A Cross-Sectional Analysis of U.S. Yogurt Demand

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Among processed and manufactured dairy products marketed in the United States, yogurt has one of the shortest histories and sharpest growth trends. To examine the socioeconomic factors associated with U.S. at-home yogurt demand, a demand system is used to analyze three yogurt products. Findings suggest that own-prices have negative effects and total expenditure has a positive effect on U.S. yogurt demand. Demographic factors do not have a large impact.

Among the processed and manufactured dairy products marketed in the United States, yogurt has a relatively short history. The appearance of significant numbers of advertisements, both print and visual, and an almost four-fold increase in plain and flavored yogurt production from 1989 to 2007 suggest that milk producers, dairy product manufacturers and marketers, and consumers are more aware of yogurt products today than they did two decades ago. This increased awareness has been most likely triggered by the publicized links between yogurt consumption and a healthy lifestyle and diet.

A wide array of dairy products are processed or manufactured in the U.S.; these products provide important nutrients, including vitamins and calcium, for healthy diets. Low-fat yogurt, cheese, and fluid milk are considered to be great sources of calcium, and are the three dairy products currently supported by the USDA for good health and nutrition. The Dairy Council of California named yogurt the food trend of the decade. "Yogurt was named the food trend of the decade by Harry Balzer, Vice President with the market research firm NPD Group" (PR Newswire 2010). Yogurt is a convenient food and provides multiple health benefits, which are fuelling its rising popularity.

There are not many economic studies that focus primarily on yogurt consumption, and this paper aims to fill the gap. Given the concern with improving health in the U.S., assessing the factors that contribute to healthy food choices is of great importance. Demographic factors are major determinants of household consumption patterns (Pollak and Wales 1981). Granner et al. (2004) note that disparities in healthy food consumption among households could be due to a number of environmental, social, cultural, psychological, and behavioral factors. They further note that a better understanding of the determinants of food choice, including differences across groups, could be of great importance in reducing nutritional disparities and promoting healthful diets. In examining the factors that determine fruit and vegetable consumption among adolescents from 11 to 15 years of age, they found that Blacks reported greater social influences, and Whites reported greater family environmental influences than did adolescents of other races. An important finding of their study was that White and female participants reported a higher preference for vegetables than did Black and male participants.

Studies have indicated that meals eaten in restaurants are generally of lower nutritional quality than meals at home, mainly due to higher fat and calorie contents in the former. Taking this as given, Freeman (2007) and Binkley (2006) have discussed and analyzed the importance of socioeconomic and demographic factors in the decision to patronize restaurants, particularly fast food restaurants. Freeman (2007) notes that fast food has become a major source of nutrition in low-income, urban neighborhoods across the U.S., with social and cultural factors contributing to the popularity of fast food among inner-city populations. He further notes that these factors have resulted in a relatively large number of fast food establishments and limited access to healthy food choices in urban areas. Binkley (2006) identified demographic measures, including race, ethnicity, education, gender and age, as well as lifestyle measures (e.g., hours spent watching TV), and the Body Mass Index of survey

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respondents as the factors that contribute to fast food purchases. His findings indicated that such variables as income, age, and gender matter in the decision to consume food away from home in both fast food and table-service establishments, but that they are conditional factors, dependent on the nutritional awareness of the consumer. Regarding the role of race in fast food and away from home purchases, Binkley (2006) found that the only significant race effect was that Blacks were less likely to dine at table-service facilities.

Given the importance of dietary fiber intake in the prevention of certain diseases, Nayga (1996) examined the impact of socioeconomic and demographic factors on fiber intake when food is consumed both at home and away from home. His results indicated that gender, household size, age, and income, among other factors, significantly affected dietary fiber intake away from home, whereas weight, urbanization, region, race, ethnicity, gender, diet status, household size, age, and income significantly affected the amount of dietary fiber consumed at home.

