)	(0.043)	(0.047)	(0.045)	(0.033)
Kleenex	0.078*	-2.966*	0.096*	0.083*	0.095*	0.115
	(0.031)	(0.715)	(0.039)	(0.040)	(0.040)	(0.066)
Charmin	0.206*	0.209*	-2.948*	0.212*	0.223*	0.203*
	(0.067)	(0.054)	(0.398)	(0.071)	(0.060)	(0.058)
Store brand	0.053	0.050	0.053	-2.911*	0.056	0.048
	(0.066)	(0.038)	(0.050)	(0.870)	(0.058)	(0.042)
Quilted Northern	0.159*	0.153*	0.161*	0.161	-2.945*	0.148*
	(0.073)	(0.047)	(0.049)	(0.081)	(0.532)	(0.052)
Scott	0.151*	0.233*	0.184*	0.158*	0.179*	-2.921*
	(0.067)	(0.085)	(0.057)	(0.072)	(0.071)	(0.695)
	B. After					
Angel Soft	-3.142*	0.042	0.046	0.048	0.048	0.037
	(0.752)	(0.038)	(0.045)	(0.051)	(0.050)	(0.036)
Kleenex	0.170*	-3.163*	0.194*	0.198*	0.183*	0.208*
	(0.059)	(0.602)	(0.050)	(0.079)	(0.062)	(0.084)
Charmin	0.200*	0.224*	-3.217*	0.221*	0.209*	0.207*
	(0.067)	(0.055)	(0.454)	(0.076)	(0.060)	(0.062)
Store brand	0.067	0.076	0.071	-3.334*	0.070	0.070
	(0.083)	(0.057)	(0.064)	(0.955)	(0.075)	(0.057)
Quilted Northern	0.207*	0.201*	0.205*	0.216*	-3.070*	0.180*
	(0.081)	(0.050)	(0.049)	(0.091)	(0.566)	(0.056)
Scott	0.140*	0.208*	0.170*	0.173*	0.152*	-3.118*
	(0.069)	(0.082)	(0.066)	(0.082)	(0.071)	(0.778)

Note. Effect of row prices on column shares. Numbers in parentheses are standard errors.
* Significant at the 5% level of significance

Kleenex's prices become statistically significant and increase. Therefore, the post-merger strong sales of Kleenex may be explained by these increased cross-elasticities. In addition, the substitutability between Kleenex and Scott is large. The change in Scott's price affects the change in Kleenex's share relatively a lot, and the opposite is true as well. The ability to set the price of Scott after the merger allowed Kimberly to simultaneously optimize the prices of Kleenex and Scott, which might help Kimberly to improve its profit.

In summary, consumers are not heterogeneous in brand preferences, except for one brand. On the other hands, consumers show a high degree of heterogeneity in price sensitivity, which means that very price-sensitive consumers exist in the market. In addition, the own-elasticities of toilet tissue brands are relatively high. According to Tellis (1988), the average own-elasticity is -1.76 across categories. The elasticities of all the brands in the analysis are greater than this. Compared with the averages for detergent (-2.77) and toiletries (-1.38) that seem to have similar characteristics—commodity and storable goods—the elasticities of toilet tissue brands are still larger. With all these results—homogeneous brand preferences and large own-elasticities—taken into account, it implies that competition between manufacturers seems very intense in the toilet tissue market.

Supply side results

I first compare the model fit to data for the four different pricing equations, and then discuss the results from the best-fitting model.

Table 5 summarizes the minimized sum of squared errors for each model and test statistics. It appears that the model incorporating conduct parameters fits the data best, when the smallest sums of squared errors are taken into account. The test statistics also supports the model as the best-fitting game. That is, all the three discrete games—vertical Nash, manufacturer-Stackelberg, and retailer-Stackelberg—are

Table 5 Model Fit Statistics

Model	Before		After	
	Sum of squared errors	Test statistic	Sum of squared errors	Test statistic
A. Retailer				
Vertical Nash	814,594,900	165,611*	1,387,207,300	173,173*
Manufacturer Stackelberg	814,594,900	595.69	1,387,207,300	622.90
Retailer Stackelberg	234,119,580	509.04	210,447,940	491.84
Conduct parameter	154,232	-	177,574	-
B. Manufacturer				
Vertical Nash	1,677.11	41,697.50*	2,122.31	44,456.68**
Manufacturer Stackelberg	36,415,476,000	10,979.40	35,133,876,000	10,904.72
Retailer Stackelberg	1,677.11	1,156.49	2,122.31	1,239.53
Conduct parameter	1390.01	-	1,524.90	-

