ECONOMIC AND DEMOGRAPHIC FACTORS AFFECTING THE DEMAND FOR FLUID MILK ALTERNATIVE BEVERAGES IN THE UNITED STATES

A Thesis

by

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MASTER OF SCIENCE

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ABSTRACT

During the past two decades, production and consumption of fluid milk alternative beverages in the United States have been evolving, while the market penetration of fluid milk is decreasing rapidly. Soymilk has been the dominant fluid milk alternative beverage in the past. However, in recent years, consumers have migrated from soymilk to other fluid milk alternatives, especially almond milk. 2014 Nielsen Homescan panel data were used in examining demographic and economic factors affecting demand for fluid milk alternative beverages such as almond milk, soymilk, coconut milk and fluid milk, flavored fluid milk, lactose-free fluid milk and flavored lactose-free fluid milk using Tobit econometric procedures. The conditional and unconditional own-price, cross-price and income elasticities for each beverage were estimated, along with demographic factors affecting consumption of these beverages.

Household income, age of household head, employment status and education level of household head, race, ethnicity, region, and age and presence of children are significant drivers affecting the demand for these fluid milk and selected fluid milk alternative beverages. The conditional own-price elasticity of demand for almond milk, soymilk, coconut milk, fluid milk, flavored fluid milk, lactose-free milk and flavored lactose-free lactose free milk was estimated to be -0.50, -0.41, -0.46, -0.63, -0.45, -0.50 and -0.54 respectively. Almond milk, soymilk and flavored lactose-free milk found to be gross complements for coconut milk, and fluid milk found to be a gross substitute for coconut milk.

Beverage manufacturers and marketers can use the economic and demographic findings of demand concerning fluid milk alternative beverages to target these beverages to existing and potential customers. This thesis is the first in the literature to scientifically investigate consumer demand for coconut milk in the United States and derive respective own-price cross-price and income elasticities.

Future research in this area includes: (a) using the elasticity estimates to simulate the welfare effects of fluid milk farmers in the United States in the event of a change in demand for fluid milk alternative beverage marketplace; (b) shed light on pricing strategies at different levels of supply chain for fluid milk alternative beverages.

DEDICATION

I would like to dedicate this work to my parents, Yingming Li and Meizhen Liu. Anything good that has come to my life has been because of your endless love and support. I sincerely appreciate all you have done to get me to this point. I promise, I will give you back the quality time that you deserve!

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I would like to thank the Department of Agricultural Economics at Texas A&M. Special thanks go to department head for graduate programs, Dr. David Leatham and program coordinator Ms. Brandi Blankenship for their kindness and patience. Thanks also go to my classmates, professors and colleagues. Grateful thanks are expressed to Mark Senia and Alicia Copeland for teaching me how to deal with the Nielsen Homescan panel data, to Ms. Traci Lacy for directing my work at the Provost Office, and to Commi and Steven for providing me an internship opportunity at Element Box Inc.

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CHAPTER I

INTRODUCTION AND JUSTIFICATION

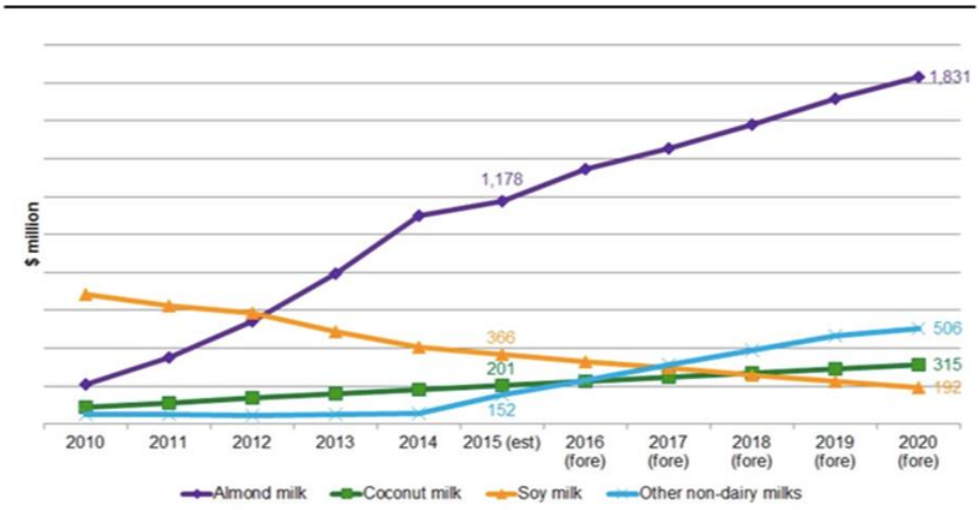
The Fluid Milk Alternative Beverages Market

Fluid milk alternative beverages are plant-based milk which is extracted through grains, nuts and seeds. Unlike the regular fluid milk beverages, they have low cholesterol and low fat content. With the increase in awareness, rising health concerns, and the increasing vegan population, in the United States, the demand for fluid milk alternative beverages has been increasing over the past decade. The global fluid milk alternative beverages market is estimated to grow at a rate of 16% over the period 2014-2019. In terms of value, the global fluid milk alternative beverages market is projected to reach about $19.5 billion by 2020. In 2014, the global consumption of fluid milk alternatives was 583.2 kiloton (KT), and is projected to grow at a rate of about 15.2% from 2015 to 2020 (Research and Market, 2015).

The fluid milk alternative beverages market can be segmented into four divisions: Soymilk, Almond Milk, Coconut Milk, and Others (rice milk, hazelnut milk, hemp milk, and oat milk). Soymilk used to be dominated in the fluid milk alternative beverages market in the past. However, in recent years, consumer migrated from soymilk to other fluid milk alternatives such as almond milk and coconut milk due to taste, health concerns and calories counts. It is estimated that sales of soymilk in U.S. declined 5.8% from $981 million in 2009 to $924 million in 2010, and another 8.5% in 2010 reaching $846 million in 2011. In 2012, almond milk has overtaken soymilk and has become America's most popular plant-based milk alternative accounting for 4.1% of

total milk sales (KCT.org, 2014). In 2014, almond milk took the top spot of U.S. fluid milk alternative beverages market with 65.5% of the market share, which puts soymilk in the second spot with a 30% share. To put this into context, almond milk had captured only 3% of the market in 2008 (Beverage Industry, 2015). Almond milk aids in improving the immune function and helps in reducing the risk of osteoporosis. Moreover, it contains no hormones and is prescribed by dermatologists to patients with acne. Almond milk is a good source of unsaturated fats, is rich in proteins and omega fatty acids, and is derived from natural almond oils. It helps in improving vision, strengthens the bone, maintains cardiovascular health, building strong muscles, and aids in controlling the blood pressure (Infiniti Research Limited, 2015). Considering all the advantages of almond milk, it has a great potential to growth in the U.S. fluid milk alternative beverages market. As shown in the Information Resources Inc. (IRI), Chicago, refrigerated almond milk dollar sales increased 24% in the 52 weeks ending May 17, 2015. Other fluid milk alternative beverages like coconut milk also show great potential for growth. According to data from Information Resources Inc. (IRI), Chicago, refrigerated coconut milk dollar sales grew by 9.2% in the 52 weeks ending May 17, 2015. Coconut milk took the fourth-largest part of the fluid milk alternatives segment, with 3% market share last year (Beverage Industry, 2015).

Figure 1 shows the total retail sales and forecast of fluid milk alternative milk from year 2010 to 2020.



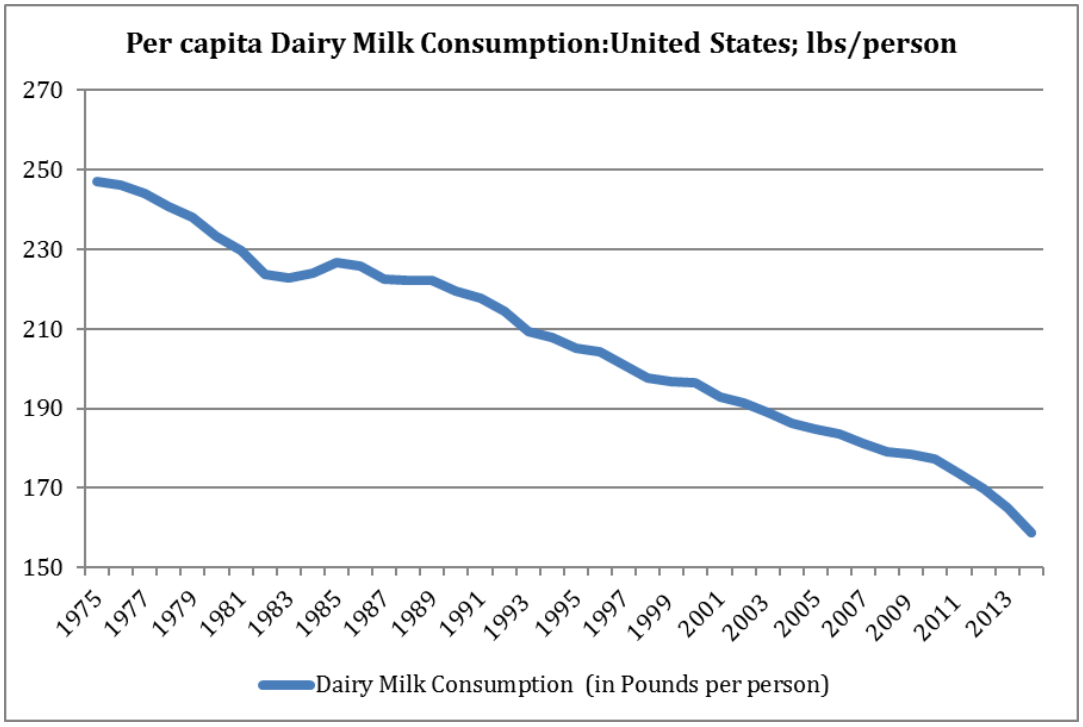
Source: Based on Information Resources Inc., InfoScan Reviews; SPINS; USDA Economic Research Service; US Census Bureau, Economic Census/Mintel (B.M.C., 2016)

Figure 1 Total Retail Sales and Forecast of Fluid Milk Alternative Milk 2010-2020

The Traditional Fluid Milk Market

While the fluid milk alternative beverage market is growing in the United States, the traditional fluid milk market has been decreasing during past two decades. Per capita fluid milk consumption has been falling for years: it dropped 25% from 1975 through 2012. Fluid milk's rate of decline in 2011 and 2012 was the highest in more than a decade (StarTribune, 2014). Consumers want variety and convenience in their beverages, as well as healthier refreshment. As a result, most traditional beverage categories continue to struggle and lose ground to newer niche concepts

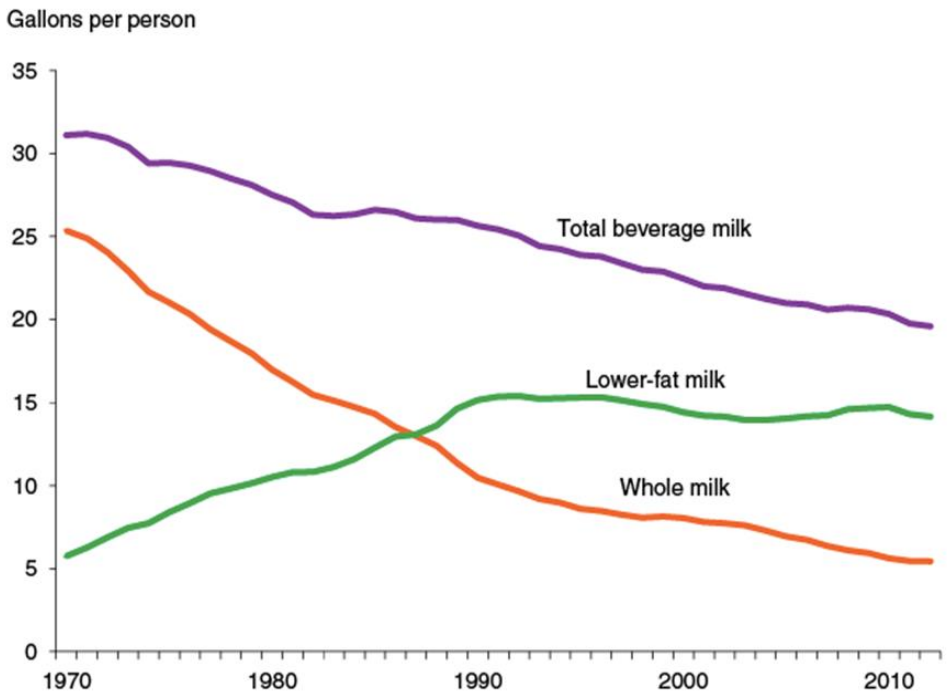
Figure 2 shows the per capita fluid milk consumption in United States from 1975 to 2014 (in pounds per person).



Source: USDA

Figure 2 Per Capita Fluid Milk Consumption in U.S. 1975 – 2014

While Americans continue to drink about 8 ounces of fluid milk, they are consuming it less frequently than in the past. Researchers said that competition from other beverages—especially carbonated soft drinks, fruit juices, and bottled water—is likely contributing to the changes in frequency of fluid milk consumption. In addition, substitutes for fluid milk (including almond milk, coconut milk, and soymilk) have provided alternatives for consumers (Li, 2016).



Source: USDA, Economic Research Service, Food Availability Data System (Bentley, 2014)

Figure 3 Total Consumption of Fluid Milk, Low-Fat and Whole Milk in U.S. 1970 – 2012

From Figure 3, we can see that the people in the United States tend to drink more low-fat milk, and the consumption of whole milk is decreasing significantly since 1970s. Since fluid milk alternative beverages contain less fat potentially, it might be one of the reasons why it's a popular substitute for fluid milk. To make their product more competitive, fluid milk companies are going to force stressing the protein levels of their products, along with other healthy added ingredients such as "ancient grains." More flavored milks will be introduced as well as additional organic milk products (Packaged Facts, 2015).

Research on the Demand for Fluid Milk Alternative Beverages Market

While the research about fluid milk alternative beverages' benefits with emphasis on the healthy ingredient and performance edge are abundant, when it comes to the demand analysis for fluid milk alternative beverage, especially the economic and demographic factors, the research is scarce. Fengxia Dong (2006) researched the Asian diary market considering the effects of demographics, income, and prices. By using Heien and Wessells's technique, he found that fluid milk product consumption growth is decomposed into contributions generated by income growth, population growth, price change, and urbanization and these contributions are quantified. He also found that fluid milk market growth was mostly driven by income and population growth and, as a result, raised world fluid milk prices. Dharmasena and Capps (2014) used data from U.S. households for year 2008 to examine market competitiveness of soymilk. They found that income, age, employment status, education level, race, ethnicity, region and presence of children are significant drivers affecting the demand for soymilk. They also found that fluid milk and flavored fluid milk are competitors for soymilk, and soymilk is a competitor for white milk. Copeland and Dharmasena (2015) also have investigated the growth of the fluid milk alternative beverage market in the United States, by using household-level purchase data from 2011 Nielsen Homescan panel. They estimated the conditional and unconditional own-price, cross-price and income elasticities for soymilk and almond milk. They also found that income, age, employment status, education level, race, ethnicity, region and presence of children are significant drivers affecting the demand for fluid milk alternative beverages. However, according to the best of our

knowledge, study investigating consumer demand for coconut milk could not be found in the existent literature.

Coconut Milk Market in the United States

Coconut-milk has been used primarily in Southeast Asian cooking for ages. Recent years, consumers in the United States have begun to show interest in coconut milk as a potential substitute for fluid milk. With the 2014 Innova trend report showing that coconut milk product introductions grew 36% from 2012 to 2013. Also, the Food Navigator-USA (2015) report noted that coconut milk dollar sales were up double-digits from 2013 to 2014.

The potential reasons that made coconut milk popular are likely to be follows: (1) compared with traditional fluid milk beverages, coconut milk has more flavors such as: vanilla, original, unsweetened and chocolate, which provide more choices for consumers. (2) coconut milk contains more calcium and vitamin than fluid milk. For example, due to fortification, Silk coconut milk has a mildly nutty taste with 50% more calcium than fluid milk. It is also a great source of vitamin D because of the same reason. (3) coconut milk has fewer calories and fat than fluid milk, which may be better for consumers who intend to drink it regularly. (4) coconut milk is a good substitute for fluid milk for those people who are lactose intolerant. Approximately 65% of the human population has a reduced ability to digest lactose after infancy. Lactose intolerance in adulthood is most prevalent in people of East Asian descent, affecting more than 90% of adults in some of these communities (Jacobsen, 2015). In the United States, as many as 90% of Asian Americans and 75% of African Americans and Native Americans are lactose intolerant. Coconut milk is a good substitute of milk for those people, and (5)

with greater consumer awareness of coconut water as a beneficial sports drink substitute, people are becoming more interested in coconut-based products, such as coconut milk.

