A COMPARATIVE STUDY OF HOUSEHOLD DEMAND FOR MEATS BY U.S. HISPANICS

A Thesis

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Dedication

This thesis is dedicated to those teachers who shared with me their knowledge and wisdom along the way during my participation in the Master of Science program at Louisiana State University. I express to you immense appreciation and gratitude for your teaching, time, and diligence.

Ad Maiorem Dei Gloriam

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Abstract

The general objective of this research project was to study the consumption behavior of U.S. Hispanics for meat products. A comprehensive review of literature on the studies of U.S. Hispanic consumers was performed by means of a systematic survey; different sources of information useful in studying Hispanic consumers were documented. The simultaneous increase in population and income of Hispanics in the United States is attractive to food companies, and makes more relevant the study of their consumer behavior patterns for discovering future market opportunities.

Censored incomplete demand systems of the LinQuad form were used for recognizing the consumption patterns of Hispanics, Whites, African Americans, and households of other minorities. The analyzed dataset was extracted from the Consumer Expenditure Survey released by the U.S. Bureau of Labor Statistics.

The estimation of elasticities required two steps; in the first step, the decision to purchase was modeled and in the second step demand equations using instrumental variables were estimated to eliminate selectivity bias. Both steps used a concatenated forward stepwise modeling approach. It was found that Full Information Maximum Likelihood (FIML) under a high level of censoring produces inconsistent own price elasticities and bigger standard errors, due to violations of multivariate normality of the error terms and high level of censoring. The discussed results come from Iterative Seemingly Unrelated Regression since it was able to produce a greater number of significant parameters and more consistent elasticities compared to FIML.

The role of ethnicity in the consumption of meat products in the U.S. marketplace was evaluated by means of a demand system that had dummy variables for comparing patterns of

Hispanics with the rest of the ethnic groups. Hispanics on average allocated more for total food expenditures, consumed more at home, and spent 21.5%, 8.1%, 5.4% more on meat products than Whites, African Americans, and households of other minorities, respectively.

Three sets of demand systems are presented. The first set includes elasticities from demand systems that only included prices and income; the second set is augmented with household size in Amsterdam scale; the third set uses the complete proposed set of demographics.

Keywords: ethnicity, LinQuad demand system, censored equations, meat consumption, selectivity bias, hispanics.

Chapter 1

Introduction

1.1 Introduction

The face of America is changing and the Hispanic population is a driving force of this change. It is predicted that by the year 2050, more than half of the U.S. population will be composed of ethnic minorities. Such predictions seem to be supported by trends in the 1990 and 2000 population census data. The 2000 U.S. Census revealed that 32.8 million Latinos resided in the United States, representing about 12 percent of the total U.S. population. Stated differently, more that one in eight people who live in the U.S. is of Hispanic origin. This would make the U.S. the third largest Hispanic speaking country in the world (U.S. Census Bureau, 2001; Humphreys, 2003).

Not only is the Hispanic population within the U.S. large but it is also the fastest growing segment of the population. The Asian and African American populations are also growing at a lower rate of growth than Hispanics. From 1990 to 2000 the Hispanic population in the United States increased by more than 50 percent. Similar to other ethnic groups, Hispanics seem to have a geographic concentration that facilitates interaction and dependence among themselves. For example, according to the 2000 Census, half of all Hispanics lived in California and Texas and 32 percent of the Texas population was Hispanic in that year. The 2000 Census reveals that the largest percentage increase in the Hispanic population occurred in the Southern region of the U.S., Florida presented the highest increase in Hispanic population growth.

The accelerating growth in the U.S. Hispanic population is paralleled by growth in purchasing power. According to Humphreys (2003), the immense buying power of the nation's Hispanic consumers will fuel the U.S. consumer market as never before. It is estimated that this

market will control about $653 billion in spending power in 2003, and it is projected that for the 1990-2008 period, the nation's Hispanic buying power will grow at a compound annual rate of 8.8 percent, which is likely to be double that of non-Hispanics. In sheer dollar power, the report of Humphreys states that Hispanics' buying power will rise up to $1,014.2 billion in 2008. Comparatively, this increases their buying power by 357 percent from 1990, relatively much higher compared to a 148 percent increase of the buying power of all consumers. It was estimated that by 2005, the buying power of Hispanics would exceed that of African-Americans.

The explosive growth in the Hispanic population and its purchasing power implies a growing market for food products. These market conditions are of interest for the food industry. Recent conferences, for example, the Expo Comida Latina, 6th Hispanic Market Boom and the 10th U.S. Hispanic Marketing conference highlight the sizeable impact this market is expected to have on the demand for food products. Likewise, this fundamental market trend is gaining the interest of the scientific community (Kisilbash and Garman (1975); Fan and Solis (1994, 1998); Holcomb, Park and Capps (1995); Fan and Lewis (1999); Lanfranco (2001); Food Marketing Institute, (2002); Lanfranco et al. (2002a, 2002b); Perkins, (2004); Zamora (2004); Ford, (2005); Kasarda and Johnson (2006)). These recent studies have shown that Hispanics may exhibit different consumption patterns compared to the rest of the U.S. population.

This study proposes to analyze the demand for meats among various ethnic groups in the U.S. to assess the empirical evidence on the demand for meats by U.S. Hispanics with that of other ethnic groups. The study will be based on a system of demand equations for disaggregated meat products using data from the 2003 Consumer Expenditure Survey released by the U.S. Department of Labor Statistics. The approach is similar to that used in Lanfranco et al. (2002a).

1.2 Background Information

The discovery of America in 1492 by Cristóbal Colón, a trader, established the beginning of the Hispanic presence on the continent. Spaniards colonized mainly the Caribbean, Central and South America, and they also had a presence in the southern states, their presence extended from California to Florida. Despite that fact, Hispanics are not mentioned in the first census of the United States in which 3, 929, 214 people were reported. Two million people of Hispanic origin were reported in 1940 (Gibson and Jung, 2002).

In the U.S. Census 2000, 281.4 million residents were counted in the United States (excluding the Commonwealth of Puerto Rico and the U.S. Virgin Islands), of which 35.3 million were Hispanic (Guzman, 2001). Thus, approximately one in eight people in the United States is of Hispanic origin. The population of the United States will continue growing, increasing up to 419.9 million by 2050 (U.S. Census Bureau, 2004b). It is predicted that by the year 2050, more than half of the U.S. population will be composed of ethnic minorities. The population projections by ethnicity are presented in Table 1.1, Hispanics by 2010 will compose almost 16% of the U.S. population, by 2030 Hispanics will be 20% and by 2050 they will comprise almost 25% of the total population.

Table 1.1 Projections of U.S. Population by Ethnicity (values in thousands).

POPULATION	2000	2010	2020	2030	2040	2050
Total	282,125	308,936	335,805	363,584	391,946	419,854
White alone	228,548	244,995	260,629	275,731	289,690	302,626
Black alone	35,818	40,454	45,365	50,442	55,876	61,361
Asian alone	10,684	14,241	17,988	22,580	27,992	33,430
All other races	7,075	9,246	11,822	14,831	18,388	22,437
Hispanic (of any race)	35,622	47,756	59,756	73,055	87,585	102,560
White alone, not Hispanic	195,729	201,112	205,936	209,176	210,331	210,283

Source: U.S. Census Bureau.

The U.S. Census Bureau identifies Hispanic people on the basis of a question that asked for self identification of the person's origin or descendancy. Respondents were asked to select their origin (or the origin of some other household member) from a flash card listing ethnic origins. Persons of Hispanic origin, in particular, are those who indicated that their origin was Mexican-American, Chicano, Mexican, Mexicano, Puerto Rican, Cuban, Central or South American, or other Hispanic (U.S. Census Bureau, 1993).

In the period 1990-2000, the U.S. population grew 32.7 million for an overall rate of growth of 13%; the Hispanic populations grew by 12.9 million with a rate of growth of 58% (U.S. Census Bureau, 2001). This fact makes the U.S. the third largest Hispanic speaking country in the world (Humphreys, 2003).

Not only is the Hispanic population within the U.S. large but it is also the fastest growing segment of the population. It is growing at a rate many times faster than that of the average population. The Asian and African American populations are growing also, but at a lower rate than that of Hispanics. From 1990 to 2000 the Hispanic population in the United States increased by more than 50 percent. Similar to other ethnic groups, Hispanics seem to have a geographic concentration that facilitates interaction and dependence among themselves. For example, half of all Hispanics lived in California and Texas in 2000, and about 32 percent of the Texas population was Hispanic in that year. The Census 2000 (2004a) reveals that the largest percentage increase in the Hispanic population occurred in the Southern region of the U.S., with Florida being the leader.

According to data from the 2000 U.S. Census (2004a), almost 50% of Hispanics are White. The median age for Hispanics is 25.8 years. Hispanics are younger compared to the average of the U.S. population of 35.3 years. There are 9,222,402 Hispanic households of which

94% percent of the Hispanic population is comprised. The average Hispanic household is comprised of 3.62 members compared to the average American household with 2.59 members. Hispanics are more likely to live in rented housing; almost 54.3% of Hispanics live in those conditions. Most Hispanics are of Mexican origin, followed by Puerto Rican, Central American, South American, and Cuban.

Hispanics are not only important for population growth but also for business expansion. Businesses owned by Hispanics in the United States totaled 1.2 million in 1997, employing over 1 million people and generating nearly $200 billion in revenues (U.S. Department of Commerce, 1997).

Hispanics, in addition to owning companies, also participate actively in the economy, despite the fact that Hispanic workers earn less than non-Hispanic White workers. Among full-time year-round workers in 1999, 23.3 percent of Hispanics and 49.3 percent of non-Hispanic Whites earned $35,000 or more. The proportion of workers making $50,000/year or more was 9.6 percent of Hispanics compared with 27.4 percent of non-Hispanic Whites (Therrien and Ramirez, 2000).

The simultaneous increase in population and income of Hispanics in the U.S. is attractive to food companies, and makes more relevant the study of their consumer behavior patterns for discovering market opportunities. As Nevaer (2004) expressed regarding Hispanics, it is a diverse market fragmented by demographic, economic and social conditions; divided also by language, acculturation levels, and income levels; nevertheless they also present unlimited opportunities accompanied with a myriad of challenges that marketers need to address. The impact of Hispanics in the U.S. food marketing has also been recognized in the scientific community (Kisilbash and Garman (1975); Fan and Solis (1994, 1998); Holcomb, Park and

Capps (1995); Fan and Lewis (1999); Food Marketing Institute, (2002); Lanfranco, (2001, 2002a, 2002b); Perkins, (2004); Zamora (2004); Ford, (2005); Kasarda and Johnson (2006)).

Three main studies have been published regarding the purchasing power of Hispanics. The U.S. Department of Commerce (2000) forecasted the aggregate purchasing power of minorities. According to their results, it will reach $4.3 trillion (1998 dollars) by 2045. The overall population is expected to increase the purchasing power from $6.5 trillion in 2000 to $13.4 trillion by 2045. Hispanic Intelligence® (2005) reports that the Hispanic segment of the U.S. economy might reach $1 trillion by 2010. Their estimates are based on data released from the U.S. Census Bureau.

Disposable personal income is personal income less personal tax and non-tax payments. It is the income available to persons for spending or saving (U.S. Department of Commerce, 2000; Humphreys, 2003). Humphreys defines buying power as the share of total personal income that is available for spending on personal consumption, personal interest payments, and savings held by individuals. Disposable personal income per capita grows overtime in the U.S. economy (Bureau of Economic Analysis, 2005).

Humphreys (2003) reports that Hispanics, by 2008, will record $1,014.2 billion in purchasing power, an increase of 357% from $222 billion estimated in 1990; the experienced growth of Hispanic purchasing power will occur at a higher rate than any other ethnic group in the United States.

According to Humphreys (2003) the immense buying power of the nation's Hispanic consumers will fuel the U.S. consumer market as never before. It was estimated that this market will control about $653 billion in spending power in 2003. It was projected that for the 1990-2008 period, the nation's Hispanic buying power would grow at a compound annual rate of 8.8

percent, which is twice the rate of growth for non-Hispanics. Comparatively, this would increase the buying power by 357 percent from 1990 relative to a 148 percent increase for all consumers. It was estimated that by 2005 the buying power of Hispanics would exceed that of African-Americans.

Recent studies have shown that Hispanics may exhibit different consumption patterns compared to the rest of the U.S. population. Growth of the Hispanic population and its purchasing power makes significant the understanding of their consumption patterns. Such consumption patterns affect the demand for goods and services provided by companies operating in the United States.

Consumption patterns can be explained by Engel curves, single demand equations, and systems of demand equations. Engel curves are generally referred to the linear representation between the quantity demanded for a single good and income (Perloff, 2004). Basically, individuals make purchase decisions based on their income, preferences and economic behavior. Aggregate Engel curves provide a good representation of the state of a particular market, making available the economic behavior of individuals by analyzing the allocation of expenditures overtime. It has been shown that income distribution is an important determinant of aggregate food consumption (Chambers and Pope, 1992).

Hispanics have their own culture, traditions and food consumption habits. The growth of the U.S. Hispanic market will have impacts on the demand for food, specifically ethnic foods that tie consumers to their country of origin; Batres-Marquez, et al. (2001) and Zamora (2004) have also acknowledged this argument.

The Center for Agricultural and Rural Development, Batres-Marquez, et al. (2001), surveyed the attitudes of U.S. Salvadorans toward ethnic foods; respondents indicated that the

three most important reasons for not consuming Salvadoran foods were availability, low quality, and high prices. This study failed to provide the effect of prices and income in the quantities consumed, and the survey was administered to a sub-segment of the U.S. Hispanic market.

Zamora (2004) showed that people of Central American Origin (CAO) prefer beans from their home country (Guatemalans, Hondurans, Nicaraguans, Salvadorans) and are willing to pay a premium price for them. Zamora states that the concentration of each CAO group varies from city to city. In cities with a high concentration of a specific CAO group, it is more likely that Latino groceries will sell beans from that specific country. From the studies of Batres-Marquez, et al. (2001) and Zamora (2004) we learn that Hispanics have their own preferences for food.

Paulin (1998, 2003) analyzed expenditures at the aggregate level using budget shares for the periods 1994-1995 and 2000-2001 from the Consumer Expenditure Survey. The author described how expenditures are different among broad categories of items, geographic origins of Hispanics and changes in time periods. Both studies did not include restrictions on parameters from the theory of food demand systems. The estimated Engel curves for food at home in the period 1994-1995 showed that Puerto Rican and Central/South American families have different income elasticities compared to Mexicans. However, in 2000-2001 neither group presented statistically significant differences from Mexicans. Income elasticity for food at home had risen from 0.228 to 0.229 for Mexicans, while Central/South American figures fell from 0.406 to 0.303. These differences illustrated the dynamics in the Hispanic market. The author did not focus on describing the food items consumed.

Fan and Solis (1998) developed an augmented Almost Ideal Demand System (AIDS), using 23 demographic variables. They compared expenditures between Hispanics and Non-Hispanic Whites. They found that Hispanic households allocate significantly more of their

budget to food at home, shelter, and apparel and significantly less to food away from home, household equipment & operation, entertainment, education, health care, alcohol and tobacco. The authors also simulated differences in consumption among different items and ethnic groups. Income, prices, and other demographic variables were controlled in this study. The authors suggest that differences between Hispanics and non-Hispanic Whites can be attributed to cultural differences and non-economic constraints. Their findings were limited to highly aggregated expenditures, high diversity among Hispanics, data availability and possible bias caused by model specification.

Lanfranco, et al. (2000b) built semi-logarithmic Engel curves for Hispanic consumers using cross sectional data from the "Continuing Survey of Food Intakes by Individuals" (CSFII94-96). It was found that demand for particular food groups appeared to be relatively inelastic with respect to income, and demonstrated unitary elasticity with respect to household size. It was found that education was an important determinant of demand.

Also, Lanfranco, et al. (2000b) found that consumers who participated in food stamps or WIC programs are more likely to consume more pork and fats, but less sugar. Some confidence intervals ranged from negative to positive values which the authors suggested could be due to data aggregation. The parameters were estimated by OLS, using the two step Heckman procedure (HP) for sample selection bias correction.

Lanfranco, et al. (2002b) analyzed Hispanic expenditures categorized by total food, food at home and food away from home, using semi logarithmic functional forms, the OLS estimator with heteroskedasticity correction, and data from the CSFII (1994-96). It was found that Hispanics spent more in food at home when compared to the average American household, the results are not surprising given that Hispanics earn lower average incomes, and the survey

sample contained 47.6% reported income levels equals to or lower than to the poverty threshold. The household size determined higher demand for food consumed at home. Consumption of food away from home was found to increase as income increased, but its elasticity had more variation. The authors suggested that since Hispanic socialization is centered on the family, the home provides a better setting for socialization compared to eating outside the home. Consequently household composition and culture influence food consumption habits.

Lanfranco, et al. (2002a) studied the demand for 10 meat items for Hispanic Americans, African Americans, non-Hispanic Whites and a composite of other ethnic groups. The data used was the 1998 Consumer Expenditure Survey. Their approach was to use an incomplete demand system by estimating Marshallian demand functions of the LinQuad form, differentiating the demand process for purchase decisions and quantities consumed. It was found that purchasing decisions were more influenced by household size than income.

For all ethnic groups, the income elasticity was less than one, thus no item was regarded as a luxurious good. The demand for ground beef was the most income inelastic regardless of ethnicity. The differences in income elasticities and household size elasticities suggest that demand for meat products is different due to specific tastes, preferences, and income associated with individuals within each ethnic group.

This study proposes to analyze the demand for meats among various ethnic groups in the U.S. to assess empirically the difference in consumption between Hispanics, Non-Hispanic Whites, African Americans and households of Other Minorities. The study is based on a system of demand equations for disaggregated meat products using the "2003 Consumer Expenditure Survey" from the U.S. Department of Labor.

1.3 Problem Definition

In the last four decades, the U.S. Hispanic market has experienced astonishing growth in population and purchasing power, bringing unprecedented opportunities in the food market, particularly for meat products which are the largest component of the American diet. Hispanics comprise a young population group; their food preferences and elasticities are likely to evolve with the changing population, income growth, and acculturation. Because of the dynamics of Hispanics as consumers of food products, timely information on their consumption patterns and elasticities for meats must be frequently updated for it to be valuable to the food industry of the United States.

Most of the literature related to Hispanic food consumption does not take into account the interdependent nature of demand. Some studies do not include elasticities; they are merely descriptive in nature. How do meat expenditure patterns of Hispanics change? Which products are considered substitutes and complements among meat products? What is the responsiveness in consumption of meat products by Hispanics when relative prices change? What is the effect of income changes in meat expenditures? Are the parameters of the consumption relations sensitive and significant? What statistically significant differences can be found in response to changes in prices, income and socio-economic variables among ethnic groups? The aim of this research project is to provide answers to these questions; thus, market information for this segment will be generated, along with its differentiation from the economic behavior of other ethnic groups.

Consumption patterns will be recognized by the computation of own price elasticities, cross price elasticities, income elasticities, and the effects of socio-economic variables. This research project estimates an augmented censored LinQuad demand system corrected for

selectivity bias. The results for the Hispanic market segment will be compared with those of non-Hispanic Whites, African Americans, and households of other minorities.

1.4 Justification

The Hispanic population increased by 57.9 percent, from 22.4 million in 1990 to 35.3 million in 2000, the total U.S. population increased only 13.2 percent (Guzman, 2000). According to the US Census Bureau (2004b) the population projections show that Hispanics by 2050 will account for more than 100 million people in the U.S.

The U.S. Hispanic market presents unlimited opportunities for companies in the food industry and agribusinesses. Since it is a market with a constantly increasing population and that growth is accompanied by the expansion of their purchasing power. Much of this purchasing power will be spent on food. As documented in Lanfranco et al. (2002a), Hispanics commit a higher percentage of their expenditures to total food relative to other population groups, therefore, it is important to analyze the demand of food products by U.S. Hispanics.

Although, Hispanic consumers present new opportunities; their purchasing decisions are not very well understood in terms of their economic behavior. This study is expected to provide consumer information that can be used in the strategic marketing plans and business plans of new and established companies. According to Valdes (2002), the Hispanic market is composed of young people, a population constantly growing, highly characterized by diversity with different levels of geographic concentration, and households that have higher numbers of members than other ethnic groups. The Hispanic market also has high variation in terms of acculturation levels and educational attainment. Consequently this market is heterogeneous, and a comprehensive understanding of it is needed.

Researchers, corporations, agribusinesses, farmers, governmental agencies and businesses in general may benefit from the results that this study is likely to produce. This research project offers the potential for determining the impact of domestic policies in the allocation of expenditures toward food consumption. Stakeholders in Louisiana and the U.S. food industry, and in particular the meat industry, are beginning to take aggressive initiatives to serve the Hispanic market. It is now more common to find a variety of food products that cater to Hispanics. Marketing to U.S. Hispanics has been of interest to prominent companies such as ABC, Bank of America, Bayer, Capital One, Citibank, Dell Corporation, Farmer's Insurance, Kraft General Foods, Nestle, Quaker Oats, Taco Bell, Verizon, Wells Fargo, and Yahoo, among others. Hispanics spend a higher percentage of their income on food and beverages compared to White, African American and households of other minorities, bringing an unprecedented market opportunity to U.S. agriculture. As recently stated by the former Agriculture Secretary Ann M. Veneman: *"At a time when rural America is facing challenges as important as any in recent memory, the dynamic growth of Hispanic populations in rural areas offers new energy, new ideas and new directions. Today this demographic shift can serve as a powerful engine of growth and prosperity"* (Veneman, 2003).

1.5 Research Objectives

The general purpose of this research project is to study the consumption behavior of U.S. Hispanics for meat products and to estimate price and income elasticities based on classical demand theory using cross sectional data from the "Consumer Expenditures Survey".

The specific objectives are to:

1. Provide a comprehensive review of literature on the studies of U.S. Hispanic consumers.

2. Estimate a system of demand equations for the calculation of price, income, and household size elasticities for meat products consumed by various cultural groups including U.S. Hispanics, Non-Hispanic Whites, African American and households of other minorities.

1.6 Procedures

- **Objective One**

Literature on food consumption was collected and analyzed, emphasizing the demand for meat products. Many of the sources of literature were demographic and sociological because much work has been published on understanding how consumer preferences of ethnic groups tend to vary over time, perhaps through acculturation and assimilation. While initiating this project, it became clear that a single reservoir for consumer literature on U.S. Hispanics is lacking. Therefore, providing a summary of it will contribute to research efficiencies for researchers who may have an interest in the study of the Hispanic market in the future. Similarly, there is a lack of data on Hispanics which makes it difficult to obtain all required data from a single source, details on existing databases and their use in applied demand analysis is provided.

- **Objective Two**

A system of demand equations of the LinQuad form was estimated for ten meat products (ground beef, roast, steak, other beef, bacon, pork chops, ham, other pork, chicken, and canned fish) using an incomplete system of censored equations. Hispanic households will be compared to other ethnic groups (non-Hispanic White, African American and households of other minorities). This specification is similar to that used in other studies (Lanfranco et al. 2002a).

The LinQuad model has appealing properties for the estimation of demand systems (e.g. Agnew, 1998; and Lanfranco, 2002a) and is stated as:

$$(1.1) \qquad q_i = a_i + \sum_{j=1}^{K} b_{ij} p_j + g_i x \left[y - \sum_{j=1}^{K} a_j p_j - \frac{1}{2} \sum_{j=1}^{K} \sum_{k=1}^{K} b_{jk} p_j p_k \right], \; i, j, k = 1, \ldots, K$$

For example, if there are two meat products, beef (q_1) and pork (q_2), the demand equation for beef becomes:

$$(1.2) \qquad q_1 = a1 + \sum_{j=1}^{2} b_{12} p_2 + g_1 x \left[y - \sum_{j=1}^{2} a_2 p_2 - 1/2 \sum_{j=1}^{2} \sum_{k=1}^{2} b_{2k} p_2 p_k \right], i, j, k = 1,2.$$

In this final expression, the symmetry restriction has been imposed which reduces the number of parameters to be estimated. In practice, equation (1.1) is expanded to include demographic and socioeconomic variables of interest to the researcher. Heteroskedasticity is inherent in this model, and to correct for it, deflated expenditures as opposed to physical quantities serve as the dependent variable (e.g. Agnew, 1998; Lanfranco et al. 2002a) both sides of the equation are multiplied by the corresponding price. The final form of the model is augmented with socio-economic and demographic variables and is given by the following functional form:

$$(1.3) \quad e_i = p_i \left\{ a_i + \sum_{k=1}^{K} b_{ik} p_k + \sum_{l=1}^{L} d_{il} D_l + g_i \left[y - \sum_{k=1}^{K} a_k p_k - \frac{1}{2} \sum_{j=1}^{K} \sum_{k=1}^{K} b_{jk} p_j p_k - \sum_{k=1}^{K} \sum_{l=1}^{L} d_{kl} p_k D_l \right] \right\}.$$

The econometric procedure will be based on Heckman's two step approach (e.g. Heckman, 1979; Amemiya, 1985; Shonkwiler and Yen, 1999; Lanfranco et al. 2002a). The analysis will use data from the "2003 U.S. Consumer Expenditure Survey" for 10 meat products (ground beef, roast beef, steak, other beef, bacon, pork chops, ham, other pork, chicken, and canned fish).

Chapter 2

A Survey of Literature on U.S. Hispanic Consumers

This chapter is in compliance with objective one of this research project: the identification and analysis of literature related to food consumption behavior of U.S. Hispanics. The consumption of meat products is emphasized because demand systems for meats are estimated. Objective one also includes the documentation of existing sources of information useful in studying Hispanic consumers. The structure of this chapter is organized into four sections.

The first section describes the steps of the performed strategic search so that such framework helps its replication. The second section introduces previous studies related to the U.S. Hispanic market, including scientific and popular literature; it will be wide in scope, including studies from the perspectives of nutrition, marketing, and economics. The third section presents the review of books, commercial reports, marketing research companies, databases, e-retailers and wholesalers of ethnic foods. The fourth section reviews previous studies concerning demand analysis of food products with focus on differences in consumption of food products by ethnic groups. This section provides a comprehensive understanding of the consumer behavior of food, more specifically the consumption of meats by U.S. Hispanics.

2.1 Strategic Search

Information about the U.S. Hispanic food market is relatively scarce; therefore, a systematic procedure for searching relevant information was implemented. The strategic search framework is presented in figure 2.1. It shows in more detail the sequence of the performed systematic search. The search for information started with an establishment of the definition of the information needed, then, it was used to elicit keywords for identifying internal and external

sources of relevant information. Internal resources included those from the LSU library system. External resources were very diverse, ranging from powerful search engines such as google.com to websites of organizations like the Food Marketing Institute and the Agricultural Marketing Resource Center. Keywords and sources of information are presented in the appendixes A and B, respectively.

As can be seen in figure 2.1, the search started from definitions of keywords and sources of information, followed by retrieval and classification of information to be used later in further decisions that included reading of summaries, storage of document, reading, classification and citation of the document.