Because yogurt consumption is often associated with a healthy lifestyle, the primary objective of this study is to assess the importance of socioeconomic and demographic factors in the decision to purchase yogurt products. Using the Nielsen 2005 Homescan data, which contain demographic and food purchase information for a nationwide panel of representative households in the U.S., the demand for three yogurt product groups (refrigerated, frozen novelty, and drinkable) are estimated using a Translog demand system. The data have consumer bundles exhibiting both interior and corner solutions (zero observations). To account for zero observations, the two-step estimation procedure developed by Shonkwiler and Yen (1999) is used in estimating the model. This procedure allows for assessment of the importance of socioeconomic factors and demographics in the overall decision to purchase any yogurt product, and of the importance of such factors in the level of purchase within a yogurt product group.

The U.S. Yogurt Market

Overview

While it is difficult to identify the exact time period when the U.S. yogurt industry began, Trager (1997) notes that the industry can be traced back to small-scale production by Armenian immigrants in Massachusetts in the late 1920's, which resulted in the Colombo Yogurt Company. In the early 1940s, Daniel Carraso emigrated from France to New York City, where he founded the Dannon yogurt company. A challenge at the time was that few Americans had ever tried yogurt. In 1947 Dannon introduced flavored yogurt, which appealed to the American taste. By 1950 the company had moved to a new manufacturing facility in Long Island, and distribution expanded from New York to other East Coast cities.

The industry continued to slowly develop throughout the 1960s, but the decade of the 1970s saw new impetus for growth in two important ways. First, the mid 1970s saw the arrival of the leading yogurt in France (Yoplait) in the U.S. Secondly, modern technologies were developed by the industry that resulted in wider availability of frozen yogurt products. Even with these industry changes, distribution remained limited mostly to the New England area and the Northeast until the 1980s when consumption became a more national phenomenon (Trager 1997). By the early 1990s production of plain and flavored yogurt and frozen yogurt had reached notable levels (Table 1). As the data indicate, plain and flavored yogurt production followed a steady upward path from 1989 forward, reaching about 3.5 billion pounds in 2007. Frozen yogurt production also grew steadily, but for a much shorter period of time, and peaked in 1995 at 152.1 million gallons. By 2007 frozen product production had fallen by more than half, to about 61 million gallons.

In 2008 a number of marketing initiatives were undertaken to increase the size of the U.S. frozen yogurt market. There have also been major efforts to promote yogurt consumption among various populations, with health-benefit claims generally directed toward older consumers but also, to a lesser degree, to younger adults. The introduction of yogurt in drinkable single-serving sizes has been one approach in the effort to reach younger, more active consumers. The dairy industry has also promoted yogurt with additives such as omega-3, and yogurt is included in the industry's recently established 3-Every-Day program, which advocates healthy eating.

Analyses of Yogurt Markets

Economic analyses of the U.S. yogurt market date back to the 1970s, when the United Dairy Industry Association (UDIA) used weekly household sales data to examine yogurt purchases based on location, container size, flavor, income, ethnicity, and family characteristics (UDIA n.d.). At that time, regional differences were quite significant, with sales in the Pacific and Northeast regions far exceeding sales in other regions and the national average. Additionally, consumers at that time were mostly immigrants or first-generation Americans.

Boehm and Babb (1975) examined price responses of perishable manufactured dairy products, which included frozen desserts and specialty products such as cottage cheese, half-and-half, sour cream, dairy-based dips, and yogurt. Both long- and short-run analyses were completed, using household data. The own-price responsiveness of yogurt was –0.51 in the long run (statistically significant) and –0.36 in the short run (not statistically significant). The income elasticity was 0.20. Boehm and Babb (1975) found that yogurt consumers were particularly responsive to specials and that, as in previous studies, regional differences existed in consumption.

Kepner, Knutson, and Nichols (1978) conducted an in-depth study that reinforced the results of earlier works. They noted that the typical yogurt consumer was female; from the Pacific, Northeast,

Table 1. Annual Production of Yogurt Products, 1989–2007.

