Strawberry or Plain Yogurt? Product Line Expansions and Manufacturer's Bargaining Power with Retailers

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Abstract

This paper empirically analyzes how a manufacturer's preexisting number of vertically differentiated product lines, and the number of horizontally differentiated products within each product line affects its bargaining power with retailers. We measure manufacturer's bargaining power by the share of variable profits retained when contracting with retailers to sell its products. The analysis focuses on the US yogurt industry since this oligopoly industry has a relatively large number of manufacturers selling their, often large, menu of differentiated products through retailers. Surprisingly, we find that a manufacturer's expanded provision of horizontally differentiated products under a given line, and the number of vertically differentiated product lines, do not have statistically significant impacts on its bargaining power with retailers, i.e., do not change the manufacturer's *share* of the profit pie with retailers. However, consistent with existing theory, we find evidence that product menu expansions increase the manufacturer's variable profit, no doubt owing to an expansion in the *size* of the full variable profit pie shared with retailers. As such, the evidence suggests that it is profit-maximizing for manufacturers to product proliferate, even though this strategy has no effect on its bargaining power with retailers.

JEL Codes: L10, L13, L66

Key Words: product line expansions, relative bargaining power between vertically related agents in supply chain, product differentiation, yogurt industry

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1. Introduction

New product introductions that extend the firm's product line have become a popular competition strategy of product managers [Kekre and Srinivasan (1990); Kadiyali et al. (1998), Draganska and Jain (2005)]. With new product introductions, firms can choose to introduce new product lines or expand the existing product lines to extract more consumer surplus. For example, Apple Inc. introduced a series of iPhone models into the smartphone market. At any given point in time, the series of Apple smartphones available to consumers, currently iPhone 6 to iPhone11, differ in price and quality given the fact that consumers differ in their intensity of preference for quality [Moorthy (1984)]. Adopting a "vertical" line extension strategy, which corresponds to establishing product lines of differing quality, can better enable firms to target different market segments distinguished by consumers' differing willingness to pay for a change in quality [Mussa and Rosen (1978); Lancaster (1990)].

On the other hand, firms can offer new products that differ in some attributes, but do not differ in overall quality and price; yet these new introductions may serve as effective competitive tools for the firms. For example, Unilever & Pepsi Co introduced Lipton Iced Tea and Diet Lipton Iced Tea products. These two products have similar price and quality, but vary in other attributes, primarily sugar content, that do not have unanimous preference rankings across consumers, making this an example of a "horizontal" product line extension. With the help of horizontal product line extensions, firms can use a product proliferation strategy as a substitute for price competition [Connor (1981)]. Increased variety and longer product lines allow for a firm to capture consumers with heterogeneous tastes. Hence, firms have the advantage to use product proliferation as a defensive mechanism to protect themselves against competitors [Connor (1981); Lancaster (1979); Bayus and Putsis (1999)].

The yogurt industry provides ideal examples of both strategies, vertical and horizontal product line extensions. Several yogurt manufacturers each carries multiple product lines and offers different flavors under each line. For instance, General Mills carries yogurt product lines such as Yoplait, Liberte, and Annie's, Mountain High.[3] These product lines differ in quality and price (due to differences in attributes such as fat and protein content, probiotics or yogurt style

[3] https://www.generalmills.com/en/Brands/yogurt

(e.g. Greek versus non-Greek)); that is, these product lines can reasonably be defined as being vertically differentiated. Actual yogurt products within each product line, are horizontally differentiated, that is, products within a given line sell for a similar price and are typically distinguished by attributes, such as flavor, that are not unanimously preferred by consumers.

The profitability of the distribution channel depends on the total margins and how these margins are split between manufacturers and retailers. The size of the profit pie is determined by the ability of manufacturers and retailers to extract surplus from consumers by charging higher prices. However, the *slices* of the profit pie going to manufacturers and retailers respectively are a reflection of their relative bargaining power in interacting with each other [Draganska et al. (2010)]. By offering a greater number of vertically differentiated product lines with promotions, manufacturers can increase market share and profitability of their products [Lancaster (1979); Kekre and Srinivasan (1990)], and perhaps their bargaining power with retailers. In other words, while the size of the profit pie likely increases with a greater number of vertically differentiated product lines and perhaps with a greater number of horizontally differentiated products within each line, which in turn likely increases manufacturer's profit, it is not clear whether manufacturers' *share* of the profit pie also increases. When Chobani entered the U.S. yogurt market in 2007, it had a single product line (brand) with a large number of flavors. A recent website search shows that Chobani now offers eleven different product lines with a large number of flavors within each line.[4] While Chobani's expanded product lines, and expanded flavors within each line, are likely to have positive impacts on its profit, did these product expansions increased its share of the profit pie, i.e., its bargaining power with retailers?

The primary objective of this study is to investigate the extent to which the preexisting number of distinct product lines, as well as the preexisting number of horizontally differentiated products within each product line influence manufacturers' bargaining power with retailers. To achieve our objective, we follow the general framework of Draganska et al. (2010). Our study focuses on the yogurt industry since this industry provides ideal examples of varying degrees of both vertical and horizontal product differentiation across several manufacturers.

Our research methodology involves three distinct steps. In the first step, we estimate a differentiated products consumer demand model using scanner data on yogurt sales at supermarket and drug store retail outlets. Given demand parameter estimates, in the second step we use a

[4] https://www.chobani.com/products/, accessed (December 19, 2019).

supply-side model of Nash bargaining between manufacturers and retailers to estimate parameters of relative bargaining power between manufacturer-retailer pairs. With parameter estimates of relative bargaining power between manufacturer-retailer pairs in hand, in the third step we use a sequence of linear regression models to estimate the influence of the preexisting number of distinct product lines, and the preexisting number of horizontally differentiated products within product lines on manufacturers' bargaining power with retailers.

Our analysis adds to the literature that studies manufacturer-retailer relative bargaining powers within the vertical channel [Draganska et al. (2010); Crawford and Yurukoglu (2012); Doudchenko and Yurukoglu (2016); Bonnet and Bouamra-Mechemache (2015); Bonnet et al. (2015); Grennan (2013); Grennan (2014); Haucap et al. (2013); Ellickson et al. (2018)]. Earlier studies in this literature focused on the determinants of the retailer's bargaining power. In this study, we empirically investigate the basic assumption of Lancaster (1979) and Kekre and Srinivasan (1990) that offering many product lines and assortment increases the market share, profitability and indirectly the bargaining power of the manufacturer with retailers.

For the yogurt industry, our results indicate that bargaining power is mostly on the retailer side. We find that relative bargaining power varies depending on the manufacturer-retailer pair. The analysis goes on to assess the influence the preexisting number of vertically differentiated product lines, and the preexisting number of horizontally differentiated products within product lines (measured by the number of flavors within product lines) have on the bargaining power of manufacturers with retailers. Surprisingly, we find that: *(i)* expanding existing product lines horizontally; and *(ii)* expanding the number of quality-differentiated brands, have no statistically discernable impact on the manufacturer's bargaining power with retailers. However, consistent with theoretical predictions in Lancaster (1979) and Kekre and Srinivasan (1990), we find evidence suggesting that it is still optimal for manufacturers to choose to product proliferate horizontally and vertically, even though these product proliferation strategies have no impact on manufacturer's bargaining power with retailers.

The rest of the paper is organized as follows: Section 2 provides a description of the data; Section 3 outlines the econometric model of the yogurt market; Section 4 explains the estimation and identification strategies; Section 5 discusses the results; Section 6 provides the main conclusions of the paper.

2. Data

This study primarily uses data made available by the U.S. marketing firm, Information Resources Inc. (IRI). IRI collected data by using scanning devices from a sample of stores belonging to different retail chains located in various areas of the U.S. The data consist of weekly prices and the total sales of almost all brands of yogurt sold in the U.S. We use data in year 2012.[5]

We chose to delineate the geographic market areas by county, which is often a smaller geographic area compared to IRI designated geographic market areas. In our study, each market is defined as the unique combination of county, month and year. Each product in the dataset is defined as a unique combination of non-price characteristics, such as, yogurt style (Greek vs. non-Greek), brands, flavor/scent, organic information, and packaging type. Thus, packaged yogurt under the same brand with a different yogurt style, and organic information are designated as different products (e.g. Organic Greek yogurt with a strawberry flavor is a different product than Organic Greek yogurt with a blueberry flavor in a given retailer store). For each product in each market, we aggregate weekly data up to monthly sales and dollar value revenue from sales. The average retail product prices are computed by dividing monthly sales revenue by monthly unit sales.

We use a discrete choice demand model similar to Villas-Boas (2007), which requires computing product shares, as well as the share of an outside option in each market. First, we describe how potential market size is measured in this study, which is used in computing product shares and the share of the outside option in each market. Following Villas-Boas (2007), we assumed per capita yogurt consumption for each individual in the U.S. is half of the per capita yogurt consumption per month. After obtaining the population of each county from the Bureau of Labor Statistics (BLS), we multiplied the number of adult population with half of the per capita yogurt consumption, which yields the measure we use for potential market size for each defined market, respectively. The observed share associated with each product in a given market is computed by dividing the product's unit sales by the market's potential size measure. The observed share of the outside option is computed as one minus the sum of observed shares across products within a given market. Table 1 lists and defines the variables used in the analysis.

