

# The Competitive Effects of a New Product Introduction: A Case Study<sup>1</sup>

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**Abstract:** This paper analyzes the competitive effect of a new product introduction in the bath tissue industry. We break the overall competitive effect into two parts: the effect on the prices of existing products caused by the increased competition, and the additional variety effect resulting from the availability of the new product. Using retail scanner data from before and after the introduction, we directly estimate the price effects. Then, using retail scanner data from after the introduction only, we estimate the additional variety effect. Finally, we use the estimated post-introduction demand structure, along with an assumed model of competition, to estimate the price effects indirectly. By comparing the “indirect” estimates with the “direct” estimates, we are able to assess the validity of alternative models of competition among bath tissue manufacturers.

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## **I. Introduction**

The continuous development and introduction of new products is an important source of improvement in consumer welfare. New product introductions are particularly prevalent in the “fast moving consumer goods” segment of the US economy, which encompasses products sold through high volume retail channels such as supermarkets, drug stores, and mass merchandisers. For instance, recent introductions by fast moving consumer goods manufacturers include General Mills’ introduction of a “Frosted Cheerios” line extension, Coca-Cola’s introduction of a new sports beverage product (“All-Sport”) to compete with Gatorade, and Kimberly-Clark’s introduction of a bath tissue product (“Kleenex Bath Tissue”).

An important economic question is how much consumers benefit from new product introductions or, in the language of antitrust, what competitive effects the new product introductions have.<sup>2</sup> In the general case, consumers are affected by new product introductions in two ways. First, they gain the surplus associated with the additional variety provided by the new product. The magnitude of this consumer surplus gain is in general a function of how closely substitutable consumers view the new product and existing products. A new product that is closer to existing products will add less consumer surplus. Second, the introduction of a new product creates increased competition for existing products. If the manufacturer of the new product has no existing products in the market, the new product will typically lead to lower prices for all

competing products, a result which benefits consumers.<sup>3</sup> The extent to which a particular existing product's price is affected by the introduction of the new product is a function of the closeness between the existing product and the new product, as well as of the form competition takes in the market. If the manufacturer of the new product has other products in the market, a possible outcome of the new product introduction is an increase in the prices of these other products which would harm consumers, see Hausman (1997a). The overall net effect on consumers of a new product introduction is the sum of the additional variety effect and the price effect.<sup>4</sup>

In this paper, we estimate the net benefit to consumers associated with the introduction of the Kimberly-Clark bath tissue product "Kleenex Bath Tissue" (henceforth, KBT). Using retail scanner data from before and after the introduction, we estimate directly the reductions in price for existing products in the bath tissue market that resulted from the introduction of KBT, i.e., the price effect. Then, using retail scanner data from after the introduction, we estimate the additional consumer surplus associated with the availability of KBT (evaluated at the lower category prices), i.e., the additional variety effect. We find that consumers have been made significantly better off by the introduction.

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<sup>2</sup> The terms "anti-competitive" and "pro-competitive" are usually used by economists to describe events that decrease and increase, respectively, consumer welfare. The antitrust laws are generally viewed to be consumer welfare statutes.

<sup>3</sup> Our use of the term "market" in this paper refers to the meaning in economics as opposed to the meaning in antitrust (i.e., "relevant market").

<sup>4</sup> These welfare effects are "static." A new product introduction might also have "dynamic" welfare effects. For instance, a new product might create a whole new market segment, leading to subsequent "me-too" product introductions. Miller Lite, which created the light beer segment, is an example.

In addition, we use the estimated post-introduction demand structure, along with an assumed model of competition, to estimate indirectly the price effects of the KBT introduction. By comparing this “indirect” estimate of the price effects to the “direct” estimate of the price effects that are obtained using the pre- and post-introduction data as described above, we can assess the validity of the predictions generated by the assumed model of competition. We focus in particular on the Nash-Bertrand model. Given the important role played by the Nash-Bertrand model in the economic literature on differentiated products, e.g., analyses of the competitive effects of mergers, an assessment of its validity (even for a particular industry) is valuable. We also examine several alternative models of competitive behavior.

## **II. The Bath Tissue Market**

As in many consumer product industries, bath tissue products fall into several quality tiers, “premium,” “economy,” and “private label.” However, the bath tissue market is somewhat unusual in that premium brands account for a substantial share of dollar sales (typically over 70%). Premium bath tissue brands are generally produced using a base tissue that is thicker and softer than the base tissue used to produce the brands in the non-premium segments. This higher quality tissue is typically more costly to produce, due both to higher manufacturing costs and higher raw material (pulp) costs. The premium bath tissue brands are generally priced significantly higher than the brands in the other segments.<sup>5</sup>

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<sup>5</sup> Even within the premium segment, however, significant variation in quality exists. Charmin is on the higher end of the segment and Angel Soft on the lower end.

Prior to the KBT introduction, the major premium brands were Charmin (manufactured by Procter & Gamble), Northern (James River), Angel Soft (Georgia Pacific), and Cottonelle (Scott).

Kimberly-Clark, one of the world's largest tissue producers, was well known for its Kleenex facial tissue brand, but it did not offer a major bath tissue product prior to 1991. Kimberly-Clark believed that a bath tissue product would provide a way to extend the Kleenex brand name and make use of Kimberly-Clark's superior tissue technology without cannibalizing any existing Kimberly-Clark product. Thus, in 1991, Kimberly-Clark rolled out Kleenex Bath Tissue in selected regions of the US, positioning it as a premium brand. Kimberly-Clark subsequently increased the distribution of the product to other regions of the US.<sup>6</sup>

The major "economy" brand was ScotTissue, manufactured by Scott. ScotTissue is made from a lower quality tissue than the premium brands. But, ScotTissue is considered to be an atypical economy brand in that it has substantial brand-name recognition among consumers and a loyal customer base. ScotTissue is targeted toward consumers who desire many sheets per roll. Given the large number of sheets per roll and the thinness of each sheet, ScotTissue's price (per sheet) is quite low, even below the price of private label.

As in other consumer product markets, private label products over time have taken a significant share of the bath tissue market. Private label products are produced by

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<sup>6</sup> After its merger with Scott in 1995, Kimberly-Clark combined the Scott Cottonelle product and its KBT product into a single product called "Kleenex Cottonelle" (which had the characteristics of the KBT product). As a result, the Kleenex product attained national distribution.

tissue manufacturers for supermarkets (and other retailers) who then market and sell them under their own labels. Supermarkets generally receive a higher margin on private label products than they do on branded products.

The production technology in the bath tissue industry is characterized by sizable fixed costs, as tissue machines are a significant capital investment. Marginal costs are driven primarily by the cost of pulp, which is the main input into tissue production. Pulp prices are cyclical, following the “pulp cycle.” Price competition in the industry appears to be strong, with bath tissue manufacturers seeking to keep their tissue machines running at full capacity by reducing prices when necessary.

Anecdotal evidence suggests that after, and even prior to, Kimberly-Clark’s entry into a region, Procter & Gamble reacted aggressively by reducing the price of Charmin. The Procter & Gamble price reductions were followed by price reductions in the other premium brands. Thus, the introduction of KBT is thought by industry participants to have increased competition in the industry and lowered industry prices. Below, we analyze this issue.

### **III. Estimating the Value to Consumers of a New Brand**

The total effect on consumers of the introduction of a new brand, i.e., the compensating variation, can be written as the difference in the consumers’ expenditure function before and after the introduction, holding utility constant at the post-introduction level:

$$(1) \quad CV = e(p_1, p_N, r, u_1) - e(p_0, p_N^*(p_0), r, u_1)$$

where  $p_1$  is the vector of post-introduction prices of the competing products,  $p_N$  is the post-introduction price of the new product,  $r$  is a vector of prices of products outside the industry (which are assumed to be unaffected by the introduction), and  $u_1$  is the post-introduction utility level. The pre-introduction utility level could also be used which would yield an equivalent variation measure. The function  $p_N^*(p_0)$  defines the “virtual” price for the new product, i.e., the reservation price at which demand for the new product would be zero given the prices of the other products.

This total benefit to consumers can be broken into two parts,

$$(2) \quad CV = \left[ e(p_1, p_N, r, u_1) - e(p_1, p_N^*(p_1), r, u_1) \right] + \left[ e(p_1, p_N^*(p_1), r, u_1) - e(p_0, p_N^*(p_1), r, u_1) \right]$$

and written as  $CV = VE + PE$ . The first term (“VE”—the “variety effect”) represents the increase in consumer welfare due to the availability of the new brand, holding the prices of the existing brands constant at their post-introduction level.

The second term (“PE”—the “price effect”) represents the change in consumer welfare due to the change in the prices of existing brands after the introduction. By changing the competitive structure of the industry, the new brand introduction can lead to either an increase or decrease in the prices of existing brands. If the new brand competes closely with the existing brands of the same manufacturer, the manufacturer may be able

to raise the price of its existing brands. If, however, the new brand competes more closely with the brands of other manufacturers (or the new brand is the first product in the industry for that manufacturer), the prices of these other brands are likely to fall. Thus, in addition to providing additional variety, the introduction of a new brand can change consumer welfare through an effect on the prices of existing brands.

Hausman (1997a) examines the case of a new ready-to-eat cereal brand that competes closely with existing products of the same manufacturer. In this case, the price effect term is negative (to first order). However, the variety effect term is sufficiently large that the net effect on consumers was to make them better off because the additional surplus due to the availability of the new brand exceeded the decrease in surplus due to the (small) post-introduction price increases. Hausman (1997a) had available only post-introduction data, which was used to estimate the post-introduction demand structure. Given the estimated demand structure and assuming the Nash-Bertrand model of differentiated products competition, Hausman (1997a) estimated the price effects of the new brand introduction.

For this paper, we were able to obtain both pre-introduction and post-introduction data on the sales of bath tissue products. Given these data, we take two approaches to estimating the price effect term from equation (2) associated with the introduction of KBT. In the first, “direct,” approach, we combine the pre- and post-introduction data to directly estimate the effect of the KBT introduction on the prices of existing bath tissue products. With the direct approach, we avoid having to estimate the structure of

consumer demand for bath tissue products and we also avoid having to make assumptions about the form of competition in the industry.<sup>7</sup>

The second, “indirect,” approach requires only the existence of post-introduction data. We use these data to estimate the structure of demand for bath tissue products. Then, given the structure of demand and an assumption about the form of competition between firms in the industry, we estimate what would happen to the prices of the other bath tissue products if KBT were removed from store shelves. The indirect approach is valuable because it requires only post-introduction data. However, it depends upon the assumption regarding the form of competition that prevailed in the industry both before and after the introduction.

