DEMAND ANALYSIS CONCERNING THE PROMISED LAND WHITE AND CHOCOLATE MILK BRANDS IN TEXAS

A Thesis

by

DAVID ELDON BINGHAM

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Approved by:

Chair of Committee,	Oral Capps, Jr.
Committee Members,	Victoria Salin
	Clair Nixon
	Senerath Dharmasena
Head of Department,	C. Parr Rosson III

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ABSTRACT

This thesis provides a unique perspective to the milk market relative to previous studies. While there is rich literature on the various sectors of the milk market, a contribution to this literature was made by providing a specific econometric analysis of the Promised Land brand. Previous work conducted by Capps and Salin (2010) provided the foundation for this thesis. The purpose of this thesis was threefold:

1. Estimate household demand functions for Promised Land white and chocolate milk using Nielsen homescan data. The demand functions were estimated using a tobit model to estimate the conditional and unconditional own-price and cross-price effects of Promised Land white and chocolate milk.
2. Assess the impacts of household demographic drivers of demand for Promised Land white and chocolate milk.
3. Use the empirical results derived from the tobit model to identify substitutes and complements of Promised Land white and chocolate milk and provide a profile of households that purchase Promised Land white and chocolate milk.

The study concluded that households who purchased Promised Land white were insensitive to changes in the price of Promised Land white milk. The price of private label milk was the only cross-price that was significant in the quantity of Promised Land white milk purchased. The estimated elasticities showed that Promised Land white milk and private label white milk were substitutes.

From the estimated elasticities, it was found that households that purchased Promised Land chocolate milk were largely insensitive to changes in the price of Promised Land chocolate milk. It was also found that the prices of Nesquick, Oak Farms, and private label chocolate milk had a significant effect on the quantity of Promised Land chocolate milk purchased. Of these significant prices, private label and Oak Farms chocolate milk were substitutes for Promised Land chocolate milk. The price of Nesquick chocolate milk demonstrated a complementary relationship with Promised Land chocolate milk.

DEDICATION

To my wonderful family who are the cause I fight for and the reason I strive and excel.

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I would like to thank my committee chair and mentor, Drs. Oral Capps, Jr. and Senerath Dharmasena, who were indespensable to my research. I would also like to acknowledge my committee members, Drs. Victoria Salin and Clair Nixon, for their guidance and support throughout the course of this research.

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TABLE OF CONTENTS

LIST OF FIGURES

LIST OF TABLES

CHAPTER I

INTRODUCTION

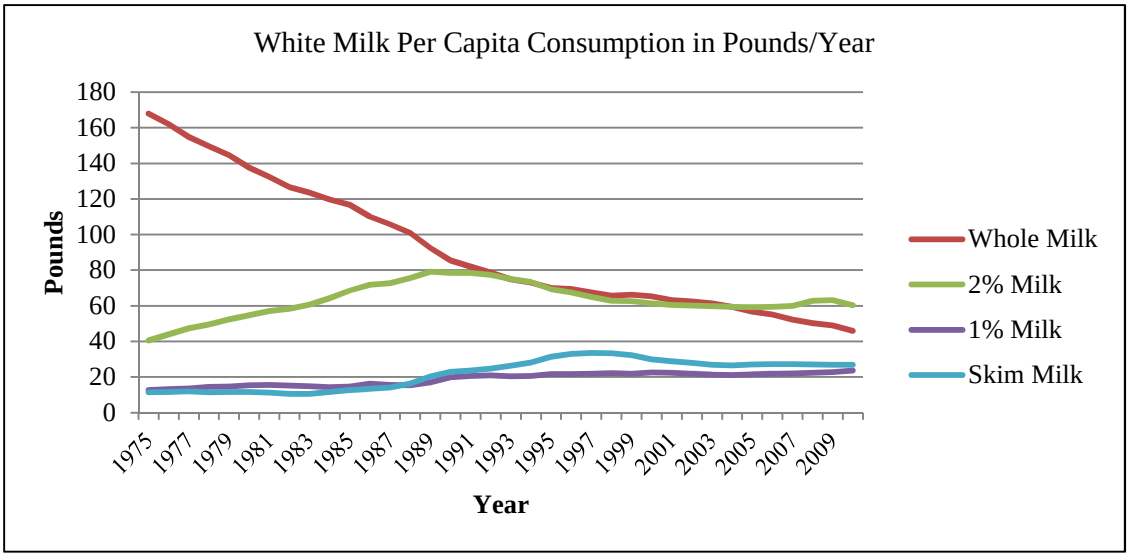
Milk is a commodity that is directly linked to the human experience. In infancy, it is milk that provides the essential nutrients to a child's development. When America was largely a farming nation and clean drinking water was difficult to find, milk was a cornerstone of consumption. However, as markets and society evolved, milk consumption drastically decreased in the United States. This change in milk consumption largely occurred over the past 40 years.

A report by the U.S. Department of Agriculture (USDA 2011) revealed that many individuals have completely cut fluid milk out of their regular consumption. The study compared the percentages of individuals consuming any form of fluid milk by age group from 1977-1978 to 2005-2006. The percentage of children consuming any form of fluid milk from ages 2 to 11 decreased from just over 90% in 1977-1978 to 80% in 2005-2006. The consumption of fluid milk by adolescents, ages 12 to 19, dropped 32% from 76% in 1977-1978 to 48% in 2005-2006. Only 43% of middle-aged adults, ages 20 to 49, consumed any form of fluid milk in 2005-2006 compared to 55% in 1977-1978. The consumption of fluid milk by individuals over 50 also decreased from 65% to 50% over this timeframe. Finally, only 50% of the fluid milk consumed in 2005-2006 was white milk consumed as a beverage, while the other 50% was either white milk consumed with cereal, flavored milk, or milk added to another drink.

Not only had the percentage of individuals drinking fluid milk decreased, but the quantity each individual drinks was also decreasing. Figure 1 shows that per capita white milk consumption decreased notably from 1975 to 2010. Whole milk per capita consumption decreased the most, falling from 168 pounds/year in 1975 to 46 pounds/year in 2010 (a 72% drop). One factor in the decline of whole milk consumption was the change in consumer preferences away from high-fat milk to low-fat and fat-free milk. Per capita consumption of all low-fat and fat-free milks increased from 1975 to 2010. The underlying reason for the change in consumer milk fat preferences was likely health related. Several state and federal government initiatives recommended switching from high-fat fluid milk to low-fat or fat-free fluid milk as a way to improve health.

In the U.S. Department of Health and Human Services (2010) release of new dietary guidelines, because "Americans are experiencing an epidemic of overweight and obseity," (p. 2) people are encouraged to switch from high-fat to low-fat milk or fat-free milk. Despite the change in milk-fat preferences, overall per capita consumption of white fluid milk was down 32% from 1975 to 2010. One key factor in the decrease of per capita milk consumption was the growing number of substitutes in the non-alcoholic beverage market, specifically the growth of the soft drink industry (Dharmasena 2010; Harnack, Stang, and Story 1999).

The changes in consumer milk-fat preferences have been studied extensively by Cornick, Cox, and Gould (1994) and Gould (1996). Articles illustrating the effects of advertising on milk consumption (Capps and Schmitz 1991; Kinnucan 1986) and consumer milk-fat preferences include (Kaiser 1997; Kaiser and Reberte 1996).



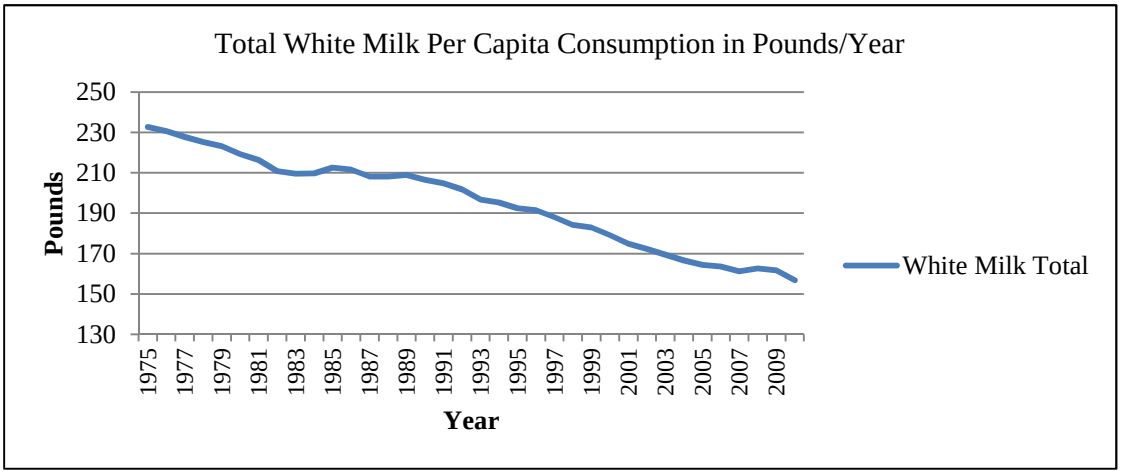


Figure 1. White milk per capita consumption from 1975 to 2010.
Source. USDA (2011).