[5] Data are available from 2001 to 2012.

Table 1. Description of available variables

Name	**Description**
Price	Average monthly prices in dollar per ounce.
Market Share (S_j)	Monthly market shares for each product (S_j) are computed as the total quantity sold divided by the potential market size.
Feature count	Counts feature(s) (i.e., frequent shopper program, large size advertisement) occurred for product during that month.
Display count	Counts the special display(s) (e.g. end aisle, lobby) occurred for each product during that month.
Sugar	Sugar price per ounce
Protein	Protein information per ounce of yogurt
Organic Information	Dummy=1 if the product is organic, zero otherwise
Yogurt style	Dummy=1 if the product is Greek yogurt, zero otherwise
Total Sugar	Amount of sugar per ounce of yogurt
Sodium	Amount of sodium per ounce of yogurt
Total Fat	Amount of total fat per ounce of yogurt

For the empirical analysis, we need to supplement the IRI-dataset with data on non-price product characteristics and consumer demographics. Data on non-price product characteristics are collected based on nutritional facts from label reads of each brand, such as calorie, sugar, fat, and protein contents, under the assumption that those characteristics did not change over the observed period. Assuming an individual's income is presumably relevant to his/her demand for yogurt, we have drawn income information of consumers from the Public Microdataset Sample (PUMS). Our model considers the interactions of consumer demographics with the price and select non-price product characteristics, such as yogurt style, i.e. Greek versus non-Greek style.

Table 2 provides descriptive statistics for single-pack, 6-ounces yogurt products. The average price of yogurt per ounce is \$0.149. Data on the price for sugar, a cost-shifting variable, are obtained from the United States Department of Agriculture (USDA) database.[6] The cost-shifting variable relates more closely to manufacturers' cost.

Table 2. Descriptive Statistics of single-pack, 6-ounces yogurt products

Description	Mean	S.E.	Min	Max
Average price ($/ounce)	0.149	0.0005	0.05	0.55
Aggregate sales (ounces)	1191.26	17.93	6	35154
Sugar prices (cents/ounce)	68.935	0.004	67.9	69.6
Feature	0.507	0.006	0	4
Display	0.045	0.002	0	4
Total Sugar (per ounce)	2.85	0.094	0	6.22
Protein (per ounce)	1.236	0.0509	0.5	2.64
Sodium (per ounce)	14.66	0.037	0.66	45.28
Total Fat (per ounce)	0.227	0.003	0	2.5

2.1 Relevant Measures of Manufacturers' Product Line(s)

To assess the influence of number of vertically differentiated product lines (product line width), and number of horizontally differentiated products within product lines (product line depth) on the bargaining power of manufacturers, we constructed measures of product line width and product line depth, respectively.

Supposedly, the number of flavors offered under each brand of a given manufacturer can increase consumers' brand loyalty and willingness to pay for that manufacturer's products. The idea is that if the manufacturer differentiates itself from the other competitors horizontally, then it can increase consumer loyalty and demand, and perhaps in turn charge higher price-cost margins. We construct measures of manufacturers' product line depth using the number of flavors under each product line of a given manufacturer. Some manufacturers carry more than one product line; however, our empirical framework requires assigning to each manufacturer a single value measuring their product line depth. Thus, we define two alternative measures of a manufacturer's product line depth: (*i*) *Product Line Depth - Maximum*, which is the number of flavors offered

[6] https://www.ers.usda.gov/data-products/sugar-and-sweeteners-yearbook-tables.aspx

within the given manufacturer's largest product line; and (*ii*) *Product Line Depth - Average,* which is the average number of flavors offered across the given manufacturer's product lines.

Due to the difference in quality across product lines, having a variety of quality differentiated product lines can better enable firms to capture distinct segments of the market. Thus, we hypothesize that manufacturers with relatively more brands have greater bargaining power with a given retailer. We define *Product Line Width* as the number of brands carried by each manufacturer.

To ensure that we use measures of product line depth and product line width that are exogenous, or at least pre-determined, within the context of our empirical bargaining model, we constructed these variables by using manufacturers' product menu information from January through April in year 2012. Table A1 in Appendix A1 lists manufacturers and their available brands. Note however, the demand and supply-side bargaining models are estimated on sales of products from May through December of 2012. As such, manufacturers' product menu data are obtained prior to the period used for actual econometric estimation of the bargaining model. Table 3 provides descriptive statistics on product line width, product line depth and industry sales share, respectively, across manufacturers in our data sample.

Column (1) of Table 3 shows the number of product lines for each manufacturer. Among the 30 manufacturers in our data sample, nineteen of them (i.e., 63 percent of them) offer a single product line; nine of them (i.e., 30 percent of them) offer two product lines; one (i.e., 3.33 percent of them) offers seven product lines; and one manufacturer (i.e., 3.33 percent of them) offers nine product lines.

Columns (2) and (3) of Table 3 show manufacturers *Product Line Depth - Maximum* and *Product Line Depth – Average*, respectively. Private labels (PL) products - under the assumption of each PL is produced by a common, outside manufacturer - offers 89 different flavors; while Chobani offers a single product line with 16 flavors; General Mill's largest product line has 27 flavors, with an average 11 flavors per line; and Group Dannon's largest product line offers 17 flavors, with an average 9 flavors per line.

The last column of Table 3 shows the industry sales share of each manufacturer in the data. Based on the share of industry sales data, Chobani has the highest share of industry sales, followed by Private Label, General Mills and Group Dannon, respectively.

Table 3. Each manufacturer's product line width, product line depth and industry sales share

Producer Name	**(1)** **Product Line Width**	**(2)** **Product Line Depth-Maximum**	**(3)** **Product Line Depth-Average**	**(4)** **Industry sales share(%)**
Chobani Inc.	1	16	16	34.02147
Private Label	1	89	89	26.20433
General Mills Inc.	7	27	10.71	21.31476
Group Dannon	9	17	8.56	16.45848
Liberty Products Inc.	2	6	5	0.30474
Johanna Foods Inc	2	18	10	0.29776
WhiteWave	1	5	5	0.28393
Fage	1	1	1	0.21803
Turtle Mountain Inc	1	7	7	0.14004
Wallaby Yogurt Company Inc.	2	14	9.5	0.11391
Tula Food Inc	1	6	6	0.10977
The Hain Celestial Group Inc.	2	4	4	0.07477
Tillamook	1	9	9	0.07285
WholeSoy & Co	1	7	7	0.06144
Cascade Fresh	2	11	6.5	0.05672
Redwood Hill Farm	1	5	5	0.05508
Dean Foods	1	4	4	0.05184
Alpina	2	1	1	0.03834
Prairie Farms	1	11	1.22	0.02931
H P Food Inc	2	7	7	0.02021
Greece By Tyras	1	6	6	0.01773
Emmi Roth Inc.	1	7	7	0.01568
Green Mountain Creamery	1	5	5	0.01495
Kalona Organics	1	2	2	0.00728
Maple Hill Creamery	1	2	2	0.00586
Schreiber Foods Inc.	1	4	4	0.00473
Mehadrin Dairy	2	4	3	0.00334
National Dairy Holdings	2	15	9.5	0.00149
Green Valley Organics	1	2	2	0.00112
Springfield Creamery	1	5	5	0.00003

Notes: Product line width and Product line depth measurements are computed based on manufacturers' product menu information from January through April of year 2012.

3. Econometric Model of the Yogurt Market

We model the market for yogurt using a structural model of demand and strategic behavior of retailers and manufacturers. The empirical strategy is as follows. First, we estimate consumers' preferences in the yogurt market. Consumers in a market face a choice set that includes the offers of different yogurt products, and each product is defined as a combination of non-price characteristics. Using demand estimates, along with an assumed static Nash equilibrium price-setting behavior among downstream retailers, we recover retail price-cost margins. By using exogenous cost-shifting variables of yogurt production within a supply-side manufacturer-retailer Nash bargaining framework, we estimate parameters that measure the relative bargaining power of manufacturers with respect to retailers for each manufacturer-retailer pair. In the final step of the empirical strategy, we use a sequence of linear regression models to estimate the influence of number of distinct product lines, and number of horizontally differentiated products within product lines on manufacturers' bargaining power with retailers.

