Impact of Increasing Demand for Dairy Alternative Beverages on Dairy Farmer Welfare in the United States

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Abstract

Production and consumption of dairy alternative beverages in the United States has been on the rise as per capita consumption of fluid milk continues to fall. Almond milk and soymilk are the fastest growing categories in the U.S. dairy alternative marketplace. Using household-level purchase data from 2011 Nielsen Homescan panel and tobit econometric procedure, the conditional and unconditional own-price, cross-price and income elasticities for soymilk and almond milk were estimated. Income, age, employment status, education level, race, ethnicity, region and presence of children are significant drivers affecting the demand for dairy alternative beverages, such as almond milk and soy milk.

We use the estimates from the tobit econometric procedure to predict how changes in demographic profiles, prices and income will likely affect demand for the aforementioned dairy and dairy alternative products, and how these changes in retail demand will affect the blend price, production and producer surplus of U.S. dairy farmers subject to the federal milk marketing order system. To model the farm-side effects we follow Balagtas and Sumner (2001) and use estimates of elasticities of supply for milk from the literature.

Keywords: Almond milk, soymilk, lactose free milk, tobit model, Nielsen Homescan data, household level demand

JEL Classification: *D11, D12, P46*

Background and Justification

There are many different types of nonalcoholic beverages available in the United States today. Functionality and health dimensions of beverages have changed over the years. On top of conventional hydration and refreshment functions, beverages now are fortified with numerous vitamins, minerals, proteins, antioxidants, favorable fatty acids, etc. (BMC, 2010; 2011, 2012).

Currently, calcium and vitamin fortified dairy alternative beverages are becoming readily available in mainstream markets, providing consumers an alternative, specifically for those who have restricted diets. To strengthen the position of this, the new food guidelines developed under the "ChooseMyPlate", placed dairy alternatives such as soymilk, rice milk and almond milk in the "Dairy Group" (USDA, 2014). This placement raised eyebrows of dairy producers and marketers in the United States. Although, the dairy industry in the United States offers a wide array of milk and processed dairy products to consumers, per capita consumption of milk has been declining over the past 25 years ((Davis *et al.*, 2010; USDA-ERS, 2013). This decline in demand for dairy milk could probably be due to Americans becoming increasing concerned with their health. Dairy alternative beverages are generally perceived as a healthier option, since they have fewer calories and don't contain the growth hormones found in dairy milk. The combination of health concerns and the availability of dairy alternative products on the market, have led to constant growth for dairy alternative milk producers.

The product mix in the dairy alternative industry has changed greatly over the past five years. Soymilk was the original market leader, with soy being the primary or secondary ingredient in 78 percent of market launches in 2012 (Innova Market Insights, 2013). Although, almond milk demand has surged since its entry into the market, with an estimated 65.5% of total dairy alternative product demand. Soymilk currently represents only 25% of total dairy alternative product demand (IBISWorld, 2015). Growth in dairy alternatives has been attributed to improved health-related claims and consumer perceptions, appealing and convenient packaging, and a plethora of flavors available. The shift from soymilk to almond milk could be due to the fact that almond milk is seen as healthier since it has no saturated fat, fewer calories than soymilk, and is rich in Vitamin E.

Sales of dairy alternative beverages reached nearly $2 billion in 2013, driven up largely as a result of popularity of almond milk (The Washington Post, 2014). The dairy alternative beverage industry is dominated by WhiteWave Foods (57.1% market share) who produces and markets almond milk and soymilk under the brand name Silk. Currently, Silk has 60% of the market for plant-based beverages with Silk Pure Almond being the main driver in the company's growth since 2010. Blue Diamond Growers is another industry leader with 21.2% market share. They produce and market almond milk under the brand name Almond Breeze. It is estimated that Almond Breeze holds 35% share of the almond milk market, with sales growing an average of 52.9% annually from 2010-2015 (IBISWorld, 2015).

This increasing demand for dairy alternative beverages and declining demand for dairy milk in the United States could negatively affect dairy producers in terms of low prices for dairy milk as well as reduced farm income/welfare. Therefore, it is of interest for dairy producers in the United States to know the competitiveness of dairy alternatives in the dairy marketplace and their implications on dairy prices and farm income/welfare.