Year	Plain and flavored yogurt (1,000 pounds)	Total frozen yogurt (1,000 gallons)
1989	912,378	82,454
1990	982,583	117,577
1991	1,052,978	147,137
1992	1,153,921	134,067
1993	1,285,836	149,933
1994	1,392,521	150,565
1995	1,645,938	152,097
1996	1,588,142	114,168
1997	1,574,050	92,167
1998	1,638,992	97,246
1999	1,717,181	90,851
2000	1,836,591	94,478
2001	2,002,825	71,153
2002	2,310,582	70,771
2003	2,506,562	70,394
2004	2,707,313	54,544
2005	3,058,328	66,132
2006	3,301,435	65,999
2007	3,477,727	60,712

Source: USDA-NASS (2010).

and Mid-Atlantic regions; resided in a household with relatively high income (≥ $20,000 per year); and was between ages 13–19 or 35–44. They also noted that yogurt consumers were typically college educated and head of the household.

Veeman and Peng (1997) examined dairy demand in Canada using quarterly data from 1984 to 1993. By estimating a dynamic Almost Ideal Demand System (AIDS) for ice cream, yogurt, cottage cheese, and cream, they found an own-price demand elasticity of –0.81 (not significant) and an expenditure elasticity of 1.97 for yogurt.

Recent studies have focused on the importance of product differentiation and branding as demand-driving factors. Cotterill, Putsis, and Dhar (2000) analyzed how private labels and national brands influenced price-setting behavior and market share. Using scanner data, Giacomo (2008) examined yogurt demand in Italy with a nested logit model and assessed the welfare gains associated with the introduction of new brands by the same manufacturer. Orth and Firbasová (2003) investigated the extent to which "ethnocentrism" (the appropriateness of buying products from foreign countries) can predict consumers' choice of domestically produced yogurt or imported yogurt in the Czech Republic. Orth and Firbasová (2003) also investigated the role of demographic factors such as age, conditional on ethnocentric behavior. Kim, Allenby, and Rossi (2002) used a random utility specification to estimate the demand for Dannon yogurt flavors (blueberry, plain, strawberry, etc.) in 8-ounce sizes.

Empirical Framework

This study focuses on the demand for yogurt products. For product groups unrelated to yogurt, utility is assumed group additive (block independent) where the utility derived from the yogurt product group (Y) and unrelated product group (G) is defined as $u(q)=u(q_Y)+u(q_G)$. This implies that the marginal utility of one dollar spent on the ith yogurt caused by one extra dollar spent on any good in group g is zero. Yogurt and related product group g are assumed blockwise dependent where $u(q)=f(u(q_Y), u(q_G))$. This suggests that the utility interaction of yogurt and non-yogurt products is a matter of the groups and not the individual goods (Theil and Clements 1987; Pollak and Wales 1992, pp. 43–53). For instance, the utility interaction of yogurt should be the same regardless to the source of production. With these assumptions, a demand model limited to yogurt products is derived.

The empirical analysis is carried out by estimating the Translog demand system (Christensen, Jorgenson, and Lau 1975), with expenditure share (w_i) equations for n goods:

$$(1)\quad w_i = \frac{\alpha_i + \sum_{j=1}^{n} \beta_{ij} \log(p_j / M)}{-1 + \sum_{k=1}^{n} \sum_{j=1}^{n} \beta_{kj} \log(p_j / M)}, \quad i=1,...,n,$$

where p_j are prices, M is total yogurt expenditure, and α_i and β_{ij} are parameters. The homogeneity restriction follows from the use of standardized prices p_j / M, and the symmetry restrictions ($\beta_{ij} = \beta_{ij}\ \forall\ k \neq j$) are also imposed. Demographic variables s_h are incorporated in the demand system Equation 1 by parameterizing α_i such that

$$(2)\quad \alpha_i = \alpha_{i0} + \textstyle\sum_h \alpha_{ih} s_h\ ,\ i = 1, ..., n\ .$$