3.1 Demand Model

We use a random coefficients logit model to estimate the demand and related price elasticities [Berry and Pakes (2001)]. Suppose there are *M* markets, *m=1,. . .,M* and in each market, there are L_m potential consumers. A typical consumer *i* can choose to either buy one of the *J* differentiated products, *j=1,. . .,J* or otherwise choose the outside good (*j*=0), allowing for the possibility of consumer *i* not buying one of the *J* marketed goods. Therefore, consumer *i* chooses between *J+1* alternatives in market *m* during time *t.* Consumer *i*'s conditional indirect utility for the outside good is $u_{i0t} = \varepsilon_{i0mt}$, while for products *j=1,. . .,J* it is:

$$U_{ijmt} = x_{jmt}\beta_i + \alpha_i p_{jmt} + county_m + v_t + product_j + \xi_{jmt} + \varepsilon_{ijmt} \tag{1}$$

where in equation (1), x_{jmt} is a vector of observed non-price product characteristics. The parameter vector β_i contains consumer-specific valuations for the product characteristics. Parameter α_i captures consumer-specific disutility of price. p_{jmt} is the price of yogurt per ounce; $county_m$ captures county-specific fixed effects; v_t captures time (month) fixed effects; $product_j$ captures product-specific fixed effects; and ξ_{jmt} is the unobserved (by the econometrician) brand characteristics (i.e., quality, reputation, etc.) that have an impact on consumer utility, whereas ε_{ijmt} is a mean-zero stochastic error term.

The distribution of consumer-specific taste parameters, β_i and α_i , is specified as follows:

$$\begin{pmatrix} \alpha_i \\ \beta_i \end{pmatrix} = \begin{pmatrix} \alpha \\ \beta \end{pmatrix} + \phi D_i + \Sigma \vartheta_i \tag{2}$$

In Equation (2), α and β parameters are the mean marginal utilities of respective observable product characteristics. D_i is an *m*-dimensional column vector of demographic variables, while ϑ_i is a *k*-dimensional column vector that captures unobserved consumer characteristics. ϕ is a $k \times m$ matrix of parameters that measure how taste characteristics vary with demographics, and Σ is a $k \times k$ diagonal matrix with a set of parameters, σ_k, on the diagonal that measures the variation in consumer tastes for respective product attributes due to random shocks. In our estimation, we consider income as a demographic variable, and we expressed the demographic variable in deviation from its respective mean. Thus, the mean of D_i is zero. Following Nevo (2000b), we assume that ϑ_i has a standard multivariate normal distribution, $\vartheta_i \sim N(0,1)$. The assumptions regarding D_i and ϑ_i along with equation (2) imply that, the mean of α_i is α, and the mean of β_i is β, while variances of these consumer-specific marginal utilities are equal to the square of the elements on the main diagonal of Σ.

We can break down the indirect utility into a mean utility, $\delta_{jmt} = x_{jmt}\beta + \alpha p_{jmt} + county_m + v_t + product_j + \xi_{jmt}$, and a deviation from this mean utility $\mu_{ijmt}(x_{jmt}, p_{jmt}, D_i, \vartheta_i; \phi, \Sigma) = [p_{jmt}, x_{jmt}](\phi D_i + \Sigma\vartheta_i)$. As such, the indirect utility can be re-written as:

$$U_{ijmt} = \delta_{jmt} + \mu_{ijmt} + \varepsilon_{ijmt} \tag{3}$$

For computational tractability, the idiosyncratic error term ε_{ijmt} is assumed to be governed by an independent and identically distributed extreme value density. Individual *i*'s probability of buying product *j* in market *m* at time *t* is as follows:

$$s_{ijmt} = \frac{\exp(\delta_{jmt} + \mu_{ijmt})}{\sum_{k=0}^{J_t} \exp(\delta_{kmt} + \mu_{ikmt})} \tag{4}$$

The market share of product *j* in market *m* at time *t* is given by:

$$s_{jmt} = \int \frac{\exp\left(\delta_{jmt} + \mu_{ijmt}\right)}{\sum_{k=0}^{J_t} \exp(\delta_{kmt} + \mu_{ikmt})} d\widehat{F(D)} dF(v) \tag{5}$$

where d$\widehat{F(D)}$ and $dF(v)$ are population distribution functions for consumer demographics and random taste shocks assumed to be independently distributed. For the integral in Equation (5), there is no closed-form solution. Thus, it must be approximated numerically by using random draws from $\widehat{F(D)}$ and $F(v)$.

Finally, the demand for product *j* is given by:

$$d_{jmt} = L_m \times s_{jmt}(x, p, \xi; \theta_d) \tag{6}$$

where in equation (6), L_m is a measure of market size in a given county; $s_{jmt}(x, p, \xi; \theta_d)$ is the model predicted share of product *j*; x, p, and ξ are vectors of observed non-price characteristics, price and the unobserved vector of product characteristics, respectively; and θ_d=(α, β, $county_m$, v_t, $product_j$, ϕ, Σ) is a vector of demand parameters to be estimated.

3.2 Supply-side of Model

We consider the vertical structure of the yogurt industry as consisting of n_f upstream manufacturers and n_r downstream retailers. Each upstream manufacturer produces a set of products, G^f, and each downstream retailer sells a set of products, R^r. A given market consists of J differentiated products. The marginal cost a manufacturer incurs in producing product *j* is denoted by mc_j^f, while the marginal cost a retailer incurs in offering the product to consumers is denoted as mc_j^r. The retail price of product *j* is denoted as p_j, and the wholesale price the retailer pays the manufacturer for the product is denoted as p_j^w. To simplify notation, we drop the time subscripts for the remainder of this section.

Retailer's profit function is given by:

$$\pi^r(p) = \sum_{j \in R^r} \left[p_j - p_j^w - mc_j^r\right] \times q_j(p) \qquad (7)$$

$$= \sum_{j \in R^r} (p_j - p_j^w - mc_j^r) \times [L \times s_j(p)]$$

The profit of manufacturer *f* from all products sold to retailers is denoted by:

$$\pi^f\big(p(p^w)\big) = \sum_{j \in G^f} \left[p_j^w - mc_j^f\right] \times q_j(p(p^w)) \qquad (8)$$

$$= \sum_{j \in G^f} (p_j^w - mc_j^f) \times [L \times s_j(p(p^w))]$$

As in Draganska et al. (2010), first, we derive the retail margins under the assumption of retailers in the yogurt market choosing final prices based on Bertrand-Nash competition. We subsequently describe the wholesale price equilibrium under the assumption that upstream manufacturers and downstream retailers negotiate the wholesale prices based on a Nash bargaining game. By following Draganska et al. (2010), we consider that each manufacturer-retailer pair secretly and simultaneously contracts over the wholesale price of product j. Also, we assume that manufacturers and retailers have rational expectations, such that both parties anticipate the ultimate equilibrium outcome.

Retail Margins

Each retailer r chooses retail prices for the products it sells to maximize its profit, $\pi^r(p)$. The resulting first-order conditions are:

$$s_j(p) + \sum_{k \in R^r} (p_k - p_k^w - mc_k^r) \frac{\partial s_k(p)}{\partial p_j} = 0 \qquad \forall\, j \qquad (9)$$

We can conveniently recover the set of retail markups by re-writing the above equation in matrix form. To do so, we define a $J \times J$ matrix that characterizes retailers' ownership structure of the products in the market. Matrix T_r has a general element, $T_r(k,j)$, equal to 1 if product k and j are sold by the same retailer, and 0 otherwise. Let Δ_r be the $J \times J$ matrix that captures the response of product share to retail prices, i.e., matrix Δ_r contains first-order partial derivatives of product shares with respect to all retail prices:

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

In vector notation, the first-order conditions characterized by equation (9) implies that the $J \times 1$ vector of retail markups (γ) is given by the following expression:

$$\gamma \equiv p - p^w - mc^r = -(T_r * \Delta_r)^{-1} \times s(p), \tag{10}$$

where p, p^w, mc^r, and $s(\cdot)$ are $J \times 1$ vectors of retail prices, wholesale prices, retail marginal costs, and product shares respectively; while $T_r * \Delta_r$ represents element-by-element multiplication of the two matrices.

Wholesale Margins

During the manufacturer-retailer negotiation process, each manufacturer presumes the set of contract terms its competitors have been offered. Manufacturer's presumptions about the contract and out-of-equilibrium beliefs can change the bargaining outcome. However, observing the linkages across negotiations and identifying what each manufacturer knows about its rivals is very challenging. To overcome this difficulty, we model the bargaining process under the cooperative approach by making a few assumptions.

Basic Assumptions of the Cooperative Bargaining Model

- Any bargaining outcome must be bilaterally renegotiation-proof, that is, no manufacturer-retailer pair can deviate from the bargaining outcome in a way that increases their joint profit, taking as given all other contracts.
- Following Marx and Shaffer (1999), Misra and Mohanty (2006), Bonnet and Boumra-Mechemecha (2015), we assume that bargaining between each manufacturer-retailer pair maximizes joint profit, taking as given all other negotiated contracts.
- We assume that each player earns its disagreement payoff, plus a share $\lambda_j \epsilon$ [0,1] of the incremental gain from trade going to the retailer, and 1-λ_j going to the manufacturer.