Despite so many advantages that coconut milk has, market researches noticed that repeat purchases are weak in coconut milk, partly due to the flavor, which is not as universally appealing as that of almond milk. Another reason might be the rising costs for coconut milk producers have been partially passed on to consumers, which has reduced demand. Therefore, to uncover the market competitiveness of coconut milk, in the fluid milk alternative beverage marketplace in the United States, further research is warranted.

Based on the fact that the fluid milk alternative beverage market is competitive and dynamic while research about the market demand for those beverages is scarce, information about the price sensitivities, substitutes or complements and demographic profiling with respect to consumption of those beverages is important for related manufacturers, retailers, advertisers and other stakeholders. More specifically, the main objectives of this study are to, (1) analyze the demographic and economic factors that influence decision to purchase coconut milk, almond milk, soymilk, fluid milk and lactose free fluid milk; (2) find out the economic and demographic factors that determine the volume of consumption; (3) estimate the income elasticity, own-price elasticity and cross-price elasticity of those beverages; (4) make some suggestion with respect to marketing as well as pricing strategies for those beverages in the dynamic and competitive marketplace.

CHAPTER II

DATA

This chapter provides explanation on data used in this research. The data we used is the Nielsen Homescan scanner data for household purchases of fluid milk and fluid milk alternative beverages along with demographic information for calendar year 2014. Below we provide a detailed account on the dataset and a description of each variable we used in this study.

Data Description

Nielsen Homescan scanner data is composed of household-level data, which comes from a sample of households that scan universal product codes (UPCs) of all purchased products after each shopping trip (Mary, 2007). These data are unique in that they provide information on household demographic characteristics that are not available in store-level scanner data (Jacobsen, 2015). The purchases data can come from a wide variety of store types, including traditional food stores, supercenters and warehouse club and online merchants. Interested consumers who are 18 or older register online to participate and are asked to supply demographic and purchase information. Consumers must report data for at least 10 of 12 months during the year to be included in the statistic sample (Einav, 2008).

In this research, we use 2014 Nielsen Homescan panel data, with 60,616 households across from the United States, which is a nationally representative sample of households. These data provide the purchase information of each beverage, including

expenditure and quantity, as well as the demographic characteristics of each household. Table 1 represents the summary statistics of all variables we will use in this study. The demographic characteristics included in this study are household income, age of household head, education status of household head, region, race, Hispanic origin, and age and presence of children in the household. The beverages included in this study are almond milk, soymilk, coconut milk, fluid milk, flavored fluid milk, lactose-free milk and flavored lactose-free milk. Almond milk, soymilk and coconut milk category are not disaggregated by flavor type. The coconut milk used for cooking is excluded from the coconut milk category. The fluid milk category is comprised of both conventional and organic varieties. Among the 60,616 households in our data set, there are 11,531 households that purchased almond milk, 5,643 households purchased soymilk, and 6,150 households purchased coconut milk. While 55,112 households bought fluid milk and 12,767 households bought flavored fluid milk, only 4,448 households purchased lactose-free milk and 523 households purchased flavored lactose-free milk.

Quantity data are standardized as liquid gallons, and the expenditure data are expressed in dollars. Unite value is generated as the ratio of expenditure (dollar) to volume (gallon), which is used as a proxy for price of the beverage. Thus the price is in dollars per gallon for each beverage category. The mean price for almond milk, soymilk, coconut milk, fluid milk, flavored fluid milk lactose-free milk and flavored lactose-free milk are $7.12/gallon, $6.86/gallon, $12.63/gallon, $4.288/gallon, $6.84/gallon, $7.26/gallon, and $8.99/gallon, respectively. It is important to note that these prices (or unit values) do not represent the price of different sizes of products. This average price

calculated an unit value in this thesis is not adjusted for the container size as well as for sign or milk pack. Here for example for coconut milk, when most products are sold in small container sizes, unit value is calculated to be somewhat higher than for beverage where beverage is sold in large containers (such as almond milk, 64 ounces).

Table 1 Summary Statistics of Variables Used in the Model

Variable	Mean	Standard Deviation
Price of Almond milk ($/gallon)	7.12	0.0075
Price of Soymilk ($/gallon)	6.86	0.0069
Price of Coconut milk ($/gallon)	12.63	0.0182
Price of Fluid Milk milk ($/gallon)	4.29	0.0117
Price of Flavored Fluid milk milk ($/gallon)	6.84	0.0132
Price of Lactose-free milk ($/gallon)	7.26	0.0047
Price of Flavored Lactose-free milk ($/gallon)	8.99	0.0064
Household income (in '1000 dollars)	59.36	32.3233
Age of Household Head less than 25 years (Base category)	0.00	0.0642
Age of household head 25-29	0.02	0.1374
Age of household head 30-34	0.04	0.2048
Age of household head 35-44	0.14	0.3459
Age of household head 55-64	0.30	0.4601
Age of household head 65 or older	0.24	0.4298
Household Head not employed (Base category)	0.44	0.4969
Employment status part-time	0.18	0.3842
Employment status full-time	0.38	0.4843
Education of Household Head: Less than high school (Base category)	0.02	0.1482
Education: High School	0.25	0.4358
Education: Undergraduate	0.60	0.4903
Education: Post-College	0.12	0.3306
Pacific (Base category)	0.12	0.3277
New England	0.05	0.213
Middle Atlantic	0.13	0.3331
East North Central	0.18	0.3834
West North Central	0.08	0.2755
South Atlantic	0.20	0.4021
East South Central	0.06	0.2401
West South Central	0.10	0.3047
Mountain	0.07	0.2605
White (Base category)	0.82	0.3827
Black	0.10	0.3044
Asian	0.03	0.1728
Other	0.04	0.2052
Non-Hispanic Ethnicity (Base category)	0.94	0.2288
Hispanic	0.06	0.2288
No Child less than 18 years (Base category)	0.79	0.4092

Table 1 Continued

Variable	Mean	Standard Deviation
Age and Presence of Children less than 6-years	0.03	0.1595
Age and Presence of Children between 6-12 years	0.05	0.2236
Age and Presence of Children between 13-17 years	0.07	0.2502
Age and Presence of Children less than 6 and 6-12 years	0.03	0.1575
Age and Presence of Children less than 6 and 13-17 years	0.00	0.062
Age and Presence of Children between 6-12 and 13-17 years	0.03	0.1779
Age and Presence of Children less than 6, 6-12 and 13-17 years	0.00	0.0682

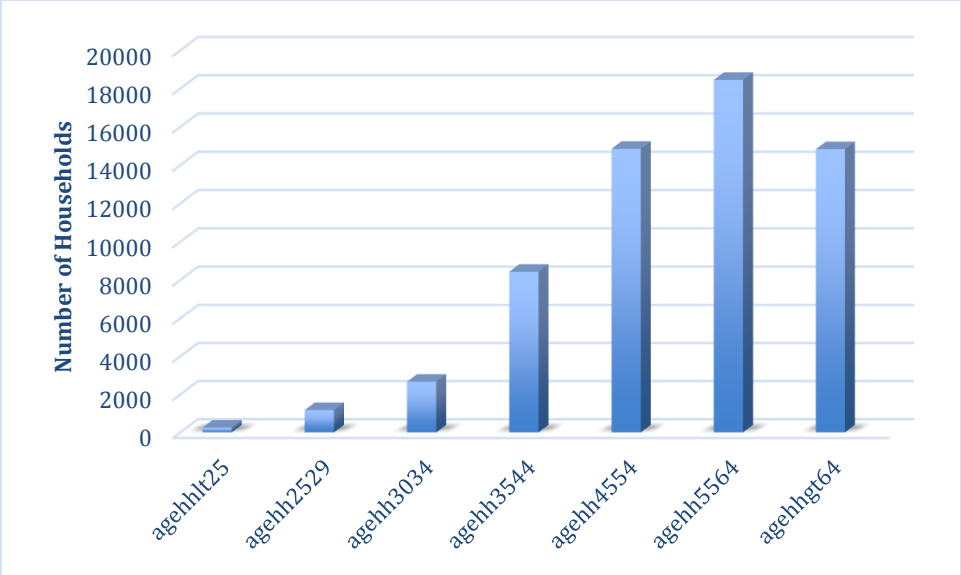
Source: Nielsen Homescan Panel for Calendar Year 2014, calculated by the author
Note: Base category of dummy variables is printed in *italics*

Variable Description

The variable "*household income*" takes on a range from 5 to 112.5 and is expressed in thousands of dollars. The average household income level of this data set is $59,365.

In this study, "*household head*" represents the female adult in the household. If a household does not have a female household head, information about the male household head was used (Dharmasena, 2011).

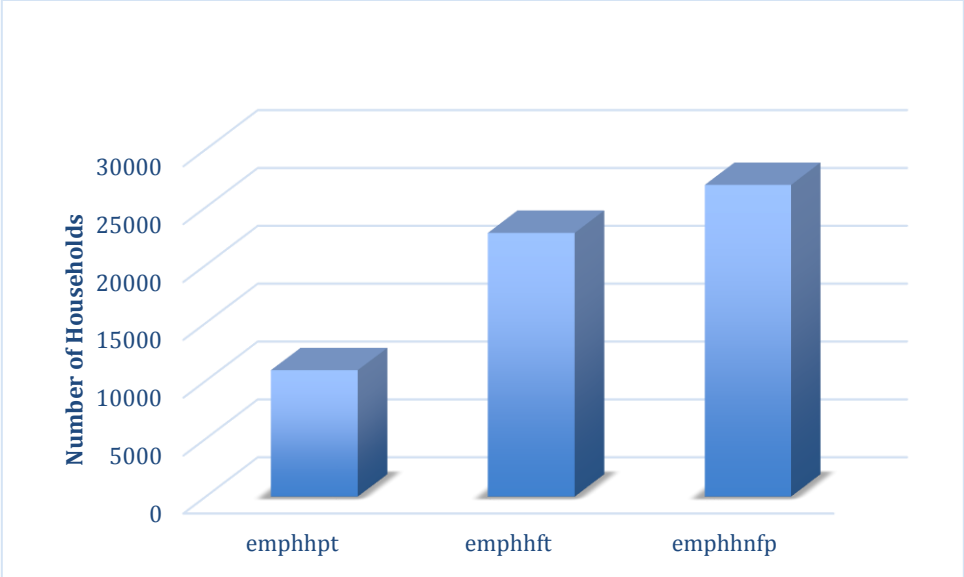
The variable "*age of the household head*" represents the age of household head, ranging from "less than 25" to "greater than 64". "*Age of household head less than 25*" was used as the base category. The majority household heads (about 79% of the sample) are older than 45-years. With 24% household heads fall into the 45-54 age category, 30% household heads belong to the 55-64 age category and 24% household heads are older than 64. More detailed information about the age of the household head are shown in Figure 4.



Source: Nielsen Homescan Panel for Calendar Year 2014

Figure 4 Data Summary for "Age of Household Head"

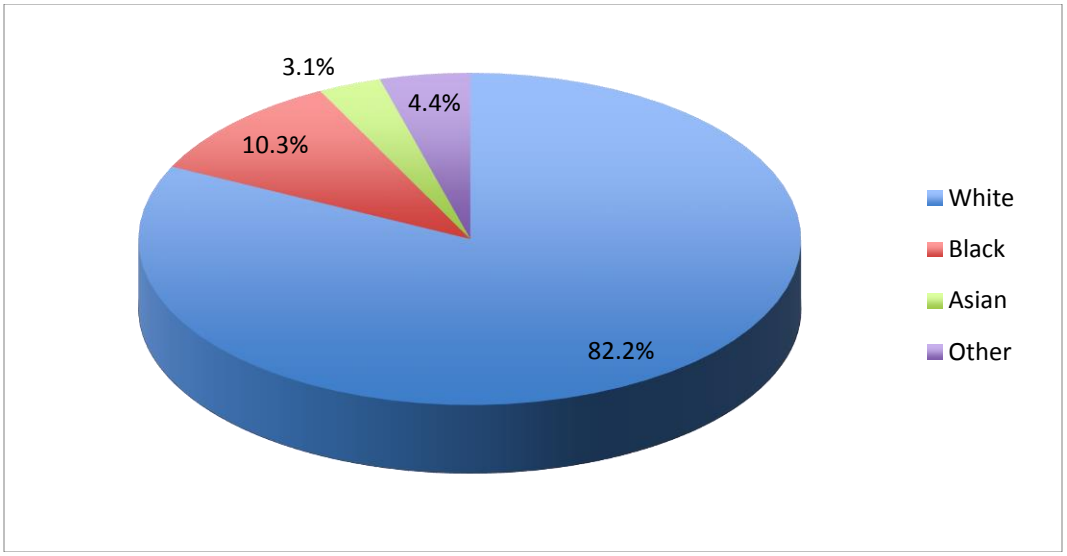
The variable "*employment status of the household head*" has three categories, namely full time employed, part-time employed and not employed for full pay. Households with a household head that was not employed for full pay were used as the base category. According to the sample, 18% of the household heads worked less than 34 hours each week and were considered as part-time employed, while 38% of the households worked at least 34 hours per week and were regarded as full time employed. Figure 5 shows the number of households in each employment category as well as the percentages.



Source: Nielsen Homescan Panel for Calendar Year 2014

Figure 5 Data Summary for "Employment Status of Household Head"

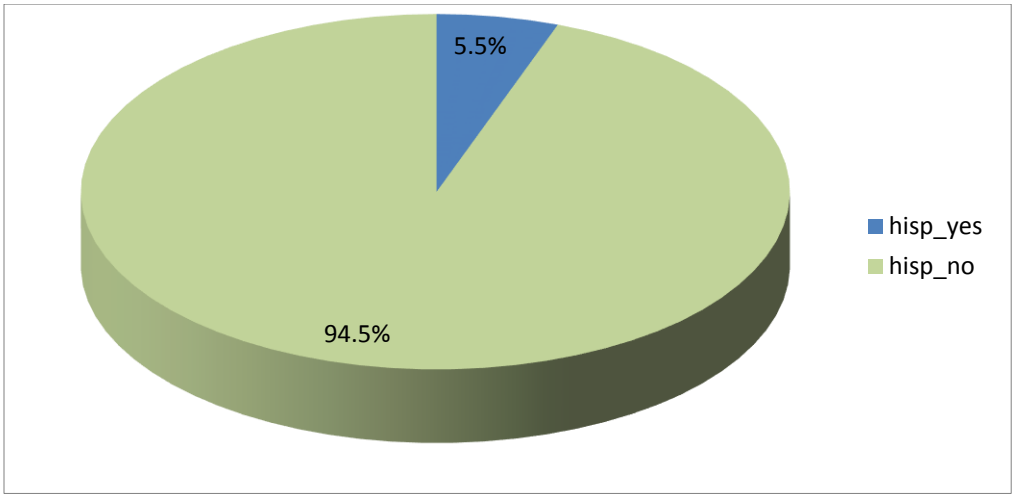
The variable "*race*" was grouped as White, Black, Aian and Other. The white household head group was used as the base category, which accounted for about 82% of the sample. Household heads that are classified as Black takes the second highest position with about 10% of the sample. Asian household heads made up 3% of the sample. Household heads classified as other accounted for 4% of the sample. Figure 6 gives a more detailed view of the distribution of the "race" variable.



Source: Nielsen Homescan Panel for Calendar Year 2014

Figure 6 Distribution of "Race" Variable

The variable "*ethnicity*" was also under consideration. It represented whether the household head is Hispanic origin or not. About 94% of the sample households are Non-Hispanics. Figure 7 shows the distribution of the "ethnicity" variable.



Source: Nielsen Homescan Panel for Calendar Year 2014

Figure 7 Distribution of "Ethnicity" Variable

The variable "*region of the household location*" is broken out into nine categories, namely: New England, Middle Atlantic, East North Central, West North Central, South Atlantic, East South Central, West South Central, Mountain, and Pacific.

Table 2 displayed the breakdown of the nine regions.