Note. The three discrete games are tested against the conduct parameter model.
* χ^2 (6 degrees of freedom) critical value = 12.59
** χ^2 (8 degrees of freedom) critical value = 15.51

rejected in favor of the conduct parameter specification. Following Kadiyali et al. (2000), I infer the best-fitting game based on the likelihood-ratio test for nested hypothesis and Vuong (1989) test for nonnested hypothesis. The Vuong test statistic is as follows:

$$V = \frac{1}{\sqrt{n}}\left\{\ln\left(\frac{f}{g}\right) - (p-q)\right\},$$

where n is the number of observation, f and g are likelihood values of two nonnested models, and p and q are the number of parameters in each model, respectively. V follows the standard normal distribution. If V is greater than the pre-determined critical value, then the model corresponding to g is rejected in favor of the model corresponding to f. The values of V for two nonnested games—manufacturer-Stackelberg and retailer-Stackelberg—are larger than the critical value of the 5% significance level (1.64). Thus, the conduct parameter specification describes the pricing behavior of the channel members best.

In Table 6, I present the cost function and conduct parameter estimates from the best-fitting model. I first discuss the parameter estimates of cost functions. Both pre-merger and post-merger cost parameter estimates for the retailer are statistically significant at the level of 5% significance. I do not report the estimate results of the store dummy because very few of the 69 store dummies are statistically significantly different from zero. There might be no big difference in marginal cost for each store. In Table 6, I also see that the constants in the manufacturer's cost function are all statistically significant both pre-merger and post-merger.

Looking at the estimated results of the conduct parameters, some of them are statistically significant, which means that the pricing strategy of the manufacturers and the retailer is different from those under Nash. Recall that when θ equals zero, the game is vertical Nash. When θ_1 to θ_6 (θ_7 to θ_{12}) is greater than 0, the retailer (manufacturers) makes lower margins than those under Nash, which implies that the manufacturers (retailer) set price more competitively than Nash. For values of θ between -1 and 0, the retailer (manufacturers) makes higher markups than those under Nash, which means that the manufacturers (retailer) behave more cooperatively toward the retailer

Table 6 Cost and Conduct Parameter Estimates from the Best-fitting Model

	Before		After	
	Parameter estimate	Standard error	Parameter estimate	Standard error
Retailer marginal costs				
Angel Soft	-65.538*	0.444	-92.787*	0.426
Kleenex	-59.468*	0.216	-90.084*	0.160
Charmin	-63.165*	0.433	-88.967*	0.445
Store	-68.974*	0.084	-99.561*	0.142
Quilted Northern	-63.245*	0.475	-93.594*	0.430
Scott	-61.169*	0.244	-86.606*	0.107
Labor	13.772*	0.269	19.001*	0.185
Manufacturer marginal costs				
Angel Soft	125.563*	0.167	83.094*	0.131
Kleenex	163.226*	0.165	78.660*	0.142
Charmin	119.030*	0.120	56.872*	0.095
Store	125.400*	0.124	83.245*	0.093
Quilted Northern	131.768*	0.160	79.524*	0.158
Scott	152.283*	0.163	94.220*	0.171
Labor	-0.146	0.174	-0.089*	0.165
Pulp	0.004	0.172	0.052	0.169
Conduct parameters				
$\theta_1(w_{as}, r_{as})$	2.229*	0.361	1.441*	0.348
$\theta_2(w_{kl}, r_{kl})$	198.280*	0.248	22.486*	0.200
$\theta_3(w_{ch}, r_{ch})$	43.565*	0.444	269.114*	0.381
$\theta_4(w_{sb}, r_{sb})$	-	-	-	-
$\theta_5(w_{qn}, r_{qn})$	45.196*	0.383	2.208*	0.404
$\theta_6(w_{sc}, r_{sc})$	455.218*	0.102	58.420*	0.170
$\theta_7(r_{as}, w_{as})$	-0.151	0.136	1.056*	0.118
$\theta_8(r_{kl}, w_{kl})$	12.324*	0.144	-0.456*	0.129
$\theta_9(r_{ch}, w_{ch})$	-0.561*	0.119	-0.697*	0.138
$\theta_{10}(r_{sb}, w_{sb})$	-	-	-	-
$\theta_{11}(r_{qn}, w_{qn})$	0.088	0.175	-0.133	0.111
$\theta_{12}(r_{sc}, w_{sc})$	0.323	0.178	-0.088	0.133

