WHAT'S DRIVING THE ORGANIC MILK MARKET?

A CONSUMER DEMOGRAPHIC PORTRAYAL

by

TRAVIS A. SMITH

(Under the Direction of Chung L. Huang)

ABSTRACT

Using Nielsen Homescan data, this study intends to model consumer demand for conventional and organic fluid milk through three analyses. Heckman's (1979) two-step sample selection model is used to investigate consumption of conventional and organic milk. The results suggest that organic households are less sensitive to changes in price than conventional households. A probit model is then employed and key findings suggest that once a household has entered the fluid milk market, income, the presence of children under the age of six, and households headed by persons under the age of forty increases the probability of entering the organic fluid milk market. Lastly, a hedonic model is constructed to estimate price premiums and discounts associated with market factors, product attributes, and branding with an emphasis on the organic attribute. Findings suggest the organic premium ranges from 28% to 119% above conventional prices depending on container size, fat content, and branding.

INDEX WORDS: organic milk, Heckman two-step, sample selection, hedonic price, Nielsen Homescan, consumer demand

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CHAPTER 1

INTRODUCTION

1.1 The Organic Environment

Spurred by concerns over personal health and nutrition, consumer interest in organic foods has grown rapidly since the early 1990s. In fact, the U.S. organic food industry has grown from just over $1 billion in sales in 1990 to almost $17 billion in sales for 2006, up 22% from 2005 (Dimitri and Greene, 2002; Organic Consumers Association, 2007). Some of the top reasons for organic usage are related to the consumer's health concerns: the absence of pesticides, growth hormones and genetically modified foods, as well as, being safer for one's health (Hartman Group, 2006). Additionally, some consumers identify organic foods with an increased nutritional value over conventionally grown foods (Hay, 1989). Consumers not only perceive organic foods as healthier than conventional foods, but also believe their production practices are more environmentally friendly too. According to the Food Marketing Institute's 2005 survey, over half (56%) of respondents who had purchased organic foods in the past six months reported buying organic foods because of the environmental impact of growing organic foods (Klonsky and Greene, 2005). This fact is echoed in the 2005 Organic Trend Tracker survey commissioned by Whole Foods Market in which 52.4% of respondents agreed with the statement that organic foods are better for the environment (Whole Foods Market, 2005).

Organic products are considered credence goods – consumers do not know that the product is organic unless they are told so (Giannakas, 2002). To clear the confusion in the marketplace and reduce the mislabeling of organic products, both consumers and producers insisted on a national standard. Thus, Congress passed the Organic Foods Protection Act of 1990 as part of the 1990 Farm Bill to establish a national standard for products produced as organic and to assure consumers that organically produced products consistently meet these standards. In October 2002 under the National Organic Program, a certification process was implemented, thereby labeling the product as to adhering to the law. The certification process insures that a product with the USDA organic label is in fact organically produced and handled. In order for a product to be labeled organic, a government-approved certifier must first inspect the farm where the food is to be grown to insure that the farmer is following the Act. Additionally, companies that handle or process organic foods must be certified to insure that when the food reaches the consumer, it is indeed organic. According to USDA regulations, organic production is defined as “a production system that is managed in accordance with the [Organic Foods Production] Act and regulations in this part to respond to site-specific conditions by integrating cultural, biological and mechanical practices that foster cycling of resources, promote ecological balance and conserve biodiversity” (Agricultural Marketing Service, 2000).

The organic food industry matured greatly over the eight year time span from 1998 to 2005. As indicated in Table 1.1, the industry’s annual sales grew from $4.3 billion in 1998 to $13.8 billion in 2005, and certified organic farmland acreage more than doubled from 1.78 million acres to 4 million acres in the U.S. Organic market penetration into the food industry rose from just under 1% to almost 2.5% in only eight years. This boost in consumer demand for organic foods, coupled with an explosion of certified organic farms, has created a newfound availability through larger retail outlets, including conventional food retail venues and food supermarkets, such as Wal-Mart. The increase in availability is most notably marked by the fact that in 1991, natural food stores represented 68% of organic food sales, while only 7% of sales were through conventional channels, such as mass merchandisers, club and grocery stores (Dimitri and Venezia, 2007). By 2005, share of organic sales in the natural food sector had declined to 48 %, while sales in conventional stores had risen to 45% (Table 1.1).

The focus of this study is a vital part of the organic dairy market: organic fluid milk, excluding buttermilk and flavored milk. According to the *Nutrition Business Journal* (*NBJ,* 2006), of the top selling organic food categories in 2005, dairy products were only second to fruits and vegetables (15% for dairy and 39% for fruits and vegetables combined). Further, the dairy sector registered the largest growth among the five organic sectors between 1998 and 2005. In 2005, organic dairy accounted for 3.5% of total dairy sales (*NBJ,* 2006). *NBJ* (2006) also reported the organic dairy sector at $2.54 billion in sales in 2006, an 18.9% increase over the previous year. Organic milk and cream makes up almost half of the organic dairy market, and U.S. retail sales of organic milk and cream reached over $1 billion in 2005, up 25% from 2004 (Dimitri and Venezia, 2007). According to SPINS, a market research and consulting firm for the natural products industry, dollar sales of organic milk for the 52-week period ending November 3, 2007 increased for gallons, half gallons and quarts at 13.5%, 13.2% and 12.2%, respectively (Goldschmidt, 2008). Likewise, Nielsen LabelTrends found that unit volume for refrigerated milk grew 18.5% for the 52-week period ending October 6, 2007 (Goldschmidt, 2008). Organic milk is just one part of the ever growing interest in the organic food market as a whole.

1.2 Problem Statement

Traditionally, studies on organic products have measured consumers’ attitudes concerning the purchase of organic foods through the contingent valuation method rather than using actual purchase choices and behaviors. The findings of these studies are often inconsistent and sometimes contradictory (Thompson and Kidwell, 1998; Yiridoe et al., 2005). Among some of the discrepancies found is the likelihood of purchasing organic foods attributed to key demographics such as age, educational attainment, and race. Discrepancies in the organic premium consumers are willing to pay are also reported in the literature. These issues are addressed in this thesis.

Concerning age, the younger consumer is believed to have a preference for chemically-free produced products that have less impact on the environment (Hay, 1989). Similarly, Gonvindasamay and Italia's (1999) results suggested that older consumers may have more restricted diets or are less likely to digress from the routine diet out of habit. On the other hand, some studies found that older consumers were more likely to purchase organics because of the perceived positive health attributes associated with organic foods (Bhaskaran and Hardley, 2002). Zhang et al. (2006a) found that older consumers are more likely to purchase fresh organic produce.

Conflicting results have also been found concerning the link between educational attainment and the likelihood of buying organic foods. Earlier studies found that education had no significant influence on the decision to purchase organic food (Wilkins and Hillers, 1994). However, a more recent study by Zhang et al. (2006a) found higher educational attainment not only positively affected the probability of entrance into the organic produce market, but also increased the consumption levels of households already in the organic produce market.

Two consumer surveys by the Hartman Group found that contrary to their findings in 2002, their 2006 survey suggested that consumers purchasing organic foods at least occasionally had somewhat higher educations (especially post graduate degrees) and somewhat higher incomes (particularly, non-users were found to have incomes less than $30,000) (Hartman Group, 2002, 2006). Additionally, both of Hartman's surveys concluded that the two ethnic and racial groups more likely to purchase organics were Asian Americans and Latino/Hispanic Americans (Hartman Group, 2002, 2006). Moreover, Zhang et al. (2006a) found Hispanic Americans were more likely to buy and consume more fresh organic produce than other races. These findings of mixed results and limited empirical evidence underline the need for a better understanding of how consumer demographics affect purchasing habits of organic consumers.

An important factor affecting the decision to purchase organic foods is the price premium that consumers must pay. High price premiums not only discourage non-users from entering the organic market, but also keep current users from purchasing more organics. On the other hand, high price premiums will encourage production of organic foods. A comprehensive review of literature on consumer perceptions and preferences of organic foods by Yiridoe et al. (2005) suggested that caution should be exercised when drawing conclusions from earlier studies with such limited short-term time-series data on willingness to pay a price premium. As indicated in subsequent chapters, the data used for the purpose of this study are not limited in its breadth. Homescan data from Nielsen are nationally representative and they have comprehensive coverage of organic food. It is interesting to note that the Organic Trade Association's (OTA) 2004 Manufacturing Survey suggests that the growth the organic market has enjoyed since 2000 is primarily due to current organic consumers increasing their purchases of organic foods rather than increasing the number of organic consumers.

Dairy, fresh produce and soymilk are among the first organic products that consumers try, and are, thus, likely tried by a wide variety of people and may indicate future consumer interest in other organic products (Demeritt, 2004). Many studies have focused particularly on these products as they are at the highest demand and, thereby, can improve the understanding of the organic food market as a whole. Organic milk is not only a highly demanded organic food, but is also at the center of recent media attention. Due to an unexpected increase in demand coupled with the lengthy certification process for organic dairies, suppliers began reporting a shortage of organic milk in early 2005. Conversion of pasture providing feed for organic dairies must be managed according to the organic standards for at least three years. Additionally, the herd must receive organic health care for 12 months before they can be certified. The lengthy conversion process creates a problem for suppliers of organic dairy products trying to produce enough product to meet the rapid growing demand for their good. Therefore, the goal of this study is to broaden the literature on organic foods by examining the consumption patterns of consumers, focusing on the organic fluid milk market.

1.3 Objectives

This research aims at improving the understanding of purchase behavior related to organic food market through the examination of the fluid milk market. Using actual retail purchase data from consumers, the goal of the study is to provide insights about of the organic milk consumers' socioeconomic characteristics, which have contributed to the growth of the organic milk market. By examining the relationship between organic milk consumption and consumer characteristics, this study can identify potential consumers of organic milk and provide a clearer perspective of what characteristics are continually driving up organic milk sales for future market implications. Specifically, the objectives of the study are

1. To identify important consumer demographics associated with conventional and organic milk consumption—the decision to participate in the fluid milk market and the level of consumption of milk.
2. To determine how consumer demographics affect the consumer's decision to enter the organic milk market once the choice to purchase milk has been made.
3. To estimate price premiums and discounts associated with market factors, product attributes, and branding focusing on the organic attribute for fluid milk.

1.4 Organization

This thesis contains six distinct chapters. Immediately following this chapter is a literature review of previous studies pertaining to the consumer demand of organic foods, with an emphasis on organic milk, and a discussion of their relevance and possible limitations. The third chapter consists of a description of the methodology used to analyze the consumer demand for conventional and organic fluid milk. Specifically, Heckman's (1979) two-step sample selection model is derived and is shown to better identify consumer behavior relative to the consumption process than simply using a standard regression. Also in chapter three, a hedonic price model is specified to estimate price premiums and discounts associated with product attributes, market factors, and branding with an emphasis on the organic attribute. Chapter four describes the data and variables used for estimation along with descriptive statistics. Estimation results are found in the fifth chapter. The sixth and final chapter summarizes the study's conclusions and potential market implications, and cites possible extensions to the research.

Table 1.1. Growth and Evolution of the Organic Food Industry, 1998 – 2005.

	1998	**2005**
Sales of Organic Food	$4.3 Billion	$13.8 Billion
Market penetration	0.94 %	2.48 %
Certified organic farmland (acres):	1.78 million	4 million
Distribution of Organic Food Sales by Channel:		
Natural foods stores	63 %	48 %
Conventional stores	31 %	45 %
Other (including farmer’s markets, food service)	6 %	7 %
Top Five Organic Food Categories by Sales:		
Fruits and vegetables	44 %	39 %
Dairy (milk, yogurt, cheese, ect.)	11 %	15 %
Beverages	13 %	14 %
Packaged/Prepared foods	14 %	13 %
Breads and grains	11 %	10 %

Source: *Nutrition Business Journal (NBJ*, 2006*)* and USDA-ERS, 2008.

CHAPTER 2

LITERATURE REVIEW

2.1 Perceptions, Attitudes, and Characteristics of the Organic Consumer

The literature aiming at identifying the organic consumer is extensive, yet researchers still do not have a fair grasp on exactly who that consumer is. In the wake of increased consumer awareness for personal health and environmental quality, a wave of studies dedicated to identifying the organic consumer began to flow in prior to the 1990 Farm Bill. As consumers began to realize their personal responsibility to make informed choices not only for personal health but to mitigate environmental degradation, the food industry witnessed a growth in demand for organic foods that has yet to slow down.

The consumer's awareness and knowledge of what constitutes a food organic and what it means for a food to be organic is a key element of not only marketing organic foods to the consumer, but also attracting new customers into the organic market. Because organic foods are credence goods (the consumer does not know the food is organic unless told so), it is important that the organic industry convey attributes associated with "organic" effectively. Some studies suggest that organic customers are aware of the general issues associated with organic farming, but do not necessarily understand all the details and unique features associated with organic farming and quality attributes (Hill and Lynchehaun, 2002). Wolf (2002), for example, found that U.S. organic lettuce consumers rated attributes, such as environmental friendliness, of organic foods 'somewhat desirable' or 'very desirable' while they rated the 'certified' organic label as ‘slightly desirable’ or ‘somewhat desirable.’ Additionally, Hutchins and Greenhalgh (1997) found that one-third of respondents were aware of existing organic labels, yet some of these respondents could not recognize the organic symbol, logo or label. Consumer awareness and knowledge impacts the consumers’ attitudes towards organic foods and their willingness to pay. Complete knowledge and awareness about organic foods does not necessarily mean a consumer will purchase the food due to other barriers such as price or skepticism of perceived attributes (Yiridoe et al., 2005; Hartman Group, 2006). Although many consumers view organic foods positively, a discrepancy of what is driving these consumers to purchase organic foods still exists.