Given the possibility here of implementing both approaches, it is natural to compare the two sets of results. This comparison provides a way to assess the validity of particular models of competition.<sup>8</sup> We focus on the Nash-Bertrand model. An assessment of this particular model is desirable given its important role in the economic analysis of differentiated products industries. For example, the Nash-Bertrand assumption is frequently employed in studies of the competitive effects of mergers, e.g., Deneckere and Davidson (1985), Hausman, Leonard, and Zona (1994), Werden and Froeb (1994), Hausman and Leonard (1997), and Werden (1997).

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<sup>7</sup> The increase in consumer surplus due to the price effect can be approximated to first order using these results and quantity data. However, determining the exact increase in consumer surplus still requires estimation of the demand structure.

<sup>8</sup> A maintained hypothesis required for this comparison is that the specification of the demand system is the same in the pre- and post-introduction periods. However, because of the flexible demand specification used, this assumption is likely to be valid.

In addition to estimating the price effect term in equation (2), we also estimate the variety effect term. Again, only the post-introduction data and the demand structure estimated on these data are required. We sum the VE and PE terms in equation (2) to obtain the total benefit to consumers resulting from the introduction of KBT. Unlike with the cereals case studied by Hausman (1997a), the introduction of KBT by Kimberly-Clark is a case of essentially *de novo* entry into an industry.<sup>9</sup> Thus, we would expect the price effects term to be positive (i.e., the prices of existing brands are reduced, increasing consumer surplus). However, whether the variety effect is larger than the price effect, or vice-versa, is an empirical question.<sup>10</sup>

#### **IV. Data**

The source for the data we use in the empirical analyses described below is AC Nielsen. In each of a number of direct marketing areas (“cities”) in the US, Nielsen selects a stratified sample of supermarkets. From each sampled supermarket, Nielsen obtains computerized data gathered by in-store point-of-sale scanning devices. As each product purchased by a consumer is passed over the scanner, the price and UPC number (which identifies the brand and package type) of the sale are recorded. Nielsen projects from its sample of stores to the population of stores to estimate the quantity sales and average price by city and week for each brand.

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<sup>9</sup> Prior to the introduction, Kimberly-Clark had a minor bath tissue brand with extremely small share (Delsey).

<sup>10</sup> If the new product were a nearly perfect substitute for an existing product, the variety effect would be close to zero. Conversely, if the new product were quite differentiated from the existing products, the price effect might well be close to zero.

We had access to weekly Nielsen data on the unit sales and price of the seven largest bath tissue products in 30 cities in the US for the period January 1992-September 1995 period (196 weeks). KBT was rolled out across the US in a series of “waves.”<sup>11</sup> The 30 cities used in our analysis fall into three groups based on the wave to which they belonged. In 17 of our 30 cities, KBT had already been introduced by the time our data begins (i.e., January 1992). We refer to these 17 cities as the “first wave” cities. In three of the 30 cities, KBT was introduced in July 1993 (the second wave). In the remaining ten cities, KBT was introduced in May 1994 (the third wave).

Table 1 provides summary information on the 30 cities, grouped by wave, for the last six months of our data (April to September 1995).<sup>12</sup> The first seven columns of Table 1 give the dollar shares of the seven brands. A particular brand’s share can vary substantially across cities. For instance, Charmin, the brand that generally has the largest share of bath tissue expenditures, had a 43.3% share in Nashville, but only a 22.7% share in Milwaukee.

The second seven columns of Table 1 give the prices for the seven brands (expressed as dollars per 28,000 sheets, which is the “standardized” quantity unit used by Nielsen). Like the share, a particular brand’s price can vary substantially across cities. Charmin’s price in Omaha was \$28.01, while its price in Miami was \$33.99. Of the seven brands, Charmin generally carried the highest price. As noted earlier, despite its branded status, ScotTissue was often priced lower than even private label.

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<sup>11</sup> We suspect that Kimberly-Clark rolled out the KBT product first in cities where its Kleenex product was strongest.

In the last column of Table 1, we provide annual bath tissue expenditure by city. These figures give an indication of relative market sizes.

While the Nielsen data provide the best available information on retail sales by geographic area, they have several shortcomings. First, individual private label products are not broken out separately. Only an aggregate private label category is available. Thus, we cannot examine variation in quality or other forms of competitive interaction among the individual private label brands. Second, the Nielsen price data does not account for the use of manufacturers' coupons.

## **V. Direct Estimates of the Price Effect of the KBT Introduction**

In the 17 first wave cities, KBT had already been introduced at the start of the period covered by our data, while for the second and third wave cities, KBT was introduced at two different points during the period. The existence of staggered introductions allows us to identify any downward shift in the prices of existing brands caused by the KBT introduction separately from movements in prices caused by other factors, such as changes in cost conditions, that would be expected to affect prices in all cities.

In particular, we examine price movements in the second and third wave cities after KBT was introduced, controlling for contemporaneous price movements in the first wave cities (where KBT had already been introduced). To the extent that the KBT introduction had a downward effect on the prices of existing brands, we should see a

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<sup>12</sup> We use a six month period in order to avoid the short run effects on prices and shares caused by temporary price reductions, i.e., sales, run by supermarkets.

downward shift in the prices in the second wave and third wave cities after KBT is introduced, relative to price movements in the first wave cities.

Specifically, for each existing bath tissue brand, we estimated an equation of the following form:

$$(3) \quad \log p_{it} = \alpha_i + W_t + I_{it} \mathbf{d}_1 + M_{it} \mathbf{d}_2 + \mathbf{e}_{it}$$

The dependent variable,  $\log p_{it}$ , is the log price of the existing bath tissue brand in city  $i$  and week  $t$ . The variables  $\alpha_i$  and  $W_t$  are fixed effects for city  $i$  and week  $t$ , respectively. These variables account for city-specific effects and week-specific effects (i.e., movements in costs that would be expected to affect prices in all cities).

The variable  $I_{it}$  is a “post-introduction” indicator variable. In other words, it equals one if KBT had been introduced in city  $i$  as of week  $t$ . The coefficient on  $I_{it}$  measures the amount by which the price of the existing brand changed after the KBT introduction, controlling for the week-specific fixed effects. This coefficient is identified separately from the week-specific effects because of the staggered waves of KBT introduction.

The variable  $M_{it}$  was included to determine whether prices in the third wave cities fell in response to the introduction of KBT in the second wave cities even though KBT had not yet actually been introduced in the third wave cities. It is possible that producers of existing brands attempted to preempt some of the KBT effect in third wave cities by lowering price in advance of the KBT entry. Thus,  $M_{it}$  equals one if city  $i$  is one of the

third wave cities and  $t$  is a week in the “interim period” between the second and third waves of introduction.

Equation (3) was estimated via OLS and a modified Newey-West procedure was used to estimate the standard errors taking account of the possibility of correlation in the error term across cities and weeks. The coefficient estimates and standard errors are provided in Table 2.<sup>13</sup>

The estimated post-introduction coefficients are negative for all brands, indicating that the prices of existing brands fell after the KBT introduction. The price of the leading bath tissue brand Charmin experienced a 3.5% reduction. This effect is estimated quite precisely with a standard error of 0.9%. Thus, although KBT achieved a share generally only one-quarter to one-third of Charmin’s (see Table 1), its introduction had a significant effect on Charmin’s price. The brand with the largest estimated price reduction (8.2%) was Cottonelle. The other two premium brands, Angel Soft and Northern, also experienced significant price reductions of 3.5% and 2.3%, respectively.

In contrast to the price behavior of the premium brands, the price of ScotTissue, an economy brand, was estimated to fall by only 0.6% (estimated standard error of 0.5%). Thus, Scott apparently made only a small change in the pricing of ScotTissue in response to the KBT entry.

The effect of the KBT introduction for private label was more similar to the effect for the premium brands than for ScotTissue. The private label price was estimated to fall

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<sup>13</sup> Table 2 actually reports the estimated percentage effect on price, i.e.,  $\exp(\delta_i)-1$ , instead of the regression coefficient  $\delta_i$  itself.

by 3.8%, even though private label brands a priori might be expected to compete less closely with KBT than Northern and Angel Soft.

The estimated interim period coefficients indicate that the producers of the existing brands adopted different strategies as to when to reduce their prices in the third wave cities.<sup>14</sup> Northern and Angel Soft prices did not decline in the third wave cities until KBT was actually introduced in those cities (i.e., their interim variable coefficients are not statistically significantly different from zero). In contrast, essentially all of the Charmin and private label price reductions in the third wave cities occurred at the time of the second wave of introduction (their estimated interim period coefficients are approximately the same size as their estimated post-introduction coefficients). For Cottonelle, part of the price reduction occurred during the interim period, with the rest coming after the KBT introduction.

Given the price effects estimated in Table 2, the second term in equation (2), i.e., the increase in consumer surplus due to the price reductions in existing brands due to the KBT introduction (evaluated at the KBT virtual price), can be estimated. A first order approximation to the consumer surplus gain could be obtained by multiplying the respective brands' quantities by their price declines and summing. An exact calculation, however, requires knowledge of the demand structure. We now turn to estimating this structure.

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<sup>14</sup> These results suggest that our estimates of the price effects of the KBT introduction may be understated to the extent that producers of existing products reduced their prices in the second and third wave cities in response to the first wave of introductions, before the start of our data.

## **VI. Estimation of the Variety Effect of the KBT Introduction**

### **A. Demand System Estimation**

To estimate the additional consumer surplus associated with the availability to consumers of the KBT brand, we estimate the structure of the demand for bath tissue using the Nielsen data. Our approach to estimation is one we have used previously (Hausman, Leonard, and Zona (1994) and Hausman (1997a)).

#### **1. Demand System Specification**

We employ a two-stage demand system based on Gorman's two-stage budgeting approach (see, e.g., Gorman (1995)). The basic idea is to have the top level correspond to overall demand for the product, here bath tissue. The second, or bottom, level of the demand system corresponds to competition among brands, e.g., KBT and Charmin. We estimate both levels of the demand system and, by combining the estimates from the two levels together, we are able to estimate the overall own and cross price elasticities for each brand.