- As in Draganska et al. (2010), we assume that a manufacturer negotiates with a given retailer for each of its products, and that each product is negotiated separately with the manufacturer.
- We assume that retail prices are not observable when bargaining over the wholesale prices. Retail prices are then considered as fixed when solving the bargaining game (Please see Draganska et al. (2010) for a detailed justification).

The equilibrium wholesale price for product *j* is derived from the bilateral bargaining problem between a manufacturer and a retailer such that each manufacturer and retailer pair maximizes the Nash product:

$$\left[\pi_j^r\left(p_j^w\right) - d_j^r\right]^{\lambda_j}\left[\pi_j^f\left(p_j^w\right) - d_j^f\right]^{1-\lambda_j} \quad (11)$$

where $\pi_j^f\left(p_j^w\right)$ is manufacturer profit and $\pi_j^r\left(p_j^w\right)$ retailer profit for product *j*. Manufacturer's profit for product *j* is given as:

$$\pi_j^f\left(p_j^w\right) = (p_j^w - mc_j^f) \times L \times s_j(p) = \Gamma_j \times L \times s_j(p) \quad (12)$$

where $\Gamma_j \equiv (p_j^w - mc_j^f)$ defines manufacturer's markup on product *j*. Retailer's profit for product *j* is given as:

$$\pi_j^r\left(p_j^w\right) = (p_j - p_j^w - mc_j^r) \times L \times s_j(p) = \gamma_j \times L \times s_j(p) \quad (13)$$

The retailer realizes disagreement payoff, d_j^r, if it does not carry manufacturer's product *j* in its store, but contracts with others. Similarly, the manufacturer realizes a disagreement payoff, d_j^f, from the sales of other products to this retailer and sales to other retailers if the negotiation fails with retailer *r* for product *j*. Assuming that the retail prices are fixed during negotiation, then the disagreement payoffs are given by:

$$d_j^r = \sum_{k \epsilon R^r \setminus \{j\}} \gamma_k \times L \times \Delta s_k^{-j}(p) \tag{14}$$

$$d_j^f = \sum_{k \epsilon G^f \setminus \{j\}} \Gamma_k \times L \times \Delta s_k^{-j}(p) \tag{15}$$

where $L \times \Delta s_k^{-j}(p)$ is the change in market demand of product *k* that occurs when product *j* is no longer sold on the market. Those quantities can be derived through the substitution patterns estimated in the demand model as follows:

$$\Delta s_k^{-j}(p) = \int \frac{\exp(\delta_{kmt} + \mu_{ikmt})}{\sum_{l=0}^{J_t \setminus \{j\}} \exp(\delta_{lmt} + \mu_{ilmt})} - \frac{\exp(\delta_{kmt} + \mu_{ikmt})}{\sum_{l=0}^{J_t} \exp(\delta_{lmt} + \mu_{ilmt})} \, d\widehat{F(D)} dF(v) \tag{16}$$

Solving equation (11) in the bargaining problem leads to the first-order condition:

$$\lambda_j \left(\pi_j^f - d_j^f\right) \frac{\partial \pi_j^r \left(p_j^w\right)}{\partial p_j^w} + \left(1 - \lambda_j\right)\left(\pi_j^r - d_j^r\right) \frac{\partial \pi_j^f \left(p_j^w\right)}{\partial p_j^w} = 0 \tag{17}$$

Under the assumption that the matrix of prices for final products is treated as fixed when wholesale prices are decided during the bargaining process, we have $\frac{\partial \pi_j^r \left(p_j^w\right)}{\partial p_j^w} = -L \times s_j(p)$ and $\frac{\partial \pi_j^f \left(p_j^w\right)}{\partial p_j^w} = L \times s_j(p)$ from equations (12) and (13). Equation (17) can thus be re-written as $\pi_j^f - d_j^f = \frac{1-\lambda_j}{\lambda_j}(\pi_j^r - d_j^r)$. Using equations (12), (13), (14) and (15), the following expression can be derived for the bargaining solution:

$$\Gamma_j \times L \times s_j(p) - \sum_{k \epsilon R^r \backslash \{j\}} \Gamma_k \times L \times \Delta s_k^{-j}(p) = \frac{1-\lambda_j}{\lambda_j} \times [\gamma_j \times L \times s_j(p) - \sum_{k \epsilon G^f \backslash \{j\}} \Gamma_k \times L \times \Delta s_k^{-j}(p)] \tag{18}$$

Using equation (18) for all products, we obtain the matrix of manufacturer's margins:

$$\Gamma = \frac{1-\lambda}{\lambda} \left(T_f * S\right)^{-1}(T_r * S)\gamma \tag{19}$$

where analogous to T_r in the case of retailers, T_f characterizes manufacturers' ownership structure of the products in the market; and S is a $J \times J$ matrix with the product market shares as diagonal elements and changes in market shares otherwise:

$$S = \begin{bmatrix} s_1 & \cdots & \Delta s_J^{-1} \\ \vdots & \ddots & \vdots \\ \Delta s_1^{-J} & \cdots & s_J \end{bmatrix}$$

Adding equations (19) and (10) leads to the vector of the total margins for manufacturer-retailer pairs:

$$p - mc^f - mc^r = \gamma + \Gamma = \frac{1-\lambda}{\lambda} \left(T_f * S\right)^{-1}(T_r * S)\gamma - (T_r * \Delta_r)^{-1} \times s(p)$$
$$= \frac{1-\lambda}{\lambda} \left[\left(T_f * S\right)^{-1}(T_r * S) \times \gamma\right] + \gamma \tag{20}$$

where $\gamma = -(T_r * \Delta_r)^{-1} \times s(p)$ is a $J \times 1$ vector of retail markups.

Because we do not directly observe manufacturers' marginal production costs, as well as retailers' marginal distribution costs, we are not able to determine analytically the bargaining power λ_j. We estimate the total marginal cost by specifying the overall channel MC_j for each product *j* as follows:

$$MC_j = \varphi\omega_j + \eta_j \tag{21}$$

where ω_j is a vector of cost-shifting variables, φ is the vector of parameters associated with the cost-shifting variables; and η_j is the error term that accounts for the unobserved shocks to marginal cost. The supply-side equation to be estimated is given by:

$$p = \varphi\omega + \frac{1-\lambda}{\lambda} B + \gamma + \eta \tag{22}$$

where we can see from equation (20) that $B = \left[\left(T_f * S\right)^{-1}(T_r * S) \times \gamma\right]$, which is a $J \times 1$ vector. Instead of using vector notation, equation (22) can be written at the product observation level as follows:

$$p_j = \varphi\omega_j + \frac{1-\lambda}{\lambda} B_j + \gamma_j + \eta_j \tag{23}$$

Since our objective is to use equation (23) to estimate manufacturer-retailer pair-specific λ, we interact variable B_j with a full set of manufacturer-retailer pair zero-one dummy variables, i.e., we estimate:

$$p_j = \varphi\omega_j + \sum_{fr\in(n_f \times n_r)} \frac{1-\lambda_{fr}}{\lambda_{fr}} B_j \times I_{fr} + \gamma_j + \eta_j \tag{24}$$

where *fr* indexes manufacturer-retailer pairs; $\left(n_f \times n_r\right)$ is the set product of manufacturer-retailer pairs; and I_{fr} is a zero-one dummy variable that is equal to one only for products offered by manufacturer-retailer pair *fr*. We are then able to obtain an estimate of λ_{fr} for each manufacturer-retailer pair. Note that the theory requires that each λ_{fr} lie between zero and one. As such, our generalized methods of moments (GMM) estimating of equation (24) imposes this parameter restriction to be consistent with the theory.

4. Estimation and Identification of Demand

To estimate the set of demand parameters, we use generalized methods of moments (GMM) following the previous literature [Berry (1994); Berry, Levinson and Pakes (1995) (BLP); Nevo (2000a); and Petrin (2002)]. The general strategy is to derive parameter estimates such that the observed product shares S_{jt} are equal to predicted product shares s_{jt}.

Instruments

To obtain consistent estimates of price coefficients, α_i, instrumental variables are required because when firms are setting their prices, they consider not only the product characteristics observed by us the researchers, x_{jmt}, but also the product characteristics, ξ_{jmt}, that are not observed by us the researchers, but observed by all consumers. Firms also take into account any changes in the product characteristics and consumer valuations.[7] To mitigate the endogeneity problem, we include product and market fixed effects. However, instruments for retail product prices are needed to deal with endogeneity problems that may remain even after controlling for product and market fixed effects.