One important empirical issue for the current application is observed zero consumption of yogurt products during the sampling period. To obtain consistent empirical estimates, the first $n - 1$ share equations are estimated with the two-step procedure (Shonkwiler and Yen 1999). The right-hand side of the deterministic share equations in Equation 1 is expressed as as $f_i(\mathrm{x}; \theta)$, where x is a vector containing all explanatory variables [log (p_j / M) and s_h] and θ is a vector containing all parameters (α_{ik} and β_{ij}). Each expenditure share w_i is generated by the deterministic function $f_i(\mathrm{x}; \theta)$ and an unobservable error term v_i, subject to sample selection (Shonkwiler and Yen 1999; Yen and Lin 2006):

$$(3)\quad w_i = 1(z'_i\gamma_i + u_i > 0)[f_i(\mathrm{x}; \theta) + v_i],\ i = 1, ..., n-1\ .$$

In Equation 3, $1(\cdot)$ is a binary indicator function and z_i is a vector of explanatory variables with parameters γ_i which, along with random error u_i, governs the binary (0 or positive) outcomes of w_i. The error vector e = $[u_1, ..., u_{n-1}, v_1, ..., v_{n-1}]'$ is assumed to be distributed as $(2n-2)$-variate normal such that $Var(u_1) = ... = Var(u_{n-1}) = 1$. In the first step, maximum-likelihood (ML) probit estimates $\hat{\gamma}_i$ are obtained based on the binary outcomes for each w_i. The augmented expenditure share equations then are estimated as a seemingly unrelated regression (SUR) system, using the ML procedure:

$$(4)\quad w_i = \Phi(z'_i\hat{\gamma}_i)f_i(\mathrm{x};\theta) + \delta_i\varphi(z'_i\hat{\gamma}_i) + \xi_i,\ i = 1, ..., n-1,$$

where, for good i, ξ_i is a heteroscedastic error term and additional parameter δ_i is the covariance between error terms u_i and v_i. Marshallian (uncompensated) demand elasticities for the first $n-1$ goods are obtained by differentiating the augmented share equations in Equation 4, and compensated (Hicksian) demand elasticities by using Slutsky's equation (Yen, Kan, and Su 2002, p. 1806). Elasticities for the nth goods then are calculated using the adding-up restrictions (Yen, Lin, and Smallwood 2003, p. 460).

Nielsen 2005 Homescan Data

The Nielsen 2005 Homescan data set contains demographic and food purchase information for a nationwide panel of representative households. Each household is given a device to scan all food items purchased at any retail outlet. Some households record only UPC-coded foods while others record both UPC-coded and weighted items. In this study a subset of 6,365 households is used, accounting for both UPC-coded and random weight products. These households reported 7,597,426 purchases, which consist of 4,001,639 dry grocery product purchases; 1,379,832 random-weight item purchases; 900,100 dairy product purchases; and 1,315,855 purchases of produce, meat, and frozen food. Each purchase record contains data on product characteristics, quantity purchased, price paid with and without promotions, date of purchase, store, as well as brand information. The purchase record is matched to a household record that contains information on the size and composition of the household, income, ethnicity, age, race, gender, education, and occupation of household members, and market location data. Projection factors or sample weights are provided by Nielsen to be used at the household level to provide representative estimates for the U.S. population.

Yogurt products are identified using the UPC descriptions and designated codes for each item and are categorized into three groups: refrigerated, frozen, and drinkable/shakes. The refrigerated group includes yogurt with clustered, whipped, and thick and creamy textures. There is no differentiation based on fat contents. Frozen yogurts are sold in several forms, including novelties such as push-ups, bars, cups, and popsicles. Soft-served and hard forms of frozen yogurts can also be purchased in quarts, half-gallons, or gallon containers. Drinkable yogurts and fluid yogurt shakes are relatively new products. The final data set used for the analysis includes all purchases of refrigerated yogurt, frozen yogurt, and drinkable yogurt. Prices are reported for all products to which coupons and sales promotions have been applied.

Empirical Results

A three-equation system, consisting of demand equations for refrigerated yogurt, frozen yogurt, and drinkable yogurt, is estimated using the two-step procedure described above, with drinkable yogurt omitted. Parameter estimates are not presented but they are available upon request.