Flavored milk is a growing presence in the milk market and has been touted as an effective way for children to acquire the nutrients in milk. Total per capita consumption of flavored milk (figure 2) has increased 61% from 1975 to 2010. While whole flavored

milk per capita consumption dropped 70% from 6.3 pounds/year 1975 to 1.8 pounds/year in 2010, low-fat flavored milk per capita consumption rose dramatically from 3.3 pounds/year in 1975 to 13.7 pounds/year in 2010, representing a 309% increase. However, chocolate milk recently encountered perception problems with regard to obesity. An article illustrated how a California school district banned flavored milk from its schools:

> The proposal by Superintendent John Deasy [to ban flavored milk] came on the heels of months of criticism by British TV chef and obesity advocate, Jamie Oliver, who said flavored milks contain the sugar equivalent of a candy bar. In a stunt on his ABC show "Food Revolution," he filled a school bus with sand to represent the amount of added sugar students in Los Angeles drink in a year through flavored milk. (Jaslow 2011, pp. 2-3)

It is noteworthy that research regarding flavored milk demand preferences remains largely unexplored.

An additional dimension to the milk market that has gained traction over the past 20 years is the organic milk market. Organic production is growing in popularity due to the high premiums producers receive for their products, sometimes as high as 40% (Valley 2005). The organic industry has seen remarkable growth in the past decade**.** In 2007, organic milk production grew by 25%, and sales totaled $1.3 billion. However, since the start of the recession, the industry has essentially stopped growing and is predicted to contract by 5% in the near term (Schultz 2011).

Alviola and Capps (2010) provided own-price and cross-price elasticities between conventional and organic milk along with the demographic drivers of demand. They found that organic and conventional milk were substitutes, and the quantity of

organic milk purchased was responsive to changes in income, while conventional milk was not.

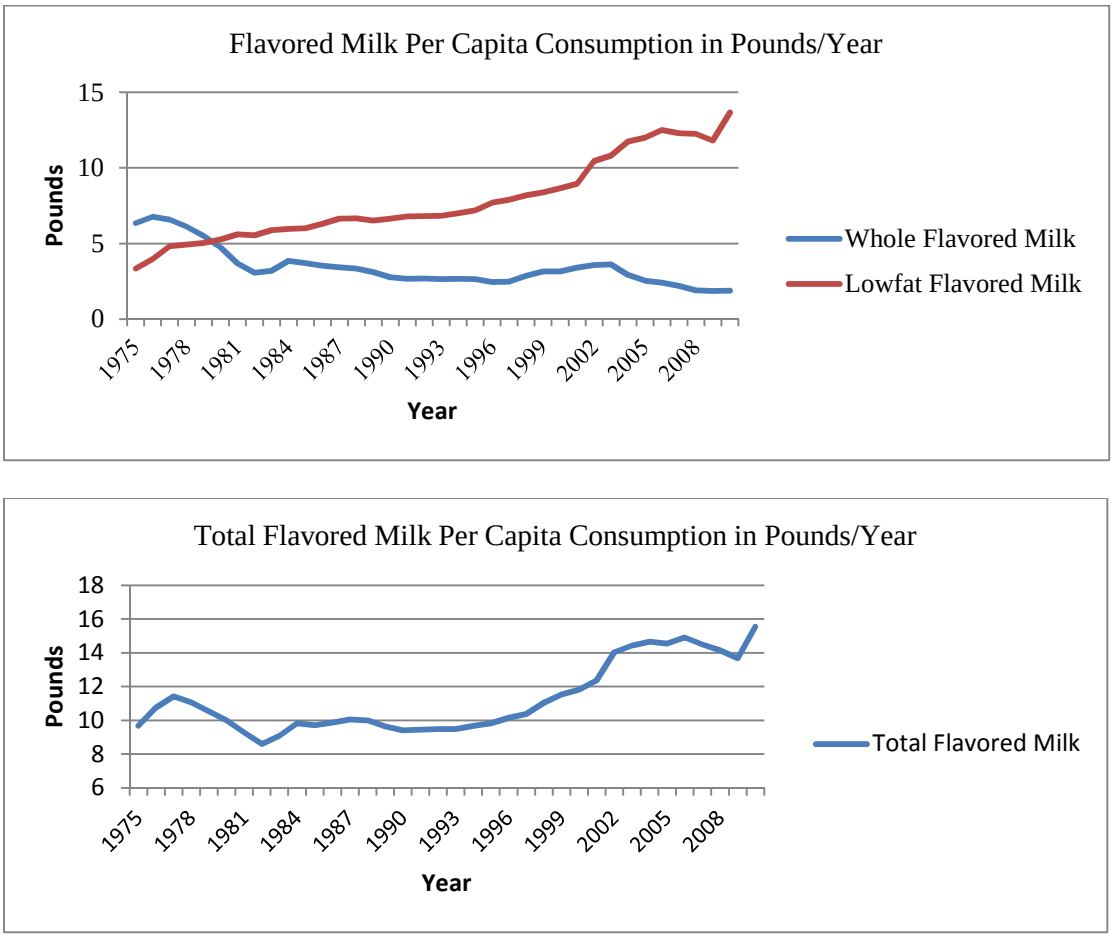


Figure 2. Flavored milk per capita consumption from 1975 to 2010.
Source. USDA (2011).

Another facet to the milk market provides an additional layer of complexity, namely the numerous milk brands. Not only does a consumer make a decision to purchase low-fat vs. whole milk or organic milk vs. conventional milk, but also which brand to purchase. However, there is little research surrounding brand preferences.

Purpose of This Study

This thesis provides a unique perspective to the milk market relative to previous studies. While there is a rich literature on the various sectors of the milk market, a contribution has been made to this literature by providing a specific econometric analysis of the Promised Land brand. Previous work conducted by Capps and Salin (2010) provided the foundation for this thesis; the Capps and Salin study provided "economic analysis relevant to the development of advertising and positioning strategies for Promised Land brand milk" (p. 1). Brand specific milk studies largely have been ignored in the literature, partially because of the difficulty in obtaining proprietary data. However, with the use of Nielsen Homescan Panel data, this hurdle was bypassed.

The thesis has a threefold objective:

1. Estimate household demand functions for Promised Land white and chocolate milk using Nielsen homescan data. The demand functions were estimated using a tobit model to estimate the own-price and cross-price effects of Promised Land white and chocolate milk. The censored nature of the Nielsen homescan data together with the use of the tobit model allowed the estimation of both the conditional and unconditional price effects and demographic affects. The inclusion of the chocolate milk demand function addressed an important aspect of fluid milk analysis that is largely unexplored. Although flavored milk is not consumed as much or frequently as white milk, the amount of per capita flavored milk consumed is growing.

2. Assess the impacts of household demographic drivers of demand for Promised Land white and chocolate milk. The demographic variables utilized in this thesis were very similar to those used by Alviola and Capps (2010) and Capps and Salin (2010). These include: income, household size, and the age and presence of children. These variables are also found in the Nielsen homescan data.
3. Use the empirical results derived from the tobit model to identify substitutes and complements of Promised Land white and chocolate milk and provide a profile of households that purchase Promised Land white and chocolate milk. This analysis allows competitive pricing strategies for Promised Land white and chocolate milk as well.

Promised Land Dairy History

The Promised Land Dairy began in 1987 with a family-owned farm in Floresville, Texas. The two cornerstones of the Promised Land Dairy brand were the selection and treatment of their milk cows and the quality of their product. Promised Land Dairy only used jersey cows in their herd, which they hailed as the "the cream of the crop as far as dairy cows are concerned" (Promised Land Milk n.d., p. 1). They also refrained from injecting hormones or antibiotics into the herd to keep the product as natural as possible. In fact Promised Land Dairy went so far as to promote their herd as "happy" and "pampered" (Promised Land Milk n.d.). The fluid milk they bring to market is known for its rich taste and fresh quality.

Promised Land Dairy also has expanded a line of flavored milks with chocolate and strawberry as the most common. Promised Land had also created several seasonal flavors such as Marvelous Mocha, Mooberry Blueberry, Double Cream White Chocolate, Egg Nog, Peaches N Cream, Creamy Dreamy Orange, Cinnamon Vanilla, and Chocolate Egg Nog (Promised Land Milk n.d.). In 2009, Promised Land Dairy was acquired by Lala USA, a subsidiary of the Mexican-based Groupo Lala. Lala USA expanded rapidly by purchasing National Dairy and Farm Land Dairies in 2009. In 2011 Lala USA also purchased Borden Dairy and changed the name of Groupo's American subsidiary from Lala USA to Borden Dairy Co. (Hoovers 2011).

Literature Review

The objective of reviewing current and past literature was to establish the foundational basis of this study and to provide sufficient precedent to use the data and estimation methods for this study. The precedence used for the model development including the demographic variables to be included in this study is mentioned in the model development section.