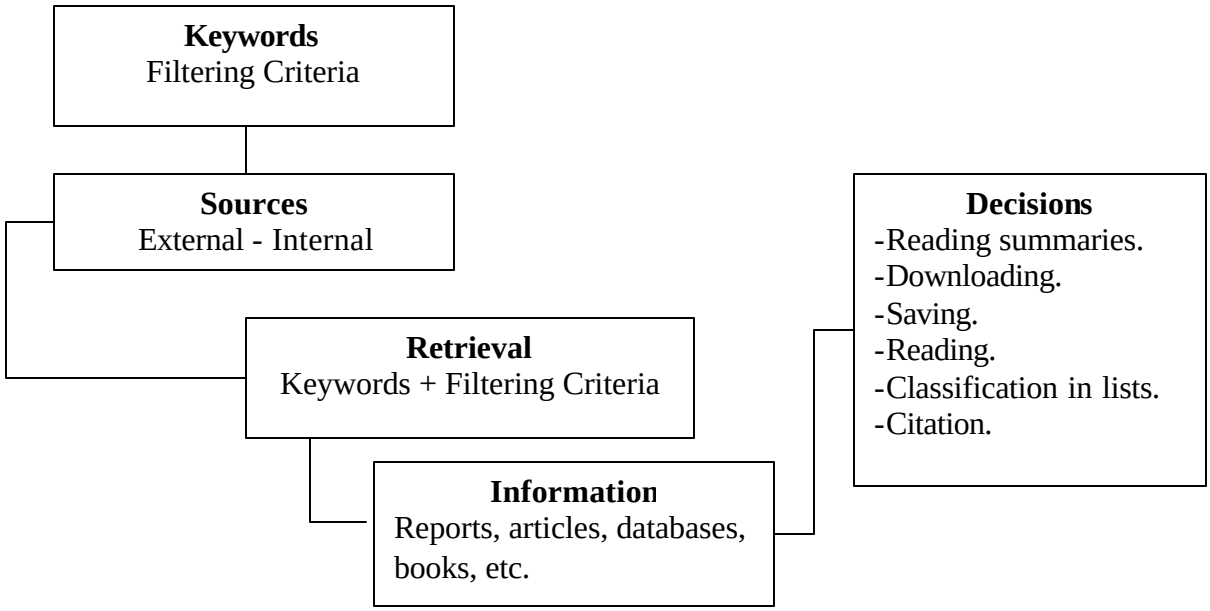

Figure 2.1: Conceptual framework for searching relevant information.

The retrieved information was filtered and classified in books, commercial reports, marketing research companies, databases, and food retailers of ethnic foods. The filtering criterion implemented consisted of classifying each piece of information on the basis of its relationship with the U.S. Hispanic food market. From the compiled information, summaries of

journal articles and books regarding the Hispanic market and multicultural marketing are presented as a preamble to the estimation of demand systems that uses censored equations of the LinQuad form.

2.2 Hispanic Market

Perhaps one of the most surprising attitudes of Hispanics as consumers is the attitude toward shopping. Hispanic retailers have had to compete with supermarket chains. In this arena, they have implemented differentiated strategies that are in accordance with the needs of the consumer and their community. Kisilbash and Garman (1975) interviewed Hispanic retailers in neighborhoods of Chicago to determine their strategies for competing with supermarkets. A total of 32% of Hispanic grocers interviewed pointed out that language and cultural affinity are the consumers' primary benefits, thus, they attract grocery shoppers. These findings imply that grocery stores that serve Hispanics, in addition to selling goods, have to provide a variety of services that fulfill more complex consumer needs. The location of the store influences the merchandising strategies. Hispanic retailers agreed that Hispanic consumers purchase most of the groceries from supermarkets, and they have to compete with them in terms of costs, prices, and by offering a variety of ethnic products that include specialty cuts of meat, bags of flour and tortillas.

The U.S. marketplace is changing in terms of demographic composition; and the marketing boards of commodities are promoting items demanded by ethnic groups. For example, Mikel (1998) recommended a set of strategies that allows members of the National Pork Board to target the ethnic market for pork, Mikel included the setting of different targeting strategies with current products and new niche markets; and targeting strategies of new niches with new products such as spicy marinated pork tenderloins, or low-fat smoked sausages. Mikel states that

niche markets formed by ethnic groups require slight variations in the product mix (price, product, place, and promotion). Mikel says that the demand of pork products can be increased by implementing strategies that promote consumption and increase brand loyalty, such strategies require the use of native language in the communication channels, appealing displays to the targeted ethnic group and consideration of ethnic demand of pork products.

Perkins (2004) mentions the efforts of some large corporations in targeting the Hispanic market. Perkins focuses on the strategy of retailers establishing close relationships with Hispanic communities. Most of his recommendations are from the marketing field, resulting from previous studies or recommendations from other consultants. Perkins recommends retailers merchandise meat products according to the tastes and preferences of Hispanic consumers through the addition of a special section with cuts that appeal to them, also he mentions the offering of processed meat products such as fajitas or marinated meats. When it comes to services, retailers may offer tools like metates, molcajetes, molinillos, comales, ollas, tomaleros, chilli pepper grills or Mexican tortilla holders. These products stimulate the consumption of meats by Hispanics. In addition, the persons who provide the services in the meat departments must be aware of the preferences in the cuts of this segment.

Perkins also discusses the role of language and culture in advertising campaigns that stimulate demand in this market. He illustrates the case of the National Pork Board, which have launched a campaign in Spanish entitled “El Cerdo es Bueno” (pork is good), so that the pork industry positions itself in this growing market; according to the National Pork Board 86% of Hispanics are pork consumers and consider pork the most delicious source of protein, and it’s the main ingredient in traditional Hispanic recipes. The campaign was initially launched in Chicago, Houston, Los Angeles, Miami, and Phoenix. Later on it was expanded to twelve other markets.

Faura (2004) portrays Hispanics as an important emerging market in the United States. First, he discusses general demographic data of this market, and then he presents language and acculturation as important factors to consider when considering targeting Hispanics of different origins, cultural and socio-economic status. The 30 most important U.S. Hispanic markets are described. Faura presents a directory of marketing research companies and a directory of media outlets and chambers of commerce associated with this market. Even though the title of his book is "The Whole Enchilada", suggesting that the book is about the Hispanic food market, Faura did not dedicate even one chapter to the food market. Faura puts into question the assertions that marketers have regarding Hispanics in the U.S. marketplace, suggesting that more research is needed for a better understanding of their consumer behavior. As can be noted, a diverse marketplace requires companies to set effective communication channels that not only stimulate demand but also keep good relations with the community where the targeted consumers reside.

Guernica (1982) analyzes the habits of media usage by Hispanics. The market is described in terms of demographics from the 1980 U.S. Census as it affects behavior of consumers. In addition, he presents a directory of media outlets for reaching the Hispanic market in the U.S.

Guernica provides recommendations for taking strategic advertisement decisions for targeting Hispanics. According to Guernica, Hispanics are less likely to use print media, and prefer radio and television. Radio and television media create a relationship with the community by providing news from the country of origin and local information that may help them to reach the American dream, information that may relate to issues of migration, labor issues, educational opportunities and so forth. Guernica states that radio and television programming is set in such a way that consumers will be comfortable, feeling rewarded with credible and relevant

information; the programming is also family oriented. Guernica arguments that U.S. Hispanics prefer Spanish language television over English language television. In addition to discussing the history of migration to United States, Guernica presented a brief history of the country of origin of Mexicans, Puerto Ricans and Cubans. A brief tabulation of consumption habits is presented, but meat consumption is not considered.

The pride that Hispanics have expressed in their heritage indicates that they will retain predictable behavior patterns directly related to the Hispanic culture, like having close family ties, respect for elders, strong sex role definition, adherence to catholic beliefs, and naturally, Spanish language use (Guernica, 1982). The implications of this argument are very important to consider when marketers try to stimulate demand for certain food products, because the culture of the individual plays a role in the decision making process of any purchase.

Valdes (2002) analyzes the Hispanic market from the perspective of the creation of advertising campaigns by making a demographic analysis of the 2000 U.S. Census. Valdes provides a segmentation approach based on life style. In the segmentation analysis, Valdes focuses on the age of the consumers, together with place of birth, the language, length of residence in the country. Valdes focuses on age because it influences the culture of the individual. Country of origin is also analyzed because it has effects on the level of acculturation, and acculturation has impacts on the decisions of purchasers and their allocation of expenditures. Language is also a variable that influences the level of acculturation that the individual possesses because it affects the process of acquiring cultural values and change that occurs within the person and how the community affects the consumer.

Valdes segments the Hispanic market according to language preferences using the AcNielsen Homescan Hispanic panel; such segmentation indicates that 36% of Hispanics prefer

Spanish only, while 33% of Hispanics prefer bilingual communication. Valdes presents some insights into consumer behavior of Hispanics but they are general and sometimes very specific for certain products; consumption habits of meats are not presented. In the final part of her book, Valdes introduces the lifestyles of Hispanics in terms of health, travel, internet use and media use. It is worthy to note that she mentions multiple times, brand loyalty of Hispanics as a factor that companies may use in developing marketing strategies. This argument has been corroborated by Patterson and Cardona (2004), evaluating brand preferences of Hispanics in New Mexico. Lastly Valdes presents a directory of organizations involved with the Hispanic market.

Herbig (1998) provides an analysis of mainstream marketing strategies applied to ethnic marketing from the perspective of cultural differences. Herbig states that *culture "is a system of communications that makes a human society possible that incorporates the biological and technical behavior of human beings with their verbal and nonverbal system of expressive behavior."* Herbig asserts that culture has an impact on the decision making process of individuals; therefore, marketers must understand cultural differences so that profitable ethnic markets are served efficiently. Herbig claims that, in the marketing process, the components of culture should be analyzed in terms of language, non verbal communication, time, life cycle, space, religion, preferences for colors and numbers, manners, customs, traditions, and food preferences. These components of culture affect the marketing process; as a result culture affects the demand for products and services.

Since culture develops in a geographic region that has a specific environment, consequently the food availability is specific; henceforth the geographic location affects the food consumption patterns of individuals belonging to a particular culture. In addition to demand,

Herbig says that culture plays a role in other components of the marketing process, specifically: standardization, research, product, advertising, promotion, sales, service, negotiation, post purchase services, customer service, and green marketing. Herbig has provided a framework for driving change in corporations that serve markets with cultural diversity, although he did not focus on any culture or commodity. Pricing was discussed in terms of the international marketplace.

Tharp (2001) describes the U.S. ethnic market from the perspectives of advertising and merchandising. The ethnic markets studied include Hispanics, African Americans and Asians. According to Tharp, the best way to penetrate the diverse Hispanic market is by developing strategies that have general appeal, because the influence of ethnicity in Hispanic purchasing decisions varies by product and service, purchase and use situation, socio-economic background, language preference, language and type of communication medium, consumer‘s individuality, and geographic location. Tharp presents different Hispanic segments that differ according to the level of acculturation and assimilation. In addition, Tharp also contrasted values of Hispanics with mainstream American values. Cultural values included family, religion, language preferences, world views, time management, human nature orientation, self perceptions and social organization. Media preferences, search strategies and buying habits are discussed briefly. Lastly, Tharp presents many cases of companies that have used ethnic marketing strategies. In summary, she mentions key tactics that have been used for increasing familiarity and demand by ethnic groups. Tharp includes the hiring of a diverse workforce, supporting community events, goodwill, aggressive sales promotion and celebrity endorsement in advertising campaigns.

Schreiber and Lenson (2000) developed their arguments in terms of how companies should strategically position their goods in the ethnic marketplace, providing practical guidance

for targeting ethnic groups. He states that companies will have competitive advantages if they follow some general recommendations like hiring diversity, segmenting ethnic groups, communications across cultures, approaching ethnic groups with multicultural marketing strategies, marketing to ethnic young teens, transforming company's culture, getting help from multicultural marketing experts, and understanding media preferences of ethnic groups.

Schreiber and Lenson present general demographics of U.S. ethnic groups such as African Americans, Asians, and Hispanics. The demographics of Hispanics are not presented in as much detail as in Valdes (2002). In addition to general demographics and ethnic marketing strategies, Schreiber also provides guidelines on how marketing plans, ethnic event sponsorship and marketing research with ethnic groups should be performed. Moreover, Valdes discusses ethnic affairs related to internet usage and health care, and Schreiber presents the results of a study made by Morehouse School of Medicine that found lack of culturally relevant health care treatment and medical information as the main causes of differences in health care of Whites and other ethnic groups. Economics is not the sole responsibility of differences in health care, the question that remains unsolved is whether or not differences in food consumption habits widen the gap in health care among ethnic groups. Finally, she recommends to segment ethnic groups and to characterize them, for offering products in accord with the segments' preferences and lastly for delivering those products through channels that effectively reach ethnic groups.

Rossman (1994) provides a historical perspective on how the diverse U.S. marketplace has evolved through migration, work, spending, acculturation and assimilation. She provides recommendations for strategies which target ethnic markets, specifically strategies related to the marketing mix, market research, identification of needs, niches, segments, positioning,

demographics, geographics, psychographics, self-identification, customer service, brand loyalty, and cause marketing.

Rossman recommends strategies for targeting African Americans, Asians, and Hispanics. The Hispanic market is presented from a cultural perspective, describing Mexicans, Puerto Ricans, and Cuban-Americans. Rossman also realizes the need for a better understanding of the Hispanic market by means of performing more accurate research, so that the market offer is in accord with the tastes and preferences of ethnic markets, thus companies will hold the brand loyalty of these consumers. Patterson and Cardona (2004) have also stated that Hispanics behave with more loyalty to brands compared to other ethnic groups.

Nevaer (2004) has characterized the U.S. Hispanic market from the point of view of politics, anthropology, sociology and even history. Nevaer presents the history of the countries of origin of Hispanics, along with the historical development of migration to the United States. Nevaer emphasizes how discrimination has occurred in Latin America and how the perception about racism is founded in differences in educational attainment and economic status. In the own words of the author, "*Hispanics are inclined to size up a person as being reasonable or unreasonable, and then to discriminate accordingly.*" Nevaer also discusses migration of Mexicans to the U.S. and the migration of Americans to México, as well as the fact that Mexican migration changed the patterns of language usage and increased the market for educational services.

Ethnicity is tied to the culture that shapes traditions and habits, in this way influences food consumption. Every ethnic group is expected to have their own food preferences, and when ethnic groups interface, food consumption habits change, some individuals are likely to add more foods to their basket while others will remove some.

Michman and Mazze (1998) characterized food industries in terms of market structure, market conduct, innovation, marketing strategies, conflict and cooperation, consumer behavior and the implications for management teams. The food industries analyzed included: fast food, ice cream, soup, breakfast, baby food, snack food, candy, soft drinks and ethnic food.

According to Michman and Mazze all the company's efforts should be framed within a strategic approach that requires the definition of the food market offer of companies delineated by the behavioral responses of the individual to economic conditions, the ethnic target market and the marketing mix preferred. Michman and Mazze, stated that companies will have sizable opportunities if they can drive necessary management changes in the company that might provide vision and expertise to marketing ethnic food to non-ethnic consumers. Before performing such recommendations, it is necessary to understand food preferences of ethnic groups, so that the generated information is later used in the marketing of ethnic food to non-ethnic populations.

In regard to the Hispanic food market, the authors refer to it as the fastest-growing ethnic market, favored with the acceptance of main stream American consumers and the potential for long term profitability. Case studies are also presented in their book, enriching its content. The recommendations of Michman and Mazze are in accordance with Miller (2005); Miller states that specialty ethnic markets present high value alternatives, lower competition, improved cash flow and higher returns, fill social and cultural needs, and lower risk by diversification. Finally Michman and Mazze say that for being successful at targeting ethnic markets requires knowledge of preferences and channels of distribution.

Cunningham (2005) advances the analysis by implying that for succeeding in ethnic markets it is also necessary to understand how ethnic consumers allocate their money, by

illustrating the pork purchasing process which involves planning, examining the level of involvement, promotions, merchandising, and advertising circulars in the meat case. This leaves unanswered the question, to what extend the findings apply to Hispanic consumers and different meat products?

2.3 Resources

Lists of resources for understanding and researching the Hispanic food market are presented. It is divided into four lists that include books, commercial reports, marketing research companies, retailers and wholesalers of ethnic foods. A useful list of books for marketing to Hispanics is presented in Appendix C. Lists are presented alphabetically by author with its year of publication, plus additional available bibliographic information. The publications presented have a theme in common: they are tightly related to the Hispanic market for food products. The series of documents cited in this research project excludes bibliographic information from this collection.

A list of commercial reports about the Hispanic food market is presented in Appendix D. The importance and relevance of the Hispanic food market in the United States has been widely recognized not only in the academic field but also in the business environment. Before purchasing commercial reports, it is advised that one evaluate such a purchase based upon the problem, information needs, and expectations in the development of marketing strategies

A list of companies that perform marketing research in the Hispanic market is presented in Appendix E. Latin Vision (2005) offers contact information for Hispanic marketing research companies, Hispanic chambers of commerce, minority business organizations, Hispanic business associations, and media corporations.

The internet boom along with the diverse U.S. marketplace has favored the growth of retailers and wholesalers of ethnic foods. Appendix F presents a sample of successful wholesalers and e-retailers of ethnic food products in the United States. As you will see when visiting this sample of companies, it is common to find manufactured foods, mainly imported from the country of origin of their target market. Some websites target specific ethnic groups, while others appeal to the general public. By visiting those websites leaves unanswered the question: can U.S. farmers and the food industry supply products that not only appeal to ethnic groups but also satisfy their appetite in accord with their food preferences?

2.4 Databases

First and foremost, this section will present resources for collection and extraction of data for unfolding food consumption patterns. The quality and type of data will determine the methodology of analysis; problems related to these matters are presented in chapter 4 in which econometrics of demand systems is exposed.

Wide spread use of computers has also made easier the use of databases for commercial purposes. Wilson (1998) has analyzed the use of databases to improve marketing techniques and customer segmentation by agricultural lending institutions. The same recommendations can be applied to the companies involved in the U.S. food marketing system. Wilson recommends the use of databases, stating that institutions must be able to implement the necessary changes that allow information sharing so that current knowledge is available to all departments. The database system must allow for an understanding of the customer in terms of loyalty, consumers' needs, networking opportunities, positioning, targeting, and segmenting.

Given the importance of database driven businesses, a summary of available databases is presented with the aim of making data available for the analysis of Hispanic food consumption

behavior. One of the concerns of econometricians, especially academic researchers that study consumer behavior, is the availability of data. Overtime, they have relied upon surveys that collect information directly from consumers. As an example Thomas (1972) mentioned the United Kingdom surveys, available since 1887, with the research work of Engel.

Since 2001 in Great Britain the government has carried out the Expenditure and Food Survey that is a merger of the British National Food Survey and the Family Expenditures Survey (British Nutrition Foundation, 2005). Individuals are sampled within a two week period, using voluntary self-reported diaries of all purchases, including food eaten out (United Kingdom National Statistics, 2005).

In the United States the USDA Agricultural Research Service has the Food Surveys Research Group (FRSG); its mission is to *"monitor and assess food consumption and related behavior of the U.S. population by conducting surveys and providing the resulting information for food and nutrition-related programs and public policy decisions."* The FRSG has been surveying consumers for studying food consumption habits since 1965. The USDA has the Food Consumption Per Capita Data System, Continuing Survey of Food Intakes by Individuals (CSFII), Nutrient Database for Dietary Studies 1.0 and the survey titled "What We Eat in America".

The ERS/USDA Food Consumption Per Capita Data System has been expanded to include three separate but related data series that each look differently at food consumption. In this system, food consumption is expressed as the amount of food available for consumption. It includes data on nutrient availability in the food supply and for the first time data on daily per capita food servings, as defined by The Food Guide Pyramid Bulletin (ERS/USDA, 2005).

In the United States, the Department of Agriculture has sampled households asking for voluntary participation in filling out a diary where purchases are recorded. The latest survey titled "What We Eat in America" is executed by the USDA Agricultural Research Service; it provides quantities for two days of food items consumed in the household plus their social, economic, and health conditions (Agricultural Research Service/USDA, 2005a).

The Agricultural Research Service (2005b) has made a survey for understanding food consumption habits of Americans, resulting in the database "Continuing Survey of Food Intakes by Individuals (CSFII)" for the years 1989, 1990, 1991, 1994, 1996, and 1998. The ARS/USDA has published a bibliographic collection of publications that have used data from the USDA Nationwide Food Surveys. It includes journal articles, bulletins, book chapters, as well as thesis and doctoral dissertations. Full integration of two nationwide dietary intake surveys occurred in 2002; the Continuing Survey of Food Intakes by Individuals (CSFII) conducted by the U.S. Department of Agriculture (USDA) and the National Health and Nutrition Examination Survey (NHANES) conducted by the U.S. Department of Health and Human Services (HHS) (USDA Agricultural Research Service, 2005a, 2005b).

Another rich source of bibliographic collections is the S-278 Research Group: Food Demand, Nutrition, and Consumer Behavior (2005). Their activities are focused on research, education needs and policy goals that are crucial to the understanding of consumer demand, household expenditures and decisions regarding nutrition, health, and food risk.

In the United States the "Consumer Expenditure Survey" (CES) executed by the Bureau of Labor Statistics (BLS) supplies information on the purchasing habits of American consumers; including their expenditures, income, and socio-economic characteristics. The CES is composed

of two survey components: the “Interview Survey” and the “Diary Survey”. They are designed to collect different types of expenditures.

The Interview Survey is designed to obtain data on the types of expenditures that respondents can recall for a period of 3 months or longer. It includes relatively large expenditures, such as those for property, automobiles, and major durable goods, and purchases that occur on a regular basis, such as rent or utilities. Each consumer unit is interviewed once per quarter for five consecutive quarters. The diary survey is designed to obtain data on frequently purchased smaller items, including food and beverages, both at home and in food establishments, housekeeping supplies, tobacco, nonprescription drugs, and personal care products and services. Each consumer unit records its expenditures in a diary for two consecutive 1-week periods. Respondents are less likely to recall such purchases over longer periods. Although the diary was designed to collect information on expenditures that could not be easily recalled over time, respondents are asked to report all expenses (except overnight travel) that the consumer unit incurs during the survey week (Bureau of Labor Statistics, 2005).

A problem with both surveys, “What We Eat in America” and the “Consumer Expenditures Survey”, is that they do not provide the decision linkage between quantities purchased and given prices. The first survey supplies quantities consumed but not prices. The second survey provides total expenditures on food items, but neither prices nor quantities are supplied. The linkage between prices, quantities, expenditures, and socio-economic characteristics is very important for uncovering authentic food consumption patterns; otherwise, merely approximations are produced. Henceforth applied economists rely upon approximate estimates using CPI information for capturing the price variation; thus, the dynamics of

consumers' responses are based upon relative prices, own socio-economic conditions and the environment in which purchases are made.

Another useful database for studying food consumption patterns is the USDA Food and Nutrient Database for Dietary Studies 1.0. It contains a database of foods, their nutrient values, and weights for typical food portions (formerly called "The Survey Nutrient Database"). It includes 10 data files, plus comprehensive documentation and a user's guide (USDA Food and Nutrient Database for Dietary Studies 1.0, 2005).

Demographic data for studying the Hispanic market can be obtained from the U.S. Census Bureau including: the Integrated Public Use Microdata Series (2005) from University of Minnesota which provides data from 1885 to 2000. The other source of demographic information is the U.S. Census Bureau, specifically from the website American Fact Finder. The U.S. Census provides much information, and depending on the analysis you might consider the use of the services of a company that specializes in the analysis of demographic information such as Claritas (2006). Another company is Infousa (2006), it provides analysis of demographic information, they provide information for targeting and selling to consumers and business thorough the sale of databases customized to the needs of the customer.

Given that the U.S. Hispanic food market is comprised of products originating from American farms and from their countries of origin. International trade data is necessary when determining supply and demand for ethnic food products. Perhaps the most useful tool for accessing Export/Import data of commodities for the United States is the "U.S. Exports and Imports of Merchandise" prepared by the US Census Bureau (2005) comes on CD-ROM and DVD-ROM, more information can be obtained from the Federal Trade Statistics subdivision of

the Census Bureau. Another source of information for analyzing Export/Import data is the International Trade Statistics database from the World Trade Organization (2005).

Even though this research project deals with cross sectional data from food surveys, the use of scanner data is explored with the aim of completing the state of the art research in demand analysis. In the last decades such data has become available from supermarkets. It is collected and distributed by database marketers. This data holds the linkage between prices and quantities consumed, although total allocation in food expenditures may not be represented, since the number of trips of the consumer to different commercial outlets is not recorded. Usually the consumer is not identified and is not followed continuously unless the panel has been defined previously. Another type of scanner data is consumer panel data, and the most well known panel data providers are AcNielsen, Information Resources Inc, and the NPD Group. Information Resources Inc. (2005) provides a variety of information obtained from scanner data for different outlets and households; in addition, this company also provides analytical services customized to their clients.

The NPD Group, founded in 1967, provides global consumer and retail information that helps manufacturers and retailers make more informed, fact-based decisions in order to optimize their businesses. According to The NPD Group many of the world's most successful companies rely on them for insight on what is selling, where and why so that they can understand and leverage the latest trends (NPD, 2005). The variety of informational services include tracking of consumers' purchases, in depth research analysis for special categories of expenditures, syndicated market research reports, customized market research, specialized market research and informational services targeted to retailers and financial institutions.

In the case of consumer panel data from AcNielsen Homescan, each household provides daily information on their purchases of consumer goods for home use. Data is collected on a continuous basis, making possible to measure the ongoing changes and interactions of households purchasing behavior across all grocery and fresh foods products. Homescan incorporates both descriptive and diagnostic information; provides information on purchaser's characteristics, purchase behavior, market penetration, share of category requirements, brand loyalty, brand switching and parallel consumption plus a wide range of other powerful analytics. The rich database not only tells you what is happening but, more importantly, it provides insights into why consumers behave the way they do (AcNielsen, 2005). AcNielsen Scantrack Ethnic Services provides information on Hispanics and African Americans at different markets, reaching 70% of the Hispanic market and 40% of African Americans.

Capps (1989) has estimated a demand system for meat products using scanner data from a store located in Houston. He found adequate predictive power, sustaining that scanner data allows for the understanding of consumer behavior patterns for developing price and marketing strategies at the retail level. Despite the benefits, he recommends being careful in making generalized conclusions from any analysis performed. Capps foresees that with proper management, scanner data may well be the ultimate data source for demand analysis at the retail level.

Cotterill (1994) reviews the use of scanner data on the demand for food products, stating that as the availability of data increases, the use of such resources for developing competitive advantages by means of quantitative analysis would increase as well. The author provides an analysis in the subject of industrial organization. Cotterill expects that "demand modeling and empirical analysis of price, advertising retailer push, and consumer pull market strategies at the

brand as well as product category or industry level will provide considerably more precise understanding of firm conduct and household behavior."

Given the massive available information from scanner data at the retail level, economic theory has been proven that provides benefits in the unfolding process of consumption patterns; perhaps one of the issues of concern with using scanner data is the aggregation process of commodities as they relate to multistage budgeting, utility trees, weak separability, strong separability and aggregation. Capps and Love (2002) have focused on aggregation issues using scanner data. They quantified a demand system for fifteen fruit juice and drink products finding that the Lebwell's procedure not only results in fewer brands to consider in a demand system, but is shown to marginally impact parameter estimates and standard errors of the non-aggregated brands. Two-stage budgeting did not reduce bias associated with conditional estimation in the last stage of the multistage budgeting approach.

Other sources of information for targeting ethnic consumers are marketing agencies. The directory titled "Multicultural Marketing in America" is an information bank of agencies, marketers, and media outlets who work on multicultural marketing published by Adweek Directories (2005). This directory provides an overview of the current status of the multicultural marketing industry in the U.S. and profiles those companies and media outlets that are creating advertising, delivering content and selling products to the multicultural consumer. The directory presents specific information for each segment; the ethnic groups included are the Hispanics/Latinos, African Americans, and Asian Americans. Within each ethnic group, profiles of the agencies are provided, including different media outlets and brand marketers, which AdWeek has identified as leaders in reaching out to ethnic consumers.