The second (or lower) stage determines buying behavior with respect to the brands, conditional on total bath tissue expenditure. For this level, we use the "almost ideal demand system" specification of Deaton and Muellbauer which allows for a second order flexible demand system, i.e., the price elasticities are unconstrained at the point of approximation, and also allows for a convenient specification for non-homothetic behavior (Deaton and Muellbauer (1981)).

Let the bath tissue expenditure share of brand  $i$  in city  $n$  in time  $t$  be defined as

$$(4) \quad s_{int} = \frac{p_{int} Q_{int}}{Y_{nt}}$$

where  $Q_{int}$  is the quantity of brand  $i$  in city  $n$  in week  $t$ ,  $p_{int}$  is the price of brand  $i$  in city  $n$  in week  $t$ , and  $Y_{nt}$  is the total expenditure on bath tissue in city  $n$  in week  $t$ .

Under the almost ideal demand system specification, the lower level demand specification for the share of brand  $i$  is:

$$s_{int} = \mathbf{a}_{in} + \mathbf{b}_i \log \frac{Y_{nt}}{P_{nt}} + \sum_{j \in B, P} \mathbf{g}_{ij} \log p_{jnt} + Z_{nt} \mathbf{q}_i + \mathbf{e}_{int}$$

$$(5) \quad \begin{aligned} n &= 1, \dots, N \\ t &= 1, \dots, T \\ i &= 1, \dots, I \end{aligned}$$

$P_{nt}$  is an overall price index for bath tissue; we use the Stone index

$$(6) \quad \log P_{nt} = \sum_{i=1}^I w_{in} \log p_{int}$$

where the weight for brand  $i$  in city  $n$  is the average (over all weeks) expenditure share of brand  $i$  in city  $n$ . The parameters  $\alpha_{in}$  in (5) are city-brand-specific fixed effects to capture time-invariant differences in demographics and consumer preferences across cities and brands. The vector  $Z_{nt}$  includes variables intended to account for changes in

demographics and preferences. For this purpose, we use monthly indicator variables (to capture seasonal effects) and a linear time trend.

In the top level equation, total bath tissue expenditure is determined as a function of the overall bath tissue price index and consumers' total expenditure. We use the following specification for the top level demand equation:

$$(7) \quad \log u_{nt} = \mathbf{m}_n + \mathbf{I} \log I_{nt} + \mathbf{d} \log P_{nt} + Z_{nt} \mathbf{f} + \mathbf{h}_{nt}$$

where  $u_{nt}$  is overall bath tissue quantity in city  $n$  in time  $t$ ,  $\mu_n$  is a fixed effect for city  $n$  (again representing time-invariant demographics and preferences),  $I_{nt}$  is total disposable income for city  $n$  and week  $t$  (obtained on an MSA basis from the BLS),  $P_{nt}$  is the bath tissue price index, and  $Z_{nt}$  is the vector of seasonal and time trend variables.

## 2. Instruments

We use an instrumental variable technique to account for the potential simultaneity problem. One possibility for developing instruments is to obtain data on cost variables that do not appear in the demand equations. However, to be useful instruments, such variables would have to be measured with a great degree of frequency and specificity (i.e., separately for the individual manufacturers). For instance, a paper pulp price variable, measured monthly and at a national level, would not ultimately be very helpful in estimating a demand equation based on the prices of eight individual bath tissue brands, measured weekly in a large number of cities. While plant-specific variable

cost data for each manufacturer would be more helpful, having access to such data is rare and indeed, we did not have access to such data.

To get around this problem, we attempt to utilize the panel structure of the underlying data. After allowing for the brand-city fixed effects, we use the prices from one city as instruments for other cities, following the approach of Hausman and Taylor (1981). The intuition is that prices in each city reflect both underlying product costs and city-specific factors that vary over time as supermarkets run promotions on a particular product. To the extent that the stochastic city-specific factors are independent of each other, prices from one city can serve as instruments for another city.

Consider the case of two cities, indexed by  $n=1$  or  $2$ , and the estimation of the share equation (5) for city 1. The reduced form equations for the prices of brand  $j$  in the two cities are

$$(8) \quad \begin{aligned} \log p_{j2t} &= \Pi_1 \log c_{jt} + \boldsymbol{m}_{j2} + Z_{2t} \Pi_2 + v_{j2t} \\ \log p_{j1t} &= \Pi_1 \log c_{jt} + \boldsymbol{m}_{j1} + Z_{1t} \Pi_2 + v_{j1t} \end{aligned}$$

A common determinant of the prices in the two cities is  $c_{jt}$ , a non-city-specific cost element that arises because of the regional or national manufacture and shipping of bath tissue products. Also appearing in the reduced form equation are the demand shifter variables ( $Z_{nt}$ ), a city-specific brand differential due to transportation costs or local wages ( $\boldsymbol{m}_{jn}$ ), and an error term ( $v_{jnt}$ ). In general, the error term  $\varepsilon_{j1t}$  from share equation (5) for

city 1 will be correlated with  $v_{j1t}$ . If so, then OLS would yield inconsistent estimates of the parameters in equation (5).

However, as long as  $v_{j2t}$  is uncorrelated with  $v_{j1t}$ , city 2's price satisfies the first requirement to be a valid instrument for city 1's price, i.e., it is uncorrelated with the error term in equation (5). Moreover, since city 2's price, after elimination of city- and brand-specific effects and the demand shifter variables, is driven by the same underlying costs,  $\log c_{jt}$ , as city 1's price, city 2's price also satisfies the second requirement to be a valid instrument for city 1's price.

We now examine the conditions under which  $v_{j2t}$  would be uncorrelated with  $v_{j1t}$ . For that purpose, it is useful to consider the error term from the share equation (5),  $\varepsilon_{j1t}$ . This error term will contain demand-shifting factors not accounted for by  $Z_{1t}$ . These demand-shifting factors can be divided into three categories. First, since supermarket shelf prices are generally set and posted in advance of the realization of demand, some factors in  $\varepsilon_{j1t}$  are not observed when prices are set. Such factors would not appear in the reduced form equations (8) and thus would not cause correlation between  $v_{j1t}$  and  $v_{j2t}$ . Second, some factors in  $\varepsilon_{j1t}$  are purely city-specific, e.g., the effects of local advertising and promotion. These factors also would not cause correlation between  $v_{j1t}$  and  $v_{j2t}$ . Third, some part of  $\varepsilon_{j1t}$  may arise from a factor that is both present across cities and not already picked up by  $Z_{1t}$ . Only this third category of factors could cause a correlation between  $v_{j1t}$  and  $v_{j2t}$ .

An example of such a factor might be a national advertising campaign, which might both affect demand in all cities and be taken into account when retail prices are set.

The variables we included in  $Z_{1t}$  may well capture the effects of national advertising. However, to better capture national advertising or any other such nationwide factor, we implemented an additional specification that allows for a more flexible effect of time on demand than our initial specification and thus would be expected to pick up more of any nationwide factors. In particular, we included in the specification separate indicator variables for each month-year period in the data. Since manufacturers' national advertising plans are often broken into monthly segments, the specification has the potential to capture the effects on demand of national advertising, eliminating the correlation that might exist among the  $v_{jnt}$ . However, we find that the results of this more flexible specification are quite similar to our original specification.<sup>15</sup>

Thus, while we cannot completely rule out the existence of some nationwide factor that causes correlation among the  $v_{jnt}$ , the results of the alternative specification do not indicate any serious problem with the instruments. In addition, we have another way of assessing the validity of the demand system estimates. In what follows, we compare estimates of the price effects of the KBT introduction, obtained indirectly using the demand system estimates, to the direct estimates of the price effects from Table 2. This comparison provides an additional test of the validity of the instruments. If the instruments were invalid, the demand structure would be expected to give a poor estimate of the price effects of the KBT introduction. However, as described below, we find a

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<sup>15</sup> Compare Table 3 below to Appendix Table 2.

reasonable similarity between the indirect and direct estimates, a finding that supports the conclusion that the demand elasticity estimates are not significantly biased.<sup>16</sup>

### 3. Elasticity Estimates

We applied the econometric approach outlined above to the Nielsen Scantrak data to estimate the bath tissue demand model. For the 17 wave three cities, the number of weeks of data available after KBT had been introduced and its share had stabilized was sufficient to estimate the demand system. The underlying demand system parameter estimates are provided in Appendix Table 1. However, elasticities are more easily interpretable and we discuss the estimates of the elasticities in the main text.

The equation for the elasticity of brand  $i$  with respect to brand  $j$ 's price is

$$(9) \quad e_{ij} = \frac{1}{s_i} [\mathbf{g}_{ij} - \mathbf{b}_i w_j] - 1 [i = j] + \left( 1 + \frac{\mathbf{b}_i}{s_i} \right) (1 + \mathbf{d}_2) w_j$$

where the variables and parameters are defined in the discussion of equations (4)-(7). For the purposes of the presentation in Table 3, we estimated the elasticities at the averages of the data across city and time. Table 3 is organized so that the first row of the elasticity matrix gives the KBT own elasticity (column 1) and the cross elasticities of KBT with respect to the other brands' prices (columns 2-8).

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<sup>16</sup> One caveat is that this comparison is implicitly a joint test of the demand system estimates along with the Nash-Bertrand assumption. Thus, in principle, invalidity in the latter could offset invalidity in the former.

The KBT own elasticity is -3.3. Among the KBT cross elasticities, the largest are with respect to the prices of Northern (0.71), Charmin (0.68), Cottonelle (0.50), and Angel Soft (0.21). These results are consistent with consumers viewing these other premium brands as the closest substitutes for KBT.

Charmin has a somewhat lower own elasticity of demand than KBT, -2.3, reflecting its position as the strongest brand in the industry. Charmin's largest cross elasticity is with Northern (0.47), followed by ScotTissue (0.28) and the three other premium brands, Angel Soft (0.26), KBT (0.26), and Cottonelle (0.24). The own elasticities for the other premium brands are all quite high, over -3.0. Overall, the cross elasticity results are consistent with the idea that a premium segment exists and that the brands within that segment compete more closely with each other than they do with brands outside the segment.

ScotTissue has an own elasticity of -1.8, which is below even that of Charmin. This result is at first surprising given that ScotTissue is a lower tier brand. However, as discussed above, industry marketing personnel consider ScotTissue to be a strong and profitable brand because its attributes ("1000 sheets per roll") appeal to a particular consumer segment and no other bath tissue product is close to it in attribute space. Thus, while charging a lower price than other brands, ScotTissue achieves a higher gross margin (its marginal cost of production is significantly lower than the premium brands). Thus, the elasticity results are, in fact, quite consistent with qualitative information from the industry.