Demographic Variables

The Nielsen data were obtained from a representative sample of the U.S. population in 2005, where consumers agreed to scan retail grocery receipts for purchases made during a 12-month period. Although the reliability of Nielsen data has been criticized, the overall accuracy of self-reported data by Homescan panelists is consistent with many other surveys of this type (Einav, Leibtag, and Nevo 2008).

The impacts of demographic variables are analyzed, which included size of household and dummy variables indicating employment and college education of female head of household, Southern region of the U.S., non-Hispanic Whites, presence of children in the home, and marital status (Table 2). Previous studies of dairy-product demand (e.g., Chouinard et al. 2010; Huang and Lin 2000) have used similar demographic variables. Table 3 shows the average size and percentage for the demographic variables as represented in the U.S. Census, the Nielsen Homescan Fresh Foods Panel (unweighted), and the subset of those households that purchased yogurt as reported in the data (also unweighted).

Compensated Demand Elasticities

Demand elasticities for the three yogurt products are derived by differentiating augmented share

Table 2. Variable Definitions and Sample Statistics (Sample Size = 6365).

Variable	Mean	Std. dev.
Quantities (ounces over 12 months)		
Refrigerated	17.51	17.32
Frozen	62.47	36.14
Drinkable	24.57	19.19
Expenditures ($ over 12 months)		
Refrigerated	1.75	1.56
Frozen	4.99	1.76
Drinkable	2.70	2.57
Prices ($ per ounce)		
Refrigerated	0.10	0.04
Frozen	0.08	0.07
Drinkable	0.11	0.06
Binary explanatory variables (yes = 1, no = 0)		
South	0.38	
White	0.77	
College	0.43	
Employment	0.44	
Children	0.26	
Married	0.61	
Continuous explanatory variable		
Household size	2.47	1.34

Table 3. Average Size and Share of Selected Demographic Variables.

Demographic variables	2005 census	2005 Homescan (unweighted)	Homescan yogurt purchasers (unweighted)
Household size	2.6	2.4	2.5
Female head employed	63 percent	54 percent	44 percent
South	36 percent	38 percent	38 percent
White	76 percent	76 percent	77 percent
Married	53 percent	57 percent	61 percent
Children present	25 percent	24 percent	26 percent
Female head had college	32 percent	34 percent	43 percent

Equation 4. The Slutsky equation is used to derive compensated demand elasticities. Compensated price elasticities are presented in Table 4. All compensated own-price elasticities are negative, as expected, and are statistically significant at the one percent level. Own-price elasticities vary widely, ranging from –0.16 for refrigerated yogurt to –0.60 for drinkable yogurt to –2.39 for frozen novelty yogurt. Own-price responses are limited for refrigerated and drinkable yogurts but considerably larger for frozen yogurt novelties.

Product relationships play major roles in consumption patterns. Relationships among yogurt categories are identified by estimated cross-price elasticities. Results reveal that refrigerated yogurts are net substitutes for frozen novelty yogurts (which include yogurt frozen chocolate bars, cookie sandwiches, and frozen cups). This finding suggests that an increase in the price of frozen yogurt novelties will result in an increase in the demand for refrigerated yogurt. A substitution relationship also exists between drinkable yogurts (including shakes) and frozen novelty yogurts. Assuming all other things are held constant, a one percent increase in the price of drinkable yogurts is expected to increase the quantity demanded of frozen yogurts by 1.395 percent. A complementary relationship is found between frozen yogurt novelties and refrigerated yogurt and between frozen yogurt novelties and drinkable yogurt. Products are considered complements if they are consumed together and not as alternatives. Based on the calculated cross-price elasticity, a one percent decrease in the price of frozen yogurt novelties would cause the demand for refrigerated yogurt to increase, displaying an indirect relationship.

