Competitive Conduct and Antitrust Policy Actions in the U.S. Dairy Industry: The Case of Dean Foods and Foremost Farms USA

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Abstract:

In April 2009 Dean Foods acquired two milk plants from Foremost Farms USA, and these plants produced three distinct brands of milk. The United States Department of Justice (DOJ) expressed concern that this acquisition would have substantial anticompetitive effects in certain markets. Consistent with this view, in July 2011, the DOJ issued a final order requesting that Dean Foods divest one of the newly acquired plants no later than ninety days subsequent to the final order. The primary objective of this paper is to empirically examine whether DOJ's concern, as well as its policy action, are supported by the data. The results suggest that except for two package sizes of milk, Dean Foods jointly priced the newly acquired brands of milk along with its pre-existing milk brands, and such cooperative price-setting behavior is consistent with an anticompetitive effect. However, the magnitudes of the percentage increases in markups due to joint pricing are sufficiently small, less than 1%, suggesting that anticompetitive effects should not be of concern. In case of the divestiture period, we find that the divested brands went back to being priced non-cooperatively as required by DOJ's order. However, the magnitudes of the percentage decreases in markups are sufficiently small, less than 1%, suggesting that divestiture effects are negligible.

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1. Introduction

Dean Foods is the nation's largest fluid milk processor, operating 81 dairy plants in 35 U.S. states in 2008. On April 1, 2009, Foremost Farms USA (referred to Foremost Farms), a Wisconsin-based dairy producers cooperative, sold its consumer products division, which included two dairy processing plants in De Pere and Waukesha, to Dean Foods. This acquisition cost $35 million that was under the federal antitrust notification statute, therefore, this merger was not reported beforehand to the federal antitrust authorities. The Department of Justice (DOJ), the state of Wisconsin, Illinois and Michigan, filed a civil antitrust suit on January 22, 2010 against Dean Foods in the U.S. District Court for Eastern Wisconsin, with the purpose to disassemble the acquisition. Because Dean Foods and Foremost Farms were the first and fourth largest milk processors in these areas, the complaint demonstrated that this merger eliminated an aggressive competitor (Foremost Farms) of the sale of fluid milk against Dean Foods in the northeastern Illinois, the Upper Peninsula of Michigan and Wisconsin. The complaint also detailed outlined the processed milk market share of Dean Foods within the region, approximately 57% before the acquisition. DOJ's complaint of this case also pointed out that this acquisition disrupted the normal dairy competition and increased the Herfindahl–Hirschman Index (HHI) by 1,127 points to 3,830, and even larger increase within the relevant geographic area, especially in the Upper Peninsula of Michigan, where HHI increased by 2,814 points to 7,510.[1] On July 29, 2011, the final judgment of this case required Dean Foods to divest Waukesha plant, and also required Dean Foods to notify DOJ any future acquisition of milk processing operation if the value of the acquisition was $3 million or greater.

In the U.S., mergers are typically challenged under Section 7 of the Clayton Act, which prohibits transactions may be "substantially to lessen competition or to create a monopoly". For the analysis of competition in differentiated products, Shapiro (1996) summarizes the implementation of the guidelines, the merging firms may find that increasing price is profitable if the merging firms' products are close substitute relative to other products. Therefore, estimating the own- and cross-price elasticities is important to analyze the merger effect.

Using the Information Resources Incorporation (IRI)[2] retail scanner data, we estimate a structural econometric demand and supply model to test the effectiveness of DOJ's anticompetitive concern and the final judgment of this merger case. We use a random

[1] The United States. Dept. of Justice. U.S. and Plaintiff v. Dean Foods Co., Jan 22, 2010, <https://www.justice.gov/atr/case-document/complaint-81>

[2] IRI Inc: A Chicago-based consulting firm that collects retail scanner data from major U.S. cities. We would like to thank IRI for making the data available. All estimates and analysis in this paper, based on data provided by IRI are by the authors and not by IRI.

coefficient logit model for the demand side estimation. One of the major advantages of this model is that it imposes very few restrictions on own- and cross-price elasticities compared to the standard logit model. Once the coefficient estimates of demand are obtained, we specify alternative supply models and different ownership structures to compute the price-cost margins. Using the exogenous variables as the cost shifters, the Vuong test is applied to assess which supply models better approximate price-setting behavior during the merger period and divestiture period respectively.

In the five IRI markets that might be affected by the acquisition of Dean Foods and Foremost Farms, we analyze four common package sizes of milk (16 ounces, 32 ounces, 0.5 gallon, 1 gallon). The results suggest that during the merger period Dean Foods actually jointly priced the new brands of milk that it acquired from Foremost Farms with its pre-existing milk brands in two package sizes (16 ounces and 0.5 gallon). The observations in these two package sizes account for 70.5% in the completed dataset, therefore, such cooperative price-setting behavior in the majority data is consistent with an anticompetitive effect. Then we compute the percentage increases in the markups based on the preferred supply model, and the magnitude of the percentage increase is less than 1%, suggesting that such anticompetitive effect should not be of concern. In the examined divestiture period, Dean Foods actual did not jointly price the brand "Golden Guernsey" (owned by Foremost Farms) with its own milk brands, and this non-cooperative price behavior validates the DOJ's divestiture order. However, based on the preferred supply model, the magnitude of percentage decreases in markups are sufficiently small, which is also less than 1%, suggesting that the effect of divestiture is trivial.

There are numerous studies focused on analyzing merger effect. Schmalensee (1988) summarizes the research on the exercise of monopoly power based on the choice of price, output, capacity and non-price rivalries such as advertising, product selection and technical changes. As the estimation of demand has been playing an important role in market power analysis, extending the discrete choice models (Berry 1994, Berry, Levinsohn and Pakes 1995), Nevo (2000, 2001) estimates a random coefficient logit model on differentiated products to study the merger effects in the U.S. ready-to-eat cereal industry. Pinkse and Slade (2002) estimate the brand-level demand of beers from panel data, and then use the structural model to assess the effects of mergers on brand competition and pricing in the UK brewing industry. Raphael Thomadsen (2005) estimates a structural demand and supply model that accounts for market geography and run counterfactual experiments to analyze how ownership structures affect prices. Ivaldi and Verboven (2005) start from a case of Volvo/Scania merger to estimate an oligopoly model with differentiated products and compare several alternative market power tests. Craig Peters (2006) applies the discrete choice model to estimate the consumer demand by using the pre-merger data and recovers the pre-merger marginal costs under a maintained assumption about firm conduct. Then he simulates the post-merger price and finds that the increased post-merger price is largely accounted for by the supply-side effects. Berry and Jia (2010) use a discrete-type version of the random coefficient model and then consider a structural model of airline oligopoly to estimate the impact of demand and supply changes on profitability. Following the previous literature, we also estimate the demand for differentiated products in dairy industry based on the random coefficient logit model.

For the vertical relationship between manufacturers and retailers, we consider the linear pricing supply model with double marginalization and a special case of passive retailers. Cotterill and Dhar (2003) study the oligopoly price strategy based on the Boston fluid milk market channel, and they consider the vertical coordination and vertical Nash (Choi 1991) to capture the strategic interactions between retailers and milk processors. Berto Villas-Boas (2007) takes a menu approach to study the yogurt distribution by supermarkets, and uses non-nested tests to determine the best-fitting model among different supply models. Bonnet and Bouamra-Mechemache (2016) consider a vertical linear contracting in French fluid milk market to estimate how the organic attribute affects the benefits and the share of profits between milk processors and retailers. Our paper also adopts the vertical linear contract in the U.S. dairy industry. And in order to investigate the DOJ's anticompetitive concern and divestiture judgement of this merger case, we do the factual and counterfactual analysis in both merger period and divestiture period, as such there are four supply models to compare in both two periods.

Following the methodology developed by Berto Villas-Boas (2007) and Bonnet and Dubios (2012), we use the non-nested test to identify which of the four supply models better approximates price-setting behavior of Dean Foods in both merger period and divestiture period.

The paper is organized as follows. Section 2 describes the fluid milk market and presents the available data in the five IRI markets that are possibly influenced by the acquisition. Section 3 outlines the empirical models on the demand side and supply side respectively. Section 4 presents and discusses the empirical results and Section 5 concludes with a brief summary of the findings.

2. The fluid milk industry and the available data

The fluid milk industry is characterized by increasing consolidation and concentration, which are likely driven by economies of size, technological change in manufacturing processes and plant and the high concentration of retail chains. While these structural changes can lead to lower prices due to cost reduction from more efficiency in production, it can also lead to higher market concentration and result in greater market power, potentially allowing firms to increase prices above competitive levels[3]. As presented in Table 1, in 2008 the number of plants operated by the top 10 largest dairy processor and manufacturers ranges from 9 to 81 plants.

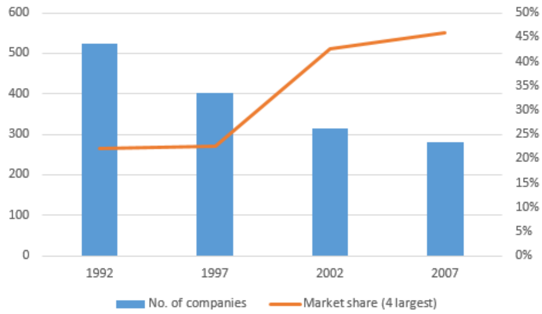
Table 1 Top Ten American Dairy Processor in 2008

Rank	Company	Sales ($ million)	Plants Number
1	Dean Foods Co.	12,454	81
2	Kraft Foods North America Inc.	4,800	16
3	Saputo Inc.	4,390	45
4	Land O' Lake Inc.	4,136	9
5	Schreiber Food Inc.	3,500	18
6	Prairie Farms Dairy	2,924	20
7	Agropur Cooperative	2,800	26
8	Kroger Co. Dairy Operation	2,500	19
9	Leprino Food Co.	2,500	9
10	Darigold Inc.	2,200	11

Souce: Dairy Foods, https://www.dairyfoods.com/ext/resources/DF/Home/Files/PDFs/archives/d/df0809Dairy-100-table.pdf

Based on the U.S. Census Bureau data, the number of companies in the fluid milk processing has declined by significant number, however, this dramatic decrease in the number of firms is companied by the striking increase in the firms' concentration. Using the largest four firms share of shipments as a measurement, the four-firm concentration ratio undergoes the increasing pattern since 1992 (Figure 1), especially with the mergers and acquisitions that Dean Foods experienced. On Dec 21, 2001, Dean Foods and Suiza Foods (the top two dairy processors) completed merger. Then the Land O' Lakes dairy cooperative sold its fluid milk plants to Dean Foods in July 2002. In 2004 Dean Foods acquires Horizon Organic Holding Corporation, and Foremost Farms USA also sold two milk plants to Dean Foods in April 2009.

Figure 1: Fluid milk processors



Source: Number of companies and the market share data are obtained from U.S. Census Bureau (1992-2007)

[3] GAO-05-50: Information on Milk Prices, Factors Affecting Prices, and Dairy Policy Options

These mergers and acquisitions lead to even higher market concentration for fluid milk processors in some markets. Referring to the case of Dean Foods and Foremost Farms, as indicated by DOJ, in some geographic area such as the northeastern Illinois, the Upper Peninsula of Michigan and Wisconsin, where it is difficult for other firms to compete with Dean Foods.

This study uses Information Resources Inc. (IRI) retail point-of-sale scanner data. Information Resources Inc. is a Chicago marketing firm which assigns the scanning devices to collect point-of-sale retail data across 50 geographically distinct markets located in metropolitan and rural areas of the United States. Dairy is one of the 30 product categories covered by IRI data, and is the product category of interest for this research. The point-of-sale data are weekly and compiled according to Universal Product Code (UPC) transactions in retail stores. Four common package sizes of milk, one gallon, half a gallon, 32 ounces and 16 ounces are included in this analysis. Considering the merger period stated in the DOJ's documents, the time period examined in this paper lies from January 2006 to December 2012. We define a product as the unique combination of non-price characteristics and retail store, where the measured non-price characteristics are: brands, type of milk, flavor, fat content, organic versus non-organic classification, and package type materials. Summary statistics of data are reported in Table 2.

Milk consumption is measured by monthly aggregate quantity of each uniquely defined product purchased in a retail store of IRI markets. For each products, an average price can be computed as the average revenue for every month (in dollars per gallon). Electricity is used in the dairy processors to drive machines and cold storage.

Electricity is a major input in the production of dairy industry and it is intensively used in the processing of fluid milk due to need for water heating, cooling and refrigeration. As such, to capture a measurable determinant of production cost, we collected state level industrial electricity price data from U.S. Energy Information Administration. All price data are deflated by the consumer price index (index base year Jan 2008 =100).

Several non-price product characteristic zero-one dummy variables were constructed to facilitate the empirical analysis. Table 2 reports summary statistics on product characteristic variables used in the empirical analysis. There are 5 categories in the type of milk, including full lactose, reduced lactose, full lactose with acidophilus, soy milk and almond milk. In the package size of 16 ounces, there is only full lactose milk. 32 ounces package size has three types of milk, approximately 75.93% of fluid milk is full lactose, 10.84% is reduced lactose and 13.23% is soy milk. There are five types of milk in the 0.5 gallon package size, where full lactose milk accounts for 46.91%, followed by soy milk (27.68%), reduced lactose milk (17.48%), almond milk (7.05%) and full lactose milk with acidophilus (0.88%). 1 gallon package size has two types of milk, full lactose milk accounts for 92.55% and soy milk (7.45%).