The own elasticity of private label is -1.69, which seems quite low for what is essentially a non-branded product. However, recall that Nielsen provides data only on the overall private label category, aggregating individual private label products. As such, the estimated elasticity reflects the elasticity of the category, not the elasticity of individual private label product. The individual products would be expected to have a higher own elasticity of demand than the category.

We estimate the top level elasticity, i.e., the own elasticity of demand for the bath tissue segment as a whole, to be -0.89 (asymptotic standard error = 0.07), which is consistent with the nature of the product and the generally low level of prices in the industry which have resulted from the intense competition between manufacturers.

The high own elasticities of demand for bath tissue brands reflects the view of industry marketing personnel that the market is fiercely competitive with low margins. With the high fixed costs of operation, bath tissue producers have strong incentives to keep their plants running at full capacity, even if that requires keeping their prices low. The magnitude of the elasticities are also consistent with the gross margins for bath tissue brands we have seen. Under the Nash-Bertrand differentiated products model (discussed in more detail below), the price-to-marginal cost markup on a manufacturer's brand is a function of the own elasticity of that brand as well as the cross elasticities between that brand and the manufacturer's other brands. Thus, a comparison of actual gross margins to the margins implied by the elasticities and the Nash-Bertrand assumption can provide a test of the Nash-Bertrand assumption. However, the difficulties associated with using accounting variables to measure economic variables are well known.

In estimating the demand system, we imposed the homogeneity and symmetry restrictions implied by economic theory. However, a Wald test of these restrictions rejects the null hypothesis that the restrictions are valid at the 5% significance level.<sup>17</sup> Given that the restrictions are necessary for the validity of the welfare calculations we perform below, we investigated the economic significance of the rejection. In Appendix Table 3, we provide the elasticity estimates based on the parameter estimates obtained from an unrestricted estimation of the demand system. A comparison between these results and the results in Table 3 reveals that in most cases the restricted and unrestricted elasticity estimates are quite similar. The only major exception (and the likely cause for the rejection of the restrictions) is the cross elasticity of KBT with respect to ScotTissue's price, for which the unrestricted estimate is negative and sizable—a result that does not make economic sense. Given that imposition of the restrictions does not appear to have an economically significant effect, we proceed by imposing the restrictions since they are necessary for proper interpretation of the welfare analysis that follows.

#### **B. The variety effect**

From equation (2), the variety effect associated with KBT, evaluated at the post-introduction prices of the other brands, is the increase in the expenditure function that would result from raising the price of KBT from its actual level to its virtual level, i.e., the price level that sets KBT demand to zero,

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<sup>17</sup> Rejection of the homogeneity and symmetry restrictions is a common finding in demand studies (Deaton (1986)).

$$(10) \quad VE = e[p_1, p_K^*(p_1), u_1] - e[p_1, p_K, u_1]$$

where we have suppressed the dependence of the expenditure function on prices outside the bath tissue industry.

The first step in the VE calculation is determining the virtual price for KBT. We use the demand system represented by equations (5) and (7) to calculate the price that would set the KBT share to zero, holding the prices of the other brands at their actual level. We estimated the KBT virtual price separately for each city, with the other variables appearing in equations (5) and (7) set to their city-specific means for the six month period April to September 1994. Asymptotic standard errors were calculated using the delta method.

Table 4 provides the results of these calculations. In column (2), the estimated virtual price for KBT is provided. In column (1), the actual KBT price is provided for comparison. Substantial variation exists across cities in the percentage amount by which the virtual price exceeds the actual price. In Syracuse, KBT's virtual price is only 10% above the actual price, whereas in Milwaukee, KBT's virtual price is almost 100% above the actual price. In general, the greater the wedge between the virtual price and actual price, the more consumers value the additional variety provided by the brand.

Given the virtual price for KBT, VE can be calculated using equation (10). Under the two-stage budgeting specification, the appropriate expression for VE is derived by application of the Hausman (1981) techniques to the top level equation (7):

(11)

$$VE = \left[ \frac{1-I}{(1+\mathbf{d}_1) I_1^I} \left( P(p_1, p_k^*(p_1)) \exp(\mathbf{d}_0 + \mathbf{d}_1 \log P(p_1, p_k^*(p_1))) - y_1 \right) + I_1^{1-I} \right]^{\frac{1}{1-I}} - I_1$$

where  $P(p_1, p_k^*(p_1))$  is the bath tissue industry price index evaluated at the existing brands' actual prices and KBT's virtual price,  $I_1$  is post-introduction personal disposable income,  $y_1$  is actual bath tissue expenditure,  $\lambda$  is the coefficient on log personal disposable income in the top level equation (7),  $\delta$  is the coefficient on the bath tissue industry price index in the top level equation, and  $\delta_0$  is the intercept of the top level equation.

We calculated VE separately for each city, setting the other brands' prices to their city-specific averages and the personal disposable income variable to its annual city-specific value.<sup>18</sup> The resulting estimates of the annual welfare effects due to increased variety are given in column (4) of Table 4 (an asymptotic standard error, calculated via the delta method in provided in column (5)). In column (6) the variety effect as a percentage of annual bath tissue expenditure is calculated. The estimates of VE range from being as little as 0.2% of annual bath tissue expenditure in Syracuse to as much as 10.3% of annual bath tissue expenditure in Milwaukee.

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<sup>18</sup> To annualize the personal disposable income figure, we doubled its value for the six month period April-September 1995.

## **VII. “Indirect” Estimation of the Price Effects of the Kleenex Bath Tissue Introduction, Testing Models of Competition, and Estimating the Overall Effect on Consumer Surplus of the KBT Introduction**

### **A. Indirect Estimates of the Price Effects of the KBT Introduction**

In Section V, we discussed the “direct” estimates of the effects on existing brands’ prices of the KBT introduction. The direct estimates were based on pre- and post-introduction data and did not require any assumptions concerning the form of competition in the bath tissue industry. In many circumstances, however, data from the period prior to the new product introduction are not available. Thus, a method for estimating the price effects of a new product in the absence of pre-introduction data would be useful.

In this section, we use the estimated demand system (which is based on post-introduction data only), along with an assumed model of competition, to estimate the price effects of the KBT introduction “indirectly.” In addition, because we also have the direct estimates, we can compare the indirect estimates derived under alternative assumed models of competition to see how well the various models predict what actually happened to prices.

We start by describing how the indirect method works. Three steps are involved. First, we specify the equilibrium conditions for the assumed model of competition for the post-introduction world. We focus here on the Nash-Bertrand model. The equilibrium conditions are a function of the prices and marginal costs of the brands as well as the parameters of the demand structure. While we observe the equilibrium prices and have estimated the demand structure parameters, the marginal costs are unknown. Thus, in the

second step, we solve the equilibrium conditions for the marginal costs. In the third step, we use the marginal costs and the demand structure parameters to determine the equilibrium prices that would prevail if KBT were absent, a situation analogous to the pre-introduction period.

### 1. Equilibrium Conditions for the Nash-Bertrand Model

Suppose there are M firms producing N products in the industry. Consider the firm controlling the first n products. Under the Nash-Bertrand assumption, the firm will set the prices of its n products, taking the prices of the other N-n products as given, so as to maximize its profits,

$$(12) \quad \max_{p_1, \dots, p_n} \sum_{i=1}^n (p_i - c_i) Q_i(p_1, \dots, p_N)$$

where the  $p_i$ ,  $i=1, \dots, n$ , are the prices of the brands sold by the firm, the  $c_i$  are marginal costs, and the  $Q_i(\cdot)$  are the demand functions which depend in general on the prices of all N products. The first order conditions for the maximization problem are, after re-arranging,

$$(13) \quad s_i(p_1, \dots, p_N) + \sum_{j=1}^n \frac{p_j - c_j}{p_j} s_j(p_1, \dots, p_N) e_{ji}(p_1, \dots, p_N) = 0$$

$$i = 1, \dots, n$$

where  $s_i(\cdot)$  is the expenditure share of brand  $i$  and  $e_{ji}(\cdot)$  is the elasticity of brand  $j$  with respect to brand  $i$ 's price. Note that both the shares and the elasticities are functions of the prices of all  $N$  brands. Each of the  $M$  firms has a set of first order conditions of form (13). The Nash-Bertrand equilibrium prices simultaneously solve the system of  $N$  equations obtained by stacking the  $N$  first order conditions of the  $M$  firms.

We pause here to note a complication that arises. The first order conditions described above are for the bath tissue manufacturers. Our data, however, reflect retail sales. Another level of distribution, consisting of the supermarkets, lies between the manufacturers and retail consumers. Since we do not observe wholesale prices and sales, we must make an assumption about supermarket price-setting behavior so that we can use the retail sales data in conjunction with the first order conditions for the producer. Under certain assumptions, we can proceed as if the manufacturers directly set retail prices. For instance, suppose supermarkets set retail prices as a fixed markup over the corresponding wholesale price. Then, for a manufacturer choosing wholesale price  $w$  and supermarkets charging a constant markup over  $w$ ,  $p = (1+\alpha)w$ , the manufacturer's profit is

$$(14) \quad (w - c)Q(w(1 + \alpha))$$

The manufacturer's first order condition is

$$(15) \quad Q(w(1+\mathbf{a})) + (w-c)Q'(w(1+\mathbf{a}))(1+\mathbf{a}) = 0$$

which simplifies to

$$(16) \quad Q(p) + (p - (1+\mathbf{a})c)Q'(p) = 0$$

Thus, redefining the manufacturer's cost to be  $(1+\alpha)c$ , the retail prices and retail demand elasticities can be used in conjunction with the manufacturer's first order condition. A similar result is obtained under the assumption that supermarkets charge a constant dollar margin over the wholesale price. For more complicated retailer behavior, a distortion might arise, but its importance would be limited by the size of supermarkets' gross margins on bath tissue.

## 2. Solving for the Marginal Costs

Prices and shares from the post-introduction period represent the post-introduction equilibrium (assuming an equilibrium has been reached). The own and cross elasticities of demand at the equilibrium can be estimated given the parameters of the demand structure. Only the marginal costs  $c_i$  in equation (13) are unknown. Thus, the  $N$  first order conditions, evaluated at the known prices and shares and the estimated demand structure parameters, represent a set of  $N$  equations in  $N$  unknowns (the  $c_i$ ). Solving these equations yields estimates of the  $c_i$ .