Objectives

The purpose of the research reported in this thesis is to evaluate the effect of dairy alternative beverages on the dairy market. The specific research objectives are to:

1. Estimate the demand for almond milk, soymilk, white milk and lactose free milk
2. Estimate the economic and demographic profiles of the dairy alternative beverage consumers in the United States
3. Investigate the economic ramifications on U.S. milk producers in the event that demand for dairy alternative beverages continues to grow as well as if over-capacity occurs and leads to declines in the dairy alternative price, the overall price received by dairy farmers

Literature Review

Previous work on consumer demand for dairy milk and dairy alternative beverages has given us some important insights into the market. Alviola and Capps (2010) estimate sociodemographic profiles of conventional and organic dairy milk consumers in the United States. The study used the 2004 Nielsen panel data, which consists of over 38,000 households, to identity the drivers of the demand for conventional and organic milk in the United States. In particular, they wanted to understand the own-price effects, the cross-price effects, the income effects, and the effects of the sociodemographic characteristics on household decisions to purchase organic or conventional milk. After the decision to purchase organic milk or conventional milk had been made, the researchers then focused on the factors that affected how much of each type of milk was purchased. In order to complete this work, Alviola and Capps (2010) employed the Heckman two-step procedure. They also addressed issues of price endogeneity, since the prices were derived as the ratio of total expenditures to total quantity purchased, by conducting Hausman tests. The results from this study indicate that organic milk and conventional milk are substitutes. The elasticities also indicate that demand for organic milk is more sensitive to changes in price of conventional milk, but that the demand for conventional milk is not very sensitive to changes in the price of organic milk. Also, that household size, number of children, employment status/education of household head, race, ethnicity, and region have a significant impact on the likelihood of a household to purchase organic milk.

Dharmasena and Capps (2014) investigated U.S. consumer demand for dairy alternative beverages, more specifically soymilk. This paper identifies the conditional and unconditional factors that affect the volume of soymilk, white milk, and flavored milk purchased. It also determines the conditional and unconditional own-price, cross-price and income elasticities of demand for soymilk, white milk and flavored milk. Finally, it provides retail-level pricing strategies for soymilk, white milk, and flavored milk in the marketplace. Dharmasena and Capps (2014) utilized the Tobit Model because the 2008 Nielsen Homescan data is censored at the household level, meaning that there were households that did not purchase soymilk. The results of this study showed that, white milk and flavored milk are substitutes for soymilk. It also demonstrated that the conditional own-price elasticity of demand for soymilk was -0.30 meaning that consumers are loyal to their product and insensitive to changes in its own price.

Gould (1996) estimated demand for milk within a system-wide framework. Gould utilized Nielsen household panel data with over 4,300 households. This research found that the three milk types which were investigated were substitutes. This study is one of the few econometric studies involving dairy milk demand that incorporates the substitution possibilities across milk types and also incorporates the censored nature of the data set.

Data and Methodology

Household purchases of soymilk, almond milk, lactose free milk and white milk (expenditure and quantity) and socio-economic-demographic characteristics are generated for each household in the Nielsen Homescan panel for calendar year 2011 (a total of 62,092 households). Out of which, 6,776 households purchased soymilk, 7,487 households purchased almond milk, 4,494 households purchased lactose free milk, and 57,574 households purchased white milk. Quantity data are standardized in terms of liquid ounces and expenditure data are expressed in terms of dollars. Then taking the ratio of expenditure to volume, we generate unit values (prices in dollars per ounce) for each beverage category.

Factors hypothesized to affect the quantity of soymilk, almond milk, lactose free milk and white milk purchased are: price of soymilk, price of almond milk, price of lactose free milk, price of white milk; age, gender, employment and education status of the household head; region; race; Hispanic origin; age and presence of children, income of the household. We hypothesize that almond milk and soymilk are substitutes, hence positive cross-price elasticities. Also, we hypothesize that education status, hence the knowledge of the product, increases the consumption of each beverage; high income households consume more of each beverage; age and presence of children at home increases the consumption of each beverage; full-time employed households consume more away from-home, hence less soymilk and almond milk are consumed at home; households in the South Atlantic region of the U.S. consume more soymilk and almond milk; Whites consume more soymilk and almond milk.