Another directory of the same nature is "The Source Book of Multicultural Experts" by Multicultural Marketing Resources Inc. (2005). This resource provides lists of experts in a wide range of industries, business leaders who are minorities and provide reliable sources of information on multicultural marketing and the demographics. It includes contact information for nearly 200 companies and individuals.

The Latin American Network Information Center (2005) presents a list of resources for researching the Hispanic market. It includes information classified in different topics including academic resources, arts, literature and humanities; business and economy, professional organizations, resources for communities, food, gender and sexuality, humor, media, music and performing arts, public affairs, popular cultural resources. Furthermore, the directory presents a list of similar directories.

So far, this section has presented a series of resources for acquiring information about the market of ethnic foods, specifically the Hispanic food market. A list of books, commercial reports, marketing research companies, databases, and e-retailers and wholesalers of ethnic foods have been presented with the aim of providing a comprehensive representation of the market for ethnic foods. Also it will aid researchers in the identification of literature and sources of data. Following this section, U.S. food consumption is discussed; the discussion is focused on the Hispanic food market for meat products.

2.5 Food Consumption

The U.S. Department of Agriculture, in the Agriculture Fact Book (2002), profiles food consumption. Total food expenditures, which include imports, fishery products, and food originating from the farm, reached $844.2 billion in 2001. Average food expenditures were $2,964 per capita and food away from home captured 47% of those expenditures, representing a

7% increase from 1981. According to the U.S. Department of Agriculture, in the new millennium America is contending with an increase in overweight adults. In 2000 62% of the adult population fell into this category, an increase of 35% from 1980. The increase in the proportion of overweight persons is due to the increase in calorie consumption, and is likely to be associated with the increase in food consumption away from home and the reduction in American's physical activity. In 2000, the aggregate food supply provided 3,800 calories per person per day which is 500 calories above the 1970 level; for a net increase of 530 calories consumed, from which 24.5% is attributed to grains and 1.5% due to meats and nuts.

After the 9/11 attacks, the U.S. Department of Agriculture (2002) has made biosecurity an important matter that has been addressed by training personnel that perform on-site food safety, consumer protection assessment, and assessments of plant's Hazard Analysis and Critical Control Point in meat and poultry plants. Also, the USDA has increased BSE testing and inspection of plants for preventing adulteration and foodborne contamination of meat and poultry products.

According to the U.S. Department of Agriculture (2002), the consumption of caloric sweeteners has shown a relatively constant consumption per capita in the last decade compared to consumption levels for the period 1950-1990. The consumption of grains has increased dramatically up to 200 pounds per capita compared to 138 pounds in the 1970's; the increase may be tied to supply shifts, demand for variety breads, instore bakery items, grain based snack foods, and an increase in sales of products made with buns, dough, and tortillas. The increase is tied also to changes in the demographics of U.S. society. Average annual per capita consumption of vegetables and fruits also has increased by 20% in 2000 compared to consumption levels of the 1970's. Total added fats and oils increased in 2000 up to 74.5 pounds per capita, a 39.51%

change in the average annual consumption per capita from the 1970's. The consumption of dairy products has increased to 593 pounds per capita in 2000, although milk consumption has decreased, consumers have preferred lower fat milk and cheese.

Per capita consumption of meats has increased up to 195.2 pounds per capita, an increase of 10.16% from consumption levels in 1970's; this increase is interesting because people have become more conscious about their health for reducing heart diseases associated with cholesterol. Per capita consumption of fish and shellfish changed from 12.5 pounds in the 1970's up to 15.2 pounds in 2000, a change of 21.6%. Likewise, per capita consumption of poultry increased from 35.2 pounds up to 66.5, a change of 88.9%. Unlike poultry, fish, and selfish consumption of read meats decreased from 129.5 pounds per capita in the 1970's to 113.5 pounds in 2000, a decrease of 12.35%, even though income per capita in the U.S. kept rising according to the U.S. Department of Agriculture (2002).

Changes in consumption per capita are driven by observed trends given that innovation in the food industry is continuous. There is more income available for food expenditures and more accessible information for the consumer as well. Borrud et al. (1996) compared daily intake of food products in the periods 1977-78 and 1994, finding that Americans are eating more grain products, drinking more noncitrus juices, and reducing intake of calories from fat. Consumption habits of meats are changing unfavorably to the consumption of red meats. The trends observed by Borrud et al. are corroborated by the findings of Blisard et al. (2002).

According to Blisard et al. (2002) annual food expenditures are expected to increase $208 billion by 2020, an increase of 26% from $800 billion in 2000. This change in expenditures is driven by changes in income, demographics and educational attainment. Changes in demographics also affect food demand, mainly through shifts in the age distribution, ethnic

diversity and total population growth. Food away from home is still not understood because the aging population is likely to prefer consuming food at home. Blisard et al. (2002) found that the increase in ethnic populations will increase per capita consumption of beef, but will increase even more the consumption of fish and poultry. According to Lanfranco (2002b), growth of the Hispanic population is expected to increase the consumption of beef.

Blisard et al. mentions that U.S. agriculture and the food industry must take into consideration the implications of tastes and preferences of the consumer. The food marketing system must be framed by a "consumer-driven agriculture," where consumers are likely to favor quality over quantity, implying that competition will take place in a marketplace that offers a variety of products with better taste, nutritional content, functionality of foods, safety and convenience.

The effect of ethnicity on food markets has been studied since the early sixties (Fan and Solis, 1994). In 1998, Fan and Solis presented a conceptual framework by which ethnicity is involved in the economic behavior of individuals; ethnicity affects culture and tradition and demographics, then they affect the taste and preferences of the individual; subsequently, besides the preferences, economic constraints and non-economic constraints are then expected to influence the economic behavior of individuals. In light of the conceptual framework of ethnicity, it is easy to see that whatever factor shapes an individual affects the individual's choices. Tharp (2001, p. 31-122) also presented a conceptual framework for describing the role of ethnicity in the consumer behavior of individuals.

Having ethnicity as a factor that influences food choices, Devine et al. (1999) used semi structured interviews for exploring ethnic identity and its influence in food choices of African American, Hispanics and Whites. They found that given a particular context ethnicity induces

the interaction of ideals, identities, and roles. Moreover, the effects of ethnicity in food choices varied by time, place, and type of food.

Harris et al. (1988) surveyed 172 students in the rural area of Chekerboard, New Mexico. Students were classified as Navajo-Jemez, Hispanics and Caucasians. Chi- square statistics were used to determine statistical differences in the food consumption of 77 food items given age, sex, and ethnicity. Ethnic differences in consumption were found for lamb/mutton, six of eight New Mexican foods, tortillas, avocados, red chile, and green chile. Enchiladas, chiles rellenos, avocados, and tortillas were eaten more by Hispanics. None of the food items presented had significant differences across ethnic groups. Few significant differences in age were found in food consumption. The analysis only covered students younger than 16, moreover, the analysis did not control for interaction between age, gender, and ethnicity.

Besides differences in ethnicity, another factor to consider in the analysis of food demand is the level of acculturation. As Aldrich and Variyan (2000) have shown, acculturation erodes the quality of the diet of Hispanics, they used data from the "Consumer Intake by individuals 1994-1996", and they used Spanish as a proxy variable for less acculturated Hispanics. Aldrich and Variyan found that this group has less knowledge of nutritional content of foods and diet-disease relationship; however, they tend to consume less saturated fat and cholesterol intake. Surprisingly, Hispanic English speakers and non-Hispanic Whites have more knowledge of nutritional content of foods and diet-disease relationship, despite that they lave lower health indexes compared to Hispanic Spanish speakers. The paper of Aldrich and Variyan (2000) tells us about the dynamic changes in the process of habit formation, and its influence in consumer behavior. Using data from the 2000 U.S. Census, Therrien and Ramirez (2000) found that 39.1% of the Hispanic population is foreign born. This finding has implications for brand loyalty, levels

of acculturation, and expenditure allocation which is correlated with the choices of food consumed by individuals. It will also have impacts at the aggregate level because market demand will differ based on the characteristics of the target market.

Besides ethnicity and acculturation, the main factor that restricts the choices of consumers in the marketplace is the income available for food expenditures. Using scanner data provided by AcNielsen, Leibtag and Kaufman (2003) found that consumers that have lower incomes are involved in different purchasing behavior. Poor people economize food expenditures, purchasing products on sale, purchasing more private label products, and purchasing less expensive meat, poultry, fruits and vegetables. The findings of Leibtag and Kaufman are in harmony with the results of previous research conducted by Fan and Stafford (1994) and Park et al. (1996).

Park et al. (1996) used data from the "National Consumption Survey 1987-88", to determine own-price, total food expenditure, and income elasticities for households segmendeted by poverty and non-poverty status for food away from home, beef, pork, chicken, fish, cheese, milk, fruits, vegetables, breakfast cereals, bread, and fats and oils. The linear expenditure system was estimated by means of a two step Heckman procedure for correcting selectivity bias from zero-expenditures. It was determined that households in the non-poverty level were more income inelastic. Total food expenditure elasticities were more elastic for households under the poverty threshold, except for fish, chicken, and fruits where non-poverty households behaved more elastically. The results for own price elasticities were mixed. Poverty status households behaved more elastic in beef, pork, fish, milk, breakfast cereals, bread, and fats and oils. The system of equations did not take into account differences in ethnicity of consumers.

Heien and Pompelli (1988) estimated a constrained (adding up, homogeneity, and symmetry) Almost Ideal System of demand equations using data from the USDA Spring 1977 Household Food Consumption Survey. The commodities included were steak, roast, and ground beef. The demand was inelastic for steak and ground beef and elastic for roast beef. Cross price effects indicated that all beef products were Hicksian substitutes. According to their findings, increases in the population of Hispanics, would increase demand for steak and decrease demand of ground beef. The most significant demographic effects came from household size, region, housing tenancy, and ethnic origin. Ethnic origin was evaluated for Whites, African Americans and Spanish (Hispanics). The effects of ethnicity were estimated, however, they were not reported.

Fan and Stafford (1994) determined through a multinomial logit regression that total expenditure, education, family composition, and ethnicity had significant effects on predicting expenditure patterns. From 13 expenditure categories, six clusters were identified. Their cluster analysis showed that Hispanics were slightly more likely to be in the food and utility dominated expenditure cluster than White households. Hispanics were also less likely to be in the expenditure clusters dominated by health care, transportation, and pleasure clusters, compared with White households. Suggesting that ethnicity plays an important role in describing consumption patterns. The data used in this analysis was originated from the Consumer Expenditures Survey 1980-1990.

Fan and Solis (1998) compared household budget allocation patterns between Hispanic Americans and Non-Hispanic White Americans using the interview section of the Consumer Expenditure Survey from 1980 to 1992. A similar analysis was performed by Fan and Solis in 1994 for data comprising the 1980-90 period. A Linearized Almost Ideal System (LAIDS)

developed by Deaton and Muellbahuer (1980) is estimated for food at home, food away from home, shelter, fuel and utilities, household equipment and operation, apparel, transportation, education, health care, alcoholic beverages, tobacco and personal care. Price and income elasticities are corrected using the formulas developed by Alston et al (e.g. Fan and Solis, 1998). Selectivity bias was corrected by using a two stage Tobit procedure. A probit equation was estimated for each expenditure category that is inserted into the LAIDS. Economic theory was considered by inserting parametric restrictions, including adding up, homogeneity and symmetry. The parameters of the system of equations were estimated by using the Iterative Seemingly Unrelated Regression (ITSUR) method, within the PROC model procedure in SAS.

Fan and Solis (1998) found that Hispanic households allocate significantly more money to food at home, shelter, and apparel and less to food away from home, entertainment, education, health care, and tobacco compared to non-Hispanic White households. Simulation results are presented as if Hispanics were non-Hispanic households. Only mean budget share differences are presented. Price, income, demographic elasticities and the statistically significant differences of Hispanic and non-Hispanic Households are not presented in the paper. Dynamics overtime are not presented even though time series data was used in the analysis.

Fan and Lewis (1999) analyzed budget allocation patterns of African Americans by estimating a Linear Approximated Almost Ideal System for food at home, food away from home, shelter, fuel and utilities, household equipment and operation, apparel, entertainment, transportation, education, health care, alcohol, tobacco, and personal care. The simulation results found that African Americans differ from Caucasians in most of the categories except for shelter, household equipment and operation, alcohol, and personal care. Differences were found with Asians in food away from home, shelter, fuel and utilities, apparel, education and health care.

Differences with Hispanics were found in food at home, food away from home, shelter, household equipment and operation, apparel, and tobacco.

Paulin (2003) compared expenditures by Hispanics in the periods 1994-1995 and 2000-2001. Changes in expenditures by country of origin are presented. Statistically significant differences are not presented for the market shares. Expenditures were regressed using a set of independent variables that included dummy variables for the time periods, geographic origin, income and other demographic variables. It was found that marginal propensity to consume food at home by Mexicans and Central and South Americans are statically significantly different for the periods 1994-1995 and 2000-2001 at the 90% confidence level. Marginal propensity to consume food at home was statistically different from Mexicans for Puerto Ricans and Central and South American in the period 1994-1995. The findings show the dynamic changes in food consumption by different groups of Hispanics. Marginal propensities to consume and income elasticities were calculated from the estimation of Engel curves using ordinary least squares, combined with the Box-Cox transformation of expenditures and income. The Box-Cox transformation helped to overcome heteroskedasticity. Economic theory of consumer behavior (restrictions on demand: adding up, homogeneity, symmetry, negativity) was neither incorporated nor tested; also, the interrelationships of variables that drive consumer decisions were not taken into consideration as a system but rather as single demand equation of expenditures without deflation of income and the series of prices.

Humphreys (2003) had forecasted the purchasing power of Hispanics in the U.S. According to his estimates, this market segment will have by 2008, a buying power of $1,014.2 billion, a 55.4% increase from 2003 estimates and holding an equivalent of 9.6% of the total U.S. consumer's buying power. According to Humphreys, in 2003, the states with high Hispanic

purchasing power are California, Texas, Florida, New York, Illinois, New Jersey, Arizona, Colorado, New Mexico, and Georgia. Based on data from the "2001 Consumer Expenditures Survey", Hispanics allocated expenditures differently compared to all consumers. Hispanics allocated a higher proportion of their expenditures on housing, transportation, and food and significantly less on health care, entertainment, reading, education, personal insurance, pensions, and tobacco products.

Lanfranco, B. A., G. C. W. Ames, and C. L. Huang from the University of Georgia are the researchers who had given attention to the food demand of the Hispanic community. Lanfranco, Ames and Wang (2000a) examined food expenditure patterns of the Hispanic population in the U.S. by modeling Engel curves for total food (TF), food eaten at home (FAH) and food eaten away from home (FAFH). Distinct functional forms were evaluated including the double-logarithmic, semi-logarithmic, quadratic, and the Working-Lesser form. Expenditures were regressed by income and socio-economic variables.

Food eaten away from home was corrected for selectivity bias by using a two part modeling approach, the first step consisted of modeling the decision to purchase followed by modeling the level of expenditures corrected for such bias. Two approaches were used for correcting the bias in the Engel curves. The first included the estimation of a probit equation that was used to compute the Inverse Mills Ratio that later was used as a regressor in the Engel curve equation. The second approach used the sample selection model described by Ameniya. The parameters for TF and FAH were estimated by using a heteroskedasticity consistent estimator (HLS).

Lanfranco, Ames and Wang (2000a) reported income and household size elasticities at the sample means with their respective 90% confidence intervals for the different functional

forms. Income elasticities for total food ranged from .28 up to .34; for food at home, the income elasticities ranged from .2 up to .27; for food away from home, the income elasticities ranged from .22 up to 1.04. Household elasticities for total food and food away from home varied from 0.31 to 0.47, according to the functional form computed, for food away from home the household size elasticities were never greater than 0.13. Similar analysis was performed by Holcomb, Park and Capps (1995). The following tables (2.6 and 2.7) present a comparison of income and household size elasticities for their findings using the two-step Heckman procedure that corrects for selectivity bias, the functional forms included are the double-logarithmic (DL), semi-logarithmic (SL), quadratic (Q), and the Working-Lesser (WL) for total food (TF), food eaten at home (FAH), and food eaten away from home (FAFH).

Table 2.6 Comparison of Income Elasticities for Different Functional Forms.

	Double-Log		Semi-Log		Quadratic		Working Lesser	
	H	L	H	L	H	L	H	L
TF	0.37	0.29	0.26	0.28	0.42	0.31	0.49	0.34
FAH	0.14	0.21	0.11	0.2	0.16	0.21	0.24	0.27
FAFH	0.48	0.53	0.41	0.78	0.63	0.78	0.29	0.22

H: Holcomb, Park and Capps, 1995.
L: Lanfranco, Ames and Wang, 2000a.

Table 2.7 Comparison of Household Size Elasticities for Different Functional Forms.

	Double-Log		Semi-Log		Quadratic		Working Lesser	
	H	L	H	L	H	L	H	L
TF	0.56	0.39	0.39	0.31	0.57	0.38	0.24	0.34
FAH	0.68	0.74	0.53	0.39	0.69	0.47	0.53	0.39
FAFH	0.14	0.12	0.04	0.02	0.19	-0.02	0.04	0.02

H: Holcomb, Park and Capps, 1995.
L: Lanfranco, Ames and Wang, 2000a.

Byrne, Capps, and Saha (1996) have analyzed the consumption of food away from home (FAFH) using data from the National Panel Diary Data. Correcting for selectivity bias, it was found that the income elasticities ranged between 0.1917 and 0.2363, and household size

elasticities ranged from 0.1949 up to 0.3315 for the period 1982-1989. The income elasticities were lower compared to the findings of Holcomb, Park and Capps (1995) and Lanfranco, and Ames and Wang (2000a); the household size elasticities were more stable.

Lanfranco, Ames and Wang (2002b) estimated Engel curves from cross sectional data of the CSFII 1994-1996. Selectivity bias was not detected, and the regressions were estimated using the specification of a two-part model. Income elasticities at the sample means for total food consumed (TF), food eaten at home (FAH) and food eaten away from home (FAFH were estimated as follow 0.2905, 0.2130, and .4847 respectively. Holcomb, Park and Capps (1995) estimated elasticities for the same categories by estimating demand equations of the semi-logarithmic functional, using the National Food Consumption survey for the period 1987-88, they did not report the confidence intervals for the elasticities. Holcomb, Park and Capps found these income elasticities to be .2654, 0.1105, and 0.4120 for TF, FAH and FAFH, respectively. In comparison with the elasticities estimated by Lanfranco, Ames and Wang (2002b) the elasticity for FAH was almost half. The elasticities for total food were similar, and the elasticities for FAFH were higher for both analyses. Research reports of Lanfranco, Ames and Wang (2002b) and Holcomb, Park and Capps (1995) did not report price elasticities because the data limited such computations.

Lanfranco, Ames and Wang (2000b) described food demand elasticities of the Hispanic community by estimating Engel curves for nine commodities [grains, vegetables, fruits, milk, meat (beef, pork, chicken), legumes, fats, sugar, and beverages)] using semi-logarithmic functional forms. Household size enters into the analysis by means of using the Amsterdam scale. Confidence intervals of the elasticities are computed at the sample means by using Taylor

series approximation. In order to overcome selectivity bias, two procedures were implemented, the two step Heckman procedure and a Sample Selection (SS) or Type II Tobit method.

As a general result, Lanfranco, Ames and Wang (2000b) observed that demand for all nine major food groups was very inelastic in terms of income variation, with elasticity point estimates smaller than 0.5 in absolute value with the exception of fruits, legumes, nuts and seed, sugar, and beverages. The income elasticity for fruits was 0.58 in 1995; for legumes, nuts and seeds was 0.56 in 1994; 1.55 for fats in 1995; 0.88 for sugar in 1996; and the income elasticity for beverages was 0.66 in 1996. Income elasticity was 0.65 in 1995 using the SS method. With respect to the observed ranges, for the grains category, the values of income elasticity in the confidence intervals were always less than unity in absolute value. The income elasticities for fruits, milk, meat, legumes, fats, and sugar reached unity in the lower bound of the confidence intervals in the 1994 sample, when using the HP method. The same behavior was observed with the HP method in 1995 for the case of beverages. Elasticities for vegetables and fruits were greater than one in the upper bound for 1995 while using the HP method, and elasticities for fats and sugar were greater than one for the last two years of the series (Lanfranco, Ames and Wang, 2000b).

Lanfranco, Ames, and Wang (2000c) estimated Engel curves for grains, vegetables, fruits, milk, meat (beef, pork, chicken), legumes, fats, sugar, and beverages using a double-logarithmic and a semi-logarithmic functional form with cross-sectional data from the CSFII 1994-1996. Heckman's two-step procedure and Amemiya's type II Tobit or Sample Selection (SS) were used to test sample selection bias. The regression coefficients for household size indicated greater statistical significance in the level equation than the estimated income coefficients for most of the food groups. Household income appeared to have a greater effect on

the decision equation. Statistical evidence of selectivity bias in the demand for food was found for most of the food groups, sometimes in association with the specific functional form used in the estimation and sometimes with the estimation method.

The correlation coefficient obtained with the SS method was statistically different from zero for fruits, beef, pork, sugar, and legumes; although, it only occurred when the double-log model was used instead of the semi-log model. So, the null hypothesis was rejected in favor of the alternative hypothesis, and the Sample Selection method provided evidence of selectivity bias in the demand for food. In addition, the Sample Selection estimation method provided more efficient coefficient estimates than the Heckman two-step procedure. In all other cases, the estimated correlation coefficient was slightly less than one, and the corresponding residual covariance matrix was nearly singular (Lanfranco, Ames, and Wang, 2000c).

Beef and sugar were the only two food groups for which evidence of selectivity bias was found using both the HP and the SS estimation methods. Only vegetables and fats did not show any evidence of selectivity bias at all (Lanfranco, Ames, and Wang, 2000c). After detecting selectivity bias, it is recommend to use full information maximum likelihood (FIML) so that the decision and level equation are estimated simultaneously due to the use of all the information about the covariance between the residuals of both equations (e.g. Davidson and Mackinson 1993, Lanfranco, Ames, and Wang, 2000c)

Lanfranco, Ames, and Wang (2001a) estimated a censored system of Engel curves using cross-sectional data from the CSFII 1994-1996. The system approach allowed the computation of more accurate representations of the decisions of the consumer, since incorporates the interrelationships between the series of prices and income. The selectivity bias was approached in the same way as it was done by Lanfranco, Ames, and Wang (2000c).

Lanfranco, Ames and Wang (2002a) compared Hispanic household demand for meats with other ethnic groups using the "1998 Consumer Expenditure Survey" released by the Bureau of Labor Statistics. Demand systems were estimated for Hispanics, Non-Hispanic White, African American, and households of other minorities. A system of demand equations of the LinQuad form were estimated, correcting for selectivity bias using the procedure proposed by Shonkwiler and Yen (1999) and Lanfranco, Ames and Wang (2001). The commodities analyzed were ground beef, roast, steak, other beef, bacon, pork chops, ham, other pork, chicken and canned fish. Income and household size elasticities are reported for each ethnic group with their respective 90% confidence intervals.

The results of the Probit estimations from the first step show that both income and household size are important factors affecting meat purchase decisions. However, the size of the household appeared to be more influential in the household's decision to spend on specific meat items than the level of income. No single income elasticity was greater than one, suggesting that the meat products analyzed can not be catalogued as luxuries. Instead, they are necessities. Hispanics were less responsive to increases in income for ground beef and chicken, and the demand for roast beef, bacon, ham, canned fish and steak were more elastic.

The demand for pork chops had negative income elasticity, suggesting that as income goes up Hispanic consumers are less likely to consume them, suggesting that the product is perceived as an inferior good. For non-Hispanic Whites other beef, other pork, chicken and canned fish were inferior goods. This segment had less preference for pork products compared to the other ethnic groups. Non-Hispanic Whites presented inelastic demand for ground beef, steak, and ham. African American consumers presented elastic demand for roast beef, bacon, and canned fish, considering inferior goods to be steak, other beef, pork chops, ham, other pork, and

chicken. These differences in the consumer responses to income suggest that ethnicity plays an important role in determining the demand of commodities.

The responsiveness to increments in the size of the household was more uniform in the sense that quantities demanded for the majority of commodities decreased. The commodities that presented positive household elasticities for Hispanics were other beef, other pork and canned fish; for non-Hispanic Whites, they were steak, other beef, chicken, and canned fish; and African Americans presented positive household elasticities for steak and other pork. Lastly, households of other minorities presented positive household size elasticities for ground beef, bacon, and canned fish.

The demand for meat products by ethnic groups in the United States is presented in more detail in Lanfranco's dissertation (2001). Lanfranco's findings showed that almost all the own price elasticities were negative and inelastic. Cross price elasticities between meat products differed across ethnic groups. For all ethnic groups, chicken and fish were substitute products. Hispanics indicated a substitute relationship for roast beef with beef steak, bacon, and pork chops; and chicken with canned fish; for White households, ham was also a substitute. Non-Hispanic Whites indicated complementarity relationship for roast beef and chicken.

For African American households, roast beef was a substitute for chicken and canned fish. For Hispanics, pork chops were substitutes for beef roast, other beef, ham, other pork and canned fish. For non-Hispanic Whites, pork chops were substitutes for beef roast, beef steak, other beef, bacon, and chicken. African Americans presented pork chops along with other beef and chicken as substitute goods.

Lanfranco (2001) found that the impact and significance of demographic variables in food consumption differ across ethnic groups. Age of the household had a negative significant

influence on the consumption of pork chops. For non-Hispanic Whites, the effect of age was positive. Age had significant relationships in the demand for beef roast, other beef, bacon, ham and canned fish. For African Americans, age was a positive and significant variable in terms of the consumption of bacon and other pork. Female respondents were associated with lower consumption of beef products. Food stamp participation was related to lower consumption of beef steak and canned fish, in contrast with the findings of Lanfranco, Ames and Wang (2001b) where food stamp participation was positively related to milk consumption and negatively related to consumption of pork and chicken. In addition to the food stamp program, the participation of Hispanics in the Women, Infants and Children (WIC) program was positively related to the consumption of fruits, milk, and pork; and negatively related to fats, beverages, and chicken.

Critiques that can be drawn from the work of Lanfranco, Ames and Wang (2002a) and Lanfranco (2001) include the comparison of ethnic groups, the estimation of the elasticities, model choice and testing procedures of the economic theory. In the case of comparison of ethnic groups, no single difference in elasticity was evaluated statistically, leaving the question on how best to test such differences so that inferences can be produced, considering that the samples for each ethnic group have different sizes and that elasticities represent a ratio of changes. A possible solution is the implementation of the simulation procedures along with F-tests used by Fan and Lewis (1999) in determining differences of budget allocation patterns of African Americans with other ethnic groups. Another possible solution is the estimation of a demand system for all households in which dummy variables are inserted to capture the effects of ethnicity. With respect to the choice of the model, the authors did not evaluate whether or not the used model out-performs other models like the AIDS of Deaton and Muellbauer (1980b), so that

the results presented not only are precise but also provide accurate representations of the decisions of the consumer. Finally, neither testing procedures of the selected model nor model selection tests are presented.

Stegelin (2002) estimated a system of demand equations of the LinQuad form, correcting for selectivity bias by using a two step Heckman procedure, where the Probit equation for modeling the purchase decision was estimated by maximum likelihood estimation. Ten meat products were included: four types of beef (ground beef, roast, steak, and other beef), four types of pork (bacon, pork chops, ham and other pork), one type of poultry (fresh and frozen chicken) and one seafood category (canned fish and seafood). Data was extracted from the "1998 Consumer Expenditure Survey." Hispanics spent 21% percent of total expenditures on food, while non-Hispanic Whites spent 15%. Total food expenditures on meats varied across ethnic groups. Hispanics, non-Hispanic Whites and African Americans allocated 22.5%, 18%, and 26% of total food expenditures on meats, respectively.

