

MARKET DEFINITION WITH  
DIFFERENTIATED PRODUCTS:  
THE POST/NABISCO CEREAL MERGER

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I. INTRODUCTION

Antitrust litigation has come to rely to a greater and greater extent on empirical methods. While the range of applications is quite broad, it is not unusual to observe multiple regression and other statistical methods being utilized in defining relevant markets and in predicting the price increases that may result from the strategic decisions of the merging firms. With respect to market definition, it is essential for the fact finder to assess buyer substitution patterns as effectively as possible. Historically, most of the relevant substitution evidence has come from indirect indicators related to seller practices—marketing studies and the like. Increasingly, however, econometric methods have been used to supplement these indicators, often with determinative outcomes. *State of New York v. Kraft General Foods, Inc.*<sup>1</sup> is a prime example; *Kraft* was a fully litigated merger in which econometric methods played an important role. The court was presented with both direct and indirect evidence of the responses of buyers to changing prices, and econometrics made much of it possible.

There are important demand- and supply-side explanations for the rapid growth of empirical methods. On the supply side, the rapid improvement in computing technology has made empirical methodologies feasible and economical. Accordingly, the enforcement agencies and economic and marketing experts in the private sector now make frequent use of supermarket scanner data available commercially from two firms, Nielsen and Information Resources, Inc. (IRI).<sup>2</sup> Coincident

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<sup>1</sup> *New York v. Kraft Gen. Foods, Inc.*, 926 F. Supp. 321 (S.D.N.Y. 1995).

<sup>2</sup> Both Nielsen and IRI use scanning devices to record supermarket sales data for a national random sample covering a range of metropolitan and rural areas. In the IRI Infoscan Data Base, for example, samples are drawn from a supermarket universe that

with the improved technology has been the development of a number of empirical methods that have been utilized with some success by industrial organization economists.<sup>3</sup>

On the demand side, judicial interest in using statistical methods also has been growing rapidly. Courts are finding, to a greater and greater degree, that reliable statistical evidence can be invaluable in deciding questions of impact, harm, and damages in a range of cases, including antitrust. Accordingly, the Federal Judicial Center's *Reference Manual on Scientific Evidence* contains a chapter on statistics and a chapter on multiple regression.<sup>4</sup>

In this essay I use the *Kraft* case as a springboard for a discussion of the increasing importance of empirical methods in merger analysis. In doing so, I emphasize, but do not restrict myself to comments relating to market definition.

While there is little debate about the importance of the Department of Justice and Federal Trade Commission Horizontal Merger Guidelines in merger cases,<sup>5</sup> there are nagging questions about the role of empirical

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includes stores with annual sales greater than \$2 million (which accounts for 82% of U.S. grocery sales). Scanner data was employed, for example, by Jerry Hausman in support of Kodak's petition for modification or termination of a 1921 consent decree restricting Kodak's ability to sell private-label film. Professor Hausman estimated that the cross-price demand elasticities between Kodak and Fuji film were high, and used that evidence to support his opinion that Kodak did not have market power. The court agreed, relying in part on Hausman's testimony. *United States v. Eastman Kodak Co.*, 853 F. Supp. 1454 (W.D.N.Y. 1994), *aff'd*, 63 F.3d 95 (2d Cir. 1995).

<sup>3</sup> See generally Jonathan B. Baker & Timothy F. Bresnahan, *Empirical Methods of Identifying and Measuring Market Power*, 61 ANTITRUST L.J. 3 (1992); Jonathan B. Baker & Daniel L. Rubinfeld, *Empirical Methods Used in Antitrust Litigation: A Review and Critique*, 1 J. AM. L. & ECON. ASS'N 386 (1999).

<sup>4</sup> David A. Kaye & David A. Freedman, *Reference Guide on Statistics*, in REFERENCE MANUAL ON SCIENTIFIC EVIDENCE 331-414 (1994); Daniel L. Rubinfeld, *Reference Guide on Multiple Regression*, in REFERENCE MANUAL ON SCIENTIFIC EVIDENCE 415-470 (1994) (rev. ed. forthcoming). These materials seek to explain empirical methods and highlight issues a court should consider in evaluating the admissibility and probative value of statistical evidence. Admissibility issues are often framed as a question of the interpretation of judicial rules intended to exclude "junk science." See generally *Daubert v. Merrell Dow Pharm., Inc.*, 506 U.S. 914 (1992); *Kumho Tire Co. v. Carmichael*, 526 U.S. 137 (1999).

<sup>5</sup> U.S. Department of Justice & Federal Trade Commission, Horizontal Merger Guidelines (1992, as amended 1997), *reprinted in* 4 Trade Reg. Rep. (CCH) ¶ 13,104. A strong case can be made that the Guidelines' analysis of market definition also is applicable in monopolization cases, albeit with a different treatment of the hypothetical monopolist test. In *United States v. Microsoft Corp.*, for example, both governments' (the United States and the States) testifying economic witnesses, Frederick Warren-Boulton and Franklin Fisher, defined the relevant market as all Intel-based PC desktop operating systems, based on Guidelines principles. Microsoft's economic expert, Richard Schmalensee, argued that a market definition (whether Guidelines-based or not) was inappropriate in this context. *United States v. Microsoft Corp.*, No. 98-1232 (D.D.C. filed May 18, 1998).

methods when mergers involve highly differentiated products. I will suggest in this essay that market definition should play a significant role in the analysis of competitive effects of mergers, but that the Guidelines are difficult to apply when products are highly differentiated. Furthermore, I believe that market definition should play a more limited role when the focus of the merger analysis involves unilateral effects.

Kraft General Foods, Inc., which owns Post cereals, entered into an agreement to buy the ready-to-eat (RTE) cereal assets of Nabisco on November 12, 1992. The acquisition was completed on January 4, 1993, without a second request by the FTC. However, on Feb. 10, 1993, five weeks after the acquisition had been completed, the New York State Attorney General sued, seeking to have the Nabisco assets divested or the merger rescinded. After a three-week trial, Judge Kimba Wood of the U.S. District Court, Southern District of New York, ruled in favor of the defendant, and the State of New York opted not to appeal the verdict. During the trial there was extensive testimony relating to market definition, coordinated effects, and unilateral effects by the State's economic expert, Ronald Cotterill, by Kraft's economic expert, myself, and by the court-appointed economic expert, Alfred Kahn. My role as defense expert carries with it the advantage of seeing the issues from the inside as a participant, and the disadvantage that one's perspective is inevitably affected by one's own position. Because my goal is to highlight methodological issues, and not to reargue the merits of the case, I am hopeful that the advantages will outweigh any disadvantages.