A common characteristic in micro-level data (data gathered at consumer level such as at the individual or household level) is a situation where some consumers may not purchase some beverages during the sampling period. The presence of these in the sample creates a zero consumption level for that observation, hence zero expenditure. As such we face a censored sample of data. Application of ordinary least squares (OLS) to estimate a regression with a limited dependent variable (such as in a censored sample like ours) gives rise to biased estimates, even asymptotically (Kennedy, 2003). Removing all observations pertaining to zero purchases and estimating regression functions only for non-zero purchases too creates a bias in the estimates (Kennedy, 2003). This phenomenon also is known as *sample selection bias*. Tobin (1958) and Heckman (1979)[1] suggested alternative models to deal with sample selection bias in estimating regression models in the presence of censored data. In this paper, we center attention on Tobin's model (Tobin, 1958) to obtain both conditional and unconditional elasticity estimates pertaining to soymilk, almond milk, lactose free milk and white milk. Also, we use the decomposition of the coefficient estimates of tobit model suggested by McDonald and Moffitt (1980) to shed light on changes in probability of being above the limit (the limit being zero in this analysis) and changes in the value of the dependent variable if it is already above the limit.

For all those transactions associated with zero quantities and hence zero expenditures, we do not observe any unit value or price. However, since we are using price of each beverage category as explanatory variables in the tobit model, we have to impute prices for those observations where no price is observed. Price imputation is done using an auxiliary regression, where observed prices for each beverage are regressed on household income, household size and region where the household is located[2]. These variables are used extensively in the price imputation literature to impute prices (Kyureghian, Nayga and Capps, 2011; Alviola and Capps, 2010). Estimated parameters from this auxiliary regression are then used to impute prices for

[1] Alternatively, the Heckman (1979) model only speaks to conditional demand estimates, although the first stage probit analysis provides information on the probability to purchase or not to purchase the product.

[2] Here we provide summary statistics for observed prices and imputed prices for each beverage category. According to means and standard deviations of observed and imputed prices for each beverage, it is clear that the prices and standard deviations were very consistent for with-in sample estimates as well as out-of-sample price imputations.

	Observed Price		Imputed Price	
	Mean	Standard deviation	Mean	Standard deviation
Almond Milk	0.0530	0.0130	0.0531	0.0020
Soymilk	0.0547	0.0167	0.0548	0.0017
White Milk	0.0300	0.0125	0.0301	0.0121
Lactose free Milk	0.0565	0.0113	0.0561	0.0045

those observations where price was not observed. This price imputation technique is well accepted in extant literature and a very common approach to deal with imputing (or forecasting) missing prices and price endogeneity issues (for example see Capps, et al, 1994; Alviola and Capps, 2010; Kyureghian, Nayga and Capps, 2011; Dharmasena and Capps, 2012; and Dharmasena and Capps, 2014). Variability of demand for different quality of beverages is addressed via income variable in the auxiliary regression. Likewise, variability of socio-demographic conditions and its effect on price is approximated via household size variable. The variability in the location of the household and its effect on price is addressed through region variable in the auxiliary regression. Once the prices for each beverage concerned (soymilk, almond milk, lactose free milk and white milk) are imputed, we use them and the other explanatory variables to estimate the tobit model pertaining to soymilk, almond milk, lactose free milk and white milk consumption. Description of the explanatory variables used in the tobit analysis of soymilk and almond milk are shown in Table 1.

The Tobit Model

The stochastic model underlying the tobit model can be expressed as follows:

$$(1) \qquad y_i = \begin{cases} X_i\beta + u_i, & X_i\beta + u_i > 0 \\ 0, & X_i\beta + u_i \leq 0 \end{cases}$$

where $i = 1,2,3, \ldots\ldots, N$, the number of observations. y_i is the censored dependent variable; X_i is the vector of explanatory variables; β is the vector of unknown parameters to be estimated; $E[u_i|X] = 0$ and $u_i \sim N(0, \sigma^2)$. The unconditional expected value for y_i is expressed in equation (2) and the corresponding conditional expected value for y_i is shown in equation (3), where the normalized index value z is shown as $z = \frac{X\beta}{\sigma}$. Also, $F(z)$ is the cumulative distribution function (CDF) associated with z and $f(z)$ is the corresponding probability density function (*pdf*).

(2) $E(y) = X\beta F(z) + \sigma f(z)$

(3) $E(y^*) = X\beta + \sigma \frac{f(z)}{F(z)}$

The unconditional marginal effect is represented by,

(4) $\frac{\partial E(y)}{\partial X} = \beta F(z).$

The conditional marginal effect is shown by,

(5) $\frac{\partial E(y^*)}{\partial X} = \beta(1 - z\frac{f(z)}{F(z)} - \frac{f(z)^2}{F(z)^2}).$

Furthermore, the McDonald and Moffitt (1980) decomposition relating both change in conditional expectations and unconditional expectations can be shown in equation (6). In other words, the total change in unconditional expected value of the dependent variable, *y* can be represented by the sum of the change in the expected value of *y* being above the limit, weighted by the probability of being above the limit and the change in probability of being above the limit weighted by the expected value of *y* being above the limit.