Table 2 United States Census Bureau Regions and States

<table>
<tr><th colspan="3">EAST</th></tr>
<tr><td><u>New England</u>

Connecticut, Maine, Massachusetts, New Hampshire, Rhode Island, Vermont</td><td colspan="2"><u>Middle Atlantic</u>

New Jersey, New York, Pennsylvania</td></tr>
<tr><th colspan="3">CENTRAL</th></tr>
<tr><td><u>East North Central</u>

Indiana, Illinois, Michigan, Ohio, Wisconsin</td><td colspan="2"><u>West North Central</u>

Iowa, Nebraska, Kansas, North Dakota, South Dakota, Minnesota, Missouri</td></tr>
<tr><th colspan="3">SOUTH</th></tr>
<tr><td><u>South Atlantic</u>

Delaware, District of Columbia, Florida, Georgia, Maryland, North Carolina, South Carolina, Virginia, West Virginia</td><td><u>East South Central</u>

Alabama, Kentucky, Mississippi, Tennessee</td><td><u>West South Central</u>

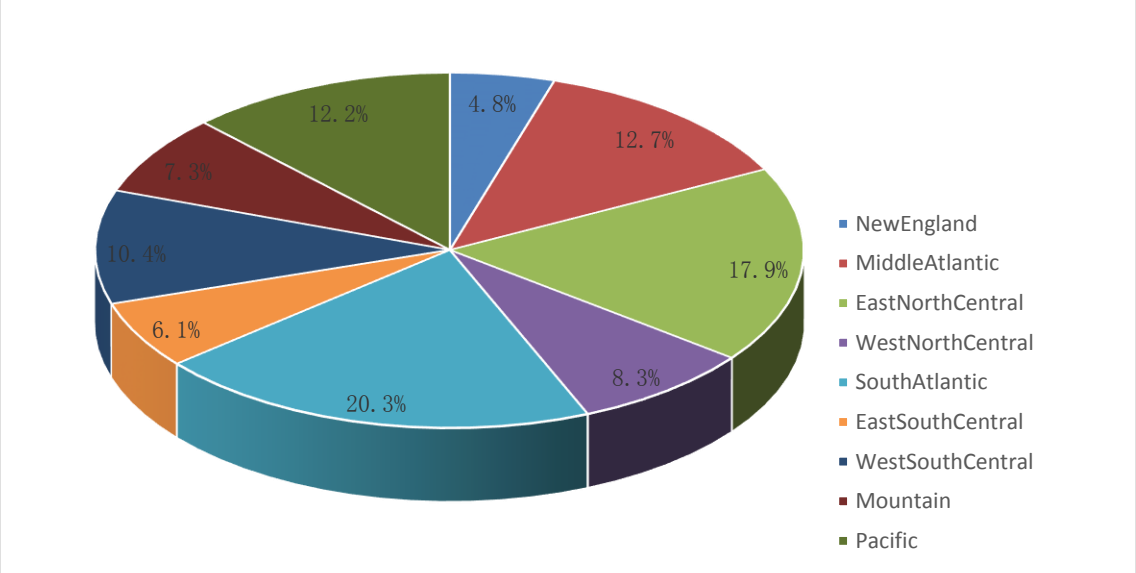
Arkansas, Louisiana, Oklahoma, Texas</td></tr>
<tr><th colspan="3">WEST</th></tr>
<tr><td><u>Mountain</u>

Arizona, Colorado, Idaho, New Mexico, Montana, Utah, Nevada, Wyoming</td><td colspan="2"><u>Pacific</u>

Alaska, California, Hawaii, Oregon, Washington</td></tr>
</table>

Source: U.S. Census Bureau

We use the Pacific region as the base category. According to the data set, there are about 4.7% households from New England, 12.7% households from the Middle Atlantic, and 17.9% households from the East North Central. Households from West North Central make up 8.3% of the sample, while 20.3% of the households are from the South Atlantic. 6.1% households are from the East South, 10.4% are from the West South Central and 7.3% are from the Mountain region. This distribution of households is consistent with the actual distribution for each region calculated by the U.S. Census Bureau. The region distribution can be seen from Figure 8.

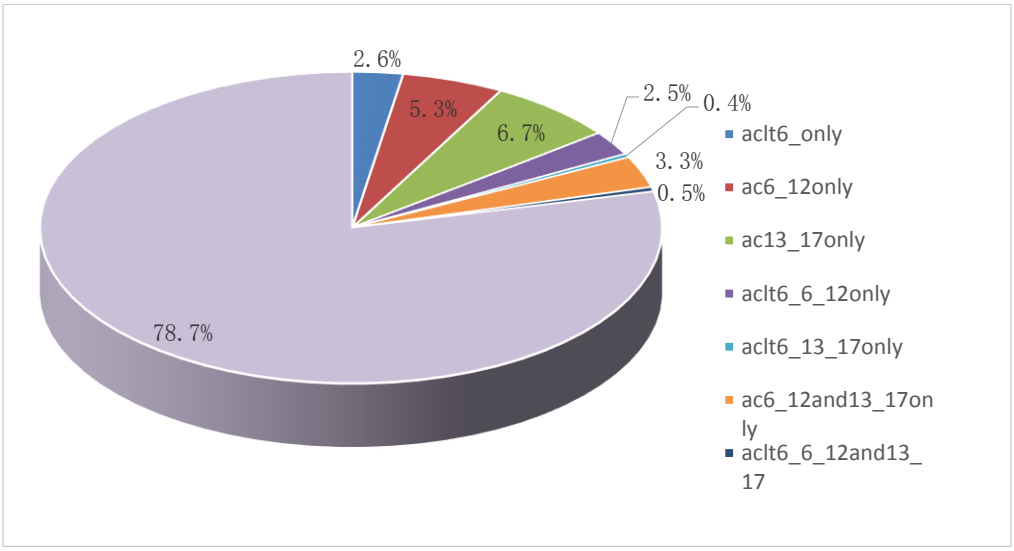


Source: Nielsen Homescan Panel for Calendar Year 2014

Figure 8 Distribution of "Region" Variable

The variable "*age and presence of children*" shows the presence of children as well as their respective ages of each household. This variable is broken down into eight categories, namely: "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" and "Households with no child". The number of percentage for each category is 2.6%, 5.3%, 6.7%, 2.5%, 0.4%, 3.3%, 0.5%, and 78.7%. The majority of households does not have a child, we use this no child category as the base category. The data distribution of the "age and presence of children" variable can be seen in Figure 9.



Source: Nielsen Homescan Panel for Calendar Year 2014

Figure 9 Distribution of "Age and Presence of Children" Variable

CHAPTER III

METHODOLOGY

The Tobit Model

In the data set considered in this study, all households did not end up buying all beverages at a given time. For households who did not buy a beverage, a zero consumption level is reported, which means the dollar amount that household spent on this beverage was zero. This type of data set with zero expenditure for some households for some beverages is called a censored sample. The decision to purchase one beverage or not to purchase is a dichotomous choice ("1" if buy and "0" if do not buy) and it could be affected by various demographic and economic factors. To find out the relationship between the consumption of beverages and the explanatory variables, we needed to take into account of the concentration of observation at zero. Because if we removed all observations with zero purchases and only use non-zero purchase observations to estimate regression functions, it would cause sample selection bias. However, application of ordinary least squares (OLS) to estimate a regression with a censored dependent variable can result in biased estimates, even asymptotically (Kennedy, 2003). To overcome the sample selection bias in estimated regression models in the presence of censored data, Tobin (1958) and Heckman (1979) suggested alternative models, namely the Tobit model and the Heckman Two-step model. By using the Tobit model, we obtained both conditional and unconditional elasticity estimates of almond milk, soymilk, coconut milk, fluid milk, flavored fluid milk, lactose-free milk, and flavored lactose-free milk. Furthermore, to analyze changes in the probability of being above the

limit (the probability to purchase one beverage in this analysis) and in the value of the dependent variable if it is already above the limit, we used decomposition of the coefficient estimates suggested by McDonald and Moffitt (1980). The independent variables we used in the Tobit model are prices of all the seven beverages, household income, the age of household head, education level of household head, race, Hispanic-origin, region, and the age and presence of children. This analysis will provide statistically significant findings of which economic factors and demographics increase or decrease the probability of consumption of each of the seven beverages.

The latent model underlying the Tobit model can be defined as follows:

$$(1) \qquad y_i = \begin{cases} X_i\beta + \mu_i\,, & X_i\beta + \mu_i > 0 \\ 0, & X_i\beta + \mu_i \le 0 \end{cases} \qquad \mu_i \sim N(0, \sigma^2)$$

where $\mathrm{i} = 1, 2, \cdots, \mathrm{N}$ represents the number of observations. y_i represents the censored dependent variable; X_i represents the vector of explanatory variables; β is the vector of unknown parameters to be estimated, μ_i is the disturbance term that is normally distrusted with a mean of zero, σ^2 is the standard error of μ_i.

Since the Tobit model is dealing with dichotomous problem, there will be two expectations of dependent variables y. There are, the unconditional expected value of y_i (as shown in equation (2)) and conditional expected value of y_i (Shown in equation (3)).

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

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

where $z = \frac{X\beta}{\sigma}$, which is the normalized index value, σ is the estimated standard error of the Tobit regression. $F(z)$ represents the cumulative distribution function (CDF) and $f(z)$ represents the corresponding probability density function (pdf), both CDF and pdf are associated with the normalized index value, z. $\frac{f(z)}{F(z)}$ is called Inverse Mill's ratio.

Corresponding to the two expectations of dependent variables, there are two types of marginal effects for the Tobit model, namely: unconditional marginal effect and conditional marginal effect. The unconditional marginal effect is expressed in equation (4), which represents the marginal effect on consumption that contains all the households no matter whether they buy the beverage or not. The conditional marginal effect is expressed in equation (5), which represents the marginal effect on consumption that contains only the households who bought the beverage.

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

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

As $E(y) = E(y^*)F(Z)$, we have

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

Equation (6) shows that the total change in the unconditional expected value of dependent variable Y is composed of two parts: first, the change in the expected value of y being above the limit weighted by the probability of being above the limit; second, the

change in the probability of being above the limit weighted by the expected value of y being above the limit. This is called the McDonald and Moffitt (1980) decomposition.

Empirical Estimation

Several functional forms of the Tobit model are investigated in this study: linear, quadratic and semi-log. All the models were tested based on model fit, significance of the variables, and Akaike and Schwarz Criteria (AIC). Out of all the models considered, the semi-log model outperformed other functional forms. In the Tobit model, since the price of each beverage is used as an explanatory variable, prices need to be imputed for households who did not purchase the beverage. An auxiliary regression was used to accomplish this imputation, where observed prices for each beverage were regressed on household income, household size, and region where the household is located. The variable household income reflects the variability of demand for different quality of beverages. Household size reflects various socio-demographic conditions. The region where the household is located reflects how prices differ based on location. Equation (7) shows how we calculated the imputed prices.

$$(7) \qquad P_{i,observed} = a_1 + (a_2 \cdot HH_{i,income}) + (a_3 \cdot HH_{i,size}) + (a_4 \; HH_{i,region}) + \mu_i$$

Where *i=1,2,3,….n*, number of households.

Once calculated, forecasted prices were used as observations for households who did not purchase the beverage. The prices for each beverage (almond milk, soymilk, coconut milk, fluid milk, flavored fluid milk, lactose-free milk and flavored lactose-free milk) were then used as explanatory variables to estimate each beverage's Tobit model pertaining to consumption. Table 3 is a summary statistics of observed and imputed

prices of almond milk, soymilk, coconut milk, fluid milk, flavored fluid milk, lactose-free and flavored lactose-free milk.

Table 3 Summary Statistics of Observed and Imputed Prices of Almond Milk, Soymilk, Coconut Milk, Fluid Milk, Flavored Fluid Milk, Lactose-free and Flavored Lactose-Free Milk

	Observed Price(dollars per gallon)			Imputed Price(dollars per gallon)		
Beverage	N	Mean	Standard Deviation	N	Mean	Standard Deviation
Almond Milk	11531	7.17	0.017	49085	7.17	0.002
Soymilk	5643	6.91	0.021	54973	6.91	0.002
Coconut Milk	6150	12.8	0.054	54466	12.67	0.007
Fluid Milk	55112	4.22	0.012	5504	4.48	0.004
Flavored Fluid	12767	6.53	0.026	47849	6.91	0.006
Lactose Free	4448	7.3	0.011	56168	7.3	0.004
Flavored Lactose Free	523	8.83	0.033	60093	8.96	0.006

Source: Calculated by the author

The Tobit model for each beverage can be written as follows:

$$
\begin{aligned}
q_{ki} = {} & \beta_1 + \beta_2 \log(INCOME)_i + \beta_3 AGEHH2529_i + \beta_4 AGEHH3034_i + \\
& \beta_5 AGEHH3544_i + \beta_6 AGEHH4554_i + \beta_7 AGEHH5564_i + \beta_8 AGEHHGT64_i + \\
& \beta_9 EMPHHPT_i + \beta_{10} EMPHHFT_i + \beta_{11} EDUHHHS_i + \beta_{12} EDUHHU_i + \\
& \beta_{13} EDUHHPC_i + \beta_{14} NEWENGLAND_i + \beta_{15} MIDDLEATLANTIC_i + \\
& \beta_{16} EASTNORTH_i + \beta_{17} WESTNORTH + \beta_{18} SOUTHATLANTIC + \\
& \beta_{19} EASTSOUTH + \beta_{20} WESTSOUTH + \beta_{21} RACE\_BLACK_i + \beta_{22} RACE\_ASIAN_i + \\
& \beta_{23} RACE\_OTHER_i + \beta_{24} HISP\_YES_i + \beta_{25} AGEPCLT6\_ONLY_i + \\
& \beta_{26} AGEPC6\_12ONLY_i + \beta_{27} AGEPC13\_17ONLY_i + \\
& \beta_{28} AGEPCLT6\_6\_12ONLY_i + \beta_{29} AGEPCLT6\_13\_17ONLY_i + \\
& \beta_{30} AGEPC6\_12AND13\_17ONLY_i + \beta_{31} AGEPCLT6\_6\_12AND13\_17_i + \beta_{32} PRICE\_ALM_i \\
& + \beta_{33} PRICE\_SOY_i + \beta_{34} PRICE\_CT_i + \beta_{35} PRICE\_DAIRY_i + \beta_{36} PRICE\_DF_i + \beta_{37} PRICE\_LF_i \\
& + \beta_{38} PRICE\_LFF_i + \varepsilon_i
\end{aligned} \tag{8}
$$

Where $i = 1,2,\cdots\cdots,n$ is the number of observations (households in our work) in the model. q_{ki} corresponds to the quantity of purchase of beverage k. all the price and income data are logged. All the variables used in the equation are defined in Table 1.

Equations (8), (9), (10) represent the model for calculating unconditional own-price elasticity, cross-price elasticity and income elasticity respectively.

$$\varepsilon_{ii}^{u} = \frac{\beta F(z)}{p_i^u} \cdot \frac{p_i^u}{Q_i^u} \tag{9}$$

$$\varepsilon_{ij}^{u} = \frac{\beta F(z)}{p_j^u} \cdot \frac{p_j^u}{Q_i^u} \tag{10}$$

$$\varepsilon_{I}^{u} = \frac{\beta F(z)}{I_i^u} \cdot \frac{I_i^u}{Q_i^u} \tag{11}$$

Equations (11), (12), (13) represent the model for estimating conditional own-price elasticity, cross-price elasticity and income elasticity respectively.

$$\varepsilon_{ii}^{c} = \frac{\beta}{p_i^c}\left(1 - Z\frac{f(z)}{F(z)} - \frac{f(z)^2}{F(z)^2}\right)\frac{p_i^c}{Q_i^c} \tag{12}$$

$$\varepsilon_{ij}^{c} = \frac{\beta}{p_j^c}\left(1 - Z\frac{f(z)}{F(z)} - \frac{f(z)^2}{F(z)^2}\right)\frac{p_j^c}{Q_i^c} \tag{13}$$

$$\varepsilon_{I}^{c} = \frac{\beta}{I_i^c}\left(1 - Z\frac{f(z)}{F(z)} - \frac{f(z)^2}{F(z)^2}\right)\frac{I_i^c}{Q_i^c} \tag{14}$$

where Q_i^u is the unconditional mean of quantity, Q_i^u is the conditional mean of quantity, I_i^u is the unconditional mean income, I_i^C is the conditional mean income, P_i^u is the unconditional mean price and P_i^c is the conditional mean price. From equation (6), we obtain the changes in the probability of being above the limit for a change in a given explanatory variable.