Uncompensated Demand Elasticities

Table 5 shows the uncompensated price and expenditure elasticity estimates. Results indicate that the own-price elasticities are all negative and statistically

Table 4. Compensated Price Elasticities.

	Prices of		
Product	Refrigerated	Frozen	Drinkable
Refrigerated	–0.159	–0.293	0.452
Frozen	0.994	–2.389	1.395
Drinkable	0.896	–0.291	–0.605

All elasticities are significant at the 1 percent level of significance.

Table 5. Uncompensated Price and Expenditure Elasticities.

	Prices of			Total yogurt
Product	Refrigerated	Frozen	Drinkable	expenditure
Refrigerated	–1.012*	0.058*	–0.045*	0.998*
Frozen	0.114*	–2.026*	0.883*	1.029*
Drinkable	0.041*	0.061	–1.103*	1.000*

* indicates statistical significance at the 1 percent level of significance.

significant at the one percent level, similar to the compensated demand results. These uncompensated own-price elasticities are all greater than one, while only frozen yogurt novelties exceeded 1 for the compensated own-price elasticities. Cotterill, Putsis, and Dhar (2000) examined yogurt demand using an AIDS model and found that own-price elasticities for national brand and private brand estimates are –2.42 and –4.85, respectively. Boehm and Babb (1975) reported yogurt own-price elasticities of –0.51 (long-run) and Veeman and Peng (1997) reported yogurt own-price elasticities of –0.81 (not statistically significant), both of which are considerably smaller than the own-price elasticities reported in this study.

The cross-price elasticities estimated for the uncompensated demand elasticities produced more substitution relationships than did the compensated demand elasticities. All of the cross-price elasticities are statistically significant at the one percent level except the substitution relationship between drinkable yogurt and frozen yogurt novelties. Refrigerated yogurts serve as a gross substitute for frozen yogurt novelties and drinkable yogurt, while frozen yogurt novelties are gross substitutes for refrigerated and drinkable yogurts. The major differences in the compensated and uncompensated demand results are recognizable in the size of cross-price elasticities: compensated cross-price elasticities are considerably larger than those recorded for uncompensated demand elasticities.

Also presented in Table 5 are the expenditure elasticities, which are all statistically significant at the one percent level. All three expenditure elasticities are positive and fairly close to unity, indicating that these yogurt products are normal goods. Veeman and Peng (1997) also report positive expenditure elasticity for yogurt, but the magnitude is almost twice as large as ours, while Boehm and Babb (1975) report an expenditure elasticity for yogurt at least five times smaller than that reported in this study. These differences in elasticities could be due to a number of factors, including the growing popularity of yogurt products and/or the growth in per capita income over time.

Impact of Demographic Variables

Estimates effects of demographic variables on yogurt demand are presented in Table 6. Seven demographic variables are analyzed in the second step of the censored demand model: household size, the presence of children in the home, married couples, individuals living in the Southern region of the U.S., females who earned a four-year college degree, Whites, and working females. Of the three yogurt categories, only frozen and drinkable yogurts had demographic influences that are statistically significant. Household size, the Southern region, females with a college degree, and Whites are not a factor in the demand for yogurt at-home.

Table 6. Elasticities with Respect to Demographic Variables.

Variable	Frozen	Drinkable
Household size	–0.059	0.045
Female head employed	0.048***	–0.034***
South	–0.006	0.007
White	–0.025	0.011
Married	0.039*	–0.030**
Children present	–0.028**	0.023***
Female head had college	–0.007	0.004

Asterisks indicate level of significance: *** = 1 percent, ** = 5 percent, * = 10*. All elasticities for refrigerated yogurt are insignificant and are not presented.

As expected, the presence of children in the home has an influence on yogurt demand. Results reveal that the presence of children in the home has a negative effect on frozen yogurt demands and a positive effect on drinkable yogurt demands. The opposite is true for married couples and working females. Households with married couples and with working females consume more frozen yogurt and less drinkable yogurt.