(6) $\frac{\partial E(y)}{\partial X} = F(z)\left(\frac{\partial Ey^*}{\partial X}\right) + E(y^*)\left(\frac{\partial F(z)}{\partial X}\right)$

Empirical Estimation

Single equation tobit models each for soymilk, almond milk, white milk and lactose free milk are estimated. We have tried several functional forms such as linear, quadratic and semi-log to find which model performs best based on the following criteria, model fit, significance of variables and loss metrics such as the Akaike Information Criteria (AIC), Schwarz Information Criteria (SIC) and Hannan-Quinn Information Criteria (HQC). Ultimately we used the best functional form to calculate both conditional and unconditional marginal effects associated with each explanatory variable. The level of significance used in this study is 0.05 (*p*-value is 0.05). We find that semi-log functional form out performs other functional forms. Following derivations and results are based off of this functional form. The equations for unconditional and conditional marginal effects for the semi-log model and the corresponding unconditional and conditional own-price, cross-price and income elasticity estimates are explained below.

The unconditional marginal effect for the price variable of the semi-log model is as follows,

(7) $$\frac{\partial E(y)}{\partial p} = \frac{\beta}{P^U} F(z)$$

where P^U is the average price of all observations (unconditional price) for each beverage considered. The conditional marginal effect for the price variable for the linear-log model is as follows,

(8) $$\frac{\partial E(y^*)}{\partial p} = \frac{\beta}{P^C}(1 - z\frac{f(z)}{F(z)} - \frac{f(z)^2}{F(z)^2})$$

where, p^C is the average price of censored sample (conditional price) for each beverage considered. The unconditional income effect for each beverage for the linear-log model is expressed in equation (9) and the conditional income effect for each beverage for the linear-log model is shown in equation (10).

(9) $$\frac{\partial E(y)}{\partial I} = \frac{\beta}{I^U} F(z)$$

(10) $$\frac{\partial E(y^*)}{\partial I} = \frac{\beta}{I^C}(1 - z\frac{f(z)}{F(z)} - \frac{f(z)^2}{F(z)^2})$$

where, $I^U$is the unconditional mean income and $I^C$is the conditional mean income. The unconditional own- price, cross-price and income elasticities are represented by equations (11), (12) and (13) respectively.

(11) $$\varepsilon_{ii}^U = \frac{\beta}{P_i^U} F(z) \frac{P_i^U}{Q_i^U}$$

(12) $\varepsilon_{ij}^{U} = \frac{\beta}{P_j^U} F(z) \frac{P_j^U}{Q_i^U}$

(13) $\varepsilon_{I}^{U} = \frac{\beta}{I_i^U} F(z) \frac{I_i^U}{Q_i^U}$

The conditional own-price, cross-price and income elasticities are represented by equations (14), (15), (16) respectively,

(14) $\varepsilon_{ii}^{C} = \frac{\beta}{P_i^C} (1 - z \frac{f(z)}{F(z)} - \frac{f(z)^2}{F(z)^2}) \frac{P_i^C}{Q_i^C}$

(15) $\varepsilon_{ij}^{C} = \frac{\beta}{P_j^C} (1 - z \frac{f(z)}{F(z)} - \frac{f(z)^2}{F(z)^2}) \frac{P_j^C}{Q_i^C}$

(16) $\varepsilon_{I}^{C} = \frac{\beta}{I_i^C} (1 - z \frac{f(z)}{F(z)} - \frac{f(z)^2}{F(z)^2}) \frac{I_i^C}{Q_i^C}$

The McDonald and Moffitt (1980) decomposition explained in equation (6) can be manipulated to obtain the expression shown in equation (17) to shed light on change in probability of being above the limit (for conditional sample) for consumption of each beverage category for a change in each explanatory variable, i.e. $\left(\frac{\partial F(z)}{\partial X}\right)$.