Foundational Basis

Capps and Salin (2010) provided the foundational basis for this study. This study concluded that the own-price elasticity for Promised Land white and chocolate milk is -1.74 and -0.36, respectively. The majority of respondents who purchased Promised Land milk also purchased other milk brands. Demographic factors such as income, household size, and the age and presence of children were factors associated with the purchase of Promised Land milk. The limitations to this study were fourfold: (a) the

prices of other brands were not included in the demand analysis, (b) no analysis was done concerning complements or substitutes for Promised Land milk, (c) the own-price elasticities recorded were limited to conditional elasticities rather than including both conditional and unconditional elasticities, and (d) no consideration was given as to the import of demographics on sales (Capps and Salin 2010). This thesis addressed each of these limitations.

Data Precedent

Nielsen homescan data have become increasingly popular in economic research, because it ties household demographic variables to individual household purchases. Capps and Salin (2010) used Nielsen's (2008) panel data to estimate the own-price elasticities for Promised Land white and chocolate milk. The same data set was used in this analysis. Alviola and Capps (2010) conducted a study using Nielsen homescan data identifying the demographic drivers in purchasing organic fluid milk. Dimitri and Venezia (2007) used Nielsen homescan data to provide a demographic profile of the typical organic milk buyer. A more complete description of the 2008 Nielsen panel data will be presented in Chapter II.

Estimation Methodology Precedent

The tobit model was employed to estimate conditional and unconditional own-price and cross-price elasticities as well as marginal effects with respect to demographic variables. Previous studies have used a tobit model in order to overcome the censoring issue, when respondents record a zero for quantity purchased. Cornick, Cox, and Gould (1994) used a multivariate tobit model to overcome censored responses in their analysis

of milk consumption. Wang, Halbrendt, and Kolodinsky (1997) used a tobit model in order estimate the willingness to pay for rBST-free milk.

Overview of Data and Statistical Methods

The data that were used in this analysis was Nielsen's 2008 Homescan Panel data. Capps and Salin (2010) focused on the brand's "home region," which is defined as Texas and the Southeastern states of the United States. Promised Land's home region accounted for over 90% of households that purchased Promised Land Milk in the United States. Although the home region accounted for such an overwhelming majority of households that purchased Promised Land, the market penetration in the home region was very small. Analysis of Nielsen's 2008 Homescan Panel data revealed that the state of Texas accounted for 78% of all households that purchased the Promised Land brand in the United States. However, only 5% of Texas households who recorded white milk purchases purchased Promised Land milk over the course of 2008.

The city of Houston accounted for one third of total Promised Land sales; other major markets also were located in Texas. As for chocolate milk, 73.8% of all households who purchased Promised Land chocolate milk were Texas households. About 28.7% of the 1,023 households recording chocolate milk purchases in 2008 were for the Promised Land brand. The low market penetration translated into a data sample with a high number of respondents recording a zero for the quantity of Promised Land purchased. By limiting the sample size to Texas, a vast majority of respondents who purchased Promised Land were included, while minimizing the number of zero observations. The Tobit model (Tobin 1958) was used on the analysis due to the

presence of a large number of zero observations (a censored sample of observations). Conditional and unconditional effects were obtained through the use of McDonald and Moffitt's (1980) decomposition.

Thesis Overview

Chapter I presents the purpose of the study, history of Promised Land, literature review, overview of data and statistical methods followed by thesis overview. Chapter II discusses the development of the demand model, methodology, data description, and price imputation methodology. Chapter III presents the empirical results of the econometric analysis. Finally, Chapter IV summarizes the work, presents conclusions, and discusses limitations of the work and opportunities for additional research.

CHAPTER II

MODEL DEVELOPMENT

Two quantitative methods were used in this analysis. A regression analysis was used in order to impute missing prices attributed to zero expenditures or non-purchase of Promised Land Milk. This procedure ensured there were no zero observations in the explanatory or right-side variables. Once the prices were imputed, a tobit model was employed to estimate the own-price, cross-price, and demographic effects on the quantity of Promised Land white and chocolate milk purchased. The tobit model was used to overcome the econometric issues associated with the censored nature of the dependent variable or the quantity purchased.

Central to the purpose of any demand function is the effect of changes in price on the quantity purchased. Own-price effects measure how quantity will change with changes in its own price. In this case, the change is considered in the quantity purchased of Promised Land white and chocolate milk due to the change in the prices of Promised Land white and chocolate milk. Capps and Salin (2010) concluded that the own-price elasticities for Promised Land white and chocolate milk were -1.74 and -0.36, respectively. Similar conditional own-price elasticities in this study were expected. Cross-price effects illustrated how changes in the price of other goods changed the amount of Promised Land white and chocolate milk purchased. Through these cross-price effects, it was determined whether the other brands of milk were complements or

substitutes to Promised Land white and chocolate milk. The cross-price variables were chosen on the basis of market penetration among households in the Nielsen panel data.

This study used the demographic variables employed in Capps and Salin (2010) and in Alviola and Capps (2010). These variables included (a) household size, (b) income, (c) race and ethnicity, (d) age and presence of children, and (e) location within the state of Texas. Location accounted for the changes in awareness of the product and standard of living from one location to another.

Price Variables

The geography of this study was confined to the state of Texas, which encompasses over 90% of households that recorded a Promised Land purchase. The method for selecting the competing milk brands in the model was determined by market penetration. The brands with the highest number of households recording a purchase of that milk brand were included. This process was used twice, once for the white milk market and once for the chocolate milk market. The Texas sample comprised 4,578 households, and table 1 exhibits the market penetration for the top brands. In order to standardize prices through the different container sizes, prices were expressed in terms of dollars per ounce. These unit values were obtained by aggregating total expenditure and total ounces purchased over 2008 for each household, and then dividing the aggregate expenditure by total ounces purchased.

Table 1. Market Penetration of Top White and Chocolate Milk Brands in Texas in 2008

White Milk Brands	# of Households	% of Total White Milk Households
Borden	828	19.27
Oak Farms	911	21.20
Schepps	656	15.27
Promised Land	223	5.19
Poinsettia	830	19.32
Horizon Organic	298	6.94
Private Label	4,003	93.14
Chocolate Milk Brands	# of Households	% of Total Chocolate Milk Households
Borden	279	27.27
Oak Farms	155	15.15
Promised Land	294	28.74
Nestle Nesquick	244	23.85
Private Label	474	46.33

Note. 4,297 households recorded white milk purchases and 1,023 households recorded chocolate milk purchases
Source. Nielsen (2008).

Retailers will often market milk and other products under a brand that is owned by that particular retailer. For instance, Wal-Mart markets milk under the Great Value brand. This example constituted a private label brand, a brand not found outside of Wal-Mart. Great Value is only one of several private label brands. The Nielsen panel data set that was used lumped all of the private labels into one variable called "Private Label." Private label accounted for the largest number of households that recorded purchases for white and chocolate milk. About 4,003 out of the 4,297 households purchased private label white milk, and 474 out of the 1,023 households purchased private label chocolate milk. Hence, private label brands were bought by 93% of households purchasing white milk and 46% of households purchasing chocolate milk. Many households showed a willingness to supplement private label purchases with name brands of white milk. In

fact, 80% of white milk drinkers purchased a brand other than the private label brands in 2008. With regard to chocolate milk, there seemed to be less of a bundling effect. Private label chocolate milk represented less than half of total households that purchased chocolate milk and name brands were more popular. About 41% of households that recorded chocolate milk expenditures purchased more than one brand in 2008.

Oak Farms ranked second in the market penetration of white milk households with 21% of households that purchased white milk. Oak Farms had the least market penetration out of the included chocolate milk brands with a penetration of only 15% of households that purchased chocolate milk. Borden ranked third in market penetration for white milk and chocolate milk households. Eight hundred twenty-eight (828) households purchased Borden white milk, which represented 19% of all white milk households; 279 households purchased Borden chocolate milk, representing 27% of all chocolate milk households. Promised Land had a penetration of just over 5% of white milk households. However, Promised Land ranked second in the chocolate milk market, capturing close to 29% of chocolate milk drinkers.

All other brands were specific to only white milk or chocolate milk markets. Poinsettia penetrated 19% of white milk households, but did not have notable penetration in the chocolate milk area. Schepps was another brand that had notable market penetration in the white milk market, but did not have sufficient penetration in the chocolate milk market to be included. Horizon Organic, with a market penetration of close to 7%, had the largest market penetration of all organic white milk brands. The inclusion of an organic brand was meant to gain insight into the relationship between a

premium conventional white milk brand like Promised Land and a premium organic white milk brand. Nesquick had almost 24% of chocolate milk households, but did not have a white milk brand.

Once the price variables were selected, it was necessary to determine if collinearity existed among these variables. If the selected prices were highly correlated, then collinearity did not permit the disentangling of separate price effects. Table 2 displays the correlation matrix of the vetted prices. The correlation tables reveal that both the white and chocolate milk brands were not highly correlated with each other. As a result, collinearity was not an issue. Consequently, the white milk price variables used in the analysis were: Borden, Oak Farms, Poinsettia, Promised Land, Horizon Organic, Schepps, and private label brands (see table 3). The chocolate milk price variables used in the analysis were: Promised Land, Borden, Oak Farms, Nestle Nesquick, and private label brands (see table 3).