While some of the demographic variables are found to be statistically significant, the influence of these variables is small. All demographic effects are insignificant on refrigerated yogurt (not reported) and the effects are also quite small on frozen and drinkable yogurts. Based on these findings, it is postulated that the primary driving forces behind at-home yogurt demand are changes in yogurt prices and consumer income.

Conclusions

The empirical analysis of the Nielsen 2005 retail purchase data for three yogurt categories suggests that yogurt is a product that has discernable price, income, and demographic factors influencing its consumption, a result that is consistent with earlier studies for other food products. According to the current analysis, readily quantifiable demographic characteristics such as presence of children, marriage, and female head of household employment tend to have minimal impacts on the demand for yogurt products consumed at-home, with only presence of children in the household, married, and female head of household employed being statistically significant for some yogurt products. Price and income are the driving forces behind changes in yogurt consumption. Uncompensated own-price elasticities suggest all yogurt products are quite sensitive to changes in retail prices, which means that consumers are likely to alter the quantity they demand with any sudden increase or decrease in the own-price of yogurt products. Likewise, consumers' income affects yogurt demand: a reduction in income will cause the amount of yogurt purchased to decline.

As the consumption of plain and flavored yogurts continues to rise in the U.S., yogurt is becoming an increasing part of consumers' diets. This growth is supported by major efforts of the USDA to promote the health and nutritional benefits of low fat dairy products, particularly through the USDA dietary guidelines (USDA-USDHHS 2005) and the National Dairy Council's (2010) "3-Every-Day" program. Low-fat yogurt is considered a great source of calcium and is one of three dairy products currently recommended for good health and nutrition.

Interestingly, frozen yogurt products are not playing any major role in consumer purchase choices. Frozen yogurt production dropped by over 30,000 gallons from 1997 to 2007, but recent efforts appear to be directed at reviving such product sales. Continued purchases of competing yogurt products such as ice cream and/or ice milk may be a factor in the revival. The estimate of the frozen yogurt own-price elasticity suggests a great level of price sensitivity and the cross-price relationships are also strong. Increases in the prices of any of the yogurt products could seriously reduce the consumption of frozen yogurt at the retail level. However, according to the estimated demand elasticities, assuming all other things held constant, the dairy industry stands to benefit from increases in consumers' income and may also benefit from a reduction in the retail prices of the three yogurt products.

References

Binkley, J. K. 2006. "The Effect of Demographic, Economic, and Nutrition Factors on the Frequency of Food Away from Home." *Journal of Consumer Affairs* 40(2):372–391.

Boehm, W. T. and E. M. Babb. 1975. "Household Consumption of Perishable Manufactured Dairy Products: Frozen Desserts and Specialty Products." Station Bulletin 105. Agricultural Experiment Station, Purdue University.

Chouinard, H. H., J. T. LaFrance, D. E. Davis, and J. M. Perloff. 2005. "Milk Marketing Order Winners and Losers." CUDARE Working Papers. University of California, Berkeley. http://repositories.cdlib.org/are_ucb/1006.

Christensen, L. R., D. W. Jorgenson, and L. J. Lau. 1975. "Transcendental Logarithmic Utility Functions." *American Economic Review* 65(3): 367−383.

Cotterill, R. W., W. P. Putsis, Jr., and R. Dhar. 2000. "Market Share and Price Setting Behavior for Private Labels and National Brands." Research Report 51. Food Marketing Policy Center, Department of Agricultural and Resource Economics, University of Connecticut.

Einav, L., E. Leibtag, and A. Nevo. 2008. "On the Accuracy of Nielsen Homescan Data." Economic Research Report, No. 69. Washington, DC: Economic Research Service, U.S. Department of Agriculture, December.

Freeman, A. 2007. "Fast Food: Oppression Through Poor Nutrition." *California Law Review* 95: 2221–2259.

Giacomo, M. D. 2008. "GMM Estimation of a Structural Demand Model for Yogurt and the Effects of the Introduction of New Brands." *Empirical Economics* 34(3):537–565.

