Brand-Level Demand Analysis of Mayonnaise in Northeast Texas

Abstract

Mayonnaise is the most consumed condiment in the U.S. with domestic consumers spending some $2 billion on its consumption and with a couple of brands controlling a significant portion of the market. However, the demand for mayonnaise at the brand level has not been studied extensively in previous research. In this study, the Barten synthetic model was estimated to investigate the demand for mayonnaise and competition among major mayonnaise brands (private label, Hellmann's, Kraft, and other brands) in Northeast Texas. Compensated cross-price elasticities revealed that Kraft was the major competitor to private label and other brands, while private label was the major competitor to Kraft.

Key Words: brand competition, mayonnaise, the Barten synthetic model

JEL Classification: D12

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Introduction

The global mayonnaise and salad dressing market is worth $14.3 billion dollars, with an average growth rate of 4-5% (Ingredion Inc., 2013). The mayonnaise market was projected to continue its growth at an average growth rate of 4.5% during the period of 2016-2020 (Research and Markets, 2016). Along with already established mayonnaise markets in North America and Western Europe, there are other emerging mayonnaise markets in Eastern Europe, Latin America, Middle East and Africa that grow in double digits (Ingredion Inc., 2013). Globally, as far as individual companies, the mayonnaise market is dominated by Unilever, followed by Kraft Foods, QP, McCormick, Nestlé and a bunch of other companies (Ingredion Inc., 2013).

Mayonnaise is the favorite condiment in the U.S. with the domestic consumers spending some $2 billion on its consumption, with the ketchup consumption accounting for $800 million dollars (Ferdman and King, 2014). In the U.S., mayonnaise is the leader of the condiment market, followed by ketchup, soy sauce (worth $725 million), barbecue sauce (worth $660 million), hot sauce (worth $550 million), mustard (worth $450 million), steak sauce, and other sauces (Ferdman and King, 2014).

A number of factors influence the salad dressing and mayonnaise market: health and obesity issues, convenience, government regulations, packaging and product innovation, demographics, and retail sector growth (International Markets Bureau, 2013). In particular, health and obesity issues have contributed to consumers asking more and more for healthy food products such as salads. Healthy reductions of fats, oils, sugar, carbohydrates, and calories and additions of healthy ingredients will have a positive impact on the growth of the mayonnaise market. As a result, mayonnaise manufacturers seek to develop healthy products without compromising the taste and eating culture of consumers.

Consumers favor convenience foods because it allows them to save more time in the kitchen which they can spend on other activities that they enjoy. Stringent government regulations on manufacturing, labeling, and food supply chain are likely to slow down the market growth. Convenient and attractive packaging along with product innovation is yet another opportunity for future market growth for mayonnaise. These factors put pressure on mayonnaise manufactures to constantly innovate in order to keep up with ever changing tastes and preferences of consumers. Hispanics are the fastest growing demographic group in the U.S. and an increase of Mexican food availability in the fast food sector has also positively influenced the demand for mayonnaise. Furthermore, growth in the food service industry together with the retail sector will also strengthen the demand for salad dressing and mayonnaise ingredients.

Prior research of demand for mayonnaise has been conducted by estimating demand elasticities mostly at the product category level. However, there is lack of information on demand elasticities concerning mayonnaise at the brand level. This study is different from the previous research in a couple of aspects. First, this study was conducted at the brand level using household scanner data. Second, this study focused on the northeast part of Texas, the Dallas/Fort Worth Metroplex area, which is the largest land-locked metropolitan area in the U.S., and, which, to the best of our knowledge, has not been used to study the demand for mayonnaise. In a sense, the present analysis is a pilot study of the market of mayonnaise in Northeast Texas.

The main purpose of this study is to estimate the demand for major mayonnaise brands in Northeast Texas using a demand system approach. More specifically the objectives are to: (1) provide an overview associated with the global salad dressing and mayonnaise market and the U.S. market for condiments and sauces along with discussing factors impacting the mayonnaise market in the U.S.; (2) gain an understanding of the competition among major mayonnaise brands in Northeast Texas by examining their quantities sold, prices, and market shares; (3) compare alternative functional forms of demand systems nested within the Barten synthetic model with the purpose to determine the "best" demand system specification for analyzing the demand for mayonnaise at the brand level in Northeast Texas; (4) estimate own-price and expenditure elasticities of demand for major mayonnaise brands in Northeast Texas; (5) estimate cross-price elasticity of demand for major mayonnaise brands that will shed light on the demand interrelationships and competition among major mayonnaise brands in Northeast Texas.