According to Stegelin (2002) non-Hispanic Whites allocated meat expenditure shares lead by beef (25%), pork (24%), poultry (24) and seafood (15%). Hispanics disproportionably allocated meat expenditures in beef (39%), pork (25%), poultry (24) and seafood (12%). African-Americans had more preference for pork and poultry, spending 31% on pork, 27% on poultry, 26% on beef and 16% on seafood. The magnitude of own price elasticities, cross price elasticities, and expenditure elasticities are not reported, just brief discussions on relations of complementarity, substitution, normal, and inferior goods. Hispanics were more responsive to changes in income compared to non-Hispanic Whites. Beef roast and other beef were determined to be substitutes of beef steak for Hispanics; pork chops and bacon were found to be substitutes. Even though the goal was to compare meat expenditures by ethnic groups, statistical inferences

from tests that asses differences in elasticities is not performed. The same applies to Lanfranco (2001). He estimated elasticities for different ethnic groups, but no single test is implemented for evaluating differences in consumption. Henceforth, future studies that assess differences in consumption must implement the evaluation of such differences so that empirical evidence validates inferences regarding variation in consumption patterns of ethnic groups.

In contrast to Fan and Solis (1998), Lanfranco (2001), Lanfranco et al. (2002a), and Steglin (2002); the results of Mclean-Meyinsse (1999) show that for the case of the demand for specialty meat products purchased by grocery shoppers are determined by age, household size, education, ethnicity and prices and not by geographical location, gender, marital status, religion, occupation, and household income.

Paulin (1998, 2003), Fan and Solis (1998), Lanfranco (2001), Lanfranco et al. (2002a), and Steglin (2002) have failed to discern statically significant differences in the elasticities for different ethnic groups. A contrary case is the work of Fan and Lewis (1999), in which they used simulation for evaluating the differences in consumption among ethnic groups.

Critics of the U.S. food demand system have increased in the last two decades, from conservative to radical opinions (refer to Michman and Mazze (1998), Schlosser (2002), Trudeau (2005), and Brownell and Horgen (2003)). They have pointed out that consumers are increasingly demanding not only foods of higher quality but also foods that are healthier.

From the supply side, the meat industry is also facing challenges. There is concentration of retailers and processors. There is no doubt that either supply or demand factors are changing and adapting to the increase in population, growth of income per capita, and dynamic allocation of consumer expenditures. These challenges along with the increase in diversity of ethnic groups

in the U.S will bring many opportunities to the food industry and food marketing system by selling not only specialty meats but also special cuts that appeal to ethnic groups.

U.S. beef consumption has declined, while poultry consumption has increased significantly over the past three decades. Preference changes, relative prices, and available leisure time are important determinants shaping U.S. consumer demand for meat products (Haley, 2001).

To increase beef demand, the industry needs an enhanced vertical coordination. The industry cannot supply the kinds of beef demanded without improved price signals to producers. This includes the need for better beef quality identification, sorting, and marketing. Intense product development for targeting diverse consumer segments is essential. The industry is far from matching consumer demands and transmitting information to all stages of production, processing, and marketing. Because of the dismal state of beef demand, there is considerable opportunity for improvement. Beef demand in 1999 and early 2000 suggest modest progress (Schroeder and Mark, 2000).

From a survey designed to study meat consumption habits, performed by The University of Georgia, Rimal (2005) found that respondent's perception of the importance of nutrition and ingredients on meat labels were associated with consumer's attitude toward meat labels. Those respondents who linked nutrition and ingredient information on meat labels were likely to have a positive attitude toward meat labels. Rimal did not include ethnicity into the model, but it showed how complex its influence on demand for meat products might be.

Holzer (2005) found that there is a relation between demand for meats and information regarding the relationship between health and cholesterol intake, information was a significant shifter of retail beef demand, affecting quantities and prices. Kinnucan et al. (1997) found that

the demand for poultry products is increasing at the expense of beef products, and found significant effect of health information in U.S. demand of meats. The Food Marketing Institute (2006) explored general perceptions, attitudes and behaviors regarding meat consumption, they found that quality of the meat is the top factor for consumers when selecting their primary grocery store. Their study takes an in-depth look at meat consumption and purchasing patterns including store format shopped, nutritional concerns, frequency of preparing certain types of meat, marketing and sales techniques, organic meats and perceptions of case-ready meats (Food Marketing Institute, 2006). The findings of Holzer, Kinnucan et al. and The Food Marketing Institute tells us the importance of health information in the process of purchasing meat products.

The findings of Mclean-Meyinsse (1999), Rimal (2005), and Holzer (2005) explain the consumption trends of meats in the United States. These findings have applications in generic advertising by farmer's organizations trying to shift demand for their products. As Kinnucan et al. (1997) have found that small changes in health information have larger impacts on meat consumption than equivalently small changes in relative prices. Their findings are in harmony with those of Davis and Lin (2005a, 2005b).

Davis and Lin (2005a) recognized that pork consumption varies by ethnicity, using the "Consumer Food Intake by Individuals Survey 1996-1998". They calculated that African Americans, Non-Hispanic Whites, and Hispanics consume 63, 49 and 45 pounds of pork per capita, respectively. Davis and Lin found that southern and rural consumers are more likely to eat more pork products than consumers from other regions. Consumers are more likely to buy at stores and eat at home. Age and female gender were negatively related to the consumption of pork.

Davis and Lin (2005b) documented that beef consumption varies by ethnicity, using the "Consumer Food Intake by Individuals Survey 1996-1998," it was calculated that African Americans, Hispanics, and Whites consume 77, 69 and 65 pounds of pork per capita, respectively. Even though African Americans consume more beef products, the Hispanic population increases at faster rates than other ethnic groups. It is expected that total beef consumption by Hispanics will exceed that of African Americans and non-Hispanic Whites. Davis and Lin report that neither price nor income elasticities were statistically significant.

As has been noticed by Lanfranco, Ames and Wang (2002b), an increase in population and purchasing power of Hispanics makes this market impossible to ignore, and its study becomes more relevant. Research projects should overcome the criticism of previous studies in the field of consumer behavior of Hispanics. Future research is also needed to theoretically investigate why ethnic groups spend more or less; as our society recognizes the importance of diversity in its social and economic structure, theories regarding cultural diversity and consumption preferences should be constructed and tested (Fan and Lewis, 1999).

Batres-Marquez, et al. (2001), surveyed the attitudes of U.S. Salvadorans toward ethnic foods; respondents indicated that the three most important reasons for not consuming Salvadoran foods were availability, low quality, and high prices. This study failed to provide the effect of prices and income in the quantities consumed, and the survey was administered to a sub-segment of the U.S. Hispanic market.

Zamora (2004) showed that people of Central American Origin (CAO) prefer beans from their home country (Guatemalans, Hondurans, Nicaraguans, Salvadorans) and are willing to pay a premium price for them. From the studies of Batres-Marquez, et al. (2001) and Zamora (2004) we learn that Hispanics have their own preferences for food and places where to buy their

groceries. Although is still not clear where Hispanics buy meat products and groceries in general, neither Batres-Marquez, et al. (2001) and Zamora (2004) nor Kisilbash and Garman (1975) mentioned it explicitly; only the Food Marketing Institute (2002) have done a deeper analysis in this regard, analyzing purchasing patterns of groceries by Hispanics.

The U.S. Hispanic market presents potential market opportunities for American farmers and the food industry, therefore, it is vital the study of the consumer behavior of Hispanics in relation to non-Hispanic Whites, African Americans, and households of other minorities; thus, food companies can supply healthier foods in accord to their tastes and preferences.

2.6 Summary

This chapter identified and analyzed literature related to the food consumption behavior of U.S. Hispanics. The consumption of meat products was emphasized. Different sources of information useful in studying Hispanic consumers were documented. A strategic framework was utilized. Previous studies of the U.S. Hispanic market included scientific and popular literature. Lastly, this chapter exposed the examination of demand analysis of food products by ethnic groups, providing a comprehensive understanding of the consumer behavior of food, specifically the consumption of meats by Hispanics. Since, the other objective of this research project is the estimation of a demand system that assess the demand of meat products by Hispanics in response to price, income, and socio-economic variables, the differences in demand responses will be statically evaluated in comparison with non-Hispanic Whites, African Americans, and households of other minorities. The following chapter presents the economic theory of demand systems needed for the estimation of the demand system of meats in the United States.

Chapter 3

Economic Theory of Demand Systems

This chapter presents a condensed summary of consumer theory relevant to the estimation of LinQuad demand systems. The structure of this chapter is divided in two sections. The first section is a diagrammatic representation of duality theory for derivation of demand equations, through utility maximization and cost minimization. Duality is useful in the derivation of Marshallian demand curves of the LinQuad form. In addition to duality, this section presents the properties of demand curves consisting of adding up, homogeneity, cross-price symmetry, and negativity of own price effect.

The second section discusses two demand systems: the Almost Ideal System (AIDS) and the system of demand equations of the LinQuad form. The AIDS demand system is presented with the purpose of extending knowledge about demand systems, because it is the model from which theoretical advancements in consumer demand analysis have occurred since its appearance in the 80's. There is a large body of knowledge on the derivation of demand systems, this chapter is reproduced mainly from Varian (1978, 1984), Deaton and Muellbauer (1980a), Phlips (1983), Huang (1985), Theil and Clements (1987), Raunikar and Huang (1987), Pyndyck and Rubinfeld (2000), Jehle and Reny (2000), and Perloff (2004).

3.1 Duality

Demand is without a doubt one of the most fundamental concepts in economics, and provides a powerful analysis of markets. The demand for a good depends on the capacity of the individual to consume it; Comish (1936) refers to that capacity as the ability to consume that depends on consumer's wants, the availability of goods and services, time, energy and purchasing power. Those are the constraints in the preferences of an individual. In terms of

duality theory, income is the only factor that constrains the amount of goods to be demanded. The demand analysis of goods depends upon the assumption that consumers have preferences and derive utility from the goods consumed. The assertion that consumers posses utility functions is a statement that people do in fact have preferences (Silberberg, 1978).

Pyndyck and Rubinfeld (2000) defined the demand curve as the relationship between the quantities of a good that consumers are willing to buy at the price of the good. Hence, a demand system is compounded from a set of equations that represents the quantities of commodities that are consumed as a function of own prices, prices of other goods, income, demographics, geographic variables, and any other specific variables of interest to the researcher.

The existence of preferences and existence of utility by the consumers is assumed in the derivation of demand curves. Rational consumers are expected to maximize their utility. In this process, preferences are revealed by the selection of a set of goods that is consumed in different quantities so that the bundle produces the maximum attainable utility under the presented economic conditions. That is to say, consumers maximize utility, giving rise to an ordinal utility function, expressing preferences by consuming a set of goods that compounds the bundle. Thus, utility is maximized by the goods consumed.

A demand system can be derived from different models that depart from duality in consumer theory (Deaton and Muellbauer, (1980); Huang (1985)). From the assumed economic conditions, through utility theory, demand curves are derived in uncompensated and compensated forms, namely Marshallian and Hicksian demand curves. Marshallian demand curves are produced by maximizing a utility function constrained by the budget line. Marshallian demand curves are substituted into the utility function for producing the indirect utility function.

Marshallian demand curves can be recovered by using the Roy's identity, the following figure describes the flow of the described process.

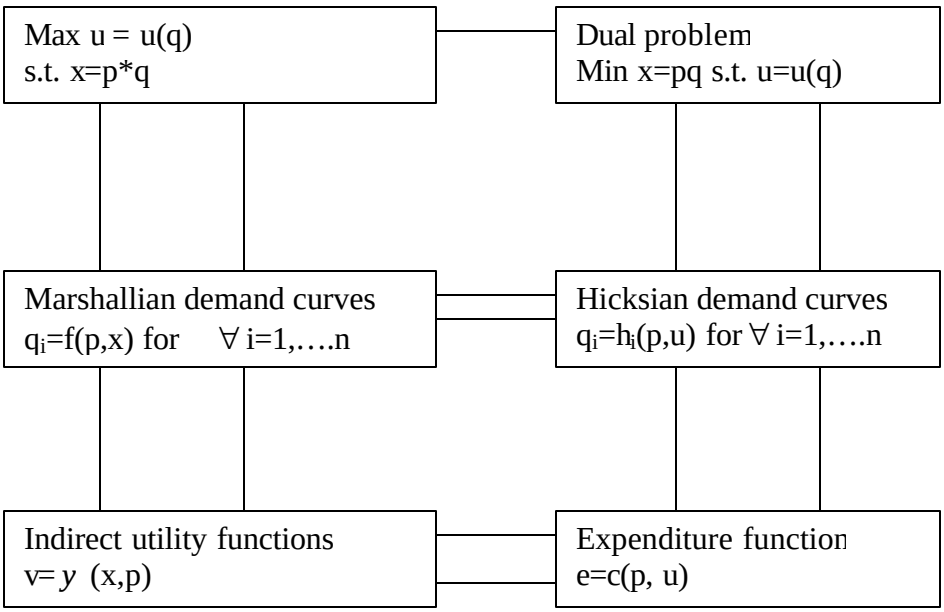

Figure 3.1 Utility Maximization and Cost Minimization.

Hicksian demand curves are produced by minimizing expenditures for a given level of utility. If Hicksian demand curves are substituted into the function that is minimized, expenditure functions are produced. Hicksian demand curves can be recovered from the expenditure function by using Sheppard's lemma. Marshallian demand curves and Hicksian demand curves can be inverted. The same relationship exists for the indirect utility function and the expenditure function (Deaton and Muellbauer (1980), Huang (1985), Jehle and Reny (2000)). Figure 3.1describes the flow in the dual process of derivation of demand curves.

3.1.1 Properties of Demand Curves

The properties of both Marshallian and Hicksian demand equations include adding up, homogeneity of degree zero, negativity of own price effect and symmetry of cross price effects. The property of adding up, states that consumers can not spend in the bundle an amount of money greater than the total available money for expenditures, the sum of expenditures on goods

is equal to total expenditures, this condition applies to both Hicksian and Marshallian demand curves. Assuming prices as given, this property restricts the quantities of goods consumed. Any change in prices requires a rearrangement, so that total expenditures remain constant overtime.

Marshallian demand functions are homogeneous of degree zero in prices and income, while Hicksian demands functions are homogeneous of degree zero in prices and utility. A system of demand equations, resulting from utility maximization, requires that own price effects are negative and cross price effects are equal, in other words the substitution effects are equal for a pair of goods $i \neq j$.

3.2 Demand Systems

In the literature of applied demand analysis, seven systems can be found. The Linear Expenditure System (LES) first estimated in 1954 by Stone, using the Klein-Rubin utility function. Another system is The Rotterdam Model introduced by Theil (1965) and Barten (1969). A different demand system that is observed in applied demand analysis is the Indirect Translog Demand Model introduced by Christensen, Jorgenson, and Lau (1975). Another system is the Quadratic Expenditure System (QES) that evolved from the LES model by Pollak and Wales (1978). The Almost Ideal Demand System AIDS has received greater acceptance by researchers and is found in current applied and theoretical research. The AIDS model was introduced by Deaton and Muellbauer in 1980.

More recently, Agnew (1998) pointed out that using the so-called LinQuad quasi-expenditure function is the only way to derive demand linear in deflated income and linear and quadratic in deflated prices and consistent with weak integrability (e.g. Lanfranco, 2001). Lanfranco, has incorporated the two-step Heckman approach for correcting selectivity bias when microdata is used. Lastly, another demand system for modeling policies is the inverse demand

system developed by Wong and Mclaren (2005), it uses the distance function approach. This research project derives Marshallian demand curves from a LinQuad demand system. Derivation of demand curves from the AIDS model is presented for completeness.

3.2.1 The Almost Ideal Demand System

In 1980, Deaton and Muellbahuer developed a demand system that they called the Almost Ideal System (AIDS). The system departs from a defined cost function of the PIGLOG class

3.1 $$\log c(u,p) = (1-u)\log\{a(p)\} + u\log\{b(p)\}$$

where a(p) and b(p) are functions of a vector of prices p, and u denotes utility. U lies between 0 (subsistence) and 1 (bliss); hence, the cost functions a(p) and b(p) represent the cost of subsistence and bliss respectively. The resulting cost functions should have a flexible functional form, and must posses enough parameters. Next step requires the specification of log (a (p)) and log (b (p)) as can be seen in equation 3.2 and 3.3

3.2 $$\log\ a(p) = a_0 + \sum_k a_k \log\ p_k + \frac{1}{2}\sum_k \sum_j g_{kj} \log\ p_k \log\ p_j$$

3.3 $$\log b(p) = \log a(p) + b_0 \prod_k p_k^{b_k}$$

and the cost function would be defined by

3.4 $$\log c(u,p) = a_0 + \sum_k a_k \log\ p_k + \frac{1}{2}\sum_k \sum_j g_{kj} \log\ p_k \log\ p_j + u b_0 \prod_k p_{k.}^{b_k}$$

Equation 3.4 is a second-order approximation of an unknown expenditure function and its differentiation produces the functions of budget shares that are dependent on prices and utility

3.5 $$w_i = a_i + \sum_j g_{ij} \log\ p_j + b_i u b_0 \prod p_k^{b_k}\ ,$$

where u is the indirect utility function that may be derived by inverting the cost function from equation 3.4. The last result is inserted in 3.5 and finally equations of the AIDS form are obtained as described by the following equation

3.6 $$w_i = a_i + \sum_j g_{ij} \log p_j + b_i \log(x/P),$$

where a, g, and b are parameters to be estimated, and P is a non linear price index defined by the following equation

3.7 $$P = \log P = a_0 + \sum_k a_k \log p_k + \frac{1}{2}\sum_j \sum_k g_{kj} \log p_k \log p_j ,$$

and the restrictions from economic theory in the AIDS model implies the following equations

3.8 $$\sum_{i=1}^{n} a_i = 1;\ \sum_{i=1}^{n} g_{ij} = \sum_{i=1}^{n} b_i = 0,$$

3.9 $$\sum_j g_{ij} = 0, \text{ and}$$

3.10 $$g_{ij} = g_{ji},$$

where equations 3.8, 3.9, and 3.10 refer to adding up, homogeneity and symmetry, respectively.

A modification of the AIDS model suggested by Deaton and Muellbauer (1980) is the approximation of log P by using the Stone's price index

3.11 $$P^* = \log P = \sum_i w_i \log p_i$$

Henceforth equation 3.6 is modified by P*, producing the Linear Approximate AIDS model (LA-AIDS) of the form

3.12 $$w_i = a_i + \sum_j g_{ij} \log p_j + b_i \log(x/P^*).$$

For more details on the derivation of the AIDS model see Deaton and Muellbauer (1980). For estimating elasticities with the AIDS and LA-AIDS models refer to Green and Alston

(1989); Alston, Foster and Green (1994); and Thompson (2004). Applied demand analysis has made wide use of the AIDS model since its appearance. Theoretical advancements in consumer behavior have been performed using static and dynamic AIDS models.

3.2.2 System of Demand Equations of the LinQuad Form

A complete demand system presents difficulties with aggregation and estimation, the first issue presents problems with loss of information, and the second issue is related to the degrees of freedom because of the dimensionality of the model. Three approaches exist for dealing with those issues. According to LaFrance (1990), the first approach is aggregation over greater categories of commodities, the second approach is to assume separability, and the third approach is to estimate an incomplete demand system that produces demand equations that can be integrated into a quasi-expenditure function that is in accord with the consistencies of a rational consumer dictated by the order of preferences.

With the order of preferences, demand equations depend on prices of the goods of interest, the prices of substitutes, the prices of complement goods and income; thus the dual theory of a complete demand system applies to an incomplete demand system so that consistent common microeconomic analysis can be performed; for example, the analyses can include the recovery of the preferences from the system of demand equations, welfare measures, and of course the calculation of the relationships described by the dual theory (including the indirect utility function, expenditure function, compensated and uncompensated demand functions).

The LinQuad model treats an incomplete demand model as complete by adding a composite commodity that represents other expenditures in the system. The demand equation that represents other goods is dropped during the estimation for avoiding singularity in the variance-covariance matrix. The LinQuad model has evolved from the theory of incomplete

demand systems developed by LaFrance (1985), LaFrance and Hanemann (1989), LaFrance (1990), Agnew (1998), LaFrance (2004), and LaFrance et al. (2005).

The integration of an incomplete demand system into a quasi-expenditure function is described. Let $x=[x_1,x_2,\ldots,x_n]'$ be the vector of the commodities of interest and $p=[p_1,p_2,\ldots p_n]'$ the vector of corresponding prices, $q=[q_1,q_2,\ldots q_m]'$ the vector of other goods with the respective vector $z=[z_1,z_2,\ldots z_m]'$ that represents their prices and let y represent total expenditures so that n commodities of interest and m commodities representing other goods exhaust total expenditures that equal income, hence total income represents total expenditures as equation 3.13 states it

3.13 $$y=\sum_{i=1}^{n} x_i p_i+\sum_{i=1}^{m} q_i z_i \quad \forall i=1,2,3,\ldots,n;\forall i=1,2,3,\ldots,m\,.$$

LaFrance & Hanemann (1989) showed that there are observable demand equations for the commodities of interest however the demand equation that represents other commodities is not observable, thus the observable demand equations have the form

3.14 $$x=h(p,z,y)\,,$$

and they are assumed to be twice continuously differentiable (C^2) from which the unobservable demand equations depart by using a composite commodity that represent such demand; using the adding up property, by representing income with the variable y, the demands for the commodities in other goods can be represented as follow

3.15 $$q^i\equiv h^i(p,z_i,y)\equiv\left[y-p'h(p,z_i,y)\right]/z_i \quad \forall i=1,2,3,\ldots,m\,.$$

Notice that if m is greater than one, equations 3.14 and 3.13 constitute an incomplete demand system if they do exhaust total income y as the equation 3.13 describes a complete demand system, because m commodities had been represented by a composite commodity that represents all other goods.

If equations of the form of 3.14 are integrable, they satisfy Sheppard's lemma so that Hicksian demands are produced

3.16 $$\frac{\partial e(p,z,u)}{\partial p} \equiv t(p,z,u) \equiv h[p,z,e(p,z,u)],$$

where $t(p,z,u)$ is a vector of compensated demand functions for the demands that represent the commodities of interest x. The expenditure function is denoted by $e(p,z,u)$ and u is the consumer's level of utility.

LaFrance and Hanemann (1989) states that it has been shown a situation where local and global integrability for incomplete demand systems are essentially equivalent; thus, the vector of prices and income are deflated by a deflator function for normalization. Thus, Hicksian demand functions are twice continuously differentiable, homogeneous demand of degree zero resulting from the normalization of prices by using the price index, demand curves represent non-negative quantities, total expenditures in the goods of interest is lower than total income, the matrix of the price effects of the goods of interest are symmetric and negative definitive. If the prior conditions exist, there is an expenditure function twice continuously differentiable (C^2), 1^o homogeneous, concave in prices (p,z) and satisfies Sheppard's lemma for all Hicksian demand functions belonging to the incomplete demand system.

LaFrance and Hanemann (1989) showed that if Hicksian demand functions are twice continuously differentiable, an incomplete system of demand equations in 3.14 has the following properties:

3.17 h(p,z,y) is homogeneous in (p,z,y),

3.18 h(p,z,y) = 0 ,

3.19 p'h(p,z,y) < y,

3.20 The Hessian matrix is negative semi-definitive, in addition the e=C^3

in p for all (p,z,y),

3.21 $$\frac{\partial q_{ij}}{\partial y} = \frac{\partial q_{ji}}{\partial y} \quad \forall i, j = 1,2,3,...n,$$

3.22 $$\frac{\partial q_{ij}}{\partial p_k} = \frac{\partial q_{ji}}{\partial p_k} \quad \forall i, j, k = 1,2,3...n.`$$

The set of conditions from 3.17-3.22 shows that weak integrability allows us to treat an incomplete demand system in virtually the same manner as a complete system, if the added composite commodity in 3.15 is non-negative, and if added to the system of equations of the form of 3.14, the resulting system of equations represent an augmented incomplete demand system that acts as a complete demand system. Then, the restrictions on the incomplete demand system implied by utility maximization are necessary and sufficient for a well-defined solution (LaFrance and Hanemann, 1989).

The foregoing analysis is general; nothing has been assumed about the functional structure of the utility function u(x,q), expenditure function e(p,z,u) or indirect utility function v(p,z,y). The conditions 3.17-3.22 can be applied to any incomplete demand model to discover the structure of the conditional preference map for the goods of primary interest. It can't recover the structure of the consumer's preferences with respect to the individual elements of the composite commodity, though in practice this should usually be a relatively minor cost (LaFrance and Hanemann, 1989). LaFrance and Hanemann (1989) pointed out that the dual structure of the conditional preferences for the commodities of primary interest is revealed by the demand functions generated from the incomplete demand system.

LaFrance (1990) investigated functional forms of demand equations departing from the weak integrability conditions developed by LaFrance and Hanemann (1989). He evaluated six semi-logarithmic demand functions, regressing quantities consumed by a set of prices and

income, homogeneity was achieved by deflating those series of prices and income by a consumer price index for non food items or the price of gold. LaFrance (1990) states that the price deflator can be any positive value, increasing, linear homogeneous function of a non-empty subset of the prices that represent other goods.

LaFrance (1990) derived quasi-indirect utility functions and quasi-direct utility functions for all the functional forms evaluated. The results of LaFrance were discouraging because the demand models had at the most one independent price coefficient and resulted in homothetic preference maps. The results obtained for the semi-logarithmic incomplete demand models are more general, and can't be derived from studies of complete demand systems (LaFrance, 1990). Despite the disappointing results, LaFrance originated the Linquad model from the application of the Roy's identity to a quasi indirect utility function integrated from demand equations that are linear in income and linear and quadratic in prices.

Agnew (1998) continued working from previous results of LaFrance (1985), LaFrance & Hanemann (1989), LaFrance (1990) and LaFrance (1998); Agnew derived welfare measures for the LinQuad model. The LinQuad model departs from the quasi expenditure function of the form of the following equation:

3.23 $$x(p,z,q) = p'a + .5p'Bp + (z,u)e^{g'p},$$

where p is a vector of deflated prices, (z,u) is the constant of integration, and a and B are the parameters to be estimated; the parameters in B correspond to the matrix of parameters for the variables representing the series of prices. The above quasi-expenditure function creates a new class of quasi-expenditure functions which produce demands with more desirable qualities (Agnew, 1998). By applying Sheppard's lemma to 3.23, demand equations of the form of 3.24 are derived:

3.24 $$x = a + Bp + g[q(z,u)e^{g'p}].$$

Then, solving equation 3.23 in terms of $(z,u)e^{g'p}$ and replacing expenditures with income y, Marshallian demands of the form of 3.25 are created,

3.25 $$x = a + Bp + g[y - a'p - .5p'Bp],$$

where a, B and ? is the set of parameters to be estimated. They represent the intercept, the matrix of price effects and the income effect, respectively.

The quadratic term for prices increases the flexibility in the Slutsky symmetry removing the restrictions that constrain the preference ordering of the linear system and homothetic conditional preferences is avoided (Agnew, 1998). There are not restrictions in the income coefficients as LaFrance (1990) found in the evaluation of semi-logarithmic demand equations. Using the Linquad quasi-expenditure function is the only way to derive demands linear in deflated income and linear and quadratic in deflated prices and consistent with weak integrability (Agnew (1998), e.g. LaFrance (1998)).