(17) $\left(\frac{\partial F(z)}{\partial X}\right) = \frac{1}{E(y^*)}$

Results and Discussion

Analysis was performed used 2011 Nielsen Homescan data comprised of 62,092 households. Summary statistics of price, expenditure and market penetration of soymilk, almond milk, lactose free milk and white milk consumption in the at-home markets of the United States in the calendar year of 2011 are depicted in Table 3. Market penetration for soymilk was found to be 11%, market penetration for almond milk was found to be 12%, while market penetration for lactose free milk was found to be around 7%. The average price paid by households who purchased soymilk was $0.05 per ounce ($3.50 for 64 ounces; the most popular container size). The average price paid by households who purchased almond milk was $0.05 per ounce ($3.39 for 64 ounces). The average price paid by households who purchased lactose free milk was $0.06 per ounce ($3.62 for 64 ounces). The average consumption/purchase of soymilk by a consuming household was estimated to be 480 ounces per year (approximately eight half gallon containers per household per year). The average consumption/purchase of almond milk by a consuming household was estimated to be 424 ounces per year (approximately seven half gallon containers per household per year). The average consumption/purchase of lactose free milk by a consuming household was estimated to be 800 ounces per year (approximately twelve half gallon containers per household per year).

We also found that household composition and demographic characteristics played an important role in the demand for both almond and soymilk. Households in the South Atlantic region of the United States (Delaware, Washington DC, Florida, Georgia, Maryland, North Carolina, South Carolina, Virginia, and West Virginia) consumed more soymilk and almond milk than those from other regions. Those who are classified as White consumed less soymilk, almond milk and lactose free milk. Also, households that classified as Hispanic consumed more soymilk, almond milk and lactose free milk than non-Hispanic households. Households with children of all ages consumed more white milk than households with no children. Finally, households in the Pacific region (Alaska, Washington, Oregon, California and Hawaii) consumed more lactose free milk than other regions.

For brevity, only the conditional elasticities will be discussed in detail. The conditional own-price elasticities of demand for soymilk, almond milk, lactose free milk and white milk are, -0.67, -0.55, -0.49 and -0.69, respectively. These elasticities indicate that consumers of these beverages are relatively insensitive to own-price changes, or those who purchase these beverages are very loyal to purchasing the beverages. The conditional cross-price elasticity of soymilk with almond milk is -0.41 and -0.24 respectively, meaning that the two dairy alternative beverages are complements. The conditional cross-price elasticity of lactose free milk and white milk is 0.41, meaning that the two goods are substitutes. The conditional cross-price elasticity of soymilk and white milk is 0.19 and the conditional cross-price elasticity of almond milk and white milk is 0.20, meaning that people who purchased these dairy alternative beverages view white milk as a substitute. Although, only the conditional cross-price elasticity of white milk with almond milk is significant, with an elasticity of -0.20 meaning that people who purchase white milk view almond milk as a complement. Table 4 displays the conditional and unconditional elasticities for all beverages.

While the present analysis is somewhat limited we will be profiling demographic characteristics of consumers with regards to these food groups. Lastly, using estimated elasticities we will be in position to discuss the welfare effects of the dairy alternative beverage boom on U.S. dairy farmers.

References

Alviola, P.A., and O.Capps, Jr. 2010. "Household Demand Analysis of Organic and Conventional Fluid Milk in the United States based on the 2004 Nielsen Homescan Panel." Agribusiness 26(3):369-388.

Balagtas, J. and D. Sumner. 2003,"The Effect of the Northeast Dairy Compact on Producers and Consumers with Implications of Compact Contagion." Review of Agricultural Economics 25(1): 123-144.

BMC, 2010, 2011, 2012, Beverage Marketing Corporation Multiple Beverage Marketplace Reports

Capps, Jr. O., R. Tsai, R. Kirby, and G. Williams. 1994. "A Comparison of Demand for Meat Products in the Pacific Rim Region." Journal of Agricultural and Applied Economics 19(1): 210-224.

Davis, Christopher G., Diansheng Dong, Don P. Blayney, and Ashley Owens. An Analysis of U.S. Household Dairy Demand, TB-1928, U.S. Dept. of Agr.,Econ. Res. Serv. December 2010.

Dharmasena, S., O.Capps Jr. 2014. "Unraveling Demand for Dairy-Alternative Beverages in the United States: The Case of Soymilk." Agricultural and Resource Economics Review 43(1):140-157.

Dharmasena, S., O.Capps, Jr. 2012. "Intended and Unintended Consequences of a Proposed National Tax on Sugar-Sweetened Beverages to Combat the U.S. Obesity Problem." Health Economics 21(6):669-694, first published online in Wiley Online Library (wileyonlinelibrary.com). DOI: 10.1002/hec.1738.

Gould, B. W. 1996. "Factors affecting US demand for reduced-fat fluid milk." Journal of Agricultural and Resource Economics, 68-81.