The successful accomplishment of the objectives of this study will be significant for future research dealing with demand for mayonnaise in Northeast Texas in: (1) helping interested parties to better understand the market structure and characteristics of the mayonnaise industry; (2) helping identify the "best" demand system specification for investigating mayonnaise demand at the brand level; (3) assisting interested parties in better understanding consumer demand behavior with respect to major mayonnaise brands; (4) assisting mayonnaise brand manufacturers as well as wholesalers and retailers carrying this product in knowing whether to raise or lower prices, or whether to price discriminate in an attempt to maximize total revenue from the sale of the product; (5) helping to produce regional forecasts of sales of mayonnaise brands to facilitate inventory management for mayonnaise manufacturers, wholesalers, and retailers; (6) policy analysis in terms of quantifying the effects of various economic policies and regulations that may lead to higher prices of various mayonnaise brands.

The remainder of the paper proceeds in the following manner. Next section provides the specification of the model estimated in the present analysis. Then, the data are presented, followed by the presentation and discussion of the estimation procedure and results. Finally, summary, conclusions, policy implications, and recommendations for future research are presented in the last section.

Specification of the Model

Barten (1993) introduced Barten's synthetic model (BSM), which includes the differential versions of the Almost Ideal Demand System (AIDS) model introduced by Deaton and Muellbauer (1980a, 1980b), the Rotterdam model introduced by Barten (1964) and Theil (1965), the NBR model introduced by Neves (1987), and the Dutch Central Bureau of Statistics (CBS) model introduced by Keller and van Driel (1985). The Barten model possesses a few characteristics that make it popular in empirical research. These characteristics include linearity in parameters, functional form flexibility, ability to introduce dynamics, and potential to render variables stationary because of the necessary first-differencing process. In addition, Barten's differential demand system assists in identifying specific functional form that is best supported by the data.

Following Matsuda (2005), the Barten model looks as follows:

(1) $w_i d\log q_i = (\beta_i + \lambda w_i)\, d\log Q + \sum_j (\gamma_{ij} - \mu w_i(\delta_{ij} - w_j)) d\log p_j \quad i=1,\ldots,n,$

where w_i denotes the budget share of i^{th} brand; q_i denotes the quantity of i^{th} brand; dlogQ denotes the Divisia Volume Index; $\delta_{ij} = 1$ if $i = j$; $\delta_{ij} = 0$ if $i \neq j$; p_j denotes the price of brand j; β, λ, γ_{ij}, and μ are the model parameters to be estimated; and ε_i is the disturbance term.

Equation (1) reduces to the AIDS when λ=1and μ=1, to the Rotterdam when λ=0 and μ=0, to the NBR when λ=0 and μ=1, and to the CBS when λ=1 and μ=0. The model satisfies the following theoretical restrictions:

(2) adding-up: $\sum_{i=1}^{n} \beta_i = 1 - \lambda$ and $\sum_{i=1}^{n} \gamma_{ij} = 0, j = 1, \ldots, n,$

(3) homogeneity: $\sum_{j=1}^{n} \gamma_{ij} = 0, i = 1, \ldots, n,$

(4) symmetry: $\gamma_{ij} = \gamma_{ji}, i, j = 1, \ldots, n, i \neq j$.

The Hicksian (compensated) price elasticities (e_{ij}^{c}) and the expenditure elasticities (e_i) from the Barten model are given by:

(5) $e_{ij}^{c} = \frac{\gamma_{ij}}{w_i} - \mu(\delta_{ij} - w_j)$ and

(6) $e_i = \frac{\beta_i}{w_i} + \lambda$,

where w_i and w_j represent the budget shares of commodity i and j, respectively, and δ is the Kronecker delta. The uncompensated price elasticities (e_{ij}^{u}) are provided through the Slutsky equation:

(7) $e_{ij}^{u} = e_{ij}^{c} - e_i w_j$.

According to the law of demand, the own-price elasticities were expected to be negative. Anticipating that all brands of mayonnaise were substitutes for each other, cross-price elasticities were expected to be positive. Expenditure elasticities were expected to be positive since mayonnaise was anticipated to be a normal good.