Table 2. Correlation Tables for White and Chocolate Milk Prices

White Milk Brand	Borden	Oak Farms	Schepps	Promised Land	Horizon Organic	Poinsettia	Private Label
Borden	1.000	0.223	0.403	0.184	0.351	0.194	0.272
Oak Farms	0.223	1.000	0.278	-0.070	0.103	0.239	0.231
Schepps	0.403	0.278	1.000	-0.079	0.217	0.248	0.305
Promised Land	0.184	-0.070	-0.079	1.000	0.367	-0.137	0.005
Horizon Organic	0.351	0.103	0.217	0.367	1.000	0.244	0.163
Poinsettia	0.194	0.239	0.248	-0.137	0.244	1.000	0.144
Private Label	0.272	0.231	0.305	0.005	0.163	0.144	1.000

Chocolate Milk Brand	CBorden	COak Farms	CPromised Land	CPrivate Label	Nestle Nesquick
CBorden	1.000	0.296	-0.028	0.088	-0.136
COak Farms	0.296	1.000	-0.048	-0.153	-0.099
CPromised Land	-0.028	-0.048	1.000	0.099	0.056
CPrivate Label	0.088	-0.153	0.099	1.000	0.024
Nestle Nesquick	-0.028	-0.099	0.056	0.024	1.000

Source. Nielsen (2008).

Table 3. Price Variable Names for White and Chocolate Milk

White Milk Brand	Variable Name
Promised Land	PromisedLand
Borden	Borden
Oak Farms	OakFarms
Horizon Organic	HorizonOrganic
Poinsettia	Poinsettia
Schepps	Schepps
Private Label	PrivateLabel
Chocolate Milk Brand	**Variable Name**
Promised Land	CPromisedLand
Borden	CBorden
Oak Farms	COakFarms
Nestle Nesquick	Nesquick
Private Label	CPrivateLabel

Source. Nielsen (2008).

Price Imputations

Prices (or unit values) in the Nielsen data were derived as the ratio of expenditures (measured in dollars) to quantities purchased (measured in ounces). If no purchases were recorded, it was not possible to directly derive the respective prices measured in dollars per ounce. In order to deal with missing price observations in the tobit analysis, a regression analysis was used to impute prices for those that were missing. This technique of overcoming censored prices was also used by Alviola and Capps (2010). Prices were estimated by regressing region, household size, and income on the prices of each brand in question. Only the missing prices were imputed. Household size and region were represented as dummy variables, and income was expressed as a continuous variable.

Region was used to impute prices to capture the variations in price with changes in location. The data set provided county information for each household. Region was divided into five areas: Houston, San Antonio, Dallas/Ft. Worth, Austin, and all other counties, with all other counties as the base variable. The Houston area included: Harris (the highest county sampled in Texas), Fort Bend, and Montgomery counties. The Dallas/Ft. Worth region included Dallas, Tarrant, Denton, and Collin counties. San Antonio was represented by Bexar County, and Austin was represented by Travis County. These four regions comprised 52.54% of total households represented in the Texas sample. Table 4 displays the location of the households by county. Dummy variables were used to delineate differences in the location within Texas.

Table 4. Households by County

County ID	County Name	# of Households	% of Total Households	Region
29	Bexar	379	8.28%	San Antonio
85	Collin	153	3.34%	Dallas
113	Dallas	324	7.08%	Dallas
121	Denton	131	2.86%	Dallas
157	Fort Bend	95	2.08%	Houston
201	Harris	701	15.31%	Houston
339	Montgomery	91	1.99%	Houston
439	Tarrant	305	6.66%	Dallas
453	Travis	226	4.94%	Austin
TOTAL		2,405	52.54%	

Source. Nielsen (2008).

Household size was represented by five dummy variables identified by the variable "HHSize." HHSize1 through HHSize4 represented household sizes that have 1 member to 4 members. HHSize5 represented all households that have 5 or more

members. HHSize5 was the base variable, so findings were compared relative to households with 5 or more members.

Income was the last variable used to impute missing prices. The income variable was a categorical variable with an arbitrary number representing each income range. In order to make the estimation easier, income was transformed into a continuous variable by taking the midpoint of each range.

The imputation equations used to estimate the censored white and chocolate milk prices are presented in figure 3 and figure 4. The prices for each brand were estimated in dollars per ounces. The variables: Houston, Dallas/Ft. Worth, Austin, and San Antonio identified the location of the household. The HHSize variable identified how many resided in the household, and the income variable represented annual household income. Table 5 and table 6 display the summary statistics for the imputed, non-imputed, and total market prices. The total market prices were used in the Tobit model to estimate quantities purchased of Promised Land milk.

$$Borden_{dolperoz} = \beta_1 + \beta_2(Houston) + \beta_3(San\ Antonio) + \beta_4(Dallas\ Ft\ Worth) + \beta_5\ (Austin) + \beta_6(HHsize1) + \beta_7(HHSize2) + \beta_8(HHSize3) + \beta_9(HHSize4) + \beta_{10}(Income) + e_1$$

$$HorizonOrganic_{dolperoz} = \beta_1 + \beta_2(Houston) + \beta_3(San\ Antonio) + \beta_4(Dallas\ Ft\ Worth) + \beta_5\ (Austin) + \beta_6(HHsize1) + \beta_7(HHSize2) + \beta_8(HHSize3) + \beta_9(HHSize4) + \beta_{10}(Income) + e_2$$

$$OakFarms_{dolperoz} = \beta_1 + \beta_2(Houston) + \beta_3(San\ Antonio) + \beta_4(Dallas\ Ft\ Worth) + \beta_5\ (Austin) + \beta_6(HHsize1) + \beta_7(HHSize2) + \beta_8(HHSize3) + \beta_9(HHSize4) + \beta_{10}(Income) + e_3$$

$$Schepps_{dolperoz} = \beta_1 + \beta_2(Houston) + \beta_3(San\ Antonio) + \beta_4(Dallas\ Ft\ Worth) + \beta_5\ (Austin) + \beta_6(HHsize1) + \beta_7(HHSize2) + \beta_8(HHSize3) + \beta_9(HHSize4) + \beta_{10}(Income) + e_4$$

$$Poinsettia_{dolperoz} = \beta_1 + \beta_2(Houston) + \beta_3(San\ Antonio) + \beta_4(Dallas\ Ft\ Worth) + \beta_5\ (Austin) + \beta_6(HHsize1) + \beta_7(HHSize2) + \beta_8(HHSize3) + \beta_9(HHSize4) + \beta_{10}(Income) + e_5$$

$$PromisedLand_{dolperoz} = \beta_1 + \beta_2(Houston) + \beta_3(San\ Antonio) + \beta_4(Dallas\ Ft\ Worth) + \beta_5\ (Austin) + \beta_6(HHsize1) + \beta_7(HHSize2) + \beta_8(HHSize3) + \beta_9(HHSize4) + \beta_{10}(Income) + e_6$$

$$PrivateLabel_{dolperoz} = \beta_1 + \beta_2(Houston) + \beta_3(San\ Antonio) + \beta_4(Dallas\ Ft\ Worth) + \beta_5\ (Austin) + \beta_6(HHsize1) + \beta_7(HHSize2) + \beta_8(HHSize3) + \beta_9(HHSize4) + \beta_{10}(Income) + e_6$$

Figure 3. Price imputation equations for white milk.

$$Borden_{dolperoz} = \beta_1 + \beta_2(Houston) + \beta_3(San\ Antonio) + \beta_4(Dallas\ Ft\ Worth) + \beta_5\ (Austin) + \beta_6(HHsize1) + \beta_7(HHSize2) + \beta_8(HHSize3) + \beta_9(HHSize4) + \beta_{10}(Income) + v_1$$

$$Nesquick_{dolperoz} = \beta_1 + \beta_2(Houston) + \beta_3(San\ Antonio) + \beta_4(Dallas\ Ft\ Worth) + \beta_5\ (Austin) + \beta_6(HHsize1) + \beta_7(HHSize2) + \beta_8(HHSize3) + \beta_9(HHSize4) + \beta_{10}(Income) + v_2$$

$$OakFarms_{dolperoz} = \beta_1 + \beta_2(Houston) + \beta_3(San\ Antonio) + \beta_4(Dallas\ Ft\ Worth) + \beta_5\ (Austin) + \beta_6(HHsize1) + \beta_7(HHSize2) + \beta_8(HHSize3) + \beta_9(HHSize4) + \beta_{10}(Income) + v_3$$

$$PromisedLand_{dolperoz} = \beta_1 + \beta_2(Houston) + \beta_3(San\ Antonio) + \beta_4(Dallas\ Ft\ Worth) + \beta_5\ (Austin) + \beta_6(HHsize1) + \beta_7(HHSize2) + \beta_8(HHSize3) + \beta_9(HHSize4) + \beta_{10}(Income) + v_4$$

$$PrivateLabel_{dolperoz} = \beta_1 + \beta_2(Houston) + \beta_3(San\ Antonio) + \beta_4(Dallas\ Ft\ Worth) + \beta_5\ (Austin) + \beta_6(HHsize1) + \beta_7(HHSize2) + \beta_8(HHSize3) + \beta_9(HHSize4) + \beta_{10}(Income) + v_5$$

Figure 4. Price imputation equations for chocolate milk.