Equation (14) is derived from the McDonald and Moffitt (1980) decomposition, shown in equation (6). Which represents the changes in the probability of being above the limit for consumption of each beverage category in response to a change in an explanatory variable.

$$\frac{\partial F(z)}{\partial X} = \frac{1}{E(y^*)}\left[\frac{\partial E(y)}{\partial X} - F(z)\left(\frac{\partial E(y^*)}{\partial X}\right)\right] \quad (15)$$

CHAPTER IV

EMPIRICAL RESULTS

Table 4 shows summary statistics of market penetration (ratio of number of households that purchased the beverage to the total number of households sampled), price (unit value), expenditure, and quantity for almond milk, soymilk, coconut milk, fluid milk, flavored fluid milk, lactose-free milk and flavored lactose-free milk for calendar year 2014.

Table 4 Summary Statistics of Market Penetration, Expenditure and Quantity for Almond Milk, Soymilk, Coconut Milk, Fluid Milk, Flavored Fluid Milk, Lactose-Free and Flavored Lactose-Free Milk

	Almond	Soymilk	Coconut Milk	Fluid milk	Flavored Fluid Milk	Lactose Free	Flavored Lactose Free
Market penetration	0.1902	0.0931	0.1015	0.9092	0.2106	0.0734	0.0086
Unconditional Average Price ($/gallon)	7.12	6.86	12.63	4.29	6.84	7.26	8.99
Conditional Average Price ($/gallon)	7.12	6.87	12.75	4.28	6.58	7.32	8.87
Unconditional Average Expenditure ($/HH/year)	3.06	1.98	0.72	68.91	2.89	2.9	0.08
Conditional Average Expenditure ($/HH/year)	16.09	21.28	7.05	75.79	13.73	39.49	9.26
Average Unconditional Quantity (gallon/HH/year)	0.47	0.31	0.07	18.78	0.57	0.41	0.01
Average Conditional Quantity (gallon/HH/year)	2.45	3.38	0.72	20.65	2.69	5.56	1.19

Source: Calculated by the author

Among the 60,616 households, the market penetration for almond milk is 19.02%, only 9.31% households purchased soymilk and 10.15% households purchased coconut milk. The vast majority households purchased fluid milk, with 90.92% market penetration, and 21.06% households bought flavored fluid milk. While 7.34% households purchased lactose-free milk, only 0.86% households purchased flavored lactose-free milk.

The unconditional average prices for almond milk, soymilk, coconut milk, fluid milk, flavored fluid milk, lactose-free milk and flavored lactose-free milk are $7.12/gallon, $6.86/gallon, $12.63/gallon, $4.29/gallon, $6.84/gallon, $7.26/gallon, and $8.99/gallon respectively. The conditional average prices paid by households that purchased almond milk, soymilk, coconut milk, fluid milk, flavored fluid milk, lactose-free milk and flavored lactose-free milk are $7.12/gallon, $6.87/gallon, $12.75/gallon, $4.28/gallon, $6.58/gallon, $7.32/gallon and $8.87/gallon respectively.

The unconditional average expenditure represents dollars spent on each beverage per household for the calendar year 2014. Among the 60,616 households in this study, the unconditional average expenditure for almond milk, soymilk, coconut milk, fluid milk, flavored fluid milk, lactose-free milk and flavored lactose-free milk are $3.06, $1.98, $0.72, $68.91, $2.89, $2.90, and $0.08 respectively. The conditional average expenditure represents the average dollars spent on each beverage for households who bought that beverage during calendar year 2014. The conditional average expenditure for almond milk, soymilk, coconut milk, fluid milk, flavored fluid milk, lactose-free milk and flavored lactose-free milk were $16.09, $21.28, $7.05, $75.79, $13.73, $39.49 and

$9.26 respectively. Since households that actually purchased each beverage are less than the 60,616 total households included in this research, the conditional average expenditure is much larger than the unconditional average expenditure, especially for soymilk, coconut milk, and lactose-free category milk.

Similar to the unconditional average expenditure, the average unconditional quantity represents quantity (in gallons) of each beverage consumed by each household for the calendar year 2014. The average unconditional quantity consumed for almond milk, soymilk, coconut milk, fluid milk, flavored fluid milk, lactose-free milk and flavored lactose-free milk are 0.47 gallons, 0.31 gallons, 0.07 gallons, 18.78 gallons, 0.57 gallons, and 0.41 gallons respectively. The average conditional quantity represents, for households who bought the beverage, average quantity (in ounce) of that beverage purchased for the calendar year 2014. The average conditional quantity consumed for almond milk, soymilk, coconut milk, fluid milk, flavored fluid milk, lactose-free milk and flavored lactose-free milk were 2.45 gallons, 3.38 gallons, 0.72 gallons, 20.65 gallons, 2.69 gallons, 5.56 gallons, and 1.19 gallons respectively. Similarly, the conditional average quantity is much larger than the unconditional average quantity.

Table 5 displays the Tobit regressions results for almond milk, soymilk, and coconut milk. Table 6 displays the Tobit regressions results for fluid milk, flavored fluid milk, lactose-free milk and flavored lactose-free milk.

Table 5 Tobit Regression Results for Fluid Milk Alternative Beverages (Almond Milk, Soymilk, Coconut Milk)

	Almond Milk			Soymilk			Coconut Milk		
Variable	Estimate	Std Error	p-Value	Estimate	Std Error	p-Value	Estimate	Std Error	p-Value
Log price almond milk	**-4801.82**	400.57	<.0001	**958.17**	146.37	<.0001	**-1278.33**	151.71	<.0001
Log price soymilk	**-871.68**	27.73	<.0001	**-8239.36**	90.81	<.0001	**-31.90**	12.69	0.012
Log price coconut milk	**-127.75**	37.95	0.0008	**-3663.32**	711.28	<.0001	-19.09	13.85	0.1679
Log price fluid milk	**-451.50**	20.43	<.0001	**-2832.86**	439.86	<.0001	**-252.97**	5.37	<.0001
Log price flavored fluid milk	**271.38**	14.00	<.0001	**4358.64**	711.07	<.0001	**78.55**	5.07	<.0001
Log price lactose-free milk	**90.35**	20.91	<.0001	-511.09	732.43	0.4853	**17.41**	7.64	0.0226
Log price flavored lactose-free milk	-138.91	79.26	0.0797	**-6088.24**	16.90	<.0001	**-59.85**	29.08	0.0396
Log household income	-202.66	114.09	0.0757	**-16343.00**	11.34	<.0001	**-89.93**	44.05	0.0412
Intercept	**125.09**	6.86	<.0001	**48.90**	13.28	0.0002	**39.12**	2.51	<.0001
Age of household head 25-29	45.22	62.79	0.4714	-168.23	121.30	0.1655	**94.24**	26.24	0.0003
Age of household head 30-34	-26.29	60.18	0.6622	-170.49	114.88	0.1378	**67.93**	25.53	0.0078
Age of household head 35-44	-95.98	58.53	0.101	**-308.26**	111.54	0.0057	**58.78**	25.07	0.019
Age of household head 45-54	**-122.41**	58.06	0.035	**-294.17**	110.48	0.0078	34.27	24.96	0.1697
Age of household head 55-64	**-129.11**	57.97	0.0259	**-332.87**	110.34	0.0026	22.34	24.93	0.3704
Age of household head >65	**-184.59**	58.34	0.0016	**-393.73**	111.14	0.0004	-10.03	25.07	0.689
Employment status part-time	**37.23**	11.25	0.0009	35.66	23.17	0.1238	**9.84**	4.09	0.016
Employment status full-time	**-27.29**	10.05	0.0066	**-61.63**	20.81	0.0031	**-25.29**	3.72	<.0001
Education: high school	**111.03**	31.36	0.0004	-18.57	59.83	0.7563	0.54	11.40	0.9623
Education: undergraduate	**168.80**	30.83	<.0001	111.24	58.53	0.0573	**33.58**	11.14	0.0026
Education: post-college	**203.42**	32.49	<.0001	**218.76**	62.06	0.0004	**52.64**	11.72	<.0001
New England	-34.31	25.55	0.1793	30.80	43.36	0.4774	-5.84	9.17	0.5241
Middle Atlantic	-24.06	15.96	0.1318	**-155.07**	32.00	<.0001	**-23.70**	5.69	<.0001
East North Central	-4.95	18.99	0.7943	**-242.06**	32.38	<.0001	**-26.82**	6.92	0.0001

Table 5 Continued

	Almond Milk			Soymilk			Coconut Milk		
Variable	Estimate	Std Error	p-Value	Estimate	Std Error	p-Value	Estimate	Std Error	p-Value
West North Central	**-74.78**	25.18	0.003	**-106.17**	38.77	0.0062	**-37.90**	9.46	<.0001
South Atlantic	**-112.12**	18.89	<.0001	**-317.77**	28.69	<.0001	**-48.76**	6.85	<.0001
East South Central	**-131.66**	31.79	<.0001	**-478.38**	40.92	<.0001	**-87.17**	12.02	<.0001
West South Central	**-141.03**	25.69	<.0001	**-371.75**	33.74	<.0001	**-68.14**	9.43	<.0001
Mountain	33.32	19.63	0.0896	**-178.83**	37.18	<.0001	-9.95	7.04	0.1576
Black	**38.69**	12.82	0.0025	**232.04**	25.37	<.0001	-0.25	4.83	0.9582
Asian	**47.50**	21.86	0.0297	**339.60**	40.96	<.0001	**91.24**	6.76	<.0001
Other	10.48	20.40	0.6074	**157.00**	40.03	<.0001	**27.97**	6.94	<.0001
Hispanic	**64.99**	17.95	0.0003	**111.27**	36.11	0.0021	**27.44**	6.18	<.0001
Children less than 6 years	-11.34	25.46	0.656	65.80	50.56	0.1931	11.99	8.82	0.1742
Children 6-12 years	21.87	18.58	0.2392	-6.25	38.26	0.8702	11.28	6.58	0.0864
Children 13-17 years	19.39	16.54	0.2412	31.71	33.67	0.3463	5.73	6.03	0.3416
Children < 6 & 6-12 years	36.72	25.92	0.1566	-4.04	53.50	0.9398	-3.11	9.29	0.7374
Children <6 & 13-17 years	-46.14	64.76	0.4762	7.59	127.84	0.9527	10.26	22.16	0.6434
Children 6-12 & 13-17 years	-8.49	23.56	0.7187	-43.70	48.26	0.3652	0.49	8.35	0.9528
Children <6 & 6-12 & 13-17	48.86	55.70	0.3804	-103.99	120.70	0.3889	-34.74	21.93	0.1131
Sigma	**682.91**	5.10	<.0001	**1150.82**	12.60	<.0001	**207.15**	2.15	<.0001
Log-likelihood	107704.00			59161.00			52776.00		
Pseudo R-square	0.00104			2.846E-08			5.23E-06		

Source: Calculated by the author. Note: Std Error is abbreviation for Standard Error. Estimated variable coefficient in bold font indicate statistical significance at the 0.05 level.

Table 6 Tobit Regression Results for Fluid Milk Beverages (Fluid Milk, Flavored Fluid Milk, Lactose-Free and Flavored Lactose-Free Milk

	Fluid Milk		Flavored Fluid Milk		Lactose-free		Flavored Lactose-free	
Variable	Estimate	Std Error	Estimate	Std Error	Estimate	Std Error	Estimate	Std Error
Log price almond milk	**-8580.19**	36.9	**-3532.11**	459.25	**-23495**	48.38	**-4669.06**	537.56
Log price soymilk	78.9	101.6	**89.19**	43.46	-181.19	121.36	82.02	71.15
Log price coconut milk	-192.83	111.19	-3.51	48.81	173.67	127.93	-43.74	84.35
Log price fluid milk	**424.56**	63.47	-30.04	27.21	-125.95	74.36	**-107.3**	42.89
Log price flavored fluid milk	**-3367.03**	37.49	22.22	16.65	**1001.89**	46.76	26.64	28.91
Log price lactose-free milk	**-736.51**	53.69	**-882.84**	17.03	2.93	72.99	**97.24**	39.57
Log price flavored lactose-free milk	**-886.21**	196.06	-192.91	99.07	**-2428.92**	146.71	**-432.19**	130.69
Log household income	**2182.16**	215.42	39	119.23	**-6307.66**	203.67	**-874.77**	68.33
Intercept	**291.04**	17.57	**21.62**	7.64	**194.06**	22.42	**51.23**	14.28
Age of household head 25-29	39.9	177.77	10.06	73.78	-342.88	215.04	-97.42	130.17
Age of household head 30-34	165.24	169.15	-33.77	70.28	**-412.9**	203.02	-34.35	119.53
Age of household head 35-44	353.26	164.3	42.04	68.27	**-406.5**	196.15	-28.68	115.72
Age of household head 45-54	**484.07**	163.04	55.65	67.8	-338.67	194.06	-33.69	114.84
Age of household head 55-64	**460.64**	162.79	3.47	67.76	-224.69	193.35	-55.08	114.72
Age of household head >65	275.82	163.49	-129.93	68.18	-176.35	194.07	-84.51	115.55
Employment status part-time	**-153.33**	30.19	6.4	12.71	-59.69	38.2	23.87	22.96
Employment status full-time	**-395**	26.66	-0.95	11.22	**-192.16**	33.88	-1.95	20.42
Education: high school	**-172.11**	72.59	-46.84	30.05	121.04	99.43	-29.31	57.56
Education: undergraduate	**-411.15**	71.35	**-119.07**	29.6	**227.72**	97.44	-10.35	56.27
Education: post-college	**-612.47**	76.89	**-213.41**	32.4	196	103.42	-29.35	60.47
New England	**-268.12**	63.52	-27.73	29.93	**865.91**	71.35	**134.7**	47.44
Middle Atlantic	11.28	42.81	19.14	19.28	-61.33	51	43.13	35.66

Table 6 Continued

	Fluid Milk		Flavored Fluid Milk		Lactose-free		Flavored Lactose-free	
Variable	Estimate	Std Error	Estimate	Std Error	Estimate	Std Error	Estimate	Std Error
East North Central	**-510.41**	50.2	**64.48**	21.96	**-456.11**	59.35	-43.14	41.35
West North Central	**-146.1**	64.77	**141.83**	27.01	141.56	77.5	**184.35**	42.08
South Atlantic	**250.78**	40.55	25.18	22.75	**-756.1**	47.25	**-101.26**	36.33
East South Central	**334.42**	58.89	**83.72**	35.19	**-1897.67**	76.49	**-232.84**	51.99
West South Central	**-110.21**	51.89	**97.69**	30.66	**-1042.88**	57.68	**91.86**	41.57
Mountain	**-277.22**	50.42	40.3	23.93	**-526.82**	64.7	50.85	39.25
Black	**-1226.2**	35.72	**-252.12**	16.76	**600.8**	38.76	-1.2	26.89
Asian	**-564.93**	62.63	**-221.13**	29.47	**440.44**	68.55	15.23	44.9
Other	**-355.94**	56.09	**-64.73**	24.22	**174.42**	64.85	-23.88	41.37
Hispanic	-98.24	50.47	-40.03	21.73	**483.78**	55.74	38.96	33.69
Children less than 6 years	**1277.56**	70.2	**168.68**	28.03	91.53	89.1	21.39	51.45
Children 6-12 years	**764.46**	50.53	**184.2**	19.97	-30.69	66.53	49.44	35.57
Children 13-17 years	**1009.38**	44.33	**157.54**	17.63	37.55	57.71	**91.4**	29.66
Children < 6 & 6-12 years	**1454.32**	72.24	**175.28**	28.45	99.92	92.65	-41.19	59.21
Children <6 & 13-17 years	**1457.47**	168.66	**175.74**	65.02	**412.1**	199.68	178.24	92.65
Children 6-12 & 13-17 years	**1592.06**	62.7	**206.19**	24.31	91.93	82.14	28.43	44.94
Children <6 & 6-12 & 13-17	**1804.05**	154.87	**212.23**	58.67	-5.65	206.76	162.89	89.33
Sigma	**2540.01**	7.76	**780.81**	5.39	**1710.62**	21.11	**484.25**	18.36
Log-likelihood	515396		119038		-48890		-5980	
Pseudo R-square	0.0009233		0.00212		0.0001271		5.19E-06	

Source: Calculated by the author. Note: Std Error is abbreviation for Standard Error. Estimated variable coefficient in bold font indicate statistical significance at the 0.05 level.