In constructing one set of retail product price instruments, we assume that input prices are uncorrelated with the unobserved econometric error, ξ_{jmt}, but highly correlated with retail price. The justification for this assumption is that consumers' brand loyalty across yogurt products is most likely uncorrelated with the prices of inputs in the production of yogurt, e.g. prices of milk, sugar, strawberry, electricity etc., but these input prices do influence the retail price of yogurt [Villas-Boas (2007)]. In addition, the intensity with which each input is used is likely to vary across yogurt brands. For example, some yogurt brands may use relatively more sugar than others; some brands may use more electricity for extra processing; only some brands use strawberry etc. As such, a change in price of a given input is likely to differentially influence production cost and therefore retail prices across yogurt brands. To allow input price to have differential production

[7] Villas-Boas (2007)

cost effects across brands of yogurt, we interact input prices with product dummies, and use these interaction variables as instruments for retail price. In fact, brands focusing on the production of different flavors are likely to use more sugar than plain yogurt brands. Therefore, the sugar usage intensity would be different between the yogurt brands. Thus, sugar prices interacted with the brand dummies are valid instruments for the endogenous retail price of yogurt. Data on the monthly price of sugar are obtained from the U.S. Department of Agriculture.

Further, as shown by Berry and Haile (2014), the heterogeneity in consumer preferences for product characteristics creates an endogeneity problem that arises from the interaction of unknown demand parameters with market shares. The mean utilities that equate observed shares to predicted shares and the income terms will also be correlated with the unobserved error term. To mitigate this source of endogeneity, first, we define "count" variables of advertising characteristics for each product, i.e. number of times within the relevant month each product has been featured and specially displayed. This type of advertising information can be obtained from the data for each product to construct BLP type instruments. Then, we compute mean advertising counts across yogurt-type (Greek versus non-Greek type) products within each market, which facilitates computation of the deviation of each product's advertising characteristic count from the relevant mean across similar yogurt-type products. We use deviation of each product's advertising characteristic count as instruments in demand estimation. Deviation of each product's advertising characteristic count from the relevant mean across similar yogurt-type products are likely to be correlated with products' market shares because consumers' preferences are likely to be influenced by differences in advertising intensities across products. To identify parameters governing consumer heterogeneity, we use the interaction of mean income with the input costs (price of sugar) and brand dummies as instruments.

5. Empirical Results

5.1 Demand

Standard Logit Model of Demand

The first and second columns in Table 4 present the coefficient estimates from the linear regression of mean utility $\delta_j = \log(S_{jmt}) - \log(S_{0mt})$ on various product and market characteristics, which is the standard logit specification of the demand model. Coefficient estimates of the standard logit specification of the demand model in columns 1 and 2 of Table 4 are obtained using ordinary least squares (OLS) and two-stage least squares (2SLS) estimation procedures, respectively. The estimates of price coefficients from OLS and 2SLS are negative and statistically significant. As mentioned before, price is an endogenous variable in demand estimation. Hence, OLS estimation in column 1 of Table 4 produces biased and inconsistent estimate of the price coefficient. To eliminate the endogeneity problem of price, we re-estimate the demand equation using 2SLS. The Wu-Hausman exogeneity test rejects the exogeneity of price at conventional levels of statistical significance, and suggests the instruments used are necessary.

Random Coefficients Logit Model of Demand

Results from the random coefficients logit (RCM) specification of the demand model are presented in columns (3), (4) and (5) of Table 4. The coefficient estimate of price in the RCM model is negative and statistically significant at conventional levels of statistical significance. Column (4) reports parameters that capture consumer taste variation unobserved by the researchers for various product characteristics. The estimated effects are statistically and economically significant, suggesting that consumers are heterogeneous with respect to their marginal disutility for price changes of yogurt products.

Consumers tend to prefer yogurt products that are Greek style. This result is evident from the positive and statistically significant coefficient estimate on the *Greek* dummy variable. Furthermore, the negative and statistically significant coefficient estimate on the interaction variable of *Greek* with consumer income suggests that lower income consumers have relatively stronger preferences for Greek style yogurt.

The positive and statistically significant coefficient estimate on the *Organic* dummy variable suggests that organic yogurt products are associated with higher levels of utility compared to non-organic yogurt products, *ceteris-paribus*.

On average, consumers tend to dislike sugar-intensive and sodium-intensive yogurt brands as evidenced by the negative and statistically significant coefficient estimates on these two variables, *Sugar* and *Sodium*, respectively. This finding may in part reflect effective nutrition awareness campaigns of various groups and institutions. For example, Harvard Medical School suggests that sugar obtained from processed foods such as flavored yogurt, cereals, and cookies can lead to obesity, and have a serious impact on heart health.[8] Based on research, there is an association between higher sugar diet and a greater risk of dying from heart disease [Yang et al., 2014]. According to the US Department of Health and Human Services, consuming low-sodium snacks can help to control daily sodium intake - which can help consumers to reduce the risk for high blood pressure and heart disease [Weinberger (1996)]

The coefficient estimate on the variable *Fat* is positive and statistically significant, suggesting that whole-fat content yogurts are preferred by consumers, *ceteris-paribus*. There is evidence that full-fat dairy is correlated with a decreased risk of obesity: If something has a richer flavor, you may need less of it to feel satisfied. As such, consumers' choice behavior with respect to yogurt consumption seems to be consistent with healthy nutrition recommendations.[9] Recent study shows that whole-fat dairy consumption is associated with lower risk of mortality and major cardiovascular disease events [Dehghan et al., (2018)].

Consumers are more likely to buy protein-intensive yogurt brands as evidenced by the positive and statistically significant coefficient estimate on the *Protein* variable. Eating yogurt each day can help individuals to achieve their daily protein intake.[10] If protein-intensive yogurt is chosen as a snack, research shows that there is a longer delay in requesting food; which helps to mitigate obesity [Khoury et al., (2014)]. In line with these findings, our results show that protein-intensive brands incentivize consumption of yogurt.

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[8] https://www.health.harvard.edu/heart-health/the-sweet-danger-of-sugar
[9] https://www.health.harvard.edu/blog/is-it-time-to-stop-skimming-over-full-fat-dairy-2019102118028
[10] http://healthyeating.sfgate.com/much-protein-yogurt-6135.html

Table 4. Demand estimation results for single-pack, 6-ounces yogurt products

Variable	Standard Logit		Random Coefficients Logit		
	OLS	2SLS	GMM		
	Mean Coef	Mean Coef	Mean Coef	Standard Deviations	Demographic Interactions
	(α, β)	(α, β)	(α, β)	(σ)	(Income)
Price	-15.732***	-30.945***	-53.067***	-4.382***	1.443***
	(0.213)	(1.18)	(2.108)	(1.138)	(0.081)
$Constant^a$	0.568***	0.971***	1.170***	1.120***	
	(0.067)	(0.073)	(0.073)	(0.356)	
Greek	0.291***	1.488***	3.135***	-1.293***	-0.126***
	(0.053)	(0.105)	(0.312)	(0.256)	(0.011)
Organic	0.144***	0.629***	1.196***		
	(0.046)	(0.064)	(0.071)		
Label reads					
$Sugar^a$	-0.281***	-0.242***	-0.189***		
	(0.025)	(0.0246)	(0.025)		
$Protein^a$	0.072***	0.071***	0.061***		
	(0.020)	(0.0204)	(0.020)		
$Sodium^a$	-0.064***	-0.0734***	-0.076***		
	(0.005)	(0.0048)	(0.005)		
Fat^a	0.178***	0.181***	0.231***		
	(0.056)	(0.0559)	(0.056)		
Advertising					
Feature	0.117*	-1.117***	-0.342*		
	(0.082)	(0.129)	(0.176)		
Display	0.864***	0.448***	0.764***		
	(0.177)	(0.206)	(0.202)		
Fixed Effects					
County	yes	yes	yes		
Month	yes	yes	yes		
Brand	yes	yes	yes		
Exogeneity Test for IVs					
Wu-Hausman		264.792***			
		(*p*=0.000)			
Other Statistics					
R^2	0.98				
GMM Objective			336.361		
# of Observations	15,224	15,224	15,224		

Notes: Standard errors in parentheses. *** p<0.01, ** p<0.05, * p<0.1. [a] Estimates are calculated using the Minimum Distance approach described in Nevo (2000b).

5.2 Elasticities

Given the structural demand estimates, we compute price elasticities of demand for each differentiated product. As previously discussed, a market is defined as a combination of time (month) and geographic location (county), while a product is defined as a unique combination of non-price characteristics.

The average of own-price elasticities is -7.54. The estimated own-price elasticities are within the “ballpark” of estimates in previous studies on the yogurt industry. For example, Draganska and Jain (2006) estimated average own-price elasticities of -4.25, and Villas-Boas (2007) find average own-price elasticity estimates of -5.9. For consumption goods, Pinkse and Slade (2004) estimate average own-price elasticities equal to -2 for beer in the UK, Nevo (2000a) finds that own-price elasticities for ready-to-eat cereals are approximately -4 on average in the US, and Chintangunta et al. (2001) report own-price elasticities that range between -2 and -4.

5.3 Supply Estimates

Using demand estimates, we compute retail margins using equation (10), which are subsequently used when estimating parameters of the supply specification in equation (24).