We performed this exercise separately for each city and calculated price-cost margins by city and brand.<sup>19</sup> Table 5 contains the price-cost margin estimates by brand and city.

### **3. Estimating the Price Effects of the KBT Introduction**

Now, given the  $c_i$  and the estimates of the demand system parameters, we can estimate the prices that would exist in the absence of KBT. Specifically, we find the vector of brand prices such that (1) the first order conditions (13) of the firms other than Kimberly-Clark are satisfied and (2) the demand for KBT is set to zero.<sup>20</sup> This exercise involves solving a nonlinear system of  $N$  equations in terms of the  $N$  brand prices.<sup>21</sup> The price effects of the KBT introduction are then estimated as the percentage difference between the observed prices (i.e., the post-introduction prices) and the prices that would exist in the absence of KBT (i.e., the pre-introduction prices). These estimates are the “indirect” estimates of the price effects.

We performed the calculations described above separately for each of the second and third wave cities, then averaged across cities to derive an average percentage price change for each brand. These average percentage price changes are comparable to the

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<sup>19</sup> As in our other calculations, the variables appearing in first order conditions (13) are set to their city-specific averages for the six month period April-September 1995. The system of equations is linear in the price-cost margin and thus are easily solved.

<sup>20</sup> We assume that the  $c_i$  for the brands other than KBT remain constant over the relevant range of output.

<sup>21</sup> We solved the system of equations using a numerical iterative procedure, which converged easily and rapidly to the solution.

direct estimates of the price effects. In addition, we calculated asymptotic standard errors for the indirect estimates using the delta method.

In column (2) of Table 6, we provide the indirect estimates obtained under the Nash-Bertrand assumption along with their asymptotic standard errors. The largest estimated price effects are for the premium brands Cottonelle (-3.6%), Northern (-3.4%), Charmin (-2.8%), and Angel Soft (-2.4%). Lesser effects were estimated for ScotTissue (-1.5%) and private label (-0.7%).

### **B. Assessing Alternative Models of Competition**

The comparison between the direct estimates discussed in Section V and the indirect estimates corresponding to an assumed model of competition provides a way to assess the validity of assumed model. The two sets of estimates should be approximately equal if the demand system is correctly specified, the firms' marginal costs are constant over the relevant range of output, and the assumed model of competition is correct. Because of the flexible functional form used for the demand system and because of the relatively small price changes involved, misspecification of the demand system, to the extent that it exists at all, is unlikely to be substantial. Likewise, for the relatively small quantity changes involved, changes in marginal cost are unlikely to be large. Thus, neither of these potential problems should lead to a substantial divergence between the indirect and direct estimates of the price impacts. Consequently, the finding of a substantial difference between the two sets of estimates would suggest a failure of the assumed model of competition to accurately describe firms' behavior.

In column (1) of Table 6, we transcribe the direct estimates of the price effects of the KBT introduction from Table 2. In column (3) of Table 6, we provide t-statistics for testing the (individual) hypotheses that the direct and indirect estimates are the same apart from statistical variation. For Charmin, Northern, Angel Soft, and ScotTissue, the direct and indirect estimates obtained under the Nash-Bertrand model assumption are reasonably close in magnitude and not statistically significantly different from zero according to the individual t-tests. For Cottonelle and private label, however, the indirect estimates are well below the direct estimates and the individual t-statistics reject the hypothesis of equality.<sup>22</sup> Thus, the results for the Nash-Bertrand model are mixed.

We also assess several alternative models of competition to see whether they produce indirect estimates closer to the direct estimates than the Nash-Bertrand model.<sup>23</sup> We first employed the following model. Pre-introduction, the premium brands are assumed to act as a perfect cartel, i.e., set their prices as if they were controlled by a single seller. Post-introduction, Kimberly-Clark refuses to participate in the cartel and the cartel disintegrates, leading to the Nash-Bertrand outcome.<sup>24</sup>

Under this model of competition, we estimate the pre-introduction prices by forming first order conditions like (13) for the assumed premium brand cartel and solving for the brand prices that jointly set the first order conditions for the cartel to zero, the first order conditions for the non-premium brands to zero, and the demand for KBT to zero.

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<sup>22</sup> A chi-square test of the hypothesis of joint equality across brands is rejected at the 5% level.

<sup>23</sup> We recognize that a large number of possible alternatives exist beyond the ones we discuss.

<sup>24</sup> This feature of the model conforms with the informal observation that Kimberly-Clark and Procter & Gamble engage in tough competition across the many markets in which they both participate.

The resulting indirect price effect estimates are provided in column (4) of Table 6. The premium cartel model predicts much larger price effects than the Nash-Bertrand model because the KBT introduction is assumed to break up the premium cartel. With the exception of Cottonelle, the premium cartel estimates are also substantially larger than the direct estimates. In addition, the individual t-tests reject equality of the direct and indirect estimates for every brand except Cottonelle. Thus, the Nash-Bertrand model is superior to the premium cartel model.

Finally, we assess a model of competition in which Kimberly-Clark is assumed to join the premium cartel post-introduction. The indirect price effect estimates under this model are provided in column (6) of Table 6.<sup>25</sup> These estimates are generally smaller than both the Nash-Bertrand estimates and the direct estimates. Thus, the Nash-Bertrand model appears to be superior to this alternative model as well.

In conclusion, while the evidence is mixed, the Nash-Bertrand model provides indirect estimates of the price effects that are reasonably close to the direct estimates. The alternative models we examined were inferior to the Nash-Bertrand model. Overall, we find these results to provide cautious support for the use of the Nash-Bertrand assumption to describe firms' competitive behavior in the bath tissue industry.

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<sup>25</sup> For this model of competitive behavior, application of the delta method failed to provide estimates of the standard errors because small changes in the demand structure parameters caused the price change calculations to “blow up.” Thus, we do not report standard errors for this model in Table 6.

### C. Overall Effect on Consumer Welfare of the KBT Introduction

From equation (2), the overall effect of the KBT introduction on consumer welfare is the sum of the variety effect and the price effect. It can be calculated as

$$(17) \quad CV = \left[ \frac{1-I}{(1+d_1)I_1^I} \left( P(p_0, p_k^*) \exp(d_0 + d_1 \log P(p_0, p_k^*)) - y_1 \right) + I_1^{1-I} \right]^{\frac{1}{1-I}} - I_1$$

where  $P(p_0, p_k^*)$  is the bath tissue industry price index evaluated at the pre-introduction prices for the existing brands and the virtual price for KBT. We performed the calculation by city using the indirect estimates of the pre-introduction prices. The results are given in Table 7.

A comparison between the total consumer welfare effects in Table 7 and the variety effects in Table 4 demonstrate that approximately half of the total consumer welfare increase is due to the variety effect, with the remaining half due to the price effects. The total welfare effect amounts to approximately 7% of bath tissue expenditure in the cities in our data.

## VIII. Conclusions

We have demonstrated how to estimate the two consumer welfare effects of a new product introduction—the variety effect and the price effect—using data from the period after the introduction. We applied this framework to estimate the consumer welfare effects of the KBT introduction. We found the total consumer welfare effect to be approximately 7% of consumer bath tissue expenditure in the cities we studied. This gain

to consumers was roughly evenly split between the effect of additional variety and the price-reducing effect of additional competition.

The demand system parameters estimated on data from the post-introduction period, along with an assumed model of competition, allowed us to estimate the price effects of the KBT introduction indirectly. Given that we also had data from the pre-introduction period, we were able to estimate the price effects directly as well, by comparing post-introduction prices to pre-introduction prices. We compared the direct and indirect estimates to evaluate alternative assumed models of competition. We found that the Nash-Bertrand model produced indirect estimates reasonably similar to the direct estimates and superior to the indirect estimates produced by the two alternative models we studied.

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Table 1: Average Shares, Average Prices, and Bath Tissue Expenditure for April - September 1995