Data

For our analysis, weekly time series data covering the period of January 1 through December 28, 2013, and derived from the Nielsen Consumer Panel Data were used. Overall, the dataset included 52 weekly observations of total quantity purchased and prices (unit values) of four major mayonnaise brands: private label, Hellmann's, Kraft, and other brands. Store brands of mayonnaise comprised the private label mayonnaise brand. The Hellmann's mayonnaise brand consisted of Hellmann's, Hellmann's Light, Best Foods, and Best Foods Light. The Kraft mayonnaise brand included Kraft, Kraft Light, and Kraft Sandwich Shop. Finally, all the brands of mayonnaise except for Hellmann's Kraft, and private label brands comprised the other brands category (Mcilhenny, Heinz, Spectrum Naturals, Smart Balance Omega, State Fair, Blue Plate, Vegenaise, McCormick, Duke's, Walden Farms, Calder's Gourmet, etc.).

The quantity purchased of a mayonnaise brand was developed by summing weekly total ounces across households and then dividing this sum by the number of unique households that purchased that mayonnaise brand in that particular week. Since the actual prices were missing, unit values were used as a proxy for them. To compute unit values, first total expenditures were adjusted by subtracting the value of coupons (if any), and then the adjusted total expenditures were divided by total ounces sold for each week. In addition, all prices (unit values) were adjusted for inflation by dividing them by the weekly interpolated Consumer Price Index (CPI) with the base period equal to the average of the CPI from 1982 to 1984 obtained from the United States Bureau of Labor Statistics (2016).

Table 1 depicts the descriptive statistics of the variables used in this analysis along with corresponding market shares. By examining the descriptive statistics on quantities, prices, and market shares of major mayonnaise brands, important insights associated with market competition among major mayonnaise brands in Northeast Texas can be gained. Over the study period, the average weekly total amounts of mayonnaise purchased per household of private label, Hellmann’s, Kraft, and other brands, were 30.61, 34.16, 32.45, and 27.45 ounces, respectively, indicating that Hellmann’s was the leading brand followed by Kraft, private label, and other brands.

Table 1. Descriptive Statistics

Variable	Units	n	Mean	Standard Deviation	Market Share (%)
Quantity					
Private label	oz	52	30.61	5.82	19
Hellmann's	oz	52	34.16	4.97	29
Kraft	oz	52	32.45	7.16	26
Other brands	oz	52	27.45	13.96	26
Price					
Private label	$/oz	52	0.04	0.00	
Hellmann's	$/oz	52	0.05	0.01	
Kraft	$/oz	52	0.05	0.01	
Other brands	$/oz	52	0.06	0.03	

Note: [a]Nielsen Consumer Panel Data, 2013.
[b]Quantities reported are on per unique household basis.
[c]Prices are unit values.

Over the study period, the average real unit values of private label, Hellmann's, Kraft, and other brands were 0.04, 0.05, 0.05, 0.06 dollars per ounce, respectively, indicating that of all the mayonnaise brands, other brands had the highest unit value followed by Hellmann's and Kraft, and private label. According to the Nielsen Consumer Panel Data for 2013, private label, Hellmann's, Kraft, and other brands had 19%, 29%, 26%, and 26% of market share over the study period, respectively, suggesting that Hellmann's was the market leader followed by Kraft and other brands, and private label. Also, based on the market shares, mayonnaise industry can be considered as a relatively concentrated industry, with two major brands, Hellmann's and Kraft, controlling 55% of the market.

Estimation Procedure and Results

To accomplish the third, fourth, and fifth objectives of this study, the BSM model was estimated for the four mayonnaise brands with parametric restrictions in place applying an Iterated Seemingly Unrelated Regression (ITSUR) procedure and using SAS 9.3 statistical software package. As long as the disturbance terms have a multivariate normal distribution, the ITSUR procedure is equivalent to maximum likelihood estimators (Judge, Hill, Griffiths, Luetkepohl, and Lee, 1988). The equation for other brands was left out from the estimation to circumvent the singularity of the variance-covariance matrix of disturbance terms, which arises from budget shares summing to unity in the BSM model. However, the parameters for the dropped equation were calculated using the parametric restrictions of adding-up, homogeneity, and symmetry. The R^2 for the dropped equation (other brands) was calculated by squaring the correlation coefficient between the actual and the predicted values of the dependent variable. The Durbin-Watson statistic for the other brands equation was computed by dividing the sum of squared differences in successive residuals by the residual sum of squares (Durbin and Watson, 1951). The issue related to the efficient estimation of system of equations in the case where error terms are contemporaneously correlated was first considered by Zellner (1962). To address the issue of serial correlation, a first-order autoregressive correction procedure (AR(1)) was used following Berndt and Savin (1975). Due to adding-up restriction, a common AR(1) coefficient was estimated for the system of equations. Finally, in this analysis, all statistical tests were done using significance level of 5%.