Supply Modeling Choice with Respect to the Production of Private Labels

With the given scanner data for private label products, we do not have any information on the identity of manufacturer(s) of these products sold by retailers. As such, we need to make assumptions about the manufacturers of private label products, and estimate the supply-side model specification in equation (24) under each of the distinct assumptions. In particular, we estimate the supply-side model under each of the following two distinct assumptions:

Assumption 1: A single outside manufacturer produces all private label products carried by retailers in our data sample.

Assumption 2: Each retailer that carries private label products contracts with a unique manufacturer to exclusively produce its private label products.

Similar to the research methodology in Bonnet and Dubois (2010) and Celine and Boumra-Mechmemache (2015), we use Vuong (1989) statistical non-nested test to assess which assumption on private label production best fits our data. The computed test statistic of the Vuong test is -4.1878, which is smaller than -1.64, implying that at the 5% level of statistical significance for this one-tale statistical test, *Assumption 2* better fits the data compared to *Assumption 1*. Thus, we rely on the assumption that each retailer's private label is produced by a unique outside manufacturer in the dataset.

Bargaining Power Parameter Estimates

In Table 5, we provide manufacturer's bargaining power parameter estimates produced by the supply-side model specification in equation (24) under *Assumption 2*. In the table, retailers are distinguished across columns, while manufacturers are distinguished across rows. The table reports on all the national brand manufacturers[11] in the data sample, but due to space limitation, not all retailers are reported in the table.[12] For a given manufacturer-retailer pair, the table reports the associated estimate of, (1 - λ_{fr}), that are strictly greater than zero. Many of the manufacturer's bargaining power parameter estimates are statistically different from zero, and differ across manufacturer-retailer pairs. Our estimates suggest that bargaining power is not an inherent characteristic of a retailer or a manufacturer, but varies depending on the identity of negotiating parties.

On average, manufacturer's bargaining power, (1 - λ_{fr}), is a mean 0.42. However, bargaining power estimates varies significantly across manufacturer-retailer pairs. It is worth noting that bargaining power estimates for the manufacturer of private label products is a mean 0.25, while manufacturers of national brands (all manufacturers except private label) have a mean bargaining power with retailers of 0.73. Thus, as expected, national brand manufacturers have greater bargaining power with retailers compared to manufacturer of private label products. These findings are consistent with the previous research suggesting that the introduction of store brands, i.e. private label products, increases retailers' bargaining power [Chintagunta et al. (2002)].

[11] Private label manufacturers' bargaining parameter estimates are reported in Appendix A2.
[12] Upon request, we are happy to make available to the interested reader the full matrix of manufacturer-retailer pairs.

Among the manufacturers in our data sample, Redwood Hill Farm has the highest degree of bargaining power across retailers, with a mean level of bargaining power equal to 0.9377, followed by bargaining power levels of Mehadrin Dairy (mean of 0.9183) and Turtle Mountain (mean of 0.9004), respectively. At the other extreme, Group Dannon, General Mills, and Chobani are manufacturers among the lowest ranked with respect to bargaining power with retailers.

It is natural to expect that manufacturers with larger share of industry sales are also likely to have greater bargaining power with retailers. However, our formal empirical results in Table 5 clearly reveal that this is not the case. The last two columns in the table report the manufactures' rank based on bargaining power and share of industry sales, respectively. The data in these two columns reveal that the manufacturers who are ranked first, second, and third based on bargaining power, are ranked fifty-sixth, sixty-sixth, and thirty-sixth respectively, based on share of industry sales. In addition, manufacturers that are ranked as twentieth, twenty-second and nineteenth based on bargaining power, are ranked as first, second and third, respectively based on share of industry sales. A notable case in the table is Chobani, a manufacturer ranked first based on share of industry sales, but ranked twentieth based on mean bargaining power across retailers.

Overall, our estimates show that the balance of bargaining power between manufacturers and retailers in the United States yogurt industry disproportionately lies with the retailers. However, there exists substantial heterogeneity in relative bargaining power across manufacturer-retailer pairs.

Table 5. Manufacturer's Bargaining Power Parameter Estimates, (1-λ), with each retailer

Manufacturer's Name	**Retailer 1**	**Retailer 2**	**Retailer 3**	**Retailer 4**	**Retailer 5**	**Retailer 6**	**Retailer 7**	**Retailer 8**	**Retailer 9**	**Retailer 10**	**Retailer 11**	**Retailer 12**	**Retailer 13**	**Retailer 14**	**Retailer 15**	**Retailer 16**	$1-\lambda$ (average across all retailers in the data that carry the manufacturers' products)	$1-\lambda$ rank	Industry Sales Share rank
Redwood Hill Farm	0.9529							0.9472			0.9363	0.9365			0.9331		0.9377	1	56
	(0.0018)							(0.0105)			(0.0046)	(0.0046)			(0.0070)				
Mehadrin Dairy									0.9184			.					0.9183	2	76
									(0.0226)										
Turtle Mountain					0.9259			0.9313			0.9085	0.9061	0.8709		0.9221		0.9004	3	36
					(0.0185)			(0.0187)			(0.0106)	(0.0121)	(0.0210)		(0.0096)				
The Hain Celestial Group	0.8978				0.8978	0.8330	0.8263			0.9155	0.9072	0.9075					0.8925	4	49
	(0.0104)				(0.0339)	(0.0396)	(0.3903)			(0.0084)	(0.0102)	(0.0101)							
Emmi Roth	0.9212																0.8879	5	72
	(0.0056)																		
Green Valley						0.8804											0.8804	6	79
						(0.0182)													
Kalona Organics										0.8628							0.8628	7	74
										0.0226									
Fage		0.8213							0.8644								0.8602	8	33
		(0.0925)							(0.0798)										
Maple Hill Creamery											0.8625	0.8632					0.8602	9	75
											(0.0232)	(0.0229)							
Greece by Tyras				0.8601													0.8592	10	71
				0.0724															
Liberty				0.8994	0.8924	0.8707	0.8960				0.8567	0.8576			0.8788		0.8571	11	19
				(0.0369)	(0.0398)	(0.0202)	(0.1348)				(0.0251)	(0.0247)			(0.0240)				
Cascade Fresh			0.8764		0.8624	0.5062	0.8838				0.8827	0.8832					0.8565	12	55
			(0.0406)		(0.0667)	(0.3246)	(0.1804)				(0.0166)	(0.0164)							
WholeSoy & Co	0.8896				0.8566			0.7865	0.7893						0.8300		0.8406	14	53
	(0.0113)				(0.0718)			(0.1996)	(0.1944)						(0.0475)				
Wallaby	0.8054				0.8505	0.7499		0.8498									0.8157	15	39
	(0.0375)				0.0798	0.0778		(0.0972)											
Springfield													0.7859				0.7859	16	80
													(0.0602)						

Table 5. Continues

WhiteWave Foods			0.7553			0.8048		0.8686			0.7337	0.7365	0.8287				0.7711	17	23
			(0.1640)			(0.0485)		(0.0745)			(0.0888)	(0.0868)	(0.0380)						
Schreiber													0.7644				0.7673	18	76
													(0.0729)						
Group Dannon	0.7459	0.7775	0.5761	0.8017	0.7558	0.6156	0.8607	0.8568	0.7633	0.8231	0.6664	0.6623	0.6488		0.7164		0.7194	19	3
	(0.0607)	(0.1401)	(0.4820)	(0.1478)	(0.2150)	(0.1856)	(0.2474)	(0.0883)	(0.2479)	(0.0385)	(0.1370)	(0.1404)	(0.1616)		(0.1337)				
Chobani	0.7429	0.8004	0.0637	0.6946	0.8549	0.7711	0.7847	0.7663	0.7656	0.8100	0.2561	0.2773	0.7271	0.8171	0.6733	0.8038	0.7017	20	1
	(0.0357)	(0.1068)	(1.8880)	(0.3135)	(0.0753)	(0.0679)	(0.5862)	(0.2154)	(0.2168)	(0.0468)	(0.4126)	(0.3887)	(0.0531)	(0.0579)	(0.0968)	(0.0656)			
Green Mountain	0.6855																0.6927	21	73
	(0.0962)																		
General Mills	0.6583	0.6923	0.3035	0.7036	0.6776	0.3205	0.5781	0.5889	0.5982	0.7679	0.4802	0.4802	0.5704		0.6576		0.6569	22	2
	(0.1104)	(0.2747)	(1.2937)	(0.3261)	(0.3720)	(0.5769)	(2.3343)	0.7372	(0.7048)	(0.0661)	(0.3269)	(0.3267)	(0.2386)		(0.1957)				
Johanna Foods		0.5360		0.4788		0.7987											0.6461	23	20
		(0.6234)		(1.0409)		(0.0486)													
Alpina					0.5005		0.8253						0.6434				0.6423	24	64
					(0.9135)		(0.3919)						(0.1739)						
Tillamook							0.5139										0.5139	26	50
							(3.1583)												
National Dairy Holdings	0.8051					0.7590						0.2466	0.5000				0.5074	27	78
	(0.0364)					(0.0701)						(0.7236)	(0.3385)						
Tula Foods						0.4876											0.4876	32	41
						(0.3267)													
H P Food																0.2142	0.4850	34	69
																(1.8141)			
Prairie Farms Dairy					0.4175												0.4249	41	66
					(1.2601)														
Dean Foods														0.0020			0.2500	56	58
														(2.9264)					

Note: Standard errors in parentheses.