## II. MARKET DEFINITION

The exercise of market power requires that the firm or firms involved (collectively) face a relatively inelastic demand curve for a product at competitive prices. Only then could it be profitable for firms to raise price by reducing output. Whether demand substitution is sufficient to prevent the exercise of market power thus depends on the extent to which consumers will substitute away from the product or products at issue in the event of a price increase. This substitution information is given by the *own-price elasticity* of demand for the product. However, identifying the set of products that must be controlled to generate market power—an issue that relates not only to market definition, but also to identification of localized competition in evaluating the unilateral competitive effects of merger—depends importantly on the set of *cross-price elasticities* of demand.

Beyond documentary sources, information about the extent and nature of demand substitution can be obtained in multiple ways: the

empirical estimation of demand elasticities based on transactions data, the use of bidding data or household diaries to learn more about the structure of preferences, and the use of marketing surveys. Interestingly, the court relied to some extent on all three in reaching its conclusion about the Post-Nabisco merger.

#### A. THE RTE CEREAL INDUSTRY

There are over 200 products in the Ready-to-Eat cereal industry. Kraft, the acquiring firm, sold twenty-one products at the time of the acquisition (under the Post trademark), while Nabisco sold another seven products. Market shares for the year 1992 were as follows: Kellogg's (37.0%), General Mills (25.1%), Kraft/Post (11.7%), Quaker (6.8%), Ralston (4.6%), Nabisco (2.8%), various private label products, including Malt-O-Meal (8.5%), other (3.5%). The HHI for the RTE industry was 2281 and the delta was 66.

The Kraft acquisition of the Nabisco cereal assets posed an intriguing dilemma for the State. On one hand, the RTE industry has an HHI substantially above 1800. On the other hand, the acquisition of a 2.8 percent market share "firm" by an 11.7 percent firm, which generates a delta less than 100, does not normally raise competitive concerns (and it did not at the FTC). Arguing against the acquisition was the fact that price competition had been less prominent than competition through advertising and other forms of marketing. In support of the acquisition was evidence of substantial product competition with respect to each of these dimensions. In *Kraft* the court noted the differentiated nature of the industry: "RTE cereals differ from one another in important respects, including type of grain, degree of sweetness, product form (e.g., flake, nugget, shredded, etc.), texture, flavor, complexity, type of additional ingredients (e.g., nuts and fruit), and perceived health benefits."<sup>6</sup>

The parties agreed that the relevant geographic market was the entire United States. The focus of the debate was the relevant product market. The State maintained that the relevant market included only "Adult" RTE cereals, whereas Kraft maintained that the market included, at a minimum, all RTE cereals. The Adult market proposed by plaintiff included Post's most successful product line, Grape Nuts (Flakes and Nuggets), and Nabisco's most significant product line, Shredded Wheat (Spoon Size and Big Biscuit).

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<sup>6</sup> *Kraft*, 926 F. Supp. at 326.

## B. EVIDENCE OF DEMAND SUBSTITUTION

The plaintiff and the defendant used, to varying degrees, several types of evidence to support their market definition position: econometrically estimated price elasticities of demand, survey evidence concerning household switching patterns among cereal products, and documentary evidence characterizing the similarities of various groupings of RTE products. In the sections that follow I will focus extensively on the econometric issues raised by the case. However, alternative sources of information about consumer switching are also important, particularly when experts frequently do not have the luxury of undertaking substantial econometric analyses of the type put forward by the experts in the *Kraft* case.

### 1. *Marketing Segments and Switching Studies*

Marketing studies are often directed towards understanding consumer buying patterns and not towards asking the narrower question of how purchasing behavior changes in response to changes in price. While such studies must be interpreted with care, they can provide useful information, especially when that information complements econometric evidence about demand elasticities.

The industry participants had extensively studied the cereal industry from a marketing perspective. It is not surprising, therefore, that the State and Kraft debated at length the proper use of a variety of marketing studies. The State, for example, relied on “interaction indices” calculated from surveys of consumer switching habits to argue that Grape Nuts and Shredded Wheat are relatively close substitutes in its unilateral effects analysis. Kraft, on the other hand, used the same survey data to suggest that Adult and Kid cereals are sufficiently substitutable to be included in the same relevant market. The court agreed, stating:

A 1993 study conducted for Post by National Eating Trends (“NET”), which looked at individual eating patterns by age over a nine-year period, showed that approximately 70% of children eat “all family cereals,” a NET-defined category that includes most of the products that the plaintiff categorized as “adult.” The same study also showed that approximately 20% of all adults eat “pre-sweet” cereals, which plaintiff generally categorizes as the “kid” market.<sup>7</sup>

While these marketing studies are often quite informative about household preferences, they were designed for other purposes, and rarely include information that is directly applicable to the issue of market

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<sup>7</sup> *Id.* at 328–29 (citation omitted). The study also suggests that one in four adults eats Kid cereals (after all, they were once kids), whereas 50% of children eat both Adult and Kid cereals. *Id.* at 329.

definition. It is important in this regard to distinguish margins from averages. Suppose that 80 percent of the average adult's cereal consumption is of Adult cereals and 70 percent of the average child's consumption is of Kid cereals. It is still quite possible that a significant number of consumers view Adult and Kid cereals to be sufficiently substitutable on the margin for switching by consumers of all ages to defeat a hypothetical increase in the price of Adult cereals. Indeed, all substitution possibilities (including inelastic demands for particular brands) are consistent with this overall consumption pattern. In *Kraft* the court clearly understood the important distinction between marketing studies that show patterns of consumption behavior and demand elasticity studies that show how consumer purchases respond to changes in price:

The "brand interaction indices" . . . do not measure the degree of substitutability between products. Interaction indices show only the extent to which a given cereal contributes to the total volume of cereal purchased by consumers of another cereal relative to the first cereal's share of market during a given period. Interaction indices do not show "switching" patterns over time; nor do they relate consumption patterns to price changes or other factors, such as promotions or advertising. . . . Interaction indices are not equivalent to, or proxies for, cross-price elasticities, because they do not purport to measure changes in consumption as a function of changes in price.<sup>8</sup>