Household income and the price of almond milk, soymilk, coconut milk, fluid milk, and flavored fluid milk are important economic determinants of almond milk purchases. However, price of lactose-free and flavored lactose-free milk does not have significant influence on almond milk purchase. In addition, significant demographic drivers of demand of almond milk are the age, employment status, and education level of the household head as well as the household's region, race, and Hispanic status. The presence of children in a household and the age of any children present do not have significant influence on almond milk purchase.

Household income and the price of almond milk, soymilk, coconut milk, fluid milk, lactose-free milk and flavored lactose-free milk are significant economic determinants of demand for soymilk. However, price of flavored fluid milk is not a significant determinant for soymilk purchase. Furthermore, demand for soymilk is influenced by demographic factors such as: the age, employment status and education of the household head. All the demographic regions except New England have significant influences on soymilk purchase. Also, race, and Hispanic status are significant drivers for demand of soymilk. Like the situation in almond milk, the presence of children in a household and the age of any children present do not have significant influence on soymilk purchase.

The significant economic determinants of demand for coconut milk are the price of almond milk, coconut milk, fluid milk, lactose-free milk, flavored lactose-free milk and household income. Soymilk price does not have a significant influence on almond purchase. Taken individually, the age of the household head, employment status,

education, race, and Hispanic origin are significant demographic variables impacting demand for coconut milk. Except for the New England and Mountain regions, other regions are significant demographic factor for coconut milk purchase. Again, the presence of children in a household and the age of any children present do not have significant influence on coconut milk purchase.

Regarding demand for fluid milk, household income and the price of coconut milk, fluid milk, flavored fluid milk, lactose-free milk and flavored lactose-free milk are important economic determinants of fluid milk purchases, while price of almond milk and soymilk do not have significant influence on fluid milk purchase. In addition, significant demographic drivers of demand of fluid milk are the age, employment status, and education level of the household head as well as the household's region and race. Hispanic status is not a significant driver of demand of fluid milk. Different from the situation in almond milk, soymilk and coconut milk, the presence of children in a household and the age of any children present is significant factor of fluid milk purchase.

The price variables that significantly affect demand for flavored fluid milk are its own price and price of almond milk. Household income is also a significant economic driver of demand for flavored fluid milk. Age and employment status of household head are not significant demographic factors for flavored fluid milk purchase. Education level of household head, region, race, Hispanic status and the presence of children and the age of any children present are significant demographic drivers of demand for flavored fluid milk.

Household income, the price of lactose-free milk, flavored lactose-free milk and fluid milk are significant economic determinants of demand for lactose-free milk. Furthermore, demand for lactose-free milk is influenced by demographic factors such as age, employment status, education of the household head as well as region, race, and Hispanic status of households. Households with children between the ages of 6 and 13 and between 13 and 17 have significant effect on lactose-free milk purchase, otherwise, the presence of children do not have significant demographic effect on the demand of lactose-free milk.

The significant economic determinants of demand for flavored lactose-free milk are the price of coconut milk, flavored fluid milk, lactose-free milk, flavored lactose-free milk and household income. Taken individually, the age of the household head, employment status, education of household head as well as the race, and Hispanic status of households are not significant demographic factors impacting demand for flavored lactose-free milk. Region is a significant demographic factor for flavored lactose-free milk purchase. Households with children aged 13 to 17 have significant effect on flavored lactose-free milk purchase, otherwise, the presence of children do not have significant demographic effect on the demand of flavored lactose-free milk.

Coefficients in Tobit model are not directly interpretable. In order to understand the meaning of coefficients in Tobit model, they need to be transformed into meaningful marginal effects. The coefficients in Tobit model can be used to generate unconditional and conditional marginal effects. The equation for unconditional marginal effects is $\frac{\partial E(y)}{\partial X} = \beta F(z)$, these marginal effects take into account all households, whether they

bought a beverage or yet to buy. The equation for conditional marginal effects is $\frac{\partial E(y^*)}{\partial X} = \beta(1 - z\frac{f(z)}{F(z)} - \frac{f(z)^2}{F(z)^2})$, these marginal effects only take the households that bought a beverage (Dharmasena, 2011).

Median unconditional marginal effects for each variable for all the seven beverages are presented in Table 7. The Median values were used in the following description as to reduce the impact of outliers and the possibility of skewed data.

Table 7 Median Unconditional Marginal Effects of the Respective Explanatory Variable in Almond Milk, Soymilk, Coconut Milk, Fluid Milk, Flavored Fluid Milk, Lactose-Free and Lactose-Free Flavored Demand Equation

Variables	Almond Milk	Soymilk	Coconut Milk	Fluid Milk	Flavored fluid Milk	Lactose-free Milk	Flavored Lactose-free Milk
Age of household head 25-29	7.55	-13.81	**7.71**	32.73	1.69	-20.43	-0.59
Age of household head 30-34	-4.37	-14.00	**5.56**	135.54	-5.68	**-24.6**	-0.21
Age of household head 35-44	-16.16	**-25.31**	4.81	**289.78**	7.07	**-24.22**	-0.17
Age of household head 45-54	**-20.59**	**-24.15**	2.8	**397.07**	9.36	-20.18	-0.2
Age of household head 55-64	**-21.71**	**-27.33**	1.83	**377.85**	0.58	-13.39	-0.33
Age of household head >65	**-31.05**	**-32.33**	-0.82	226.25	-21.86	-10.51	-0.51
Employment status part-time	**6.27**	2.93	0.81	**-125.78**	1.08	-3.56	0.14
Employment status full-time	**-4.59**	**-5.06**	**-2.07**	**-324.01**	-0.16	**-11.45**	-0.01
Education: high school	**18.7**	-1.52	0.04	**-141.18**	-7.88	7.21	-0.18
Education: undergraduate	**28.43**	9.13	**2.75**	**-337.26**	**-20.03**	**13.57**	-0.06
Education: post-college	**34.26**	**17.96**	**4.31**	**-502.4**	**-35.9**	11.68	-0.18
New England	-5.79	2.53	-0.48	**-219.93**	-4.67	**51.59**	**0.82**
Middle Atlantic	-4.06	**-12.73**	**-1.94**	9.25	3.22	-3.65	0.26

Table 7 Continued

Variables	Almond Milk	Soymilk	Coconut Milk	Fluid Milk	Flavored fluid Milk	Lactose-free Milk	Flavored Lactose-free Milk
East North Central	-22.18	**-19.87**	**-2.2**	**-418.68**	**10.85**	**-27.18**	-0.26
West North Central	**-12.61**	**-8.72**	**-3.1**	**-119.84**	**23.86**	8.43	**1.12**
South Atlantic	**-18.88**	**-26.09**	**-3.99**	**205.71**	4.24	**-45.05**	**-0.61**
East South Central	**-22.17**	**-39.28**	**-7.13**	**274.32**	**16.43**	**-113.06**	**-1.41**
West South Central	**-23.75**	**-30.52**	**-5.58**	**-90.4**	**14.47**	**-62.14**	**0.56**
Mountain	5.61	**-14.68**	-0.81	**-227.4**	6.78	**-31.39**	0.31
Black	**6.52**	**19.05**	-0.02	**-1005.83**	**-42.41**	**35.8**	-0.01
Asian	**8.06**	**27.88**	**7.47**	**-463.41**	**-37.2**	**26.24**	0.09
Other	1.85	**12.89**	**2.29**	**-291.97**	**-10.89**	**10.39**	-0.14
Hispanic	**10.89**	**9.14**	**2.25**	-80.58	-6.73	**28.82**	0.24
Children less than 6 years	-2	5.4	0.98	**1047.96**	**28.37**	5.45	0.13
Children 6-12 years	3.7	-0.51	0.92	**627.07**	**30.98**	-1.83	0.3
Children 13-17 years	3.28	2.6	0.47	**827.97**	**26.5**	2.24	**0.55**
Children < 6 & 6-12 years	6.22	-0.33	-0.25	**1192.95**	**29.48**	5.95	-0.25
Children <6 & 13-17 years	-7.61	0.62	0.84	**1195.54**	**29.56**	**24.55**	1.08
Children 6-12 & 13-17 years	-1.32	-3.59	0.04	**1305.94**	**34.68**	5.48	0.17
Children <6 & 6-12 & 13-17	8.26	-8.54	-2.84	**1479.83**	**35.7**	-0.34	0.99

Source: Calculated by the author. Note: Estimated marginal effects in bold font indicate statistical significance at the 0.05 level.

Unconditional Marginal Effects

The category households with household head between 45-54 tends to consume 21 ounces less almond milk than the base case household which is headed by a person younger than 25 years for almond milk. Likewise, if household head is aged between 55 to 64, this household head is likely to consume 22 ounces less almond milk than household head younger than 25-year-old. Also, household head older than 64 years

consumes 31 ounces less almond milk than household head younger than 25 years old. Overall, as the household head gets older, less almond milk is consumed.

Household with half-time employed household head consume about 6 ounces more almond milk per year relative to the base case of household head where household head is not employed for full pay. On the other hand, household with full time employed household heads purchase 5 ounces less almond milk than households where the household head is not employed for full pay.

Households in which the head has higher education level tend to purchase more almond milk than households in the base case who have less than a high school education. Households with high-school-educated household heads consume about 19 ounces more almond milk per year, college-educated household heads consume about 28 ounces more almond milk per year and post-college-educated household heads consume about 34 ounces more. In conclusion, the higher level of education of the household head, the more households are to consume almond milk.

As mentioned in the data description part, region was broken down into nine categories with Pacific as the base. Only West North Central, South Atlantic, East South Central, West South Central were significant determinants of demand for almond milk. Respectively, households in these regions consume about 13 ounces, 19 ounces, 22 ounces and 24 ounces less almond milk than households in the Pacific region.

Compared to the base category of white households, households where the household head identifies as black consume 6.5 ounces more almond milk and household head identifies as Asian consume 8 more ounces. Households where the

household head has Hispanic origin consume 11 ounces more almond milk than non-Hispanic households.

Finally, the age and presence of children was not a significant determinant of demand for almond milk.

Households where the household heads aged between 35 and 44 consume 25 ounces less soymilk than households where the household heads is younger than 25 years. Household heads aged between 45 and 54 purchase 24 ounces less soymilk than the base category. Household heads aged between 55 and 64 consume 27 ounces less soymilk and household heads who were older than 65 drink 32 ounces less soymilk than the base case.

Full-time employment household heads tend to consume 5 ounces less soymilk than households where household head is not employed. Post-college educated household heads purchase 18 ounces more soymilk than the base case that household heads with a education less than high school.

All, except New England, were significant determinants of demand for soymilk. Households in the Middle Atlantic, East North Central, West North Central, South Atlantic, East South Central, West South Central and Mountain regions consume less soymilk than households in the Pacific region. These households consume between 9 and 39 less ounces than the base category.

Households classified as Black, Asian, and other race consume a larger volume of soymilk (19 ounces more for Black households, 28 ounces more for Asian households and 13 ounces more for other households) than households classified as white, the base

case. Also, Hispanic households consume about 9 ounces more soymilk than non-Hispanic households.

Households with a household head aged 25 to 29 consume 8 more ounces of coconut milk than households where the household head is younger than 25 years old. As the age of the household head increases, the households tend to consume less coconut milk. When household head is aged between 30 to 34, this household head tends to consume 6 ounces more coconut milk than the base case of a household headed by a person younger than 25. Similarly, household head aged between 35 and 44 consumes 5 ounces more coconut milk than household head younger than 25 years. Households where the household head in the 25 to 29 age category tend to consume the most quantity of coconut milk each year.

Similar to the situation in almond milk consumption, household heads that worked part-time consume about 1 ounce more coconut milk per year relative to the base case of households where household head is not employed for full pay, while full-time employment household head purchases about 2 ounces less coconut milk than households where the household head is not employed.

Households in which the head has higher education level tend to purchase more coconut milk than households in the base case of less than a high school education. College-educated households drink 3 ounces more coconut milk per year and post-college-educated households drink 4 ounces more. In conclusion, the higher level of education of the household head, the more coconut milk households are to consume.

Regionally, households in the Middle Atlantic, East North Central, West North Central, South Atlantic, East South Central and West South Central consume 2 ounces, 2 ounces, 3 ounces, 4 ounces, 7 ounces and 6 ounces less coconut milk than households in the Pacific region, the base case.

Households classified as Asian, and other consume a larger volume of coconut milk (7 ounces more for Asian households and 2 ounces more for other households) than households classified as white, the base case. Also, Hispanic households purchase 2 ounces more coconut milk than non-Hispanic households.

Overall, the presence of children in a household does not have significant effects on coconut milk consumption.

Households with household head that was between the ages of 35 and 44 consume 289 ounces more fluid milk than households where the household head was younger than 25. Furthermore, household head that was between 45 and 54 consume 397 more ounces fluid milk than households aged less than 25. Household head that was between 55 and 64 consume 378 more ounces fluid milk than the base case. The 45 to 54 age category household heads purchased the most fluid milk.

All the marginal effects for employment status variables are negative, which means households where the household head was not employed (the base case) consume the most fluid milk. Compared to households where the household head was not employed, households where household head was part-time employed consume 126 ounces less fluid milk, and households where household head was full-time employed consume 324 ounces less fluid milk each year.

Unlike the fluid milk alternative beverages previously discussed, education has a negative effect on fluid milk consumption. High school educated household head consume 141 less ounces of fluid milk than household head with less than a high school education. College educated household head consume 337 less ounces of fluid milk than the base case. Post-college-educated household head consume 502 less ounces than households in the base category each year. The more education the household head has, the less fluid milk he/she will consume.

All, except Middle Atlantic, were significant determinants of demand for fluid milk. Households in the New England, East North Central, West North Central, West South Central and Mountain regions consume less fluid milk than households in the Pacific region. These households consume between 90 and 419 less ounces than the base category. Households in the South Atlantic and East South Central regions consume 206 and 274 ounces more fluid milk than households in the Pacific region.

Comparing with fluid milk alternative beverages, race has an opposite effect on fluid milk. All the marginal effects for race variables are negative, which means households that identified as anything other than white consume less fluid milk. Households that identified as black consume 1,006 ounces less than the white households. Households that identified as Asian consume 463 ounces less than the base category and Households that identified as other consume 292 ounces less fluid milk than the base case. Different from the situation in fluid milk alternative beverage, whether Households are Hispanic origin or not do not have significant effect on fluid milk consumption.

Households with children consume more fluid milk than households with no children. Households with children less than 6 years of age consume 1,048 ounces more fluid milk than the base category. Households with children between 6 and 12 consume the least fluid milk compared with other age category, but they still consume 627 ounces more fluid milk than households without children. Overall, households with children consume anywhere between 627 ounces and 1,480 more ounces than the base category.

Age and employment status of the household head were not significant determinants of consumption of flavored fluid milk. College and post-college educated households consume 20 and 36 ounces less flavored fluid milk, respectively, than households with less than a high school education.

Households in the East North Central, West North Central, East South Central and West South Central regions consume 11, 24, 14 and 16 ounces more flavored fluid milk respectively than households in the Pacific region, the base category.

Similar to the situation with fluid milk consumption, more flavored fluid milk is consumed in white households. Households that identified as black consume 42 ounces less fluid milk than households that identified as white. Asian households consume 37 ounces less fluid milk than the base category. Households that identified as other consume 11 ounces less fluid milk than the base case. Whether Households are Hispanic origin or not do not have significant effect on flavored fluid milk consumption.

Households with children consume more flavored fluid milk than households with no children. Households with children less than 6 years of age consume 28 ounces more flavored fluid milk than the base category. Households with children aged between

6 and 12 purchased 31 ounces more flavored fluid milk each year than households with no children. Households with children between 13 and 17 consume the least of flavored fluid milk compared with other age categories, but they still consume 27 ounces more fluid milk than households without children. Overall, households with children consume anywhere between 27 ounces and 36 more ounces than the base category.

Households where the household head is aged between 30 and 34 consume 25 ounces less lactose-free milk compared with the base case of households where the household head younger than 25. Also, household head who is aged between 35 and 44 consume 24 ounces less lactose-free milk compared with the base category.

Full-time employment decreases the consumption of flavored lactose-free milk. Compared with household head who was not employed, full-time employed household head consumes 11 ounces less lactose-free milk. College educated household consume 14 ounces more lactose-free milk compared with the base case of less than high school education.