Heckman, J. J. 1979. "Sample Selection Bias as a Specification Error." Econometrica 47: 153-161.

Innova Market Insights, FoodBusinessNews.net, accessed January 7, 2013.

KCT.org, (2014) "Demand for Almond Milk is Growing, but is it Bad for the Planet?" Internet access: http://www.kcet.org/living/food/the-nosh/demand-for-almond-milk-is-soaring-but-is-it-bad-for-the-planet.html (accessed on September 3, 2014)

Kennedy, P. 2003. Limited Dependent Variables. A Guide to Econometrics, MIT Press.

Kyureghian, G., O. Capps, Jr., and R. Nayga. 2011. "A Missing Variable Imputation Methodology with an Empirical Application." Advances in Econometrics 27A:313-337.

McDonald, J. F., and R. A. Moffitt. 1980. "The Uses of Tobit Analysis." The Review of Economics and Statistics 62(2): 318-321.

Neville, Antal (2015). "Soy and Almond Milk Production in the US" . IBISWorld, (internet access on April 1, 2014: http://clients1.ibisworld.com/reports/us/industry/default.aspx?entid=4195)

The Washington Post, (2014), "Got Milk? From a Cow or a Plant?" Internet access: http://www.washingtonpost.com/news/to-your-health/wp/2014/06/10/got-milk-from-a-cow-or-a-plant/ (acceded on September 3, 2014).

Tobin, J. 1958. "Estimation of Relationships for Limited Dependent Variables." Econometrica 26(1): 24-36.

USDA, (2014). "What foods are included in the Dairy Group?". ChooseMyPlate, (internet access on September 3, 2014: http://www.choosemyplate.gov/food-groups/dairy.html)

USDA-ERS Economic Research Service (ERS). 2013. Diary Data: http://www.ers.usda.gov/data-products/dairy-data.aspx#.UXSd6yvwLTV. Internet access December 27, 2013.

Table 1: Description of the Explanatory Variables Used in the Tobit Analysis of Soymilk, Almond Milk, Lactose Free Milk and White Milk

Explanation
Price of Soymilk and Almond Milk (all in $/oz)
Household Income (dollars)
Age of Household Head less than 25 years (Base category)
Age of Household Head between 25-29 years
Age of household Head between 30-34 years
Age of household Head between 35-44 years
Age of household Head between 45-54 years
Age of household Head between 55-64 years
Age of household Head greater than 64 years
Household Head not employed for full pay (Base category)
Household Head Part-time Employed
household Head Full-time Employed
Education of Household Head: Less than high school (Base category)
Education of Household Head: High school only
Education of Household Head: Undergraduate only
Education of Household Head: Some post-college
Region: East (Base category)
Region: Central (Midwest)
Region South
Region West
Race White (Base category)
Race Black
Race Oriental
Race Other (non-Black, non-White, non-Oriental)
Non-Hispanic Ethnicity (Base category)
Hispanic Ethnicity
No Child less than 18 years (Base category)
Age and Presence of Children less than 6-years
Age and Presence of Children between 6-12 years
Age and Presence of Children between 13-17 years
Age and Presence of Children less than 6 and 6-12 years
Age and Presence of Children less than 6 and 13-17 years
Age and Presence of Children between 6-12 and 13-17 years
Age and Presence of Children less than 6, 6-12 and 13-17 years
Household Head both Male and Female (Base category)
Household Head Male only
Household Head Female only

Source: Constructed by authors; base category of dummy variables are printed in italics.

Table 2: Tobit Regression Results for Soymilk, Almond Milk, Lactose Free Milk and White Milk