## 2. Demand Elasticities

Demand elasticities played an especially important role in *Kraft*. The State of New York used them to support a relevant market containing only Adult cereals, which included the two significant merging products, Post Grape Nuts and Nabisco Shredded Wheat. I argued that the relevant market should be all ready-to-eat cereals, in part based on evidence of relatively high cross-price elasticities between specific Adult cereals and Kid cereals. The elasticities were estimated with a panel data set containing three years of weekly information for ten metropolitan areas. Equations were estimated for approximately twenty of the more important RTE cereal products. Specifically, demand elasticities were estimated as part of a demand system in which the quantities sold of numerous cereal products were specified to be a function of their own price, the prices of other RTE products, measures of product-specific marketing and advertising expenditures, and a series of product and geographical fixed effects (that account for differences across metropolitan areas relating to cost and/or demand). After reviewing a range of methodological issues and attempting to relate the demand elasticities to the evidence

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<sup>8</sup> *Id.* at 333 (citations omitted).

from marketing studies, the court eventually chose to define the market to include all RTE cereals, rather than the smaller set of Adult cereals.

### 3. *Data on Household Purchasing Dynamics*

Data describing cereal-buying behavior raise particularly intriguing methodological issues. First, most cereal purchasing data are aggregated to the household level, whereas many purchasing decisions are based on individual preferences. Data suggesting the great variety of household brands purchased in a year could, therefore, overstate the importance of variety in individual preferences; this pattern may reflect to a large extent the varying tastes of household members. Despite this issue, after some discussion and general agreement by both parties involved in *Kraft*, the court chose to rely on the household data.<sup>9</sup>

Second, households often buy cereals in large volumes, especially when coupons and other marketing incentives are available. Failure to account for inventorying of consumer goods could affect one's estimates of demand parameters. One might, for example, underestimate the price sensitivity of demand if one simply correlated current consumption decisions (using household survey data) with current prices.<sup>10</sup>

Third, one should take seriously the possibility that different groups of consumers, with different preferences and incomes, may be more price sensitive than others. The market definition question depends crucially on the fraction of individuals who are most likely to switch in the face of a hypothetical 5 or 10 percent price increase by a monopolist in the hypothesized relevant market. This information can be obtained from a single demand function (whether linear, log-linear, logit, or another functional form), or from a separate set of demand functions estimated for significant socioeconomic subgroups. Either way, one must be careful to interpret estimated price elasticities correctly.

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<sup>9</sup> According to the court:

Although it is conceivable that data concerning purchases by households that contain children and adults is not probative of whether individual cereal eaters would switch from one cereal to another (*e.g.*, adults who prefer plain cereals may buy pre-sweet cereals only for their children and not for themselves), . . .

There is evidence that household purchasers make purchase decisions themselves, and are not mere "order-takers" for others in the households.

*Id.* at 325.

<sup>10</sup> See Jonathan B. Baker, *Contemporary Empirical Merger Analysis*, 5 GEO. MASON L. REV. 347, 352–55 (1997). Moreover, firms selling branded consumer products may not compete solely on price. Other marketing variables, including advertising and promotion and possibly some physical product characteristics, may affect buyer substitution patterns. If such variables are important in buyer decision making, they should be considered in the analysis of demand, although we do not address their modeling and measurement here.

Suppose, for example, that one has estimated a single linear demand function. Then, the calculated price elasticity of demand at the mean will characterize the price sensitivity of the average purchaser. Alternatively, one could have estimated separate demand functions for adults and children, and then used information about the fraction of individuals in each group to construct a weighted average aggregate demand function. This could result in a different market definition because it could misstate the degree of switching that is likely to occur among both subgroups in response to a hypothetical price increase. To my knowledge, neither economic expert pursued this issue in detail, in part because the data did not allow for the separation of households by preference types. Interestingly, however, the court did note that “[a]pproximately 75% of the buyers of any particular RTE cereal are either ‘light’ or ‘medium’ buyers of that product. . . . Post focuses its marketing efforts mainly on light and medium buyers, in addition to potential new buyers. . . . When buyers are lost, they are usually the light and medium buyers.”<sup>11</sup> The implication seems clear (and appropriate): the demands of light and medium users are more price elastic than the demand of heavy users.

### C. METHODOLOGICAL ISSUES

There are a number of important issues that must be resolved when one undertakes an econometric analysis of demand elasticities. In this section I review three fundamental issues, all of which played a role in *Kraft*.

#### 1. Estimation

When demand elasticities are estimated in antitrust applications, the most common regression models work with inverse demand functions in which the price of a product is given as a function of the quantity of various products sold (including a number of actual or potential substitutes) and a group of demand-shift variables (e.g., income). Often the data are a panel, with observations drawn from multiple markets (such as geographic areas) and at a number of times (typically weeks, months, quarters, or years). The own- and-cross elasticities of demand can be calculated from the estimated parameters of the demand function.<sup>12</sup>

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<sup>11</sup> *Kraft*, 926 F. Supp. at 327.

<sup>12</sup> In some antitrust applications, residual demand functions (rather than the more traditional Marshallian—structural—demand functions) are estimated. However, because the Merger Guidelines rely on Marshallian elasticities for market definition, I will not pursue the estimation of residual demand elasticities further here. In *Kraft* both experts chose to rely on direct rather residual demand elasticities. (A residual demand function

In *Kraft* there was relatively little debate about the primary econometric data set (weekly data for ten metropolitan areas over three years)—the data are relatively rich in comparison to other industries, and data of this type are regularly used in the industry and by scholars. There was, however, significant debate about identification.