Table 5. Summary Statistics of Imputed and Non-imputed White Milk Prices

Total Market	Description	Observations	Mean	Median	Std Dev	Min	Max
Borden	Price of Borden milk in dollars/ounces	4,578	0.0496	0.0472	0.0083	0.0138	0.1250
Oak Farms	Price of Oak Farms milk in dollars/ounces	4,578	0.0395	0.0391	0.0067	0.0186	0.124
Schepps	Price of Schepps milk in dollars/ounces	4,578	0.0437	0.0438	0.0073	0.0117	0.0931
Promised Land	Price of Promised Land milk in dollars/ounces	4,578	0.0592	0.0561	0.0078	0.0077	0.1305
Poinsettia	Price of Poinsettia milk in dollars/ounces	4,578	0.0291	0.0304	0.0028	0.0155	0.0514
Horizon Organic	Price of Horizon Organic milk in dollars/ounces	4,578	0.0540	0.0537	0.0029	0.0107	0.0834
Private Label	Price of Private Label milk in dollars/ounces	4,578	0.0304	0.0289	0.0066	0.0013	0.1138
Imputed Prices	Description	Observations	Mean	Median	Std Dev	Min	Max
Borden	Price of Borden milk in dollars/ounces	3,750	0.0463	0.0472	0.0052	0.0338	0.0602
Oak Farms	Price of Oak Farms milk in dollars/ounces	3,667	0.0388	0.0391	0.0039	0.0308	0.0473
Schepps	Price of Schepps milk in dollars/ounces	3,922	0.0430	0.0438	0.0046	0.0325	0.0519
Promised Land	Price of Promised Land milk in dollars/ounces	4,355	0.0576	0.0561	0.0063	0.0436	0.0711
Poinsettia	Price of Poinsettia milk in dollars/ounces	3,748	0.0300	0.0304	0.0018	0.0261	0.0328
Horizon Organic	Price of Horizon Organic milk in dollars/ounces	4,280	0.0531	0.0537	0.0021	0.0469	0.0565
Private Label	Price of Private Label milk in dollars/ounces	575	0.0305	0.0210	0.0018	0.0260	0.0327
Non-Imputed Prices	Description	Observations	Mean	Median	Std Dev	Min	Max
Borden	Price of Borden milk in dollars/ounces	828	0.0493	0.0484	0.0163	0.0138	0.1250
Oak Farms	Price of Oak Farms milk in dollars/ounces	911	0.0390	0.0348	0.0130	0.0186	0.1238
Schepps	Price of Schepps milk in dollars/ounces	656	0.0423	0.0386	0.0168	0.0117	0.0931
Promised Land	Price of Promised Land milk in dollars/ounces	223	0.0593	0.0541	0.0208	0.0077	0.1305
Poinsettia	Price of Poinsettia milk in dollars/ounces	830	0.0287	0.0280	0.0049	0.0155	0.0514
Horizon Organic	Price of Horizon Organic milk in dollars/ounces	298	0.0539	0.0547	0.0080	0.0107	0.0834
Private Label	Price of Private Label milk in dollars/ounces	4,003	0.0303	0.0284	0.0070	0.0013	0.1138

Source. Nielsen (2008) and calculations by the author.

Table 6. Summary Statistics of Imputed and Non-imputed Chocolate Milk Prices

Total Market	Description	Observations	Mean	Median	Std Dev	Min	Max
Borden	Price of Borden milk in dollars/ounces	4,578	0.0662	.0662	0.0056	0.0263	0.1271
Oak Farms	Price of Oak Farms milk in dollars/ounces	4,578	0.0674	.0676	0.0045	0.0056	0.1568
Nesquick	Price of Nesquick milk in dollars/ounces	4,578	0.0715	.0721	0.0060	0.0181	0.1844
Promised Land	Price of Promised Land milk in dollars/ounces	4,578	0.0760	.0751	0.0080	0.0056	0.1568
Private Label	Price of Private Label milk in dollars/ounces	4,578	0.0441	.0436	0.0048	0.0094	0.1244
Imputed Prices	Description	Observations	Mean	Median	Std Dev	Min	Max
Borden	Price of Borden milk in dollars/ounces	4,299	.0663	.0662	.0040	.0583	.0823
Oak Farms	Price of Oak Farms milk in dollars/ounces	4,423	.0676	.0676	.0030	.0610	.0721
Nesquick	Price of Nesquick milk in dollars/ounces	4,334	.0716	.0721	.0034	.0637	.0768
Promised Land	Price of Promised Land milk in dollars/ounces	4,284	.0761	.0751	.0059	.0595	.0851
Private Label	Price of Private Label milk in dollars/ounces	4,104	.0441	.0437	.0018	.0398	.0497
Non-Imputed Prices	Description	Observations	Mean	Median	Std Dev	Min	Max
Borden	Price of Borden milk in dollars/ounces	279	0.0640	.0610	0.0162	0.0263	0.127
Oak Farms	Price of Oak Farms milk in dollars/ounces	155	0.0629	.0613	0.0180	0.0155	0.1175
Nesquick	Price of Nesquick milk in dollars/ounces	244	0.0691	.0738	0.0216	0.0181	0.1844
Promised Land	Price of Promised Land milk in dollars/ounces	294	0.0744	.0721	0.0218	0.0056	0.1568
Private Label	Price of Private Label milk in dollars/ounces	474	0.0434	.0403	0.0140	0.0094	0.1244

Source. Nielsen (2008) and calculations by the author.

Demographic Variables

Capps and Salin (2010) and Alviola and Capps (2010) provided the basis for the demographic variables included in this study. These demographic variables are discussed in two sections, shopper variables and household variables. Both the white and chocolate milk models used the same demographic variables and the same variable names.

Shopper Variables

The shopper demographic variables allowed the model to identify the insights into the reasons consumers purchase a product. The specific shopper variables included in this model were age, race, and Hispanic origin.

The age variable illustrated linked various age groups to the consumption of Promised Land milk. The role of milk is likely to be different from one age group to the next. These groups were: ages 18 to 24, ages 25 to 29 years old, ages 30 to 34, ages 35 to 44, ages 45 to 54, ages 55 to 64, and ages above 64. The age group 18 to 24 represented only a few households in the Texas sample, so for this study age groups 18 to 24 and 25 to 29 will be combined into one age group. The base age group was ages under 30.

Race and Hispanic origin illustrated the role and uses of milk in different cultures. In one culture, milk might be used as a more active ingredient in cooking, in which case the quality of milk might not matter. Other cultures might consume milk as a beverage and might be more concerned with taste and quality. To account for the effects of race, four dummy variables were used: Black, White, Asian, and Other. The White variable served as the base variable. Two dummy variables were used to account for

ethnicity: Hispanic and non-Hispanic. The non-Hispanic variable was the base or reference category.

Household Variables

Household variables identified the constraints the shopper was under when they were making purchasing decisions. The household variables were household size, income, the age and presence of children, and location.

Household size was represented as a continuous variable with numbers from 1 to 9, each number representing the total number of members in the household, with the number 9 representing a household of 9 or more. It was expected that the estimated coefficient would be negative, meaning that as the household size increased, households purchased less Promised Land milk. Promised Land milk was marketed as a high quality product with a premium price (table 5 and 6). So, it was expected that households purchased a lower costing milk product as the number of members in the household increased.

The income variable illustrated the budget constraint. The estimated elasticity derived from the income variable revealed whether Promised Land white and chocolate milk were inferior, normal, or luxury goods. Due to the high price associated with Promised Land milk, it was expected that the estimated coefficient would have a positive sign or that Promised Land white and chocolate milk were normal goods. Income was converted into a continuous variable by assigning each household the midpoint of the income range indicated in the original data set.

The age and presence of children was considered an important variable in a survey conducted in the Capps and Salin (2010) study. The survey respondents also mentioned the benefits of milk in the development of children. This analysis used four dummy variables to represent the age and presence of children variable: less than 6 years old, between the ages of 6 and 12, between the ages of 13 and 17, and households without children present. The base category corresponded to households who recorded no children present. Children of younger households were expected to purchase Promised Land due to the nutrient-rich quality of the milk. However, after the development of children was complete, it was hypothesized that the need for high-fat and high nutrient milk was less important.

The estimated coefficients of the location variables had the potential to identify target markets for Promised Land products. If a location showed a greater willingness to purchase Promised Land white or chocolate milk, then the manufacturer of the brand could focus their advertising dollars on that specific location to maximize revenues. Location was divided into five dummy variables representing the different urban and rural areas located in Texas. The five locations were: Houston, Dallas, San Antonio, Austin, and all other areas. The “all other areas” variable served as the reference category. These locations were created from the county identified by each household. The total list of demographic variables with summary statistics is shown in table 7.