There are four types of flavor in the total dataset. The data in 16 ounces size only has one flavor as regular white milk. Both 32 ounces and 0.5 gallon dataset have four types of flavor, among which the flavor of regular white accounts the most, followed by vanilla, original and plain. Three types of flavor in 1 gallon dataset, 92.55% of which is the regular white milk, followed by the flavor of vanilla (1.28%) and original (6.17%).

We classify the fat content of dairy milk into two categories, whole milk and non-whole milk. In addition, we put plant-based milk products, such as soy milk and almond milk, into the fat content category of non-whole milk. There are 40.66% whole milk in 16 ounces dataset, and 32 ounces dataset has 34.32% whole milk, but only 24.74% in 0.5 gallon dataset and 44.36% in 1 gallon dataset.

There is no single variable in the IRI dataset that is constructed with the purpose of identifying milk products that are organic. As such, in order to identify organic milk products in the data we examine variables with various descriptive information on each product and classify the relevant product as organic if: (1) the brand description includes the word “organic”; or (2) the process description includes the phrases, “organic”, “organic homogenized”, “organic pasteurized”, “organic ultra-pasteurized”, or “organic pasteurized and homogenized”; or (3) there are other dairy companies produce organic products, but neither the brands nor the process include any “organic”, we browse all the brands online information, and we found that company such as Castle Rock, Stonyfiled Farm, Stremick heritage also focus on the organic dairy production, therefore, we treat the products from these three firms as organic products. Based on this organic classification methodology we then constructed a zero-one dummy variable that takes a value of one only when the relevant product is classified as “organic. Organic milk products account for 20.08% of the milk products in 1 gallon dataset.

Since materials used for making milk containers differ, we create a set of dummy variables to capture the range of container materials. In 16 ounces dataset, 6.12% is packed by carton, 93.88% is packed by plastic. 49.43% of milk in 32 ounces dataset use the carton package, 50.57% use the plastic package. Carton package accounts the most in 0.5 gallon dataset 72.16%, followed by plastic package (21.97%) and 0.059% in glass package. For 1 gallon package size, plastic package takes 92.37%, only 7.53% and 0.10% in carton and glass package respectively. We supplement the IRI scanner with consumer demographic information, such as income and age, and these data are drawn from Public Use Microdata Sample database (PUMS). As the PUMS data are yearly, in order to be consistent with the time period that is studied in our paper, data on consumers' income and age are also drawn from the PUMS for 2006 to 2012.

Table 2: Summary Statistics

Description	Size 1 (16 ounces container)					Size 2 (32 ounces container)					Size 3 (0.5 gallon container)					Size 4 (1 gallon container)				
	Mean	Standard deviation	Min	Max	Obs	Mean	Standard deviation	Min	Max	Obs	Mean	Standard deviation	Min	Max	Obs	Mean	Standard deviation	Min	Max	Obs
Real Milk Price (dollars per gallon)[1]	8.7442	1.3784	3.6775	15.6715	21,114	6.8082	1.6500	1.9321	18.4454	29,901	6.5012	1.4850	1.2917	13.2329	158,439	4.0205	1.4562	0.9786	10.3600	45,267
Mean Personal Income(dollars per year)	36,789	3,543.56	24,806.06	41,743.07	21,114	35,840.59	3,912.51	24,806.06	41,743.07	29,901	36,296.74	3,632.69	24,806.06	41,743.07	158,439	36,042.13	3823.19	24806.06	41743.07	45,267
IRI Market Population (per year)	6,040,018	3,393,889	96,527	9,108,058	21,114	5,844,167	3,529,616	96,527	9,108,058	29,901	5,595,475	3,479,540	96,527	9,108,058	158,439	5,239,710	3,513,091	96,527	9,108,058	45,267
Age	50.0524	16.5273	15	95	21,114	47.8215	17.3157	15	95	29,901	44.3298	19.5273	15	95	158,439	45.2451	18.0210	15	95	45,267
Real Electricity Price (cents per kWh)	6.1135	0.8647	4.2471	7.8745	21,114	6.1566	0.7958	4.2471	7.8745	29,901	6.1729	0.8204	4.2471	7.8745	158,439	6.1889	0.8065	4.2471	7.8745	45,267
Milk Type Dummy Variables:																				
Full Lactose Milk	1	0	1	1	21,114	0.7593	0.4275	0	1	29,901	0.4691	0.4990	0	1	158,439	0.9255	0.2626	0	1	45,267
Reduced Lactose Milk[2]	-	-	-	-	-	0.1084	0.3108	0	1	29,901	0.1748	0.3798	0	1	158,439	-	-	-	-	-
Full Lactose Milk with Acidophilus	-	-	-	-	-	-	-	-	-	-	0.0088	0.0937	0	1	158,439	-	-	-	-	-
Soy Milk	-	-	-	-	-	0.1323	0.3388	0	1	29,901	0.2768	0.4474	0	1	158,439	0.0745	0.2626	0	1	45,267
Almond Milk	-	-	-	-	-	-	-	-	-	-	0.0705	0.2559	0	1	158,439	-	-	-	-	-
Flavor Type Dummy Variables:																				
Regular White	0.9339	0.2484	0	1	21,114	0.8634	0.3434	0	1	29,901	0.6271	0.4836	0	1	158,439	0.9255	0.2626	0	1	45,267
Vanilla	0.0661	0.2484	0	1	21,114	0.0734	0.2608	0	1	29,901	0.1623	0.3687	0	1	158,439	0.0128	0.1125	0	1	45,267
Original	-	-	-	-	-	0.0628	0.2426	0	1	29,901	0.1214	0.3266	0	1	158,439	0.0617	0.2406	0	1	45,267
Plain	-	-	-	-	-	0.0004	0.0200	0	1	29,901	0.0892	0.2849	0	1	158,439	-	-	-	-	-
Fat Content Dummy (=1 if whole milk)	0.4066	0.4912	0	1	21,114	0.3432	0.4748	0	1	29,901	0.2474	0.4315	0	1	158,439	0.4436	0.4968	0	1	45,267
Oragnic milk Dummy (=1 if organic)	-	-	-	-	-	-	-	-	-	-	0.2277	0.4193	0	1	158,439	0.2008	0.4006	0	1	45,267
Package Type Dummy Variables:																				
Package of Carton	0.0612	0.2397	0	1	21,114	0.4943	0.5000	0	1	29,901	0.7216	0.4482	0	1	158,439	0.0753	0.2639	0	1	45,267
Package of Plastic	0.9388	0.2397	0	1	21,114	0.5057	0.5000	0	1	29,901	0.2197	0.4140	0	1	158,439	0.9237	0.2655	0	1	45,267
Package of Glass	-	-	-	-	-	-	-	-	-	-	0.0587	0.2352	0	1	158,439	0.0010	0.0322	0	1	45,267

1. Take 2008 as the base year, adjust the price by CPI
2. Reduced lactose milk includes the lactose-free milk

3. The empirical models

3.1 Demand of differentiated products

With the data presented in Section 2, we use a random coefficient logit model to estimate demand (Berry, Levinsohn and Pakes 1995, Nevo 2000 and 2001). In the random coefficient logit model, the own price elasticity will not necessarily be driven by a functional form and it allows for flexible substitution patterns. These advantages make it appropriate to obtain consistent estimates of the demand parameters to compute price-cost margins for merger analysis.

Suppose we observed aggregate quantities, non-price characteristics and prices for *J* differentiated products sold in *T* markets (market is defined as the combination of time and geographic location), the conditional indirect utility of consumer *i* from product *j* in market t is given by:

$$U_{ijt} = X_{jt}\beta_i + \alpha_i p_{jt} + \rho_{year} + \tau_{month} + \gamma_{market} + \xi_{jt} + \varepsilon_{ijt} \quad (1)$$

where X_{jt} is a vector that includes observed non-price product characteristics; and β_i is the vector of consumer-specific taste parameters associated with observed product characteristics; ρ_{year}, τ_{month} and γ_{market} represent fixed effect controls for year, month, and geographic location of IRI market respectively. p_{jt} is the price of product *j* in market *t*, and α_i represents the individual-specific marginal utility of price. ξ_{jt} represents product characteristics that are unobserved by econometricians but observed by consumers; ε_{ijt} represents the random component of utility that is assumed independent and identically distributed across consumers, products and markets.

The random coefficients α_i and β_i are allowed to vary across consumers according to:

$$\begin{pmatrix} \beta_i \\ \alpha_i \end{pmatrix} = \begin{pmatrix} \beta \\ \alpha \end{pmatrix} + \Gamma D_i + \Sigma v_i \qquad (2)$$

where D_i is an m-dimensional column vector of demographic variables (assuming there are m distinct demographic variables), and each demographic variable enters the vector in the form of deviation of individual *i*'s demographic variable from the mean of the market sample of individuals; Γ is a L-by-m dimension matrix of parameters (L is the number of random taste parameters in $\begin{pmatrix} \beta_i \\ \alpha_i \end{pmatrix}$), where the parameters measure how taste characteristics vary with demographics; v_i is a L-dimensional column vector of unobserved shocks to consumer taste for respective product characteristics; and Σ is a L-by-L diagonal matrix, where elements on the main diagonal are parameters that measure variation in taste due to the random shocks in v_i.

In the demand estimation, demographic variables in D_i are income and age, and those demographic variables in D_i are expressed in deviations from their respective means. Therefore, the mean of each variable in D_i is zero. Following Nevo (2000), we assume that v_i has a standard multivariate normal distribution, $v_i \sim N(0, I)$, then the mean of $\binom{\beta_i}{\alpha_i}$is $\binom{\beta}{\alpha}$ and the variance is equal to the square of the elements on the main diagonal of Σ.

The mean utility across consumers of purchasing each *J* products, δ_{jt}, is given by

$$\delta_{jt} = X_{jt}\beta + \alpha p_{jt} + \rho_{year} + \tau_{month} + \gamma_{market} + \xi_{jt} \qquad (3)$$

And the consumer-specific deviations from the mean utility $\mu_{ijt} = \left(x_{jt} \;\; p_{jt}\right) \times (\Gamma D_i + \Sigma v_i)$, therefore, as in Nevo (2000), the indirect utility can be redefined in terms of mean utility and the deviation from the mean utility, that is,

$$U_{ijt} = \delta_{jt} + \mu_{ijt} + \varepsilon_{ijt} \qquad (4)$$

where the mean of $(\mu_{ijt} + \varepsilon_{ijt})$ equals zero, capturing effects of the random coefficients.

The specification of the demand model is completed with the inclusion of an outside good denoted by good zero. The outside good allows for the possibility that consumer *i* may not purchase any of the products in a given market, and the mean utility of the outside good is normalized to be zero and constant over time. The indirect utility from this outside option is $U_{i0t} = \varepsilon_{i0t} = 0$.

Assuming that ε_{ijt} is independent and identically distributed with an extreme value type I density, the predicted market share of product *j* in market *t* is given by

$$s_{jt} = \int_{A_{jt}} \left(\frac{\exp(\delta_{jt} + \mu_{ijt})}{1 + \sum_{l=1}^{J} \exp(\delta_{lt} + \mu_{ilt})} \right) d\hat{F}(D) d\phi(v_i) dv_i \qquad (5)$$

where A_{jt} represents the set of consumers who choose product *j* in market *t*, $\hat{F}(D)$ is the empirical distribution of demographic variables (income, age, etc.) in the market. $\Phi(\cdot)$ is the standard normal distribution function. Since there is no closed-form solution for the integral in equation (5), this integral must be approximated numerically using random draws from $\hat{F}(D)$ and $\Phi(\cdot)$. And We use 300 random draws from $\hat{F}(\cdot)$ and $\Phi(\cdot)$ for the numerical approximation of $s_{jt}(\cdot)$. As it is mentioned in Section 2, consumer demographic information, such as income and age, are randomly drawn from Public Use Microdata Sample database (PUMS).

Based on the discrete choice model above, the demand for product j in market t is simply given by:

$$d_{jt} = s_{jt}\left(x_{jt}, p_{jt}, \xi_{jt}; \Theta\right) \times M_t \tag{14}$$

where Θ is the vector of demand parameters to be estimated, and M_t is a measure of the potential market size of market t. Specifically, $\Theta = (\theta_1, \theta_2)$, where $\theta_1 = (\beta, \alpha, \rho, \tau, \gamma)$ and $\theta_2 = (\Gamma, \Sigma)$.

We construct the potential market size measure, M_t, in each market using the following procedure. First, we obtained data on annual per capita dairy fluid milk consumption from United States Department of Agriculture Economic Research Service (USDA ERS).[4] Since USDA ERS per capita dairy fluid milk consumption data are measured in liquid pounds, we converted the unit of measurement of these data to gallons, and divide by 12 to obtain average monthly per capita consumption of dairy fluid milk in gallons. Second, even though we were not able to obtain per capita consumption of soy milk directly, we sourced data on annual total sales of soy milk in gallons,[5] and divide these unit sales data by population size to obtain average annual per capita soy milk consumption. We then convert these average annual per capita soy milk consumption data to average monthly per capita soy milk consumption. This method is also used to compute monthly per capita consumption of almond milk. But since the sales data of almond milk is only available from year 2008, we only compute the monthly per capita consumption of almond milk from 2008 to 2012. Third, monthly per capita milk (dairy soy and almond) consumption is obtained by summing monthly per capita consumption of dairy fluid milk and soy milk. Last, potential market size measure, M_t, in each market is computed by using the population size of the relevant geographic market multiplied by monthly per capita milk consumption.