Agnew (1998) determined that the LinQuad model is not dependent in linearity; a logarithmic version produces a similar model to the PIGLOG specification of the AIDS model. The Linquad model maintains the same structure but adds a quadratic term in the vector of prices. According to Agnew, the Linquad model avoids simultaneity from the use of budget shares of subgroup expenditures, and its logarithmic version makes it a more robust model in the estimation of welfare measures. It is apparent that the LinQuad model is superior to the AIDS given all the inconsistencies, and criticism from empirical evidence revealed by LaFrance (2004) when he integrated the AIDS model and the quadratic price independent generalized linear incomplete demand system.

From the restriction of adding up that generates global integrability in the system, the overall expenditures function under weak integrability is not an equality rather is an inequality. Under global integrability the expenditure function that is produced is a function of the prices of the goods of interest p and the prices of other goods z under the given level of utility that will minimize the overall expenditure function. Under an incomplete demand system, the series of prices for other goods z are not obtainable and they are not practical to implement; thus, that information is lost or is simply scarce in the process of minimization of the expenditure function under weak integrability. According to LaFrance and Hanemann (1989) and LaFrance (1990) the integrability conditions for incomplete models, from which the Linquad model is derived, exhaust the implications of utility maximization. Therefore, the Linquad model losses information from the composite commodity that is represented by unobservable demand equations, therefore the model is in accord with the economic theory of incomplete demand systems elaborated by LaFrance et al. (2005).

The imposition of homogeneity is necessary in a framework of incomplete demand systems, thus demand for the goods of interest will not change when prices and income increases simultaneously. Therefore, prices and income need to be deflated by a deflator that represents the cost of other goods. Consequently, according to LaFrance (1985) the deflator has the following form $p(z) = p(z_1, z_2, z_3, ...z_m)$ and is twice continuously differentiable, positive valued, non-decreasing, linear homogeneous and a concave function of the prices of the other goods. For example, LaFrance mentions the price of gold or the consumer price index for non food items.

The AIDS model of Deaton and Muellbauer (1980a, 1980b) requires parametric constraints in addition to the development of a linear or non linear price index constructed from

the goods included in the model, such price index deflates total expenditures. In the Linquad model a consumer price index is used for imposing homogeneity.

Having described the properties of adding up and homogeneity for incomplete demand systems, the remaining restrictions from neoclassical consumer demand theory are: negativity, symmetry, and concavity.

The property of the expenditure function that produces consistent preference ordering requires that the demand function is concave in prices; thus, the expenditure function must be symmetric in the coefficients of prices in the system. If demands are consistent with the weak integrability conditions then demand functions will also have the symmetry property of the Hessian matrix so that the parameters of B in equation 3.25 are symmetric, that is to say $ß_{ij}=ß_{ji}$ $\forall i = 1,2,3,...n$.

In the B matrix, own price effects are expected to be negative but not strictly negative because of potential corner solutions and Giffen goods, a product is defined as a giffen good when increase of its price makes the consumer to buy more of it. The restrictions in the coefficients in B can be imposed as symmetric cross price effects, if they are not imposed and if they exist, the data and procedures are in harmony with economic theory, if the symmetric relations in the B matrix are not imposed the number of parameters to be calculated negatively effect the degrees of freedom. This research project deals with the construction of a demand system of meats compounded by 10 equations, in this case, without restrictions the model estimates 100 parameters only for the B matrix, 10 parameters correspond to own price effects and 90 parameters correspond to cross price effects; by imposing symmetry, the basic hypothetical constraint of demand systems, only 45 parameters are estimated. By imposing

symmetry the total number of parameters to be estimated for the B matrix is 55. Not rejecting symmetry restrictions strengths the model's explanatory validity (Agnew, 1998).

The B matrix (see equation 3.25) must be negative semidefinitive for ensuring concavity. Agnew (1998) states that such imposition ensures that the parameters estimated in the demand equations allow their integration with respect to prices into the expenditures function. Thus, more accurate measures of welfare are obtained. Agnew (1998) and Lanfranco (2001) mention the use of the Cholesky factorization for imposing concavity. Such imposition does not reduce the number of parameters; consequently there is not increase in the degrees of freedom.

Based on the Marshallian demand equation in 3.25, the own price elasticity, cross price elasticity, and the income elasticity have the form of equations 3.26, 3.27, and 3.28 respectively as follows:

3.26 $$x_{ii} = \frac{\partial x_i}{\partial p_i} * \frac{\overline{p}_i}{\overline{x}_i} = \left[b_{ii} - g_i (a_i + \sum_j b_{ij} p_j) \right] * \frac{\overline{p}_i}{\overline{x}_i},$$

3.27 $$x_{ij} = \frac{\partial x_i}{\partial p_j} * \frac{\overline{p}_j}{\overline{x}_i} = \left[b_{ij} - g_i (a_j + \sum_k b_{jk} p_k) \right] * \frac{\overline{p}_j}{\overline{x}_i},$$

3.28 $$h_i = \frac{\partial x_i}{\partial y} * \frac{\overline{y}}{\overline{x}_i} = g_i * \frac{\overline{y}}{\overline{x}_i} \ .$$

Equations of the form of 3.26, 3.27 and 3.28 correspond to the general formulas of the elasticities that depart from the Marshallian demand function $q = q(p_i, p_j, x)$, equations 3.29, 3.30, and 3.31 represent own price elasticity, cross price elasticity and expenditure elasticity , respectively as follow:

(3.29) $$e_{ii} = \lim_{\Delta p \to 0} \frac{\Delta q}{q} \Big/ \frac{\Delta p}{p} = \lim_{\Delta p \to 0} \frac{\Delta q}{\Delta p} \Big/ \frac{p}{q} = \frac{p}{q} \frac{dq}{dp} = \frac{\partial q_i}{\partial p_i} \frac{p_i}{q_i},$$

(3.30) $$e_{ij} \lim_{\Delta p_j \to 0} \frac{\Delta q}{q} \Big/ \frac{\Delta p_j}{p_j} = \lim_{\Delta p \to 0} \frac{\Delta q}{\Delta p_j} \Big/ \frac{p_j}{q} = \frac{p_j}{q}\frac{dq}{dp_j} = \frac{\partial q_i}{\partial p_j}\frac{p_j}{q_i}, \forall i \neq j,$$

(3.31) $$x = \lim_{\Delta x \to 0} \frac{\Delta q}{q} \Big/ \frac{\Delta x}{x} = \lim_{\Delta p \to 0} \frac{\Delta q}{\Delta x} \Big/ \frac{x}{q} = \frac{x}{q}\frac{dq}{dx} = \frac{\partial q}{\partial x}\frac{x}{q}.$$

If the cross price elasticity is negative goods are said to be substitutes; on the other hand, if cross price elasticities are positive, goods are said to be substitutes; and if the elasticity is zero, in this case goods are said to be independent. When the expenditure elasticity of demand is greater than one, goods are referred as luxurious, when it is lower than one goods are classified as necessities, lastly when the goods have expenditure elasticities lower than zero goods are called inferior necessity.

Notice that in any particular elasticity, the relations of change assume that the remaining variables in the equation are not involved in the effect of the variable of interest, they remain constant, for example, own price elasticity of demand involves only the effect of changes in its own price in quantities consumed of the good, Ceteris paribus.

Chapter 4

Econometrics of Demand Systems

This chapter presents the econometrics of demand systems that make use of cross sectional data. It will be discussed to the extent that facilitates the estimation of a demand system compounded by equations of the linear quadratic form (LinQuad), using two steps estimation procedure for censored demand equations, this procedure is helpful for correcting selectivity bias when dependent variables have values of zero. The organization of this chapter is divided into five sections.

The first section exposes limitations of data in the study of consumer demand. The second section discusses succinctly the estimation of Engel curves and the selection of functional forms. The third section presents procedures for testing and correcting selectivity bias, this section will discuss the origin of the system of censored demand equations of the LinQuad form. The fourth section discusses the insertion of variables in demand systems for capturing the effects of socio-economic conditions of the consumer. The fifth section reviews the selected econometric model for the estimation of demand systems and the computational procedures involved.

4.1 Limitations of Data

The available data determines the type of analysis that can be performed for unfolding consumption patterns. Cross sectional data usually comes from surveys performed by the USDA, BLS and surveys designed by researchers. Time series data are usually aggregations from these surveys.

Both surveys, “What We Eat in America” and the “Consumer Expenditures Survey” present problems when statistical analysis is executed because they do not provide the decision

linkage between quantities purchased and given prices. “What We Eat in America” provides quantities consumed but not the prices. The “Consumer Expenditures Survey” provides total expenditures on food items, but neither prices nor quantities purchased are supplied.

The maintenance of the linkage between the decisions of quantities consumed or expenditures allocated under given prices, the income and socio-economic characteristics of the consumer is essential for recognizing dependable food consumption patterns; if not, simply rough calculations are created. Departing from these problems related to data; the analysis, the interpretations and conclusions of research findings should circumvent these issues.

Another problem with data is related to prices. Different households face different prices that affect their decisions on how much to consume and spend. Price differentials come from seasonality, geographic location, heterogeneity of food products, price discrimination, and the dynamics of marketing practices executed by retailers, wholesalers and farmers. Price differentials are very important to keep in mind because they have effects on the responsiveness and sensitivity of consumers to how much money they allocate in a specific expenditure category and also what quantities of the items individuals will consume.

When the data does not provide the linkage discussed earlier. Researchers incorporate price indexes that capture price variations and the price of items for calculating quantities consumed. Price indexes and prices of items may originate from different surveys, and they are used as proxy variables that assist in the completion of the analysis of other surveys.

Scanner data may provide a solution for keeping the linkage of prices with quantities consumed. Capps (1989) advised caution in the generality of the conclusions made from any analyses performed from this type of data; he foresaw that with proper management, scanner data may well be the ultimate data source for demand analysis at the retail level.

Nevertheless, Capps (1989) elucidates that scanner data may be useful for short-run predictive models, despite concerns about the generalization of findings at the national or regional level, the inclusion of non-price factors and prices of other items like other foods and non-food products, and lastly the differences in the comparisons with other research results may reflect differences in databases, estimation methods, approaches (single demand equations vs. demand systems) and theoretical assumptions of the models. For reviewing the econometric considerations in the use of electronic scanner data for conducting consumer demand analysis refer to Capps and Love (2002) and Stockton (2004).

The nature of the data allows the formulation of single demand models, static and dynamic demand systems that may be complete or incomplete. Whatever type of analysis is chosen, the aggregation and assumptions of the model have to be stated explicitly. This research project uses an incomplete static demand system.

Another limitation of data, especially with cross sectional and panel data is that for some observations zero expenditures are found in the dependent variables of interest. There is a myriad of possible reasons why this happens, and it will be covered in the topic of correction for selectivity bias following the discussion of Engel curves and single demand equations. This problem is not common in time series data because the data has been aggregated.

4.2 Engel Curves and Single Demand Equations

Depending upon the problem, demand can be analyzed from two approaches: single equations and demand systems. The data available will dictate the suitable analysis to be performed. Cross sectional data and panel data can originate single demand equations and demand systems. Time series data allows the formulation of dynamic single demand equations as well as dynamic systems of demand equations.

In the case of single demand equations, the estimation of Engel curves has been used widely for determining consumption patterns and forecasting of consumption. Engel curves regress expenditures of a particular commodity in function of income. It is common that Engel curves are estimated in different forms that include Linear, Semi-Log, Double-Log, Inverse, Log-Inverse, and Log-Log inverse. According to Miller et al. (1984) the selection of the functional form of single equations should be guided by economic and statistical theory. Besides the marginal effects and elasticities the properties of these forms can be seen in Thomas (p. 34, 1972), Ramanathan (253-278, 1995), and Hill, Griffiths, and Judge (p.128-132, 2001). Single demand equations can model own price effects, cross price effects, income, dummy seasonal variables, trend, market strategic behavior and non-price strategies implemented in the marketing system (for more details of potential applications using single demand equations see Byrne, Capps, and Williams (1993); Ghosh and Das (2002); and Okunade (1992)).

Despite the easy estimation of single demand equations, the estimation of elasticities in compensated and uncompensated form still is not clear. Alston, Chalfant and Piggott (2002) states that parameters from a single equation model of the Double-Log form are calculated by deflating income (but not prices) using Stone's (1954) price index, conserving real income as a constant, thus the estimated parameters can be interpreted as compensated elasticities. In this scenario, homogeneity is imposed by restricting the coefficients on the prices to sum zero. The modified Double-Log form has the added virtue of sharing a right-hand side with the linear-approximate version of the Almost Ideal System (Alston, Chalfant and Piggott, 2002). Since current research has not focused on the validation of their findings, the proper estimation of elasticities in compensated form and uncompensated form based in economic theory still remains as an empirical question.

According to Alston, Chalfant and Piggott (2002) uncompensated price elasticities are obtained when the monetary variables are deflated by one of the series of prices or total expenditures. Homogeneity is imposed by summing the parameters from the vector of prices and income and the sum is equaled to zero. Therefore, deflating income and prices by the Consumer Price Index (CPI) not only inserts bias in the estimation but also wrong inferences are produced because CPI include price variation from goods that are not in the model or simply the price variation of the commodity of interest is not included. In this case, when homogeneity is inserted into uncompensated single equation demand models, quantities consumed or total expenditures depend only upon real income and relative prices.

The findings of Alston, Chalfant and Piggott are very important to consider when CPI is used as a proxy variable for inserting price variation in demand models. Special care must be taken when using demand systems for obtaining the effects of changes in prices in quantities demanded by consumers. Single demand equations are now being used widely. Current research with single demand equations has developed along with the development of time series models. Currently, demand systems have received acceptance since they represent more accurately the decisions of the consumer. There are complete and incomplete demand systems. Incomplete demand models are generally used when the researcher faces problems with data availability and search for parsimony in the model. Assumptions are needed for dealing with aggregation, preference ordering, integrability and estimation procedures.

4.3 Selectivity Bias

When dealing with microdata from consumer expenditure surveys, the problem of values of zero expenditures in the dependent variable columns arise by reasons of selectivity bias, corner solutions or simply selected zero consumption at the time of the survey; the last reason

might be related to positive inventories and dynamics that occur in the habit formation process. Heckman (1979) states that censored samples may arise from self selection by individuals and sample selection decisions by analysts.

Tobin (1958) stated that when estimating relations, the accumulation of observations with zero values, the ordinary least squares (OLS) estimator produces inconsistent estimates. An explanatory variable in such relationships may be expected to influence both the probability of limit responses and the size of non-limit responses (Tobin, 1958). The Tobit model is specified as follows:

4.1 $$q_t = 0 \text{ if } bX_t + x_t < 0,$$

4.2 $$q_t = bX_t + x_t \text{ if } bX_t + x_t > 0 \quad t = 1,2,3,...n,$$

where q_t is the dependent variable , X_t is the vector of independent variables and b is the vector of parameters to be estimated, x_t is the error term assumed to be normally independent. As can be seen in equations 4.1 and 4.2, the decision to consume, and the quantity to consume are based on the one set of estimated Tobit coefficients (Haines, Guilkey, and Popkin, 1988). According to Byrne, Capps and Saha (1996), the use of the Tobit model restricts the directional effects to be the same for both participation decision and the expenditure level decision. Thus, the real behavioral pattern is not followed using the Tobit model, the results are not consistent and a model that describes the two step process is needed.

Heckman (1979) proposed a method for dealing with the issue of zero expenditures, modeling the participation decision using a Probit model that determines the probability of participation, and then the level expenditure equation is estimated by ordinary least squares, and the equation that represents the level expenditures is augmented with a new variable, the inverse Mill's ratio (IMR), the ratio of the estimated values of the standard normal density function to

the estimated value of the standard normal cumulative distribution function. The Inverse Mill's Ratio is calculated for each observation in the dataset, mathematically the Heckman procedures can be described as follows:

4.3 $$p^* = Zn + e,$$

4.4 $$q^* = f(bX) + m \ ,$$

4.5 $$IMR = \frac{y(Zv)}{\Phi(Zv)},$$

where, equation 4.3 models the realization of the latent variable p^*, the binary realization variable p takes the values of 1 when $p^*>0$ and takes 0 when $p^* \leq 0$, Z is a vector of parameters to be estimated and v is the set of independent variables. From equation 4.4, q^* contains the information for individuals for which the binary realization equals 1. As stated before, the final equation that is estimated is augmented with the Inverse Mill's Ratio $\frac{y(Zv)}{\Phi(Zv)}$ for correcting selectivity bias in the demand equation of interest, as described by the following equation:

4.6 $$q = f(bX) + l\left(\frac{y(Zv)}{\Phi(Zv)}\right),$$

where $f(bX)$ is the equation of interest and $\frac{y(Zv)}{\Phi(Zv)}$ is the instrumental variable called IMR. In the final estimation only observations with non-limit responses are used, the IMR becomes a variable that links the participation decision and the equation that represents the quantity demanded. According to Heckman (1979) the presence of selectivity bias is found in the sample when the parameter l is statistically significant.

Heien and Wessells (1990) estimated a demand system that incorporates the Inverse Mill's Ratio for observations with zero value in the dependent variables as described by the following equation:

4.7 $$IMR = \frac{y\,(Zv)}{1-\Phi(Zv)}.$$

Thus, the demand system used all the observations available in the dataset. Notice the distinction of the IMR from equation 4.5 and 4.7. There is a difference in the calculation of the IMR, the denominator in 4.7 is calculated by subtracting the standard normal cumulative distribution function from 1, the value that represents the total area under the curve of the normal distribution.

Byrne, Capps and Saha (1996) used the approach of Heien and Wessells (1990) in a single equation, since its computation is relatively simple and produces consistent and asymptototically more efficient parameters compared to other estimators.

Shonkwiller and Yen (1999) pointed out that the two step Heckman procedure used by Heien and Wessells (1990) is inconsistent. Shonkwiller and Yen proposed a new estimator for a demand system of equations with limited dependent variables. Their results from Monte Carlo simulation suggested that their procedure performs well while the estimator of Heien and Wessells performs poorly.

Shonkwiller and Yen's procedure uses two steps. In the first step the value of the standard normal density function $y\,(Zv)$ and the estimated value of the standard normal cumulative distribution function $\Phi(Zv)$ are estimated for each household. In the second step, the objective function that is maximized is weighted by the standard normal cumulative distribution

function $\Phi(Zv)$ and adds an extra term that represents the standard normal density function $y(Zv)$. The econometric model has the following form:

4.8 $$q_{it} = \Phi(Z_{it}v_i) f(b_i X_{it}) + d_i y(Z_{it}v_i)) + x_{it}$$

$$\forall i = 1,2,3,...m; \ \forall t = 1,2,3,...T,$$

where, q represents the quantity demanded for the i_{th} equation and the t_{th} observation, the term $f(b_i X_{it})$ is the function of interest, and the error term x_{it} is assumed to be normal.

According to Shonkwiller and Yen (1999) the error term in equation 4.8 is heteroskedastic and the covariance matrix needs to be corrected by the Murphy-Topel approach that combines the first step (estimation of the Probit regression) and the second step (demand system estimation) in a single estimation block by maximum likelihood.

Lanfranco et al. (2002a) followed the procedure of Shonkwiller and Yen (1999), substituting the function $f(b_i X_{it})$ in 4.8 with the Linquad functional form developed by LaFrance (1990) and Agnew (1998), presented in equation 3.25. This research project followed the same procedures of Lanfranco et al. (2002a) and Lanfranco (2001). The resulting demand system is composed by censored demand equations of the LinQuad form (SCEDEL), described by equation 4.8.

4.4 Censored LinQuad Model Augmented with Socio-Economic Variables

Demographic variables in a demand equation serve as shifters; in such a way that more explanatory power is achieved, allowing for a more accurate understanding of the behavior of consumers. Variables included in the analysis are household income, ethnicity, household size, age of reference person, sex of the reference person, educational level of the reference person, urban status of the household, and food stamp participation of the household.

Household size is introduced in the system of censored demand equations of the LinQuad form (SCEDEL model) represented by the Amsterdam scale. Such a procedure is followed by Lanfranco (2002a, 2001). The Amsterdam scale represents members of the household by summing a scaled value that gives reference to males 18 years and over with the value of 1; males and females under 14 years are valued as 0.52 equivalent scale; females above 14 years are valued as 0.90 equivalent scale; and males between 14-17 years old are valued as 0.98 equivalent scale Deaton and Muellbauer (1980a).

Thus, augmenting the SCEDEL model with demographic variables, the term $f(b_i X_{it})$ from equation 4.8, is modified as follows:

4.9 $$q_{it} = \Phi(Z_{it} v_i) * f(a + Dd + Bp + g[y - a'p - p'Dd - .5p'Bp - a(d)]) + d_i y(Z_{it} v_i) + x_{it}$$

$$\forall i = 1,2,3,...m; \ \forall t = 1,2,3,...T,$$

where, d is a set of demographic variables, $a(d)$ is an arbitrary real valued function of all variables in d, and x_{it} is the error term assumed to be normal.

The LinQuad demand system when estimated in terms of quantities has heteroskedasticity, given that, the model is estimated in terms of deflated expenditures, thus both terms of equation 4.8 is multiplied by the corresponding price and produces the following equation:

4.10 $$e_i = dp_i * \Phi(Z_{it} v_i) * (a + Dd + Bp + g[y - a'p - p'Dd - .5p'Bp - a(d)]) + d_i y(Z_{it} v_i) + x_{it},$$

$$\forall i = 1,2,3,...m; \ \forall t = 1,2,3,...T,$$

where e_i represents deflated expenditures for the item i, dp_i represents deflated prices for the item i, $\Phi(Z_{it} v_i)$ is the standard normal cumulative distribution function, $f(b_i X_{it})$ stands for the quantities demanded for the item i using the LinQuad functional form, $y(Z_{it} v_i)$ represents the standard normal density function, and x_{it} is the error term assumed to be normal.

4.5 Selected Model

The unfolding of consumption patterns was accomplished by using four demand systems of the SCEDEL form augmented with demographic variables for Hispanics, White, African American and households of other minorities. From equation 4.10 the estimated demand equations have the following explicit functional form:

4.11

$$e_i = \Phi(Z_{it}v_i) * p_i * \left\{ \begin{array}{l} b_0 + b_1 p_i + b_2 p_2 + b_3 p_3 + b_4 p_4 + b_5 p_5 + b_6 p_6 + b_7 p_7 + \\ b_8 p_8 + b_9 p_9 + b_{10} p_{10} + b_{11} hsize + b_{12} age + b_{13} sex + \\ b_{14} plt18 + b_{15} po64 + b_{16} fs + b_{17} urbs + b_{18} ed1 + b_{19} ed2 + \\ b_{20}\left[dwincome - (\sum_{k=1}^{k} a_k p_k) - \frac{1}{2}(\sum_{j=1}^{k}\sum_{k=1}^{k} b_{jk} p_j p_k) - \sum_{k=1}^{k}\sum_{l=1}^{L} b_{kl} p_k D_l \right] \end{array} \right\}$$

$$+ d_i y\,(Z_{it}v_i) + x_i \quad \forall i = 1,2,3,...,10 \qquad \forall l = 1,2,3...,9 \quad \forall k = 1,2,3,...10\,,$$

where expenditures in other goods (XOG) correspond to the term described by the following equation

4.12 $$\text{XOG} = \left[dwincome - (\sum_{k=1}^{k} a_k p_k) - \frac{1}{2}(\sum_{j=1}^{k}\sum_{k=1}^{k} b_{jk} p_j p_k) - \sum_{k=1}^{k}\sum_{l=1}^{L} b_{kl} p_k D_l \right],$$

where the variable dwincome represents weekly deflated income; the term $\sum_{k=1}^{k} a_k p_k$ represents the sum of products of the intercepts and their own prices. The term $\sum_{j=1}^{k}\sum_{k=1}^{k} b_{jk} p_k$ represents the sum of the cross products of the series of prices, and the term $\sum_{k=1}^{k}\sum_{l=1}^{L} b_{kl} p_k D_l$ represents the cross products of demographic shifters with the series of prices for the demand equation of item i.

The probability of positive expenditures depends on logarithm of income and household size and is represented by $\Phi(Z_{it}v_i)$. The standard normal probability for item i is represented

by $y\ (Z_{it} v_i)$ and also depends on logarithm of income and household size. Expected signs for the estimated coefficients of p_i, p_2, p_3, p_4, p_5, p_6, p_7, p_8, p_9, p_{10}, hsize, age, sex, plt18, po64, fs, urbs, ed1, ed2, and XOG are depicted in table 4.1. Own price effects are expected to be negative. Cross price effects are expected to be positive because of relationships of substitution. Demographic variables are demand shifters; the expected sign of the coefficients is mixed as can be seen in table 4.1. Refer to section 5 of chapter 2 of this thesis, where a review of literature in food consumption is discussed.

From equation 4.11, the tem x_i represents the error term for the demand equation of item i, and it is assumed to have a normal distribution. The commodities included in the analysis were ground beef, beef roast, beef steak, other beef, bacon, pork chops, ham, other pork, chicken, and canned fish. The composite commodity that represents expenditures in other goods in the incomplete demand system is not estimated for avoiding singularity in the covariance matrix.

The only restriction from economic theory that was imposed was symmetry, so that $b_{ij} = b_{ji}$. Each demand system has ten equations, from which 10 parameters correspond to intercepts, 10 parameters to own prices, 45 parameters to cross price effects, 90 parameters to demographic variables, 10 parameters to income effects, and 10 parameters corresponding to the standard normal distribution. Therefore each demand system contained 175 estimated parameters.

Table 4.1 Expected Signs of the Estimated Parameters

Variable	Description	Parameter	Expected Sign*
p_i	Deflated price of item 1	b_1	-
p_2	Deflated price of item 2	b_2	+
p_3	Deflated price of item 3	b_3	+
p_4	Deflated price of item 4	b_4	+
p_5	Deflated price of item 5	b_5	+
p_6	Deflated price of item 6	b_6	+
p_7	Deflated price of item 7	b_7	+
P_8	Deflated price of item 8	b_8	+
p_9	Deflated price of item 9	b_9	+
p_{10}	Deflated price of item 10	b_{10}	+
hsize	Household size	b_{11}	+
age	Age of reference person	b_{12}	-
sex	Sex of reference person	b_{13}	-
plt18	Persons under 18 years younger	b_{14}	+
po64	Person over 64 years	b_{15}	+
fs	Food stamp participation	b_{16}	-
urbs	Urban status	b_{17}	+
ed1	Education of reference person	b_{18}	-
ed2	Education of reference person	b_{19}	-
xog	Expenditures in other goods	b_{20}	+
dwincome	Deflated weekly income		

*Expected signs are stated under the Ceteris paribus condition.

4.5.1 Comparison between Ethnic Groups

Even though the intention of Lanfranco (2001) was to unfold differences in allocation of expenditures between ethnic groups, the study fails to state statistically significant differences in the allocation of meat expenditures. In addition to the estimation of a demand system for each ethnic group, a system for the whole population was performed for inserting dummy variables that represent ethnicity, thus equation 4.11 became:

$$4.12 \quad ex_i = \Phi(Z_{it} v_i) * p_i * \left\{ \begin{array}{l} b_0 + b_i p_i + b_2 p_2 + b_3 p_3 + b_4 p_4 + b_5 p_5 + b_6 p_6 + b_7 p_7 + \\ b_8 p_8 + b_9 p_9 + b_{10} p_{10} + b_{11} hsize + b_{12} age + b_{13} sex + \\ b_{14} plt18 + b_{15} po64 + b_{16} fs + b_{17} urbs + b_{18} ed1 + b_{19} ed2 + \\ b_{20} hisp1 + b_{21} hisp2 + b_{22} hisp3 + \\ b_{23} \left[dwincome - (\sum_{k=1}^{k} a_k p_k) - \frac{1}{2} (\sum_{j=1}^{k} \sum_{k=1}^{k} b_{jk} p_j p_k) - \sum_{k=1}^{k} \sum_{l=1}^{L} b_{kl} p_k D_l \right] \end{array} \right\}$$

$$+ d_i y\,(Z_{it} v_i) + x_i \qquad \forall i = 1,2,3,...,10 \qquad \forall l = 1,2,3...,9 \quad \forall k = 1,2,3,...10\,;$$

where the variables hisp1, hisp2, and hisp3 represent dummy variables for comparison of Hispanic households with White, African American and households of other minorities, respectively. The temx_i represents the error term for the demand equation of item i, and it is assumed to be normal, independent and homogeneous.