Table 7. Demographic Variables

Shopper Demographic Variables	Variable Name	Mean	Std Dev	Min	Max
Less Than 30 Years Old (BASE VARIABLE)	Agelt30	0.019	0.137	0	1
Ages 30 to 34	Age3034	0.046	0.209	0	1
Ages 35 to 44	Age3544	0.181	0.385	0	1
Ages 45 to 54	Age4554	0.287	0.453	0	1
Ages 55 to 64	Age5564	0.271	0.444	0	1
Ages Over 64	Agegt64	0.196	0.397	0	1
White (BASE VARIABLE)	White	0.784	0.411	0	1
Black	Black	0.107	0.309	0	1
Asian	Asia	0.026	0.161	0	1
Other	Other	0.083	0.275	0	1
Not Hispanic (BASE VARIABLE)	Hisp_no	0.865	0.341	0	1
Hispanic	Hisp_yes	0.135	0.341	0	1
Household Demographic Variables	**Variable Name**	**Mean**	**Std Dev**	**Min**	**Max**
Income	Income	61,429	37,714	2,500	200,000
Household Size	HHSize	2.369	1.249	1	9
No Children (BASE VARIABLE	NoKids	0.686	0.429	0	1
Children Under Age 6	AClt6	0.081	0.273	0	1
Children Ages 6 to 12	AC6_12	0.124	0.299	0	1
Children Ages 13 to 17	AC13_17	0.118	0.322	0	1
Other Regions (BASE VARIABLE)	Other_Region	0.475	0.499	0	1
Houston	Houston	0.194	0.395	0	1
Dallas/Ft Worth	Dallas_FtWorth	0.199	0.399	0	1
Austin	Austin	0.049	0.217	0	1
San Antonio	San Antonio	0.083	0.276	0	1

Source: Nielsen (2008).

Non-linear Effects of Certain Explanatory Variables

It is difficult to know whether the relationships between the dependent and right hand side variables were going to be best explained through a linear or non-linear mathematical functional form. It was determined which relationship best fit using economic theory and other model selection criteria such as Akaike Information Criterion (AIC), Schwartz Information Criterion (SIC), and variable significance. AIC,

mathematically expressed by AIC = 2k – 2ln(L), was used to gauge the fit of the model, while penalizing the model as the number of parameters (k) increases. (L) was the maximized value of the likelihood function. The objective in model selection was to minimize the AIC. SIC, mathematically expressed as SIC = -2ln L + k ln (n), was similar to AIC in that it measured fit, while penalizing the fit as the number of parameters increased.

Variable significance described whether a coefficient associated with a right-hand side variable was significant, or different from zero, and thus determined if it had any effect on the dependent variable. In order to ensure that a group of variables should be included in the model, a X^2-test was conducted for each variable group to ensure the variable group was significantly different than zero.

In the case of the prices, income, and household size, to capture the potential for non-linearity, a logarithmic representation was used. The logarithmic representation was illustrated by placing an 'l' in front of the variable.

Homogeneity was imposed on the price and income variables for both markets (Zellner 1962) so that price and income effects conformed to demand theory, where the sum of own-price, cross-price, and income elasticities must be zero.

The demand estimation models are exhibited in figure 5. The explanatory variables in the model for Promised Land white milk included: $lPromisedland_h$, $lBorden_h$, $lOakFarms_h$, $.lHorizonOrg_h$, $lSchepps_h$, $lPoinsettia_h$ and $lPrivateLabel_h$ represented the log of the white milk prices for household 'h'; $lIncome_h$ was the log of household's 'h' income; $lHHSize_h$ was the log of the household size for household 'h';

Houston, Dallas_FtWorth, Austin, and San Antonio represented the region where household ‘h’ was located; Black, Asian, and Other represented the race of the shopper for household ‘h’; Hisp_yes was the ethnicity of the shopper for household ‘h’; Aclt6, Ac6_12, Ac13_17 represents the age and presence of children in household ‘h’; and v_h is the error associated with household ‘h.’

The explanatory variables in the model for Promised Land Chocolate milk included: $lCPromisedland_h$, $lCBorden_h$, $lCOakFarms_h$, $.lCNesquick_h$ and $lCPrivateLabel_h$ represented the log of the chocolate milk prices for household ‘h’; $lIncome_h$ was the log of household’s ‘h’ income; $lHHSize_h$ was the log of the household size for household ‘h’; Houston, Dallas_FtWorth, Austin, and San Antonio represented the region where household ‘h’ was located; Black, Asian, and Other represented the race of the shopper for household ‘h’; Hisp_yes was the ethnicity of the shopper for household ‘h’; Aclt6, Ac6_12, Ac13_17 represented the age and presence of children in household ‘h’; and e_h was the error associated with household ‘h.’

White Milk Model

$$Quantity\ of\ Promised\ Land\ White\ Milk$$

$$= \beta_1 + \beta_2 lPromisedLand_h + \beta_3 lBorden_h + \beta_4 lOakFarms_h + \beta_5 lHorizonorg_h$$
$$+ \beta_6 lSchepps_h + \beta_7 lPoinsettia_h + \beta_8 lPrivateLabel_h + \beta_9 lIncome_h + \beta_{10} lHHSize_h$$
$$+ \beta_{11} Houston_h + \beta_{12} San\_Antonio_h + \beta_{13} Dallas\_FtWorth_h + \beta_{14} Austin_h + \beta_{15} Black_h$$
$$+ \beta_{16} Asian_h + \beta_{17} Other_h + \beta_{18} HispYes_h + \beta_{19} Aclt6_h + \beta_{20} Ac6\_12_h + \beta_{21} Ac13\_17_h + v_h$$

Chocolate Milk Model

$$Quantity\ of\ Promised\ Land\ Chocolate\ Milk$$

$$= \beta_1 + \beta_2 lCPromisedLand_h + \beta_3 lCBorden_h + \beta_4 lCOakFarms_h + \beta_5 lNesQuick_h$$
$$+ \beta_6 lCPrivateLabel_h + \beta_7 lIncome_h + \beta_8 lHHSize_h + \beta_9 Houston_h + \beta_{10} San\_Antonio_h$$
$$+ \beta_{11} Dallas\_FtWorth_h + \beta_{12} Austin_h + \beta_{13} Black_h + \beta_{14} Asian_h + \beta_{15} Other_h$$
$$+ \beta_{16} HispYes_h + \beta_{17} Aclt6_h + \beta_{18} Ac6\_12_h + \beta_{19} Ac13\_17_h + e_h$$

Figure 5. Demand equations for white and chocolate milk models.

Estimation Method

Since not all households purchased Promised Land, the dependent variable was censored. In order to overcome the censoring problem, the tobit model was employed. Tobin (1958) explained the problem that arises when a majority of observations are near a limit; in this case, the limit corresponded to zero expenditure or a non-purchase. Tobin (1958) explained that

> Account should be taken of the concentration of observations at the limiting value when estimating statistically the relationship of a limited variable to other variables and in testing hypotheses about the relationship. An explanatory variable in such a relationship may be expected to influence both the probability of the limit responses and the size of non-limit responses. (p. 25)

Tobin (1958) further illustrated that a probit model can only capture the "probability of [the] limit and non-limit responses," (p. 25) but did not have the ability to measure "the value of non-limit responses" (p. 25). In other words, the probit model cannot measure the magnitude of the effect an explanatory variable will have on the dependent variable. Tobin (1958) then showed that a multiple regression model can only explain "the value of the variable" (p. 25) but does not provide any information as to the change in the probability. In addition, Tobin (1958) determined that a "hybrid of probit analysis and multiple regression…is called for" (p. 25) and created a model that can measure both the probability and value of the effects. The tobit model is shown below:

$$y_t = X_h\beta + u_h \quad if X_h\beta + u_h > 0$$

$$y_h = 0 \qquad\qquad if X_h\beta + u_h \leq 0$$

$$t = 1, 2, \dots, N,$$

where N is the number of observations (households), y_h is the dependent variable, X_h is the vector of explanatory variables, β is the estimated parameter and μ_h is the normally distributed error term with a zero mean and variance.

McDonald Moffitt Decomposition

Later McDonald and Moffitt (1980) reinforced Tobin's view that when data sets "often have values clustered at zero… [Tobin's technique] is to be preferred, in general, over alternative techniques that estimate a [model with only] the observations above the limit" (p. 318). McDonald and Moffitt's (1980) contribution to Tobin's model lies in being able to use the estimated coefficients to "provide more information than is commonly realized" (p. 318). Simply put, the method allowed the researcher to obtain the conditional and unconditional marginal effects. The conditional effect was defined as the change in y_t of the observations above the limit, and the probability of being above limit. The unconditional effect was the change of y_t on all observations both on and above the limit, and the probability of being at the limit. McDonald and Moffitt (1980) summarized their decomposition as follows:

$$\partial Ey^*/\partial X_i = \beta_i[1 - zf(z)/F(z) - f(z)^2/F(z)^2]$$

This derivative provided the *conditional* marginal effects, where β_i is the estimated coefficient, F(z) is the cumulative normal distribution function, f(z) is probability density function for a normal distribution, and z is the z-score z=Xβ/σ. The parameters to be estimated in the tobit analysis are β_i *and* σ,the standard deviation or scale parameter associated with the use of the normal distribution.

$$\partial Ey/\partial X_i = F(z) * \beta_i$$

This derivative provided the *unconditional* effects, where β_i is the estimated coefficient and F(z) is the cumulative normal distribution function. Note that z-scores vary for each observation or household.