[4] https://www.ers.usda.gov/data-products/dairy-data/

[5] https://www.statista.com/statistics/552967/us-soy-milk-sales/

Using the random coefficient logit model to estimate the demand not only allows for consumer heterogeneity, but also provides a more flexible pattern of substitution between products. The own- and cross-elasticity of the market demand d_{jt} are given by

$$\eta_{jkt} = \frac{\partial sd_{jt}}{\partial p_{kt}} * \frac{p_{kt}}{d_{jt}} = \begin{cases} -\frac{p_{jt}}{d_{jt}} \int \alpha_i \, s_{ijt}(1 - s_{ijt}) d\hat{F}(D)\phi(v_i)dv_i & if \; j = k \\ \frac{p_{kt}}{d_{jt}} \int \alpha_i \, s_{ijt} s_{ikt} d\hat{F}(D)\phi(v_i)dv_i & otherwise \end{cases} \quad (6)$$

where $s_{ijt} = \frac{\exp(\delta_{jt}+\mu_{ijt})}{1+\sum_{l=1}^{J}\exp(\delta_{lt}+\mu_{ilt})}$ is the probability of consumer *i* purchasing product *j*. Each consumer has different price sensitivity, which will be averaged to a mean price sensitivity using s_{ijt} as weights. And the cross-price elasticities will be driven by product characteristics and consumers' heterogeneity.

3.2 Estimation and instruments

Parameters of the demand model are estimated using Methods of Simulated Moments (MSM) algorithm outlined in Nevo (2000). We construct the MSM estimator by using instrumental variables that are orthogonal to product characteristics captured in ξ_{jt} that are unobserved to us but observed by firms and consumers. Instrumental variables for the product price of milk are needed because it is likely that ξ_{jt} is correlated with milk price.

Θ is the vector of demand parameters to be estimated and it is obtained by Method of Simulated Moments following Nevo (2000) estimation algorithm. The Nelder-Mead (1965) non-derivative (Simplex) search method is explored to perform a non-linear search, as simplex search is more robust and might avoid the sensitivity of initial value in a quasi-Newton method.

In the mean utility function (Eq.3), ξ_{jt} represents the product characteristics such as brand loyalty, promotional activities, the shelf display, etc. which are observed by the firms and consumers but unobserved by the econometrician. Therefore, the price of product j in market t (p_{jt}) is correlated with ξ_{jt}. To obtain the consistent estimates of α_i, instrumental variables are required because when setting the prices, the manufactures would consider not only the observed product characteristics such as the fat content, the flavor, but also the unobserved characteristics. And the manufactures would also take any changes in the product characteristics and valuations into account, thus, the product fixed effect, the year and month dummies and the geographic location dummies are included.

The variables used to instrument milk price are state-level electricity price for the industrial sector interacted with milk brand dummies. It is reasonable to assume that an input price such as electricity price is uncorrelated with ξ_{jt}, but highly correlated with price. For example, the brand loyalty is most likely to be uncorrelated with the state-level electricity price, but the price of electricity would definitely influence the fluid milk price. In fact, in year 2006 the electricity consumption in dairy industry accounted for nearly 13% of the entire food industry electricity usage (U.S. DOE 2006b). Furthermore, manufacturers become increasingly automated which means more electrical equipment and higher electricity usage. Therefore, the monthly state-level electricity price for the industrial sector are collected from U.S. Energy Information Administration. We choose the monthly state-level industrial electricity price instead of national average level because the industrial electricity price in different states contains relatively significant variation, which indicates a potentially good identification for the cost function.

The underlying intuition to interact the electricity price with brand dummies is to allow this input price to enter the production function of each brand differently. In fact, the brand "lactaid" focus on the reduced lactose dairy milk, which is likely to consume more electricity than processing regular full lactose dairy milk. It is also known that the shelf life of organic milk is longer than conventional milk, because organic milk usually undergoes ultrahigh temperature (UHT) processing or treatment, and conventional milk is generally used a standard preservation process. Therefore, the electricity consumption would be different between the organic milk brands such as "Horizon organic" and conventional milk brands such as "Deans". UHT requires higher electricity consumption, as such, electricity usage required by the production process is different across organic milk brands and conventional milk brands. Yet another example in which electricity usage required by the production process likely differ across various milk brand products is based on the fat content present in the final milk product.

3.3 Testing among alternative supply models

The major purpose of this paper is to test DOJ's anticompetitive concern of the merger case in Dean Foods and Foremost Farms, and also evaluate DOJ's final divestiture order. The general strategy is to compare price-setting behavior in the alternative supply models, and use the non-nested test to investigate which supply models that better fits the available data. With the vertical relationship between manufacturers and retailers, we consider the linear pricing supply model with double marginalization and a special case of passive retailers. Referring to the factual and counterfactual ownership structures in the merger period and divestiture period, there are four models to compare against each other.

3.3.1 Linear pricing supply model (double marginalization)

We assume there is Stackelberg model that the manufacturers set the wholesale price p_j^w first in Bertrand Nash fashion, and then the retailers follow to set the retail price p_j also under the Bertrand Nash pricing game. This vertical relationship is solved by the backward induction. For both manufacturers and retailers, we assume that the multi-product firm Nash-Bertrand equilibria in the pre- and post-merger period, as well as in the divestiture period. First, Suppose there are R retailers, let $r = 1,2,\dots,R$ index retailers and S_r be the subset of the products that are sold by retailer r. We assume that each retailer r would choose the price p_j to maximize the profit by the following profit function.

$$\max_{p_j} \Pi_r = \max_{p_j} \sum_{j \in S_r} \left(p_j - p_j^w - mc_j^r\right) M * s_j(p, \xi, \Theta) - C_r \qquad (7)$$

where $s_j(p, \xi, \Theta)$ is the market share of product *j*, which is a function of the prices of all products, *M* is the size of the market, and C_r is the fixed cost of retailing. Market subscripts are suppressed in Eq.7 and the subsequent equations for the notional convenience. The pure Bertrand Nash price p_j of any product *j* sold by retailer *r* must satisfy the first-order conditions

$$s_j(p, \xi, \Theta) + \sum_{k \in S_r} (p_k - p_k^w - mc_k^r) \frac{\partial s_k(p, \xi, \Theta)}{\partial p_j} = 0 \quad for\ j \in S_r \qquad (8)$$

If we assume the retail ownership matrix as T_r which is defined as follows:

$$\mathrm{T}_{i,j} = \begin{cases} 1, & if\ \exists\ f: \{i, j\} \subset S_r \\ 0, & otherwise \end{cases}$$

let Δ_r be a matrix of first-order derivatives of product market shares with respect to retail prices, where $\Delta_{ij} = \frac{\partial s_i(p,\xi,\Theta)}{\partial p_j}$, and Δ_r can be expressed as:

$$\Delta_r = \begin{pmatrix} \frac{\partial s_1}{\partial p_1} & \cdots & \frac{\partial s_J}{\partial p_1} \\ \vdots & \ddots & \vdots \\ \frac{\partial s_1}{\partial p_J} & \cdots & \frac{\partial s_J}{\partial p_J} \end{pmatrix}$$

Then Eq.8 can be rewritten in matrix notation as:

$$[p - p^w - mc^r] = -[T_r * \Delta_r]^{-1} s(p) \qquad (9)$$

Suppose there are F manufacturers, let $f = 1,2, \dots, F$ index manufacturers and $\mathcal{F}_f$ be the subset of the J products that are produced by manufacturer *f*. We assume that each manufacturer *f* would choose the wholesale price p_j^w to maximize the profit by the following profit function.

$$\max_{p_j^w} \Pi_f = \max_{p_j^w} \sum_{j \in \mathcal{F}_f} (p_j^w - mc_j^w) M * s_j\big(p(p_j^w), \xi, \Theta\big) - C_f \qquad (10)$$

where $s_j\big(p(p_j^w), \xi, \Theta\big)$ is the market share of product *j*, which is a function of the prices of all products, M is the size of the market, and C_f is the fixed cost of production. The first order conditions The Bertrand Nash equilibrium wholesale price p_j^w of any product *j* produced by firm *f* must satisfy the first-order conditions:

$$s_j\big(p(p_j^w), \xi, \Theta\big) + \sum_{m \in \mathcal{F}_f} (p_m^w - mc_m^w) \frac{\partial s_m\big(p(p_j^w), \xi, \Theta\big)}{\partial p_j^w} = 0 \qquad (11)$$

The first order conditions are *J* equations implying marginal cost for each product.

First, Let Ω_f be a $J \times J$ matrix that describes firms' ownership structure of the *J* products, and let Ω_{jr} be an element in Ω, where

$$\Omega_{ij} = \begin{cases} 1, & if\ \exists\ f\colon \{i,j\} \subset \mathcal{F}_f \\ 0, & otherwise \end{cases}$$

Second, let Δ_f be a $J \times J$ matrix of first-order derivatives of product market shares with respect to prices, where $\Delta_{ij} = \frac{\partial s_i(p,\xi,\Theta)}{\partial p_j^w}$. Δ_f can be expressed as:

$$\Delta_f = \begin{pmatrix} \frac{\partial s_1}{\partial P_1^w} & \cdots & \frac{\partial s_J}{\partial P_1^w} \\ \vdots & \ddots & \vdots \\ \frac{\partial s_1}{\partial P_J^w} & \cdots & \frac{\partial s_J}{\partial P_J^w} \end{pmatrix}$$

Therefore, in the vector notation, the first order conditions become

$$s(p) + [\Omega_f * \Delta_f](p^w - mc^w) = 0 \qquad (12)$$

And Eq.12 implies a markup equation as

$$[p^w - mc^w] = -\left[\Omega_f * \Delta_f\right]^{-1} s(p) \qquad (13)$$

Given the manufacturers and retailers markups from Eq.9 and Eq.13, the marginal cost under the double marginalization supply model can be recovered as follows:

$$\underbrace{mc^r + mc^w}_{\widehat{mc}} = \left[p - p^w — [T_r * \Delta_r]^{-1} s(p)\right) + \left[p^w - \left(-\left[\Omega_f * \Delta_f\right]^{-1} s(p)\right)\right]$$

$$= p — [T_r * \Delta_r]^{-1} s(p) - \left(-\left[\Omega_f * \Delta_f\right]^{-1} s(p)\right) \qquad (14)$$

where $\widehat{mc}$ is the vector of the sum of marginal cost from both retailers and manufacturers.

Then from Eq.14 we can estimate the overall price-cost margins without obtaining the wholesale prices from manufacturers. And the supply model under the double marginalization scenario can be expressed as

$$p = \widehat{mc} - [T_r * \Delta_r]^{-1} s(p) - \left[\Omega_f * \Delta_f\right]^{-1} s(p) \qquad (15)$$

3.3.2 Passive retailers model

If the retailers have zero markup, using the same notation as above, the Eq.9 under the passive retailers model can be rewritten as:

$$[p - p^w - mc^r] = 0 \qquad (16)$$

which implies that $p - p^w = mc^r$.

And the markup of manufacturers from Eq.13 can be expressed as follows:

$$[p^w - mc^w] = -\left[\Omega_f * \Delta_f\right]^{-1} s(p) \qquad (17)$$

Then sum up Eq.16 and Eq.17, we can derive the overall price-cost margins as

$$p - (\underbrace{mc^r + mc^w}_{\widehat{mc}}) = -\left[\Omega_f * \Delta_f\right]^{-1} s(p) \qquad (18)$$

where $\widehat{mc}$ is the vector of the sum of marginal cost from both retailers and manufacturers.

Therefore the supply model under the passive retailers scenario can be expressed as

$$p = \widehat{mc} - \left[\Omega_f * \Delta_f\right]^{-1} s(p) \qquad (19)$$

3.3.3 Non-nested Tests among alternative supply models

We create $\Omega_{f\_factural}$ and $\Omega_{f\_counterfactual}$ to represent the matrices describing the factual and counterfactual ownership structure of brands. In the merger period, $\Omega_{f\_factural}$ is useful to capture the cooperative pricing behavior, while $\Omega_{f\_counterfactual}$ helps to identify the non-cooperative pricing setting. During the divestiture period, we use $\Omega_{f\_factural}$ to check if the pricing behavior is consistent with divestiture order, and $\Omega_{f\_counterfactual}$, on the other hand, is used to do the counter factual analysis pricing strategy of divestiture policy. Therefore under the vertical relationship with double marginalization and passive retailer supply models, there are four competing models described as follows:

Model 1: Double marginalization with factual ownership structure of manufacturers:

$$p = \widehat{mc}_1 - [T_r * \Delta_r]^{-1} s(p) - \left[\Omega_{f\_factual} * \Delta_{f\_factual}\right]^{-1} s(p)$$
$$= \widehat{mc}_1 + markup_r + markup_{f\_factual}$$

Model 2: Double marginalization with counterfactual ownership structure of manufacturers:

$$p = \widehat{mc}_2 - [T_r * \Delta_r]^{-1} s(p) - \left[\Omega_{f\_counterfactual} * \Delta_{f\_counterfactual}\right]^{-1} s(p)$$
$$= \quad \widehat{mc}_2 + markup_r + markup_{f\_counterfactual}$$

Model 3: Passive retailers with factual ownership structure of manufacturers:

$$p = \widehat{mc}_3 - \left[\Omega_{f\_factual} * \Delta_{f\_factual}\right]^{-1} s(p) = \widehat{mc}_3 + markup_{f\_factual}$$

Model 4: Passive retailers with counterfactual ownership structure of manufacturers:

$$p = \widehat{mc}_4 - \left[\Omega_{f\_counterfactual} * \Delta_{f\_counterfactual}\right]^{-1} s(p)$$
$$= \widehat{mc}_4 + markup_{f\_counterfactual}$$

The non-nested tests (Vuong, 1989) then is applied to decide which ownership structure and which vertical relationship is preferred.