	Shares							Average Prices							Bath Tissue Expenditure
	Kleenex	Cottonelle	ScotTissue	Charmin	Northern	Angel Soft	Private Label	Kleenex	Cottonelle	ScotTissue	Charmin	Northern	Angel Soft	Private Label	
<b>First Wave Cities (KBT Introduced Prior to January 1992)</b>															
Charlotte	10.0%	6.4%	25.8%	36.1%	7.2%	11.3%	3.2%	\$25.82	\$22.97	\$15.06	\$32.60	\$25.27	\$22.19	\$17.23	\$10,308,700
Chicago	10.5%	10.6%	23.1%	26.6%	16.2%	4.4%	8.6%	\$26.01	\$25.50	\$14.06	\$30.36	\$26.05	\$22.43	\$15.73	\$35,658,610
Dallas	10.7%	7.8%	11.1%	37.1%	14.2%	10.7%	8.4%	\$25.71	\$23.82	\$16.23	\$32.92	\$25.24	\$22.32	\$18.83	\$21,537,900
Houston	12.1%	5.1%	14.0%	36.6%	11.5%	12.3%	8.4%	\$24.99	\$25.10	\$15.57	\$31.97	\$25.05	\$22.67	\$15.23	\$20,311,590
Jacksonville	7.6%	7.3%	14.1%	38.4%	10.4%	12.7%	9.5%	\$25.15	\$26.00	\$15.75	\$32.92	\$25.02	\$21.88	\$17.70	\$6,027,665
Kansas City	8.3%	13.1%	3.9%	39.9%	22.8%	5.1%	7.0%	\$25.38	\$20.77	\$16.88	\$30.16	\$22.66	\$20.90	\$18.64	\$7,846,531
Memphis	6.2%	10.1%	8.8%	35.0%	18.9%	14.4%	6.5%	\$26.34	\$22.99	\$18.45	\$30.26	\$23.40	\$21.01	\$17.79	\$7,274,787
Miami	9.1%	5.5%	14.4%	38.4%	10.6%	10.8%	11.2%	\$24.81	\$26.81	\$15.99	\$33.99	\$26.56	\$22.64	\$18.07	\$22,377,420
Milwaukee	15.3%	17.1%	15.0%	22.7%	21.5%	3.3%	5.1%	\$25.27	\$25.63	\$15.92	\$31.49	\$25.23	\$21.53	\$17.51	\$9,404,768
Nashville	7.2%	6.5%	8.4%	43.3%	15.7%	14.7%	4.3%	\$25.45	\$21.68	\$16.12	\$30.19	\$24.16	\$21.04	\$15.97	\$8,399,963
New Orleans	9.5%	6.8%	22.1%	34.5%	10.2%	8.1%	8.8%	\$24.16	\$23.44	\$14.91	\$31.14	\$25.20	\$21.60	\$15.64	\$17,037,200
Oklahoma City	7.2%	12.9%	3.4%	37.0%	31.4%	1.2%	6.9%	\$26.87	\$24.56	\$17.06	\$33.30	\$23.35	\$23.88	\$17.19	\$9,405,713
Omaha	8.5%	8.6%	5.9%	40.9%	23.3%	3.2%	9.4%	\$23.93	\$23.39	\$15.96	\$28.01	\$23.40	\$22.40	\$16.66	\$4,413,216
Orlando	9.2%	7.9%	15.7%	32.9%	12.0%	11.7%	10.6%	\$24.61	\$24.80	\$15.56	\$31.81	\$25.60	\$21.86	\$18.34	\$9,226,082
San Antonio	13.5%	2.7%	15.8%	36.3%	9.7%	10.0%	11.9%	\$24.10	\$27.81	\$15.69	\$30.00	\$24.02	\$22.30	\$19.10	\$14,287,750
St. Louis	13.7%	12.3%	4.5%	35.8%	18.6%	10.5%	4.6%	\$24.06	\$25.36	\$17.13	\$30.78	\$25.19	\$22.98	\$18.23	\$11,116,830
Tampa	11.1%	5.4%	15.8%	31.3%	12.8%	13.3%	10.3%	\$25.10	\$26.24	\$15.60	\$32.47	\$25.67	\$21.84	\$17.65	\$17,248,630
<b>Second Wave Cities (KBT Introduced July 1993)</b>															
Baltimore	6.8%	8.7%	21.5%	33.8%	10.9%	7.5%	10.7%	\$28.43	\$24.49	\$15.10	\$35.97	\$28.14	\$22.59	\$19.92	\$13,355,130
Detroit	8.5%	16.3%	10.7%	21.9%	29.1%	8.6%	4.9%	\$27.27	\$24.57	\$16.42	\$33.30	\$26.12	\$21.56	\$18.85	\$22,675,920
Washington, DC	8.2%	8.1%	14.8%	34.4%	12.2%	10.1%	12.2%	\$27.31	\$26.52	\$16.14	\$33.00	\$26.43	\$25.45	\$20.81	\$25,934,260
<b>Third Wave Cities (KBT Introduced May 1994)</b>															
Buffalo/Rochest	5.6%	12.0%	30.4%	24.0%	9.1%	5.5%	13.3%	\$25.56	\$21.31	\$13.31	\$30.55	\$26.11	\$22.84	\$14.66	\$12,964,710
Cincinnati	8.6%	12.7%	4.2%	35.6%	22.2%	10.4%	6.3%	\$24.83	\$23.03	\$18.23	\$33.00	\$25.44	\$23.22	\$17.09	\$12,540,490
Cleveland	5.8%	12.3%	13.8%	43.0%	18.0%	3.6%	3.6%	\$23.93	\$22.67	\$14.38	\$31.66	\$24.62	\$22.05	\$15.81	\$18,891,790
Columbus	4.6%	12.1%	3.6%	34.1%	14.7%	24.6%	6.3%	\$26.08	\$23.70	\$16.65	\$34.56	\$25.70	\$22.05	\$16.81	\$10,069,940
Denver	6.6%	2.1%	11.1%	29.8%	23.2%	7.3%	19.9%	\$25.99	\$25.36	\$15.43	\$32.62	\$25.62	\$22.48	\$20.53	\$14,596,440
Los Angeles	8.2%	1.7%	21.2%	30.8%	15.6%	7.5%	15.0%	\$25.71	\$28.13	\$15.68	\$32.32	\$26.82	\$24.73	\$23.13	\$64,969,910
Louisville	5.8%	12.9%	3.5%	46.4%	19.2%	7.5%	4.8%	\$22.69	\$22.16	\$15.29	\$30.26	\$22.71	\$22.70	\$15.12	\$8,873,668
Pittsburgh	6.0%	8.6%	19.9%	36.5%	13.8%	10.9%	4.3%	\$24.25	\$23.16	\$15.34	\$31.37	\$24.89	\$21.82	\$17.61	\$18,263,740
San Diego	6.7%	1.4%	16.8%	29.8%	14.6%	8.3%	22.5%	\$25.37	\$30.95	\$16.29	\$32.03	\$26.38	\$24.61	\$23.54	\$9,917,793
Syracuse	2.4%	15.9%	32.2%	21.4%	9.4%	9.4%	9.3%	\$25.16	\$23.95	\$13.63	\$31.54	\$25.68	\$22.68	\$14.95	\$8,406,757

Notes:

(1) Prices are in 1992 dollars and are for a standard quantity unit (28,000 sheets)

**Table 2: Direct Estimates of the Price Effects of the KBT Introduction**

<b>Brand</b>	<b>Post-Introduction</b>	<b>Interim</b>	<b>R-Squared</b>
<b>Cottonelle</b>	-8.2% (1.3%)	-5.8% (1.4%)	0.37
<b>Charmin</b>	-3.5% (0.9%)	-3.1% (0.7%)	0.43
<b>Northern</b>	-2.3% (0.8%)	-0.4% (0.9%)	0.38
<b>Angel Soft</b>	-3.5% (0.6%)	-0.5% (0.7%)	0.37
<b>ScotTissue</b>	-0.6% (0.5%)	-1.2% (0.6%)	0.67
<b>Private Label</b>	-3.8% (0.9%)	-4.6% (1.1%)	0.72

## Notes:

- (1) Dependent variable is log price.
- (2) Fixed effects for city and week also included in the specification.
- (3) Standard errors in parentheses.

**Table 3: Own and Cross Price Elasticities**

		With Respect To The Price Of						
		Kleenex	Cottonelle	Charmin	Northern	Angel Soft	ScotTissue	Private Label
Elasticity Of The Demand For	Kleenex	-3.293 (0.103)	0.502 (0.068)	0.679 (0.089)	0.707 (0.080)	0.207 (0.072)	0.086 (0.059)	0.016 (0.049)
	Cottonelle	0.560 (0.075)	-3.304 (0.098)	0.737 (0.086)	0.360 (0.082)	0.621 (0.072)	-0.147 (0.058)	0.129 (0.048)
	Charmin	0.255 (0.026)	0.242 (0.023)	-2.292 (0.042)	0.471 (0.028)	0.262 (0.025)	0.280 (0.021)	0.079 (0.017)
	Northern	0.493 (0.053)	0.230 (0.050)	0.933 (0.064)	-3.078 (0.078)	0.391 (0.051)	0.065 (0.041)	0.021 (0.034)
	Angel Soft	0.326 (0.090)	0.765 (0.082)	1.132 (0.099)	0.804 (0.094)	-4.066 (0.127)	0.378 (0.081)	0.172 (0.064)
	ScotTissue	0.098 (0.043)	-0.079 (0.039)	0.656 (0.052)	0.097 (0.045)	0.204 (0.049)	-1.803 (0.069)	0.027 (0.036)
	Private Label	0.024 (0.070)	0.165 (0.062)	0.233 (0.081)	0.023 (0.073)	0.146 (0.073)	0.012 (0.069)	-1.685 (0.073)

**Table 4: Variety Effect**

	(1)	(2)	(3)	(4)	(5)	(6)
	Actual Price	Virtual Price	% Difference	Additional Annual Consumer Welfare	Standard Error	% of Annual Bath Tissue Expenditure
<b>First Wave Cities (KBT Introduced Prior to January 1992)</b>						
Charlotte	\$25.82	\$38.72	50.0%	\$885,024	\$40,740	4.3%
Chicago	\$26.01	\$39.85	53.2%	\$3,413,716	\$157,817	4.8%
Dallas	\$25.71	\$39.64	54.2%	\$2,127,198	\$98,361	4.9%
Houston	\$24.99	\$40.70	62.9%	\$2,565,144	\$119,086	6.3%
Jacksonville	\$25.15	\$34.20	36.0%	\$294,376	\$13,468	2.4%
Kansas City	\$25.38	\$35.50	39.9%	\$458,040	\$20,994	2.9%
Memphis	\$26.34	\$33.94	28.8%	\$239,898	\$10,961	1.6%
Miami	\$24.81	\$35.91	44.7%	\$1,597,754	\$73,585	3.6%
Milwaukee	\$25.27	\$46.78	85.1%	\$1,930,798	\$90,711	10.3%
Nashville	\$25.45	\$34.12	34.1%	\$372,261	\$17,037	2.2%
New Orleans	\$24.16	\$35.53	47.0%	\$1,322,570	\$60,869	3.9%
Oklahoma City	\$26.87	\$35.98	33.9%	\$414,203	\$18,969	2.2%
Omaha	\$23.93	\$33.85	41.5%	\$274,906	\$12,586	3.1%
Orlando	\$24.61	\$35.76	45.3%	\$670,719	\$30,809	3.6%
San Antonio	\$24.10	\$41.66	72.9%	\$2,290,555	\$106,845	8.0%
St. Louis	\$24.06	\$41.85	74.0%	\$1,825,954	\$85,229	8.2%
Tampa	\$25.10	\$39.43	57.1%	\$1,855,238	\$85,819	5.4%
<b>Second Wave Cities (KBT Introduced July 1993)</b>						
Baltimore	\$28.43	\$37.43	31.6%	\$520,717	\$23,849	1.9%
Detroit	\$27.27	\$38.49	41.1%	\$1,401,117	\$64,438	3.1%
Washington, DC	\$27.31	\$38.13	39.6%	\$1,501,499	\$69,057	2.9%
<b>Third Wave Cities (KBT Introduced May 1994)</b>						
Buffalo/Rochester	\$25.56	\$32.09	25.5%	\$343,644	\$15,692	1.3%
Cincinnati	\$24.83	\$35.27	42.0%	\$803,682	\$36,926	3.2%
Cleveland	\$23.93	\$30.35	26.8%	\$548,634	\$25,126	1.5%
Columbus	\$26.08	\$31.48	20.7%	\$182,400	\$8,337	0.9%
Denver	\$25.99	\$34.05	31.0%	\$548,647	\$25,126	1.9%
Los Angeles	\$25.71	\$35.88	39.6%	\$3,767,335	\$173,654	2.9%
Louisville	\$22.69	\$28.78	26.8%	\$257,190	\$11,755	1.4%
Pittsburgh	\$24.25	\$30.99	27.8%	\$565,463	\$25,889	1.5%
San Diego	\$25.37	\$33.27	31.1%	\$375,580	\$17,185	1.9%
Syracuse	\$25.16	\$27.75	10.3%	\$40,929	\$1,868	0.2%
Total				\$33,395,190		3.5%