Granner, M. L., R. G. Sargent, K. S. Calderon, J. R. Hussey, A. E. Evans, and K. W. Watkins. 2004. "Factors of Fruit and Vegetable Intake by Race, Gender, and Age Among Young Adolescents." *Journal of Nutrition Education and Behavior* 36(4):173–180.

Huang, K. S. and B. H. Lin 2000. "Estimation of Food Demand and Nutrient Elasticities From Household Survey Data." Technical Bulletin No. 1887. Washington, DC: Economic Research Service, U.S. Department of Agriculture, August.

Kepner, K. W., R. D. Knutson, and J. P. Nichols. 1978. "Yogurt, Frozen Yogurt (Soft Serve), Hard Frozen Yogurt." Washington, DC: American Cultured Dairy Products Institute.

Kim, J., G. M. Allenby, and P. E. Rossi. 2002. "Modeling Consumer Demand for Variety." *Marketing Science* 21(3):229–250.

National Dairy Council. 2010. "3-Every-Day™ of Dairy." Rosemont, IL. Available at: http://www.nationaldairycouncil.org/EducationMaterials/Pages/3EveryDayOfDairy.aspx. Accessed February 5, 2010.

Nayga, R. M. 1996. "Dietary Fiber Intake Away-From-Home and At-Home in the United States." *Food Policy* 21(3):279–290.

Orth, U. R. and Z. Firbasová. 2003 "The Role of Consumer Ethnocentrism in Food Product Evaluation." *Agribusiness: An International Journal* 19(2):137–153.

Pollak, R. A., and T. J. Wales. 1992. *Demand System Specification and Estimation*. Oxford: Oxford University Press.

———. 1981. "Demographic Variables in Demand Analysis." *Econometrica* 49(6):1533–1551.

PR Newswire. 2010. "Yogurt Named Food Trend of the Decade." Consumer Trends. http://www.prnewswire.com/news-releases/yogurt-named-food-trend-of-the-decade-82580027.html. Access date: 02/01/10.

Shonkwiler, J. S. and S. T. Yen. 1999. "Two-Step Estimation of a Censored System of Equations." *American Journal of Agricultural Economics* 81(4): 972−982.

Theil, H. and K. W. Clements. 1987. *Applied Demand Analysis: Results from System-wide Approaches*. Cambridge, MA: Ballinger Publishing Company.

Trager, J. 1997. *The Food Chronology: A Food Lover's Compendium of Events and Anecdotes from Prehistory to the Present Day*. New York: Owl Books.

United Dairy Industry Association (UDIA). No date. "The Household Yogurt Market, April 1972−March 1973." Marketing and Economic Research Division. Rosemont, IL.

U.S. Department of Agriculture, National Agricultural Statistics Service (USDA-NASS). 2010. Data and Statistics: Quick Stats 2.0 Beta. Washington, DC. Available at: http://www.nass.usda.gov/Data_and_Statistics/Quick_Stats/index.asp. Accessed February 5, 2010.

U.S. Department of Agriculture and U.S. Department of Health and Human Services (USDA-USDHHS). 2005. *Dietary Guidelines for Americans, 2005*. Washington, DC, U.S. Department of Agriculture. http://www.healthierus.gov/dietaryguidelines. Accessed February 5, 2010.

Veeman, M. and Y. Peng. 1997. "Canadian Dairy Demand." Project Report Series 24037. Department of Rural Economy, University of Alberta—Edmonton, Alberta, Canada.

Yen, S. T., K. Kan, and S. Su. 2002. "Household Demand for Fats and Oils: Two-Step Estimation of a Censored Demand System." *Applied Economics* 34(14):1799−1806.

Yen, S. T. and B-H. Lin. 2006. "A Sample Selection Approach to Censored Demand Systems." *American Journal of Agricultural Economics* 88(3):742–749.

Yen, S. T., B. Lin, and D. M. Smallwood. 2003. "Quasi and Simulated Likelihood Approaches to Censored Demand Systems: Food Consumption by Food Stamp Recipients in the United States." *American Journal of Agricultural Economics* 85(2):458−478.