Factors that motivate consumers to purchases organic foods vary across studies. For instance, The Packer (2002) reported appearance was the primary product attribute during a shopping trip affecting the consumer’s choice to purchase organic foods. However, due to recent changes in production technology, the Hartman Group (2006) found the absence of growth hormones and genetically modified foods as the most important factor when a consumer chose to purchase organic foods. Demeritt (2002) found about two-thirds (66%) of respondents rated health and nutrition as the top factor influencing their choice of purchasing organic foods, followed by taste (38%). Among various attributes rated ‘very desirable’ or ‘extremely desirable’ to organic consumers was ‘high in nutritive value’ (Wolf, 2002). Likewise, Hay (1989) also found that organic consumers feel organic foods exhibit more nutritive value than their conventional counterparts.

The topic of nutritive value in organically versus conventionally grown foods is a hotly debated issue. A review of literature on the comparison of these two types of food production systems has been conducted by several researchers (Woese et al., 1997; Bourn and Prescott, 2002; Benbrook et al., 2008). Both Woese et al. (1997) and Bourn and Prescott (2002) found with the exception of lower levels of undesirable nitrates in organically grown foods, no strong evidence existed that the two production systems differ substantially in concentrations of other nutrients studied. While Benbrook et al. (2008) also found similar results on nitrate levels, they claimed that there existed strong evidence that organic foods were more nutrient dense, on average, than conventionally grown foods, especially in levels of antioxidants and very important polyphenols.

From a purely marketing standpoint, the identification of the organic consumer's characteristics is fundamental to the further success of the organic food industry. The Hartman Group's (2006) report provides some insight into the evolution of organic consumer, as well as, triggers and motivations to the use of organics. According to their report, Asian Americans and Latino/Hispanic Americans were more likely to purchase organics relative to whites and African Americans (Hartman Group, 2006). They also cited child development as a primary social influence on organic awareness, interest and use. Supporting this finding related to child development, a USDA report found that contrary to the ever changing demographics of the organic consumer, the one element that has remained the same through the years is parents of young children or infants are more likely to purchase organic foods (Dimitri and Venezia, 2007).

The contingent valuation approach has been a popular method to identify purchase behaviors and choices between organically produced foods verses conventionally produced foods. The willingness to pay for an organic food is the price premium that consumers pay for attributes associated with organics and the additional costs of producing organic foods such as increased input costs, certification costs, and lowered yields. However, studies on organic consumer attitudes vary greatly depending on geographic region of the study due to cultural differences and other factors that are hard to control in surveys (Yiridoe et al., 2005). For example, using survey data, Wolf (2002) found that 30% of respondents in California were willing to pay a 50% premium for organically grown grapes. While O'Donavan and McCarthy (2002) found that about 70% of Irish consumers were not willing to pay more than a 10% premium for organic meat. As indicated in the following section, it is apparent that breadth of data and geographical location affects studies intending to not only identify the organic consumer, but also the factors influencing the choice to enter the organic market.

2.2 Demand for Organic Versus Conventional Foods

Understanding how consumers perceive organically grown foods compared to conventionally grown goods is the basis of understanding the demand for organic foods. According to Lancaster (1966), consumer demand is linked to the characteristics and attributes inherent in economic goods. Consumers derive utility not from the good itself, but from the characteristics and attributes that the good possess. Thus, the consumer's perceived attributes of organic foods influence their decision to purchase either conventional or organic foods. Currently, few studies have concurrently investigated the interrelationship between demand for organic and conventional foods. Even fewer have focused on the organic fluid milk market. This section will review selected studies investigating the demand of organic versus conventional foods and the following section will focus on fluid milk.

Using monthly supermarket scanner data from September 1990 to December 1996, Glaser and Thompson (1998) found own-price elasticities for the four selected frozen vegetables: broccoli, green beans, green peas, and sweet corn, ranged from -1.63 to -2.27. Their findings implied that a small change in price would bring forth large changes in quantities. Further, changes in price for organic frozen vegetables were two to three times more sensitive than their conventional counterparts. They note as nominal prices of organics declined in 1995 and 1996, own-price responsiveness became less sensitive. They also found substitution of organic frozen vegetables for conventional vegetables was statistically weak, but some evidence of asymmetrical substitution existed – increases in conventional prices induced large increases in quantities of organics whereas increases in organic prices had almost no effect on purchases of conventional frozen vegetables.

Again, using monthly scanner data, Thompson and Glaser (2001) investigated the demand for conventional and organic baby food for the twelve year period from 1988 to 1999. Like that of their previous study, they found decreases in organic baby food prices brought about increases in organic purchases. However, decreases in price for conventional baby food had almost no effect on conventional purchases. Their cross-price elasticity estimates suggested that a reduction in organic baby food prices elicited limited substitution away from the conventional market. Both Glaser and Thompson’s (1998) and Thompson and Glaser’s (2001) previously mentioned studies have some limitations. The two product categories studied (frozen vegetables and baby food) make up a very small portion of the organic food industry, and the findings may be hard to extend to the organic food industry as a whole. Additionally, their data only reported purchase information about the products and not demographic characteristics of the consumers making the purchases.

Using detailed national scanner data with purchase information and demographic characteristics of the consumers from 1999 to 2003, Zhang et al. (2006b) investigated the interrelationship between selected organic and conventional vegetables (potatoes, tomatoes, onions, and lettuce). They found income elasticities of all organic vegetables included in the study were higher than those of their conventional counterparts, implying that given an increase in the budget share on the selected fresh vegetables, consumers allocated a higher share of their budget to organic than to conventional vegetables. However, contrary to the findings of Glaser and Thompson (1998), Zhang et al. (2006b) found all own-price elasticities, except potatoes, to be less than one in magnitude, implying less than proportional change in response to own-price.

Huang and Lin (2007) estimated price premiums and discounts associated with the organic attribute, market factors and consumer demographics across major market areas of fresh tomatoes using national scanner data. Using the hedonic model approach, they found that price premiums for the organic attribute vary across market regions from 9% (Southeast) to 29% (Northeast) above conventional tomatoes. They also found a positive impact between income and the price paid for fresh tomatoes. Their findings reinforce the necessity of using national data versus regional data to fully understand purchase behavior of organic foods.

Lin et al. (2008) estimated a censored demand system to investigate socio-demographic characteristics and price elasticities for conventional and organic fresh fruits. Some of their key findings on socio-demographics included household income significantly and positively impacted the purchase of both conventional and organic apples and strawberries, as well as other organic fruits. Estimated expenditure elasticities for organic and conventional fresh fruits tended to be unitary; implying an increase in a consumer's spending on fresh fruit would induce a proportional increase in spending on conventional and organic fresh fruits. Asymmetric cross-price effects, like that of Glaser and Thompson (1998) and Thompson and Glaser (2001), were again found between organic and conventional products. Cross-price elasticities suggested that a change in relative prices would more likely cause some consumers of conventional fruits to "cross-over" to organic fruits, while the reverse was less likely to happen, i.e. the organic consumers would "revert" to conventional fruits. These studies further the expectation that organic premiums and demand not only vary across food products but also across market factors such as region. We look to further expand the literature by examining how the demand for conventional and organic milk varies across product attributes, market factors, and consumer characteristics.

2.3 Demand Analyses of Conventional and Organic Milk

As increased demand for organic products prevails, it is of no surprise that the focus of many studies is those products at the top of the organic market. Only second to fruits and vegetables, dairy has been a mainstay as one of the most popular organic food products on the market (*NBJ*, 2006). A main component of the organic dairy market is fluid milk. In this section the focus will be on studies that have investigated the demand of conventional and organic fluid milk.

Glaser and Thompson (2000) provided a detailed look into the milk market by examining key demand elasticities across type (organic, branded and private label), container size (gallon, half gallon and quarts) and fat content (nonfat/skim, 1%, 2%, and whole milk) for the given time period November 1996 to December 1999. They found that organic milk was highly own-price elastic, though in later time periods in the given sample these elasticities declined. They concluded that price promotions or long term reductions in price of organic milk could stimulate organic milk sales considerably. Their estimated cross-price elasticities indicated that organic and branded milk are substitutes. However, changes in organic milk prices elicited little changes in branded purchases, but changes in branded prices had significant effects on organic purchases. It seems that this asymmetric substitution effect is prevalent in the organic food industry –

organic foods are more responsive to changes in their conventional counterpart's prices than the response to changes in prices of organic foods.

A severe limitation of Glaser and Thompson's (2000) research is their data source. They recognized the fact that analyzing "newly introduce products," such as organic milk, can cause small expenditure shares at some sample points, thus skewing the magnitudes of the elasticity estimates. Another limitation of their data set is that it only constitutes sales in supermarkets, not sales in natural foods stores or other outlets such as farmer's market. Considering the fact that 67% of organic sales in 1998, almost a third of their sample, occurred in natural food stores (*NBJ*, 2006), they are potentially missing much of the organic milk market.

Dong et al. (2004) applied the double-hurdle model to examine participation and purchase behavior in the fluid milk market for upstate New York over a four-year period from 1996 to 1999. While they did not specifically examine organic milk, their research is still applicable in the sense that they use actual purchase data to model impacts of price, income and other demographic variables on the decision to participate in the milk market as well as the consumption levels. Although their general purpose was to find the effect of advertising on milk purchases, they found price elasticity to be negative and inelastic. Specifically, their findings suggested that a 1% increase in the price of milk per gallon induces a 0.1% decrease in consumption levels. Again, a limiting factor of their research is the use of regional data, and only applies to consumers in the upstate New York area.

Considering the implementation of the organic label under the National Organic Program, Kiesel and Villas-Boas (2007) investigated how this alters consumer purchase behavior of organic fluid milk. They found that consumer preference was significantly affected by the appearance of the USDA organic label on milk. Their results indicated that the presence of the

USDA organic seal increased the probability of purchasing organic milk. They also estimated that the implementation of the organic label by the USDA created a large enough increase in consumer welfare to outweigh the costs of the program for the given sample period.

Grebitus et al. (2007) investigated consumers' attitudes and socio-demographics, as well as, certain quality characteristics on consumption patterns of consumers in Germany for conventional and organic pork, potatoes and milk. They found in general for all products that the credence attribute, 'organic,' positively affected the consumer's decision to purchase the organic food. When investigating differences in conventional and organic milk, they found consumers that desire special sizes, such as smaller packs for single households or bigger packs for families, may have chosen conventional milk because organic has no similar option. Additionally, they found that the brand of organic milk significantly affected purchase behavior probably due to the fact that consumers associated certain brands with organic. They also found that older consumers were more likely to purchase conventional milk as opposed to organic milk.

CHAPTER 3

METHODOLOGY

The primary objective of demand theory is to describe what factors determine the consumer's allocation of resources on the available goods and services in the market place, and to evaluate the influence of the factors (Theil, 1975). In order to improve the understanding of consumer demand for organic and conventional milk, this objective will be addressed through three different analyses. The first objective is to model the demand for organic and conventional milk through Heckman's (1979) two-step sample selection model. Secondly, to determine what household characteristics are influencing the consumer's decision to enter the organic milk market once the choice to purchase milk has been made, a discrete repsonse model is specified. Specifically, the probit model is used to analyze the decision process and determine the marginal probability that each household characteristic has on purchasing organic milk. The last analysis is to estimate price premiums and discounts associated with market factors, product attributes, and branding focusing on the organic attribute for fluid milk.

3.1 Neoclassical Consumer Demand Theory

Classical demand theory is concerned with an individual consumer making decisions with respect to purchase the most satisfactory bundles of goods and services within the constraints of available resources at a given point in time. The building blocks of the consumer demand theory include a set of n commodities (q_1, …, q_n), and the axioms concerning the ordering of preference. It is assumed that the consumer behaves rationally in accordance with his/her preference orderings and that the consumer possesses full information about the market prices of the commodity set. Following the neoclassical approach, a consumer's preference orderings can be summarized and translated into a mathematical device called a "utility function," $U = U(q_1, \ldots, q_n)$, which is an interpretive measure of the satisfaction derived from the consumption of alternative commodity bundles. The assumption of rationality is the principle vehicle by which personal preferences and tastes are translated into actions in the marketplace. The consumer will choose among the available alternative bundles with the objective of maximizing personal satisfaction or the utility function. Thus, the consumer allocation problem can be formulated into a utility maximization framework.

$$\text{Maximize } U(\vec{q}) \text{ subject to } I = p_j q_j ,$$

where p_j and q_j is the price and quantity of commodity j and I represents total outlay or income. First order conditions from maximizing the above utility function with respect to quantity will result in a set of Marshallian demand functions, which summarize all relevant information about the consumer's behavior with respect to the collection of commodities he/she buys for each possible set of market parameters. Mathematically, the demand function for commodity j that is derived from the constrained utility maximization can be represented as:

$$q_j = g_j(\vec{p}, I) .$$

The above demand function is said to exhibits certain properties that allow one to predict a consumer's market behavior through revealing the person's tastes and preferences.