## 2. Identification

Identification is often a central issue in demand function estimation. As a general rule, price and output are jointly determined by the intersection of demand and supply; that is, they are both “endogenous” variables. If cost variables do not change over time, or there are insufficient data that describe cost movements that do occur, then demand functions will not be identified and ordinary least squares estimation of demand functions may not generate unbiased estimates of the demand parameters. This, in turn, may lead to biased estimates of the own- and cross-elasticities of demand. Fortunately, price and output often vary because of shifts in supply, in which case ordinary least squares can perform well in demand function estimation. However, if price and output vary because of both shifts in demand as well as supply, then the ordinary least squares regression results will typically not generate unbiased estimates, and instrumental variables estimation will be required.<sup>13</sup>

Variables that shift costs provide the most natural “instruments” for isolating a demand function in the data because they identify when price and output are changing mainly because of shifts in supply. These instruments might include, for example, important input prices. In the rare event that there are measurable cost-shifting variables for all of the products at issue, identification and estimation of demand are likely to be straightforward. However, in many cases, the number of cost shifters is small and, in particular, fewer than the number of endogenous prices. As a result, identification will be possible only if further assumptions are made about the nature of the demand system.

One common identification strategy is to restrict the parameters of the demand system, for example, by constraining all products in a group

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omits the quantity variables for products other than the one of interest and adds a group of cost-shift variables thought to affect the price and output of the omitted products.)

<sup>13</sup> One exception may arise in time series analyses, including those involving scanner data, in which the variables are observed over short time intervals (e.g., weekly). In some industries, prices may be set sufficiently in advance of consumer purchases so that they are predetermined, thus avoiding simultaneity problems in measuring the demand elasticities with respect to short term price promotions. But the use of high frequency data may require careful modeling of the relationship between consumer inventorying and seller promotions in order to recover the demand elasticities with respect to intermediate term price variation. See Baker, *supra* note 10, at 352–55.

to enter the demand system with a common parameter, or by imposing symmetry on the demand system. If the number of free parameters is limited, then even a handful of cost-shift variables may be sufficient to identify them. The attractiveness of this strategy depends importantly upon the strength of the non-statistical evidence justifying the restrictions. For example, it is likely to be reasonably effective when objective measures provide a good indicator of "closeness" in product space; these measures can be used to constrain the relationship among the individual demand functions.

The strategy of restricting the parameters of the demand system is almost invariably adopted when estimating demand functions for individual goods in differentiated products markets when there are a substantial number of products, as, for example, mergers in branded consumer products industries where product space is densely packed.<sup>14</sup>

Issues of identification and estimation did play a role in *Kraft*. Both economic experts estimated demand functions using both ordinary least squares and instrumental variables estimators. In the latter case the instruments were chosen to be the prices of cereals in geographic areas other than the one in which prices were determined. I was doubtful that instruments were required in this case because of the substantial lag between price setting and consumer purchasing decisions. However, the issue turned out to be of minor significance because the key parameters were not substantially different in any case.<sup>15</sup>

### 3. *Functional Forms*

Even if the demand function can be identified, other econometric issues must be addressed if demand elasticities are to be appropriately

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<sup>14</sup> The analysis of the price effects in such situations can be both theoretically and empirically demanding. The theoretical issues are complex because the increased prices of the merging firms' products can induce increases in rivals' prices, and because the analysis of these effects can be sensitive to assumptions about the form of demand functions (e.g., whether linear or nonlinear), demand symmetries (e.g., whether or not there are symmetries in the system of demand equations), the nature of the interaction among firms (e.g., Bertrand or Cournot competition), and the possible presence of economies of scale and scope. In cases involving consumer products, the analysis may also be sensitive to the assumptions that are made (or not made) about the timing of consumer purchases. See, e.g., Raymond Deneckere & Carl Davidson, *Incentives to Form Coalitions with Bertrand Competition*, 16 RAND J. ECON. 473, 476-86 (1985).

<sup>15</sup> This instrumental variables approach can be an attractive method for exploiting scanner data containing prices in multiple cities when it is difficult to observe cost-shift variables in the same frequency as the price data if the nationwide component reflects mainly nationwide variation in product cost rather than demand. Indeed, this approach may have generated reasonable estimates in one data set involving breakfast cereals. But when the method is employed in other industries (or other time periods in the same industry), where the critical assumption cannot be tested, it would be useful to have some

estimated.<sup>16</sup> One prominent question involves the choice of functional form. In *Kraft*, issues relating to functional form played a relatively inconsequential role. I believe that to be partly the result of the court's emphasis on market definition and coordinated effects. The experts for both parties tended to rely on elasticities obtained from log-linear demand equations. The empirical evidence suggested that there was little difference between price elasticities estimated by log-linear and linear demand systems, so as long as the elasticities were evaluated at current market prices. Functional form tends to be more important when the price effects of proposed acquisitions are simulated for purposes of evaluating unilateral effects.

#### 4. Multi-Level Decisionmaking

The empirical issues are also complex because with numerous products, a complete empirical analysis is not likely to be possible. For example, in the RTE cereal industry, with approximately 200 products, it would be necessary to estimate 40,000 ( $200 \times 200$ ) own- and cross-price elasticities in a constant elasticity demand model. Without some strong assumptions, estimation would be impossible. Simplification is usually achieved through strong assumptions about the relationship between brands and/or the attributes of brands.<sup>17</sup>

In one approach to limiting the parameters of the demand system, the restrictions are achieved by characterizing demand decisions according to a multi-level decision-making process, by aggregating individual brands into sensible aggregates, and by assuming that the demands for products in one "branch" or segment of the "tree structure" are separable from the demands of products in other branches.<sup>18</sup> For example, one might think of cereal choice as occurring at the third stage of a three-

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basis for believing that shocks to the nationwide component of prices in the industry and time period under study mainly result from variation in cost, not demand. See Baker & Rubinfeld, *supra* note 3, for further discussion.

<sup>16</sup> Specification issues related to the omission of advertising and promotion when buyers hold inventories, and the time period over which the demand elasticity is measured, are considered in Baker, *supra* note 10, at 347-61, and are not discussed further here.

<sup>17</sup> It is generally not a good idea to assume that cross-price elasticities are zero. However, it may be reasonable to impose symmetry among the elements of the Slutsky matrix that underlies the determination of demand substitution, but one would normally expect cross-price elasticities to be asymmetric.