The Influence of Product Line Width and Depth on Manufacturer's Bargaining Power

To gain more insight into the impact of preexisting *product line width* and *product line depth* on the bargaining power of manufacturers with retailers, we first estimate the following regression:

$$\left(1-\lambda_{fr}\right)=\sum_{f=1}^{n_f}\tau_f I_f+\sum_{r=1}^{n_r-1}\tau_r I_r+\epsilon_{fr} \qquad (25)$$

where I_f represents a zero-one dummy variable that equals to 1 only for bargaining power measures $\left(1-\lambda_{fr}\right)$ that belong to manufacturer *f* with other retailers; τ_f is a fixed effect parameter for manufacturer *f* that captures manufacturer-specific attributes that are observed as well as unobserved by us the researchers, which influence the manufacturer's bargaining power with retailers; n_f is the number of manufacturers in our data sample; I_r represents a zero-one dummy variable that equals to 1 only for bargaining power measures $\left(1-\lambda_{fr}\right)$ associated with retailer *r*; τ_r is a fixed effect parameter for retailer *r* that captures retailer-specific attributes that are observed as well as unobserved by us the researchers; n_r is the number of retailers in our data sample; and ϵ_{fr} is a mean-zero stochastic error term. Using fixed effects, note that equation (25) controls for both observed as well as unobserved manufacturer-specific and retailer-specific attributes that may influence the bargaining power of manufacturers with retailers.

Once estimates of τ_f are obtained from equation (25), we then estimate the following regression:

$$\tau_f=\rho_0+\rho_1 Product\ Line\ Depth_f+\rho_2 Product\ Line\ Width_f+\zeta_f \qquad (26)$$

where ζ_f is a mean-zero stochastic error term capturing other manufacturer-specific determinants of the manufacturer's bargaining power with retailers. The advantage of the empirical approach captured by equation (25) and equation (26) above is that we explicitly recognize and account for determinants of manufacturers' bargaining power that are unrelated to *product line depth* and *product line width*. Since we do not have information to enable computing measures of *product line width* and *product line depth* for store brand manufacturers, we exclude private label manufacturer(s) from the linear regressions in equation (25) and equation (26).

Table 6 presents the results where there are two specifications of equation (26) distinguished only by the measure of preexisting *product line depth* used. Model 1 uses the measure *Product Line Depth – Maximum,* which as previously described is a variable measuring the number of flavors offered within the given manufacturer's largest product line. However, Model 2 uses the measure *Product Line Depth – Average*, which as previously described is a variable measuring the average number of flavors offered across the given manufacturer's product lines.

The coefficient estimates in Table 6 suggest that a manufacturer's preexisting range of horizontally differentiated products, *product line depth,* driven by its strategy to extend the depth of existing product lines, has no statistically discernable impact on its bargaining power with retailers. Similarly, a manufacturer's preexisting number of quality-differentiated brands, i.e. *product line width*, has no statistically discernable impact on the bargaining power of the manufacturer with retailers. In other words, the empirical evidence suggests that greater depth in manufacturer's existing product lines and number of quality-differentiated brands do not influence its bargaining power with retailers.

Table 6. Bargaining power as a function of manufacturer’s characteristics

VARIABLES	(1) Model 1	(2) Model 2
Product Line Depth (Maximum)	-0.00545	
	(0.0107)	
Product Line Depth (Average)		-0.00991
		(0.0154)
Product Line Width	-0.0167	-0.0241
	(0.029)	(0.0235)
Constant	1.484***	1.514***
	(0.0862)	(0.111)
Observations	29	29
R-squared	0.052	0.057

Notes: Standard errors in parentheses. ***p<0.01, ** p<0.05, * p<0.1

These results raise the following question: If expanding *product line depth* and *product line width* have no influence on manufacturers' bargaining power with retailers, then why do so many manufacturers actively pursue product proliferation strategies? The subsequent analysis and discussion shed some light on answering this question.

Why do so many manufacturers actively pursue product proliferation strategies?

Why do manufacturers continue to introduce similar products under existing product lines? Is it because expanding product lines horizontally serves to increase the size of the profit pie that is shared with retailers? Is there also evidence that by offering broader product lines, manufacturers have the advantage to meet the needs and wants of heterogeneous consumers; and thus increase consumer demand for the manufacturer's menu of products? Our empirical analysis now provides some evidence with respect to answering these questions.

Previous theoretical research [e.g. Lancaster (1990) and Ratchford (1990)] examined the reasons for firms' decision to product proliferate, and posit the following:

- A broader product line can increase the overall demand faced by the firm.
- Instead of focusing on one product, a broader product line may yield cost advantages for the firm owing to economies of scope.
- Broad product lines can deter entry and allow an incumbent firm to increase its prices.

As mentioned in Connor (1981); manufacturers are choosing to apply product proliferation because they believe that new products are essential for firm growth and for financial success. In addition, Connor (1981) argues that manufacturers believe that product proliferation can broaden consumers' choice, and through market segmentation, better meets consumer demand. Developing horizontally differentiated products may also work as an effective defense strategy to maintain the market share for the manufacturer's leading products. For example, manufacturers offering unique flavors, or other unique attributes under a given brand might generate an increase in that brand's reputation among consumers [Berger et al. (2007)].

With the arguments from the theoretical research in hand, we use our measurements for manufacturers' product line depth and product line width, to assess their impact on the manufacturer's variable profit, quantity sold (demand), and price-cost margins. For this part of the analysis we run the following regressions:

$$Z_f = \sum_{f=1}^{n_f} \psi_f I_f + \sum_{r=1}^{n_r-1} \psi_r I_r + \omega_{fr} \quad (27)$$

where, for economy of presentation, we define Z_f to represent either variable profit, quantity sold (demand), or mean price-cost margin of each manufacturer; while the variables and parameters on the right-hand-side of equation (27) are defined similar to those in equation (25). In particular, ψ_f is a fixed effect parameter for manufacturer f that captures manufacturer-specific attributes that are observed as well as unobserved by us the researchers, which influence either the manufacturer's variable profit, quantity sold (demand), or mean price-cost margin, depending on which of these three measures Z_f represents in equation (27). Once estimates of ψ_f are obtained from equation (27), we then estimate the following regression:

$$\psi_f = \kappa_0 + \kappa_1 Product\ Line\ Depth_f + \kappa_2 Product\ Line\ Width_f + \varsigma_f \quad (28)$$

Table 7 report results from estimating equation (28) in cases where Z_f represent either variable profit, quantity sold (demand), or mean price-cost margin of each manufacturer in the previously estimated equation (27). Results for the impact of manufacturers' product line depth and product line width on their variable profits are reported in columns (1) and (2) of the table. The results indicate that expanding product line depth increases the variable profit of manufacturers. However, the number of vertically differentiated product lines does not have a statistically significant impact on the manufacturer's variable profit. In summary, even though expanding product line depth seems to have no impact on the bargaining power of a manufacturer with retailers, we find evidence that such an expansion increases the manufacturer's variable profit, no doubt owing to an expansion in the *size* of the full variable profit pie shared with retailers. As such, consistent with the theoretical literature [Lancaster (1979); Connor (1981); Quelch and Kenny (1994)], the evidence suggests that it is profit-maximizing for manufacturers to product proliferate.

Table 7. Variable profit, Quantity sold and Price-cost Margins as a function of manufacturer's characteristics

	(1) Variable Profit	(2) Variable Profit	(3) Quantity sold	(4) Quantity sold	(5) Mean Price-cost Margins	(6) Mean Price-cost Margins
Product line depth (maximum)	41.23		1,738		0.0292**	
	(33.65)		(1,195)		(0.0121)	
Product line depth (average)		83.44*		3,326*		0.0460**
		(47.13)		(1,669)		(0.0171)
Product line width	20.91	76.08	1,050	3,400	0.0149	0.0555**
	(91.38)	(72.23)	(3,246)	(2,558)	(0.0329)	(0.0261)
Constant	-2,518***	-2,794***	-92,719***	-103,293***	-0.799***	-0.921***
	(271.4)	(340.8)	(9,642)	(12,067)	(0.0976)	(0.123)
Observations	29	29	29	29	29	29
R-squared	0.099	0.15	0.139	0.193	0.299	0.330

Notes: Standard errors in parentheses. ***p<0.01, ** p<0.05, * p<0.1

Results reported in columns (3) and (4) of Table 7 show that a manufacturer's product line depth has a positive impact on the unit sales of its products. However, a manufacturer's product line width does not have a statistically significant effect on unit sales of its products. Again consistent with the theoretical literature [Lancaster (1979); Connor (1981); Quelch and Kenny (1994)], our empirical results suggest that offering broader product lines with similar qualities (horizontal product differentiation) can allow better matching of products with consumers' heterogonous tastes, yielding higher demand for the given manufacturer's products.