The neoclassical model of consumer behavior has the advantage of simplicity and has been proven as a useful tool in analyzing consumer behavior and consumption patterns. However, it has several limitations, many of them stem from its assumptions. The neoclassical approach assumes a static framework that ignores time and the role of habit as an aspect of consumption choice. It is also limited to the study of existing goods and services that are currently available on the marketplace. It says nothing about demand for new products that may be introduced and does not include analyses of choice patterns under risk and uncertainty. Aside from the effects of price and income, it has nothing to say about the effects of other factors which may affect taste and preference such as socioeconomic, demographic, sociological, psychological, cultural, nutritional, and regional factors that determine the level of consumption of a given commodity. Last but not least, the assumptions that goods are infinitely divisible and that the consumer has complete information are, by and large, unrealistic. In reality, consumers do not buy all goods and services available in the commodity space and they have imperfect information with regard to income, commodity prices, quality, and availability just to name a few.

3.2 An Introduction to Sample Selection

When modeling demand for a good with household panel data, it is possible that the observed consumed quantities of that good may be zero for many of the households—zero consumption. This places a lower limit on the dependent variable at zero if one is to include all survey respondents in the estimation. Zero consumption is often interpreted as a result of economic non-consumption (i.e., corner solutions due to price sensitivity), short-run consumption (infrequency of purchase), or behavioral factors (certain foods are avoided due to diet, health, and cultural reasons). This can cause incidental truncation – consumption of the good is zero as a result of the outcome of another variable, market participation. It can be assumed that short-run consumption is not a factor if purchase records span for a long enough time. When faced with a limited dependent variable in panel data, such as the one suggested here, a concentration of values at the limit (zeros) must be considered.

As suggested by Tobin (1958), explanatory variables may be expected to influence both the probability of limit responses (participation) and size of non-limit responses (consumption). If only the probability to participate is desired, then a probit analysis would be sufficient. However, when considering the effect of explanatory variables on the consumption of the limited dependent variable using a standard regression model, the assumptions of the model are violated due to a concentration of observations at the limit, and exclusion of these observations when available is inefficient (Tobin, 1958). Traditionally, the Tobit model developed by Tobin (1958) has been applied to analysis of data containing truncated or censored observations. However, this model has been shown to be very restrictive, especially when analyzing not only the participation process but the consumption process as well (Lin and Schmidt, 1984). Therefore, this study proposes using a two-step sample selection model to allow for the two stochastic processes.

Sample selection bias results from using a nonrandom sample because of an omitted variable problem (Heckman, 1979). When using household panel data, sample selection bias can occur when the household decides not to consume the food item – the household has decided to self select itself out of the sample. The biasness is a result of using a nonrandomly selected sample to estimate behavioral relationships. Following Heckman (1979), the next section will show the biasness that arises due to sample selection and outline a model that uses a two-step estimator to estimate a behavioral function by a least squares method.

3.3 Two-Step Sample Selection Model Derivation

Derivation of the biasness

As proposed by Heckman (1979), consider a random sample of *N* households. For an individual household *i*, the following two equations emerge:

(1.1) $$Y_{1i} = X_{1i}\beta_1 + \varepsilon_{1i}$$

(1.2) $$Y_{2i} = X_{2i}\beta_2 + \varepsilon_{2i} \qquad (i = 1,\ldots, N),$$

where X_{ji} is a $1\times K_j$ vector of exogenous variables and β_j is a $K_j \times 1$ vector of parameters, and

$$E(\varepsilon_{ji}) = 0, \qquad E(\varepsilon_{ji}\varepsilon_{j'i''}) = \sigma_{jj'}, \text{ for } i = i'',$$

$$E(\varepsilon_{ji}\varepsilon_{j'i''}) = 0, \text{ for } i \neq i''.$$

The equation of interest to estimate is (1.1) and the usefulness of (1.2) will be discussed further below. Using a random sample from the full population, the regression function of (1.1) could be written as

(1.3) $$E(Y_{1i}|X_{1i}) = X_{1i}\beta_1.$$

However, if data are missing for Y_1 after drawing a random sample, then the sample selection rule is applied, and $n < N$, where *n* is the number of households included in the selected subsample. The regression function of equation (1.1) using the selected subsample is

(1.4) $$E(Y_{1i}|X_{1i}, \text{selected subsample}) = X_{1i}\beta_1 + E(\varepsilon_{1i}|\text{selected subsample}).$$

If the conditional probability of the error term using the selected subsample is zero, then the two regression equations using a random sample from the full population (1.3) and the selected subsample (1.4) become the same, and least squares estimators may be used on β_1. The only cost of doing so is a loss in efficiency. However, this is not always the case.

Now suppose a rule can be applied for when to use the selected subsample: data are only available for Y_{1i} if $Y_{2i} > 0$. Consequently, if $Y_{2i} \leq 0$, data for Y_{1i} will be missing. Thus,

$$E(\varepsilon_{1i} | X_{1i}, \text{selected subsample}) = E(\varepsilon_{1i} | X_{1i}, Y_{2i} > 0)$$
$$= E(\varepsilon_{1i} | X_{1i}, \varepsilon_{2i} > -X_{2i}\beta_2).$$

Given the case that ε_{1i} and ε_{2i} are independent, so that data on Y_1 are missing randomly, the conditional mean of ε_{1i} is zero. However, in the case of using the selected subsample data are not missing randomly and the mean is nonzero. Thus, the regression function is

(2) $$E(Y_{1i} | X_{1i}, Y_{2i} > 0) = X_{1i}\beta_1 + E(\varepsilon_{1i} | \varepsilon_{2i} > -X_{2i}\beta_2).$$ [1]

The selected subsample regression equation (2) depends on X_{1i} and X_{2i}. The estimators and parameters of equation (1.1) fit on the selected subsample equation (2) but omit the final term as a regressor. Thus, as stated by Heckman (1979), the bias that results from using a nonrandomly selected sample to estimate behaviors arises from the problem of omitted variables.

Two-Step Estimator Derivation

As shown by Heckman (1979), an estimator can now be derived and used in the second step of estimation to account for sample selection bias. Assuming $h(\varepsilon_{1i}, \varepsilon_{2i})$ is a bivariate normal density, it can be shown that (Johnson and Kotz, 1972)

(3.1) $$E(\varepsilon_{1i} | \varepsilon_{2i} > -X_{2i}\beta_2) = \frac{\sigma_{12}}{(\sigma_{22})^{\frac{1}{2}}}\lambda_i,$$

(3.2) $$E(\varepsilon_{2i} | \varepsilon_{2i} > -X_{2i}\beta_2) = \frac{\sigma_{22}}{(\sigma_{22})^{\frac{1}{2}}}\lambda_i,$$

where

---

[1] It is important to note that equation (2) collapses to the Tobit model when $X_{1i} = X_{2i}$, $\varepsilon_{1i} = \varepsilon_{2i}$ and $\beta_1 = \beta_2$.

$$\lambda_i = \frac{\phi(Z_i)}{1-\Phi(Z_i)} = \frac{\phi(Z_i)}{\Phi(-Z_i)},$$

where ϕ and Φ are the density and distribution function for a standard normal variable, respectively, and

$$Z_i = -\frac{X_{2i}\beta_2}{(\sigma_{22})^{\frac{1}{2}}}.$$

The inverse Mills ratio is λ_i. It is a monotone decreasing function of the probability that an observation is selected into the sample (i.e. $Y_{2i} > 0$). The final term in equation (2) can now be replaced with equations (3.1) and (3.2) thus yielding the following regression equations

(4.1) $$Y_{1i} = X_{1i}\beta_1 + \lambda_i\gamma_1 + e_{1i},$$

(4.2) $$Y_{2i} = X_{2i}\beta_2 + \lambda_i\gamma_2 + e_{2i},$$

where γ_j is a $K_j \times 1$ vector of parameters and

$$\gamma_j = \frac{\sigma_{j2}}{(\sigma_{22})^{\frac{1}{2}}},$$

and

$$E\left(e_{1i} \middle| X_{1i}, \lambda_i, \varepsilon_{2i} > -X_{2i}\beta_2\right) = 0,$$

$$E\left(e_{2i} \middle| X_{2i}, \lambda_i, \varepsilon_{2i} > -X_{2i}\beta_2\right) = 0,$$

$$E\left(e_{ji}e_{j''i'} \middle| X_{1i}, X_{2i}, \lambda_1, \varepsilon_{2i} > -X_{2i}\beta_2\right) = 0, \text{ for } i \neq i'.$$

Additionally,

$$E\left(e_{1i}^2 \middle| X_{1i}, \lambda_i, \varepsilon_{2i} > -X_{2i}\beta_2\right) = \sigma_{11}\left[\left(1-\rho^2\right) + \rho^2\left(1 + Z_i\lambda_i - \lambda_i^2\right)\right],$$

$$E\left(e_{1i}e_{2i} \middle| X_{1i}, X_{2i}, \lambda_i, \varepsilon_{2i} > -X_{2i}\beta_2\right) = \sigma_{12}\left(1 + Z_i\lambda_i - \lambda_i^2\right),$$

$$E\left(e_{2i}^2 \middle| X_{2i}, \lambda_i, \varepsilon_{2i} > -X_{2i}\beta_2\right) = \sigma_{22}\left(1 + Z_i\lambda_i - \lambda_i^2\right),$$

where

$$\rho^2 = \frac{\sigma_{12}^2}{\sigma_{11}\sigma_{22}}$$

and

$$0 \le \left(1 + \lambda_i Z_i - \lambda_i^2\right) \le 1.$$

All the necessary information is now available to set up a procedure to estimate an equation by least squares that will account for sample selection bias.

Procedure and Application to Fluid Milk Market

If λ_i was were known through Z_i, it could be entered as a regressor in equation (4.1). Equation (4.1) could then be estimated by the means of ordinary least squares (OLS) to account for selection bias. However, the true value of λ_i is unknown, and Z_i is function of X_{2i} and β_2 implying $\lambda_i(X_{2i}, \beta_2)$. Additionally, when using the selected subsample, data for Y_{1i} are not available when $Y_{2i} \le 0$, but X_{2i} is however know for these observations using the full sample. Nevertheless, a consistent estimator of β_2 can be obtained from the first-step probit estimation by allowing Y_{2i} to become the decision to enter the fluid milk market by the *i*-th household that is modeled by the variable $MILK_i$ so that,

$$MILK_i = X_{2i}\beta_2 + e_{2i}, \text{ where } MILK_i = \begin{cases} 1 \text{ if } Y_{2i} > 0 \\ 0 \text{ otherwise} \end{cases}; \; i = 1,\ldots, N,$$

where X_{2i} is a vector of household characteristics and β_2 is a vector of parameters. Y_{2i} is the observed average quantity of fluid milk purchased per shopping trip for the *i*-th household. An estimation of β_2 can then be used to estimate λ_i to include into equation (4.1) through the following procedure:

(a) Obtain an estimate of β_2 using all *N* households from the probit model

$$\mathrm{P}\left(MILK_i = 1 \middle| X_{2i}\right) = \Phi\left(X_{2i}\beta_2\right),$$

(b) Obtain the estimated inverse Mills ratios for at least all *n* households

$$\hat{\lambda}_i = \lambda_i\left(X_{2i}, \hat{\beta}_2\right),$$

(c) Obtain $\hat{\beta}_1$ and $\hat{\gamma}_1$ from OLS regression using the selected subsample

$$Y_{1i} = X_{1i}\beta_1 + \hat{\lambda}_i\gamma_1 + e_{1i}, \qquad (i = 1,\ldots, n), \tag{5}$$

where Y_{1i} is the observed average quantity (AvQ_i) of fluid milk purchased when $Y_{2i} > 0$ ($Milk_i$ = 1) and X_{1i} is a vector of explanatory exogenous variables. These estimators are $\sqrt{N}$ -asymptotically normal (Wooldridge, 2002 p. 564). More specifically, by allowing X_{1i} to contain a constant term, prices, and household characteristics equation (5) becomes

$$AvQ_i = \alpha_0 + \alpha_1 P_i + \alpha_2 ORG_i + \alpha_3 ORG_i * P_i + \sum_{r=1}^{22}\delta_r X_{2ri} + \gamma_1\hat{\lambda}_i + e_{1i}, \ (i = 1,\ldots, n), \tag{6}$$

where AvQ_i is the average quantity of milk purchased per shopping trip, P_i is the average price paid for milk, ORG_i is a variable defining the household as organic, and X_{2ri} represents a set of household characteristics.

A test for sample selection bias can be obtained by using the estimates from the regression equation (6) through a simple *t* test. The null hypothesis of no selection bias is H_0: $\gamma_1 = 0$. The asymptotic variance of $\hat{\gamma}_1$ and $\hat{\beta}_1$ is not effected by $\hat{\beta}_2$ when $\gamma_1 = 0$. Thus, a standard *t* test on $\hat{\gamma}_1$ is valid test of the null hypothesis of no selection bias (Wooldridge, 2002 p. 564).