<sup>18</sup> Separability of demand and multi-stage budgeting are not equivalent. Weak demand separability is necessary and sufficient for the last (lowest level) of the budgeting process. For the higher stages, the assumption that expenditures can be allocated among groups depends on stronger separability assumptions or on other restrictions on preferences. See generally Aviv Nevo, *Mergers with Differentiated Products: The Case of the Ready-to-Eat Cereal Industry* (unpublished Ph.D. dissertation 1997) (on file with author); ANGUS DEATON & JOHN MUELLBAUER, *ECONOMICS AND CONSUMER BEHAVIOR* ch. 16 (1980).

stage decision-making process. The top level determines the demand for RTE cereal, the second level divides the choice of the 200 cereal brands into three segments (Kid cereals, Family cereals, and Adult cereals), and the third stage determines the demand for brands within one of the three segments. The multi-stage model thus would reduce the choice among 200 brands into a choice among three segments, and then with the aggregation of brands within segments, a further choice of, for example, eight product categories—drastically reducing the number of elasticities that must be estimated to 201 (192 within-segment own- and cross-elasticities and nine between-segment elasticities). As the number of parameters is reduced, the analyst has greater flexibility in the specification of the structure of demand; flexible functional forms that require more parameters than constant elasticity demand functions are now possible options even in data sets that are limited in size.

In *Kraft*, the appropriateness and the proper application of the multi-stage decision-making model played a crucial role. The use of a multi-stage model is appealing conceptually, and is supported by the actual practices of the companies. At the time of the acquisition, Nabisco used three RTE segments—“Adult,” “All Family” and “Kid” — while Post used five segments—“Simple Health Nutritional,” “Taste Enhanced Wholesome,” “All Family Basic,” “Family Acceptable Kid” and “Traditional Kid.” The four-level tree structure that includes the Post five segments is shown in Figure 1.

While the benefits of reducing the number of parameters in a demand system are appealing—to facilitate identification when instruments are few, to simplify computations, or to deal with limited data—the results can be quite sensitive to the restrictions that are made. What I did not understand well prior to *Kraft* was the sensitivity of estimated demand parameters to the particular specification of the demand model. It became clear during the course of *Kraft* that the decision to include a product or group of products in one segment rather than another can substantially affect the conclusion that one reaches concerning the definition of the relevant antitrust market.

The intuition can be most easily seen with an example. A nesting that adopts Nabisco’s division of cereals into Kid, All Family, and Adult segments increases the likelihood that Kellogg’s Sugar Frosted Flakes and General Mills’s Cap’n Crunch (both Kid cereals) will be found to be relatively close substitutes for each other, but decreases the likelihood that Kellogg’s Sugar Frosted Flakes will be found to be highly substitutable with Kellogg’s Corn Flakes (an All Family cereal) or Post’s Shredded Wheat (an Adult cereal). Intuitively, this grouping of cereals is likely to

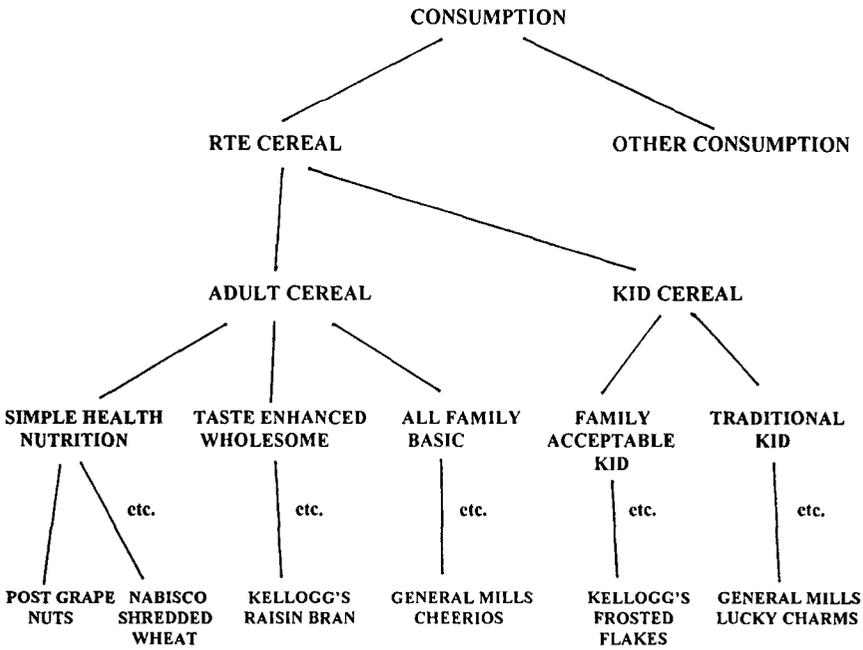


Figure 1. A Four-Level “Tree Structure”

make any two Kid cereals appear to be closer substitutes than they in fact are, because a restricted number of products within the Kid segment are competing to be close substitutes. Moreover, this grouping is likely to make a Kid cereal and a cereal in, say, the Adult segment appear to be less close substitutes than they in fact are because they are not competing directly.

The difference between direct competition (within segments) and indirect competition (between segments) can be seen another way, if we focus on the calculation of cross-price elasticities of demand. Within a segment, the cross-price elasticity can be determined directly from the estimated parameters of a single demand function. However, the estimated cross-price elasticity of demand between two products in different segments must be calculated indirectly, in a series of steps. Suppose that we are calculating the cross-price elasticity between product A in segment 1 and product B in segment 2. First, one must determine the effect of a 1 percent price increase for product A on the average price of segment 1 cereals (because segment 1 is viewed as an aggregate in the multi-stage model). The segment price increase is less than 1 percent, since it is reduced by the fraction of segment 1 that consists of product

A sales. Second, one must calculate the effect of a price increase on segment 1 cereals on the quantity demanded of segment 2 cereals. This is given by the cross-price elasticity between the average of all products in segment 1 and segment 2 (because both segments are viewed as aggregates). Finally, the resulting quantity demanded of segment 2 cereals must be translated into a quantity demanded of product *B*. The quantity demanded of *B* is obtained by reducing the segment 2 demand by the share of the segment made up by product *B*. The details and an example are given in the Appendix, *infra*.