Table 2 presents the estimated coefficients, p-values, goodness-of-fit (R^2), and Durbin-Watson statistics associated with the Barten synthetic demand system. The range of R^2 was from 0.49 to 0.92, suggesting that the individual equations of the demand system explained a considerable amount of variability in each of the dependent variables (except for the private label equation where R^2 was 0.29). Durbin-Watson statistics for the four equations along with the statistically significant serial correlation coefficient (rho1) indicated that serial correlation was corrected in the Barten model. Of the 17 parameter estimates seven were statistically significant.

Table 3 shows the results of joint hypothesis tests of λ and μ. The significance of the chi-squared (χ^2) statistic for the joint hypothesis tests of λ and μ suggested that the general BSM was statistically superior to the Rotterdam model, the Linear Approximate AIDS model, the NBR model, and the CBS model.

Table 2. Coefficients of the BSM, R^2, and Durbin-Watson Statistic (n = 52)

Brand	R^2	Durbin-Watson
Private label	0.2867	2.0892
Hellmann's	0.4922	2.1658
Kraft	0.6642	2.0245
Other brands	0.92	1.9926
Parameter	Coefficient	p-value
g_{11}	-0.1076*	0.0448
g_{12}	0.0183	0.5931
g_{13}	0.0616	0.0533
g_{14}	0.0278	0.0583
g_{22}	-0.0296	0.64
g_{23}	0.0168	0.6216
g_{24}	-0.0055	0.73
g_{33}	-0.1137	0.0567
g_{34}	0.0354*	0.0297
g_{44}	-0.0576	0.1463
b_1	-0.3608*	0.0019
b_2	-0.5825*	0.0005
b_3	-0.3341*	0.0261
b_4	0.0483	0.7664
λ	2.2291*	0.0002
μ	0.2813	0.2537
rho1	-0.4039*	0.0001

Note: [a]The parameters g_{ij} indicate interactive effects. Subscript 1 refers to private label, 2 refers to Hellmann's, 3 refers to Kraft, 4 refers to other brands. For instance, g_{12} denotes the price effect of Hellmann's on the volume of private label.
[b]The estimates of b_4 and g_{44} were recovered using adding-up restriction as $b_4 = 1 - (b_1 + b_2 + b_3 + \text{lambda})$ and $g_{44} = 0 - (g_{14} + g_{24} + g_{34})$.
[c]rho1 is the autocorrelation coefficient on the error terms, the AR(1) process. To ensure adding up, a common rho1 is evident in any demand system.
[d]Asterisk indicates significance at the 0.05 level.

Table 3. Joint Hypothesis Tests of λ and μ

Hypothesis	χ2	p-value
H_0: λ =0, μ =0 (Rotterdam)	28.62	0.0001
H_0: λ =1, μ =1 (AIDS)	9.73	0.0077
H_0: λ =1, μ =0 (CBS)	11.26	0.0036
H_0: λ =0, μ =1 (NBR)	18.18	0.0001

Even though the estimated Barten model parameters do not have a direct economic interpretation, they were used along with budget shares to compute compensated and uncompensated price elasticities, and expenditure elasticities at the sample means for all the mayonnaise brands. Table 4 shows the uncompensated own-price and cross-price elasticities with p-values reported below each elasticity value.

As expected, all the uncompensated own-price elasticity estimates were negative and statistically significant. In particular, the own-price elasticity of demand for private label was -0.853, meaning that for every 1% increase in the price of private label, the quantity demanded of private label decreased by 0.853%, holding everything else constant. The own-price elasticity of demand for Hellmann's was -0.371, meaning that for every 1% increase in the price of Hellmann's, the quantity demanded of Hellmann's decreased by 0.371%, holding everything else constant. The own-price elasticity of demand for Kraft was -0.89, meaning that for every 1% increase in the price of Kraft, the quantity demanded of Kraft decreased by 0.89%, holding everything else constant. Finally, the own-price elasticity of demand for other brands was -1.055, meaning that for every 1% increase in the price of other brands, the quantity demanded of other brands decreased by 1.055%, holding everything else constant.