3.4 Characteristics Theory

A sever limitation of the neoclassical theory of consumer demand is its inability to explain why consumers derive utility from commodities as well as its inability to predict demand for new products. Realizing the limitations of the neoclassical approach, Lancaster (1966) proposed the characteristics theory to address some of the inherent limitations found in the neoclassical demand theory. The characteristics theory assumes that consumers derive utility from the characteristics or attributes inherent in a good or service. It is the intrinsic properties of a particular good that make it different from other goods that, in some instances, may be quite similar. The model developed by Lancaster (1966) makes several modest assumptions. It is not the good itself that gives rise in utility to the consumer, but the characteristics within the good. In general, it is assumed that a good possess more than one characteristic and that many characteristics will be shared by more than one good. And finally, goods in combination may create characteristics completely different than those pertaining to the goods separately.

Agricultural economists have expanded the general idea that consumers purchase goods because of the utility derived from the good's intrinsic properties to develop hedonic approaches that model price as a function of quality attributes to estimate the implicit values of product characteristics (Ladd and Martin, 1976; Ladd and Suvannunt, 1976). Hedonic modeling relies on the fact that the price of a product must be low enough relative to the prices of other products to be represented on the efficiency frontier (Lancaster, 1966). The theory states that the price of a product is a function of all its associated attributes *z*,

$$p(z) = (z_1, z_2, ..., z_n),$$

so that the marginal implicit values of the product's attributes sum up to the price paid by the consumer (Ladd and Suvannunt, 1976). The amount of attributes demanded by the consumer must be met by the amount supplied by the producer (Rosen, 1974). This implies that both consumers and producers distinguish product attributes approximately the same way and that the decisions made by each group leads to an equilibrium condition that neither consumers nor suppliers have any incentive to change (Huang and Lin, 2007).

Given the nature of Homescan data that may contain multiple observations from the same household, the error terms are likely clustered-correlated and not independently distributed. Thus, the covariance estimates obtained from applying the standard ordinary least squares estimation are likely biased, which would yield inappropriate standard errors and misleading tests of statistical significance (Brogan, 1997). The error terms in the hedonic price equation are assumed to be cluster-correlated, and the Stata program's family of commands "svy" designed for survey data (StataCorp, 2005) is used, which performs the regression procedure via the weighted least squares for survey data, to estimate the hedonic equation. Therefore, the price of milk, P_i, in the hedonic model is specified as

$$P_{it} = \alpha_0 + \sum_{n=1}^{11} \alpha_n MKT_{nit} + \sum_{r=1}^{7} \beta_r PRO_{rit} + \sum_{s=1}^{5} \gamma_s BND_{sit} + \delta_1 ORG_{it} + \sum_{v=2}^{8} \delta_v ORG_{it} * PRO_{vit} + e_{it}$$

where P_{it} is the price of milk paid by the *i*-th household in time *t*; MKT_{it} represents a set of market factors such as type of store, on-sale occasion, season, region, and location (urban) of purchase; PRO_{it} represents product attributes such as container size, fat content and the lactose-free attribute; BND_{it} represents the branding of milk such as the use of a major brand or in-store brand (private label) for conventional and organic milk; ORG_{it} represents the organic attribute of milk, and e_{it} is the error term. Interactive terms between organic purchases and product attributes are included to allow for price differentiation among the two types of milk.

The hedonic price model represents a reduced-form equation reflecting both the supply and demand influences simultaneously. Unfortunately, there is no rule-of-thumb for choosing the appropriate functional form *a priori* in regression analysis. Thus, the choice of the functional form remains an empirical issue. Due to its ease of interpretation, the linear functional form is chosen.

CHAPTER 4

DATA AND VARIABLES

4.1 Data Source

The data source of this study is the Nielsen Homescan data. This data source is rich in specific information associated with each household panelist. The panelists constitute a random sample that is representative of the U.S. population and provide purchase information of food items for at-home consumption. Linked to each panelist are key household characteristics such as income, household size, regional location, urbanization, race/ethnicity, age, education, presence of children, and marital status. Each household is supplied with a scanner device that the panelist uses at home to record grocery items purchased at all retail outlets. The household either scans the Uniform Product Code (UPC) or a designated code for random-weight purchases for each food item. Each purchase records the date, the quantity purchased, expenditure for that quantity, promotional information including whether or not the item is on sale, and detailed product characteristics. The focus of this study is to use milk purchases with an emphasis on the organic attribute.

Sales of conventional and organic milk for at-home consumption from January 2002 to December 2006 are shown in Figure 4.1. Sales figures were calculated as a representation of the United States on a monthly basis via the weighted sums method using the weights associated with each household panelist provided by Nielsen. As indicated in Figure 4.1, sales of conventional milk remained somewhat steady over the given time period at around $700 million.

May 2004 and January 2005 denoted the highest monthly conventional sales volumes of about $860 million, but leveled off again around $700 million in the last quarter of 2006. Organic milk sales for at-home consumption, on the other hand, remained very steady around $6 million for the first three years from January 2002 to December 2004. However, beginning in January 2005 through April 2006, sales of fluid milk for at-home consumption averaged monthly increases of almost $960,000. Organic milk sales reached its height for the given time period in April 2006 at almost $24 million. The organic sales figures are most noticeable in Figure 4.2 along with organic market shares of total monthly fluid milk sales. Organic market shares roughly follow the organic sales volumes due to relatively steady sales of conventional milk. At its highest point, organic market shares of fluid milk for at-home consumption reached just over 3% for the month of April in 2006.

The incredible increases in monthly sales for organic milk maybe expected due to the large increases in demand for organic milk reported in that time period. Theresa Marquez, chief marketing executive for Organic Valley, the US's largest organic cooperative, reported that Organic Valley's overall dollar sales were up 39% in 2006, led by fluid milk (*NBJ*, 2007). Marquez also reported that Organic Valley "had to drop out of [Wal-Mart's] program a couple of years ago because of the shortage of milk," referring to Organic Valley's decision in December 2004 (*NBJ*, 2007). The USDA reported certified organic milk cows in 2002 at 62,207 and at just over 74,000 in both 2003 and 2004 (USDA-ERS, 2008). However, possibly due to the growing demand for organic milk, organic certified milk cows rose to 87,082 in 2005 (USDA-ERS, 2008). The increased production of organic milk in 2005 helped meet the increased demand, resulting in record sales figures for organic milk.

For the purpose of this study, data from 2006 are used as it is the most recent. Total enrollment in the Homescan panel for 2006 was 7,534 households, but to avoid would-be data problems resulting from incomplete reporting, only those households that report purchases for at least 10 months, leaving 7,457 households are included. Panelists do not explicitly report prices; they report total expenditure and the quantity of milk purchased. Prices for organic and conventional milk are derived as unit values – the ratio of reported expenditures to the reported quantities for each purchase record, net of any promotional and sale discounts. In order to avoid potential problems stemming from inadvertent reporting errors, derived unit values greater than the sample mean plus three standard deviations are considered outliers and thus excluded from the sample.

Each purchase record is then identified by type (organic, lactose-free, or conventional), fat content (nonfat/skim, low-fat, whole, or unknown), container size (quart, half gallon, gallon, or other), and branding (major, minor/regional, and in-store private label brands) according to the appropriate coding supplied in the data by Nielsen. To categorize milk into three fat contents the definitions of fat contents as defined by U.S. Food and Drug Administration are used (Kurtzweil, 1998). ‘Nonfat/skim’ milk has less than 0.5 grams of milk fat per cup, ‘low-fat’ milk has less than 4.7 grams of milk fat per cup[1], and ‘whole’ milk has 8 grams of fat per cup (Kurtzweil, 1998). Purchases recorded as ‘other’ container sizes or ‘unknown’ fat contents are excluded from the hedonic analysis only (make up 1.7% of total records).

Table 4.1 shows purchase frequencies and percentage of purchases across container size and fat content for conventional and organic milk. Low-fat milk makes up the largest proportion of both conventional (53.5%) and organic (47.1%) milk purchases. The percentage of nonfat/skim milk purchases is about the same for conventional (28.4%) and organic (27%) milk.

[1] The definition of ‘low-fat’ includes milk labeled as 0.5%, 1%, 1.5%, 2% and reduced/low fat.

Organic whole milk is bought slightly more often (24.8%) than conventional whole milk (18.1%). However, purchase differences among container sizes across types of milk are more evident. Conventional milk is bought in gallon containers most frequently (58.8%) and organic milk is clearly predominantly purchased in half gallon containers (86.9%). Purchases of organic milk in quarts are rare, making up only 2.3% of total purchases, whereas conventional quarts are bought 7.1% of the time. Likewise, gallon purchases of organic milk are also low (10.9%). The findings across container size are not surprising. Other studies have also found that organic milk is largely available only in half gallon containers (Glaser and Thompson, 2000; Grebitus et al.2007), whereas conventional milk is more likely available in a variety of container sizes.

For the purpose of modeling participation and consumption, purchase data is aggregated into annual data. The disaggregated cross-sectional data set is used for the hedonic pricing model as described in the previous chapter. After aggregation of purchase information, households that purchased milk at least once are defined as milk-purchasing households, and these households are further defined as either organic or conventional. If the household purchased organic milk at least once during 2006, that household is defined as organic. Otherwise, the household is defined as conventional.

An aggregated data set containing all 7,457 households in the panel regardless of purchase behavior will be used in the two-step sample selection model discussed in the previous chapter. From this data set a subset of milk consuming households is created—those households that purchased milk at least once during 2006. There are 7,013 such households called the “milk panel.” After distinguishing households as either organic or conventional, there are 6,625 households in the “conventional panel” and 388 households in the “organic panel.” Because the milk panel represents only those households that have decided to purchase milk, this panel will be used in the probit analysis to determine probabilities associated with household characteristics that influence the decision to go organic. To reinforce the need of this analysis, as indicated in Table 4.2, household characteristics for the conventional and organic panel can differ substantially across purchase behaviors and household characteristics. Moreover, the means for several of these variables are statistically different. Further explanations of the variables are discussed in the following section.

4.2 Variables and Summary Statistics

The average quantity of milk (AvQ) that each household purchases per shopping trip is defined as the annual quantity of milk purchased divided by the number purchase records (shopping trips) in which milk is bought. Therefore, this quantity can be thought of as the average amount of milk in ounces, whether it is organic or conventional, that a household buys during a typical shopping trip. In Table 4.2, the frequency represents the average number of shopping trips a household purchased milk. For example, organic households averaged purchasing milk about 25 times, or just about every other week. Conventional households exhbit similar purchase frequencies, although they tend to purchase milk more often, about 28 times per year.

The price of milk (Price) represents a household's average calculated unit price for milk in cents per ounce, accounting for all of its milk purchases, conventional and organic. As indicated in Table 4.2, organic households pay a higher price for all milk than conventional households, and the mean of these prices across conventional and organic households are statistically different. It is important to note that some organic households purchase both organic and conventional milk. Thus, average prices for milk (Price) in the organic panel will be higher than those of the conventional panel, since organic milk tends to carry a price premium. On average, conventional households paid 2.64 ¢/oz., or about $1.69 per half gallon for non-organic milk, and organic households paid 5.22 ¢/oz., or about $3.34 per half gallon for organic milk. This represents about a 98% price premium at the mean prices for organic milk, which is consistent with the literature (Glaser and Thompson, 2000; Dimitri and Venezia, 2007).

Household income (Income) is categorically defined into 19 different classes ranging from the lowest range of "under $5,000" to a medium of "$35,000-$39,999" to the highest range of "$200,000 or more." For the purpose of making statistical comparison, the midpoint of each income category is used to represent income (in thousands of dollars). As indicated in Table 4.2, a large jump in average income from the conventional panel ($58,710) to the organic panel ($71,690) is noted and that these means are statistically different from each other. Household income is additionally defined by 'Inc_pov'—the ratio of 'Income' over the federal poverty level. Identification of the likelihood of purchasing organic foods related to income levels in previous studies have had mixed results (Stevens-Garmon et al., 2007). Following Zhang et al. (2006a and 2006b), and Lin et al. (2008), the hypothesis is that an increase in income status will positively affect the probability of purchasing organic milk. However, it is unclear how income will affect quantities of milk purchased. Dong et al. (2004) found that income had little effect on consumption milk in upper state New York.

The presence of a preschool child (Child6) is defined as a child under the age of 6. Likewise, the presence of a school child (Child17) is defined as children between the ages 6 and 17. The importance of milk consumption among all children is due to the fact that milk has necessary components for growth such as vitamin D and calcium. According to the U.S. Department of Health and Human Services (HHS, 2005), children aged 2 to 8 should consume 2 cups of fat-free or low-fat milk or milk equivalent per day, and children aged 9 years and older should consume 3 cups. Therefore, it is hypothesized that the presence of younger children will have a less positive impact on quantities purchased relative to older children. The sample statistics show that the organic panel has a higher percentage (8%) of households with preschool children than the conventional panel (3%) and that they are significantly different from each other. However, the presence of school children in both panels is about the same and not significantly different. Although studies differ on the likelihood of purchasing organic milk to the presence of children, it is of traditional *a priori* expectation that the presence of preschool-age children will positively impact the probability of purchasing organic foods.