By construction, the cross-price elasticity between products in different segments is likely to be small. For example, the cross-price elasticity of Corn Flakes with respect to the price of Sugar Frosted Flakes in a model with Kid and Adult segments depends, in part, on the elasticity of the aggregate of all Kid cereals with respect to the price of Frosted Flakes and, in part, on the share of all Adult cereals made up by Corn Flakes and on the share of Kid cereals made up by Frosted Flakes. While the elasticity involving the two aggregates need not be small, the overall elasticity is likely to be, because the calculated elasticity is reduced by the segment share of Corn Flakes and the segment share of Frosted Flakes, respectively.<sup>19</sup>

#### D. MARKET DEFINITION—FOLLOWING THE HORIZONTAL MERGER GUIDELINES

##### 1. A *Multi-Stage Model*?

In *Kraft* the plaintiff's economic expert used a three-stage decision-making model:

- Stage 1: The choice of cereal v. other consumption items
- Stage 2: The choice of Adult v. Kid cereals
- Stage 3: The choice among individual Adult cereal products

The econometric support for this market definition was based on a relatively low estimated price elasticity of demand for "Adult" cereals.<sup>20</sup>

<sup>19</sup> According to the court, "[h]is [plaintiff's economic expert] model was biased in favor of finding very low cross-price elasticities between 'adult' and 'kid' cereals." *Kraft*, 926 F. Supp. at 334.

<sup>20</sup> In the appendix, *infra*, I describe how cross-price elasticities between individual products in different segments can be calculated. The price elasticity of demand for Adult cereals could be calculated either in a single equation in which the "price" of Adult cereals is a function of the quantity of Adult cereals and other variables, or it can be calculated as a weighted sum of the price elasticities calculated on a product-by-product basis. Either approach necessitates aggregation and relies on important assumptions. (Note, in particular, that the "price" of Adult cereals involves aggregation, because it is typically calculated as the ratio of total revenues to total units sold.)

Recall that under the Merger Guidelines the issue is whether the estimated elasticity suggests that a hypothetical profit-maximizing monopolist would increase prices significantly.<sup>21</sup> The plaintiff's expert testified that the elasticity was sufficiently low for this to be the case.

While appealing, this approach to market definition is inappropriate, in part, because it does not build a product market from the ground up, as the Guidelines recommend.<sup>22</sup> Under the Guidelines, the product market is expanded by adding the next-best substitute (the product to which the diversion resulting from a price increase would be the greatest). But, the Guidelines' approach, while clear in theory, is itself difficult to apply in the highly differentiated cereal industry. For example, suppose one begins with Shredded Wheat and Grape Nuts, and then adds further products. It is not obvious where the Guidelines' approach will lead. Because there is no obvious chain of substitutes, and there are a number of rules of thumb that could be used to add products sequentially, it is hard to know where any particular chain of substitutions will lead.<sup>23</sup> Although neither expert pursued this issue at trial, there is reason to believe that the result could be multiple competing market definitions.

Given the low estimated demand elasticity for Adult cereals, why wasn't the Adult market a suitable relevant market? There are several reasons. First, the confidence band surrounding the Adult own-price elasticity was sufficiently wide that, even assuming a correctly specified model, one could not rule out a larger market on demand substitution grounds. Second, market definition is not an end in itself. Rather, it provides a foundation on which one can evaluate likely competitive effects. In the case brought by the State, the most significant value of market definition was its use in analyzing the likelihood of coordinated effects. Given that all major cereal companies sell products in each of the various brand segments, and given the relative ease of supply-side substitution, it is difficult to see how a system of tacitly collusive pricing could be achieved,

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<sup>21</sup> The appropriate analysis, that relies on the Lerner condition, asks whether the increased profits from the sale of a higher-priced product to inframarginal (non-switching) consumers outweighs the reduced profits associated with the lost margins of marginal (switching) customers.

<sup>22</sup> See Gregory J. Werden, *Market Delineation Under the Merger Guidelines: A Tenth Anniversary Retrospective*, 38 ANTITRUST BULL. 517 (1993).

<sup>23</sup> See Gregory J. Werden, *Demand Elasticities in Antitrust Analysis*, 66 ANTITRUST L.J. 363 (1998). The court-appointed expert made this point clearly when he based his view that the correct market was all RTE cereals on the fact that "(1) there is no clear break in the chain of substitutes among RTE cereals, and (2) the chain of substitutes for RTE cereals is not along straight, unidirectional lines radiating out in a uniform and orderly manner." *Kraft*, 926 F. Supp. at 335.

if at all, without encompassing the entire RTE market.<sup>24</sup> The court apparently agreed, relying, in part, on its view that “there is no clear break in the chain of substitutes among cereals that would permit definition of a market smaller than all RTE cereals.”<sup>25</sup>

## 2. *The Role of Own-Price Elasticities and Cross-Price Elasticities*

The most direct approach to market definition focuses on the own-price elasticity of demand for the product or group of products in the potential relevant market. This can most easily be accomplished by estimating a demand function that uses variables reflecting the average price of cereal, the aggregate quantity of cereal purchased, and other variables. Alternatively, one could estimate individual demand equations for specific brands and then compute the own-price elasticity for an aggregate product from the individual estimated own- and cross-price elasticities for the range of included products. In *Kraft* the plaintiff’s economic expert specified a system of demand equations, while emphasizing own-price elasticity. Yet, the defendant’s economic expert and the court placed a great deal of attention on cross-price elasticities of demand for individual products that were obtained from a system of individual product demand equations. Technically, market definition can be appropriate using either own- or cross-price elasticities because own-price elasticity is a weighted average of all the cross-price elasticities. There are reasons, however, to prefer the use of cross-price elasticities when markets are highly differentiated. One reason is that building up market definition in the traditional manner is inherently complex and difficult, for the reasons given previously, and cross-price elasticities can help one to determine an appropriate chain of substitutes.<sup>26</sup> Second, cross-price

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<sup>24</sup> According to the court:

These [manufacturing] processes are not dedicated to producing cereals in only one marketing segment; . . . If prices for cereals in the “adult” market were to increase significantly relative to the prices of other cereals, Kellogg, General Mills, Post and other manufacturers could increase production of “adult” cereals relatively quickly and easily by redirecting the use of some portion of the capacity currently used to product “kid” cereals.

*Kraft*, 926 F. Supp. at 332 (citation omitted).

<sup>25</sup> *Id.* at 333.

<sup>26</sup> According to Judge Wood:

In a differentiated product market such as the RTE cereal market, the decision whether to include a product in the market is inevitably somewhat arbitrary, because not all products in a relevant market compete equally with all other products. In such a market, any market definition is likely to exclude some products . . . that are included in the market. Whether such errors of inclusion or exclusion are significant depends in part on the relevant cross-price elasticities of demand between the individual products.