Nielsen Homescan Data

The Nielsen 2008 Homescan Panel data is a dataset that sampled households across the United States. The demographic specifications in the 2008 data illustrated the vast number of markets Nielsen used to sample specific households. These households were taken from 52 scan-track markets located throughout the United States. Twenty-five (25) of the 52 scan track markets were labeled as major markets. These markets were divided into four regions in the U.S., which were: East, Central, South and West regions. The Texas sample had 3 of the 25 major scan-track markets, which were: Dallas, Houston, and San Antonio. There were 61,440 households sampled in the national dairy data set. The Texas sample had 4,578 households, which represented 7.5% of the total U.S. population. According to the 2008 U.S. Census, Texas comprised 8% of the U.S. population, suggesting that the Texas sample was proportional to the U.S. population. Of the 4,578 households represented, 4,297 of those households had recorded white milk purchases over the course of 2008, and 1,023 of the 4,578 households in Texas purchased chocolate milk in 2008.

CHAPTER III

EMPIRICAL RESULTS

In this chapter, the empirical results associated with the demand functions for Promised Land white milk and chocolate milk are reported. The results for each brand of Promised Land milk are divided into two parts: price variables and demographic variables. The results for both Promised Land white and chocolate milk were derived using SAS 9.2 with the Proc QLIM procedure. The acceptable level of significance for this analysis was 0.10.

Promised Land White Milk

The parameter estimates and p-values associated with the white milk demand function are shown in table 8. The X^2 statistics in the table reveal that all of the groups of demographic variables are statistically significant despite the low value of R^2. As is common with the use of cross-sectional data, tobit models tend to exhibit a weak goodness-of-fit measurement (Alviola and Capps 2010).

McDonald and Moffitt's (1980) work, as previously defined, was used to derive the conditional and unconditional marginal effects. In an overview of table 8, all the conditional marginal effects were greater than the unconditional marginal effects. It is logical that the effects of those who already purchased Promised Land white milk had a greater impact on the quantity sold than those for any potential consumer of Promised Land white milk.

Table 8. Parameter Estimates and *p*-Values as Well as Conditional and Unconditional Marginal Effects Associated With the Tobit Analysis of Promised Land White Milk

	Variable Name	Estimates	*p*-value	Conditional marginal effects	Unconditional marginal effects
Price Variables	lPromisedLand	-473.515	0.004	-1,106.56	-21.97
	lBorden	-195.253	0.321	-565.12	-9.06
	lOakFarms	176.100	0.425	605.78	8.17
	lHorizonOrganic	-376.454	0.319	-936.24	-17.47
	lSchepps	-264.319	0.225	-829.95	-12.26
	lPoinsettia	150.951	0.692	671.59	7.01
	lPrivateLabel	918.799	0.000	4059.2	42.63
Income	lIncome	63.692	0.159	6.18	2.96
Household Size	lHsize	-97.417	0.288	-7.1	-4.52
Age	Age3034	-113.901	0.627	-14.96	-5.28
	Age3544	-270.104	0.197	-35.49	-12.53
	Age4554	-244.064	0.237	-32.07	-11.32
	Age5564	-28.852	0.887	-3.79	-1.34
	Agegt64	-213.850	0.307	-28.09	-9.92
Region	Houston	271.418	0.002	35.66	12.59
	San_Antonio	167.484	0.137	22.01	7.77
	Dallas_FtWorth	175.868	0.095	23.11	8.16
	Austin	264.429	0.065	34.74	12.27
Race	Black	-513.635	0.000	-67.48	-23.83
	Asian	68.996	0.675	9.06	3.2
	Other	50.707	0.692	6.66	2.35
Ethnicity	Hisp_yes	-50.201	0.642	-6.59	-2.33
Age and Presence of Children	Aclt6	102.586	0.452	13.48	4.76
	Ac6_12	-283.803	0.029	-37.29	-13.17
	Ac13_17	157.815	0.160	20.73	7.32
	Constant	-1,052.140	0.020		
	Sigma	891.783	0.000		
Goodness of Fit	R^2	0.016			
	Number of Observations	4,578			
	Wald tests	X^2statistic	*p*-value		
	(1) Age3034 =Age3544 =Age4554 =Age5564 =Agegt64 =0	11.47	0.043		
	(2) Houston=San_Antonio=Dallas_FtWorth=Austin=0	11.78	0.019		
	(3) Black=Asian=Other=0	15.87	0.001		
	(4) Aclt6=Ac6_12=Ac13_17=0	6.86	0.077		

Source. Computations by the author using SAS 9.2.

Price Variables

Table 9 shows that Promised Land and Private Label are the only significant price variables, and the two brands are substitutes. It is usually a point of concern when the estimated coefficient of a competitor is larger than the estimated coefficient of the own price; however, it is reasonable to assume that multiple private label brands could have a larger total effect on the sale of Promised Land milk than its own price.

Remember Capps and Salin (2010) were able to observe that consumers were bundling different brands, but could not conclude the nature of the relationship among brands. One of the main objectives of this study was to obtain the own-price and cross-price conditional and unconditional elasticities. These elasticities were obtained using the McDonald Moffitt decomposition referenced in Chapter II. Table 10 illustrates the price elasticities with the significant prices bolded. In the case of white milk, Promised Land consumers were very insensitive to pricing changes as evidenced by a conditional own-price elasticity of -0.23. This elasticity suggested that a 1% increase in the price of Promised Land white milk would cause the quantity purchased to decrease by .2% for current customers. However, the unconditional own-price elasticity of -1.65 suggested the total Texas market (buyers as well as non-buyers) was sensitive to changes in the price of Promised Land white milk.

Table 9. Average White Milk Prices Expressed as Dollars/Ounce

Variable	Average Price ($/ounce)
Promised Land	0.05922
Horizon Organic	0.05402
Borden	0.04956
Schepps	0.04371
Oak Farms	0.03947
Private Label	0.03041
Poinsettia	0.02913

Source. Nielsen (2008) and computations by the author.

Table 10. Conditional and Unconditional White Milk Price Elasticities

Variable	Conditional Elasticity	Unconditional Elasticity
Promised Land	**-0.23**	**-1.65**
Borden	-0.10	-0.68
Horizon Organic	-0.18	-1.31
Schepps	-0.13	-0.92
Oak Farms	0.09	0.61
Private Label	**0.45**	**3.19**
Poinsettia	0.07	0.52
Income	**0.14**	**0.22**
Household Size	-0.06	-0.34

Source. Nielsen (2008) and computations by the author.

Since the only statistically significant cross-price was the price of Private Label milk, not much can be said about the other cross-price elasticities. The Private Label conditional cross-price elasticity of .45 suggested that the price of Private Label milk had the largest effect on the sale of Promised Land white milk for those who were already purchasing this brand. The same result was true concerning the unconditional cross-price elasticity between Private Label and Promised Land brands. The homogeneity condition was imposed on the unconditional elasticities. That is, the sum of the own-price, cross-price, and income elasticities equals zero.

Demographic Variables

As per the Wald test given in table 8, the age of the shopper was a determinant of the purchase of Promised Land white milk. However, each of the individual age variables were not significant, therefore, nothing can be said of the age variables with regard to their affect on the amount Promised Land white milk purchased.

Income was a factor in the purchase of Promised Land white milk, while household size was not a statistically significant factor. The sign for income seems to make economic sense. The positive sign associated with the income variable suggested that sales would increase as income increased. Since Promised Land milk was the most expensive brand of the tested group, it made sense that as income increased, sales would also increase, and as income decreased, sales would decrease.

However, the conditional and unconditional income elasticities were both between zero and one, which suggested that Promised Land white milk was a necessity despite the premium price. The coefficients associated with the “age of children” variables all were significant as a group. In particular, households with pre-adolescent children aged 6 to 12 purchased less Promised Land milk compared to the households with no children.

“Black” shoppers purchased significantly less Promised Land milk than White shoppers. “Asian” and “Other Races” were not statistically significant. Hispanic heritage was also not a significant factor with regard to the quantity of Promised Land white milk purchased.

For region, this study used “all other locations” as the base variable so the effect on the quantity purchased for each location was in comparison to the “all other locations” variable. All regions had positive coefficients, which suggested that the “all other locations” variable affected the sales of Promised Land milk the least. Houston had the greatest positive conditional and unconditional marginal effect on sales, followed closely by Austin, and then by Dallas/Ft. Worth, and San Antonio.

Chocolate Milk

The parameter estimates, conditional and unconditional marginal effects for the chocolate milk market are shown in table 11. The Wald statistics confirmed that the non-price variables contributed to the model, although the individual variables might not be statistically significant. The R^2 was .005, again typical of this type of model in the way of a goodness-of-fit measurement.

Price Variables

In this study all price variables except Borden were statistically significant. The only complement in the chocolate milk market was the Nesquick price variable; the rest of the brands were substitutes with Promised Land chocolate milk. Promised Land and Nesquick were the two most expensive brands and had a complementary relationship, while Oak Farms and Private Label were less expensive than Promised Land and Nesquick and displayed relationships of substitutes to Promised Land chocolate milk (table 12).