It is well known that fluid milk is highly perishable and milk packaging is important to effectively guarantee the quality of milk and maintain the nutrition during storage and transportation. The type of packaging material is one of the critical factors to influence the production cost. In our available dataset, there are three types of materials, including glass, plastic and paperboard carton. Compared to the plastic and carton package, although glass is an excellent packaging material, it is costly to manufacture (Karaman, 2015), therefore, we package material dummies are the important cost shifters.

As butterfat is the most expensive component in milk, fluid milk features differential costs (Xia and Sexton, 2009). Therefore, we also include the fat content dummy in the marginal cost specification.

The plant-based milk is viewed as one of the common substitutes to dairy milk. Two mostly widely consumed plant-based milk substitute are soy milk and almond milk (Yadav et.al, 2017), and the plant-based milk is often generate at reasonable cost compared to dairy milk. In our dataset, we create a set of milk type dummies to distinguish dairy milk, soy milk and almond milk, and we also view these dummies as important marginal cost shifters

Organic milk virtually prohibits the use of antibiotics and hormones in the cow herd and the use of synthetic chemicals in the production of cattle feed. And the farms with organic milk production are also required to accommodate the animals' natural nutritional and behavioral requirements. The tougher standard and additional requirements in organic milk production would increase production costs compared with the conventional milk. On average, organic dairies have estimated costs about \$5 to \$8 per cwt higher than conventional dairies (McBride and Greene, 2009). As such, we also include the organic milk dummy in the marginal cost specification.

Electricity is viewed as the most important direct input in the dairy industry, and we use the interaction of the electricity price with brand dummies as the instruments in the demand model, therefore, we also include these instruments in the marginal cost specification.

Based on the above information, we assume the following specification for marginal costs, which yields

$$mc = \lambda + \psi W + \kappa$$

where λ includes time fixed effects, geographic market fixed effects and product fixed effects, W is the vector of cost shifters including the package material dummies, the fat content dummies, the milk type dummies, the organic dummy and the electricity price interacts with brand dummies, ψ is a vector of estimated parameters of cost shifters, and κ is the unobservable (to the econometrician) random shock to the cost. Under the assumption that $E(\kappa|\lambda, W) = 0$, λ, ψ can be estimated consistently.

There are four models to compare, and for any two models h and h', we would like to apply the non-nested test between

$$p = markup^{h} + \lambda^{h} + \psi^{h}W + \kappa^{h}$$

and

$$p = markup^{h'} + \lambda^{h'} + \psi^{h'}W + \kappa^{h'}$$

where $markup$ is a vector of the sum of retailer and manufacturer markups. In the passive retailer supply model, as the retailers' markup is zero, then the $markup$ is the manufacturer markup.

Assume that κ_j^{h} and $\kappa_j^{h'}$ are normally distributed, LL_j^{h}, $LL_j^{h'}$ and LR are constructed as follows

$$LL_j^{h} = \log[\phi(p - markup^{h} - \lambda^{h} - \psi^{h}W)] \qquad (20)$$

$$LL_j^{h'} = \log\left[\phi\left(p - markup^{h'} - \lambda^{h'} - \psi^{h'}W\right)\right] \qquad (21)$$

$$LR = \sum_{j=1}^{J}(LL_j^{h} - LL_j^{h'}) \qquad (22)$$

Voung (1989) shows that the likelihood ration statistics LR can be normalized by its own variance, and the variance is given by

$$v^2 = \frac{1}{J}\sum_{j=1}^{J}(LL_j^{h} - LL_j^{h'})^2 - \left[\frac{1}{J}\sum_{j=1}^{J}\left(LL_j^{h} - LL_j^{h'}\right)\right]^2 \qquad (23)$$

Therefore, the non-nested test statistic is $Q = J^{0.5}\frac{LR}{v}$, which is asymptotically standard normal distributed under the null hypothesis that model h and model h' being compared by the test are asymptotically equivalent. Based on the one-tale test at 5% level of significant, the selection procedure involves comparing Q with the critical values. $Q > 1.64$ implies that model h is statistically preferred and rejects model h'. $Q < -1.64$ suggests that model h is statistically rejected in favor of model h'. $-1.64 < Q < 1.64$ indicates that model h and model h' cannot be statistically distinguished.

4. Econometric Estimation and Inferences

4.1 Demand Estimation

Random coefficients logit model of demand is employed to estimate the differentiated products. This model imposes very few restrictions on own- and cross-price elasticity compared to the standard logit model. Using random coefficients logit model can obtain consistent estimates of the demand parameters required for recovering the price-cost margins. In four different package sizes of milk, we also perform standard logit models, and considering the use of instruments for the prices, the Ordinary Least Square (OLS) and Two Stage Least Square (2SLS) are reported in the Appendix. Consistent with economic theory, within four different package sizes of milk, the OLS and 2SLS coefficient estimates on price are negative and statistically significant.

4.1.1 Results from Random Coefficients Logit Demand Model

The results of random coefficients logit model of demand for four package sizes are presented in Table 3. Panel A of Table 3 reports the estimated coefficients in the mean utility function, which are associated with the linear parameters in Eq.3, while Panel B presents the results that measure consumers' taste heterogeneity and these estimated coefficients are associated with the non-linear parameters in Eq.2. We also include a Wu-Hausman test in Panel B to examine the endogeneity of the price. This test provided strong evidences for the endogenous nature of price across the different packages sizes of milk. As such, instruments are needed for the price.

We analyze the demand in four different package sizes of milk separately, because various sized packages of milk are offered at distinct unit prices. The traditional economic theory suggests that manufacturers can engage in price discrimination by using preferences over package sizes to segment the types of consumers. Moreover, consumers might have diverse preferences for the same product attributes in different package sizes of milk.

Within four different package sizes of milk, the price coefficients are negative and statistically significant, suggesting that, on average, consumers' level of utility is inversely related to the price of the product. As such, consistent with expectation, if non-price product characteristics across competing products are equal, then our estimated price effect implies that consumers will choose the milk product that has the lower price.

The estimated coefficients on fat-content dummy are positive and statistically significant in the package size of 16 ounces and 0.5 gallon, however, they are negative and statistically significant in both 32 ounces and 1 gallon package size. After controlling for price, the results indicate that consuming whole milk in 16 ounces and 0.5 gallon sizes would increase the average consumer's utility, but in 32 ounces and 1 gallon package size consumers prefer non-whole milk.

The coefficient estimates on the vanilla flavor dummy variable are negative and statistically significant in both 16 ounces and 0.5 gallon package sizes, suggesting that compared with vanilla flavor, consumers prefer regular white milk. The vanilla flavoring added to milk can either be artificial or real, and vanilla extract often contains alcohol, therefore, consumers may prefer to avoid milk products with added vanilla flavoring for health reasons. However, in the package sizes of 32 ounces and 1 gallon, the coefficient estimates on the vanilla flavor dummy variable are positive and statistically significant, indicating that in both two sizes of milk, the vanilla flavor of milk would generate higher marginal utility for the average consumer. There is more flavored milk in the 0.5 gallon package size than any of the other three sizes, the coefficient estimates on the "original" and "plain" flavor dummies are negative and statistically significant. These results suggest that in the 0.5 gallon package size, the regular white milk generates higher marginal utility for the average consumer than other flavors. Within the rest of the three flavors, vanilla is still preferred to original and plain, and original is the least preferred. It might be reasonable as the original is sweeter and carries more calories compared to the flavor of vanilla and plain.

There are three types of milk in the package size of 32 ounces, which are the regular full lactose milk, the reduced lactose milk and soy milk. The coefficient estimate of regular full lactose dummy is positive and statistically significant, revealing that the regular full lactose milk has a positive marginal utility for the average consumer. In the package size of 0.5 gallon, there are five types of milk, including three types of dairy milk and two types of plant-based milk. The four coefficient estimates of milk type dummies are negative and statistically significant, suggesting that the regular full lactose milk brings the higher marginal utility for the average consumer. Soy milk is the second preferred, and almond milk is less preferred to soy milk and reduced lactose milk, while it has higher marginal utility compared to the acidophilus milk. In these five types of milk, acidophilus milk is the least preferred, although acidophilus can help to relieve the lactose intolerance and aid in digestion, the milk has been enriched with acidophilus usually tastes a little tangy and sweeter and contains more calories.

The coefficient estimate on "organic" dummy in the package size of 0.5 gallon is negative and statistically significant, suggesting that although organic milk is free of hormones and antibiotics, consuming organic milk cannot generate higher marginal utility for an average consumer. However, different from the result in 0.5 gallon package size, purchasing organic milk in the package size of 1 gallon generates higher marginal utility. It might be reasonable to assume that 1 gallon is preferred for the household with more family members, particularly with more kids. Children tend to be vulnerable to chemicals, drinking organic milk reduces the risk of exposure to toxic pesticides and hormones and contributes their healthy development.

From Panel B of Table 3, the standard deviations of price are statistically significant in three package sizes except for 0.5 gallon, indicating that price is important to explain the consumer's heterogeneity in other the package sizes. In the package sizes of 16 ounces and 0.5 gallon, the positive and statistically significant coefficient estimates of the interaction of income and price suggest that the consumers with higher income prefer to purchase high priced products. In the package size of 32 ounces and 1 gallon, income cannot significantly affect the mean price sensitivity. For all four package sizes of milk, consumer's age does not affect the sensitivity the preference on fat content.

Table 3: Demand Estimation for Four Package Sizes of Milk

Panel A: **Variables in the mean utility function: Associated parameters**, α and β.	Random Coefficients Logit Model							
	Size 1 (16 ounces container)		Size 2 (32 ounces container)		Size 3 (0.5 gallon container)		Size 4 (1 gallon container)	
	Coefficient Estimates	Std. Error	Coefficient Estimates	Std. Error	Coefficient Estimates	Std. Error	Coefficient Estimates	Std. Error
Real Milk Price	-199.10**	9.56	-138.18**	22.97	-87.94**	16.94	-345.85**	83.54
Fat Content [a]	1.76**	0.15	-1.18**	0.06	0.35**	0.03	-0.38**	0.10
Flavor: Vanilla [a]	-1.99**	0.04	0.08**	0.02	-1.19**	0.01	0.16**	0.04
Flavor: Original [a]	-	-	-	-	-1.38**	0.01	-	-
Flavor: Plain [a]	-	-	-	-	-1.29**	0.01	-	-
Milk type: Full lactose [a]	-	-	2.16**	0.06	-	-	-	-
Milk type [1]: Reduced lactose [a]	-	-	-	-	-0.87**	0.01	-	-
Milk type[2]: Milk with acidophilus [a]	-	-	-	-	-3.40**	0.02	-	-
Milk type: Soy milk [a]	-	-	-	-	-1.49**	0.01	-	-
Milk type: Almond milk [a]	-	-	-	-	-2.12**	0.02	-	-
Organic [a]	-	-	-	-	-0.03**	0.01	0.35**	0.04
Constant [a]	-0.32	0.48	1.35**	0.70	2.91**	0.28	-10.78**	0.09
Time fixed effects	YES		YES		YES		YES	
Product fixed effects	YES		YES		YES		YES	
Market fixed effects	YES		YES		YES		YES	
Panel B: **Variables that measure taste heterogeneity across Consumers: Associated parameters, θ_2.**								
$Constant$	-0.41	0.64	0.29	0.83	0.35	0.87	0.42	0.74
$Real\ Milk\ Price$	-20.97**	4.86	29.29**	4.94	4.31	18.48	71.44**	28.86
$Income \times Real\ Milk\ Price$	10.11**	2.16	1.65	13.22	9.00**	0.97	-5.83	143.83
$Age \times Fat\ Content$	3.48	21.85	-5.71	5.10	3.02	25.04	-14.77	21.70
GMM Objective Function Value	0.0088		0.0130		0.0152		0.0310	
Observations	21,114		29,901		158,439		45,267	
Test of Endogeneity: H_0: Real Milk Price is Exogenous								
Dubin (score) Chi-sq (1)	9605.71 (P-Value = 0.00)		1242.33 (P-Value = 0.00)		867.63 (P-Value = 0.00)		1324.44 (P-Value = 0.00)	
Wu-Hausman F(1, 20480)	17094.2 (P-Value = 0.00)		1248.59 (P-Value = 0.00)		841.21 (P-Value = 0.00)		1322.17 (P-Value = 0.00)	

Notes: *indicates statistical significance at the 10% level, **indicates statistical significance at the 5% level

[1] Reduced lactose also includes lactose free milk.

[2] The milk is full lactose with acidophilus

[a] Coefficient estimates from the Generalized Least Square regression of estimated product fixed effects on non-price product characteristics.

4.1.2 Elasticities

Given the structural demand estimates, price elasticities of demand for each differentiated product can be calculated. Since a particular market is defined as the combination of time and geographic location, there are 420 unique markets in the dataset of each package size. The products are likely to have stable own- and cross-price elasticities in a given market, so as to estimate the own- and cross-price elasticities of products owned by Dean Foods and Foremost Farms, we select the markets located in Green Bay and Milwaukee in March 2007, as these two markets examined are in the pre-merger period which helps to measure the substitutability of products owned by Dean Foods and Foremost Farms.