	Soymilk			Almond Milk			Lactose Free Milk			White Milk		
Variable	**Estimate**	**Std Error**	***p*-Value**	**Estimate**	**Std Error**	***p*-Value**	**Estimate**	**Std Error**	***p*-Value**	**Estimate**	**Std Error**	**p-Value**
Intercept	-9445.19154	586.060839	<.0001	-8361.905	472.92825	<.0001	-9839.244	993.78429	<.0001	-11160	216.358216	<.0001
Log price soymilk	-1737.56255	68.270833	<.0001	-536.4369	76.782453	<.0001	-213.42	187.68038	0.2555	121.525508	158.613545	0.4436
Log price almond milk	-1058.21880	109.191492	<.0001	-1237.480	65.108557	<.0001	-999.2965	220.46304	<.0001	-546.02957	175.924626	0.0019
Log price white milk	506.909110	31.402357	<.0001	459.33787	25.424421	<.0001	1190.7193	57.848700	<.0001	-3712.9245	47.263437	<.0001
Log price lactose free milk	-549.81	156.535474	0.0004	-1046.311	122.07840	<.0001	-2391.201	176.78286	<.0001	301.922319	208.355355	0.1473
Log household income	86.017994	16.326311	<.0001	117.21719	13.361550	<.0001	190.19868	29.687372	<.0001	50.852379	23.411895	0.0299
Age of household head 25-29	-375.581587	184.582337	0.0419	179.42360	179.69309	0.3180	-419.8324	384.73861	0.2752	232.216425	293.038193	0.4281
Age of household head 30-34	-454.902840	179.709508	0.0114	103.49118	176.53896	0.5577	-378.0118	374.27004	0.3125	512.079509	284.980993	0.0724
Age of household head 35-44	-477.114356	176.030341	0.0067	90.165921	174.19921	0.6047	-354.0657	367.72962	0.3356	522.866387	279.043090	0.0610
Age of household head 45-54	-515.735969	175.309962	0.0033	-23.84674	173.77952	0.8909	-333.0744	366.56273	0.3635	741.780930	278.336547	0.0077
Age of household head 55-64	-534.489133	175.266901	0.0023	-72.36303	173.74104	0.6770	-227.8312	366.41979	0.5341	581.228812	277.857692	0.0365
Age of household head >64	-595.103954	175.890056	0.0007	-189.9200	174.16402	0.2755	-108.0014	367.17980	0.7687	506.556304	278.197856	0.0686
Employment status part-time	68.354055	25.652685	0.0077	66.601582	20.783159	0.0014	-91.35611	48.099957	0.0575	-167.48821	38.739719	<.0001
Employment status full-time	-36.044817	23.151678	0.1195	-65.98464	18.827979	0.0005	-215.1408	42.959851	<.0001	-347.92600	34.500902	<.0001
Education: high school	-5.018432	64.843642	0.9383	101.10200	56.701754	0.0746	-6.964703	118.74326	0.9532	-107.57588	90.058774	0.2323
Education: undergraduate	139.985725	63.347361	0.0271	256.2938	55.526852	<.0001	253.27753	115.85613	0.0288	-240.40030	88.412595	0.0065
Education post-college	200.967545	67.874552	0.0031	298.27746	58.968287	<.0001	383.35607	123.94205	0.0020	-305.26666	96.388258	0.0015
New England	-161.730014	52.548437	0.0021	-232.7284	42.126626	<.0001	-6.596466	86.401816	0.9391	415.425255	77.475297	<.0001
Middle Atlantic	-74.611388	35.798528	0.0371	-100.6316	28.880809	0.0005	76.290681	63.149029	0.2270	216.637024	54.464820	<.0001
East North Central	-200.899425	40.120813	<.0001	-312.0174	32.395366	<.0001	-618.1875	69.037317	<.0001	240.300638	57.543889	<.0001
West North Central	-269.659055	44.554673	<.0001	-329.5446	36.191903	<.0001	-790.0605	84.576985	<.0001	710.388277	63.667185	<.0001
South Atlantic	-231.102065	36.314395	<.0001	-210.3286	28.819821	<.0001	-224.2610	61.985193	0.0003	387.119064	53.572484	<.0001
East South Central	-334.736506	50.285825	<.0001	-382.1956	40.369428	<.0001	-850.1677	93.383486	<.0001	342.396025	71.814714	<.0001