Table 11. Parameter Estimates and *p*-Values as Well as the Conditional and Unconditional Marginal Effects Associated With the Tobit Analysis of Promised Land Chocolate Milk

Variable Categories	Variable Name	Estimates	*p*-value	Conditional marginal effects	Unconditional marginal effects
Price Variables	lCPromisedLand	-412.182	0.000	-789.48	-23.903
	lCBorden	55.623	0.727	119.304	3.226
	lCOakFarms	278.935	0.096	604.8	16.176
	lNesquick	-196.458	0.081	-393.266	-11.393
	lCPrivateLabel	284.691	0.011	916.269	16.509
Income	lIncome	-10.608	0.619	-0.423	-0.615
Household Size	lHsize	83.895	0.035	6.325	4.865
Age	Age3034	38.463	0.731	1.535	2.231
	Age3544	15.548	0.877	0.0621	0.902
	Age4554	33.549	0.738	1.339	1.946
	Age5564	-18.676	0.853	-0.746	-1.083
	Agegt64	-220.633	0.041	-8.808	-12.795
Region	Houston	164.534	0.000	23.163	9.542
	San_Antonio	171.704	0.001	24.172	9.957
	Dallas_FtWorth	136.631	0.001	19.234	7.923
	Austin	36.034	0.630	5.073	2.09
Race	Black	-138.784	0.007	-19.538	-8.048
	Asian	87.092	0.240	12.261	5.051
	Other	-3.369	0.955	-0.474	-0.1954
Ethnicity	Hisp_yes	-16.951	0.736	-2.386	-0.983
Age	Aclt6	-65.51	0.269	-9.222	-3.799
	Ac6_12	-133.904	0.008	-18.851	-7.765
	Ac13_17	-8.094	0.862	-1.139	0.469
Goodness of Fit	Constant	-634.683	0.000		
	Sigma	466.412	0.000		
	R^2	0.005			
	Number of Observations	4,578			
	Wald tests	X^2statistic	*p*-value		
	(1) Age3034 = Age3544 = Age4554 = Age5564 = Agegt64 = 0	24.32	0.0002		
	(2) Houston = San_Antonio= Dallas_FtWorth=Austin = 0	24.1	0.0001		
	(3) Black = Asian = Other = 0	8.93	0.0302		
	(4) Aclt6 = Ac6_12 = Ac13_17 = 0	7.76	0.0513		

Source. Computations by the author.

Table 12. Average Chocolate Milk Prices Expressed as Dollars/Ounce

Variable	Average Price ($/ounce)
Promised Land	0.07601
Nesquick	0.07148
Oak Farms	0.06741
Borden	0.06618
Private Label	0.04407

Source. Computations by the author.

The own-price conditional elasticity for Promised Land chocolate milk was -0.54, which suggested that customers of Promised Land were not very sensitive to changes in price (table 13). The unconditional own-price elasticity for Promised Land chocolate milk was -3.301, which means that the Texas market was highly responsive to changes in the price of Promised Land chocolate milk. Oak Farms had the largest conditional cross-price elasticity at 0.37, while Private Label had the second largest effect on the sales of Promised Land consumers. Nesquick's significant complementary status with Promised Land chocolate milk meant that as the price of Nesquick decreased, current customers of Promised Land chocolate milk increased their quantity purchased. Table 13 shows the conditional and unconditional elasticities for chocolate milk associated with the Promised Land brand. The homogeneity condition was imposed on the unconditional elasticities. That is, the sum of the own-price, cross-price, and income elasticities equals zero.

Table 13. Conditional and Unconditional Chocolate Milk Price Elasticities

Variable	Conditional Elasticity	Unconditional Elasticity
Promised Land	**-0.54**	**-3.30**
Nesquick	**-0.25**	**-1.57**
Borden	0.07	0.45
Oak Farms	**0.37**	**2.23**
Private Label	**0.36**	**2.28**
Income	-0.02	-0.09
Household Size	**0.13**	**0.67**

Source. Computations by the author.

Demographic Variables

The base variable for the age of the shopper was less than 30, so all results were in comparison to that demographic. The only significant age coefficient was the "greater than 64" age group. Shoppers over the age of 64 purchased significantly less than the "less than 30" base age group.

Income was not significant, but household size exhibited strong significance and a positive coefficient. The positive coefficient showed that sales actually increased as the household increased. This result may be attributed to the function of chocolate milk and the differentiation among chocolate milk brands. White milk has many functions (cereal, cooking, cookies and milk, etc.), while chocolate milk is predominately consumed as a beverage.

The age of children illustrated that households with children ages 6 to 12 purchased less Promised Land chocolate milk compared to households with no children. "Black" shoppers purchased significantly less Promised Land chocolate milk than "White" shoppers. The "Hispanic" demographic did not prove to be a significant factor in the quantity of Promised Land chocolate milk purchased.

"All other locations" had the lowest effect and Austin's effect was not significantly different from the "all other locations" variable. San Antonio had the largest conditional and unconditional marginal effect on the quantity purchased with Houston as a close second. The Dallas/Ft. Worth area was also positive, but had the third largest conditional and unconditional marginal effect associated with location.

CHAPTER IV

CONCLUSIONS, IMPLICATIONS, AND LIMITATIONS

The findings from the tobit analysis for Promised Land white milk indicated a positive relationship between household income and purchases of Promised Land. Households with children who were between 6 and 12 years old purchased less Promised Land white milk than households with no children present.

In terms of region, households located in Houston purchased more Promised Land white milk than any other region, with Austin, and Dallas/Ft. Worth areas all purchasing more Promised Land white milk than all other areas in Texas. As for race, Black households were likely to purchase less Promised Land milk than White households.

From these demographic indicators, it was found that income, the age and presence of children, region, and race had a significant effect on the quantity of Promised Land white milk purchased. From the estimated elasticities, it was found that households who purchased Promised Land white were insensitive to changes in the price of Promised Land white milk, while households who did not purchase Promised Land milk were far more sensitive to changes in the price of Promised Land white milk. The price of private label milk was the only cross-price that was significant in the quantity of Promised Land white milk purchased. The estimated elasticities showed that Promised Land white milk and private label white milk were substitutes. Households who did not

purchase Promised Land white milk were more sensitive to changes in private label white milk than households who already purchased Promised Land white milk.

The findings from the tobit analysis for Promised Land chocolate milk indicated that income was not a significant factor in the purchase of this brand. Households with more family members were likely to purchase more Promised Land chocolate milk. Households with children ages 6 to12 purchased less Promised Land chocolate milk than households with no children.

In terms of region, households located in San Antonio were most likely to purchase more Promised Land chocolate milk than the other regions. Households located in Houston and Dallas/Ft. Worth were more likely to purchase more Promised Land chocolate milk than households located in Austin and "all other regions."

Households with shoppers ages over 64 purchased significantly less Promised Land chocolate milk than shoppers between 18 and 30 years old. As for race, Black households purchased less Promised Land chocolate milk than White households.. Region showed that Houston, San Antonio, and Dallas/Ft. Worth purchase significantly more than all other locations. From these demographic indicators, it was found that household size, the age and presence of children, the age of the shopper, region, and race had a significant effect on the quantity of Promised Land chocolate milk purchased.

From the estimated elasticities, it was found that households that purchased Promised Land chocolate milk were largely insensitive to changes in the price of Promised Land chocolate milk, while households that did not purchase Promised Land chocolate milk, were very sensitive to changes in the price of Promised Land chocolate

milk. It was also found that the prices of Nesquick, Oak Farms, and private label chocolate milk had a significant effect on the quantity of Promised Land chocolate milk purchased. Of these significant prices, Private Label chocolate milk and Oak Farms chocolate milk were substitutes for Promised Land chocolate milk and had the largest effect on the quantity of Promised Land chocolate milk purchased. The price of Nesquick chocolate milk demonstrated a complementary relationship with Promised Land chocolate milk. All price effects were larger for households that did not purchase Promised Land chocolate milk than for households that purchased Promised Land chocolate milk.

The results from this study will enhance the marketing efforts of Promised Land's white and chocolate milk brands by targeting consumer segments specific to each product. For Promised Land white milk, the target market is affluent households, households with children who are not ages 6 to 12, White households and households located in Austin and Houston.

For Promised Land chocolate milk, the target market is households with larger sizes, households located in San Antonio and Houston, White households, and shoppers who are not older than 64.

Also, owing to the results of own-price and cross-price elasticities, LALA USA could lower the price of Promised Land white or chocolate milk to increase the base of consumers. However, they could raise the price of Promised Land white or chocolate milk to current customers and increase sales.

One of the major limitations of this study was that only one year of household data for 2008 was used. Findings would be enhanced with data over multiple years and more recent data. Also, the idea of container size is a major limitation to this study. Since pricing strategies change with different container sizes, the aggregate unit values in this study could be understated or overstated depending on the container sizes available for each brands. For example Promised Land does not produce a gallon container size. The idea of seasonality was also unexplored in this study. Further research would benefit by taking these limitations into account.

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