A panelist's race/ethnicity is defined as: White, African, Hispanic, Asian or none of the above (Other). It is unclear how race will affect milk purchasing habits. However, we can see in Table 4.2 that there is a shift amongst the racial composition between conventional and organic households. There is a significantly higher presence of Asian and Hispanic households in the organic panel. This reinforces previous findings that Asian and Hispanic Americans are more likely to purchase organic foods (Hartman Group, 2006; Zhang et al., 2006a).

Age of the household head is defined categorically into three age groups: less than 40 years old (Age1), between 40 and 64 years old (Age2) or over 65 years old (Age3). For households with more than one head, age is defined by the oldest head. The sample statistics indicate that the distribution of age across the conventional and organic panels differ in that there is a higher presence of younger organic consumers and lower presence of older organic consumers. While there has been some conflicting results concerning the relationship between age and organic participation, the sample statistics suggest that age negatively affects the likelihood of purchasing organic foods following studies like that of Hay (1989), Govindasamay and Italia (1999) and Zhang et al. (2006a).

Like age, education is classified into categories and the highest educational attainment of the household head is used. Households are defined as having less than a high school education (Educ1), a high school diploma (Educ2), some college experience (Educ3) or at least a college degree (Educ4). Also like age, education has been found to have some inconsistent results amongst studies. Although Table 4.2 indicates that the relationship between education and milk purchases are positively correlated in both panels, the distribution of education is more left-hand skewed for the organic panel. Only two of the education variables are significantly different from each other: those with a high school diploma (Educ2) or with a college degree (Educ4). Therefore, the descriptive statistics suggest a positive correlation between educational attainment and purchases of organic milk.

As recorded in the Homescan data, households reside in one of four regions of the United States: south, northeast, central or west. To further define geographical location in relation to city centers, households are designated as being urban or rural. A household is defined as being located in an urban area (Urban) if the household falls into one of the 52 designated market areas as defined by Nielsen. Although it is unclear how a specific region affects milk purchasing behavior, it is hypothesize that households located in urban areas will be more likely to purchase organic milk due to its increased availability in these areas. Likewise, as indicated in Table 4.2, the decrease of the presence of households purchasing organic milk relative to conventional milk in the northeast and central and an increase in the west may also be sign of availability or awareness of organic milk in these areas.

Consumers with concerns about individual health and nutrition have been found to be more likely to purchase organic foods (Harper and Makatouni, 2002; Wier and Andersen, 2003). However, the Nielsen data does not explicitly define attitudes towards personal health and nutrition. According to the U.S. Department of Health and Human Services, the Surgeon General has clear and well documented facts that cigarettes are known to be detrimental to human health (HHS, 2004). This study suggests that the consumption of cigarettes would be a good proxy for modeling a household's attitude towards a healthier diet. Purchasing information for cigarettes is available through Nielsen Homescan data. According to the Center for Disease Control and Prevention (CDC, 2007), the National Center for Health Statistics identifies a person as a smoker according to their National Health Interview Survey by answering the following two questions:

1. "Have you smoked at least 100 cigarettes in your entire life?" and
2. "Do you now smoke cigarettes every day, some days or not at all?"

If the person answer yes to question one and answers either "every day" or "some days" to question two, then that person is classified as a smoker. Unfortunately, there is no way of knowing if the household is currently smoking every day or on some days, but we can determine the number of cigarettes purchased for the given year. It is assumed cigarettes purchased by a household will be consumed by that household. Therefore, a household is defined as a smoker if the household has purchased at least 100 cigarettes for 2006. It is expected that these households will be less likely to purchase organic milk. This expectation is echoed in the sample statistics. The presence of smokers amongst organic households is half (7%) that of conventional households (15%). Such a relationship will be examined in the empirical analysis.

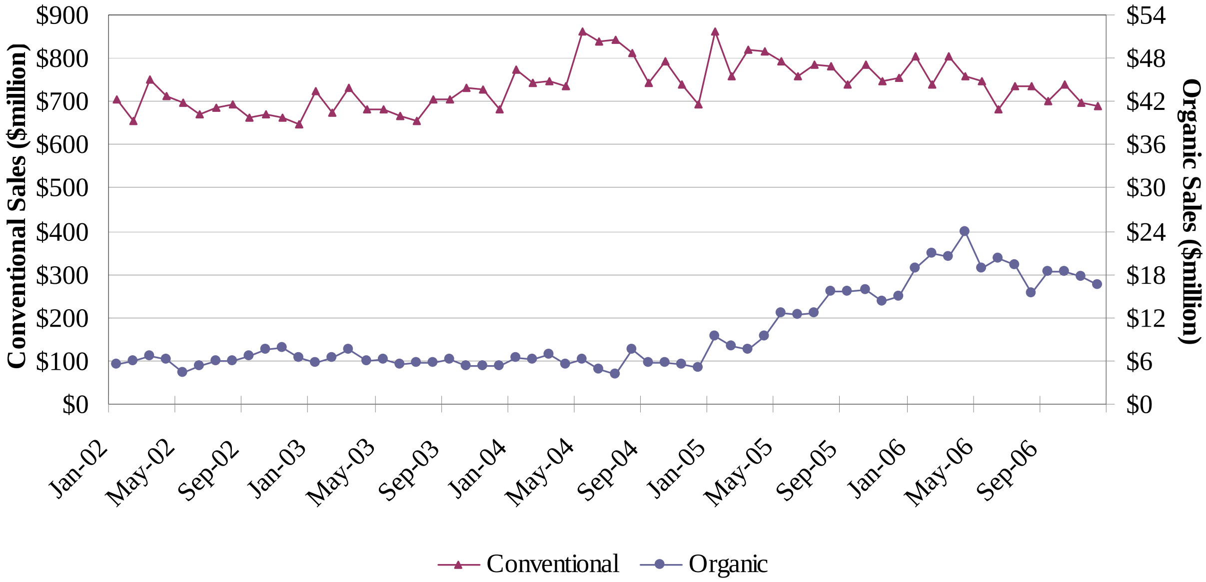

Figure 4.1. Organic and Conventional Milk Sales for At-Home Consumption, 2002-2006.

Source: Nielsen Homescan Data, 2002-2006.

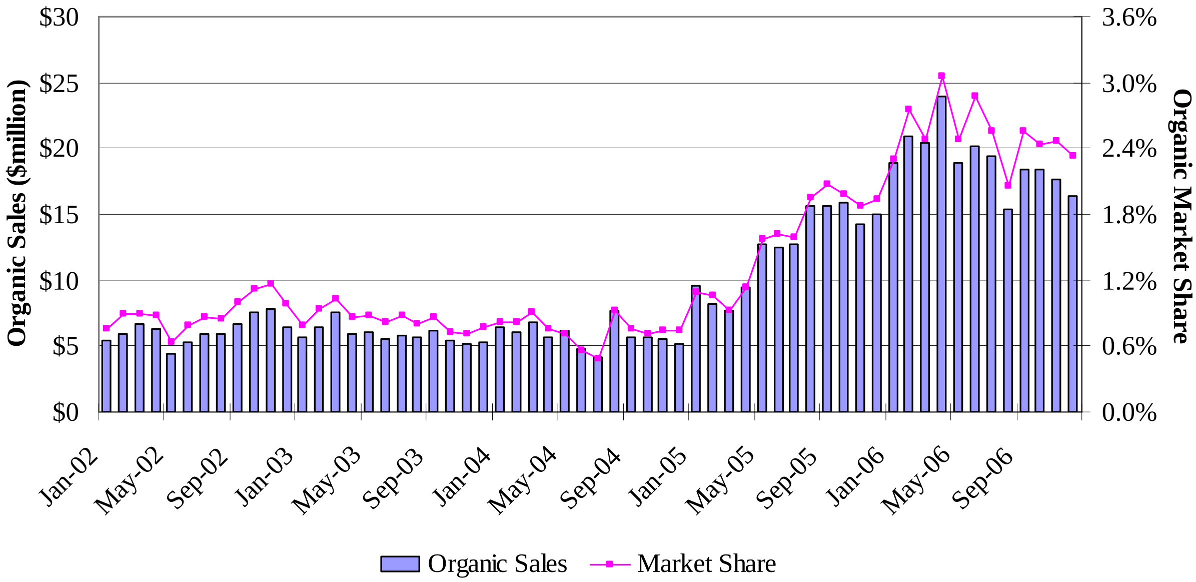

Figure 4.2. Organic Milk Sales and Market Share of Total Fluid Milk for At-Home Consumption, 2002-2006.

Source: Nielsen Homescan Data, 2002-2006.

Table 4.1. Milk Purchases Across Container Size and Fat Content, 2006.

Frequency Total % Fat content % Container size %	**Conventional** Quarts	 Half Gallons	 Gallons	Total
Nonfat/skim	**3,875** 2.09 7.35 29.44	**19,303** 10.39 36.60 30.48	**29,559** 15.92 56.05 27.06	**52,737** 28.40
Low-fat	**5,680** 3.06 5.72 43.15	**32,438** 17.47 32.65 51.22	**61,225** 32.97 61.63 56.06	**99,343** 53.49
Whole	**3,608** 1.94 10.73 27.41	**11,590** 6.24 34.46 18.30	**18,431** 9.92 54.81 16.88	**33,629** 18.11
Total	**13,163** 7.09	**63,331** 34.10	**109,215** 58.81	**185,709**

Frequency Total % Fat content % Container size %	**Organic** Quarts	 Half Gallons	 Gallons	Total
Nonfat/skim	**22** 0.56 1.99 24.72	**916** 23.28 83.05 26.80	**165** 4.19 14.96 38.64	**1,103** 27.04
Low-fat	**41** 1.04 2.21 46.07	**1,659** 42.17 89.48 48.54	**154** 3.91 8.31 36.07	**1,854** 47.13
Whole	**26** 0.66 2.66 23.21	**843** 21.43 86.28 24.66	**108** 2.75 11.05 25.29	**977** 24.83
Total	**89** 2.26	**3,418** 86.88	**427** 10.85	**3,934**

Source: Nielson Homescan Data, 2006.

Table 4.2. Comparison of Conventional and Organic Milk Consuming Households, 2006.

	Conventional Panel		**Organic Panel**		**Equality Test**
Variable	Mean	Std. Dev.	Mean	Std. Dev.	t-stat
Purchase Characteristics					
AvQ (oz.)	112.64	65.194	90.68	44.592	9.14 ***
Price (cents/oz.)	2.64	0.838	4.01	1.211	-22.12 ***
$Price_{org}$ (cents/oz.)	--	--	5.22	0.926	N/A
Frequency[a]	27.75	21.099	25.19	19.400	2.51 ***
Household Characteristics					
Income ($1,000)	58.71	38.606	71.69	44.782	-5.59 ***
Inc_pov	4.19	2.738	5.01	3.041	-5.18 ***
HHsize	2.35	1.295	2.40	1.273	-0.64
Child6	0.03		0.08		-3.73 ***
Child17	0.20		0.19		0.21
Married	0.59		0.63		-1.79 *
White	0.75		0.66		3.73 ***
African	0.13		0.09		2.26 **
Hispanic	0.07		0.15		-4.37 ***
Asian	0.04		0.08		-3.07 ***
Others	0.02		0.02		-0.48
Age1	0.10		0.19		-4.51 ***
Age2	0.62		0.60		0.86
Age3	0.28		0.21		3.20 ***
Educ1	0.02		0.01		0.78
Educ2	0.18		0.06		9.47 ***
Educ3	0.30		0.29		0.44
Educ4	0.50		0.64		-5.36 ***
South	0.38		0.38		-0.12
Northeast	0.22		0.19		1.93 *
Central	0.17		0.08		6.19 ***
West	0.22		0.35		-5.16 ***
Urban	0.86		0.93		-4.52 ***
Smoker	0.15		0.07		5.14 ***
Sample Size	6,625		388		

Source: Nielson Homescan Data, 2006.
Note: ***, **, and * indicate that the means are significantly different at least at the 1%, 5%, and 10% significance level, respectively.
[a] Average number of record entries (shopping trips) that contain a milk purchase.

CHAPTER 5

ESTIMATION RESULTS

The results of three different analyses are presented in this chapter. First, this study investigates purchase patterns in the fluid milk market by analyzing the participation process (the decision to purchase milk) and the consumption process (the quantity of milk purchased) by estimating a two-step sample selection model. Secondly, the study determines how socioeconomic factors are affecting the consumer's decision to enter the organic milk market once the choice to purchase milk has been made. A probit model[1] is used in the following section to analyze this process. Lastly, a hedonic price model is estimated to determine premiums and discounts associated with market factors, product attributes and branding, focusing on the organic attribute. Variables and definitions included in the sample selection model and the hedonic model can be found in Table 5.1 and 5.2, respectively. Parameters of all our models are estimated with the statistical software package Stata 9.0 (StataCorp, 2005).