**Table 5: Estimated Price-Cost Margins**

		Kleenex	Cottonelle	ScotTissue	Charmin	Northern	Angel Soft	Private Label
<b>First Wave Cities (KBT Introduced Prior to January 1992)</b>								
0	7 Charlotte	29.0%	19.8%	70.6%	45.2%	17.8%	30.5%	38.7%
0	8 Chicago	30.1%	30.3%	67.4%	37.1%	33.0%	14.5%	63.0%
0	12 Dallas	30.4%	24.1%	48.1%	46.0%	30.1%	29.3%	62.5%
0	18 Houston	33.0%	16.1%	54.8%	45.6%	25.8%	32.4%	62.3%
0	20 Jacksonville	23.6%	22.5%	54.5%	47.0%	24.0%	33.2%	65.4%
0	21 Kansas City	25.2%	36.3%	22.1%	48.1%	41.2%	16.3%	57.9%
0	25 Memphis	20.3%	29.7%	41.6%	44.4%	36.6%	36.1%	56.1%
0	26 Miami	27.1%	17.4%	55.5%	46.9%	24.4%	29.5%	69.0%
0	27 Milwaukee	38.5%	42.4%	55.5%	33.2%	39.8%	11.1%	50.3%
0	29 Nashville	22.7%	20.7%	40.9%	50.5%	32.3%	36.6%	45.9%
0	30 New Orleans	27.9%	20.8%	66.6%	43.9%	23.6%	23.9%	63.5%
0	32 Oklahoma City	22.7%	36.1%	19.7%	45.9%	49.5%	4.3%	57.6%
0	33 Omaha	25.8%	26.6%	32.1%	48.8%	41.8%	11.0%	65.1%
0	34 Orlando	27.3%	23.9%	57.5%	42.7%	26.7%	31.2%	67.8%
0	43 San Antonio	35.6%	7.8%	58.5%	45.4%	22.7%	28.0%	70.4%
0	47 St. Louis	35.9%	34.6%	25.4%	44.9%	36.3%	29.0%	47.4%
0	49 Tampa	31.3%	16.9%	57.8%	41.3%	28.0%	34.3%	67.1%
<b>Second Wave Cities (KBT Introduced July 1993)</b>								
1	3 Baltimore	21.6%	25.9%	65.7%	43.4%	24.9%	22.4%	68.1%
1	15 Detroit	25.7%	41.3%	46.4%	32.4%	47.5%	24.9%	49.0%
1	50 Washington, DC	25.1%	24.5%	55.9%	43.9%	27.0%	28.1%	70.9%
<b>Third Wave Cities (KBT Introduced May 1994)</b>								
2	6 Buffalo/Rochester	18.6%	33.5%	74.3%	34.6%	21.6%	17.5%	72.9%
2	9 Cincinnati	26.1%	35.5%	23.9%	44.8%	40.5%	28.7%	55.3%
2	10 Cleveland	19.2%	34.1%	53.4%	50.2%	35.4%	12.0%	41.4%
2	11 Columbus	15.9%	34.5%	20.6%	43.6%	30.9%	50.0%	55.2%
2	13 Denver	21.3%	5.9%	49.2%	40.0%	41.6%	22.0%	80.8%
2	23 Los Angeles	25.1%	3.7%	66.4%	40.8%	32.1%	22.5%	75.2%
2	24 Louisville	19.2%	36.0%	20.0%	52.5%	36.9%	22.4%	48.5%
2	37 Pittsburgh	19.7%	25.7%	63.6%	45.5%	29.5%	29.7%	46.0%
2	44 San Diego	21.4%	2.4%	60.3%	40.0%	30.8%	24.2%	83.0%
2	48 Syracuse	8.9%	40.9%	75.7%	31.8%	22.2%	26.7%	64.8%

**Table 6: Comparison of Direct and Indirect Estimates of the Price Effects of the Kleenex Bath Tissue Introduction**

<b>Brand</b>	(1) <b>Direct Estimate</b>	(2) <b>Indirect Estimate Nash-Bertrand Model</b>	(3) <b>t-test</b>	(4) <b>Indirect Estimate Premium Cartel w/o KC</b>	(5) <b>t-test</b>	(6) <b>Indirect Estimate Premium Cartel w/ KC</b>
<b>Cottonelle</b>	-8.2% (1.3%)	-3.6% (0.3%)	3.4	-7.8% (1.2%)	0.2	-1.8%
<b>Charmin</b>	-3.5% (0.9%)	-2.8% (0.1%)	0.7	-6.8% (1.1%)	2.3	-1.5%
<b>Northern</b>	-2.3% (0.8%)	-3.4% (0.2%)	1.4	-7.6% (1.2%)	3.8	-1.3%
<b>Angel Soft</b>	-3.5% (0.6%)	-2.4% (0.3%)	1.6	-6.9% (1.1%)	2.7	-1.1%
<b>ScotTissue</b>	-0.6% (0.5%)	-1.5% (0.4%)	1.3	-3.1% (0.6%)	3.1	-1.4%
<b>Private Label</b>	-3.8% (0.9%)	-0.7% (0.7%)	2.7	-1.5% (0.8%)	1.9	-0.5%

Notes:

(1) Standard errors in parentheses.

(2) For the column (6) estimates, the delta method did not provide reliable standard errors.

**Table 7: Total Consumer Welfare Effect**

	Additional Annual Consumer Welfare	Standard Error	% of Annual Bath Tissue Expenditure
<b>First Wave Cities (KBT Introduced Prior to January 1992)</b>			
Charlotte	\$1,754,180	\$58,426	8.5%
Chicago	\$6,682,785	\$210,602	9.4%
Dallas	\$4,228,866	\$122,449	9.8%
Houston	\$4,776,188	\$144,324	11.8%
Jacksonville	\$682,051	\$18,831	5.7%
Kansas City	\$1,061,718	\$30,752	6.8%
Memphis	\$642,623	\$15,852	4.4%
Miami	\$3,338,276	\$97,410	7.5%
Milwaukee	\$3,357,554	\$110,936	17.9%
Nashville	\$918,508	\$25,343	5.5%
New Orleans	\$2,680,007	\$83,209	7.9%
Oklahoma City	\$1,039,178	\$31,851	5.5%
Omaha	\$618,081	\$18,272	7.0%
Orlando	\$1,398,709	\$39,214	7.6%
San Antonio	\$3,991,522	\$127,511	14.0%
St. Louis	\$3,351,054	\$104,458	15.1%
Tampa	\$3,530,768	\$103,259	10.2%
<b>Second Wave Cities (KBT Introduced July 1993)</b>			
Baltimore	\$1,256,388	\$38,199	4.7%
Detroit	\$3,186,138	\$89,451	7.0%
Washington, DC	\$3,309,137	\$92,868	6.4%
<b>Third Wave Cities (KBT Introduced May 1994)</b>			
Buffalo/Rochester	\$895,911	\$35,413	3.5%
Cincinnati	\$1,816,064	\$50,109	7.2%
Cleveland	\$1,542,599	\$46,307	4.1%
Columbus	\$587,529	\$14,224	2.9%
Denver	\$1,318,052	\$39,486	4.5%
Los Angeles	\$7,889,748	\$255,163	6.1%
Louisville	\$735,136	\$21,674	4.1%
Pittsburgh	\$1,504,396	\$43,393	4.1%
San Diego	\$861,086	\$28,390	4.3%
Syracuse	\$196,926	\$9,843	1.2%
Total	\$69,151,179		7.3%

Appendix Table 1: Demand System Parameter Estimates

Top Level Equation		Coefficient	Standard Error
Constant		1.267373	1.192603
Time Trend		-0.000564	0.000082
Months		0.053558	0.009134
		-0.018446	0.009057
		-0.039466	0.008989
		-0.041973	0.008665
		-0.037427	0.008568
		-0.047270	0.008683
		-0.039320	0.008316
		-0.033675	0.008423
		-0.039100	0.008409
		-0.058543	0.008559
		-0.015193	0.009002
Cities		-0.035964	0.058298
		-0.824509	0.176820
		-0.356293	0.055235
		-0.648758	0.078491
		-0.252406	0.095171
		-0.627925	0.024123
		-0.175677	0.081262
		0.407630	0.020512
		-0.346636	0.032376
		-0.013526	0.073271
		0.696960	0.064610
		0.332719	0.103779
		-0.158365	0.133236
		-0.093072	0.061054
		0.248137	0.062497
		-0.766667	0.032445
Log PDI		1.092470	0.117842
Log Industry Price Index		-0.838952	0.074782

Kleenex Share Equation

	Coefficient	Standard Error
Constant	-0.233452	0.087456
Time Trend	0.000038	0.000012
Months	-0.016291	0.003060
	-0.001514	0.002986
	0.002256	0.003017
	-0.005324	0.002936
	-0.012449	0.002937
	0.009796	0.003019
	0.004665	0.002913
	0.014775	0.002976
	0.006725	0.002983
	0.009637	0.003072
	-0.003825	0.003217
Cities	0.012589	0.005826
	-0.037807	0.008014
	-0.001538	0.003479
	0.018852	0.003417
	-0.005215	0.010403
	0.029226	0.008208
	0.047640	0.008988
	-0.035565	0.003749
	0.049298	0.006540
	-0.001002	0.007171
	-0.002707	0.003567
	0.020518	0.006977
	0.034829	0.012743
	0.017914	0.006516
	0.014607	0.004559
	0.040333	0.005857
L(Y/P)	0.032503	0.008550
Log Kleenex Price	-0.243757	0.010939
Log Cottonelle Price	0.054611	0.007151
Log ScotTissue Price	0.010624	0.005918
Log Charmin Price	0.075978	0.008634
Log Northern Price	0.077135	0.008265
Log Angel Soft Price	0.022978	0.007608