*Id.* at 334. The presence of a chain of substitutes should not, by itself, be seen as dispositive

elasticities are a useful device for illustrating why the “Adult” market definition cannot be valid. By showing that there are substantial cross-price elasticities between Adult and Kid cereals, one can show by example that the own-price elasticity of demand decreases if a Kid cereal replaces an Adult cereal in the proposed relevant market. As the court stated:

Although the calculation of cross-price elasticities of demand does not in and of itself provide a market definition, it does provide information relevant to assessing whether a proposed market definition is or is not reasonable. In this case, cross-price elasticities confirm that there is demand-side substitution between cereals inside and outside plaintiff’s proposed “adult” market.<sup>27</sup>

The court added:

[A]lthough the cereals grouped together . . . satisfy the letter of the Merger Guidelines’ five percent test, there may be other groupings of RTE cereal brands that would also pass muster. For example, [the] “adult” market includes “Wheaties” and excludes “Honey-Nut Cheerios,” but an “adult” market that excludes “Wheaties” and includes “Honey-Nut Cheerios” might also satisfy the Merger Guidelines. Examined from this standpoint, [the] “adult” market is arbitrary.<sup>28</sup>

It goes without saying that the actual grouping of products would not have been entirely arbitrary if the Merger Guidelines been followed.

The proper role of own- and cross-price elasticities will vary depending on the nature of the product market being studied and on the issues raised in a particular case. The court’s preference for cross-price elasticities should, therefore, be seen as case specific, and should not necessarily be generalized. According to Judge Wood:

Cross-price elasticity is a more useful tool than own-price elasticity in defining a relevant antitrust market. Cross-price elasticity estimates tell one where the lost sales will go when the price is raised, while own-price elasticity estimates simply tell one that a price increase would cause a decline in volume.<sup>29</sup>

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with respect to the market definition question. A Guidelines analysis could support a narrower market definition, even without a clear break in the chain.

<sup>27</sup> *Id.* at 333 (citation omitted).

<sup>28</sup> *Id.* at 361.

<sup>29</sup> *Id.* at 333. This opinion was supported by the court-appointed expert Alfred Kahn, who said:

own-price elasticity, in a sense you don’t have to know what went into it in setting your profit-maximizing price. If you really know what the price elasticity is, it tells you what the profit-maximizing price is. . . . On the other hand, if you want to know what constitutes a market— and I think that is what Professor Rubinfeld is getting at— then it is necessary to have some sense of the extent to which you are losing if you raise your price because you are losing to substitute, and what are those substitutes.

Trial Transcript, vol. 5, at 934, *Kraft* (No. 93 Civ. 0811).

## III. UNILATERAL EFFECTS

Estimating the elasticity of demand may not be an end in itself. In evaluating mergers for unilateral competitive effects in differentiated products markets, for example, the goal is to understand the power of the incentive for the merger partners to raise prices after the loss of the localized competition the partners previously posed for each other.<sup>30</sup> The elasticities of demand themselves may provide indicators of the strength of these incentives, or they may be combined with information or assumptions about cost and oligopoly behavior to simulate the effect of the merger on price. Simulations also provide a valuable method of assessing the sensitivity of price forecasts to uncertainty in parameter estimates and to alternative assumptions about the underlying demand and supply functions and market structure.<sup>31</sup>

The simulation exercise is not without risk, however. Analysts using the simulation approach need to confront issues that relate to cost determination, to the identification of the nature of oligopoly behavior, and to modeling the way cost and demand may change with the output reductions associated with the exercise of market power (including the possible need to make out-of-sample projections).<sup>32</sup> These difficulties may mean that in some cases complex simulations will contribute little more than can be learned about the anticompetitive incentive of the merging firms to raise price from the demand elasticities alone.

Estimated elasticities played an important role in the analysis of unilateral effects in *Kraft*. Merger simulation techniques that relied on the same estimated elasticities were used by experts for both sides to debate the significance and magnitude of the price effects that could arise from the merger. Perhaps because the simulated price effects generated by the plaintiff's and the defendant's expert differed substantially, the court did not comment in detail about the simulation analyses in its findings of fact. The court did rely to some extent on the econometric evidence, however, when it concluded that a merger placing these brands under common ownership would provide little incentive for the merged firm to raise price based on estimates of a low cross-price elasticity between Grape Nuts and Shredded Wheat, without need for a more sophisticated indicator of post-merger pricing incentives.<sup>33</sup> The court concluded that

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<sup>30</sup> 1992 Merger Guidelines, *supra* note 5, § 2.21.

<sup>31</sup> See, e.g., Werden, *supra* note 23, at 363-409.

<sup>32</sup> See generally Baker & Rubinfeld, *supra* note 3.

<sup>33</sup> The court did find reliable defendant's expert econometric analysis that found insubstantial unilateral effects. *Kraft*, 926 F. Supp. at 35. According to the court, the "precise amounts of the cross-price elasticities that Professor Rubinfeld found varied depending

the "evidence does not support plaintiff's claim that the Acquisition will have adverse unilateral competitive effects."<sup>34</sup> It noted, in addition, that the "evidence, including consumer consumption and purchase information, and econometric evidence, shows that Grape-Nuts and Nabisco Shredded Wheat compete with many other products and are not the first and second choices of a significant number of consumers."<sup>35</sup>

Market definition played, at best, a minimal role in the unilateral effects discussion of *Kraft*. Perhaps this was the natural consequence of the market definition issue having been resolved during the phase of the trial that emphasized coordinated effects. Whatever the case, I believe that market definition should be de-emphasized in unilateral effects generally. To understand a unilateral effects analysis one does need to determine the set of products that are in sufficiently close proximity to the products at issue so as to conceivably generate a meaningful unilateral effect. But the actual delineation of those products in the market from those outside the market is not vital. In the large majority of situations, the products under debate with respect to the inclusion issue are likely to, at best, be slightly substitutable with the products at issue. Their exclusion is unlikely to create any significant bias, and their inclusion will only be of consequence if data limitations are paramount. Thus, while I do believe it appropriate to include Fruit Loops in the relevant RTE market, I strongly doubt that the exclusion of Fruit Loops from the unilateral effects analysis would be of any consequence.