5.1 Milk Consumption Choices Accounting for Sample Selection Biasness

For the purpose of this study, a two-step sample selection model is used to correct for the biasness from unobservable factors that occur when a household chooses to enter the fluid milk market or not. For example, the dislike of milk, presence of lactose intolerance, or philosophy

[1] Amemiya (1981) suggests using a logit model in cases with extremely large samples and with heavy concentration of observations in the tails of the distribution. However, preliminary results of both the logit and probit model using our data show no substantial differences. Thus, we chose to use the results of the probit model for ease of interpretation.

behind the perceived positive attributes associated with drinking milk are unobserved but may influence the choice to purchase milk. The aim of the model is to explain the probability of entering the fluid milk market based on household characteristics and what factors affect the quantities consumed of fluid milk once in the market. In order to compare the demand of organic milk with that of conventional milk, a variable is included that defines the household as organic or not and allow that variable to interact with price. As indicated in Table 5.3, the R^2 is 0.416 implying that 41.6% of the variation of consumption is explained by the explanatory variables. Given the use of cross-sectional data, a relatively low R^2 is expected and 0.416 is quite good. As mentioned in Chapter 3, a test for sample selection biasness can be made through a standard *t*-test of the null hypothesis of no selection bias when $\gamma_1 = 0$. The estimated coefficient of the inverse Mills ratio is significantly different than zero at least at the 1% significance level, suggesting that sample selection exists.

Concerning household characteristics, many of the variables correspond to *a priori* expectations in both the first and second step of estimation. The first step, or the participation equation, corresponds to the probability of entering the fluid milk market modeled by a probit analysis. The second step, or consumption equation, corresponds to the amounts of fluid milk consumed once in the fluid milk market modeled by ordinary least squares (OLS) accounting for sample selection biasness. Consumption levels are allowed to vary across household characteristics, prices and whether or not the household purchases organic milk. As indicated in Table 5.3, household demographics such as size, presence of children, race, and education all significantly affect participation and consumption of milk. Furthermore, estimated coefficients for household type (organic or not) and the price of fluid milk can give further insight into the relationship between the conventional and organic milk markets.

No significant relationship between ‘Income’ and the probability of entering the fluid milk market is found. The results suggest that neither participation nor consumption of milk in general is dependent upon a household’s income. Similarly, Dong et al.’s (2004) study of the fluid milk in the upper New York state area found income elasticities for milk to be insignificant.

As household size increases, the probability that the household will purchase milk increases as well. This result is expected since the larger number of household members, the greater the chance that one of the members will desire to consume milk. For each additional member in the household, a household will purchase 13.8 more ounces per average shopping trip. Surprisingly, the presence of at least one child under the age of 6 in the household has no effect on the probability of purchasing milk, although the presence of an older child (between 6 and 17 years) has a positive effect. The presence of children under the age of 6 years increases the average purchase quantity by 13.5 ounces. Likewise, the presence of a child between the age of 6 and 17 is present by 16.8 ounces. This corresponds with the notion that the presence of children in general increases a household’s purchase quantities of milk. Marital status also positively effects the household’s decision to purchase milk, and households that are married purchase 17.2 more ounces of milk on average per shopping trip than those households that are not married. While some correlation will exist between household size and the presence of children or marital status, these results can give us a better idea of how the age of children and marital status can affect consumption choices of a household.

Generally speaking, the results indicate that households of other races are less likely to enter the fluid milk market, compared to the purchasing behaviors of white households. The negative relationship could be due to the high prevalence of lactose intolerance among non-whites according to Scrimshaw and Murray (1988) and Sahi (1994). These authors have found that in the United States lactose intolerance is prevalent in 15% of whites, 53% of Mexican Americans and 80% of the African American population and reaching almost 100% in some Asian countries. Both African and Asian Americans are significantly less likely to choose to purchase fluid milk. For those African and Asian Americans that do choose to enter the fluid milk market, they consume 17.9 and 9.1 ounces less per shopping trip than whites, respectively. Likewise, Hispanics in the milk market purchase just over 4 ounces less than whites.

No significance was found to affect the probability of entering the fluid milk market among the three age groups, but differences among the age groups once the decision to purchase milk has been made do emerge. Generally speaking, age has a negative effect on quantities purchased of fluid milk. This is of no surprise since the prevalence of lactose-intolerance increases with age. Younger consumers under the age of 40 purchase 5.2 more ounces than those between the age of 40 and 64 per shopping trip, while older consumers over the age of 65 purchase just under 5 ounces less.

Household heads with an educational attainment of a college degree or beyond are less likely to purchase milk compared to any of the three other education groups. Once in the milk market, education negatively affects purchase quantities. For example, household heads with an educational attainment of less than high school purchases 14.9 ounces per shopping trip more than a household head with at least a college degree. Likewise, household heads with an educational attainment of either a high school diploma or some college purchase about 4 ounces per shopping trip more than those with a college degree.

Little evidence is found to affect the probability of entering the milk market across region and location (Urban) of the household. Those households residing in the Western region of the U.S. have a lower probability of entering the fluid milk market than those residing in the

Southern region. However, once households in the Northeastern and Central regions of the U.S. decide to buy milk, they purchase 22.3 and 5.9 ounces less than households in the Southern region, respectively. Households in the Western region of the U.S. purchase 6.5 more ounces per shopping trip than those in the South. Households in urban areas tend to purchase 3.5 ounces less milk per shopping trip and those in rural areas. These results are plausible since milk prices and preferences for milk vary across regions (Leibtag, 2005).

Households defined as organic (purchasing organic milk at least once during 2006) purchase a little over 64 ounces less per shopping trip than households that solely purchase conventional milk. Since organic milk carries a price premium, it is expected that organic households purchase smaller quantities when considering this premium. Furthermore as indicated in Table 4.1, organic milk is usually sold in half gallon containers whereas conventional milk is predominantly sold in gallon containers. Thus, it is of no surprise that organic households buy about half the quantity as conventional households.

As expected, the price of milk significantly affects the amount of milk a household consumes on an average shopping trip. Since conventional households only purchase non-organic milk, only the estimated coefficient of the price paid for all milk (Price) needs to be considered. However, to account for organic households the interactive variable 'Price*Organic' is used. Thus, an increase in price of one cent per ounce (64 cents per half gallon) induces a reduction of 38.3 ounces by conventional households, but only a reduction of 15.8 ounces for organic households. More specifically, the mean quantity and price of milk for each respective type of household found in Table 4.2 are used to estimate price elasticities of demand using the following procedure

$$\mathrm{E}_{Q,P} = \hat{P}\left(\frac{\overline{P}}{\overline{Q}}\right),$$

where $\hat{P}$ is the estimated price coefficient of milk, and $\overline{P}$ and $\overline{Q}$ are the mean price of milk and average quantity of milk bought per shopping trip for type of household (conventional or organic). Thus, the estimated price elasticity of demand for a conventional household is -0.898 and the estimated price elasticity of demand for an organic household is -0.697. Specifically, the results suggest that a 1% increase in the price of milk in general induces a 0.90% reduction in consumption by conventional households but only a 0.70% reduction by organic households, implying that organic households are somewhat less responsive to changes in the price of milk. Considering that organic households may purchase both organic and conventional milk, the smaller response to a change in the price of milk in general may reflect the organic consumer's commitment to a healthier diet that is so often associated to organic foods.

5.2 Probability of Purchasing Organic Milk

This study estimates a household's probability of entering the organic milk market based on their characteristics once the decision to purchase milk has been made. Results from the probit model are presented in Table 5.4. The estimated coefficients from the probit model do not provide any meaningful economic interpretations *per se* except that they do represent the potential change in the probability of observing organic or not. In other words, the estimated coefficients serve as an indicator of how they may affect positively or negatively the probability that a household will choose organic or conventional milk due to a unit change in a particular household characteristic. A more meaningful approach is to compute the marginal effects or marginal probabilities, which measure the change in probability of choosing organic or conventional milk with respect to a change in each household characteristic. For continuous variables (i.e. income and household size) the marginal effect is the partial derivative of the probability of entering the organic milk market, $\Pr(ORG_i = 1)$, with respect to each characteristic, X_i. However, the probability derivatives of a binary variable do not exist. Thus, the marginal effect for a given binary variable is calculated by the difference in probabilities between the two alternative categories, holding all other variables at the sample means.

The model performs quite well given that the likelihood ratio statistic, Wald χ^2, is 161.73 with 19 degrees of freedom and shows that the model is significantly different from the null or intercept-only model at least at the 1% significance level. Although the overall goodness of fit as measured by McFadden's pseudo-R^2 is relatively low, about 6%, this may be expected for a binary response model based on cross-sectional data.

For the purpose of modeling the probability of purchasing organic milk associated with household income, 'Inc_pov' is used. The ratio of household income over the federal poverty level incorporates both the household size and income. Contrary to findings on participation in the milk market in general, income has a positive effect on the probability of purchasing organic milk and is significantly different from zero at the 1% significance level. This infers that consumers do not consider their level of income when choosing to purchase fluid milk in general, but do however when choosing to purchase the more expensive organic milk. This result is consistent with previous recent findings of organic milk (Dimitri and Venezia, 2007) and with organic foods in general (Zhang et al., 2006a, 2006b; Li et al., 2007; Lin et al., 2008) that higher income households are more likely to purchase organics. However, some studies have suggested that as mainstream grocery stores replace natural and specialty food stores as the main supplier of organic foods, income could play a smaller role in the consumer's purchase decision of organic foods (Stevens-Garmon et al., 2007).

As expected, the presence of preschool age children (under the age of 6) has a positive effect on the probability of purchasing organic milk. The finding that the presence a younger child increases the probability of purchasing organic foods is consistent with the literature concerning organic foods in general (Hartman Group, 2006; Dimitri and Venezia, 2007). However, the presence of school age children (between 6 and 17 years) has no effect on the probability of purchasing organic milk. In the previous analysis concerning the decision to purchase milk in general, we found the opposite result related to the presence of children. This may infer that parents of young children under the age of 6 may be more concerned about food safety, nutrition and other related organic attributes when there are infants or younger children present in the home. Wier et al.'s (2008) study of consumers in Great Britain and Demark found that the presence of younger children significantly impacts purchases of organic foods rather than children in general. The estimated marginal effect of having at least one child under the age of 6 years suggests that the probability of purchasing organic milk increases by 4.8% versus when the household has no preschool-age children. The marital status of a household was found to be insignificant

Little evidence was found among the various races and ethnicities to affect the decision to purchase conventional or organic milk. Only Hispanic households were found to have a significant positive effect on the decision to purchase organic milk compared to the reference group, whites. This conforms to previous findings that Hispanic Americans are more likely to purchase organic foods than whites (Hartman Group, 2006; Zhang et al., 2006a). Hispanic households are 4% more likely to purchase organic milk than whites.

Although findings on the probabilities of purchasing organic foods among age groups vary across studies, the findings are consistent with that of Hay (1989), Govindasamy and Italia

(1999), and Grebitus et al. (2007) in which younger persons are more likely to buy organic foods. Among the three age groups with reference to middle-age household heads between the ages of 40 and 64, the younger households (less than 40 years of age) are more likely to purchase organic milk. Specifically, younger households are 2.5% more likely to buy organic milk. While little evidence associated with the probability of purchasing organic milk in relation to educational attainment is found, household heads with a high school diploma are found to have a decreased probability of purchasing organic milk of 3.3% in relation to those households headed by a college graduate.[2]

Significant differences emerge among region and location of the household. Households located in the Central U.S. have a negatively probability of buying organic milk, whereas those in the West are more likely go organic. As indicated in Table 5.4, the marginal probability of purchasing organic milk increases by 1.3% for households located in the West, but decreases by 2.4% for households located in the Central region compared to those in the Southern region. These results are plausible for a couple of reasons. Dimitri and Venezia (2007) found that premiums paid for organic milk over their conventional counterparts were at their lowest in the West (72%) when compared to the Northeast (126%), Central (106%) and South (89%), even though the average price for conventional milk was at its highest in the West ($2.27/half gallon) and at its lowest in the Central region ($1.85/half gallon). Given these facts, it is not surprising that consumers in the Western region would be more likely to purchase organic milk when faced with lower premiums, and likewise consumers in the Central region would be more likely to purchase conventional milk. Additionally, although only 7 percent of organic dairies are located in the West, these operations hold about a third of total U.S. organic milk cows (McBride and

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[2] It has been suggested that the correlation between income and educational attainment blurs the impact of these variables (Dimitri and Venesia, 2007; Li et al., 2007). However in our model, excluding income as a variable does not significantly change the impact of the education and vice versa.

Greene, 2007). Thus, transportation costs of organic milk may be lower, and availability and awareness may be higher in the West in comparison to other regions. The same can be thought for households located in urban areas. Urban households are more likely to be organic milk purchasers than rural households. Households located closer to central business districts may be more aware and have greater access to organic milk than those located on more rural areas. Specifically, urban households are 1.8% more likely to purchase organic milk than rural households.

Consumer concerns over food issues such a health, nutrition, and safety have been linked to the purchase behavior of organic foods (Demeritt, 2002; Hartman Group, 2006). Consumers with more concerns about nutrition and health have been found to be more likely to purchase organic foods (Harper and Makatouni, 2002; Wier and Andersen, 2003). Those concerned with food safety are also found to be more likely to purchase organic foods (Gifford and Bernard, 2004). Given the nature of the Homescan data, a unique approach is taken to model these concerns through purchase behavior.