Cottonelle Share Equation

	Coefficient	Standard Error
Constant	-0.190335	0.089863
Time Trend	-0.000128	0.000011
Months	-0.005326	0.003153
	0.008254	0.003080
	0.002605	0.003110
	0.009409	0.003025
	0.009104	0.003027
	0.011068	0.003111
	0.005889	0.003006
	0.001590	0.003068
	0.008900	0.003075
	0.002186	0.003166
	0.001942	0.003316
Cities	0.002207	0.006003
	0.056279	0.008224
	0.026261	0.003582
	0.016068	0.003516
	0.077164	0.010715
	0.089259	0.008429
	0.081352	0.009225
	0.011257	0.003859
	0.161268	0.006758
	0.004575	0.007377
	0.016135	0.003676
	0.114438	0.007179
	0.086181	0.013087
	0.042397	0.006703
	0.002169	0.004689
	0.123077	0.006018
L(Y/P)	0.023548	0.008798
Log Kleenex Price	0.054611	0.007151
Log Cottonelle Price	-0.222472	0.009357
Log ScotTissue Price	-0.013660	0.005322
Log Charmin Price	0.072746	0.007560
Log Northern Price	0.035509	0.007771
Log Angel Soft Price	0.060475	0.006852

ScotTissue Share Equation

	Coefficient	Standard Error
Constant	0.176602	0.052274
Time Trend	-0.000090	0.000007
Months	-0.000305	0.001783
	0.003343	0.001742
	0.000758	0.001760
	-0.000370	0.001714
	0.002222	0.001715
	-0.002345	0.001757
	0.001261	0.001693
	0.001208	0.001730
	-0.000864	0.001735
	0.000041	0.001782
	-0.000476	0.001867
Cities	0.090937	0.003399
	0.060070	0.004859
	-0.053007	0.002031
	-0.027370	0.002039
	-0.025109	0.006095
	-0.129472	0.004952
	-0.064604	0.005607
	-0.016620	0.002213
	-0.018488	0.003849
	-0.086648	0.004295
	0.059692	0.002085
	-0.141022	0.004186
	-0.110882	0.007615
	-0.005311	0.003814
	0.012266	0.002770
	-0.119745	0.003545
L(Y/P)	-0.006555	0.005035
Log Kleenex Price	0.010624	0.005918
Log Cottonelle Price	-0.013660	0.005322
Log ScotTissue Price	-0.115206	0.009327
Log Charmin Price	0.081510	0.006516
Log Northern Price	0.009096	0.006058
Log Angel Soft Price	0.025952	0.006731

Charmin Share Equation

	Coefficient	Standard Error
Constant	1.046300	0.089082
Time Trend	0.000114	0.000011
Months	0.022632	0.003103
	-0.004286	0.003010
	-0.004479	0.003042
	-0.002527	0.002960
	-0.005710	0.002963
	-0.014965	0.003044
	-0.009840	0.002941
	-0.007131	0.003005
	-0.005500	0.003009
	-0.011453	0.003096
	0.002968	0.003243
Cities	0.026403	0.005901
	-0.048398	0.008077
	0.045411	0.003526
	0.042226	0.003478
	0.010598	0.010532
	-0.020632	0.008385
	-0.087057	0.009215
	0.080057	0.003790
	-0.168245	0.006683
	0.058569	0.007336
	0.000342	0.003600
	-0.030343	0.007093
	-0.051760	0.013115
	-0.038471	0.006605
	-0.000733	0.004715
	-0.040673	0.005982
L(Y/P)	-0.055451	0.008667
Log Kleenex Price	0.075978	0.008634
Log Cottonelle Price	0.072746	0.007560
Log ScotTissue Price	0.081510	0.006516
Log Charmin Price	-0.475177	0.012330
Log Northern Price	0.144743	0.008834
Log Angel Soft Price	0.080910	0.008184

Northern Share Equation

	Coefficient	Standard Error
Constant	-0.072269	0.098991
Time Trend	0.000001	0.000013
Months	-0.004458	0.003476
	-0.012404	0.003395
	-0.007882	0.003432
	-0.017274	0.003339
	-0.006424	0.003346
	-0.017052	0.003439
	-0.010160	0.003313
	-0.021807	0.003380
	-0.019405	0.003392
	-0.003310	0.003492
	-0.002626	0.003659
Cities	-0.063791	0.006613
	0.027690	0.009069
	-0.005141	0.003955
	-0.011712	0.003885
	-0.027713	0.011792
	0.111287	0.009305
	0.066179	0.010167
	-0.031674	0.004258
	0.100738	0.007412
	0.056158	0.008133
	-0.026857	0.004055
	0.167876	0.007919
	0.112212	0.014417
	-0.001137	0.007381
	-0.024116	0.005136
	0.046937	0.006624
L(Y/P)	0.019949	0.009688
Log Kleenex Price	0.077135	0.008265
Log Cottonelle Price	0.035509	0.007771
Log ScotTissue Price	0.009096	0.006058
Log Charmin Price	0.144743	0.008834
Log Northern Price	-0.330303	0.012121
Log Angel Soft Price	0.061154	0.007882

Angel Soft Share Equation

	Coefficient	Standard Error
Constant	0.433596	0.076250
Time Trend	-0.000023	0.000010
Months	0.002790	0.002663
	0.002842	0.002595
	0.001382	0.002621
	0.008683	0.002550
	0.008544	0.002553
	0.007533	0.002622
	0.004177	0.002531
	0.005981	0.002585
	0.002963	0.002593
	-0.003334	0.002667
	-0.002701	0.002793
Cities	-0.020225	0.005061
	-0.021700	0.006977
	-0.009145	0.003025
	-0.004273	0.002990
	-0.045220	0.009039
	-0.069604	0.007192
	-0.027647	0.007875
	-0.009546	0.003260
	-0.117943	0.005695
	0.007453	0.006253
	-0.028277	0.003102
	-0.110255	0.006079
	-0.108022	0.011143
	-0.036217	0.005671
	-0.009358	0.004008
	-0.037936	0.005120
L(Y/P)	-0.035347	0.007433
Log Kleenex Price	0.022978	0.007608
Log Cottonelle Price	0.060475	0.006852
Log ScotTissue Price	0.025952	0.006731
Log Charmin Price	0.080910	0.008184
Log Northern Price	0.061154	0.007882
Log Angel Soft Price	-0.262795	0.010665

Appendix Table 1: Demand System Parameter Estimates

Estimated Variance-Covariance Matrix of Error Terms

	Top Level	Kleenex	Cottonelle	ScotTissue	Charmin	Northern	Angel Soft
Top Level	0.008560	-0.000087	-0.000051	-0.000159	-0.000082	0.000376	0.000328
Kleenex	-0.000087	0.001092	-0.000182	-0.000076	-0.000330	-0.000270	-0.000176
Cottonelle	-0.000051	-0.000182	0.001157	-0.000078	-0.000238	-0.000440	-0.000173
ScotTissue	-0.000159	-0.000076	-0.000078	0.000351	-0.000021	-0.000106	-0.000053
Charmin	-0.000082	-0.000330	-0.000238	-0.000021	0.001118	-0.000326	-0.000154
Northern	0.000376	-0.000270	-0.000440	-0.000106	-0.000326	0.001425	-0.000201
Angel Soft	0.000328	-0.000176	-0.000173	-0.000053	-0.000154	-0.000201	0.000833

## Appendix Table 2: Own and Cross Price Elasticities

Month Specific Indicator Variables Included in the Specification

		With Respect To The Price Of						
		Kleenex	Cottonelle	Charmin	Northern	Angel Soft	ScotTissue	Private Label
Elasticity Of The Demand For	Kleenex	-3.914 (0.088)	0.456 (0.060)	0.505 (0.079)	0.662 (0.070)	0.423 (0.062)	0.095 (0.053)	0.073 (0.043)
	Cottonelle	0.534 (0.065)	-3.571 (0.087)	0.638 (0.080)	0.550 (0.074)	0.522 (0.062)	-0.063 (0.051)	-0.022 (0.042)
	Charmin	0.190 (0.023)	0.182 (0.021)	-2.518 (0.038)	0.315 (0.025)	0.198 (0.021)	0.204 (0.020)	0.032 (0.015)
	Northern	0.414 (0.048)	0.279 (0.046)	0.472 (0.063)	-3.553 (0.071)	0.298 (0.045)	0.096 (0.039)	-0.009 (0.031)
	Angel Soft	0.553 (0.077)	0.586 (0.071)	0.754 (0.090)	0.633 (0.082)	-4.181 (0.103)	0.139 (0.067)	-0.014 (0.053)
	ScotTissue	0.084 (0.039)	-0.061 (0.034)	0.434 (0.049)	0.175 (0.040)	0.079 (0.039)	-2.263 (0.068)	-0.042 (0.031)
	Private Label	0.114 (0.061)	-0.050 (0.055)	0.069 (0.072)	0.041 (0.065)	-0.024 (0.060)	-0.083 (0.060)	-1.691 (0.062)

**Appendix Table 3: Own and Cross Price Elasticities**  
 Estimated Without Homogeneity and Symmetry Restrictions

		With Respect To The Price Of						
		Kleenex	Cottonelle	Charmin	Northern	Angel Soft	ScotTissue	Private Label
Elasticity Of The Demand For	Kleenex	-3.666 (0.115)	0.334 (0.092)	0.715 (0.125)	0.580 (0.107)	0.339 (0.126)	-0.982 (0.171)	0.032 (0.096)
	Cottonelle	0.954 (0.131)	-3.194 (0.105)	0.525 (0.142)	0.735 (0.122)	0.336 (0.144)	-0.086 (0.195)	-0.218 (0.110)
	Charmin	0.183 (0.037)	0.212 (0.029)	-2.305 (0.043)	0.331 (0.035)	0.331 (0.040)	0.556 (0.054)	0.057 (0.031)
	Northern	0.486 (0.089)	0.149 (0.071)	1.379 (0.099)	-3.077 (0.083)	0.402 (0.097)	-0.149 (0.132)	0.152 (0.074)
	Angel Soft	0.378 (0.126)	0.927 (0.101)	0.791 (0.134)	0.977 (0.117)	-4.072 (0.139)	0.856 (0.188)	0.316 (0.105)
	ScotTissue	0.126 (0.050)	-0.065 (0.040)	0.448 (0.056)	0.122 (0.047)	0.108 (0.054)	-1.839 (0.074)	0.059 (0.042)
	Private Label	0.283 (0.089)	0.364 (0.071)	0.351 (0.098)	0.121 (0.083)	0.178 (0.097)	0.185 (0.132)	-1.659 (0.074)