In general, the average company own- and cross-price elasticities are obtained by the mean product own- and cross-price elasticities that belongs to a particular company. The literature frequently shows lower own price elasticities, however, they are always generated by a more aggregate level. For example, Gould (1995) reported own-price elasticities about -0.60 for reduced fat milk in American. In a study by Schmit et al. (2002), the total milk own-price elasticity was -0.243. Davis et al. (2009) pointed out the definitions of non-price categories play important roles in empirical estimation of the demand elasticities. As such, when more non-price attributes included in the product definition, the estimated results are in line with ours. Lopez and Lopez (2009) reported own-price elasticities ranging from -1.9 to -2.4 for different brands. Kinoshita et al. (2001) found elasticities ranging from -0.2 to 6.1 depending on the brand and location of purchase. Bonnet et al. (2015) found the own-price elasticities of demand for fluid milk vary between -1.79 and -6.56 based on the analysis of 25 brands and 7 retail stores.

For both two unique markets, Table 4 presents the average elasticities of three companies[6] in each package size. The mean of own-price elasticity in four package sizes are different, the price of 16 ounces milk is the most sensitive, followed by 1 gallon, the 32 ounces and 0.5 gallon. In Table 4, we only report the own- and cross-price elasticities on the regular full lactose dairy milk, however, the soy milk (brand: 8th Continent and Silk Light), the organic milk (brand: Organic Valley, Horizon Organic and Wisconsin Organics), and the reduced lactose dairy (brand: Deans Easy, Hood Lactaid, Land O' Lakes Dairy Ease) all have larger own-price elasticities than regular full lactose dairy milk[7]. All the cross-price elasticities are positive and statistically significant, but much small in the magnitude, however this is not surprising as the products differ not only by non-price characteristics but also by retail stores.

For the package size of 16 ounces, the own-price elasticity of Dean Foods is the least sensitive compared with Foremost Farms and Kemps in the Green Bay market, however, in Milwaukee market, the dairy milk offered by Kemps enjoys the lowest own-price elasticities. Referring to the cross-price elasticities, the dairy milk offered by Dean Foods are more substitutable by Foremost Farms rather than Kemps in both markets. In the package size of 32 ounces, Dean Foods has the highest own-price elasticity in both selected markets, followed by Foremost Farms and Kemps. As in the package size of 16 ounces, the dairy milk offered by Dean Foods are still more substitutable by Foremost Farms.

[6] We also calculate the own- and cross-elasticities of Kemps, as mentioned in the DOJ's complaint, Kemps is a major competitor for Dean Foods and Foremost Farms in the five markets.
[7] The own-price elasticities of brands owned by these 3 firms in the two selected markets are reported in the Appendix.

Although in the package size of 0.5 gallon, the dairy milk of Dean Foods is still the most sensitive to the price change in the Green Bay market, it has the lowest own-price elasticity in the Milwaukee market. And in both markets, the cross-price elasticity between Dean Foods and Foremost Farms is still higher compared to the one from Kemps. In the container size of 1 gallon, the dairy milk of Dean Foods has the lowest own-price elasticities in both markets. Although the magnitude of cross-price elasticities is larger in package size of 1 gallon compared with the other three sizes, the pattern of cross-price elasticities for Dean Foods to Foremost Farms and Kemps are similar in all sizes.

Table 4: Mean estimated own- and cross-price elasticities

Market: Green Bay in March 2007				**Market: Milwaukee in March 2007**			
	Dean Foods	Foremost Farms	Kemps		Dean Foods	Foremost Farms	Kemps
Size 1: (16 ounces)				**Size 1 (16 ounces)**			
Dean Foods	-11.6194**	0.00028**	0.00016**	Dean Foods	-10.9011**	0.00103**	0.00080**
	(0.1538)	(5.51E-05)	(3.00E-05)		(0.2031)	(0.0001)	(7.82E-05)
Foremost Farms	0.00021**	-12.7289**	0.00017**	Foremost Farms	0.00091**	-11.3917**	0.00102**
	(4.83E-05)	(0.5670)	(3.00E-05)		(0.0001)	(0.2751)	(0.0001)
Kemps	0.00033**	0.00023**	-13.9675**	Kemps	0.00099**	0.00069**	-10.7734**
	(9.37E-05)	(8.62E-05)	(1.2329)		(8.15E-05)	(5.57E-05)	(0.2569)
Size 2: (32 ounces)				**Size 2: (32 ounces)**			
Dean Foods	-5.8992**	0.00033**	0.00025**	Dean Foods	-5.9606**	0.00054**	0.00024**
	(0.1505)	(1.7E-05)	(1.00E-05)		(0.1625)	(4.55E-05)	(1.29E-05)
Foremost Farms	0.00017**	-5.1577**	0.00022**	Foremost Farms	0.00013**	-5.4278**	0.00014**
	(1.30E-05)	(0.1707)	(1.30E-05)		(1.16E-05)	(0.0576)	(1.24E-05)
Kemps	0.00016**	0.00028**	-4.7496**	Kemps	0.00022**	0.00044**	-4.8710**
	(2.30E-05)	(2.50E-05)	(0.1111)		(1.25E-05)	(3.80E-05)	(0.0270)
Size 3: (0.5 gallon)				**Size 3: (0.5 gallon)**			
Dean Foods	-2.8921**	0.00072**	0.00060**	Dean Foods	-2.8055**	0.00040**	0.00020**
	(0.0002)	(0.0001)	(0.0001)		(0.0747)	(3.00E-05)	(2.00E-05)
Foremost Farms	0.00022**	-2.7460**	0.00059**	Foremost Farms	0.00025**	-3.2638**	0.00020**
	(2.52E-05)	(0.0791)	(8.82E-05)		(3.00E-05)	(0.1975)	(2.00E-05)
Kemps	0.00023**	0.00072**	-2.8616**	Kemps	0.00026**	0.00042**	-3.3990**
	(2.93E-05)	(9.36E-05)	(0.1742)		(2.00E-05)	(2.00E-05)	(0.1111)
Size 4: (1 gallon)				**Size 4: (1 gallon)**			
Dean Foods	-6.3935**	0.02421**	0.03820**	Dean Foods	-6.7046**	0.01265**	0.01307**
	(0.1298)	(0.0028)	(0.0071)		(0.1643)	(0.0009)	(0.0010)
Foremost Farms	0.00728**	-6.5634**	0.03968**	Foremost Farms	0.01872**	-7.8493**	0.01812**
	(0.0005)	(0.1823)	(0.0053)		(0.0018)	(0.0660)	(0.0011)
Kemps	0.00746**	0.02560**	-6.5869**	Kemps	0.01716**	0.01614**	-7.2944**
	(0.0008)	(0.0032)	(0.4200)		(0.0014)	(0.0008)	(0.1798)

Noted: **indicates statistical significance at the 5% level, standard error is reported in parenthesis.

4.2 Non-nested test on different supply models

After estimating the demand model, we derive the predicted markups and recover the marginal cost for each supply model. The non-nested likelihood ratio statistical test developed by Rivers and Vuong (2002) is then performed to assess which model better approximates price-setting behavior during the merger period and divestiture period respectively.

According to IRI dataset, Dean Foods actually acquired two milk plants from Foremost Farms since January 2008, because from January 2008 the ownership of the brands such as "Golden Guernsey", "Morning Glory" changes from Foremost Farms to Dean Foods. On January 22, 2010, the Department of Justice (referred to DOJ) filed a complaint against Dean Foods, with the purpose to disassemble the acquisition. According to the DOJ's final judgment of this case, Dean Foods divested one milk plant to Open Gate Capital in January 2012.

Based on these information, in the merger period, we create a factual ID to capture cooperative pricing-setting of Dean Foods, as well as a counterfactual ID to analyze the non-cooperative pricing strategy that Dean Foods might adopt. The factual analysis and counterfactual analysis in four package sizes of milk would help us to investigate whether DOJ's anti-competitive concern of this merger case exists or not.

In the divestiture period, we also construct a factual ID to describe the non-cooperative pricing behavior of Dean Foods regarding the divested brands and its pre-existing brands. Meanwhile, the counterfactual analysis is built to test the effectiveness of DOJ's divestiture judgment.

Under the scenarios of double marginalization supply model and passive retailers supply model, combined with factual and counterfactual analysis, there are four competing regression models to be tested against each other in both merger period and divestiture period. In those models, time fixed effects, geographic market location fixed effects and product fixed effects are all included.

4.2.1 Non-nested test on different supply models: Merger period

In the package size 16 ounces, the ownership of the brand "Golden Guernsey Morning Glory" has been changed from Foremost Farms to Dean Foods since January 2008. The available merger period in the dataset is from January 2008 to September 2009.

Table 5 presents the non-nested test statistics among four compared models. Within the double marginalization supply model, the cooperative pricing behavior is preferred. And under the passive retailer supply model, it still prefer cooperative pricing strategy. However, the non-nested test statistics cannot distinguish whether double marginalization or passive retailer is preferred.

Under either double marginalization supply model or passive retailer model, the non-nested test statistics show that cooperative pricing dominates competitive pricing, revealing that Dean Foods jointly priced the new brand of milk that it acquired from Foremost Farms. Such cooperative price-setting behavior across Dean Foods's pre-existing brands and the brand that previously owned by Foremost Farms validates the anticompetitive concern expressed by DOJ.

Table 5: Results of non-nested test of 16 ounces package size during the merger period

Merger period (Jan 2008 – Sep 2009)	Model 2: Double marginalization (Non-cooperative pricing)	Model 3: Passive retailer (Cooperative pricing)	Model 4: Passive retailer (Non-cooperative pricing)
Model 1: Double marginalization (Cooperative pricing)	2.906	0.779	0.782
Model 2: Double marginalization (Non-cooperative pricing)	-	0.776	0.779
Model 3: Passive retailer (Cooperative pricing)	-	-	2.931

In the package size of 32 ounces, there are three brands involved in the acquisition, “Golden Guernsey”, “Golden Guernsey Morning Glory” and “Morning Glory”. The ownership of these three brands all has been changed from Foremost Farms to Dean Foods since January 2008. However, the time period that Dean Foods owned these brands were different. The brands “Golden Guernsey” and “Golden Guernsey Morning Glory” were owned by Dean Foods from January 2008 to April 2010 and from January 2008 to December 2011, respectively. Dean Foods owned the brand “Morning Glory” from January 2008 to December 2012. As the divestiture period examined in our paper is from January 2012 to December 2012, we select the merger period from January 2008 to December 2011 for the package size of 32 ounces.

Table 6 presents the non-nested test statistics among four compared models in package size of 32 ounces. We can conclude that double marginalization supply model with competitive pricing behavior is the best. Because the non-test statistic in the second column is negative while the test statistics in the third row are positive. As such, the non-nested test statistic suggests that this supply model better approximates price-setting behavior compared to other three models during the merger period. And this result indicates that Dean Foods independently, rather than jointly, priced the new brand of milk that it acquired from Foremost Farms. Such non-cooperative price-setting behavior across Dean Foods’s pre-existing brands and these brands that were previously owned by Foremost Farms does not support the concern expressed by DOJ.

Table 6: Results of non-nested test of 32 ounces package size during the merger period

Merger period (Jan 2008 – Dec 2011)	Model 2: Double marginalization (Non-cooperative pricing)	Model 3: Passive retailer (Cooperative pricing)	Model 4: Passive retailer (Non-cooperative pricing)
Model 1: Double marginalization (Cooperative pricing)	-3.975	4.438	4.428
Model 2: Double marginalization (Non-cooperative pricing)	-	4.441	4.432
Model 3: Passive retailer (Cooperative pricing)	-	-	-7.484

In the package size of 0.5 gallon dataset, two brands “Golden Guernsey” and “Morning Glory” involved in the acquisition. The brand “Golden Guernsey” is produced by Waukesha plant, its ownership has been changed from Foremost Farms to Dean Foods since January 2008. However, according to DOJ’s final judgment, Dean Foods divested Waukesha plant to Open Gates Capital Cooperation in January 2012, as such, the ownership of this brand changed again from Dean Foods to Open Gate since January 2012. The brand “Morning Glory” belongs to another milk plant located in De Pere, and Dean Foods still keeps this plant even after DOJ’s divestiture order. Therefore, Dean Foods owned the brand “Morning Glory” from January 2008 to December 2012. In order to analyze the pricing behavior of Dean Foods in the completed merger period, we choose the time from January 2008 to December 2011 as the merger period.

The non-nested test statistics among four compared models are presented in Table 7. It can be concluded that passive retailer with cooperative pricing behavior is the best as the non-test statistics in the third column are negative and the test statistic in the fourth row is positive. The non-nested test statistic indicates that this model specification can better approximate price-setting behavior compared to other models during the merger period. The non-nested test statistics imply that Dean Foods actually jointly priced the new brands of milk that it acquired from Foremost Farms with its pre-existing brands. Such cooperative price-setting behavior supports the DOJ’s anticompetitive concern when it filed an antitrust lawsuit against Dean Foods.

Table 7: Results of non-nested test of 0.5 gallon package size during the merger period

Merger period (Jan 2008 – Dec 2011)	Model 2: Double marginalization (Non-cooperative pricing)	Model 3: Passive retailer (Cooperative pricing)	Model 4: Passive retailer (Non-cooperative pricing)
Model 1: Double marginalization (Cooperative pricing)	-3.067	-33.5312	-33.5310
Model 2: Double marginalization (Non-cooperative pricing)	-	-33.5312	-33.5311
Model 3: Passive retailer (Cooperative pricing)	-	-	5.0812

Similar to the package size of 0.5 gallon, the same two brands as “Golden Guernsey” and “Morning Glory” also involved in the acquisition of the package size of 1 gallon dataset. And the merger period and the divestiture period are exactly same to the package size of 0.5 gallon. Table 8 presents the non-nested statistical test among 4 competing models for the merger period of 1 gallon milk. It can be found from Table 8, all the test statistics in the fourth column are negative, suggesting that the passive retailer supply model with non-cooperative pricing strategy better approximates price-setting behavior of Dean Foods during the merger period. And it also indicates that even obtaining two new brands of milk from Foremost Farms, Dean Foods still priced them separately in the package size of 1 gallon. Such non-cooperative price-setting behavior doesn’t support the DOJ’s anti-competitive complaint.