4.6 Description of Variables in the Dataset

The estimation of the demand system considered weekly deflated expenditures of meat products as the dependent variables. Quantities consumed were calculated by dividing the expenditures of the household in product i by its corresponding average monthly price reported by the Bureau of Labor Statistics for each regio n. The products in the demand system were ground beef, beef roast, beef steak, other beef, bacon, pork chops, ham, other pork, chicken, and canned fish.

For each product two dependent variables were considered. In the first step of the estimation, the decision to consume was modeled; the binary dependent variables for this purpose were coded as pur, which ranged from pur1 to pur10. In the second step of the estimation, deflated weekly expenditures were used with the variables coded as dcost, which ranged from dcost1 to dcost10. Table 4.2 represents the dependent variables considered in the

estimation process. The model was not estimated as a function of quantities consumed because of problems with heteroskedasticity, refer to Agnew (1998) and Lanfranco (2001).

The independent variables in the demand systems were the series of prices for each product and the socio-economic and demographic characteristic of the consumer unit. The series of prices for each region were coded as sp, varying from sp1 to sp10; for identifying the price of each meat product, refer to table 4.3 for more details. Socio-economic and demographic characteristics were included in the models, two type of variables were used, continuous and dummy variables; the continuous variables had positive numeric values. In the case of the dummy variables the comparisons are executed with its indicated default's response. For example, the dummy variable "Hispanic origin", contains three subsets of dummy variables for making the comparison in differences in consumption patterns of White, African American, and other minorities households with households of Hispanic origin (Table 4.4).

Table 4.2 List of Dependent Variables.

Variable	Type	Code	Description
Ground Beef	Continuous	dcost1*	Deflated household's weekly expenditures.
	Binary	pur1**	Household's decision to purchase.
Roast Beef	Continuous	dcost2	Deflated household's weekly expenditures.
	Binary	pur2	Household's decision to purchase.
Beef Steak	Continuous	dcost3	Deflated household's weekly expenditures.
	Binary	pur3	Household's decision to purchase.
Other Beef	Continuous	dcost4	Deflated household's weekly expenditures.
	Binary	pur4	Household's decision to purchase.
Bacon	Continuous	dcost5	Deflated household's weekly expenditures.
	Binary	pur5	Household's decision to purchase.
Pork Chops	Continuous	dcost6	Deflated household's weekly expenditures.
	Binary	pur6	Household's decision to purchase.
Ham	Continuous	dcost7	Deflated household's weekly expenditures.
	Binary	pur7	Household's decision to purchase.
Other pork	Continuous	dcost8	Deflated household's weekly expenditures.
	Binary	pur8	Household's decision to purchase.
Poultry	Continuous	dcost9	Deflated household's weekly expenditures.
	Binary	pur9	Household's decision to purchase.
Seafood	Continuous	dcost10	Deflated household's weekly expenditures.
	Binary	pur10	Household's decision to purchase.

* Expenditures in real values, $/week/consumer unit.

** Non-purchase is the default value.

Table 4.3 List of Independent Variables Related to Prices.

Variable	Type	Code	Description
Ground Beef	Continuous	sp1	Price of all uncooked ground beef, $/pound.
Roast Beef	Continuous	sp2	Price of all uncooked roast beef, $/pound.
Beef Steak	Continuous	sp3	Price of all uncooked beef steak, $/pound.
Other beef	Continuous	sp4	Price of all uncooked other beef (excluding veal), $/pound.
Bacon	Continuous	sp5	Price of all uncooked sliced bacon, $/pound.
Pork Chops	Continuous	sp6	Price of all uncooked pork chops, $/pound.
Ham	Continuous	sp7	Price of all uncooked ham (excluding canned ham and luncheon slices), $/pound.
Other pork	Continuous	sp8	Price of all uncooked other pork (excluding canned ham and luncheon slices), $/pound.
Poultry	Continuous	sp9	Price of all uncooked, whole fresh chicken, $/pound.
Seafood	Continuous	sp10	Price of all tuna, light, chunk, $/pound.
CPI*	Continuous	cpi1	Non-food consumer price index.

Source: Bureau of Labor Statistics.
*Not seasonally adjusted, and its base period is 1982-84.

Table 4.4 List of Independent Variables Related to Socio-Economic and Demographic Characteristics of the Ethnic Groups.

Variable	Type	Code	Description
Hispanic origin	Dummy	hisp1	White households (Default: Hispanics).
Hispanic origin	Dummy	hisp2	African American households (Default: Hispanics).
Hispanic origin	Dummy	hisp3	Households of other minorities. (Default: Hispanics).
Weekly income	Continuous	sdwincome	Deflated weekly income.
Expenditures in other Goods	Continuous	xog	Household's expenditures (Income - meat expenditures).
Household's size (Amsterdam Scale)	Continuous	hsize	Adult equivalents per household.
Persons less than 18 years old	Continuous	plt18	Number of persons per household.
Persons over 64 years old	Continuous	po64	Number of persons per household.
Age	Continuous	age	Age of reference person.
Sex	Dummy	sex	Sex of the reference person (Default: female).
Food Stamps	Dummy	fs	Household with food stamps recipients (Default: non-recipients).
Urbanization Status	Dummy	urbs	Household's urbanization status (Default: rural).
Education	Dummy	ed1	Reference person with some high school or completed (Default: primary school as the highest level of education).
Education	Dummy	ed2	Reference person with some college, bachelor's degree or advanced degrees (Default: primary school as the highest level of education).
Hispanic origin*	Discrete	hisp	Variable for processing.

*This variable helped the processing of the data; H=1, W=2, AA=3, and OM=4.

4.7 Computational Procedures

The first step of the selected model of the form of equation 4.11 required the estimation of Probit regressions for each commodity, so that the standard normal density function y (Zv) and the estimated value of the standard normal cumulative distribution function $\Phi(Zv)$ were estimated for each household. The SAS program (version 9.1.3) has two computational methods for this stage, the qlim and the probit procedure. Stata provides an interface for sample selection models in addition to data management techniques, version 9 of Stata was selected for this step.

In addition to reporting the coefficients of the probit regressions, marginal effects are estimated. Stata defines the probit model as

4.13 $$\Pr(y_j \neq 0 | x_j) = \Phi(x_j b),$$

where $\Phi(x_j b)$ is the standard cumulative normal distribution and $x_j b$ is its numeric value in the Z scores. Thus, marginal effects are estimated as the following equation

4.14 $$\frac{\partial \Phi}{\partial x_1} = f(\bar{x})\, b_1,$$

so that the change in probability for an independent variable x is $\frac{\partial \Phi}{\partial x_1}$, it is the height of the normal distribution multiplied by the x coefficient, thus, $\frac{\partial \Phi}{\partial x_1}$ is the infinitesimal change in probability (Stata, 2005).

The second step of the analysis, estimated demand systems of the form of equation 4.11 was performed by Iterative Seemingly Unrelated Regression and Full Information Maximum Likelihood, these techniques are available in the "proc model" procedure of the SAS program version 9.1.3. Starting values were estimated under SUR and initiated by OLS, in order to ensure faster convergence at 0.0000001 and more accuracy of the estimates.

Elasticities were estimated based on the LinQuad demand system. The own price elasticities, cross price elasticities, and the income elasticities have the form of equations 3.26, 3.27, and 3.28, respectively. Based on the selected model, refer to equation 4.11, elasticities were estimated as follow:

4.15 $$x_{ii} = \frac{\partial x_i}{\partial p_i} * \frac{\overline{p}_i}{\overline{x}_i} = \Phi(Z_{it} v_i) * \left[b_{ii} - g_i (a_i + \sum_j b_{ij} p_j) \right] * \frac{\overline{p}_i}{\overline{x}_i},$$

4.16 $$x_{ij} = \frac{\partial x_i}{\partial p_j} * \frac{\overline{p}_j}{\overline{x}_i} = \Phi(Z_{it} v_i) * \left[b_{ij} - g_i (a_j + \sum_k b_{jk} p_k) \right] * \frac{\overline{p}_j}{\overline{x}_i},$$

4.17 $$h_i = \frac{\partial x_i}{\partial y} * \frac{\overline{y}}{\overline{x}_i} = \Phi(Z_{it} v_i) * g_i * \frac{\overline{y}}{\overline{x}_i}$$

where equations 4.15, 4.16, 4.17, represent own price elasticities, cross price elasticities, and the income elasticities, respectively. The term $\Phi(Z_{it} v_i)$ represents the standard cumulative distribution function. Household size elasticities had the following functional form:

4.18 $$\mathrm{H}_i = \frac{\partial x_i}{\partial h_i} * \frac{\overline{h}_i}{x_i} = \Phi(Z_{it} v_i) * \left[b_{11i} - g_i \sum_j b_{11i} \overline{p}_i) \right] * \frac{\overline{h}_i}{\overline{x}_i}$$

where $\Phi(Z_{it} v_i)$ is the standard cumulative distribution function, $\left[b_{11i} - g_i \sum_j b_{11i} \overline{p}_i) \right]$ is the first derivative of the demand with respect to household size for equation i, $\frac{\overline{h}_i}{\overline{x}_i}$ correspond to the ratio of the average household size and average quantity demand of the item i.

4.8 Testing Procedures

Probit regressions were evaluated through likelihood ratio tests that follow a chi-square distribution. Classification tables were also useful in determining which variables to include in

this step. The restrictions on the parameters were evaluated by means of t-tests, using 90% and 95% confidence levels. Differences in consumption of meat products by ethnic groups were evaluated by means of the evaluation of the significance of the dummy variables hisp1, hisp2 and hisp3 for each meat product, using 90% and 95% levels of confidence. For more information about the econometrics of demand systems refer to Edgerton, et al. (1996).

Chapter 5

Results

This chapter is divided into seven sections and communicates the results from the econometric models described in the previous chapter. The first section describes the named survey and explains the extraction process of the dataset. The second section presents the descriptive analysis of the sample in terms of the socio-economic characteristics of the households as well as their expenditures and imputed prices. The third section discusses the decision of consumers to purchase meat products; as well as the marginal effects from Probit regressions, this step was useful for calculating the standard normal density function and standard normal cumulative distribution function for each household. The inclusion of variables in the Probit regressions followed a forward stepwise modeling framework concatenated with the estimation of censored demand systems of the LinQuad form.

The fourth section discusses the role of ethnicity in demand for meat products. The fifth section discusses the set of systems in function of only prices and income. The sixth section discusses the demand systems augmented with the variable that corresponds to household size in Amsterdam scale. The seventh section presents the results of systems augmented with the complete set of demographics that was proposed in chapter four. The systems were estimated under Full Information Maximum Likelihood and Iterative Seemingly Unrelated regression, and for each system own price elasticities, cross-price elasticities, income elasticities and household size elasticities were calculated. The included ethnic groups in the analysis were Hispanics, non-Hispanic Whites, African Americans, and a composite of households of other minorities; an additional system was estimated for all households in the sample so that its results may serve as a benchmark in the discussion.

5.1 Data

This research project makes use of data from the "Consumer Expenditure Survey", released by the Bureau of Labor Statistics; the Census Bureau is in charge of collection of data and data processing. The purpose of the program is to collect information about the buying habits of American consumers and adjust the basket utilized in the estimation of the CPI.

The Consumer Expenditure program consists of two separate components, each with its own questionnaire and independent sample. One of the components is a diary or recordkeeping survey completed by the sample consumer units for two consecutive 1-week periods; the sample is surveyed across a 12-month period. The other component is an interview panel survey in which each consumer unit in the sample is interviewed once every 3 months over five consecutive quarters to obtain a year's worth of data. New panels are initiated every month of the year (Bureau of Labor Statistics, 2003).

The interview survey includes monthly out-of-pocket expenditures such as housing, apparel, transportation, health care, insurance, and entertainment. The diary survey includes weekly expenditures of frequently purchased items such as food and beverages, tobacco, personal care products, and nonprescription drugs and supplies (Bureau of Labor Statistics, 2006).

This research project has analyzed meat expenditures based on the "2003 Consumer Expenditure Survey," using only the diary component. It contains information from 15,827 independent diaries. The database contains four types of tables. One table contains aggregated information for the consumer unit (family). The second table contains information for each member of the consumer unit (members). The third table contains information about income for the consumer unit (income), and the fourth table contains the expenditures recorded at the

consumer unit level (expenditures). The files are contained on CD-Rom; different types of tables are divided by quarter.

Expenditures and income are categorized by the universal classification code (UCC), if a UCC is not recorded in the file it is because the consumer unit did not recorded it. The information in the database is recorded in numeric and character format.

The diary survey does not contain information linked to quantities and prices. Consequently, prices were inserted into the model to calculate quantities consumed. Average monthly prices were collected from the Bureau of Labor Statistics; the prices were matched with the region of the consumer unit and month in which the diary was completed.

The Bureau of Labor Statistics divides the population into four regions: Northeast, Midwest, South and West. The Northeast region includes the states of Connecticut, Maine, Massachusetts, New Hampshire, New Jersey, New York, Pennsylvania, Rhode Island, and Vermont. The Midwest region includes the states of Illinois, Indiana, Iowa, Kansas, Michigan, Minnesota, Missouri, Nebraska, North Dakota, Ohio, South Dakota, and Wisconsin. The Southern region includes the states of Alabama, Arkansas, Delaware, District of Columbia, Florida, Georgia, Kentucky, Louisiana, Maryland, Mississippi, North Carolina, Oklahoma, South Carolina, Tennessee, Texas, Virginia, and West Virginia. The Western region includes the states of Alaska, Arizona, California, Colorado, Hawaii, Idaho, Montana, Nevada, New Mexico, Oregon, Utah, Washington, and Wyoming.

5.1.1 Extraction of the Dataset

The construction of the dataset began with the exploration and familiarization with the database, with a focus on the variables of interest. The exploration included counting the number of records for each table, continued with the identification of variables and matching those

variables with the questions asked in the diary. The variable that identifies each consumer unit (CU) was checked for missing values and for repeated identification numbers. The number of observations was counted for each quarter and for each different table (family, members, income, and expenditures). The format for each variable in the model, the range of possible values, missing values, and the meaning of the responses for the questions asked in the diary were identified. The process was repeated in each table of quarterly data. The extraction of expenditures and household size was carried out for each quarter.

The process began with aggregation of expenditures at the consumer unit level. Eighteen UCC's were used for the aggregation of 10 broad products that included ground beef, roast beef, beef steak, other beef, bacon, pork chops, ham, other pork, chicken, and fish. The description of the extracted UCC's can be seen in table 5.1.

Table 5.1 Universal Classification Codes of Expenditures used in the Aggregation.

UCC	Description
30110	Ground beef, excluding canned
30210	Chuck roast, excluding canned
30310	Round roast, excluding canned
30410	Other beef roast, excluding canned
30510	Round steak, excluding canned
30610	Sirloin steak, excluding canned
30710	Other steak, excluding canned
30810	Other beef, excluding canned
40110	Bacon
40210	Pork chops
40310	Ham, excluding canned
40410	Other pork, excluding canned
60110	Fresh and frozen whole chicken
60210	Fresh or frozen chicken parts
60310	Other poultry
70110	Canned fish, seafood and shellfish
70230	Fresh fish and shellfish
70240	Frozen fish and shellfish

Source: 2003 Consumer Expenditures Survey.

The extraction was completed using the data step with concatenated dynamic structured queries in SAS®. Structured Query Language (SQL) was used for the formulation of the queries; refer to SAS (2004). SQL is the common language of most commercial relational databases like MySQL, Oracle, Sybase, DB2, Microsoft Access and MS SQL server. The code was tested using hypothetical tables with a structure similar to that of the data of interest; this process allowed for the inspection and corroboration of performed operations that were required in the extraction of the dataset.

The extraction was performed in two steps. The first step consisted of extracting expenditures at the UCC level for each consumer unit. The second step consisted on summing the expenditures for each consumer unit at the UCC level because some consumer units recorded the same UCC more than one time during the week of the questionnaire. The described steps above required the creation of two dynamic filters with restrictive queries for each UCC. The data extracted was sorted and merged by the unique identification number of the consumer unit.

Household size was extracted from the members table for each consumer unit, the Amsterdam scale was used for this purpose. The extraction was performed in two steps. In the first step, each member of the consumer unit was allocated a value of the scale based on age and sex. Then the value assigned for each member was summarized at the household level.

The files containing the extracted information of family characteristics, expenditures and household size were sorted and merged by the identification number of each consumer unit. The operations previously mentioned were repeated for each quarter. Thereafter, the data was aggregated for the whole year by joining the extracted information contained in each quarter.

The aggregated dataset was filtered with the intention of producing a valuable dataset for the analysis. Households in the filtered dataset were required to have completed the diary survey;

have an income response greater than zero, households that completed the income response, households which purchased at least one meat item during the week of the questionnaire. The resulting dataset contained 6,858 diaries with mean weekly income of $1,074.07 that ranged from $1,093.67 up to $1,054.47 within the 90% confidence interval.

The filtered dataset had a problem with the income response; there were 939 respondents with income too low or too high. In order to have a more uniform data, the dataset was trimmed, using consumer units within one standard deviation from the mean weekly income. The resulting dataset contained 5,919 respondents with annual income ranging from $4,664.00 up to $107,150.00. This range ensured that the mean annual income from the previous dataset was located in the new dataset since its 99% confidence interval ranged from $54,255 up to $57,448. The trimming of the dataset provided more consistency, and not only avoided problems in the estimation of Probit regressions with coefficients equal to zero but also eliminated respondents with not economically logical responses. The behavioral responses were more in accord with economic theory.

5.2 Descriptive Analysis of the Selected Dataset

5.2.1 Descriptive Analysis of Socio-Economic Characteristics

Descriptive statistics of the selected dataset are presented in tables 5.2 to 5.13. The sample contained 821 households of Hispanic origin (H), 4,118 Non-Hispanic White households (W), 664 African American households (AA), and 316 households belonging to other minorities (OM), corresponding to 13.87%, 69.57%, 11.22%, and 5.34% of the sample, respectively (Table 5.2).

The majority of Hispanics with Mexican and Mexican American origin were mainly distributed in the Midwest, Southern and Western regions. Hispanics of Central American and

South American descendancy were concentrated in the Northeast, Southern and Western regions. Puerto Ricans and Cubans were concentrated in the Northeast and Southern regions, respectively (Table 5.3).

More Hispanic households were located in the Western and Southern regions, in contrast with White and African American households who were located mainly in the South and Midwest. Most households were located in urban areas, varying with the size of the population. More than 60% of households of the H group were found in areas with a population greater than 1.2 million people. The same proportions were observed in households of the AA group. In contrast, White households had a more balance distribution (Table 5.4).

Hispanic households had the biggest household size. On average, they had 3.49 members followed by African Americans with 2.90 members per household. The household size had the same proportion in terms of the Amsterdam scale. Hispanic households had by far more younger members, in contrast with White households who had a greater number of older members. The average age of the reference person was 51.63 years for White households, in contrast with Hispanics at 43.79 years (Table 5.5). The sex of the reference person was relatively uniform for all ethnic groups.

The average annual income for the households was $36,310.00, $45,209.00, $33,906.00, and $42,758.00 for households of the H, W, AA and OM groups, respectively. Hispanic households had the lowest average weekly income per earner and average weekly income per adult equivalent scale, despite the fact that they had on average more earners. More than 20% of the AA households were below the poverty threshold. The same proportion of households was recipients of food stamps. There were more White households below the poverty threshold

compared to H, AA and OM households, and proportionally they had the lowest number of households in this indicator due to differences in sub-sample size (Table 5.5).

More than 40% of Hispanic households had reference persons in jobs with occupations as handler, helper, laborer, other service and administrative support and clerical. Those occupations were very similar to AA households, with the exception that more than 16% of African Americans participated in occupations related to professional administrative support and sales. On the contrary, W and OM households had more than 20% of the reference person in occupations related to professional administrative support and sales (Table 5.6).

The gap in educational levels of the reference person was wider. The reference person of OM households had more education. More than 38% had at least a bachelor degree. In contrast. H and AA households had barely 13% of the reference person holding a bachelor's degree. Almost 50% of African American households had reference persons with some high school and completed high school. White households had almost 50% of the reference person with some college, associate degree and bachelor degree. The reference persons of Hispanic households had the lower educational level, with 66% of the reference persons with high school as the highest educational attainment level (Table 5.7).

The number of households belonging to different income classes was more uniform in the Hispanic segment. Whites had 80% of the households in the income class greater than $20,000/year, and almost 40% of households had income greater than $50,000/year, it was very similar to OM households with 36% of households in that income class. The percentage of households under $20,000/year was higher for AM households, followed by H and OM households (Table 5.8).

Households in different ethnic groups had a similar composition of wage earners, with 50% of the households composed of head only and head and spouse. White households together with African Americans had the highest proportion of households with no earners, representing about one fifth of total households (Table5.9).

White households had the highest housing ownership with 75% of the households owning a house. In contrast, 45% of African American households and 42% Hispanic households were renting (Table 5.10).

The family composition of Hispanics had the higher proportion of households under the category husband and wife with children below 17 years old. The category husband and wife with children older than 17 years had the highest proportion among households belonging to other minorities. More than one fifth of the African American and White households had family composition with single persons (Table 5.11).

The distribution of male and female reference persons was relatively balanced among ethnic groups. Among Hispanics 64.31% of the households had a married reference person, followed by other minorities with 62.97% of households reporting married reference persons. (Tables 5.12 – 5.13).

The average values of the demographic variables are similar to those from the 2000 U.S. Census, thus, the extracted dataset closely represents the U.S. population; in fact, the objective of the Consumer Expenditure Survey is to represent the consumption patterns of the U.S. market as a whole. The following tables, from 5.2 up to 5.25, correspond to data from the 2003 Consumer Expenditure Survey, released by the U.S. Bureau of Labor Statistics.

Table 5.2 Number of Households by Region and Ethnic Group.

	Hispanics		Non-Hisp. Whites		African American		Other Minorities	
Region	No. HH*	%	No. HH	%	No. HH	%	No. HH	%
Northeast	98	11.94	793	19.26	83	12.50	33	10.44
Midwest	71	8.65	1207	29.31	154	23.19	41	12.97
South	297	36.18	1280	31.08	387	58.28	86	27.22
West	355	43.24	838	20.35	40	6.02	156	49.37
Total	821	100	4118	100	664	100	316	100

*No. HH: stands for number of households and is used in all remaining tables.

Table. 5.3 Country of Origin of Hispanic Households by Region.

	Northeast		Midwest		South		West	
	No. HH	%	No. HH	%	No. HH	%	No. HH	%
Mexican	8	8.2	33	46.5	97	32.7	184	51.8
Mexican-American	2	2.0	18	25.4	70	23.6	84	23.7
Chicano	0	0.0	2	2.8	2	0.7	23	6.5
Puerto Rican	30	30.6	11	15.5	17	5.7	4	1.1
Cuban	0	0.0	2	2.8	25	8.4	9	2.5
Cuban-American	1	1.0	0	0.0	2	0.7	0	0.0
Central or South American	37	37.8	0	0.0	75	25.3	30	8.5
Other Hispanic	20	20.4	5	7.0	9	3.0	21	5.9
Total	98	100	71	100	297	100	355	100

Table 5.4 Number of Households by Urban Status and Population Size.

	Hispanics		Non-Hisp. Whites		African American		Other Minorities	
	No. HH	%	No. HH	%	No. HH	%	No. HH	%
Urbanization								
Urban	769	93.67	3572	86.74	617	92.92	298	94.30
Rural	52	6.33	546	13.26	47	7.08	18	5.70
Total	821	100	4118	100	664	100	316	100
Population Size								
More than 4 million	282	34.35	811	19.69	179	26.96	92	29.11
1.20-4 million	241	29.35	1222	29.67	225	33.89	65	20.57
0.33-1.19 million	94	11.45	627	15.23	101	15.21	94	29.75
125- 329.9 thousand	89	10.84	536	13.02	35	5.27	32	10.13
Less than 125 thousand	115	14.01	922	22.39	124	18.67	33	10.44
Total	821	100	4118	100	664	100	316	100

Table 5.5 Socio-Economic Characteristics of Households by Ethnic Group.

Characteristic	Hispanics	Non-Hisp. Whites	African American	Other Minorities
Number of Households	821	4118	664	316
Proportion of Households in the sample	13.87	69.57	11.22	5.34
Average number of persons/household	3.49	2.52	2.90	2.86
Household size, Amsterdam scale	2.89	2.18	2.39	2.50
Average number of persons under 18 years old	1.22	0.61	1.10	0.66
Average number of persons over 64 years old	0.22	0.42	0.23	0.30
Average age of household head	43.79	51.63	47.38	47.67
Average annual household income, $/year	36310.02	45209.14	33906.59	42758.62
Average weekly household income, $/week	698.27	869.41	652.05	822.28
Average number of earners	1.60	1.34	1.25	1.52
Average weekly household income per earner, $/week	435.62	650.95	522.27	541.34
Average weekly household income per adult equivalent scale, $/week	241.32	398.70	272.79	329.28
Number of Households under poverty threshold	168	340	160	45
Percentage of households under poverty threshold	20.61	8.26	24.10	14.24
Number of food stamps recipients	125	500	133	57
Percentage of Households recipients of food stamps	15.34	12.14	20.03	18.04

*The poverty threshold for a household of four members, including two children was $18,859.00/year.

Table 5.6 Jobs of Reference Persons.

	Hispanics		Non-Hisp. Whites		African American		Other Minorities	
Occupation	No. HH	%	No. HH	%	No. HH	%	No. HH	%
Administrator, manager	46	7.80	342	12.32	39	8.25	25	11.06
Teacher	19	3.22	149	5.37	20	4.23	6	2.65
Professional adm. support, technical, sales	45	7.63	559	20.14	76	16.07	56	24.78
Adm. Support, including clerical	58	9.83	355	12.79	63	13.32	26	11.50
Sales, retail	26	4.41	146	5.26	23	4.86	9	3.98
Sales, business goods and services	12	2.03	123	4.43	7	1.48	8	3.54
Technitian service	29	4.92	143	5.15	28	5.92	11	4.87
Protective Service	12	2.03	32	1.15	19	4.02	1	0.44
Private household service	12	2.03	16	0.58	9	1.90	3	1.33
Other service	96	16.27	278	10.01	80	16.91	38	16.81
Machine operator, asembler, inspector	50	8.47	147	5.30	23	4.86	8	3.54
Transportation operator	20	3.39	87	3.13	14	2.96	3	1.33
Handler, helper, laborer	91	15.42	137	4.94	34	7.19	17	7.52
Mechanic, repairer, precision production	8	1.36	108	3.89	21	4.44	6	2.65
Construction mining	40	6.78	112	4.03	15	3.17	7	3.10
Farming	20	3.39	20	0.72	0	0.00	0	0.00
Forrestry, fishing, groundskeeping	3	0.51	8	0.29	0	0.00	2	0.88
Armed forces	3	0.51	14	0.50	2	0.42	0	0.00
Total	590	100	2776	100	473	100	226	100

Table 5.7 Educational Level of Reference Person.