#### IV. CONCLUSION

*Kraft* has received substantial attention because it provides a relatively rare example of a litigated case that followed the Merger Guidelines and relied heavily on empirical methods. While there is much to be learned from the case, one overarching lesson is the importance of melding the technical econometric evidence with other quantitative marketing evidence, and most significantly with qualitative materials, including documents and deposition testimony. There are many crucial choices to be made in constructing, estimating, and simulating econometric models. These choices can only be evaluated in the broader context of the specific case. With econometric and related qualitative materials, the whole is certainly greater than the sum of the parts.

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on the assumptions he made regarding advertising and marketing variables, but his calculations consistently showed that any unilateral effects are likely to be very small." *Id.* at 356.

<sup>34</sup> *Id.* at 352.

<sup>35</sup> *Id.*

The court was clearly aware of the importance of making reasoned judgments about quantitative evidence. Thus, Judge Wood cites the admonition of the introduction to the Merger Guidelines: “it is not possible to remove the exercise of judgment from the evaluation of mergers under the antitrust laws,’ and ‘mechanical application of those standards may provide misleading answers to the economic questions raised under the antitrust laws.’”<sup>36</sup> Judge Wood also points to *United States v. Connecticut National Bank*,<sup>37</sup> stating that “the market ‘need not—indeed cannot—be defined with scientific precision,’” and to *FTC v. Coca Cola Co.*,<sup>38</sup> noting that “[m]arket definition is ultimately ‘a matter of business reality—a matter of how the market is perceived by those who strive for profit in it.’”

There is little doubt that the use of empirical methods in antitrust will continue well into the future. It is hoped that the lessons to be gleaned from *Kraft* will make those experiences just a little bit better.

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<sup>36</sup> *Id.* at 358 n.9 (citation omitted).

<sup>37</sup> 418 U.S. 656, 669 (1974).

<sup>38</sup> 641 F. Supp. 1128, 1132 (D.D.C. 1986)

## APPENDIX

### CALCULATING CROSS-PRICE ELASTICITIES IN A MULTI-STAGE DEMAND MODEL

The procedure for calculating cross-price elasticities can best be seen by example. (The numbers are illustrative only—specific cross-price elasticities remain confidential.) Consider the four-level structure given in the text. Post Grape Nuts and Ralston Chex are both thought to be Adult cereals and relatively close substitutes. Indeed, the cross-price elasticity of Grape Nuts with respect to Chex, estimated in a single stage least-squares equation that includes a wide range of other cereals prices, is equal to .20. In relation to other combinations of cereal products, this is a relatively high cross-price elasticity. Now, consider the consequence of placing Grape Nuts and Chex in different segments of the multi-stage tree structure. To calculate the cross-price elasticity between two products in different segments, I use the fact that there is “separability” among segments. In this context this is equivalent to assuming that the quantity demanded of a product in one segment is a function of the average price of products in each of the segments (the total expenditure in that segment divided by the total quantity sold). The relevant cross-price elasticity between Grape Nuts and Ralston Chex is given by the following equation:

$$E_{GN,RC} = S_{RC,AFB} * E_{SHN,AFB} * S_{GN,SHN}$$

where:

GN = Post Grape Nuts

RC = Ralston Chex

SHN = Simple Health Nutritional cereals

AFB = All Family Basic cereals.

$E_{SHN,AFB}$  = cross-price elasticity (the percentage change in the quantity of SHN with respect to a 1 percent change in the price of AFB)

$S_{RC,AFB}$  = RC share of AFB cereal segment

$S_{GN,SHN}$  = GN share of SHN cereal segment

To calculate the overall cross-price elasticity, assume a 1 percent change in the price of Ralston Chex. Because all other All Family Basic cereal prices are unchanged, the average price of AFB cereals will

increase by less than 1 percent. The first term, which represents the increased price of AFB cereals, is given by Ralston Chex's share of the sales of All Family Basic cereals. The second term measures the cross-price elasticity between two segments, which can be estimated directly using least squares. The product of the first two terms represents the percentage change in the quantity of Simple Health Nutritional cereals resulting from the calculated increase in the price of All Family Basic Cereals. The third term translates this segment quantity response into a quantity response for Grape Nuts. Because all cereals in the SHN segment are assumed to be similarly affected by the price increase, this term is given simply by Grape Nuts's share of all SHN cereals.

Following the procedure just outlined, I find that:

- (1)  $E_{GN,SHN} = .20$ , assuming that GN's share of SHN in the sample was 20%
- (2)  $E_{SHN,AFB} = .15$
- (3)  $E_{AFB,RC} = .16$ , assuming that RC's share of AFB in the sample was 16%.

The calculated cross-price elasticity is .0048. Clearly, the assumption of a multi-stage tree structure leads to a significant reduction in the cross-price elasticity. This reduction arises because the multi-stage structure imposes very strong constraints on the data, and these constraints are not likely to be overcome with any particular data set.

I note also that Aviv Nevo has come to a similar conclusion.<sup>1</sup> He compares the cross-price elasticities computed from an estimated multi-level demand system and those computed from a random coefficients discrete choice model. In both cases segment information is used. For the multi-level system the segment information is used as described above, and for the discrete choice model he treats each segment as an attribute of the cereal. He finds that segmentation in the multi-level system imposes a prior that is too strong for the data to overcome. For example, suppose GM Total Raisin Bran is placed (perhaps wrongfully) in the simple health nutrition segment, while Kellogg's and Post's Raisin Bran are placed in the taste enhanced wholesome segment. His estimates suggest that in the multi-level system the reaction in the market share of GM Total to a change in the price of Kellogg's Raisin Bran is very small.

An additional example is the case of Kellogg's Frosted Flakes, which was classified as a Kid cereal. When its price increases, the predicted

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<sup>1</sup> See Aviv Nevo, *Mergers with Differentiated Products: The Case of the Ready-to-Eat Cereal Industry* ch. 6 (unpublished Ph.D. dissertation 1997) (on file with author).

change in the market shares of either Kellogg's Corn Flakes or General Mills's Cheerios, both classified as Family cereals, is essentially zero. In both these cases the results of the discrete choice model (with dummy variables that account for the different segments) are more intuitive. This suggests that the use of segment information is not fundamentally flawed, but that one has to be careful as to how it is imposed on the data.