Table 8: Results of non-nested test of 1 gallon package size during the merger period

Merger period (Jan 2008 – Dec 2011)	Model 2: Double marginalization (Non-cooperative pricing)	Model 3: Passive retailer (Cooperative pricing)	Model 4: Passive retailer (Non-cooperative pricing)
Model 1: Double marginalization (Cooperative pricing)	-4.944	-6.472	-6.537
Model 2: Double marginalization (Non-cooperative pricing)	-	-6.349	-6.423
Model 3: Passive retailer (Cooperative pricing)	-	-	-4.022

4.2.2 Non-nested test on different supply models: Divestiture period

The final judgment of DOJ requested Dean Foods to divest the Waukesha plant, as such the brand “Golden Guernsey” produced by Waukesha plant was sold to Open Gates Capital Cooperation in January 2012. And in IRI dataset, “Golden Guernsey” only exist in the package size of 0.5 gallon and 1 gallon. Therefore, we only perform the non-nested test on different supply models in these two package sizes, and the examined divested period is from January 2012 to December 2012.

Table 9 describes the non-nested test statistics of the 4 compared models in the package size of 0.5 gallon. All the non-test statistics in the second row are positive, indicating that double marginalization with non-cooperative pricing is the best model to approximate price-setting behavior of Dean Foods compared to other models during the divestiture period. The non-cooperative pricing strategy is preferred also suggest that Dean Foods did not jointly price the brand “Golden Guernsey” with its own brands in the divestiture period, and this separate price behavior verifies the effectiveness of the DOJ’s divestiture decision.

Table 9: Results of non-nested test of 0.5 gallon package size during the divestiture period

Merger period (Jan 2012 – Dec 2012)	Model 2: Double marginalization (Cooperative pricing)	Model 3: Passive retailer (Non-cooperative pricing)	Model 4: Passive retailer (Cooperative pricing)
Model 1: Double marginalization (Non-cooperative pricing)	18.7013	18.9043	18.904
Model 2: Double marginalization (Cooperative pricing)	-	32.696	32.695
Model 3: Passive retailer (Non-cooperative pricing)	-	-	-0.251

Table 10 presents the non-nested test statistics of the four compared supply models in the package size of 1 gallon. The test statistics in the third column are negative while in the fourth row is positive, which suggests that the passive retailer supply model with non-cooperative pricing strategy can better approximate Dean Foods price-setting behavior during the divestiture period. Similar to the package size of 0.5 gallon, the non-cooperative price behavior also validates the effectiveness of the DOJ’s divestiture judgment.

Table 10: Results of non-nested test of 1 gallon package size during the divestiture period

Merger period (Jan 2012 – Dec 2012)	Model 2: Double marginalization (Cooperative pricing)	Model 3: Passive retailer (Non-cooperative pricing)	Model 4: Passive retailer (Cooperative pricing)
Model 1: Double marginalization (Non-cooperative pricing)	7.060	-14.461	-14.479
Model 2: Double marginalization (Cooperative pricing)	-	-14.603	-14.573
Model 3: Passive retailer (Non-cooperative pricing)	-	-	4.229

4.3 The percentage changes in markups based on the selected supply models

Once the preferred supply model has been selected according to the non-nested Rivers and Vuong test (2002), we can compute the price-cost margins of Dean Foods in different package sizes of milk. In merger period, Dean Foods only adopt the cooperative price-setting behavior in the package size of 16 ounces and 0.5 gallon, Table 11 shows the average percentage changes in markups of Dean Foods in these two package sizes respectively. It is to be noted that the largest average percentage increased in price-cost margins is 0.05%. The average percentage changes in the estimated markups are positive, implying a cooperative pricing behavior that Dean Foods performed once the acquisition happened, however, the magnitude are less than 1%. And such small magnitude suggests that anticompetitive effects should not be of concern.

Table 11: The percentage changes in estimated price-cost margins of Dean Foods during the merger period

Merger period	Mean	Std.Error
Size 1 (16 ounces)	0.003%**	3.08E-06
Size 3 (0.5 gallon)	0.05%**	8.12E-06

Noted: **indicates statistical significance at the 5% level; standard error is reported in parenthesis.

The percentage change in the markups are also computed in the divestiture period based on the preferred supply models in the package size of 0.5 gallon and 1 gallon. Table 12 shows Dean Foods' average percentage changes in markups during the divestiture period. As expected, it can be seen that the average percentage changes in the estimated markups are negative, which indicates that Dean Foods adopted non-cooperatively price behavior as required by DOJ's order. However, the magnitude of the mean percentage changes of estimated markups in both sizes are less than 1%. And the sufficiently small magnitude suggests divestiture effects are negligible.

Table 21: The percentage changes in estimated price-cost margins of Dean Foods during the divestiture period

Divestiture period	Mean	Std.Error
Size 3 (0.5 gallon)	-0.003%**	1.16E-06
Size 4 (1 gallon)	-0.064%**	7.90E-05

Noted: **indicates statistical significance at the 5% level; standard error is reported in parenthesis.

5. Conclusions

The primary objective of this paper is to empirically test the DOJ's anticompetitive concern and the effectiveness of final judgment on the merger case of Dean Foods and

Foremost Farms USA. Based on the IRI retail point-of-sale scanner data, this paper analyzes demand and supply of differentiated products in the five IRI markets that might be affected by this acquisition.

On the demand side, we individually analyze four common sizes of milk using random coefficient logit models, and derive the predicted markups and recover the marginal cost. On the supply side, we consider the linear pricing supply model with double marginalization and a special scenario of passive retailers. Within these two supply models, we do the factual and counterfactual analysis to test the DOJ's anticompetitive concern and examine the effectiveness of the DOJ's final judgment. Therefore in both the merger period and divestiture period, there are four supply models to compare against each other. The non-nested likelihood ratio statistical test developed by Rivers and Vuong (2002) is performed to compare which model better approximates price-setting behavior of Dean Foods.

In the merger period, the non-nested test statistics in package size of 16 ounces and 0.5 gallon suggest that Dean Foods actually jointly priced the new brands of milk that it acquired from Foremost Farms USA with its pre-existing milk brands, and such cooperative price-setting behavior supports the DOJ's anticompetitive concern. However, the non-nested test statistics in package size of 32 ounces and 1 gallon demonstrate that Dean Foods separately priced the merged brands and its pre-existing brands, which implies that the concern expressed by the DOJ cannot support by the data in these two package sizes.

However, although the cooperative price-setting behavior of Dean Foods in package size of 16 ounces and 0.5 gallon is consistent with an anticompetitive effect, the magnitudes of the percentage increases in markups due to joint pricing are sufficiently small, less than 1%, suggesting that anticompetitive effects actually should not be of concern. In the case of the divestiture period, Dean Foods divested the Waukesha plant required by DOJ's order. And we find that the divested brands is priced separately rather than jointly. Nevertheless, the magnitudes of the percentage decreases in markups are less than 1%, and such sufficiently small changes suggest that divestiture effects are negligible.

Appendix

This Appendix contains six tables (Table A(I)-A(VI)). Table A(I) presents the demand estimation results from Ordinary Least Square (OLS). Table A(II) reports the demand estimation from standard logit model (2SLS). Table A(III)-A(VI) present the own- and cross-price elasticities of different brands in four sizes in two selected markets.

Table A(I) : Demand Estimation for Four Package Sizes of Milk (OLS)

Variables in the mean utility function: Associated parameters, α and β.	Ordinary Least Square Estimation							
	Size 1 (16 ounces Container)		Size 2 (32 ounces Container)		Size 3 (0.5 gallon Container)		Size 4 (1 gallon Container)	
	Coefficient Estimates	Std. Error	Coefficient Estimates	Std. Error	Coefficient Estimates	Std. Error	Coefficient Estimates	Std. Error
Real Milk Price	-47.81**	0.59	-21.00**	0.54	-32.59**	0.27	-39.12**	0.75
Fat Content [a]	-0.79**	0.012	-1.03**	0.01	-1.23**	0.004	-1.47**	0.01
Flavor: Vanilla [a]	-1.55**	0.03	0.10**	0.02	-1.47**	0.01	-0.06*	0.03
Flavor: Original [a]	-	-	-	-	-1.64**	0.01	-	-
Flavor: Plain [a]	-	-	-	-	-1.38**	0.01	-	-
Milk type: Full lactose [a]	-	-	2.30**	0.03	-	-	-	-
Milk type [1]: Reduced lactose [a]	-	-	-	-	-1.09**	0.01	-	-
Milk type[2]: Milk with acidophilus [a]	-	-	-	-	-4.02**	0.02	-	-
Milk type: Soy milk [a]	-	-	-	-	-0.75**	0.01	-	-
Milk type: Almond milk [a]	-	-	-	-	-1.78**	0.02	-	-
Organic [a]	-	-	-	-	-0.72**	0.01	-1.14**	0.02
Constant [a]	-0.58**	0.19	0.83**	0.27	2.99**	0.10	-11.22**	0.10
Time fixed effects	YES		YES		YES		YES	
Product fixed effects	YES		YES		YES		YES	
Market fixed effects	YES		YES		YES		YES	
R^2	0.9967		0.9984		0.9980		0.9961	
Observations	21,114		29,901		158,439		45,267	

Notes: *indicates statistical significance at the 10% level, **indicates statistical significance at the 5% level
[1] Reduced lactose also includes lactose free milk.
[2] The milk is full lactose with acidophilus
[a] Coefficient estimates from the Generalized Least Square regression of estimated product fixed effects on non-price product characteristics.

Table A(II) : Demand Estimation for Four Package Sizes of Milk (2SLS)

Variables in the mean utility function: Associated parameters, α and β.	Standard Logit Model (2SLS)							
	Size 1 (16 ounces Container)		Size 2 (32 ounces Container)		Size 3 (0.5 gallon Container)		Size 4 (1 gallon Container)	
	Coefficient Estimates	Std. Error	Coefficient Estimates	Std. Error	Coefficient Estimates	Std. Error	Coefficient Estimates	Std. Error
Real Milk Price	-169.37**	2.41	-87.35**	2.41	-69.95**	1.38	-232.16**	8.46
Fat Content [a]	-0.79**	0.02	-1.03**	0.01	-1.23**	0.004	-1.42**	0.01
Flavor: Vanilla [a]	-1.68**	0.05	0.10**	0.02	-1.43**	0.01	-0.13**	0.05
Flavor: Original [a]	-	-	-	-	-1.59**	0.01	-	-
Flavor: Plain [a]	-	-	-	-	-1.39**	0.01	-	-
Milk type: Full lactose [a]	-	-	2.26**	0.05	-	-	-	-
Milk type [1]: Reduced lactose [a]	-	-	-	-	-0.92**	0.01	-	-
Milk type[2]: Milk with acidophilus [a]	-	-	-	-	-3.82**	0.02	-	-
Milk type: Soy milk [a]	-	-	-	-	-0.85**	0.02	-	-
Milk type: Almond milk [a]	-	-	-	-	-1.80**	0.02	-	-
Organic [a]	-	-	-	-	-0.60**	0.01	0.24**	0.05
Constant [a]	-031	0.32	0.82**	0.34	2.95**	0.11	-10.14**	0.16
Time fixed effects	YES		YES		YES		YES	
Product fixed effects	YES		YES		YES		YES	
Market fixed effects	YES		YES		YES		YES	
Observations	21,114		29,901		158,439		45,267	

Notes: *indicates statistical significance at the 10% level, **indicates statistical significance at the 5% level

[1] Reduced lactose also includes lactose free milk.

[2] The milk is full lactose with acidophilus

[a] Coefficient estimates from the Generalized Least Square regression of estimated product fixed effects on non-price product characteristics.