	Hispanics		Non-Hisp. Whites		African American		Other Minorities	
Level of Education	No. HH	%	No. HH	%	No. HH	%	No. HH	%
No school	10	1.22	3	0.07	4	0.60	2	0.63
Grade 1-8	182	22.17	144	3.50	38	5.72	7	2.22
Gr. 9-12 (No degree)	108	13.15	294	7.14	102	15.36	31	9.81
High School	242	29.48	1287	31.25	203	30.57	76	24.05
Some college	122	14.86	842	20.45	166	25.00	57	18.04
Associate's degree	48	5.85	409	9.93	61	9.19	21	6.65
Bachelor’s degree	81	9.87	777	18.87	68	10.24	76	24.05
Master's degree	25	3.05	273	6.63	15	2.26	28	8.86
Prof./Ph.D.	3	0.37	89	2.16	7	1.05	18	5.70
Total	821	100	4118	100	664	100	316	100

Table 5.8 Annual Income Composition of Households by Ethnic Group.

	Hispanics		Non-Hisp. Whites		African American		Other Minorities	
Income Level	No. HH	%	No. HH	%	No. HH	%	No. HH	%
< 5000	2	0.24	7	0.17	3	0.45	2	0.63
5000- 9999	70	8.53	201	4.88	78	11.75	24	7.59
10000-14999	89	10.84	295	7.16	97	14.61	22	6.96
15000-19999	81	9.87	314	7.63	68	10.24	25	7.91
20000-29999	151	18.39	605	14.69	115	17.32	59	18.67
30000-39999	116	14.13	542	13.16	79	11.90	40	12.66
40000-49999	92	11.21	523	12.7	68	10.24	29	9.18
50000-69999	126	15.35	776	18.84	84	12.65	51	16.14
>70000	94	11.45	855	20.76	72	10.84	64	20.25
Total	821	100	4118	100	664	100	316	100

Table 5.9 Composition of Wage Earners.

	Hispanics		Non-Hisp. Whites		African American		Other Minorities	
Composition	No. HH	%	No. HH	%	No. HH	%	No. HH	%
Head only	228	27.77	1031	25.04	236	35.54	87	27.53
Head & spouse	181	22.05	1034	25.11	124	18.67	69	21.84
Head, spouse & others	66	8.04	281	6.82	24	3.61	33	10.44
Head & others	115	14.01	422	10.25	89	13.4	37	11.71
Spouse only	60	7.31	315	7.65	31	4.67	16	5.06
Spouse and others	17	2.07	34	0.83	2	0.30	11	3.48
Others only	53	6.46	133	3.23	32	4.82	17	5.38
No earners	101	12.30	868	21.08	126	18.98	46	14.56
Total	821	100	4118	100	664	100	316	100

Table 5.10 Housing Tenure of Households by Ethnic Group.

	Hispanics		Non-Hisp. Whites		African American		Other Minorities	
Tenure Status	No. HH	%	No. HH	%	No. HH	%	No. HH	%
Own with mort.	332	40.44	1885	45.77	255	38.4	136	43.04
Own without mort.	129	15.71	1215	29.50	98	14.76	55	17.41
Owned mort. not rep.	5	0.61	42	1.02	2	0.30	0	0.00
Rented	347	42.27	931	22.61	302	45.48	121	38.29
Occupied, not payment	8	0.97	45	1.09	7	1.05	4	1.27
Total	821	100	4118	100	664	100	316	100

Table 5.11 Family Composition of Households.

	Hispanics		Non-Hisp. Whites		African American		Other Minorities	
Composition	No. HH	%	No. HH	%	No. HH	%	No. HH	%
Husband and wife								
H/W only	97	11.81	1150	27.93	84	12.65	57	18.04
H/W, & ch < 6	61	7.43	218	5.29	20	3.01	19	6.01
H/W, & ch 6-17	178	21.68	650	15.78	88	13.25	43	13.61
H/W, & ch > 17	79	9.62	287	6.97	41	6.17	41	12.97
All other H/W	87	10.6	139	3.38	21	3.16	34	10.76
Male & ch <18	8	0.97	37	0.90	1	0.15	0	0.00
Female & ch <18	52	6.33	161	3.91	107	16.11	6	1.90
Single person	104	12.67	920	22.34	156	23.49	62	19.62
Other Cus	155	18.88	556	13.50	146	21.99	54	17.09
Total	821	100	4118	100	664	100	316	100

Table 5.12 Sex of Reference Person in the Household.

	Hispanics		Non-Hisp. Whites		African American		Other Minorities	
Sex	No. HH	%	No. HH	%	No. HH	%	No. HH	%
Female	371	45.19	2076	50.41	433	65.21	158	50.
Male	450	54.81	2042	49.59	231	34.79	158	50
Total	821	100	4118	100	664	100	316	100

Table 5.13 Marital Status of Reference Person.

	Hispanics		Non-Hisp. Whites		African American		Other Minorities	
Status	No. HH	%	No. HH	%	No. HH	%	No. HH	%
Married	528	64.31	2476	60.13	264	39.76	199	62.97
Widowed	40	4.87	476	11.56	87	13.1	26	8.23
Divorced	67	8.16	567	13.77	105	15.81	36	11.39
Separated	41	4.99	88	2.14	50	7.53	7	2.22
Never married	145	17.66	511	12.41	158	23.8	48	15.19
Total	821	100	4118	100	664	100	316	100

5.2.2 Descriptive Analysis of Expenditures

This research project models demand systems in two steps, the first step models the decision to purchase and the second step models the level of quantities consumed. In the first step, dummy variables were created for defining positive expenditures (value of 1) so that the default of the comparison is made with those who did not report weekly expenditures in the diary.

Overall, the highest censoring (zero expenditures) was found in other beef products, followed by roast beef and trailed by pork chops and other pork. In the case of Hispanic households, censoring above 80% was found in other beef, roast beef and other pork; for White households such a level was found also in pork chops. African Americans were similar to White households; in addition they had high censoring in ham products (Table 5.14).

The average weekly expenditures on total food was $ 130.66, $127.04, $103.74, $120.49 for Hispanic, White, African American and households of other minorities, respectively. White households lead average weekly expenditures on food away from home, and Hispanics lead total food at home, spending on average $93.61 per week. Not surprisingly, Hispanics had the highest average weekly expenditures on meats followed by other minorities and trailed by African American households (Table 5.15).

Average weekly budget shares reveal that Hispanics, Whites, African Americans and household of other minorities spend on average 18.71%, 14.61%, 15.61%, and 14.65% of the average weekly income in total food products, respectively (Table 5.15).

Hispanic households allocated on average 3.52% of the average weekly income on meat expenditures representing 18.82% of total food expenditures. Hispanics allocated 22.2% and 17% of meat expenditures on poultry and beef steak products respectively (Table 5.16).

White households allocated on average 2.22% of the average weekly income on meat expenditures representing 15.20% of total food expenditures. Whites allocated 21.1% and 16.7% of meat expenditures on poultry and seafood products respectively (Table 5.17). African American households allocated on average 3.47% of the average weekly income on meat expenditures representing 21.79% of total food expenditures. African Americans allocated 23.6% and 18.5% of meat expenditures on poultry and seafood products, respectively (Table

5.18). Households of other minorities allocated on average 2.83% of the average weekly income on meat expenditures representing 19.31% of total food expenditures. They allocated 32.3% and 21.3% of meat expenditures on seafood and poultry products, respectively (Table 5.19).

Differences in average weekly budget shares on meat expenditures illustrated that Hispanic households allocated less on bacon and ground beef products and more on beef steak products compared to White households. With respect to African American households Hispanics spent less on bacon and pork chops and more on other beef and beef steak products. In comparison with other minorities, Hispanic households spent less on seafood and other pork and more on ham and beef products (Table 5.20).

Meat expenditures among all households had high variation departing from zero; the variation was measured in terms of the standard deviation. It was found that for all households the highest variation was found on beef steak expenditures followed by other beef products, and trailed by seafood and ground beef products (Table 5.21). Meat expenditures by Hispanics had high variation on beef steak and seafood products. White households had high variation on beef steak, other beef, and ground beef. African American households had high variation on beef steak, seafood and poultry. Finally, for other minorities high variation in meat expenditures occurred on seafood, poultry, and beef steak. Refer to the tables from 5.22 to 5.25.

Some consumer units, on average, have reported expenditures greater than income, that is due to underreporting of income and incomplete response of income by respondents; the BLS has made efforts to identify consumer units that have completed the income response. Refer to the manual of the 2003 diary survey in page 13. For further discussion about the reliability of the survey, refer to page 55 of the mentioned manual.

Table 5.14 Decision to Consume Meat Products by Households of Different Ethnic Groups.

Exp. Category	Decision*	Hispanics	%	Non-Hisp. Whites	%	African American	%	Other Minorities	%
		No. HH	%	No. HH	%	No. HH	%	No. HH	%
Ground Beef	N.P.	443	53.96	2266	55.03	353	53.16	204	64.56
	P.	378	46.04	1852	44.97	311	46.84	112	35.44
Roast Beef	N.P.	699	85.14	3588	87.13	583	87.8	284	89.87
	P.	122	14.86	530	12.87	81	12.2	32	10.13
Beef Steak	N.P.	552	67.24	3187	77.39	515	77.56	242	76.58
	P.	269	32.76	931	22.61	149	22.44	74	23.42
Other beef	N.P.	742	90.38	3829	92.98	612	92.17	296	93.67
	P.	79	9.62	289	7.02	52	7.83	20	6.33
Bacon	N.P.	652	79.42	3178	77.17	483	72.74	258	81.65
	P.	169	20.58	940	22.83	181	27.26	58	18.35
Pork Chops	N.P.	665	81	3548	86.16	516	77.71	268	84.81
	P.	156	19	570	13.84	148	22.29	48	15.19
Ham	N.P.	609	74.18	3420	83.05	563	84.79	274	86.71
	P.	212	25.82	698	16.95	101	15.21	42	13.29
Other pork	N.P.	664	80.88	3530	85.72	535	80.57	239	75.63
	P.	157	19.12	588	14.28	129	19.43	77	24.37
Poultry	N.P.	313	38.12	2076	50.41	250	37.65	138	43.67
	P.	508	61.88	2042	49.59	414	62.35	178	56.33
Seafood	N.P.	501	61.02	2552	61.97	386	58.13	122	38.61
	P.	320	38.98	1566	38.03	278	41.87	194	61.39

*Decision: N.P. stands for Non-purchasers households and P stands for households that purchase the meat item.

Table 5.15 Average Weekly Income and Average Weekly Expenditures by Ethnic Groups.

Category	Hispanics	Non-Hisp. Whites	African American	Other Minorities
Average weekly income/Household, $/week	698.27	869.41	652.05	822.28
Total Food	130.66	127.04	103.74	120.49
Food at Home	93.61	86.63	77.58	84.75
Food away from Home	37.06	40.41	26.16	35.74
Meat Expenditures	24.60	19.31	22.61	23.27
Ground Beef	3.02	2.96	3.01	2.19
Roast Beef	1.63	1.24	1.31	0.97
Beef Steak	4.19	2.84	2.76	2.43
Other beef	0.95	0.73	0.60	0.46
Bacon	0.84	0.95	1.15	0.73
Pork Chops	1.41	0.91	1.57	1.23
Ham	1.36	1.12	1.08	0.70
Other pork	1.50	1.25	1.59	2.10
Poultry	5.45	4.08	5.35	4.95
Seafood	4.25	3.23	4.19	7.52

Table 5.16 Average Weekly Shares for Hispanic Consumers.

Expenditures	Value	WI	ENF	TF	FAH	FAFH	MX
Average weekly income/Household, $/week (WI)	698.27	100.00					
Average weekly expenditures on non-food items (ENF)	567.61	81.29	100.00				
Total Food (TF)	130.66	18.71	23.02	100.00			
Food at Home (FAH)	93.61	13.41	16.49	71.64	100.00		
Food away from Home (FAFH)	37.06	5.31	6.53	28.36	39.59	100.0	
Meat Expenditures (MX)	24.60	3.52	4.33	18.82	26.27	66.4	100.0
Ground Beef	3.02	0.43	0.53	2.31	3.22	8.1	12.3
Roast Beef	1.63	0.23	0.29	1.25	1.74	4.4	6.6
Beef Steak	4.19	0.60	0.74	3.20	4.47	11.3	17.0
Other beef	0.95	0.14	0.17	0.72	1.01	2.6	3.8
Bacon	0.84	0.12	0.15	0.65	0.90	2.3	3.4
Pork Chops	1.41	0.20	0.25	1.08	1.51	3.8	5.7
Ham	1.36	0.19	0.24	1.04	1.45	3.7	5.5
Other pork	1.50	0.22	0.26	1.15	1.60	4.1	6.1
Poultry	5.45	0.78	0.96	4.17	5.83	14.7	22.2
Seafood	4.25	0.61	0.75	3.25	4.54	11.5	17.3

Table 5.17 Average Weekly Shares for Non-Hispanic White Consumers.

Expenditures	Value	WI	ENF	TF	FAH	FAFH	MX
Average weekly income/Household, $/week (WI)	869.41	100.00					
Average weekly expenditures on non food items (ENF)	742.37	85.39	100.00				
Total Food (TF)	127.04	14.61*	17.11	100.00			
Food at Home (FAH)	86.63	9.96	11.67	68.19	100.00		
Food away from Home (FAFH)	40.41	4.65	5.44	31.81	46.65	100.0	
Meat Expenditures (MX)	19.31	2.22	2.60	15.20	22.29	47.8	100.0
Ground Beef	2.96	0.34	0.40	2.33	3.42	7.3	15.4
Roast Beef	1.24	0.14	0.17	0.98	1.43	3.1	6.4
Beef Steak	2.84	0.33	0.38	2.23	3.27	7.0	14.7
Other beef	0.73	0.08	0.10	0.57	0.84	1.8	3.8
Bacon	0.95	0.11	0.13	0.75	1.10	2.4	4.9
Pork Chops	0.91	0.10	0.12	0.72	1.05	2.3	4.7
Ham	1.12	0.13	0.15	0.88	1.30	2.8	5.8
Other pork	1.25	0.14	0.17	0.98	1.44	3.1	6.5
Poultry	4.08	0.47	0.55	3.21	4.71	10.1	21.1
Seafood	3.23	0.37	0.43	2.54	3.73	8.0	16.7

Table 5.18 Average Weekly Shares for African American Consumers.

Expenditures	Value	WI	ENF	TF	FAH	FAFH	MX
Average weekly income/Household, $/week (WI)	652.05	100.00					
Average weekly expenditures on non food items (ENF)	548.31	84.09	100.00				
Total Food (TF)	103.74	15.91	18.92	100.00			
Food at Home (FAH)	77.58	11.90	14.15	74.78	100.00		
Food away from Home (FAFH)	26.16	4.01	4.77	25.22	33.72	100.00	
Meat Expenditures (MX)	22.61	3.47	4.12	21.79	29.14	86.41	100.0
Ground Beef	3.01	0.46	0.55	2.90	3.87	11.49	13.3
Roast Beef	1.31	0.20	0.24	1.27	1.69	5.02	5.8
Beef Steak	2.76	0.42	0.50	2.66	3.55	10.54	12.2
Other beef	0.60	0.09	0.11	0.58	0.77	2.30	2.7
Bacon	1.15	0.18	0.21	1.11	1.48	4.39	5.1
Pork Chops	1.57	0.24	0.29	1.52	2.03	6.01	7.0
Ham	1.08	0.17	0.20	1.05	1.40	4.15	4.8
Other pork	1.59	0.24	0.29	1.53	2.05	6.07	7.0
Poultry	5.35	0.82	0.98	5.15	6.89	20.44	23.6
Seafood	4.19	0.64	0.76	4.04	5.40	16.02	18.5

Table 5.19 Average Weekly Shares for Consumers Belonging to Other Minorities.

Expenditures	Value	WI	ENF	TF	FAH	FAFH	MX
Average weekly income/Household, $/week (WI)	822.28	100.00					
Average weekly expenditures on non food items (ENF)	701.79	85.35	100.00				
Total Food (TF)	120.49	14.65	17.17	100.00			
Food at Home (FAH)	84.75	10.31	12.08	70.33	100.00		
Food away from Home (FAFH)	35.74	4.35	5.09	29.67	42.18	100.0	
Meat Expenditures (MX)	23.27	2.83	3.32	19.31	27.46	65.1	100.0
Ground Beef	2.19	0.27	0.31	1.81	2.58	6.1	9.4
Roast Beef	0.97	0.12	0.14	0.80	1.14	2.7	4.2
Beef Steak	2.43	0.30	0.35	2.02	2.87	6.8	10.5
Other beef	0.46	0.06	0.06	0.38	0.54	1.3	2.0
Bacon	0.73	0.09	0.10	0.61	0.87	2.1	3.2
Pork Chops	1.23	0.15	0.18	1.02	1.45	3.4	5.3
Ham	0.70	0.09	0.10	0.58	0.83	2.0	3.0
Other pork	2.10	0.26	0.30	1.74	2.48	5.9	9.0
Poultry	4.95	0.60	0.71	4.11	5.84	13.9	21.3
Seafood	7.52	0.91	1.07	6.24	8.87	21.0	32.3

Table 5.20 Differences in Average Share of Meat Expenditures of Hispanics with Respect to Other Ethnic Groups.

	Ethnic Group				Difference in Percentage		
Product	Hispanics (H)	Non-Hispanics White (NHW)	African American (AA)	Other Minorities (OM)	H/NHW	H/AA	H/OM
Ground Beef	12.3	15.4	13.3	9.4	-25.20	-8.13	23.58
Roast Beef	6.6	6.4	5.8	4.2	3.03	12.12	36.36
Beef Steak	17.0	14.7	12.2	10.5	13.53	28.24	38.24
Other beef	3.8	3.8	2.7	2.0	0.00	28.95	47.37
Bacon	3.4	4.9	5.1	3.2	-44.12	-50.00	5.88
Pork Chops	5.7	4.7	7.0	5.3	17.54	-22.81	7.02
Ham	5.5	5.8	4.8	3.0	-5.45	12.73	45.45
Other pork	6.1	6.5	7.0	9.0	-6.56	-14.75	-47.5
Poultry	22.2	21.1	23.6	21.3	4.95	-6.31	4.05
Seafood	17.3	16.7	18.5	32.3	3.47	-6.94	-86.7

Table 5.21 Descriptive Statistics of Weekly Income, Household Size and Meat Expenditures for All Households.

Variable	N	N Miss	Minimum	Maximum	Range	Sum	Mean	Std Dev	t Value	Pr > |t|**	Upper 90%	Lower 90%
Weekly Income	5919	0	89.692308	2060.58	1970.88	4846297.46	818.77	502.11	125.45	<.0001	829.51	808.03
Household Size*	5919	0	0.90	13.62	12.72	13731.70	2.32	1.13	158.34	<.0001	2.34	2.30
Meat Expenditures	5919	0	0.41	2038.52	2038.11	122077.98	20.62	34.58	45.89	<.0001	21.36	19.89
Ground Beef	5919	0	0	362.83	362.83	17370.54	2.93	6.90	32.71	<.0001	3.08	2.79
Roast Beef	5919	0	0	211.27	211.27	7628.97	1.29	5.70	17.39	<.0001	1.41	1.17
Beef Steak	5919	0	0	1128.95	1128.95	17711.97	2.99	16.94	13.59	<.0001	3.35	2.63
Other beef	5919	0	0	546.74	546.74	4317.49	0.73	8.05	6.97	<.0001	0.90	0.56
Bacon	5919	0	0	27.89	27.89	5602.22	0.95	2.10	34.64	<.0001	0.99	0.90
Pork Chops	5919	0	0	42.50	42.50	6342.57	1.07	3.00	27.44	<.0001	1.14	1.01
Ham	5919	0	0	94.56	94.56	6677.29	1.13	3.67	23.66	<.0001	1.21	1.05
Other pork	5919	0	0	376.25	376.25	8101.68	1.37	6.15	17.13	<.0001	1.50	1.24
Poultry	5919	0	0	64.24	64.24	26392.06	4.46	6.25	54.85	<.0001	4.59	4.33
Seafood	5919	0	0	104.00	104.00	21933.17	3.71	7.75	36.80	<.0001	3.87	3.54

*Amsterdam scale.

**P-value for testing zero mean of the variable.

Table 5.22 Descriptive Statistics of Weekly Income, Household Size and Meat Expenditures for All Hispanic Households.

Variable	N	N Miss	Minimum	Maximum	Range	Sum	Mean	Std Dev	t Value	Pr > |t|**	Upper 90%	Lower 90%
Weekly Income	821	0	92.480769	2028.92	1936.44	573279.42	698.27	452.68	44.20	<.0001	724.29	672.25
Household Size*	821	0	0.90	9.28	8.38	2375.60	2.89	1.35	61.22	<.0001	2.97	2.82
Meat Expenditures	821	0	0.85	223.44	222.59	20192.92	24.60	24.73	28.50	<.0001	26.02	23.17
Ground Beef	821	0	0	35.18	35.18	2478.30	3.02	4.45	19.43	<.0001	3.27	2.76
Roast Beef	821	0	0	159.38	159.38	1340.17	1.63	7.05	6.63	<.0001	2.04	1.23
Beef Steak	821	0	0	138.78	138.78	3437.84	4.19	9.96	12.04	<.0001	4.76	3.61
Other beef	821	0	0	157.65	157.65	776.98	0.95	6.10	4.44	<.0001	1.30	0.60
Bacon	821	0	0	15.49	15.49	692.63	0.84	1.95	12.40	<.0001	0.96	0.73
Pork Chops	821	0	0	40.46	40.46	1158.37	1.41	3.67	11.01	<.0001	1.62	1.20
Ham	821	0	0	26.12	26.12	1113.19	1.36	2.90	13.38	<.0001	1.52	1.19
Other pork	821	0	0	48.92	48.92	1232.90	1.50	4.11	10.47	<.0001	1.74	1.27
Poultry	821	0	0	63.42	63.42	4477.07	5.45	6.99	22.37	<.0001	5.85	5.05
Seafood	821	0	0	73.03	73.03	3485.48	4.25	8.63	14.10	<.0001	4.74	3.75

*Amsterdam scale.

**P-value for testing zero mean of the variable.

Table 5.23 Descriptive Statistics of Weekly Income, Household Size and Meat Expenditures for All Non-Hispanics White Households.

Variable	N	N Miss	Minimum	Maximum	Range	Sum	Mean	Std Dev	t Value	Pr > |t|**	Upper 90%	Lower 90%
Weekly Income	4118	0	90.519231	2060.58	1970.06	3580216.08	869.41	506.60	110.13	<.0001	882.39	856.42
Household Size*	4118	0	0.90	8.34	7.44	8979.80	2.18	1.00	140.44	<.0001	2.21	2.16
Meat Expenditures	4118	0	0.41	2038.52	2038.11	79520.59	19.31	37.45	33.09	<.0001	20.27	18.35
Ground Beef	4118	0	0	362.83	362.83	12206.18	2.96	7.68	24.76	<.0001	3.16	2.77
Roast Beef	4118	0	0	211.27	211.27	5111.54	1.24	5.37	14.82	<.0001	1.38	1.10
Beef Steak	4118	0	0	1128.95	1128.95	11674.80	2.84	19.00	9.58	<.0001	3.32	2.35
Other beef	4118	0	0	546.74	546.74	2997.66	0.73	9.18	5.09	<.0001	0.96	0.49
Bacon	4118	0	0	27.89	27.89	3915.18	0.95	2.11	28.98	<.0001	1.00	0.90
Pork Chops	4118	0	0	32.27	32.27	3751.05	0.91	2.63	22.20	<.0001	0.98	0.84
Ham	4118	0	0	94.56	94.56	4622.12	1.12	3.89	18.51	<.0001	1.22	1.02
Other pork	4118	0	0	376.25	376.25	5151.78	1.25	6.78	11.84	<.0001	1.42	1.08
Poultry	4118	0	0	55.38	55.38	16800.47	4.08	5.87	44.58	<.0001	4.23	3.93
Seafood	4118	0	0	97.85	97.85	13289.83	3.23	6.66	31.10	<.0001	3.40	3.06

*Amsterdam scale.

**P-value for testing zero mean of the variable.

Table 5.24 Descriptive Statistics of Weekly Income, Household Size and Meat Expenditures for African American Households.

Variable	N	N Miss	Minimum	Maximum	Range	Sum	Mean	Std Dev	t Value	Pr > |t|**	Upper 90%	Lower 90%
Weekly Income	664	0	90.384615	2019.23	1928.85	432961.12	652.05	461.45	36.41	<.0001	681.55	622.55
Household Size*	664	0	0.90	13.62	12.72	1587.18	2.39	1.28	47.99	<.0001	2.47	2.31
Meat Expenditures	664	0	0.43	546.43	546.00	15010.33	22.61	29.91	19.48	<.0001	24.52	20.69
Ground Beef	664	0	0	83.72	83.72	1995.44	3.01	5.21	14.86	<.0001	3.34	2.67
Roast Beef	664	0	0	140.54	140.54	871.77	1.31	6.60	5.13	<.0001	1.73	0.89
Beef Steak	664	0	0	309.11	309.11	1830.36	2.76	13.23	5.37	<.0001	3.60	1.91
Other beef	664	0	0	32.81	32.81	399.06	0.60	2.65	5.85	<.0001	0.77	0.43
Bacon	664	0	0	18.57	18.57	762.46	1.15	2.36	12.52	<.0001	1.30	1.00
Pork Chops	664	0	0	30.10	30.10	1044.23	1.57	3.44	11.76	<.0001	1.79	1.35
Ham	664	0	0	35.38	35.38	720.20	1.08	3.60	7.77	<.0001	1.31	0.85
Other pork	664	0	0	36.64	36.64	1053.86	1.59	4.17	9.81	<.0001	1.85	1.32
Poultry	664	0	0	64.24	64.24	3550.18	5.35	7.21	19.10	<.0001	5.81	4.89
Seafood	664	0	0	82.97	82.97	2782.77	4.19	8.82	12.25	<.0001	4.75	3.63

*Amsterdam scale.

**P-value for testing zero mean of the variable.

Table 5.25 Descriptive Statistics of Weekly Income, Household Size and Meat Expenditures for Households belonging to Other Minorities.

Variable	N	N Miss	Minimum	Maximum	Range	Sum	Mean	Std Dev	t Value	Pr > |t| **	Upper 90%	Lower 90%
Weekly Income	316	0	89.69230	2019.23	1929.54	259840.85	822.28	520.24	28.10	<.0001	870.56	774.00
Household Size*	316	0	0.90	6.72	5.82	789.12	2.50	1.23	36.21	<.0001	2.61	2.38
Meat Expenditures	316	0	0.52	148.00	147.48	7354.14	23.27	24.18	17.11	<.0001	25.52	21.03
Ground Beef	316	0	0	21.64	21.64	690.63	2.19	3.79	10.25	<.0001	2.54	1.83
Roast Beef	316	0	0	30.00	30.00	305.50	0.97	3.45	4.98	<.0001	1.29	0.65
Beef Steak	316	0	0	71.00	71.00	768.97	2.43	6.43	6.73	<.0001	3.03	1.84
Other beef	316	0	0	23.60	23.60	143.79	0.46	2.18	3.71	0.00	0.66	0.25
Bacon	316	0	0	11.62	11.62	231.96	0.73	1.81	7.19	<.0001	0.90	0.57
Pork Chops	316	0	0	42.50	42.50	388.92	1.23	4.22	5.19	<.0001	1.62	0.84
Ham	316	0	0	19.86	19.86	221.78	0.70	2.34	5.32	<.0001	0.92	0.48
Other pork	316	0	0	57.09	57.09	663.14	2.10	5.27	7.07	<.0001	2.59	1.61
Poultry	316	0	0	45.78	45.78	1564.35	4.95	6.43	13.68	<.0001	5.55	4.35
Seafood	316	0	0	104.00	104.00	2375.09	7.52	13.09	10.21	<.0001	8.73	6.30

*Amsterdam scale.