Households in New England purchase more lactose-free milk than households in the Pacific region while households in East North Central, South Atlantic, West South Central, and Mountain consume 27, 45, 113, 62 and 31 ounces less lactose-free milk respectively relative to the base case, the Pacific region.

Households classified as black, Asian and other race consume more lactose-free milk than the base case of white. Black households consume 36 ounces more lactose-free milk each year than white households. Asian households consume 26 ounces more lactose-free milk than households classified as white. Other race households drink 10

ounces more lactose-free milk than the base case. Households with Hispanic origin consume 29 more ounces than the base case of Non-Hispanic origin. Households with children less than 6 and children aged between 13 and 17 drink 25 more ounces lactose-free milk than households with no children.

Demographic factors such as age of household head, employment status, education level of household head, the race of households are not significant drivers of consumption of flavored lactose-free milk.

Households in New England, West North Central, West South Central purchase 0.8, 1.1 and 0.6 more ounces flavored lactose-free milk than households in the Pacific region, while households in South Atlantic and East South Central consume 0.6 and 1.4 ounces less flavored lactose-free milk relative to the base case, the Pacific region. Furthermore, households with children aged between 13 and 17 consume 0.6 ounces more flavored lactose-free milk than households with no children.

Table 8 and table 9 report the conditional marginal effects and the probability of being above the limit (purchase) for each beverage for each demographic variable. Similar to the unconditional marginal effects, we used the median values instead of the mean to reduce the impact of outliers and the possibility of skewed data.

Table 8 Median Conditional Marginal Effects of the Respective Explanatory Variables and the Probability of being above the Limit for Almond Milk, Soymilk, Coconut Milk.

Variable	Almond Milk		Soymilk		Coconut Milk	
	Marginal Effects	Changes in Pro	Marginal Effects	Changes in Pro	Marginal Effects	Changes in Pro
Age 25-29	10.03	1.89%	-2.58	-2.87%	**18.05**	**10.28%**
Age 30-34	-5.83	-1.10%	-2.62	-2.91%	**13.01**	**7.41%**
Age 35-44	-21.29	-4.01%	**-4.73**	**-5.25%**	**11.26**	**6.41%**
Age 45-54	**-27.15**	**-5.12%**	**-4.52**	**-5.01%**	6.56	3.74%
Age 55-64	**-28.63**	**-5.40%**	**-5.11**	**-5.67%**	4.28	2.44%
Age >65	**-40.94**	**-7.72%**	**-6.05**	**-6.71%**	-1.92	-1.09%
Part-time Employed	**8.26**	**1.56%**	0.55	0.61%	**1.88**	**1.07%**
Full-time Employed	**-6.05**	**-1.14%**	**-0.95**	**-1.05%**	**-4.84**	**-2.76%**
High school Educated	**24.62**	**4.64%**	-0.29	-0.32%	0.1	0.06%
Undergraduate Educated	**37.44**	**7.06%**	1.71	1.90%	**6.43**	**3.66%**
Post-college Educated	**45.12**	**8.51%**	**3.36**	**3.73%**	**10.08**	**5.74%**
New England	-7.61	-1.43%	0.47	0.53%	-1.12	-0.64%
Middle Atlantic	-5.34	-1.01%	**-2.38**	**-2.64%**	**-4.54**	**-2.58%**
East North Central	-1.1	-0.21%	**-3.72**	**-4.13%**	**-5.14**	**-2.92%**
West North Central	**-16.58**	**-3.13%**	**-1.63**	**-1.81%**	**-7.26**	**-4.13%**
South Atlantic	**-24.87**	**-4.69%**	**-4.88**	**-5.42%**	**-9.34**	**-5.32%**
East South Central	**-29.2**	**-5.50%**	**-7.35**	**-8.16%**	**-16.69**	**-9.50%**
West South Central	**-31.28**	**-5.90%**	**-5.71**	**-6.34%**	**-13.05**	**-7.43%**
Mountain	7.39	1.39%	**-2.75**	**-3.05%**	-1.9	-1.08%
Black	**8.58**	**1.62%**	**3.56**	**3.96%**	-0.05	-0.03%
Asian	**10.54**	**1.99%**	**5.22**	**5.79%**	**17.47**	**9.95%**
Other	2.32	0.44%	**2.41**	**2.68%**	**5.36**	**3.05%**
Hispanic	**14.41**	**2.72%**	**1.71**	**1.90%**	**5.25**	**2.99%**
Children less than 6	-2.51	-0.47%	1.01	1.12%	2.3	1.31%
Children 6-12	4.85	0.91%	-0.1	-0.11%	2.16	1.23%
Children 13-17	4.3	0.81%	0.49	0.54%	1.1	0.63%
Children < 6 & 6-12	8.14	1.54%	-0.06	-0.07%	-0.6	-0.34%
Children <6 & 13-17	-10.23	-1.93%	0.12	0.13%	1.96	1.12%
Children 6-12 & 13-17	-1.88	-0.35%	-0.67	-0.74%	0.09	0.05%
Children<6&6-12 &13-17	10.84	2.04%	-1.6	-1.77%	-6.65	-3.79%

Source: Calculated by the author. Note: Estimated marginal effects in bold font indicate statistical significance at the 0.05 level.

Table 9 Median Conditional Effects of the Respective Explanatory Variables and the Probability of being above the Limit for Fluid Milk, Flavored Fluid Milk, Lactose-Free and Flavored Lactose-Free Milk

Variable	Fluid Milk		Flavored Fluid Milk		Lactose-free		Flavored Lactose-free	
	Marginal Effects	Changes in Pro	Marginal Effects	Changes in Pro	Marginal Effects	Changes in Pro	Marginal Effects	Changes in Pro
Age 25-29	24.69	0.39%	2.41	0.40%	-55.91	-3.23%	-10.63	-0.90%
Age 30-34	102.26	1.63%	-8.09	-1.36%	**-67.32**	**-3.89%**	-3.75	-0.32%
Age 35-44	**218.62**	**3.48%**	10.08	1.69%	**-66.28**	**-3.83%**	-3.13	-0.27%
Age 45-54	**299.57**	**4.77%**	13.34	2.24%	**-55.22**	**-3.19%**	-3.68	-0.31%
Age 55-64	**285.07**	**4.54%**	0.83	0.14%	-36.63	-2.12%	-6.01	-0.51%
Age >65	170.7	2.72%	-31.14	-5.23%	-28.75	-1.66%	-9.22	-0.78%
Part-time Employed	**-94.89**	**-1.51%**	1.53	0.26%	-9.73	-0.56%	2.6	0.22%
Full-time Employed	**-244.45**	**-3.89%**	-0.23	-0.04%	**-31.33**	**-1.81%**	-0.21	-0.02%
High school Educated	**-106.51**	**-1.70%**	-11.23	-1.88%	19.74	1.14%	-3.2	-0.27%
Undergraduate Educated	**-254.45**	**-4.05%**	**-28.54**	**-4.79%**	**37.13**	**2.15%**	-1.13	-0.10%
Post-college Educated	**-379.04**	**-6.04%**	**-51.15**	**-8.59%**	31.96	1.85%	-3.2	-0.27%
New England	**-165.93**	**-2.64%**	-6.65	-1.12%	**141.18**	**8.16%**	**14.7**	**1.25%**
Middle Atlantic	6.98	0.11%	4.59	0.77%	-10	-0.58%	4.71	0.40%
East North Central	**-315.87**	**-5.03%**	**15.45**	**2.59%**	**-74.37**	**-4.30%**	-4.71	-0.40%
West North Central	**-90.41**	**-1.44%**	**33.99**	**5.71%**	23.08	1.33%	**20.11**	**1.71%**
South Atlantic	**155.2**	**2.47%**	6.04	1.01%	**-123.28**	**-7.12%**	**-11.05**	**-0.94%**
East South Central	**206.96**	**3.30%**	**21.47**	**3.37%**	**-309.41**	**-17.88%**	**-25.4**	**-2.16%**
West South Central	**-68.2**	**-1.09%**	**23.41**	**3.93%**	**-170.04**	**-9.83%**	**10.02**	**0.85%**
Mountain	**-171.56**	**-2.73%**	9.66	1.62%	**-85.9**	**-4.96%**	5.55	0.47%
Black	**-758.85**	**-12.08%**	**-60.43**	**-10.15%**	**97.96**	**5.66%**	-0.13	-0.01%

Table 9 Continued

Variable	Fluid Milk		Flavored Fluid Milk		Lactose-free		Flavored Lactose-free	
	Marginal Effects	Changes in Pro	Marginal Effects	Changes in Pro	Marginal Effects	Changes in Pro	Marginal Effects	Changes in Pro
Asian	**-349.62**	**-5.57%**	**-53**	**-8.90%**	**71.81**	**4.15%**	1.66	0.14%
Other	**-220.28**	**-3.51%**	**-15.52**	**-2.61%**	**28.44**	**1.64%**	-2.61	-0.22%
Hispanic	-60.8	-0.97%	-9.59	-1.61%	**78.88**	**4.56%**	4.25	0.36%
Children less than 6	**790.64**	**12.59%**	**40.43**	**6.79%**	14.92	0.86%	2.33	0.20%
Children 6-12	**473.1**	**7.53%**	**44.15**	**7.41%**	-5	-0.29%	5.39	0.46%
Children 13-17	**624.67**	**9.95%**	**37.76**	**6.34%**	6.12	0.35%	**9.97**	**0.85%**
Children < 6 & 6-12	**900.03**	**14.33%**	**42.01**	**7.05%**	16.29	0.94%	-4.49	-0.38%
Children <6 & 13-17	**901.98**	**14.36%**	**42.12**	**7.07%**	**67.19**	**3.88%**	19.45	1.65%
Children 6-12 & 13-17	**985.28**	**15.69%**	**49.42**	**8.30%**	14.99	0.87%	3.1	0.26%
Children<6&6-12 &13-17	**1116.47**	**17.78%**	**50.87**	**8.54%**	-0.92	-0.05%	17.77	1.51%

Source: Calculated by the author. Note: Estimated marginal effects in bold font indicate statistical significance at the 0.05 level.

Conditional Marginal Effects and Changes in Probability of Purchase

As shown in Table 8, household with household head between 45-54 years consume 27 ounces less almond milk compared to the household with household head less than 25 years, the base category. Also, households where the household head is aged between 45 and 54 are 5.1% less likely to consume almond milk than the base category of households where the household head is younger than 25. It then follows that household head aged between 55 to 64 are 5.4% less likely to consume almond milk and consume 29 ounces less almond milk than households where household head younger than 25-year-old. Furthermore, household head older than 64 consumes 41 ounces less almond milk than household head younger than 25 years old. These households are 7.7% less likely to consume almond milk than the base category.

The conditional marginal effect for the employment status variable for household heads who are employed part-time would consume 8.3 more ounces than households where the household head is not employed fort full pay and are 1.6% more likely to consume almond milk than the base category. Households where the household head is employed full-time would consume 6.1 ounces less almond milk and are 1.1% less likely to buy almond milk than the base category.

Households where the household head with a high school degree consume 25 ounces more and are approximately 4.6% more likely to consume almond milk than households with less than a high school education. College educated households purchase 37 ounces more of almond milk and are 7.1% more likely to buy almond milk than the base category. Furthermore, post-college educated households consume 45

ounces more almond milk and are 8.5% more likely to buy almond milk than the base case.

Households in the West North Central, South Atlantic, East South Central and West South Central regions were less likely to consume almond milk than households in the Pacific region, the base category. These households consume 17, 25, 29 and 31 respectively less ounces than the base category, with a range of probabilities from 3.1% to 5.9%.

Non-white households tend to consume more almond milk than white households. Households that identified as black are 1.6% more likely to consume almond milk and would consume 8.6 more ounces than the base category of households that identified as white. Households that identified as Asian are 2.0% more likely to consume almond milk and would consume 11 ounces more almond milk than white households. Households who were Hispanic origin would consume 14 more ounces than households where the household head was not of Hispanic origin, and 2.7% more likely to consume Almond milk than the base case. The presence of children does not have significant effect on almond milk consumption.

Households with household heads aged between 35 and 44 consume 5 ounces less soymilk and are 5.3% less likely to purchase soymilk than households with household heads younger than 25 years. Household heads aged between 45 and 54 also purchase 5 ounces less soymilk than the base category and are 5.0% less likely to consume. Household heads aged over 55 years consume about 5.5 ounces less soymilk and are about 6.0% less likely to purchase than the base case.

Full-time employment household heads tend to consume 1 ounce less soymilk and are 1.1% less likely to purchase than households where household head is not employed for full pay. Post-college-educated household heads purchase 3.4 ounces more soymilk than the base case that household heads with an education less than high school. Households where household head has post-college-education are 3.7% more likely to buy soymilk.

Households in the Middle Atlantic, East North Central, West North Central, South Atlantic, East South Central, West South Central and Mountain regions consume 2.4 ounces, 3.7 ounces, 1.6 ounces, 4.9 ounces, 7.4 ounces, 5.7 ounces and 2.8 ounces less soymilk respectively than households in the Pacific region. These households are between 1.8% and 8.2% less likely to purchase soymilk than the base category, the Pacific region.

Households classified as Black, Asian, and other race consume are more likely to purchase soymilk (4.0% more likely for Black households, 5.8% more likely for Asian households and 2.7% more likely for other households) than households classified as white, the base case. Black households purchase 3.6 ounces less soymilk while Asian households and other households purchase 5.2 ounces and 2.4 ounces more soymilk. Hispanic households consume about 1.7 ounces more soymilk and are 1.9% more likely to purchase than non-Hispanic households.

Households with a household head aged 25 to 29 are 10.3% more likely to consume coconut milk and consume 18 more ounces than households where the household head is younger than 25 years old. As the household head older, they tend to

consume less coconut milk. When household head is aged between 30 to 34, this household is 7.4% more likely to purchase coconut milk and tends to consume 13 ounces more coconut milk than the base case of a household headed by a person younger than 25. Similarly, households head aged between 35 to 44 are 6.4% more likely to consume coconut milk and consume 11 ounces more coconut milk than household head younger than the base category.

Compared to households where household head is not employed for full pay, households with household head worked part-time are 1.1% more likely to consume coconut milk and consume about 2 ounce more per year. However, full-time employment household head is 2.8% less likely to consume coconut milk and purchases 5 ounces less coconut milk than households where the household head is not employed.

College-educated households drink 6 ounces more coconut milk per year and are 3.7% more likely to purchase coconut milk than households where household head has a less than high school education. Post-graduate-educated households consume 10 ounces more coconut milk and are 5.7% more likely to buy than the base category.

Regionally, households in the Middle Atlantic, East North Central, West North Central, South Atlantic, East South Central and West South Central consume 5 ounces, 5 ounces, 7 ounces, 9 ounces, 17 ounces and 13 ounces less coconut milk than households in the Pacific region, the base case. Households in these regions are anywhere from 2.6% to 9.5% less likely to consume coconut milk than the base category.

Households classified as Asian and other are more likely to consume coconut milk (10.0% for Asian households and 3.1% for other households) than households

classified as white, the base case. Asian households consume 17 more ounces coconut milk and other households consume 5 ounces more than the base category. Hispanic households are 3.0% more likely to purchase coconut milk than non-Hispanic households and consume about 5 ounces more coconut milk.

The presence of children in a household does not have significant effects on coconut milk consumption.

Household heads that are between the ages of 35 and 44 consume 219 more ounces of fluid milk and are 3.5% more likely to buy than households where the household head is younger than 25. Furthermore, household heads that are between 45 and 54 consume 230 more ounces fluid milk and are 4.8% more likely to purchase fluid milk than household heads aged less than 25. Household heads that were between 55 and 64 consume 285 more ounces and 4.5% more likely to consume fluid milk than the base case.

Households with household head not employed for full pay (the base case) consume the most fluid milk. Compared to the base category, households where household head was part-time employed consume 95 ounces less fluid milk and were 1.5% less likely to buy fluid milk. Households where household head was full-time employed consume 244 ounces less fluid milk each year and 3.9% less likely to buy fluid milk.

Education has a negative effect on fluid milk consumption. High school, college and post-college educated households are 1.7%, 4.1% and 6.0% less likely to consume

fluid milk. These households consume 254 and 379 ounces less fluid milk, respectively, than household heads with less than a high school education.