Homescan panelists do not explicitly state their perceptions, attitudes, or opinions towards organic foods. This study proposes to test the hypothesis that the purchase of goods that are known to be detrimental to human health will be negatively correlated with the purchase of organic foods. According to the U.S. Department of Health and Human Services (USDHHS, 2008), "smoking harms nearly every organ of the body; causing many diseases and reducing the health of smokers in general." The definition of a cigarette smoker as defined in Chapter 4 by the Center for Disease Control and Prevention (CDC, 2007) is used as a proxy for the lifestyle choice of purchasing unhealthy goods. The results suggest households headed by a cigarette smoker are less likely to purchase organic milk relative to those that do not smoke. Specifically, the estimated marginal effect suggests that households defined as smokers are 2.1% less likely to purchase organic milk than those that do not smoke. This result is congruent with the initial assumption – households that purchase cigarettes, thereby putting less value on their own personal health, are less likely to purchase organic milk.

5.3 Hedonic Pricing Model Results

In this study, a linear hedonic model for the price[3] of milk as a function of market factors, products attributes and branding is estimated. The regression results are presented in Table 5.5. The R^2, a measure of goodness-of-fit, is 0.640 implying that 64% of the variation in price is explained by the independent variables. Given that cross-sectional data is used, the reported R^2 is quite high and is deemed satisfactory. The coefficients represent a change in price (cents/ounce) relative to the reference group (minor/regional branded, conventional, half gallon, nonfat/skim milk, purchased in the winter, in a southern rural area, not on-sale, or in a discount store). Overall, the estimated coefficients appear to be reasonable in magnitude and satisfactory in terms of statistical significance.

All market factors are significantly different from zero at the 1% significance level, with the exception of 'Urban.' As expected, milk sold at a discount store or on sale was priced significantly lower. Milk sold at a discount store is priced 0.23 ¢/oz. (15 cents per half gallon) less than milk sold through other venues, and milk on sale is discounted 0.33 ¢/oz. (21 cents per half gallon) below the regular price. Additionally, seasonal variation is also evident from the estimated results and represents the smallest variation among all estimated results. This is expected since dairy farmers are paid a relatively uniform price under the Federal Milk

[3] All prices are computed as a unit price paid by dividing total expenditure, net of any promotional and sales discounts, by the total quantity purchased.

Marketing Order according to marketing area (Agricultural Marketing Service, 2008). The Federal Milk Marketing Order insures a minimum price calculated on a monthly basis that the buyer, or handler, must pay the dairy farmer (Agricultural Marketing Service, 2008). Prices of milk in the spring were 0.03 ¢/oz. more than those in the winter, but were 0.03 and 0.04 ¢/oz. less in the summer and fall, respectively. Average monthly prices given to dairy farmers in dollars per hundredweight reflect the estimated season variation in 2006 (Agricultural Marketing Service, 2006).

Estimated results for regional prices are consistent with previous research (Leibtag, 2005), in which milk prices are significantly higher in the southern region of the United States. Milk prices were at their lowest in the central region, 0.47 ¢/oz. less than prices in the south, equating to about a 30 cents price discount per half gallon of milk. Dimitri and Venezia (2007) also found milk at its lowest price in the central region. Prices are significantly lower in the east and west relative to the south constituting a price discount of 0.34 and 0.16 ¢/oz., respectively. Leibtag (2005) found that consumers in rural areas pay lower average prices for milk than those in urban areas. A possibility is that urban consumers are purchasing milk in smaller containers, whereas rural consumers may purchase milk in larger containers, thus leading to lower calculated average prices. However, the model is controlling for other factors such as container size, and no significant difference in prices paid for milk by urban and rural households is found.

Product attributes such as the lactose-free attribute, container size, and fat content all significantly affect the price of milk. As expected, consumers pay a large premium of 1.84 ¢/oz. for lactose-free milk due to the increased manufacturing costs of removing lactose. As with many goods, purchasing products in bulk packaging, or in our case—larger container sizes, carries a price discount. The estimated results suggest that the price of a quart of milk is 0.68

¢/oz. more expensive than a half gallon container. Likewise, the price of a gallon of milk is 0.71 cents cheaper than a half gallon of milk. In contrast, the price of milk increases with fat content. Both the price of low-fat and whole milk is more than that of nonfat/skim milk, 0.08 and 0.20 ¢/oz., respectively. This is because milk fat, or butterfat, has a market value so that consumers have to pay a premium for the increased fat content.

Not surprisingly, the branding of milk can affect price both negatively and positively. For both conventional and organic milk, in-store (or private label) brands are significantly lower in price relative to the minor/regional brands (reference) of their respective type of milk (conventional or organic). Likewise, the price of a major brand of conventional and organic milk carries a premium. However, a difference in magnitude across the type of milk associated with branding does appear. For example, the price range (major brand premium) for conventional milk between an in-store brand (discount of 0.15 ¢/oz.) and a major branded (premium of 0.27 ¢/oz.) is 0.42 ¢/oz. Whereas, the respective price discount and premium for organic milk sold under an in-store brand or a major brand is 0.62 and 0.23 ¢/oz., equating to a price range twice that of conventional milk (0.85 ¢/oz.).

Grebitus et al. (2007) found that milk consumers in Germany were influenced by the brand of organic milk more so than the brand of conventional milk, leading them to believe that consumers may use certain brands as a cue for the credence attribute ‘organic.’ In addition to the premiums associated with major branding of organic milk, the organic attribute itself carries a large and significant price premium of 2.54 ¢/oz. The results suggest that consumers purchasing organic milk are willing to not only pay the large organic premium but also pay a larger premium for a major organic brand over an in-store organic brand. This infers that consumers place a higher value on a major organic brand compared to a major conventional brand over the in-store counterpart.

By allowing the organic attribute to interact with the lactose-free attribute, fat content, and container size, additional changes in price corresponding to each product attribute for organic milk can be tested. The estimated negative coefficient for organic lactose-free milk suggests that the lactose-free premium in organic milk (equating to 0.20 ¢/oz.) is much smaller than when sold under conventionally labeled milk (1.84 ¢/oz.). This may be due to the fact that consumers are already paying a large organic premium and may not be willing to pay much more of an additional premium for the lactose-free attribute. Nevertheless, lactose-free carries a price premium among organic milk.

As indicated in Table 5.6, the container size of organic milk further affects price. Price premiums and discounts associated with container size are 'stretched' or 'deepened' when sold as organic. For example, organic milk sold in quarts has an additional price premium of 0.73 ¢/oz. over its conventional counterpart sold in quarts equating to a total price premium of 1.41 ¢/oz. above that of a half gallon of conventional milk. However, the opposite is true for organic milk sold in gallons in which the total price discount equates to 1.26 ¢/oz. relative to a conventional gallon. Because organic milk carries such a high price premium due to additional production costs, we would expect the price premiums and discounts related to container size to increase per ounce.

Additional changes in price for organic milk associated with fat contents were only found to be significantly different between low-fat and nonfat/skim. Contrary to the findings of conventional low-fat milk (0.08 ¢/oz. premium above nonfat/skim), the negative coefficient for the interactive term between organic and low-fat suggests that organic low-fat milk has a price discount of 0.07 ¢/oz. compared to organic skim/nonfat milk, thus placing a premium on organic nonfat/skim milk over its low-fat counterpart. This premium for nonfat/skim organic milk is plausible considering the fact that consumers with concerns about individual health and nutrition have been found to be more likely to purchase organic foods (Harper and Makatouni, 2002; Wier and Anderson, 2003). The increased butterfat content in low-fat and whole milk may be viewed by the organic milk consumer as an unhealthy food choice, and thus, they are willing to pay an additional premium for the nonfat product. Even though the interactive term between organic and whole milk is not statistically significant, the positive coefficient for whole milk over nonfat/skim milk does indicate that organic whole milk has a price premium over organic nonfat/skim milk (as indicated in Table 5.4). Consumers that have a positive attitude towards cooking or enjoy cooking 'very much' have been found to be more likely to purchase organic foods (Wilkins and Hillers, 1994; Li et al., 2007). Generally speaking, whole milk is the most desirable choice of milk among our alternatives to be used for cooking due to its increase butterfat content. The results suggest that organic milk consumers are willing to pay a premium over organic low-fat milk due to increases awareness about their individual health (nonfat/skim) and their affinity towards cooking (whole).

Table 5.6 breaks down organic premiums by container size and fat content for each type of branding—in-store, minor/regional (reference), and major organic brands. Previous studies using the contingent valuation approach typically report organic price premiums as a percent above conventional prices instead of absolute dollars and cents in order for respondents to report their willingness-to-pay for organic food in relative terms. To be consistent with the literature for comparison, both the absolute price value of the organic premium and the premium as a percentage above the average actual prices of conventional milk are reported. Holding market factors constant, the organic premium in absolute value is calculated by adding together the relevant estimated coefficients for organic milk found in Table 5.5. For example, the organic premium for a half gallon of low-fat milk under a major brand accounting for all estimated premiums and discounts is 2.70 ¢/oz. ($1.73 per half gallon), which is about 92% above the average actual price paid for a gallon of low-fat conventional milk.

As indicated in Table 5.6, premiums as a percent above conventional prices for organic milk can vary from about 28% (gallon of low-fat in-store branded organic milk) to about 119% (quart of nonfat/skim major branded organic milk) depending on container size, fat content, and branding. As expected, organic premiums in terms of both absolute value and as a percentage, are negatively associated with container size due to the additional price discounts linked with buying in bulk. In general concerning fat content, low-fat milk has the lowest absolute organic premium, as well as, lowest premium as a percent above conventional milk across all branding and container sizes. Although organic whole milk has the largest premium in absolute terms amongst each brand/container size category, the premium as a percentage above its conventional counterpart can be either lower or higher than nonfat/skim milk depending on the category.

Further as expected, price premiums increase with the level of branding. Organic milk purchased under an in-store (private label) brand, which makes up about 30% of organic milk purchases, has the lowest reported premiums. Organic purchases in the reference group, representing locally branded milk and emerging minor brands, constitute only 14% of all organic purchases. The remainder and majority of organic milk purchases (56%) are made under a major organic brand. Not surprisingly, premiums for organic milk are at their highest in terms of both absolute value and percentage above conventional prices when sold under a major organic brand. Given the fact that about 87% of organic milk purchases were made in half gallon containers

(Table 4.2) coupled with the high frequency of purchases under a major organic brand, a likely conclusion is that the premium paid for organic milk mostly falls in the range of 2.70 to 2.96 ¢/oz., or about 92% to 98% above conventional prices.

The estimated organic premiums for milk are slightly higher than that of Glaser and Thompson's (2000) estimates. However, they estimate organic price premiums (regardless of the organic brand) as a percentage above conventional private label (in-store brand) and conventional branded milk separately. For example, they find that organic milk is priced between 66% and 72% above conventional in-store branded milk and between 50% and 63% above conventional branded milk for a half gallon. However, their lower estimated premiums may be linked with their data which is limited to supermarket chains and excludes other venues such as specialty and natural food stores and 'farm-to-consumer' venues such as the farmer's market. Considering that 67% of organic food was sold in specialty and natural food stores in 1998, it is likely that their data is missing an important outlet for organic foods given the time period of when their data was collected (November 1996 to December 1999) and the venue (supermarket chains). Estimated premiums presented in this study may give a more accurate representation of the organic milk market as a whole.

Table 5.1. Variables and Definitions of the Milk Panel, 2006.

Variable	**Definition**
Dependent Variable	
AvQ	Average quantity of ounces of milk purchased per shopping trip
Independent Continuous Variables	
Price	Average price paid in cents per ounce for all milk purchases
Income	Household income is the midpoint of the income class in $1,000
HHsize	Household size – number of people in a household
Inc_pov	The ratio of household income over the federal poverty level
Independent Binary Variables (1 = yes, 0 = no)	
Organic	Household is an organic milk purchaser
Child5	Presence of at least one child under the age of 6
Child17	Presence of at least one child between the ages of 6 and 17
Married	Household marital status is married
White	Household head is White
African	Household head is African American
Hispanic	Household head is Hispanic American
Asian	Household head is Asian American
Others	Household head race/ethnicity is not specified
Age1	Age of household head is less than 40 years
Age2	Age of household head is between 40 and 64 years
Age3	Age of household head is 65 years and above
Educ1	Household head's highest education is less than high school diploma
Educ2	Household head's highest education is a high school diploma
Educ3	Household head's highest education is some college
Educ4	Household head's highest education is at least a college degree
South	Household resides in the southern United States
Northeast	Household resides in the northeastern United States
Central	Household resides in the central United States
West	Household resides in the western United States
Urban	Household resides in an urban area
Smoker	Household is defined as a cigarette smoker

Source: Nielson Homescan Data, 2006.

Table 5.2. Variables Included in the Hedonic Model, 2006.