Note. I do not report estimates result of store dummy. Few estimates are statistically significantly different from zero.
as-Angel Soft, kl-Kleenex, ch-Charmin, sb-Store brand, qn-Quilted Northern, sc-Scott.
* Significant at the 5% level of significance

(manufacturers) than under Nash game[7]. I assume that θ_4, and θ_{10} equals zero because pricing decision of store brand is unlikely to be strategic. The values of all the conducts parameters, except for two conducts—θ_{11}, and θ_{12}— change after the merger. First of all, I recognize the changes of the game rule that the retailer follows. Both before and after the merger, the retailer made a smaller margins, on average, for Kleenex and Scott than those under Nash; both θ_2 and θ_6 are positive and statistically significant. However, the retailer made much higher margins after the merger which means that it priced more competitively. The retailer's margins for Quilted Northern, the number two brand in the market, also increased post-merger. On the other hand, the retailer's markup for Charmin dropped after the merger.

Next, looking at the changes of the manufacturer game, some estimates of conduct parameter show the change of sign. I find that the Kimberly priced more competitively for Kleenex after the merger. Specifically, it priced softer than under Nash prior to the merger whereas it priced tougher than under Nash after the merger. As a result, Kimberly generated higher margins from Kleenex after the merger. On the other hand, Angel soft generated smaller margins; it behaved in a more accommodating way before the merger. For the interaction between the retailer and the manufacturer of Quilted Northern, there was no change.

What brought about all these changes? The fact that Kimberly, the manufacturer of Kleenex and Scott, priced more competitively might

7) "Behaving cooperatively" here does not mean that retailer and manufacturer jointly maximize their profits, as commonly defined in economics literature.

imply that Kimberly tried to take the initiative in the relationship with the retailer. The tougher stance of the retailer post-merger also reflects the retailer's intention to retain the initiative. It also might mean that Kimberly gained enough power by merging with other toilet tissue company. Conversely, the producer of Angel Soft, the weakest brand, might have no choice but to cooperate more with the retailer because it seemed to have little power.

To summarize, the conduct parameter model best describes interaction of channel members in the toilet tissue market. Further, the interaction of each manufacturer-retailer pair is different from each other. As Kadiyali et al. (2000) pointed out, the game is heterogeneous across manufacturer-retailer pairs. The vertical relationship seems to depend on the manufacturer's relative position in the market.

7. Conclusions

This paper empirically studies the channel interactions before and after the horizontal merger between manufacturers. I applied the random coefficient logit model for the demand side. Employing the notion of equilibrium, I specified the pricing behavior of both retailer and manufacturer. I tested three discrete games—vertical Nash, manufacturer Stackelberg, and retailer Stackelberg. In addition to testing these scenarios, I incorporate a conduct parameter into the model which determines at what point pricing behavior lies in the continuum. The result of model selection test supports the conduct parameter model.

The results from the conduct parameter estimates show that the competitive landscape for the wholesale market of toilet tissue has changed as a result of the merger between Kimberly and Scott. I find that the interaction between channel members is not fixed and can change depending on the market structure. I find that the merging firm took a tougher stance toward the retailer while the weakest brand behaved in a more cooperative way. This implies that a horizontal merger between influential manufacturers could be a threat to a retailer.