All demographic variables, except Middle Atlantic, were significant determinants of demand for fluid milk. Households in the New England, East North Central, West North Central, West South Central and Mountain regions consume less fluid milk than households in the Pacific region. These households consume between 68 and 316 less ounces than households in the Pacific region. Households in these regions are anywhere between 1.1% and 5.0% less likely to consume fluid milk than the base category. Households in the South Atlantic and East South Central regions consume 155 and 207 ounces more fluid milk and are 2.5% and 3.3% more likely to buy fluid milk than the base case.

Different from fluid milk alternative beverages, race has an opposite effect on fluid milk. Households that identified as anything other than white consume less fluid milk. Black households consume 759 ounces less fluid milk and were 12.6% less likely to purchase than the white households. Asian households consume 350 ounces less and were 5.6% less likely to purchase than the base category. Households classified as other consume 220 ounces less fluid milk and were 3.5% less likely to buy than the base case.

Households with children are more likely to consume fluid milk. The range is from7.5% to 17.8%. Households with children consume more fluid milk than households with no children. Overall, households with children consume anywhere between 473 ounces and 1116 more ounces than the base category.

Age and employment status were not significant determinants of demand for flavored fluid milk. College and post-college educated households are 4.8% and 8.6% less likely to purchase flavored fluid milk and consume 29 and 51 ounces less flavored fluid milk, respectively, than households with less than a high school education.

Households in the East North Central, West North Central, East South Central and West South Central regions are 2.6%, 5.7%, 3.4% and 3.9% more likely to consume flavored fluid milk and consume 15, 34, 21, and 23 ounces more flavored fluid milk respectively than households in the Pacific region.

Fluid milk is more popular for white households, so does flavored fluid milk. Households identified as black are 10.2% less likely to consume flavored fluid milk and consume 60 ounces less than households that identified as white. Asian households are 8.9% less likely to purchase flavored fluid milk and consume 53 ounces less than the base category. Households that identified as other are 2.6% less likely to purchase fluid milk and consume 16 ounces less fluid milk than the base case. Hispanic status has no significant effect on flavored fluid milk consumption.

Overall, households with children consume anywhere between 37 and 51 more ounces of flavored fluid milk than the base category. They are more likely to purchase flavored fluid milk than households with no children, then range is from 6.3% to 8.5%.

Household heads who are aged between 30 and 34 are 3.9% less likely to purchase, household head who is aged between 35 and 44 are 3.9% less likely to purchase and household head who is aged between 45 and 54 are 3.1% less likely to purchase lactose-free milk than household head younger than 25. Compared with

household heads younger than 25, household head aged between 30 and 54 consume about 60 ounces less lactose-free milk.

Compared with households where household head is not employed, full-time employed household head consume 31 ounces less lactose-free milk and is 1.8% less likely to purchase. Moreover, college educated households consume 37 ounces more lactose-free milk compared with the base case and is 2.2% more likely to purchase lactose-free milk.

Households located in the New England region consume more lactose-free milk than households in the Pacific region. On the other hand, households in East North Central, South Atlantic, West South Central, and Mountain consume 74, 123, 309, 170 and 86 ounces less lactose-free milk respectively relative to the Pacific region. Households in these regions are less likely to purchase lactose-free milk.

Households classified as black consume 98 ounces more lactose-free milk each year than white households and are 5.7% more likely to buy lactose-free milk. Asian households are 4.2% more likely to consume and consume 72 ounces more lactose-free milk than households classified as white. Households classified as other race are 1.6% more likely to consume and consume 28 ounces more lactose-free milk than the base category. Households with Hispanic origin households are 4.6% more likely to purchase and purchase 79 more ounces than the base case of Non-Hispanic origin. Furthermore, households with children less than 6 and children aged between 13 and 17 are 3.9% more likely to buy lactose-free milk and drink 67 more ounces than households with no children.

Age of household head, employment status, education level of household head, the race of households are not significant drivers for the flavored lactose-free milk consumption.

Households in New England, West North Central, West South Central are 1.3%, 1.7% and 0.9% more likely to purchase flavored lactose-free milk and purchase 15, 20 and 10 more ounces flavored lactose-free milk than households in the Pacific region. On the other hand, households in South Atlantic and East South Central are 0.9% and 2.2% less likely to consume flavored lactose-free milk and consume 11 and 25 ounces less flavored lactose-free milk relative to the base case, the Pacific region. Furthermore, households with children aged between 13 and 17 consume are 0.9% more likely to consume and consume 10 ounces more flavored lactose-free milk than households without children.

Elasticities

Table 10 and Table 11 show the unconditional and conditional own-price, cross-price and income elasticities for all the beverages considered in this research. For each variable, the unconditional elasticity estimates are consistently larger than corresponding conditional elasticities, that is to say when all households are taken into account, the demand and income elasticities are relatively more elastic than only considering households who bought a beverage.

Table 10 Unconditional Own-price, Cross-Price and Income Elasticities for Coconut Milk, Almond Milk, Soymilk, Fluid Milk, Flavored Fluid Milk, Lactose-Free and Flavored Lactose-Free Milk

Beverage	Coconut Milk	Almond Milk	Soymilk	Fluid Milk	Flavored Fluid Milk	Lactose Free	Lactose Free Flavored
Coconut Milk	**-2.66**	**-1.24**	**-0.99**	**0.14**	-0.07	-0.25	**-0.68**
Almond Milk	**-0.34**	**-2.39**	**-1.29**	0.03	**0.21**	0.24	0.51
Soymilk	-0.20	**-0.35**	**-2.47**	-0.07	-0.01	-0.17	-0.27
Fluid Milk	**0.83**	**0.74**	**0.46**	**-1.12**	0.05	**1.36**	0.17
Flavored Fluid	**0.18**	**0.25**	0.07	**-0.24**	**-2.10**	0.00	**0.62**
Lactose Free	**-0.63**	-0.38	-0.38	**-0.29**	-0.46	**-3.29**	**-2.75**
Flavored LF*	**-0.95**	-0.56	**-2.41**	**0.72**	0.09	**-8.54**	**-5.56**
Income	**0.41**	**0.34**	**0.17**	**0.10**	**0.05**	**0.26**	**0.32**

Note: "LF*" represents lactose-free milk, numbers in bold font are significant at *P*-value 0.05.

Table 11 Conditional Own-price, Cross-price and Income Elasticities for Coconut Milk, Almond Milk, Soymilk, Fluid Milk, Flavored Fluid Milk, Lactose-Free and Flavored Lactose-Free Milk

Beverage	Coconut Milk	Almond Milk	Soy Milk	Fluid Milk	Flavored Fluid	Lactose Free	Flavored Lactose Free
Coconut Milk	**-0.46**	**-0.26**	**-0.15**	**0.08**	-0.02	-0.03	**-0.07**
Almond Milk	**-0.06**	**-0.50**	**-0.21**	0.01	**0.05**	-0.04	0.05
Soymilk	-0.03	**-0.07**	**-0.41**	-0.04	0.00	0.04	-0.03
Fluid Milk	**0.14**	**0.16**	**0.08**	**-0.63**	0.01	**0.21**	0.02
Flavored Fluid	**0.03**	**0.05**	0.01	**-0.14**	**-0.45**	0.00	**0.06**
Lactose Free	**-0.11**	-0.08	-0.06	**-0.16**	-0.10	**-0.50**	**-0.27**
Flavored LF*	**-0.16**	-0.12	**-0.40**	**0.41**	0.02	**-1.31**	**-0.54**
Income	**0.07**	**0.07**	**0.03**	**0.05**	**0.01**	**0.04**	**0.03**

Note: "LF*" represents lactose-free milk, numbers in bold font are significant at *P*-value 0.05.

Almond milk, soymilk and flavored lactose-free milk are gross complements in demand for coconut milk with unconditional cross-price elasticities of -1.24, -0.99, -0.68, respectively. Fluid milk is a substitute for coconut milk with an unconditional cross-price elasticity of 0.14. The corresponding conditional cross-price elasticities for

coconut milk with regard to almond milk, soymilk and flavored fluid milk are -0.26, -0.15 and -0.07, indicating gross complementary behavior in demand. The conditional cross-price elasticity of fluid milk with regard to coconut milk is estimated to be 0.08, which is a gross substitute for coconut milk.

The unconditional own-price elasticity of demand for almond milk is -2.39 and the conditional counterpart is -0.50. The unconditional estimate is larger than the conditional elasticity showing that a higher own-price response and more substitutability between beverages when all households, whether they buy almond milk or not, are taken into account. Coconut milk and soymilk are gross complements for almond milk with unconditional cross-price elasticities of -0.34 and -1.29. The corresponding conditional cross-price elasticities for almond milk with regard to coconut milk and soymilk are -0.06 and -0.21. Flavored fluid milk is a substitute for almond milk with an unconditional cross-price elasticity of 0.21 and corresponding conditional cross-price elasticity of 0.05.

The unconditional and conditional own-price elasticities of demand for soymilk are -2.47 and -0.41. The unconditional cross-price elasticity of soymilk with respect to almond milk is -0.35 while the corresponding conditional cross-price elasticity is -0.07, demonstrating that almond milk is a gross complement for soymilk.

The unconditional and conditional own-price elasticities for fluid milk are -1.12 and -0.63. Coconut milk, almond milk, soymilk and lactose-free milk are gross substitutes in demand for fluid milk with unconditional cross-price elasticities of 0.83, 0.74, 0.46 and 1.36 respectively. The conditional cross-price elasticities for fluid milk

with regard to coconut milk, almond milk, soymilk and lactose-free milk are 0.14, 0.16, 0.08 and 0.21, indicating gross substitutability behavior in demand.

The unconditional own-price elasticity of demand for flavored fluid milk is -2.10 and the corresponding conditional own-price elasticity is -0.45. Coconut milk, almond milk and flavored lactose-free milk are gross substitutes for flavored fluid milk with unconditional cross-price elasticities of 0.18, 0.25 and 0.62, while the conditional cross-price elasticities are 0.03, 0.05 and 0.06, respectively. Fluid milk is a complement for flavored fluid milk with an unconditional and conditional cross-price elasticity of -0.24 and -0.14.

The unconditional and conditional own-price elasticities of demand for lactose-free milk are -3.29 and -0.50. The unconditional cross-price elasticities of lactose-free milk with respect to coconut milk, fluid milk and flavored lactose-free milk are -0.63, -0.29 and -2.75, respectively, meaning they are gross complements consumption. The conditional cross-price elasticities of lactose-free milk with regard to coconut milk, fluid milk and flavored lactose-free milk are -0.11, -0.16 and -0.27.

The unconditional own-price elasticity in demand for flavored lactose-free milk is -5.5, which is significantly smaller than the corresponding conditional own-price elasticity -0.54. The unconditional cross-price elasticities of flavored lactose-free milk with respect to coconut milk, soymilk and lactose-free milk are -0.95, -2.41 and -8.54, while the corresponding conditional cross-price elasticities of flavored lactose-free milk are -0.16, -0.40 and -0.54, respectively, indicating that these three beverages are gross

complements for lactose-free milk. Fluid milk is a substitute for flavored fluid milk with unconditional cross- price elasticity of 0.72 and conditional cross-price elasticity of 0.41.

The unconditional and conditional income elasticities of demand for all the seven beverages are positive and significant, meaning that these beverages are normal good.

Comparison of Previous Empirical Results

Dharmasena and Capps (2014) used 2008 Nielsen Homescan panel data to find factors affecting demand for soymilk, fluid milk and flavored fluid milk. Copeland and Dharmasena (2015) used 2010 Nielsen Homescan panel data to unravel drivers affecting demand for soymilk, almond milk, fluid milk and lactose-free milk. They all used Tobit model in the empirical estimation and calculated the market penetration, unconditional and conditional own-price, cross-price, and income elasticities. By comparing our empirical results with Dharmasena and Capps (2014), and Copeland and Dharmasena (2015), we see the evolving fluid milk and fluid alternative milk market in the United States during past couple of years. Table 12 shows market penetration, unconditional and conditional own-price, cross-price and income elasticities of soymilk, almond milk, fluid milk, flavored fluid milk, and lactose-free milk in 2008, 2010, and 2014 respectively.

Table 12 Comparison of Previous Empirical Results

	Research	Year of Data	Soymilk	Almond Milk	Fluid Milk	Flavored Fluid Milk	Lactose-free Milk
Market Penetration	Dharmasena & Capps (2014)	2008	12.58%	N/A	95.42%	26.80%	N/A
	Copeland & Dharmasena (2015)	2010	10.91%	12.06%	92.72%	N/A	7.24%
	This Thesis (2016)	2014	9.31%	19.02%	90.92%	21.06%	7.34%
Unconditional Own Price Elasticity	Dharmasena & Capps (2014)	2008	**-1.68**	N/A	**-0.86**	**-1.39**	N/A
	Copeland & Dharmasena (2015)	2010	**-3.37**	**-2.72**	**-0.97**	N/A	**-2.85**
	This Thesis (2016)	2014	**-2.47**	**-2.39**	**-1.12**	**-2.1**	**-2.75**
Conditional Own Price Elasticity	Dharmasena & Capps (2014)	2008	**-0.30**	N/A	**-0.53**	**-0.32**	N/A
	Copeland & Dharmasena (2015)	2010	**-0.67**	**-0.55**	**-0.69**	N/A	**-0.49**
	This Thesis (2016)	2014	**-0.41**	**-0.5**	**-0.63**	**-0.45**	**-0.54**
Unconditional Income Elasticity	Dharmasena & Capps (2014)	2008	**0.16**	N/A	**0.02**	-0.03	N/A
	Copeland & Dharmasena (2015)	2010	**0.17**	**0.26**	**0.01**	N/A	**0.23**
	This Thesis (2016)	2014	**0.17**	**0.34**	**0.10**	**0.05**	**0.26**
Conditional Income Elasticity	Dharmasena & Capps (2014)	2008	**0.03**	N/A	**0.01**	-0.01	N/A
	Copeland & Dharmasena (2015)	2010	**0.03**	**0.05**	**0.01**	N/A	**0.07**
	This Thesis (2016)	2014	**0.03**	**0.07**	**0.05**	**0.01**	**0.04**

Source: Collected by the author. Note: Estimated elasticities in bold font indicate statistical significance at the 0.05 level.

It is evident, as shown in Table 12 that the market penetration for soymilk has been decreasing from 2008 to 2014, while the market penetration for almond milk has been increasing during the same period, a notable change in the consumption patterns with regards to fluid milk alternative beverages in the United States. More than 90% households in the United States purchased fluid milk from 2008 and 2014, however, the market penetration for fluid milk decreased from 95.42% in 2008 to 90.91% in 2014. Consumption for lactose-free milk was relatively stable.

The unconditional and conditional own-price elasticities for almond milk and lactose-free milk are very close in these three research, while fluid milk and flavored fluid milk has become more elastic. We also found that the unconditional and conditional income elasticities for all the beverages are very stable from 2008 to 2014.

CHAPTER V

CONCLUSIONS AND IMPLICATIONS

The fluid alternative beverage market in the United States has been evolving while the market penetration of fluid milk has been decreasing rapidly during the past decade and a half. Using Nielsen Homescan panel data for household purchase of beverages and associated demographic variables for calendar year 2013, we estimated the demand for almond milk, soymilk, coconut milk, fluid milk, flavored fluid milk, lactose-free milk and flavored lactose-free milk. Due to the existence of non-purchase observation or the censored data set, we used Tobit model (Tobin, 1958) to identify unconditional and conditional factors affecting the consumption of these beverages. Moreover, we calculated unconditional and conditional own-price, cross-price and income price elasticities for each beverage. Based on the elasticities calculated, we can determine whether the beverages are substitutes or complements in consumption.

Main Conclusions

We found that household income is a significant economic factor determining demand for all the seven beverages. The price of the beverage itself is also a significant economic factor for the demand for each beverage. Demographic factors such as age of household head and employment status are significant factors for demand of all the beverages except for flavored fluid milk and flavored lactose-free milk. Education and race are significant drivers for all the beverages except for flavored lactose-free milk. Hispanic-origin is a significant factor determining demand for almond milk, soymilk, coconut milk and lactose-free milk. Region of the households is a significant driver for

all the seven beverages. Age and presence of children is not a significant factor affecting the demand for fluid milk alternative beverages, however it is a significant driver for fluid milk.