	Soymilk			Almond Milk			Lactose Free Milk			White Milk		
Variable	**Estimate**	**Std Error**	***p*-Value**	**Estimate**	**Std Error**	***p*-Value**	**Estimate**	**Std Error**	***p*-Value**	**Estimate**	**Std Error**	**p-Value**
West South Central	-305.684655	50.251410	<.0001	-480.0560	40.491930	<.0001	-687.9401	80.705706	<.0001	-36.621796	68.783751	0.5944
Mountain	-67.862316	43.718161	0.1206	-62.78910	34.858182	0.0717	-442.6760	83.809207	<.0001	-175.48991	64.931179	0.0069
Black	264.911346	28.946944	<.0001	127.21999	23.994168	<.0001	752.05255	50.166588	<.0001	-1363.9369	47.449208	<.0001
Asian	365.949805	47.274321	<.0001	172.87588	39.608372	<.0001	488.23182	89.370543	<.0001	-825.54393	82.444827	<.0001
Other	152.525828	45.738427	0.0009	73.555919	37.993146	0.0529	373.41761	82.076020	<.0001	-486.29988	74.218003	<.0001
Hispanic	201.949945	40.253923	<.0001	112.71087	33.434339	0.0007	479.77540	72.161776	<.0001	-152.40549	66.201969	0.0213
Children less than 6 years	84.350077	54.796876	0.1237	-39.84436	45.318887	0.3793	264.20342	102.60716	0.0100	1520.41199	87.574925	<.0001
Children 6-12years	61.350417	40.990527	0.1345	-34.92693	33.792622	0.3013	27.390288	79.720686	0.7312	1116.88195	63.865220	<.0001
Children 13-17years	28.897435	36.921105	0.4338	-60.58383	30.489969	0.0469	-107.2704	73.149746	0.1425	1500.00725	56.063911	<.0001
Children < 6 & 6-12 years	-78.257634	60.406071	0.1951	-16.92109	47.157599	0.7197	230.92664	109.88605	0.0356	1930.74516	92.589330	<.0001
Children <6 & 13-17years	-23.801569	136.746755	0.8618	-153.9490	112.44673	0.1710	-587.7410	308.67260	0.0569	1951.94163	207.563230	<.0001
Children 6-12&13-17years	-79.749346	52.937844	0.1319	-151.3224	43.169474	0.0005	-166.2950	105.26264	0.1142	2368.03068	78.581238	<.0001
Children <6 & 6-12&13-17	-8.085699	122.295650	0.9473	-82.16713	99.149984	0.4073	-55.43069	249.37499	0.8241	2967.88346	192.770782	<.0001
Female head only	-45.074026	24.382887	0.0645	52.377763	19.636161	0.0076	-71.66616	44.322668	0.1059	-1145.0410	35.866126	<.0001
Male head only	-204.689815	35.107394	<.0001	-220.6680	29.293455	<.0001	-299.1859	63.964750	<.0001	-1034.7436	49.056689	<.0001
Sigma	1331.393688	12.981876	<.0001	1115.1679	10.404135	<.0001	2149.8927	26.531313	<.0001	3277.09256	9.750145	<.0001

Source: Calculated by authors; significance of estimated coefficients is based on *p*-value 0.05

Table 3: Summary Statistics of Price, Quantity, Expenditure, Income and Market Penetration of Soymilk, Almond Milk, Lactose Free Milk and White Milk Consumption in the United States At-Home Markets in 2011

		Soymilk	Almond Milk	Lactose Free Milk	White Milk
	Market Penetration (%)	10.91	12.06	7.24	92.72
Conditional	**Average Quantity (gallons/household/Year)**	3.75	3.37	6.25	25.21
	Average Expenditure ($/household/Year)	23.74	21.51	44.29	83.47
	Average Price ($/gallon)	7.00	6.78	7.24	3.84
Unconditional	**Average Quantity (gallons/household/Year)**	0.41	0.40	0.45	23.37
	Average Expenditure ($/household/Year)	2.59	2.59	3.21	77.40
	Average Price ($/gallon)	7.01	6.79	7.17	3.86

Source: Calculated by authors

Table 4: Unconditional and Conditional Own-price, Cross-price and Income Elasticities of Demand for Soymilk, Almond Milk, Lactose Free Milk and White Milk Demand

Unconditional Own-Price, Cross-Price and Income Elasticities

	Soymilk	Almond Milk	White Milk	Lactose Free Milk	Income
Soymilk	**-3.37**	**-2.05**	**0.98**	**-1.07**	**0.17**
Almond Milk	**-1.18**	**-2.72**	**1.01**	**-2.30**	**0.26**
White Milk	0.03	**-0.14**	**-0.97**	0.08	**0.01**
Lactose Free Milk	-0.25	**-1.19**	**1.42**	**-2.85**	**0.23**

Conditional Own-Price, Cross-Price and Income Elasticities

	Soymilk	Almond Milk	White Milk	Lactose Free Milk	Income
Soymilk	**-0.67**	**-0.41**	**0.19**	**-0.21**	**0.03**
Almond Milk	**-0.24**	**-0.55**	**0.20**	**-0.46**	**0.05**
White Milk	0.02	**-0.10**	**-0.69**	0.06	**0.01**
Lactose Free Milk	-0.07	**-0.34**	**0.41**	**-0.49**	**0.07**

Numbers in bold font are statistically significant at p-value 0.05