Table A(III): The own- and cross-price elasticities of different brands in 16 ounces containers

Market: Green Bay in March 2007				Market: Milwaukee in March 2007			
Brands	Deans	Golden Grnsy Mg	Kemps	Brands	Deans	Golden Grnsy Mg	Kemps
Deans	-11.6194**	0.00028**	0.00016**	Deans	-10.9011**	0.00103**	0.00080**
	(0.1538)	(5.51E-05)	(3.00E-05)		(0.2031)	(0.0001)	(7.82E-05)
Golden Grnsy Mg	0.00021**	-12.7289**	0.00017**	Golden Grnsy Mg	0.00091**	-11.3917**	0.00102**
	(4.83E-05)	(0.5670)	(3.00E-05)		(0.0001)	(0.2751)	(0.0001)
Kemps	0.00033**	0.00023**	-13.9675**	Kemps	0.00099**	0.00069**	-10.7734**
	(9.37E-05)	(8.62E-05)	(1.2329)		(8.15E-05)	(5.57E-05)	(0.2569)

Noted: **indicates statistical significance at the 5% level, standard error is reported in parenthesis. Deans is owned by Dean Foods and Golden Grnsy Mg is owned by Foremost Farms

Table A(IV)-1: The own- and cross-price elasticities of different brands in 32 ounces containers

Market: Green Bay in March 2007								
Brands	Deans	Deans Easy	Golden Guernsey	Golden Grnsy Mg	Morning Glory	Hood Lactaid	Kemps	Private Label
Deans	-7.9296**	0.00021**	0.00073**	0.00087**	0.00050**	0.00068**	0.00060**	0.00152**
	(0.0771)	(3.06 E-05)	(2.74 E-05)	(7.50 E-05)	(7.12 E-05)	(6.45 E-05)	(4.00 E-05)	(0.0002)
Deans Easy	0.00076**	-9.5570**	0.00104**	0.00127**	0.00068**	0.00107**	0.00083**	0.00225**
	(0.00017)	(0.4191)	(0.0001)	(0.0002)	(2.19 E-04)	(0.0002)	(0.0001)	(0.0005)
Golden Guernsey	0.00049**	0.00019**	-7.7561**	0.00082**	0.00048**	0.00063**	0.00057**	0.00144**
	(8.87E-05)	(5.39 E-05)	(0.3358)	(0.0001)	(1.22 E-04)	(0.0001)	(7.01 E-05)	(0.0003)
Golden Grnsy Mg	0.00048**	0.00019**	0.00067**	-7.4949**	0.00046**	0.00063**	0.00056**	0.00141**
	(6.13 E-05)	(3.62 E-05)	(3.57 E-05)	(0.2206)	(8.32 E-05)	(7.56 E-05)	(4.91 E-05)	(0.0002)
Morning Glory	0.00033**	0.00012**	0.00047**	0.00056**	-5.9877**	0.00040**	0.00041**	0.00097**
	(5.21 E-05)	(2.92 E-05)	(3.27 E-05)	(7.56 E-05)	(0.3531)	(6.01 E-05)	(4.59 E-05)	(0.00065)
Hood Lactaid	0.00085**	0.00037**	0.00117**	0.00142**	0.00075**	-10.1274**	0.00092**	0.00253**
	(0.0001)	(7.54 E-05)	(6.25 E-05)	(0.0002)	(1.46 E-04)	(0.0520)	(8.31 E-05)	(0.0003)
Kemp	0.00037**	0.00014**	0.00052**	0.00062**	0.00037**	0.00045**	-6.4341**	0.00107**
	(6.61 E-05)	(3.78 E-05)	(3.63 E-05)	(9.51 E-05)	(9.67 E-05)	(7.68 E-05)	(0.2501)	(0.0002)
Private Label	0.00050**	0.00020**	0.00070**	0.00084**	0.00048**	0.00065**	0.00058**	-7.6429**
	(7.02 E-05)	(4.25 E-05)	(4.30 E-05)	(0.0001)	(9.47 E-05)	(8.81 E-05)	(5.66 E-05)	(0.3106)

Noted: **indicates statistical significance at the 5% level, standard error is reported in parenthesis. The brands of Dean Easy and Hood Lactaid are reduced lactose dairy milk, Deans and Deans Easy are owned by Dean Foods; Golden Guernsey, Golden Grnsy Mg and Morning Glory are owned by Foremost Farms.

Table A(IV)-2: The own- and cross-price elasticities of different brands in 32 ounces containers

Market: Milwaukee in March 2007						
Brands	Deans	Deans Easy	Golden Guernsey	Kemps	Hood Lactaid	Private Label
Deans	-8.5463**	0.00003**	0.00057**	0.00017**	0.00011**	0.00077**
	(0.1984)	(1.94 E-06)	(5.24 E-05)	(1.05 E-05)	(4.76 E-06)	(4.46 E-05)
Deans Easy	0.00025**	-10.5024**	0.00072**	0.00021**	0.00015**	0.00102**
	(3.09 E-05)	(0.1791)	(0.0002)	(2.81 E-05)	(1.36 E-05)	(0.0001)
Golden Guernsey	0.00018**	0.00003**	-7.7286**	0.00016**	0.00010**	0.00068**
	(1.51 E-05)	(2.47 E-06)	(0.0952)	(1.47 E-05)	(6.22 E-06)	(5.49 E-05)
Kemps	0.00016**	0.00003**	0.00047**	-7.0822**	0.00009**	0.00060**
	(8.18 E-06)	(1.29 E-06)	(3.97 E-05)	(0.0377)	(3.33 E-06)	(2.76 E-05)
Hood Lactaid	0.00026**	0.00005**	0.00073**	0.00021**	-10.576**	0.00103**
	(1.61 E-05)	(2.84 E-06)	(7.50 E-05)	(1.47 E-05)	(0.0416)	(6.78 E-05)
Private Label	0.00022**	0.00004**	0.00064**	0.00019**	0.00013**	-9.4783**
	(3.46 E-05)	(6.92 E-06)	(0.00052)	(3.18 E-05)	(1.55 E-05)	(1.12)

Noted: **indicates statistical significance at the 5% level, standard error is reported in parenthesis. The brands of Dean Easy and Hood Lactaid are reduced lactose dairy milk, Deans and Deans Easy are owned by Dean Foods; Golden Guernsey, Golden Grnsy Mg and Morning Glory are owned by Foremost Farms USA.

Table A(V)-1: The own- and cross-price elasticities of different brands in 0.5 gallon containers

Market: Green Bay in March 2007

Brands	8th Continent	Kemps	Kemps Select	Morning Glory	Golden Guernsey	Organic Valley	Silk Light	Deans Easy	Deans	Land O' Lakes Dairy Ease	Private Label	Hood Lactaid
8th Continent	-5.7952**	0.00088**	0.00005**	0.00078**	0.00063**	0.00013**	0.00004**	0.00015**	0.00023**	0.00005**	0.00037**	0.00017**
	(0.0701)	(8.40 E-05)	(9.84 E-08)	(8.05 E-05)	(9.94 E-05)	(1.24 E-05)	(2.14 E-06)	(1.25 E-05)	(2.05 E-05)	(2.87 E-07)	(2.38 E-05)	(1.34 E-05)
Kemps	0.00004**	-2.7632**	0.00005**	0.00076**	0.00060**	0.00011**	0.00003**	0.00014**	0.00023**	0.00005**	0.00037**	0.00014**
	(5.49 E-06)	(0.2351)	(1.10 E-07)	(0.0001)	(0.0002)	(1.89 E-05)	(3.48 E-06)	(2.08 E-05)	(3.63 E-05)	(8.25 E-07)	(4.03 E-05)	(2.07 E-05)
Kemps Select	0.00004**	0.00085**	-3.0582**	0.00076**	0.00060**	0.00011**	0.00003**	0.00014**	0.00022**	0.00005**	0.00036**	0.00014**
	(7.82 E-06)	(0.0002)	(0.2562)	(0.0002)	(0.0003)	(2.75 E-05)	(4.99 E-06)	(3.04 E-05)	(5.50 E-07)	(5.50 E-07)	(6.00 E-05)	(3.01 E-05)
Morning Glory	0.00004**	0.00086**	0.00005**	-2.7261**	0.00060**	0.00011**	0.00003**	0.00013**	0.00023**	0.00005**	0.00036**	0.00014**
	(4.42 E-06)	(0.0002)	(4.22 E-08)	(0.0871)	(0.0001)	(1.53 E-05)	(4.95 E-06)	(1.66 E-05)	(5.29 E-07)	(4.40 E-07)	(3.36 E-05)	(1.67 E-05)
Golden Guernsey	0.00004**	0.00085**	0.00005**	0.00076**	-2.8057**	0.00010**	0.00003**	0.00013**	0.00022**	0.00005**	0.00036**	0.00014**
	(7.75 E-06)	(0.0002)	(8.47 E-08)	(0.0002)	(0.2382)	(2.72 E-05)	(4.94 E-06)	(3.01 E-05)	(4.86 E-07)	(4.86 E-07)	(5.99 E-05)	(2.97 E-05)
Organic Valley	0.00006**	0.00093**	0.00005**	0.00080**	0.00064**	-6.7703**	0.00004**	0.00016**	0.00024**	0.00006**	0.00039**	0.00019**
	(5.18 E-06)	(0.0001)	(2.36 E-07)	(0.0001)	(0.0001)	(0.1325)	(3.19 E-06)	(1.84 E-05)	(1.09 E-06)	(1.09 E-07)	(3.21 E-05)	(2.05 E-05)
Silk Light	0.00005**	0.00088**	0.00005**	0.00078**	0.00062**	0.00012**	-5.3448**	0.00015**	0.00023**	0.00005**	0.00037**	0.00016**
	(4.04 E-06)	(0.0001)	(1.40 E-07)	(9.65 E-05)	(0.0001)	(1.45 E-05)	(0.1602)	(1.48 E-05)	(2.45 E-05)	(6.31 E-07)	(2.85 E-05)	(1.57 E-05)
Deans Easy	0.00005**	0.00087**	0.00005**	0.00078**	0.00062**	0.00012**	0.00004**	-5.2679**	0.00005**	0.00037**	0.00016**	0.00005**
	(6.06 E-06)	(0.0002)	(1.44 E-07)	(0.0001)	(0.0002)	(2.18 E-05)	(3.79 E-06)	(0.1187)	(4.14 E-07)	(4.24 E-07)	(4.29 E-05)	(2.36 E-05)
Deans	0.00004**	0.00088**	0.00005**	0.00076**	0.00060**	0.00011**	0.00003**	0.00014**	-2.8921**	0.00005**	0.00037**	0.00014**
	(4.91 E-06)	(0.0001)	(7.05 E-08)	(0.0001)	(0.0002)	(1.70 E-05)	(3.11 E-06)	(1.85 E-05)	(0.1290)	(6.43 E-07)	(3.63 E-05)	(1.86 E-05)
Land O' Lakes Dairy Ease	0.00005**	0.00089**	0.00005**	0.00079**	0.00063**	0.00013**	0.00004**	0.00016**	0.00023**	-6.2278**	0.00037**	0.00017**
	(1.32 E-05)	(0.0003)	(5.05 E-07)	(0.0003)	(0.0005)	(4.98 E-05)	(8.35 E-06)	(5.25 E-05)	(6.43 E-07)	(0.0000)	(8.99 E-05)	(5.37 E-05)
Private Label	0.00004**	0.00088**	0.00005**	0.00076**	0.00060**	0.00011**	0.00003**	0.00014**	0.00023**	0.00005**	-2.7616**	0.00014**
	(3.15 E-06)	(8.01 E-05)	(4.28 E-08)	(8.09 E-05)	(9.89 E-05)	(1.08 E-05)	(1.99 E-06)	(1.17 E-05)	(2.06 E-05)	(3.75 E-07)	(0.0808)	(1.18 E-05)
Hood Lactaid	0.00005**	0.00091**	0.00005**	0.00079**	0.00064**	0.00014**	0.00004**	0.00016**	0.00024**	0.00006**	0.00038**	-6.3098**
	(4.96 E-06)	(0.0001)	(1.79 E-07)	(0.0001)	(0.0001)	(1.81 E-05)	(3.07 E-06)	(1.78 E-05)	(2.85 E-05)	(9.42 E-07)	(3.22 E-05)	(0.0492)

Note: **indicates statistical significance at the 5% level, standard error is reported in parenthesis. The brands of Dean Easy, Land O'Lakes Dairy Ease and Hood Lactaid are reduced lactose dairy milk, the brand Organic Valley is the organic milk, Deans and Deans Easy, Land O'Lakes Dairy Ease are owned by Dean Foods; Golden Guernsey and Morning Glory are owned by Foremost Farms.

Table A(V)-2: The own- and cross-price elasticities of different brands in 0.5 gallon containers