As expected, the own-price elasticities of demand are negative for all beverages. The cross-price elasticities found in this research indicate that almond milk, soymilk and flavored lactose-free milk are gross complements for coconut milk and fluid milk is a gross substitute for coconut milk. The cross-price elasticities of almond milk show that coconut milk, almond milk and soymilk are gross complements for almond milk and flavored fluid milk is a gross substitute for almond milk. Furthermore, almond milk demonstrates gross complementary behavior with soymilk. Coconut milk, almond milk, soymilk and lactose-free show gross substitutability towards fluid milk category. All the three fluid milk alternative beverages and lactose-free milk are substitutes for fluid milk. Fluid milk is a gross complement for flavored fluid milk and lactose-free milk while fluid milk is a substitute good for coconut milk and flavored lactose-free milk. Coconut milk, fluid milk and flavored lactose-free milk show gross complementary behavior with lactose-free milk. Moreover, coconut milk, soymilk and lactose-free milk indicate complementary behavior with flavored lactose-free milk as well.

Potential Implications

Beverage manufacturers and marketers can use the economic and demographic findings of demand concerning fluid milk alternative beverages to target these beverages to existing and potential customers. Demand elasticities of fluid milk alternative beverages can be used by researchers to enrich existing fluid milk and/or dairy sector market models in the United States. This thesis is the first in the literature to

scientifically investigate consumer demand for coconut milk in the United States and derive respective own-price cross-price and income elasticities.

Future research in this area include: (a) using the elasticity estimates to simulate the welfare effects of fluid milk farmers in the United States in the event of a change in demand for fluid milk alternative beverage marketplace; (b) shed light on pricing strategies at different levels of supply chain for fluid milk alternative beverages.

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APPENDIX A

DEMOGRAPHIC VARIABLES

Table 13 SAS Code for Each Demographic Variable

Variable	Code
Age of household head 25-29	agehh2529
Age of household head 30-34	agehh3034
Age of household head 35-44	agehh3544
Age of household head 45-54	agehh4554
Age of household head 55-64	agehh5564
Age of household head >65	agehhgt64
Employment status part-time	emphhpt
Employment status full-time	emphhft
Education: high school	eduhhs
Education: undergraduate	eduhhu
Education: post-college	eduhhpc
Black	black
Asian	asian
Other	other
Hispanic	hisp_yes
New England	newengland
Middle Atlantic	middleatlantic
East North Central	eastnorthcentral
West North Central	westnorthcentral
South Atlantic	southatlantic
East South Central	eastsouthcentral
West South Central	westsouthcentral
Mountain	mountain
Children less than 6 years	aclt6_only
Children 6-12 years	ac6_12only
Children 13-17 years	ac13_17only
Children < 6 & 6-12 years	aclt6_6_12only
Children <6 & 13-17years	aclt6_13_17only
Children 6-12 & 13-17 years	ac6_12and13_17only
Children <6 & 6-12 & 13-17	aclt6_6_12and13_17only

APPENDIX B

SAS CODE

1. Almond milk

```
*price imputation auxilliary regression for Almond milk;
proc reg data=AAEA.ALM2014_1;
model ALM_P=hinc hsize NewEngland MiddleAtlantic EastNorthCentral
WestNorthCentral SouthAtlantic EastSouthCentral WestSouthCentral
Mountain;
run;
data AAEA.ALM2014_2; set AAEA.ALM2014_1;
if (Total_ALM_oz ne 0 or Total_ALM_exp ne 0) then
ALM_P_2=Total_ALM_exp/Total_ALM_oz;
if (Total_ALM_oz =0 or Total_ALM_exp = 0)
then ALM_P_2=0.05744 + 0.00001247*hinc -
0.00056142*hsize+0.00210*NewEngland+0.00073172*MiddleAtlantic -
0.00245*EastNorthCentral-0.00080775*WestNorthCentral-
0.00316*SouthAtlantic -0.00021842*EastSouthCentral-
0.00146*WestSouthCentral-0.00139*Mountain;
run;
*Following is the tobit model for Almond milk;
Proc QLIM data=AAEA.all_drinks_Tobit ndraw=250 seed=55;
model Q_ALM= lp_ALM_2 lp_soy_2 lp_CT_2 lp_White_2 lp_WF_2 lp_LF_2
lp_LFF_2
linc agehh2529 agehh3034 agehh3544 agehh4554 agehh5564 agehhgt64
emphhpt emphhft eduhhhs eduhhu eduhhpc
NewEngland MiddleAtlantic EastNorthCentral WestNorthCentral
SouthAtlantic EastSouthCentral WestSouthCentral Mountain
black asian other hisp_yes aclt6_only ac6_12only ac13_17only
aclt6_6_12only aclt6_13_17only ac6_12and13_17only aclt6_6_12and13_17;
endogenous Q_ALM ~ censored(lowerbound=0);
nloptions maxiter=500; /*maximum number of iterations set at 300*/

output out=AAEA.ALM_Tobit_output conditional expected marginal xbeta;
run;
```

2. Soymilk

```
*price imputation auxilliary regression for Soymilk;
proc reg data=AAEA.SOY2014_1;
model SOY_P=hinc hsize NewEngland MiddleAtlantic EastNorthCentral
WestNorthCentral SouthAtlantic EastSouthCentral WestSouthCentral
Mountain;
run;
data AAEA.SOY2014_2; set AAEA.SOY2014_1;
if (Total_SOY_oz ne 0 or Total_SOY_exp ne 0) then
SOY_P_2=Total_SOY_exp/Total_SOY_oz;
if (Total_SOY_oz =0 or Total_SOY_exp = 0)
then SOY_P_2=0.05541 + 0.00004090*hinc -0.00086110*hsize-
0.00142*NewEngland+0.00055756*MiddleAtlantic -0.00192*EastNorthCentral-
```

```
0.00257*WestNorthCentral-0.00331*SouthAtlantic -
0.00426*EastSouthCentral-0.00561*WestSouthCentral-0.00171*Mountain;
run;
*Following is the tobit model for Soymilk;
Proc QLIM data=AAEA.all_drinks_Tobit ndraw=250 seed=55;
model Q_Soy= lp_ALM_2 lp_soy_2 lp_CT_2 lp_White_2 lp_WF_2 lp_LF_2
lp_LFF_2 linc agehh2529 agehh3034 agehh3544 agehh4554 agehh5564
agehhgt64 emphhpt emphhft eduhhhs eduhhu eduhhpc
NewEngland MiddleAtlantic EastNorthCentral WestNorthCentral
SouthAtlantic EastSouthCentral WestSouthCentral Mountain
black asian other hisp_yes aclt6_only ac6_12only ac13_17only
aclt6_6_12only aclt6_13_17only ac6_12and13_17only aclt6_6_12and13_17;
endogenous Q_SOY ~ censored(lowerbound=0);
nloptions maxiter=500; /*maximum number of iterations set at 300*/
output out=AAEA.SOY2_Tobit_output conditional expected marginal xbeta;
run;
```

3. Coconut Milk

```
*price imputation auxilliary regression for coconut milk;
proc reg data=AAEA.CT2014_1;
model CT_P=hinc hsize NewEngland MiddleAtlantic EastNorthCentral
WestNorthCentral SouthAtlantic EastSouthCentral WestSouthCentral
Mountain;
run;
data AAEA.CT2014_2; set AAEA.CT2014_1;
if (Total_CT_oz ne 0 or Total_CT_exp ne 0) then
CT_P_2=Total_CT_exp/Total_CT_oz;
if (Total_CT_oz =0 or Total_CT_exp = 0)
then CT_P_2=0.08959 + 0.00016923*hinc + 0.00041279*hsize-
0.00291*NewEngland+0.00099389*MiddleAtlantic+0.00239*EastNorthCentral+0
.00323*WestNorthCentral-0.00613*SouthAtlantic -
0.00630*EastSouthCentral-0.00652*WestSouthCentral-0.00399*Mountain;
run;

*Following is the tobit model for Coconut milk;
Proc QLIM data=AAEA.all_drinks_Tobit ndraw=250 seed=55;
model Q_CT= lp_ALM_2 lp_soy_2 lp_CT_2 lp_White_2 lp_WF_2 lp_LF_2
lp_LFF_2
linc agehh2529 agehh3034 agehh3544 agehh4554 agehh5564 agehhgt64
emphhpt emphhft eduhhhs eduhhu eduhhpc NewEngland MiddleAtlantic
EastNorthCentral WestNorthCentral SouthAtlantic EastSouthCentral
WestSouthCentral Mountain
black asian other hisp_yes aclt6_only ac6_12only ac13_17only
aclt6 6 12only aclt6 13 17only ac6 12and13_17only aclt6_6_12and13_17;
endogenous Q_CT ~ censored(lowerbound=0);
nloptions maxiter=500; /*maximum number of iterations set at 300*/
output out=AAEA.CT_Tobit_output conditional expected marginal xbeta;
run;
```

4. Dairy Milk

```
*price imputation auxilliary regression for dairy milk;
proc reg data=AAEA.White2014_1;
```

```
model White_P=hinc hsize NewEngland MiddleAtlantic EastNorthCentral
WestNorthCentral SouthAtlantic EastSouthCentral WestSouthCentral
Mountain;
run;
data AAEA.White2014_2; set AAEA.White2014_1;
if (Total_White_oz ne 0 or Total_White_exp ne 0) then
White_P_2=Total_White_exp/Total_White_oz;
if (Total_White_oz =0 or Total_White_exp = 0)
then White_P_2=0.03846 + 0.00003092*hinc -0.00196*hsize-
0.00141*NewEngland-0.00015371*MiddleAtlantic -0.00720*EastNorthCentral-
0.00317*WestNorthCentral+0.00174*SouthAtlantic -
0.00195*EastSouthCentral-0.00211*WestSouthCentral-0.00731*Mountain;
run;
*Following is the tobit model for Dairy milk;
Proc QLIM data=AAEA.all_drinks_Tobit ndraw=250 seed=55;
model Q_White= lp_ALM_2 lp_soy_2 lp_CT_2 lp_White_2 lp_WF_2 lp_LF_2
lp_LFF_2 linc agehh2529 agehh3034 agehh3544 agehh4554 agehh5564
agehhgt64 emphhpt emphhft eduhhhs eduhhu eduhhpc
NewEngland MiddleAtlantic EastNorthCentral WestNorthCentral
SouthAtlantic EastSouthCentral WestSouthCentral Mountain
black asian other hisp_yes aclt6_only ac6_12only ac13_17only
aclt6_6_12only aclt6_13_17only ac6_12and13_17only aclt6_6_12and13_17;
endogenous Q_White ~ censored(lowerbound=0);
nloptions maxiter=500; /*maximum number of iterations set at 300*/
output out=AAEA.White_Tobit_output conditional expected marginal xbeta;
run;
```

5. Flavored Dairy Milk

```
*price imputation auxilliary regression for flavored dairy;
proc reg data=AAEA.WF2014_1;
model WF_P=hinc hsize NewEngland MiddleAtlantic EastNorthCentral
WestNorthCentral SouthAtlantic EastSouthCentral WestSouthCentral
Mountain;
run;
data AAEA.WF2014_2; set AAEA.WF2014_1;
if (Total_WF_oz ne 0 or Total_WF_exp ne 0) then
WF_P_2=Total_WF_exp/Total_WF_oz;
if (Total_WF_oz =0 or Total_WF_exp = 0)
then WF_P_2=0.06174 + 0.00002362*hinc -0.00183*hsize-
0.00040646*NewEngland-0.00471*MiddleAtlantic -0.01552*EastNorthCentral-
0.01255*WestNorthCentral-0.00218*SouthAtlantic -
0.00644*EastSouthCentral-0.00142*WestSouthCentral-0.00113*Mountain;
run;
*Following is the tobit model for Flavored Dairy milk;
Proc QLIM data=AAEA.all_drinks_Tobit ndraw=250 seed=55;
model Q_WF= lp_ALM_2 lp_soy_2 lp_CT_2 lp_White_2 lp_WF_2 lp_LF_2
lp_LFF_2
linc agehh2529 agehh3034 agehh3544 agehh4554 agehh5564 agehhgt64
emphhpt emphhft eduhhhs eduhhu eduhhpc NewEngland MiddleAtlantic
EastNorthCentral WestNorthCentral SouthAtlantic EastSouthCentral
WestSouthCentral Mountain
```

```
black asian other hisp_yes aclt6_only ac6_12only ac13_17only
aclt6_6_12only aclt6_13_17only ac6_12and13_17only aclt6_6_12and13_17;
endogenous Q_WF ~ censored(lowerbound=0);
nloptions maxiter=500; /*maximum number of iterations set at 300*/
output out=AAEA.WF_Tobit_output conditional expected marginal xbeta;
run;
```

6. Lactose-free Milk

```
*price imputation auxilliary regression for lactose-free milk;
proc reg data=AAEA.LF2014_1;
model LF_P=hinc hsize NewEngland MiddleAtlantic EastNorthCentral
WestNorthCentral SouthAtlantic EastSouthCentral WestSouthCentral
Mountain;
run;
data AAEA.LF2014_2; set AAEA.LF2014_1;
if (Total_LF_oz ne 0 or Total_LF_exp ne 0) then
LF_P_2=Total_LF_exp/Total_LF_oz;
if (Total_LF_oz =0 or Total_LF_exp = 0)
then LF_P_2=0.06159 + 0.00003211*hinc -0.00068309*hsize-
0.00142*NewEngland-0.00058481*MiddleAtlantic-0.00744*EastNorthCentral-
0.00530*WestNorthCentral-0.00607*SouthAtlantic -
0.00847*EastSouthCentral-0.01153*WestSouthCentral-0.00422*Mountain;
run;
*Following is the tobit model for lactose-free milk;
Proc QLIM data=AAEA.all_drinks_Tobit ndraw=250 seed=55;
model Q_LF= lp_ALM_2 lp_soy_2 lp_CT_2 lp_White_2 lp_WF_2 lp_LF_2
lp_LFF_2
linc agehh2529 agehh3034 agehh3544 agehh4554 agehh5564 agehhgt64
emphhpt emphhft eduhhhs eduhhu eduhhpc NewEngland MiddleAtlantic
EastNorthCentral WestNorthCentral SouthAtlantic EastSouthCentral
WestSouthCentral Mountain
black asian other hisp_yes aclt6_only ac6_12only ac13_17only
aclt6_6_12only aclt6_13_17only ac6_12and13_17only aclt6_6_12and13_17;
endogenous Q_LF ~ censored(lowerbound=0);
nloptions maxiter=500; /*maximum number of iterations set at 300*/
output out=AAEA.LF_Tobit_output conditional expected marginal xbeta;
run;
```

7. Flavored Lactose-free Milk

```
*price imputation auxilliary regression for flavored lactose free milk;
proc reg data=AAEA.LFF2014_1;
model LFF_P=hinc hsize NewEngland MiddleAtlantic EastNorthCentral
WestNorthCentral SouthAtlantic EastSouthCentral WestSouthCentral
Mountain;
run;
data AAEA.LFF2014_2; set AAEA.lFF2014_1;
if (Total_LFF_oz ne 0 or Total_LFF_exp ne 0) then
LFF_P_2=Total_LFF_exp/Total_LFF_oz;
if (Total_LFF_oz =0 or Total_LFF_exp = 0)
then LFF_P_2=0.07155 -0.00000824*hinc
+0.00024517*hsize+0.00893*NewEngland-0.00060240*MiddleAtlantic
+0.00121*EastNorthCentral+0.00980*WestNorthCentral-
```

```
0.00568*SouthAtlantic -0.01256*EastSouthCentral-
0.00659*WestSouthCentral-0.00296*Mountain;run;
proc means data=AAEA.LFF2014_3;
var LFF_P_3 Q_LFF D_LFF;
run;
*Following is the tobit model for Flavored lactose-free milk;
Proc QLIM data=AAEA.all_drinks_Tobit ndraw=250 seed=55;
model Q_LFF= lp_ALM_2 lp_soy_2 lp_CT_2 lp_White_2 lp_WF_2 lp_LF_2
lp_LFF_2
linc agehh2529 agehh3034 agehh3544 agehh4554 agehh5564 agehhgt64
emphhpt emphhft eduhhhs eduhhu eduhhpc NewEngland MiddleAtlantic
EastNorthCentral WestNorthCentral SouthAtlantic EastSouthCentral
WestSouthCentral Mountain
black asian other hisp_yes aclt6_only ac6_12only ac13_17only
aclt6 6 12only aclt6 13 17only ac6 12and13_17only aclt6_6_12and13_17;
endogenous Q_LFF ~ censored(lowerbound=0);
nloptions maxiter=500; /*maximum number of iterations set at 300*/
output out=AAEA.LFF_Tobit_output conditional expected m
```