The demand for other brands was found to be elastic (-1.055), while the demand for private label (-0.853), Hellmann's (-0.371), and Kraft (-0.89) mayonnaise brands was found to be inelastic. While the demand is normally anticipated to be elastic at the brand level, this inelastic demand for most of the mayonnaise brands can be possibly explained by the fact that mayonnaise occupies a relatively small share in consumer's budget.

Table 4. Uncompensated (Marshallian) Own-Price, Cross-Price, and Expenditure Elasticities of the Mayonnaise Brands

	Private label	Hellmann's	Kraft	Other brands	Expenditure elasticity
Private label	-0.853*	0.07	0.297	0.122*	0.364
	(0.0001)	(0.7104)	(0.0591)	(0.0206)	(0.0977)
Hellmann's	0.069	-0.371*	0.066	-0.01	0.245
	(0.5162)	(0.0183)	(0.463)	(0.7721)	(0.0521)
Kraft	0.118	-0.122	-0.89*	-0.026	0.92*
	(0.3125)	(0.3259)	(0.0001)	(0.5305)	(0.0001)
Other brands	-0.305*	-0.648*	-0.408*	-1.055*	2.416*
	(0.0001)	(0.0001)	(0.0001)	(0.0001)	(0.0001)

Note: [a]All elasticities are calculated at the sample means.
[b]Asterisk indicates statistical significance at the 0.05 level.
[c]Numbers in parentheses are p-values.

Given the estimates of own-price elasticities, at least in the short run, a price decrease for other brands and a price increase for private label, Hellmann's, and Kraft was recommended in order to increase total revenue from the sale of the product.

As is depicted in Table 4, out of 12 cross-price elasticities four possessed statistical significance, and out of these four, only one had the expected positive sign (the cross-price elasticity for private label demand with respect to the price of other brands). Since the uncompensated cross-price elasticities reflect both substitution and income effects, the discussion of competition among mayonnaise brands was done in terms of compensated cross-price elasticities which reflect only substitution effect.

All computed expenditure elasticities along with their p-values presented in Table 4 were positive with only two of them being statistically significant. The expenditure elasticity for Kraft was 0.92, suggesting that as the expenditure for mayonnaise rose by 1%, the quantity demanded of Kraft increased by 0.92%, holding everything else constant. The expenditure elasticity for other brands was 2.416, suggesting that as the expenditure for mayonnaise rose by 1%, the quantity demanded of other brands increased by 2.416%, holding everything else constant. Other brands category was the most sensitive to changes in total expenditure (2.416).

The compensated own-price and cross-prices elasticities and their p-values are reported in Table 5. Important information as far as competition among mayonnaise brands can be obtained by studying the compensated cross-price elasticities since they provide a better picture regarding substitutability (i.e., competition) among brands, as they are net of income effects. All the compensated cross-price elasticities were positive, implying that these mayonnaise brands were net substitutes for each other. Out of 12 cross-price elasticities, six were statistically significant. The statistically significant cross-price elasticities are discussed below.

Table 5. Compensated (Hicksian) Own-Price and Cross-Price Elasticities of the Mayonnaise Brands

	Private label	Hellmann's	Kraft	Other brands
Private label	-0.783*	0.177	0.39*	0.216*
	(0.0002)	(0.2793)	(0.01)	(0.0001)
Hellmann's	0.117	-0.299*	0.129	0.054
	(0.2793)	(0.0326)	(0.1548)	(0.1048)
Kraft	0.296*	0.149	-0.655*	0.211*
	(0.01)	(0.1548)	(0.0001)	(0.0001)
Other brands	0.162*	0.061	0.209*	-0.432*
	(0.0001)	(0.1048)	(0.0001)	(0.0001)

Note: [a]All elasticities are calculated at the sample means.
[b]Asterisk indicates statistical significance at the 0.05 level.
[c]Numbers in parentheses are p-values.

The cross-price elasticity for private label demand with respect to the price of Kraft was 0.39, suggesting that a 1% increase in the price of Kraft gave rise to a 0.39% increase in the quantity demanded of private label, everything else held constant. The cross-price elasticity for private label demand with respect to the price of other brands was 0.216, suggesting that a 1% increase in the price of other brands gave rise to a 0.216% increase in the quantity demanded of private label, everything else held constant. As such, Kraft was the major competitor to private label, since the cross-prices elasticity for private label demand with respect to the price of Kraft (0.39) was greater than that with respect to the price of other brands (0.216).