Market: Milwaukee in March 2007

Brands	Organic Valley	Silk Light	Oberweis Dairy	Deans	Deans Easy	Land O' Lakes Dairy Ease	Horizon Organic	Kemps	Kemps Select	Kemps New Era	8th Continent	Private Label	Hood Lactaid	Golden Guernsey	Wisconsin Organics
Organic Valley	-5.1607**	9.22E-05**	1.85E-04**	2.72E-04**	0.00047**	9.14 E-05**	5.71 E-05**	0.00048**	4.11 E-05**	4.31 E-06**	1.22 E-04**	0.00043**	0.00073**	7.98 E-04**	0.00019**
	(0.0491)	(2.33 E-06)	(9.08 E-06)	(1.67 E-05)	(1.67 E-05)	(1.13 E-05)	(2.81 E-06)	(1.87 E-05)	(1.54 E-06)	(1.09 E-07)	(3.33 E-06)	(1.53 E-05)	(2.72 E-05)	(3.84 E-05)	(6.62 E-06)
Silk Light	2.32E-04**	-5.0153**	8.25E-05**	2.14E-04**	0.00021**	3.65 E-05**	2.12 E-05**	0.00035**	2.69 E-05**	2.95 E-06**	5.38 E-05**	0.00030**	0.00029**	5.17 E-04**	7.51 E-05**
	(7.47 E-06)	(0.0350)	(4.49 E-06)	(1.56 E-05)	(7.43 E-06)	(4.83 E-06)	(1.03 E-06)	(1.79 E-05)	(1.03 E-06)	(3.21 E-08)	(1.56 E-06)	(1.24 E-05)	(1.17 E-05)	(1,27 E-05)	(1.86 E-06)
Oberweis Dairy	2.44E-04**	4.21E-05**	-4.7578**	2.20E-04**	0.00022**	3.79 E-05**	2.25 E-05**	0.00036**	2.72 E-05**	2.98 E-06**	5.55 E-05**	0.00031**	0.00030**	5.23 E-04**	7.96 E-05**
	(4.26 E-06)	(1.65 E-06)	(0.0352)	(2.43 E-05)	(1.19 E-05)	(7.87 E-06)	(1.76 E-06)	(2.75 E-05)	(1.62 E-06)	(5.06 E-08)	(2.46 E-06)	(1.91 E-05)	(1.88 E-05)	(4.50 E-05)	(3.37 E-06)
Deans	8.70E-05**	2.19E-05**	4.64E-05**	-3.1191**	0.00012**	1.66 E-05**	8.68 E-06**	0.00030**	2.14 E-05**	2.41 E-06**	2.88 E-05**	0.00026**	0.00013**	4.08 E-04**	3.46 E-05**
	(1.52 E-05)	(7.59 E-07)	(3.67 E-06)	(0.1843)	(6.04 E-06)	(3.20 E-06)	(6.54 E-07)	(2.37 E-05)	(1.13 E-06)	(1.07 E-07)	(1.20 E-06)	(1.48 E-05)	(7.79 E-05)	(2.76 E-05)	(1.75 E-06)
Deans Easy	2.20E-04**	3.93E-05**	7.95E-05**	2.12E-04**	-4.9741**	3.49 E-05**	2.02 E-05**	0.00034**	2.64 E-05**	2.91 E-06**	5.18 E-05**	0.00030**	0.00028**	5.08 E-04**	7.17 E-05**
	(1.52 E-05)	(2.13 E-06)	(9.46 E-06)	(3.43 E-05	(0.0696)	(1.03 E-05)	(2.06 E-06)	(3.94 E-05)	(2.22 E-06)	(4.55 E-08)	(3.25 E-06)	(2.69 E-05)	(2.42 E-05)	(5.55 E-05)	(2.53 E-06)
Land O' Lakes Dairy Ease	0.00033**	5.40E-05**	1.09E-04**	2.29E-04**	0.00028**	-5.3734**	3.03 E-05**	0.00038**	3.06 E-05**	3.30 E-06**	7.12 E-05**	0.00034**	0.00040**	5.90 E-04**	0.00010**
	(3.59 E-05)	(4.69 E-06)	(2.02 E-05)	(5.80 E-05)	(3.13 E-05)	(4.44 E-05)	(4.99 E-06)	(6.57 E-05)	(4.21 E-06)	(0.00000)	(7.01 E-06)	(4.74 E-05)	(5.48 E-05)	(1.06 E-04)	(5.53 E-08)
Horizon Organic	0.00047**	7.09E-05**	1.43E-04**	2.51E-04**	0.00036**	6.85 E-05**	-5.2232**	0.00043**	3.52 E-05**	3.75 E-06**	9.35 E-05**	0.00038**	0.00055**	6.82 E-04**	0.00014**
	(3.63 E-05)	(4.54 E-06)	(1.86 E-05)	(4.29 E-05)	(3.13 E-05)	(2.33 E-05)	(0.1377)	(4.78 E-05)	(3.45 E-06)	(1.37 E-07)	(6.62 E-06)	(3.68 E-05)	(5.32 E-05)	(8.72 E-05)	(8.39 E-06)
Kemps	9.98E-05**	2.38E-05**	5.06E-05**	1.99E-04**	0.00013**	1.86 E-05**	1.01 E-05**	-3.3062**	2.19 E-05**	2.47 E-06**	3.13 E-05**	0.00026**	0.00015**	4.19 E-04**	3.93 E-05**
	(4.83 E-06)	(8.23 E-07)	(5.28 E-06)	(1.97 E-05)	(6.57 E-06)	(3.54 E-06)	(8.17 E-07)	(0.1590)	(1.12 E-06)	(3.96 E-08)	(1.28 E-06)	(1.44 E-05)	(8.60 E-06)	(2.75 E-05)	(2.44 E-06)
Kemps Select	9.14E-05**	2.26E-05**	4.67E-05**	1.93E-04**	0.00012**	1.73 E-05**	8.88 E-06**	0.00030**	-3.5898**	2.44 E-06**	2.98 E-05**	0.00026**	0.00014**	4.13 E-04**	3.50 E-05**
	(5.91E-06)	(1.07 E-06)	(5.19 E-06)	(2.92 E-05)	(8.26 E-06)	(4.63 E-06)	(7.83 E-07)	(3.41 E-05)	(0.1175)	(1.90 E-08)	(1.71 E-06)	(2.14 E-05)	(1.11 E-05)	(3.97 E-05)	(1.38 E-06)
Kemps New Era	8.49E-05**	2.18E-05**	4.50E-05**	1.92E-04**	0.00012**	1.64 E-05**	8.29 E-06**	0.00030**	2.14 E-05**	-3.4606**	2.87 E-05**	0.00025**	0.00013**	4.08 E-04**	3.31 E-05**
	(1.35 E-05)	(2.53 E-06)	(1.30 E-05)	(7.38 E-05)	(2.12 E-05)	(1.44 E-05)	(1.94 E-06)	(8.61 E-05)	(4.24 E-06)	(0.00000)	(4.07 E-06)	(5.30 E-05)	(2.61 E-05)	(1.10 E-04)	(3.41 E-06)
8th Continent	2.37E-04**	4.14E-05**	8.38E-05**	2.15E-04**	0.00022**	3.72 E-05**	2.17 E-05**	0.00035**	2.71E-05**	2.96 E-06**	-5.0641**	0.00030**	0.00030**	5.20 E-04**	7.64 E-05**
	(7.21 E-06)	(9.98 E-07)	(4.39 E-06)	(1.54 E-05)	(6.95 E-06)	(4.70 E-06)	(9.55 E-07)	(1.76 E-05)	(1.00 E-06)	(1.42 E-08)	(0.0156)	(1.22 E-05)	(1.14 E-05)	(2.52 E-05)	(8.45 E-07)
Private Label	9.49E-05**	2.29E-05**	4.87E-05**	1.98E-04**	0.00012**	1.76 E-05**	9.44 E-06**	0.00031**	2.16 E-05**	2.44 E-06**	3.01 E-05**	-3.1974**	0.00014**	4.14 E-04**	3.72 E-05**
	(3.42 E-06)	(5.90 E-07)	(2.83 E-06)	(1.51 E-05)	(4.66 E-06)	(2.50 E-06)	(5.56 E-07)	(1.74 E-05)	(8.47 E-07)	(2.40 E-08)	(9.30 E-07)	(0.0948)	(6.11 E-06)	(2.07 E-05)	(1.58 E-06)
Hood Lactaid	0.00037**	5.89E-05**	1.19E-04**	2.37 E-04**	0.00030**	5.57 E-05**	3.40 E-05**	0.00040**	3.19 E-05**	3.43 E-06**	6.26 E-05**	0.00035**	-5.2039**	6.16 E-04**	0.00012**
	(1.34 E-05)	(1.72 E-06)	(7.13 E-06)	(1.87 E-05)	(1.19 E-05)	(8.29 E-06)	(1.89 E-06)	(2.11 E-05)	(1.40 E-06)	(5.16 E-08)	(1.92 E-06)	(1.56 E-05)	(0.0474)	(3.54 E-05)	(3.32 E-06)
Golden Guernsey	8.16E-05**	2.13E-05**	4.41E-05**	1.91 E-04**	0.00011**	1.60 E-05**	8.00 E-06**	0.00030**	2.12 E-05**	2.40 E-06**	2.81E-05**	0.00025**	0.00013**	-3.2638**	3.21 E-05**
	(4.50 E-06)	(8.32 E-07)	(4.12 E-06)	(2.36 E-05)	(6.57 E-06)	(3.50 E-06)	(6.23 E-07)	(2.76 E-05)	(1.30 E-06)	(2.64 E-08)	(1.33 E-06)	(1.72 E-05)	(8.51 E-06)	(0.1975)	(1.54 E-06)
Wisconsin Organics	0.00036**	5.74E-05**	1.17E-04**	2.37 E-04**	0.00030**	5.42 E-05**	3.31 E-05**	0.00040**	3.15 E-05**	3.39 E-06**	7.57 E-05**	0.00035**	0.00043**	6.08 E-04**	-5.1078**
	(4.04 E-05)	(5.23 E-06)	(2.20 E-05)	(5.85 E-05)	(3.78 E-05)	(2.84 E-05)	(6.11 E-06)	(6.55 E-05)	(4.42 E-06)	(2.25 E-07)	(7.70 E-06)	(4.81 E-05)	(6.07 E-05)	(1.10 E-04)	(0.1700)

Note: **indicates statistical significance at the 5% level, standard error is reported in parenthesis. The The brands of Dean Easy, Land O'Lakes Dairy Ease and Hood Lactaid are reduced lactose dairy milk, the brand Organic Valley, Horizon Organic and Wisconsin Organics are the organic milk, Deans and Deans Easy, Land O'Lakes Dairy Ease and Horizon Organic are owned by Dean Foods; Golden Guernsey is owned by Foremost Farms.

Table A(VI)-1: The own- and cross-price elasticities of different brands in 1 gallon containers

Market: Green Bay in March 2007								
Brands	Deans	Golden Guernsey	Morning Glory	Kemps	Private Label	Organic Valley	Wisconsin Organics	Dariy lands best
Deans	-6.39345**	0.01428**	0.02704**	0.03820**	0.03294**	0.00166**	0.00099**	0.01859**
	(0.29030)	(0.00863)	(0.02006)	(0.03157)	(0.03161)	(0.00082)	(0.00095)	(0.00043)
Golden Guernsey	0.00765**	-6.82660**	0.02933**	0.04170**	0.03529**	0.00194**	0.00112**	0.01939**
	(0.00374)	(0.27146)	(0.02116)	(0.03433)	(0.03298)	(0.00093)	(0.00120)	(0.00015)
Morning Glory	0.00718**	0.01461**	-6.48814**	0.03910**	0.03352**	0.00175**	0.00103**	0.01876**
	(0.00358)	(0.00855)	(0.59748)	(0.03176)	(0.03184)	(0.00088)	(0.00102)	(0.00098)
Kemps	0.00746**	0.01514**	0.02859**	-6.58687**	0.03442**	0.00184**	0.00105**	0.01891**
	(0.00362)	(0.00863)	(0.02045)	(0.84004)	(0.03198)	(0.00094)	(0.00108)	(0.00139)
Private Label	0.00712**	0.01436**	0.02728**	0.03895**	-6.16470**	0.00161**	0.00088**	0.01813**
	(0.00339)	(0.00773)	(0.01928)	(0.03077)	(0.51360)	(0.00078)	(0.00080)	(0.00088)
Organic Valley	0.01004**	0.02238**	0.03903**	0.05318**	0.04543**	-11.8522**	0.00670**	0.02465**
	(0.00508)	(0.01464)	(0.02797)	(0.04016)	(0.04652)	(0.87930)	(0.00788)	(0.00049)
Wisconsin Organics	0.01004**	0.02251**	0.03911**	0.05313**	0.04548**	0.00860**	-12.0372**	0.02473**
	(0.00526)	(0.01610)	(0.02868)	(0.04149)	(0.04740)	(0.00661)	(1.18720)	(0.00054)
Dairy lands best	0.00538**	0.01120**	0.02132**	0.02884**	0.02738**	0.00116**	0.00090**	-5.74993**
	(0.00365)	(0.01216)	(0.02001)	(0.03065)	(0.03166)	(0.00071)	(0.00120)	(0.00000)

Noted: **indicates statistical significance at the 5% level, standard error is reported in parenthesis. The The brands of Organic Valley and Wisconsin Organics are organic dairy milk, Deans is owned by Dean Foods; Golden Guernsey and Morning Glory are owned by Foremost Farms.

Table A(VI)-2: The own- and cross-price elasticities of different brands in 1 gallon containers

Market: Milwaukee in March 2007							
Brands	Deans	Golden Guernsey	Kemps	Private Label	Organic Valley	Wisconsin Organics	Borden Milk
Deans	-6.7046**	0.0126**	0.0131**	0.0250**	0.0035**	0.0020**	0.0216**
	(0.1643)	(0.0009)	(0.0010)	(0.0017)	(0.0003)	(0.0002)	(0.0006)
Golden Guernsey	0.0187**	-7.8493**	0.0181**	0.0322**	0.0059**	0.0033**	0.0255**
	(0.0018)	(0.0660)	(0.0011)	(0.0018)	(0.0003)	(0.0003)	(0.0002)
Kemps	0.0172**	0.0161**	-7.2944**	0.0296**	0.0052**	0.0028**	0.0236**
	(0.0014)	(0.0008)	(0.1798)	(0.0014)	(0.0003)	(0.0002)	(0.0006)
Private Label	0.0144**	0.0130**	0.0137**	-6.3919**	0.0039**	0.0021**	0.0205**
	(0.0009)	(0.0005)	(0.0006)	(0.0926)	(0.0002)	(0.0001)	(0.0004)
Organic Valley	0.0258) **	0.0271**	0.0254**	0.0435**	-12.0652**	0.0057**	0.0344**
	(0.0021)	(0.0012)	(0.0013)	(0.0021)	(0.1426)	(0.0004)	(0.0012)
Wisconsin Organics	0.0255**	0.0266**	0.0251**	0.0430**	0.0100**	-11.7027**	0.0339**
	(0.0034)	(0.0020)	(0.0020)	(0.0034)	(0.0007)	(0.1510)	(0.0020)
Borden Milk	0.0101**	0.0096**	0.0097**	0.0210**	0.0020**	0.0012**	-6.6134**
	(0.0032)	(0.0026)	(0.0029)	(0.0052)	(0.0004)	(0.0005)	(0.0000)

Noted: **indicates statistical significance at the 5% level, standard error is reported in parenthesis. The brands of Organic Valley and Wisconsin Organics are organic dairy milk, Deans is owned by Dean Foods; Golden Guernsey is owned by Foremost Farms.

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