There are some limitations to my research. First, I did not consider interactions between manufacturers. The assumption of Bertrand Nash between manufacturers might not be realistic. In Sudhir's (2001) study, he concluded that manufacturers are tacitly collusive. Kadiyali et al. (2000) showed that some conduct parameters capturing manufacturer-manufacturer interactions are statistically significant. Generally, many consumer goods companies are in rivalry in various markets. For example, Kimberly competes against P&G in markets other than toilet tissue such as facial tissue and paper towel. They might keep an eye on the other party's behavior, and consider other competing markets when they develop a strategy for one market. A very small price-cost margin of the retailer—positive conduct parameters— may provide evidence of collusive behaviors between the manufacturers. Actually, some big manufacturers had been accused of raising and fixing prices in the commercial markets[8], and the Justice Department had investigated possible anti-competitive practices among paper companies[9]. Although the suspicion was limited in the

8) "Florida sues toilet-paper manufacturers", Telegraph Herald, May 14, 1997
9) "U.S. studies paper makers' trade practices", The New York Times, Dec 29, 1994

commercial market, there is a possibility that toilet tissue companies collusively set price in the consumer market.

Second, studying several categories might be required to reveal the nature of retailer-manufacturer interaction more completely. Big consumer goods manufacturers commonly interact with the retailer in multiple categories. Thus, the fact that they supply products to several categories might affect the relationship with retailer. Manufacturers might endure losses in one category for gains in other categories. In this sense, this research can be extended to analyzing several categories at the same time.

Next, due to the lack of data, I did not include "Cottonelle" in the analysis. This brand, however, became an inside good in the middle of the estimation period after it was combined with Kleenex. This means that at first the purchase of Cottonelle was treated as an outside good, but it was included with Kleenex in the middle of the estimation period. This probably affected the estimation results. The increase of Kleenex's sales after the merger might be caused partly by the entry of purchasers who prefer Cottonelle.

In summary, this research reveals that the changes in the market structure—horizontal merger between manufacturers—have an impact on the pricing behavior of retailer and manufacturers. This study seems to generate reasonable results that help marketing managers better understand the nature of the interactions between channel members.

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국문초록

제조업자와 유통업자의 가격책정 행위에 대한 연구: 제조업자의 수평적 합병 전과 후 비교

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본 연구는 다수의 제조업자와 공통의 유통업자 사이의 상호작용 관계를 그들의 가격책정 행위에 초점을 맞추어 연구하였다. 특히, 두 제조업자가 합병을 하기 전과 후를 비교하여 유통채널에서 발생하는 상호작용을 이해하고자 하였다. 연구를 위하여 소비자와 기업의 행동을 모형화하고 균형(equilibrium)의 개념을 이용하는 new empirical industrial organization 접근을 취하였다. 먼저, 소비자의 효용과 구매확률를 나타내는 모델로는 random coefficient logit 모델을 사용하였다. 수요 모델 파라미터의 추정 시에는 Berry, Levinsohn, and Pakes (1995)가 제안한 시뮬레이션과 contraction mapping을 사용하였다. 다만, 그들은 수요와 비용 등식을 동시에 추정하였지만 본 연구에서는 Chintagunta, Bonfrer, and Song (2002)이 제안한 2단계 추정 방식을 택하였다. 수요 모델을 추정한 후에는 추정된 값을 이용하여 세 가지의 다른 게임 규칙 가정 하에서 기업의 마진을 계산하였고 비용 등식의 계수를 추정하였다. 세 가지 규칙은 vertical Nash와 manufacturer Stackelberg, retailer Stackelberg이다. 하지만 이 세 가지 비연속 게임이 제조업자와 유통업자 사이의 다양한 상호작용 관계를

설명하지 못할 경우가 있을 수도 있다. 그래서 연속적인 상호작용 상태를 포함할 수 있는 conduct 파라미터를 도입한 모델도 함께 추정하였다. Nonnested 모델 검증 결과, conduct 파라미터를 도입한 모델이 데이터를 가장 잘 설명하였다. 합병 전과 후의 conduct 파라미터 값의 변화를 보면 합병 후 합병기업은 더 공격적으로 가격책정을 하였고, 시장점유율이 가장 작은 브랜드는 이와 반대로 행동하였다. 본 연구는 합병 후 제조업체와 유통업체가 시장 구조의 변화에 맞춰 전략을 수정하였음을 밝혀내었다.

주요어: 전략적 가격책정, 채널 상호작용, 수평적 합병

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