Variable	Definition
Dependent Variable	
Price	Unit value of milk (expenditure net of any promotions divided by the corresponding quantity), cents per ounce
Independent Binary Variables (1 = yes, 0 = no)	
MARKET FACTORS	
Discount	Purchase made from a superstore or club warehouse
Sale	Purchase made on sale
Season	Purchase made in a specific season (Spring, Summer, Fall, Winter)
Region	Purchase made in a specific region (Northeast, Central, West, South)
Urban	Purchase made in an urban area
PRODUCT ATTRIBUTES	
Container Size	Purchase made in a specific container size (quart, gallon, half gallon)
Fat Content	Purchase made in a specific fat content (low-fat, whole, nonfat/skim)
Lactose-free	Lactose-free milk purchase
Organic	Organic milk purchase
BRANDING	
In-Store Brand (Conventional)	Conventional milk purchase made under a grocery store's in-store private label brand
In-Store Brand (Organic)	Organic milk purchased made under a grocery store's in-store private label brand
Major Brand (Conventional)	Conventional milk purchase made under a major brand
Major Brand (Organic)	Organic milk purchase made under a major brand
Minor/Regional Brand	Conventional or organic milk purchase made under a minor/regional (other) brand

Source: Nielson Homescan Data, 2006.

Table 5.3. Sample Selection Model Results: Probability of Entering the Fluid Milk Market and the Effects on Quantities Consumed, 2006.

	Probit Participation Equation		OLS Consumption Equation	
Variable	Coefficient	Std. Error[a]	Coefficient	Std. Error[a]
Intercept	1.159 ***	0.109	156.671 ***	7.980
Household Characteristics				
Income	4.32E-5	7.63E-4	4.14E-6	0.020
Household size	0.136 ***	0.040	13.809 ***	1.370
Child under 6	0.368	0.245	13.491 ***	3.800
Child between 6 & 17	0.286 **	0.123	16.834 ***	2.723
Married	0.423 ***	0.066	17.172 ***	3.110
African American	-0.237 ***	0.068	-17.903 ***	2.262
Hispanic American	-0.108	0.105	-4.279 *	2.601
Asian American	-0.301 ***	0.122	-9.088 **	4.383
Others	-0.209	0.165	-5.484	5.326
Age less than 40	0.098	0.093	5.158 **	2.231
Age 65 and older	-0.045	0.056	-4.879 ***	1.341
Less than high school	0.330 *	0.199	14.880 *	8.186
High school	0.213 ***	0.076	4.126 *	2.156
Some college	0.185 ***	0.059	3.987 **	1.901
Northeast	-0.098	0.065	-22.285 ***	1.715
Central	0.102	0.080	-5.941 ***	1.809
West	-0.114 *	0.065	6.456 ***	1.971
Urban	-0.127	0.083	-3.455 *	2.127
Organic	--	--	-64.099 ***	8.530
Product Attributes				
$Price_{milk}$	--	--	-38.295 ***	0.900
$Price_{milk}$*Organic	--	--	22.535 ***	2.027
λ – Inverse Mills ratio	--	--	166.583 ***	31.893
Number of observations	7,457		7,013	
McFadden's pseudo-R^2	0.042		--	
R^2	--		0.416	
Log Likelihood	-1,539.1		-37,443.7	

Source: Nielson Homescan Data, 2006

Note: ***, **, and * indicate the estimated coefficients are significantly different from zero at least at the 1%, 5%, and 10% significance level, respectively.

[a] All reported standard errors are robust.

Table 5.4. Probability of Entering the Organic Fluid Milk Market, 2006.

	Probit		Marginal Effects	
Variable	Coefficient	Std. Error[a]	Coefficient	Std. Error[a]
Constant	-1.838 ***	0.111	--	--
Household Characteristics				
Inc_pov	0.023 ***	0.009	0.002 ***	0.001
Child under 6	0.370 ***	0.118	0.048 ***	0.019
Child between 6 & 17	-0.041	0.073	-0.004	0.007
Married	3.70E-4	0.055	3.58E-5	0.005
African American	-0.128	0.085	-0.011	0.007
Hispanic American	0.327 ***	0.081	0.040 ***	0.012
Asian American	0.181	0.113	0.020	0.014
Others	0.018	0.180	0.002	0.018
Age less than 40	0.221 ***	0.077	0.025 ***	0.010
Age 65 and older	-0.034	0.066	-0.003	0.006
Less than high school	-0.056	0.217	-0.005	0.019
High school	-0.423 ***	0.097	-0.033 ***	0.006
Some college	-0.008	0.059	-0.001	0.006
Northeast	-0.098	0.070	-0.009	0.006
Central	-0.294 ***	0.088	-0.024 ***	0.006
West	0.123 **	0.064	0.013 **	0.007
Urban	0.205 **	0.089	0.018 **	0.007
Smoker	-0.247 ***	0.088	-0.021 ***	0.006
Number of observations	7,013			
McFadden's R^2	0.057			
Log likelihood	-1,414.45			
Wald χ^2	155.81***			

Source: Nielson Homescan Data, 2006.
Note: ***, **, and * indicate the estimated coefficients are significantly different from zero at least at the 1%, 5%, and 10% significance level, respectively.
[a] All reported standard errors are robust.

Table 5.5. Hedonic Price Results of Fluid Milk, 2006.

Variable	Coefficient	Standard Error
Constant	3.174 ***	0.040
Discount	-0.229 ***	0.028
Sale	-0.328 ***	0.024
Spring	0.032 ***	0.007
Summer	-0.033 ***	0.006
Fall	-0.037 ***	0.005
Northeast	-0.337 ***	0.028
Central	-0.473 ***	0.019
West	-0.164 ***	0.057
Urban	-0.010	0.021
Lactose-free	1.836 ***	0.083
Quart	0.678 ***	0.055
Gallon	-0.713 ***	0.039
Low-fat	0.084 ***	0.017
Whole	0.195 ***	0.022
In-store brand (conventional) [a]	-0.148 ***	0.017
Major brand (conventional)	0.269 ***	0.083
In-store brand (organic)	-0.620 ***	0.119
Major brand (organic)	0.226 **	0.094
Organic	2.543 ***	0.096
Organic*Lactose-free	-1.639 ***	0.138
Organic*Quart	0.725 ***	0.113
Organic*Gallon	-0.545 ***	0.121
Organic*Low-fat	-0.153 **	0.073
Organic*Whole	-0.151	0.099
Number of observations	189,643	
R^2	0.640	

Source: Nielson Homescan Data, 2006
Note: ***, ** and * indicate the estimated coefficients are significantly different from zero at least at the 1%, 5%, and 10% significance level, respectively.
[a] Reference for all brands is the minor/regional brand.

Table 5.6. Estimated Organic Price Premiums in Cents per Ounce and in Percentage by Container Size and Fat Content for Each Type of Branding, 2006.

	Container Size		
	Quarts	Half Gallons	Gallons
Average Actual Prices: Conventional Milk			
Nonfat/Skim	3.50	2.96	1.97
Low-fat	3.59	2.95	2.12
Whole	3.71	3.04	2.31
- - - - - - - - Organic Premiums - - - - - - - -			
In-Store Brand [a,b]			
Nonfat/Skim	3.33 (95.09%)	1.92 (64.91%)	0.67 (33.71%)
Low-fat	3.26 (90.66%)	1.85 (62.88%)	0.60 (28.18%)
Whole	3.52 (94.78%)	2.12 (69.71%)	0.86 (37.32%)
Minor/Regional Brand [a,b, c]			
Nonfat/Skim	3.95 (112.81%)	2.54 (85.82%)	1.29 (65.12%)
Low-fat	3.88 (107.91%)	2.47 (83.90%)	1.22 (57.47%)
Whole	4.14 (111.47%)	2.74 (90.10%)	1.48 (64.19%)
Major Organic Brand [a,b]			
Nonfat/Skim	4.17 (119.27%)	2.77 (93.45%)	1.51 (76.56%)
Low-fat	4.10 (114.20%)	2.70 (91.57%)	1.44 (68.15%)
Whole	4.37 (117.55%)	2.96 (97.53%)	1.71 (73.99%)

Source: Nielsen Homescan Data, 2006.
[a] All premiums are in cents per ounce above the average conventional price of their respective container size and fat content.
[b] Percentages in parentheses are organic premiums as a percent above the average actual prices of the corresponding conventional milk.
[c] Reference brand.

CHAPTER 6

CONCLUSIONS, IMPLICATIONS, AND FUTURE RESEARCH

6.1 Conclusions

Noting the immense amount of attention to organic foods in the past years along with the ever increasing sales of organic foods, the aim of this study was to broaden the literature by examining a key component of the organic food market, organic fluid milk. Currently, few studies have used actual retail data to investigate the demand for organic milk. The study focused on milk as it is one of the first organic products that consumers try and may have some intuition into the organic food market as a whole (Demeritt, 2004). The scope of this study was to model the consumer demand for fluid milk, excluding buttermilk and flavored milk, using actual retail purchases. Data from the 2006 Nielsen Homescan panel were used to identify important consumer demographics that are associated with the participation, consumption, and price of fluid milk, focusing on the organic attribute.

In the first set of analyses, Heckman's (1979) two-step sample selection model was used to investigate participation and consumption patterns of the fluid milk market with an emphasis on the organic attribute. Through the inclusion of a two-step estimator, probable selection bias was found in the data and that the estimator potentially corrected for this biasness. The results showed that household characteristics included in the model influenced to some degree the consumer's decision to buy milk. The results suggested that fluid milk is a staple food consumed by people of all income levels and ages. The study concluded that once the decision to purchase milk was made, household heads under the age of 40 and those with children present purchased more milk per shopping trip on average than those over 40 or with no children. Additionally, regional location of the household was found to influence consumption quantities. Using the estimated results, price elasticities of demand were derived and indicated that organic households were less responsive to changes in price of milk than conventional households.

A probit model was then employed to determine the probabilities of entering the organic milk market once the choice to purchase milk was made. The model demonstrated plausible results and proved to be useful in analyzing what drives consumers to go organic. Key findings from the results showed that income and the presence of children under the age of 6 were driving factors influencing consumers to enter the organic milk market, and these findings were consistent with previous literature (Hartman Group 2002, 2006; Zhang et al., 2006a, 2006b; Dimitri and Venezia, 2007; Li et al., 2007; Lin et al., 2008). Based on previous findings linking consumer concerns of health and nutrition to purchases of organic foods (Harper and Makatouni, 2002; Wier and Anderson, 2003), the study found that consumers purchasing goods that are known and proven to be highly detrimental to one's health (cigarettes) were less likely to purchase organic milk. By using cigarettes as a proxy for modeling unhealthy consumption choices, the notion that organic consumers purchase organic foods with their health in mind is a reasonable statement.

The last set of analyses estimated a hedonic pricing model to investigate price premiums and discounts across market factors, product attributes and branding. The price of milk was found to vary significantly across market factors and product attributes. Most notably, prices were at their highest in the southern region of the U.S. and when sold in the spring. The lactose-free and organic attributes both carried a large and significant premium. Furthermore, additional price variation associated with container size and fat content occured for organic milk over its conventional counterpart. Estimated organic premiums above actual average conventional prices across fat contents and container size according to their branding ranged from about 28% to 119% above their respective conventional prices.

6.2 Implications and Future Research

The results suggest that marketing strategies by the organic milk industry towards families with young children under the age of 6 could be implemented to elicit more consumers. Coupled with the findings that a household with older children between the ages of 6 and 17 purchase more milk in general than those with younger children, it may be of interest to organic milk suppliers to try and keep their organic consumers with younger children as they reach age 6 and beyond. The findings also suggest that marketing organic milk to Hispanic households and those under the age of 40 could also increase purchases. The consumer's decision to purchase organic milk varies across regions and geographical location possibly due to awareness. Raising awareness and interest in less likely areas to purchase organic milk (the central region of the United States and rural areas) may also increase organic milk sales.

Given the relatively low availability of organic milk in a variety of container sizes, it might be of interest for organic milk suppliers to consider giving the consumer more container size options. Estimated premiums for a gallon of organic milk were quite lower than other sizes and this lower premium might be used to elicit more conventional users to purchase organic. Studies have shown that organic milk is a 'gateway food' and is one of the first organic foods that consumers purchase before entering the organic food realm (Demeritt, 2004). By increasing purchases of organic milk, it may bolster the organic food industry as a whole.

Additionally, estimated price premiums associated with organic milk give rise to future marketing implications. The large price premium range between in-store private label and a major brand of organically produced milk could help local venues capture some of the booming organic trend. In fact, in-store brand sales of organic milk are already eating away at sales of branded organic milk. In 2004 according to Nielsen Homescan data, in-store private label brands made up just 10% of all organic milk sales, while two major brands of organic milk made up 80% (Dimitri and Venezia, 2007). However, the results of the 2006 data show that sales of in-store private label brands made up over 32%, whereas the major brands of organic milk, including the two mentioned previously, made up just over 54% of organic milk sales. In contrast, private label sales of conventional milk have stayed relatively steady constituting 64% of sales in 2004 (Dimitri and Venezia, 2007) and according to the 2006 data, about 67% of sales.

This study investigated the organic milk market for one year, 2006. It would be of great interest to explore consumption patterns for other years prior to and after the implementation of the organic standards in late 2002. Additionally with the exception of the hedonic analysis, milk purchases were quantified across all container sizes and fat contents. Since organic and conventional milk are predominantly sold in different sizes, disaggregation into container sizes may be of interest to future research investigating participation and consumption of the organic milk market. Likewise, consumer demand for milk across fat content could also yield more specific results. The aim and intention of the study was to investigate the fluid milk market from three objective analyses in hopes that this study would be a stepping stone into further research into the organic milk market.

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