Last, results reported in columns (5) and (6) of Table 7 show that both manufacturer's product line depth and product line width has a positive and statistically significant impact on the manufacturer's mean price-cost margin charged across its menu of products. The results suggest that our finding of a positive impact of a manufacturer's product line depth on its variable profit is driven by the product line depth's influence on both unit sales and price-cost margins.

6. Conclusion

In this paper, we empirically investigate how a manufacturer's offering of different product lines, and many flavors under a given line, separately influences the manufacturer's bargaining power with retailers in the U.S. yogurt industry. To answer this question, we first estimated a structural econometric model to recover parameter estimates of relative bargaining power for a sample of manufacturer-retailer pairs. We then use a sequence of linear regression models to study how the estimates of manufacturers' bargaining power with retailers relate to the manufacturers' preexisting number of quality differentiated product lines, i.e., their product line width, as well as the number of horizontally differentiated products within these product lines, i.e., their product line depth. Our study contributes to the literature on determinants of bargaining power within the manufacturer-retailer vertical channel [Draganska et al. (2010); Crawford and Yurukoglu (2012); Doudchenko and Yurukoglu (2016); Bonnet and Bouamra-Mechemache (2015); Bonnet et al. (2015); Grennan (2013); Grennan (2014); Haucap et al. (2013); Ellickson et al. (2018)], and provides new, and surprising, empirical evidence on a couple determinants.

We find that a manufacturer's range of preexisting horizontally differentiated products, *product line depth*, driven by its strategy to extend the depth of existing product lines, and a manufacturer's preexisting number of quality-differentiated brands, i.e. *product line width*, surprisingly, have no statistically discernable impact on the bargaining power of the manufacturers with retailers. These findings raise the following question: If expanding *product line depth* and *product line width* have no influence on manufacturers' bargaining power with retailers, then why do so many manufacturers actively pursue product proliferation strategies?

Even though expanding product line depth and product line width seems to have no impact on the bargaining power of a manufacturer with retailers, i.e., does not influence the manufacturer's *share* of the profit pie with retailers, consistent with the theoretical literature [Lancaster (1979); Connor (1981); Quelch and Kenny (1994)], we find evidence that such an expansion increases the manufacturer's variable profit, no doubt owing to an expansion in the *size* of the full variable profit pie shared with retailers. As such, the evidence suggests that it is profit-maximizing for manufacturers to product proliferate. Also consistent with the theoretical literature, we find evidence suggesting that a manufacturer's product line depth has a positive impact on its unit sales across its menu of products. Furthermore, our findings suggest that the positive impact of a manufacturer's product line depth on its variable profit is driven by the product line depth's influence on both unit sales and price-cost margins charged.

Our analysis provides other interesting results. First, we find that the balance of bargaining power between manufacturers and retailers in the United States yogurt industry disproportionately lies with the retailers. However, there exists substantial heterogeneity in relative bargaining power across manufacturer-retailer pairs. Second, while it is natural to expect that manufacturers with larger share of industry sales are also likely to have greater bargaining power with retailers, our empirical results clearly reveal that this is not the case. From a policy perspective, an implication of this finding is that competition authorities will need to sharpen their focus case-by-case when assessing bargaining power, and not be unduly influenced by the relative size of the manufacturer in the industry. Last, as expected, the evidence suggests that national brand manufacturers have greater bargaining power with retailers compared to manufacturer of private label products.

The analysis in this paper is based on a structural econometric model that assumes Nash bargaining between manufacturers and retailers. The model also assumes a linear contract between each manufacturer-retailer pair with the unobservability of retail prices at the time of negotiation. While these assumptions are restrictive, they allow for the bargaining power to be estimated. Future research may want to consider how results are affected when a manufacturer-retailer pair has an option to negotiate on a bundle of products produced by the manufacturer, and compare the estimated results with results from the product-by-product negotiation assumed in our paper.

Appendix A1: Manufacturers and their available brands in year 2012.

Table A1. Manufacturers and their available brands in year 2012

Manufacturer's Name	**Manufacturer's Brands**
Alpina Productos Alimenticious	Alpina Alpina Revive
Cascade Fresh	Amande Cascade Fresh
Chobani Inc.	Chobani
Dean Foods	Dean Land O Lakes
Emmi Roth USA Inc.	Emmi
Fage USA Dairy Industry Inc	Fage Total
General Mills Inc.	Yoplait Yoplait Greek Yoplait Light Yoplait Light Thick and Creamy Yoplait Original Yoplait Thick and Creamy Yoplait Vivant
Greece by Tyras S A	Olympus
Green Mountain Creamery	Green Mountain Creamery
Green Valley Organics	Green Valley Organics
Group Dannon	Brown Cow Dannon Dannon Activia Selects Dannon All Natural Dannon Light and Fit Stonyfield Farm Stonyfield Organic YoCrunch YoCrunch Fruit Parfait
H P Hood Inc	AxelRod Crowley

Johanna Foods Inc	La Yogurt La Yogurt Custard Classics
Kalona Organics	Cultural Evolution
Liberty Products Inc.	Liberte Liberte Mediterranee
Maple Hill Creamery	Maple Hill Creamery
Mehadrin Dairy Corp	Mehadrin Mehadrin Fit N Free
National Dairy Holdings	LaLa Weight Watchers
Prairie Farms Dairy	Prairie Farms
Private Label	Private Label
Redwood Hill Farm	Redwood Hill Farm
Schreiber Foods Inc	Schreiber Lactaid
Springfield Creamery Inc	Nancys
The Hain Celestial Group Inc	Almond Dream The Greek Gods
Tillamook County Creamery	Tillamook
Tula Foods Inc	Better Whey of Life
Turtle Mountain Inc	So Delicious
Wallaby Yogurt Company Inc	Wallaby Down Under Wallaby Organic
WhiteWave Foods Company	Silk Live
WholeSoy & Co	WholeSoy & Co

Appendix A2: Private label manufacturer's estimated bargaining power parameters with respect to retailers.

Table A2. Private label manufacturer's estimated bargaining power with respect to retailers

Private Label Manufacturer	$1-\lambda$ (average across all retailers in the data that carry the manufacturers' products)	Standard Error	$1-\lambda$ rank	Industry Sales Share rank	Private Label Manufacturer	$1-\lambda$ (average across all retailers in the data that carry the manufacturers' products)	Standard Error	$1-\lambda$ rank	Industry Sales Share rank
PL30	0.8452	0.4519	13	48	PL13	0.2647	2.0518	54	59
PL59	0.5461	1.1365	25	10	PL29	0.2535	2.3736	55	12
PL41	0.5017	1.2173	28	40	PL34	0.2384	0.7317	57	13
PL36	0.5000	0.1218	29	62	PL48	0.2375	2.4879	58	18
PL45	0.4977	0.8726	30	70	PL28	0.2288	0.4411	59	6
PL8	0.4894	0.9740	31	57	PL52	0.2253	2.6156	60	22
PL7	0.4857	2.9983	33	68	PL49	0.1968	0.9799	61	32
PL15	0.4820	0.9830	35	16	PL58	0.1826	5.6402	62	8
PL42	0.4670	2.3698	36	52	PL5	0.1795	0.9375	63	21
PL6	0.4490	0.3189	37	38	PL40	0.1760	4.0275	64	29
PL1	0.4327	0.3186	38	42	PL60	0.1628	5.8843	65	11
PL56	0.4319	2.7008	39	35	PL16	0.1369	0.9680	66	26
PL25	0.4264	1.4908	40	60	PL37	0.1311	1.1667	67	63
PL21	0.4113	4.0913	42	30	PL22	0.1302	1.4986	51	60
PL2	0.4038	0.5641	43	46	PL43	0.1104	2.7090	67	76
PL24	0.4037	4.4884	44	45	PL10	0.0961	1.0316	65	74
PL32	0.3863	2.6606	45	54	PL55	0.0733	1.3162	71	7
PL11	0.3851	2.7640	46	33	PL35	0.0540	0.6919	72	17
PL31	0.3811	0.4185	47	31	PL14	0.0456	0.3005	73	15
PL27	0.3803	2.7448	48	44	PL44	0.0035	0.9875	74	28
PL4	0.3743	0.7249	49	47	PL57	0.0010	1.9241	75	9
PL50	0.3496	0.9858	50	24	PL51	0.0007	1.7008	76	5
PL53	0.3466	2.9104	51	43	PL39	0.0005	1.4462	77	37
PL12	0.3360	1.5029	52	61	PL46	0.0002	1.3955	78	34
PL18	0.3004	2.5657	53	25	PL26	0.0001	2.7621	79	4
					PL19	0.0001	1.0938	80	14

Note: Bargaining power estimates reported in Table A2 are ranked based on the manufacturer's bargaining power, $(1-\lambda)$, among all manufacturers in the data set.

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