The cross-price elasticity for Kraft demand with respect to the price of private label was 0.296, suggesting that a 1% increase in the price of private label gave rise to a 0.296% increase in the quantity demanded of Kraft, everything else held constant. The cross-price elasticity for Kraft demand with respect to the price of other brands was 0.211, suggesting that a 1% increase in the price of other brands gave rise to a 0.211% increase in the quantity demanded of Kraft, everything else held constant. As such, private label was the major competitor to Kraft, since the cross-prices elasticity for Kraft demand with respect to the price of private label (0.296) was greater than that with respect to the price of other brands (0.211).

The cross-price elasticity for other brands demand with respect to the price of private label was 0.162, suggesting that a 1% increase in the price of private label gave rise to a 0.162% increase in the quantity demanded of other brands, everything else held constant. The cross-price elasticity for other brands demand with respect to the price of Kraft was 0.209, suggesting that a 1% increase in the price of Kraft gave rise to a 0.209% increase in the quantity demanded of other brands, everything else held constant. Hence, Kraft was the major competitor to other brands, since the cross-prices elasticity for other brands demand with respect to the price of Kraft (0.209) was greater than that with respect to the price of private label (0.162).

Summary, Conclusions, Policy Implications, and Recommendations for Future Research

Mayonnaise is the most consumed condiment in the U.S. with the domestic consumers spending some $2 billion on its consumption and with a couple of brands controlling a significant portion of the market. However, the demand for mayonnaise at the brand level has not been studied extensively in previous research. In this study, the Barten synthetic model was estimated to investigate the demand for mayonnaise and competition among major mayonnaise brands (private label, Hellmann's, Kraft, and other brands) in Northeast Texas. Fifty-two weekly observations used in this study were derived from scanner data ranging from January 1 through December 28, 2013. These data contained information on total quantity purchased and prices (unit values).

The estimation results showed that the general Barten model was superior to other forms of demand systems for studying the demand for mayonnaise and competition among major mayonnaise brands in Northeast Texas. As evidenced by the uncompensated own-price elasticity estimates, the demand was inelastic for private label, Hellmann's, and Kraft, and the demand for other brands was elastic. Inelastic demand at the brand level seems counterintuitive, but not if one considers the fact that mayonnaise normally does not have a significant share in a consumer's budget. In addition, according to the uncompensated own-price elasticity estimates, to raise total revenue a price increase was suggested for private label, Hellmann's, and Kraft, while a price decrease was suggested for other brands.

All the computed expenditure elasticities were positive, suggesting that the quantity demanded of mayonnaise brands increased as expenditure for mayonnaise went up, holding everything else constant. Other brands category was the most responsive to changes in total expenditure. Compensated cross-price elasticity estimates revealed that Kraft was the major competitor to private label and other brands. At the same time, private label was the major competitor to Kraft.

In addition, this study shed some light on the competition pattern among major mayonnaise brands in Northeast Texas by calculating their market shares. In particular, this analysis revealed that in 2013 both Hellmann's and Kraft accounted for 55% of total market share, leaving the remaining 45% to private label and other brands. Per market share numbers, mayonnaise industry can be considered as a relatively concentrated industry.

The findings of this study provide useful information for policy analysis. In particular, demand elasticity estimates can be used to quantitatively evaluate the influence of various economic policies (tax policy, trade policy) and regulations (food safety and food quality regulations) that may lead to higher prices. These elasticity estimates are helpful in terms of measuring the degree of consumer responsiveness to economic policies. For example, mayonnaise brands that face inelastic demand will be less impacted by tax or price increase compared to mayonnaise brands facing more elastic demand. In addition, Unilever and Kraft Foods who have market power and do not have to take price as given can more easily pass on any cost increases to consumers when the demand for their mayonnaise brand is inelastic.

Various regulations (for example, food safety and food quality regulations) influence the production costs. With accurate estimates of demand elasticities, policy makers will be in position to quantitatively asses the effects of these regulations across mayonnaise brand manufacturers and consumers.

A few recommendations for future research need to be pointed out. First, additional data encompassing a larger region and covering multiple years would enhance the representativeness of the findings. Second, the study would benefit from considering information on substitutes for mayonnaise (ranch, olive oil, etc.). Third, future research should extend the findings by the present research by considering household characteristics. Nonetheless, despite the foregoing recommendations for future research, the present analysis is a solid contribution to studying the competition in the mayonnaise industry.

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