**P-value for testing zero mean of the variable.

5.2.3 Descriptive Analysis of Prices and CPI

The series, by region, of the consumer price index (CPI) and prices of products were obtained from the Bureau of Labor Statistics. A table was constructed in which the series of average monthly price was classified by region.

Matching with the "Consumer Expenditures Diary Survey" was performed by updating previously defined columns in the extracted dataset; the update was executed using restricted nested queries for matching month and region in both tables, the matching used SQL in SAS®. The collected CPI was in function of non-food items, such index is recommended for incomplete demand systems that use expenditure functions of the LinQuad form.

Descriptive statistics of regional average monthly prices of meat products are presented from table 5.26 to 5.29. Using the coefficient of variation as an indicator of variation for price comparison, it was found that beef steak, roast beef, and other beef products presented the highest variation in the Northeast region for the year 2003.

Other pork, roast beef, and other beef had the highest variation in the Midwest region. In the case of the Southern region, beef steak, roast beef, and ham had the highest variation from the mean. Finally, the Western region presented high variation of prices in bacon, pork chops, and roast beef. It is not coincidental that high variation in meat expenditures occurred on the mentioned commodities consumed by different households (Table 5.22).

Table 5.26 Descriptive Statistics of Average Monthly Prices of Meat Products for the Northeast Region in 2003.

Product	Minimum	Maximum	Range	Mean	Std. Dev.	Coeff. of Variation
Ground Beef	2.27	2.75	0.48	2.48	0.15	6.24
Roast Beef	3.29	4.27	0.97	3.64	0.34	9.35
Beef Steak	4.36	5.92	1.56	4.90	0.49	10.05
Other beef	2.44	3.19	0.75	2.74	0.25	9.28
Bacon	3.09	3.52	0.44	3.27	0.15	4.67
Pork Chops	2.66	3.00	0.34	2.87	0.11	3.86
Ham	1.95	2.40	0.45	2.16	0.14	6.39
Other pork	1.76	2.02	0.26	1.85	0.07	3.70
Poultry	0.98	1.27	0.29	1.11	0.09	7.96
Seafood	1.75	1.96	0.22	1.84	0.06	3.14

Table 5.27 Descriptive Statistics of Average Monthly Prices of Meat Products for the Midwest Region in 2003.

Product	Minimum	Maximum	Range	Mean	Std. Dev.	Coeff. of Variation
Ground Beef	2.13	2.55	0.43	2.28	0.12	5.34
Roast Beef	2.99	3.65	0.66	3.20	0.21	6.57
Beef Steak	4.21	5.10	0.89	4.59	0.25	5.39
Other beef	2.40	2.86	0.46	2.59	0.16	6.01
Bacon	2.79	3.03	0.25	2.94	0.07	2.27
Pork Chops	3.10	3.44	0.34	3.25	0.10	3.19
Ham	1.92	2.12	0.19	2.05	0.06	3.01
Other pork	1.98	2.57	0.59	2.19	0.20	8.92
Poultry	0.97	1.06	0.09	1.02	0.02	2.41
Seafood	1.75	1.96	0.22	1.84	0.06	3.14

Table 5.28 Descriptive Statistics of Average Monthly Prices of Meat Products for the Southern Region in 2003.

Product	Minimum	Maximum	Range	Mean	Std. Dev.	Coeff. of Variation
Ground Beef	2.32	2.74	0.41	2.44	0.12	5.01
Roast Beef	3.29	4.01	0.72	3.53	0.24	6.76
Beef Steak	4.36	5.60	1.24	4.83	0.42	8.80
Other beef	2.36	2.85	0.50	2.57	0.14	5.56
Bacon	3.32	3.74	0.42	3.55	0.16	4.55
Pork Chops	3.03	3.23	0.20	3.12	0.06	2.00
Ham	2.05	2.39	0.35	2.21	0.13	5.82
Other pork	1.66	1.90	0.25	1.80	0.09	4.96
Poultry	0.86	0.94	0.09	0.91	0.02	2.62
Seafood	1.75	1.96	0.22	1.84	0.06	3.14

Table 5.29 Descriptive Statistics of Average Monthly Prices of Meat Products for the Western Region in 2003.

Product	Minimum	Maximum	Range	Mean	Std. Dev.	Coeff. of Variation
Ground Beef	2.53	2.84	0.31	2.69	0.10	3.72
Roast Beef	3.25	4.27	1.02	3.52	0.32	8.97
Beef Steak	4.61	5.77	1.16	5.03	0.36	7.13
Other beef	2.62	3.32	0.70	2.89	0.23	7.96
Bacon	2.62	3.68	1.06	3.05	0.37	12.18
Pork Chops	2.56	3.51	0.95	3.06	0.37	11.93
Ham	2.01	2.43	0.42	2.23	0.14	6.21
Other pork	1.81	2.11	0.30	1.97	0.09	4.78
Poultry	1.15	1.26	0.11	1.20	0.03	2.77
Seafood	1.75	1.96	0.22	1.84	0.06	3.14

5.3 Decision to Purchase Meat Products by Ethnic Groups

The modeling of the decision to purchase had been performed as an intermediate step for the estimation of the censored Linquad demand system. The probability of positive expenditures was calculated through the estimation of Probit equations.

Most of the price variables in nominal and real values, presented insignificant effects in the decision to purchase; different ways of scaling the price variables were evaluated. Unfortunately the same results were produced. A few socio-economic variables had significant effects on the decision to purchase in different ethnic groups. The standard normal density function and the standard normal cumulative distribution function were estimated for each household in order to estimate censored LinQuad demand systems.

The inclusion of all variables did not produce significant differences in the average probability to consume. Henceforth, the approach of Lanfranco (2001) was followed, including only logarithm of the household weekly income and household size in Amsterdam scale as the regressors in the Probit equations. The practice of including only household's weekly income and household size as the regressors was favored since it produced less insignificant likelihood ratio (LR) tests in which the combined estimated parameters are hypothesized to be equal to zero, surprisingly those regressors produced slight variations in the classification tables of the predicted outcomes compared with the results from models with greater number of variables. After the estimation of the coefficients in the Probit regressions, marginal effects in the probability to purchase were calculated.

Hispanic households were less likely to be influenced by income in their purchase decisions as compared to White, African American and households of other minorities. Only significant marginal effects of income were found in beef steak and other beef products at 5% the

level of significance. Insignificant negative marginal effects of income were found for other pork, poultry, roast beef, and ground beef. Insignificant and positive marginal effects of income were found for bacon, pork chops, ham, and seafood.

Marginal effects measure the infinitesimal change in probability when the regressor is increased in one unit, the results of Probit regressions show that Hispanic households are more likely to consume beef steaks as income increases, and they are less likely to consume other beef products as their income increases. At the five percent level of significance, the calculated marginal effect of income was 0.507 for beef steaks and -0.0294 for other beef products (Table 5.30).

Hispanic households were influenced more by the household size than income in their decisions to purchase meat products; when they were compared with other ethnic groups. At the 5% level of confidence, significant and positive marginal effects of household size were found in ground beef (0.0474), ham (0.0362), other pork (0.283), and poultry products (0.0667). Insignificant and negative marginal effects of household size were found in bacon and seafood products, calculated at -0.0098 and -0.0019, respectively (Table 5.31).

White households responded differently than Hispanics. At the 5% level of significance, only beef steak had a positive and significant marginal effect for income with a magnitude of 0.0323. Pork chops had a marginal effect for income of -0.0150, significant at the 10% level of significance. White households had positive and significant household size marginal effects at the 5% level of significance, with the exceptions of ham and seafood products (Tables 5.32-5.33).

African American households, at the 5% level of significance, presented significant and negative marginal effects on ground beef, ham, and poultry products; significant and positive

marginal effect of income was found only for seafood products. All marginal effects of household size were positive with the exception of seafood products; same pattern was found in Hispanic and White households, but their coefficients were insignificant. African Americans had significant marginal effects for household size in ground beef, pork chops and poultry products, estimated in 0.065, 0.0352, and 0.0535, respectively (Tables5.34-5.35). Compared to Whites, African Americans were less likely to be influenced by household size.

Households of other minorities, presented negative marginal income effects for ground beef, bacon, and other pork products, but only the coefficient for ground beef was significant at the 10% level of significance. At 5% level of significance, significant marginal effects of income were found in beef steak and other beef. Their magnitudes were 0.0866 and 0.430, respectively; thus, it can be inferred that as households of other minorities increase their income, they are more likely to consume beef steak compared to other meat products like chicken, pork and seafood products (Table 5.36).

Households of other minorities presented positive marginal effects for household size with the exception of beef steak, pork chops and ham; albeit those negative estimates were insignificant. Significant and positive household size marginal effects were found in ground beef (0.051), roast beef (0.034), bacon (0.036), and other pork (0.091) at the 5% level of significance (Table 5.37).

As a general result, different ethnic groups are more likely to consume meat products as the household increases, but for some ethnic groups some marginal effects of household size were negative; with regard to the marginal effects of income, it was found that at least 3 commodities in each ethnic group were negative.

Table 5.30 Marginal Effects of Logarithm of Weekly Income for Hispanic Households.

Product	Coefficient	Standard Error	P>z	Marginal Effect
Ground Beef	-0.0598	0.0657	0.3630	-0.0237
Roast Beef	-0.0601	0.0801	0.4530	-0.0139
Beef Steak	0.1407	0.0681	0.0390	0.0507
Other beef	-0.1769	0.0887	0.0460	-0.0294
Bacon	0.0963	0.0738	0.1920	0.0274
Pork Chops	0.0358	0.0753	0.6350	0.0097
Ham	0.0736	0.0720	0.3070	0.0236
Other pork	-0.0199	0.0760	0.7930	-0.0054
Poultry	-0.0024	0.0251	0.9250	0.0469
Seafood	0.0563	0.0661	0.3950	0.0216

Table 5.31 Marginal Effects of Household Size for Hispanic Households.

Product	Coefficient	Standard Error	P>z	Marginal Effect
Ground Beef	0.1194	0.0350	0.0010	0.0474
Roast Beef	0.0441	0.0422	0.2970	0.0102
Beef Steak	0.0454	0.0355	0.2010	0.0164
Other beef	0.1283	0.0459	0.0050	0.0213
Bacon	-0.0343	0.0395	0.3850	-0.0098
Pork Chops	0.0426	0.0395	0.2800	0.0115
Ham	0.1128	0.0371	0.0020	0.0362
Other pork	0.1046	0.0389	0.0070	0.0283
Poultry	0.0400	0.0137	0.0030	0.0667
Seafood	-0.0051	0.0350	0.8850	-0.0019

Table 5.32 Marginal Effects of Weekly Income for Non-Hispanic White Households.

Product	Coefficient	Standard Error	P>z	Marginal Effect
Ground Beef	-0.0424	0.0303	0.1620	-0.0168
Roast Beef	-0.0446	0.0382	0.2440	-0.0093
Beef Steak	0.1078	0.0338	0.0010	0.0323
Other beef	0.0586	0.0465	0.2070	0.0078
Bacon	-0.0369	0.0333	0.2670	-0.0111
Pork Chops	-0.0686	0.0375	0.0680	-0.0150
Ham	0.0173	0.0356	0.6270	0.0044
Other pork	0.0196	0.0377	0.6040	0.0044
Poultry	0.0054	0.0301	0.8580	0.0022
Seafood	0.0369	0.0306	0.2270	0.0141

Table 5.33 Marginal Effects of Household Size for Non-Hispanic White Households.

Product	Coefficient	Standard Error	P>z	Marginal Effect
Ground Beef	0.2120	0.0214	0.0000	0.0839
Roast Beef	0.1285	0.0259	0.0000	0.0267
Beef Steak	0.0534	0.0230	0.0200	0.0160
Other beef	0.0897	0.0304	0.0030	0.0119
Bacon	0.1057	0.0229	0.0000	0.0319
Pork Chops	0.1314	0.0255	0.0000	0.0288
Ham	0.0211	0.0247	0.3950	0.0053
Other pork	0.1282	0.0254	0.0000	0.0286
Poultry	0.1358	0.0213	0.0000	0.0542
Seafood	0.0404	0.0213	0.0580	0.0154

Table 5.34 Marginal Effects of Weekly Income for African American Households.

Product	Coefficient	Standard Error	P>z	Marginal Effect
Ground Beef	-0.1354	0.0662	0.0410	-0.0538
Roast Beef	-0.0065	0.0852	0.9400	-0.0013
Beef Steak	0.0909	0.0729	0.2130	0.0271
Other beef	0.0714	0.0981	0.4670	0.0103
Bacon	-0.0401	0.0703	0.5680	-0.0133
Pork Chops	0.0059	0.0745	0.9370	0.0017
Ham	-0.1711	0.0803	0.0330	-0.0398
Other pork	0.0489	0.0758	0.5190	0.0134
Poultry	-0.1655	0.0676	0.0140	-0.0627
Seafood	0.1312	0.0661	0.0470	0.0512

Table 5.35 Marginal Effects of Household Size for African American Households.

Product	Coefficient	Standard Error	P>z	Marginal Effect
Ground Beef	0.1521	0.0385	0.0000	0.0605
Roast Beef	0.0334	0.0470	0.4770	0.0068
Beef Steak	0.0358	0.0429	0.4040	0.0107
Other beef	0.0798	0.0538	0.1380	0.0115
Bacon	0.0609	0.0409	0.1370	0.0202
Pork Chops	0.1189	0.0417	0.0040	0.0352
Ham	0.0738	0.0462	0.1110	0.0172
Other pork	0.0261	0.0442	0.5550	0.0072
Poultry	0.1412	0.0427	0.0010	0.0535
Seafood	-0.0049	0.0392	0.9000	-0.0019

Table 5.36 Marginal Effects of Logarithm of Weekly Income for Households of Other Minorities.

Product	Coefficient	Standard Error	P>z	Marginal Effect
Ground Beef	-0.1817	0.1039	0.0800	-0.0675
Roast Beef	0.0066	0.1384	0.9620	0.0011
Beef Steak	0.2856	0.1180	0.0150	0.0866
Other beef	0.3852	0.1903	0.0430	0.0436
Bacon	-0.0834	0.1180	0.4800	-0.0219
Pork Chops	0.0075	0.1218	0.9510	0.0018
Ham	0.1778	0.1355	0.1900	0.0378
Other pork	-0.0656	0.1132	0.5620	-0.0200
Poultry	0.1573	0.1021	0.1230	0.0619
Seafood	0.0216	0.1037	0.8350	0.0082

Table 5.37 Marginal Effects of Household Size for Households of Other Minorities.

Product	Coefficient	Standard Error	P>z	Marginal Effect
Ground Beef	0.1367	0.0631	0.0300	0.0507
Roast Beef	0.2006	0.0793	0.0110	0.0337
Beef Steak	-0.0268	0.0677	0.6930	-0.0081
Other beef	0.0033	0.1031	0.9740	0.0004
Bacon	0.1388	0.0697	0.0460	0.0365
Pork Chops	-0.0264	0.0755	0.7260	-0.0062
Ham	-0.0212	0.0798	0.7910	-0.0045
Other pork	0.2976	0.0673	0.0000	0.0907
Poultry	0.0655	0.0625	0.2940	0.0258
Seafood	0.1166	0.0648	0.0720	0.0446

The results presented in this section contrast with those of Lanfranco (2001). Lanfranco found that Hispanics had positive marginal effects of income, with the exception of other pork and the marginal effects on the probability to purchase were all positive; most of the marginal effects of household size were significant at the 90% level of confidence. The Probit regressions allowed the estimation of the standard normal density and the standard normal cumulative distribution functions for each household in different ethnic groups and commodities. These new variables were used in the estimation of censored demand systems.

The following sections present the results of the demand systems that use censored equations of the LinQuad form. Given the high demand of computing power required for the estimation of elasticities when using the complete set of demographic variables that was proposed in chapter 4 (refer to table 4.1), a forward stepwise modeling framework was followed. In the first case, all demographic variables were not included in the estimation and only prices were included. In the second case, only household size in Amsterdam scale was included in the model, the scale uses age and sex for allocating the values. Two methods of estimation were used: Full Information Maximum Likelihood (FIML) and Iterative Seemingly Unrelated regression (ITSUR). The following sections of this chapter discuss the estimates produced by ITSUR given that FIML produced bigger standard errors of the estimates, and the model violated the assumptions of normality.

5.4 Censored LinQuad Demand System: Consumption by Ethnic Groups

A censored LinQuad demand system that included prices, income, and household size was estimated under Full Information Maximum Likelihood and Iterative Seemingly Unrelated regression for identifying differences in consumption by ethnic groups. In each demand equation three dummy variables were included so that Hispanic households were compared with White, African American and households of other minorities. Differences in average weekly budget shares of meat products by Hispanics with other ethnic groups can be seen in Table 5.20. The number of significant dummy variables varies according to the estimator that was used; ITSUR produced 13 significant dummy variables and FIML produced only 9 at the 10% level of significance. FIML produced bigger standard errors.

In general, Hispanic households demand more beef products, pork products and chicken with respect to other ethnic groups. According to the results from the ITSUR procedure,

Hispanics consume less ground beef compared to White and African American households, and they consume significantly more with respect to other minorities at the 10% level of significance. White households consume less beef products compared to Hispanics; significant differences were found in beef steak at 5% level of significance. Consumption of pork products by White households was in general lower compared to Hispanics, with the exception of bacon. At the 5% level of significance, White households consume significantly less chicken and seafood products compared to Hispanic households (Table 5.38).

Positive and significant differences in consumption of meats between Hispanics and African Americans were found only on ground beef, bacon, and chicken, using a 10% level of significance. Households of other minorities allocated less expenditures on meat products compared to Hispanics (Tables 5.19, 5.20); negative and statistically significant differences were found in beef steak and ham at a 5% level of significance and ground beef at the 10% level of significance; positive and significant differences were found in other pork and seafood products at the 5% level of significance (Table 5.38).

These results have shown the similarities and differences in consumption of meat products of Hispanics with respect to other ethnic groups. It can be inferred that Hispanic and African American households are more alike in their consumption habits of meat products; this fact has also been suggested by Fan and Solis (1994, 1998). Hispanics behaved differently compared to White and households of other minorities. FIML fail to produce more significant differences; unlike the ITSUR estimator, FIML produced a positive significant difference in the demand for pork chops by African Americans when compared to Hispanics at the 10% level of significance (Table 5.39). Neither Lanfranco (2001) nor Stegelin (2002) reported significant

differences in consumption of meat products by ethnic groups. This study goes a step further by explaining the role of ethnicity in the consumption of meat products in the United States.

Table 5.38 Differences in Demand of Meats by Ethnic Groups in Comparison with Hispanic Households, using ITSUR.

	Whites		African Americans		Other Minorities	
Meat Product	Estimate	p-value	Estimate	p-value	Estimate	p-value
Ground Beef	0.519439	0.0027	0.39286	0.0848	-0.39691	0.0881
Roast Beef	-0.45959	0.44	-0.43809	0.5615	-1.15548	0.1036
Beef Steak	-0.79763	0.0352	-0.48395	0.3837	-1.1618	0.0114
Other Beef	-0.43169	0.7412	-0.65571	0.564	-1.62487	0.1875
Bacon	0.317062	0.0057	0.503875	0.0018	0.0245	0.8871
Pork Chops	-0.58729	0.0504	0.452474	0.2617	-0.12771	0.8224
Ham	-0.50715	0.1013	-0.67069	0.1285	-1.55971	0.0002
Other Pork	-0.2946	0.6213	0.542482	0.4261	2.451733	0.0122
Chicken	-1.23434	0.0115	1.193616	0.0948	-0.35379	0.6385
Seafood	-1.08137	0.0227	0.552662	0.4042	4.544399	<.0001

Table 5.39 Differences in Demand of Meats by Ethnic Groups in Comparison with Hispanic Households, using FIML.

	Whites		African Americans		Other Minorities	
Meat Product	Estimate	p-value	Estimate	p-value	Estimate	p-value
Ground Beef	0.519439	0.2795	0.39286	0.5892	-0.39691	0.7054
Roast Beef	-0.45959	0.3196	-0.43809	0.5564	-1.15548	0.3374
Beef Steak	-0.79763	0.5355	-0.48395	0.8136	-1.1618	0.7113
Other Beef	-0.43169	0.9027	-0.65571	0.9088	-1.62487	0.8417
Bacon	0.317062	0.0101	0.503875	0.0007	0.0245	0.9109
Pork Chops	-0.58729	0.0028	0.452474	0.0592	-0.12771	0.6633
Ham	-0.50715	0.2767	-0.67069	0.2446	-1.55971	0.0932
Other Pork	-0.2946	0.7787	0.542482	0.6865	2.451733	0.1184
Chicken	-1.23434	0.002	1.193616	0.021	-0.35379	0.6006
Seafood	-1.08137	0.0066	0.552662	0.2617	4.544399	<.0001

Previous work with the two-step estimation procedure provides little guidance on the specification of the Probit regression (1st step). Typically, the specification is ad hoc, resulting from a search procedure whereby significant variables are kept in the final Probit specification. This research project evaluated three specifications for the first step. In set I, only household size

and logarithm of income were used to model the decision to purchase in the Probit model. In set II, price variables were added to the specification function in set I. In set III, all the demographic variables were added. The following section discusses the results of demand systems under the three different specifications of the demand equations.

5.5 Basic Censored LinQuad Demand Systems, Set I.

This section discusses the results of the basic censored LinQuad demand systems, a system is estimated for each ethnic group. Demand functions are dependent on the series of prices that consumers face and the income of the household. An additional system was estimated for all households. It was used as a benchmark for comparisons, providing more details about the consumption relationships of the market for meat products in the United States.

Full Information Maximum Likelihood (FIML) and Iterative Seemingly Unrelated Regression (ITSUR) were the estimators applied to the analysis. The following discussion uses the estimates from the ITSUR procedures because they were more consistent.

Most of the estimated parameters were insignificant. The fit of the equations was low with R^2 ranging from 0.01 up to 0.05. The high levels of censoring and left skewed distributions of expenditures are possible causes of these results. Another reason could be the low variation in prices, since prices were imputed from average monthly prices allocated by region and month in which the household was surveyed. The number of significant parameters and elasticities increased with the size of the sample. The estimated parameters and elasticities are interpreted under the Ceteris paribus condition, and were calculated at mean points of the variables involved.

Income elasticities indicate the direction of percentage change in demand when income increases by one percent. When income elasticities are negative, goods are classified as inferior,

when they are in the range of 0 and 1 goods are necessities, and if income elasticities are greater than one goods are classified as luxurious.

As a general result, it can be seen in Table 5.40 that income elasticities for all households were positive, with the exception of other pork and seafood products. The magnitude of the income elasticities were in the range between 0.02 and 0.35, indicating that no single meat item can be regarded as luxurious good for all households.

Hispanic households presented positive income elasticities, with the exception of beef steak and pork chops, with -0.16 and -0.06 income elasticity, respectively. As income increased, Hispanics consumed more in other beef, seafood, and bacon, since the magnitudes of the income elasticities were 0.45, 0.2, and 0.12, respectively (Table 5.40).

White households presented negative income elasticities for beef steak (-0.01), pork chops (-0.006), and other pork (-0.07) (Table 5.40). The bigger income elasticities were for other beef (0.30) and poultry (0.12). The remaining income elasticities were positive, in the range between 0.006 and 0.1.

African American households presented negative income elasticities for other beef, pork chops, and ham. Unlike Hispanic and White households, African American households had positive income elasticities for beef steak with a magnitude of 0.51; the same trend was observed in households of other minorities which had a 0.99 income elasticity (Table 5.40). Unlike Hispanics, White, African Americans, households of other minorities had negative income elasticities for ground beef, roast beef and other beef (Table 5.40).

Income elasticities of ethnic groups presented different behavioral responses, showing how preferences for meats change as income increases in the consumer unit. Hispanics had more

similar responses to increases in income with Whites and African American households, and dissimilar responses with respect to households of other minorities.

Own price elasticities measured the percentage change in quantities demanded of particular good when its price changes by one percent. Most own price elasticities were negative for Hispanics, with the exception of roast beef (2.37) and other pork (2.96); these elasticities are contrary to the expected sign that economic theory dictates. Lanfranco (2001) states that positive own price elasticities might be the result of aggregation of broader categories of meat items in a single category, and Stegelin (2002) express that it might be related to substitution among the items in the same category .

Inelastic demand was found for ground beef (-0.69), ham (-0.24), and poultry (-0.62) according to the own price elasticities. The demand was more elastic for beef steak, other beef and seafood products and less elastic for bacon, and pork chops. The own price elasticity for beef steak was -10.18 and for other beef products was -6.77, suggesting that Hispanic consumers are more sensitive to reduce consumption when there is an increase in the price of these items (Table 5.41).

The cross-price elasticity indicates the percentage change in quantities demanded of a particular good when there is an increase of 1% in the price of another good. When the cross-price elasticity is negative, goods are called complements; when it is positive, goods are said to be substitutes.

Cross price elasticities for Hispanic households are illustrated in table 5.41. For the case of ground beef, with most of the meat items had relationships of complementarity with the exception of beef steak, pork chops, ham and seafood; the cross-price elasticities for these items were 0.30, 0.14, 1.68 and 0.084, respectively. As can be noted from these findings, the cross-

price elasticity of ground beef with respect to ham was the more elastic and the positive sign indicated relations of substitution among the items previously described.

Cross-price elasticities for beef steak indicated that Hispanic consumers had more relations of substitution with the rest of meat items. For example, the cross-price elasticity of beef steak with respect to bacon was 2.85 and for roast beef was 1.63. Surprisingly, other pork had a complementary relationship with most of the meat items, with the exception of other beef, ham, and seafood. For poultry and seafood products the results from cross price elasticities are mixed (Table 5.41).

Non-Hispanic White households presented negative own price elasticities, with the exceptions of other pork and poultry. White households presented more elastic demand for meat products, 3 out of 10 own price elasticities were between 0 and 1 in absolute value. In most cases, meat items for Whites had substitution relationships with other meat items, when cross price elasticities are compared with those of Hispanic households. Take for example, ham and beef products, White households presented positive cross price elasticities with almost all of the meat items (Table 5.42).

African Americans and households of other minorities presented 5 positive own price elasticities. African Americans had elastic demand in 4 meat products while households of other minorities had 5 out of 10. For both groups, cross-price elasticities indicated that ham had complementary relationships with most of the meat items; refer to tables 5.63 and 5.64. This was in contrast to the relationships found in Hispanic and White households. African American households presented substitute relationships between pork and beef products; poultry products were complements with beef steak, other beef, bacon, ham, other pork and seafood. Seafood products had relationships of complementarity with ground beef, beef steak, ham, and poultry;

the higher magnitudes of cross price elasticities were found with respect to the price of other beef (2.78) and bacon (2.11) (Table 5.43).

Consumption of beef steak for the case of households of other minorities were complements with most of the meat products, with the exception of other beef and pork chops, since they presented more substitute relationships of with other meat products. Beef products and pork products had an even number of relationships of complementarity and substitution with the rest of meat products included in the analysis. Poultry products presented relationships of substitution with ground beef, roast beef, other beef, pork chops, and seafood. Seafood products had relationships of substitution with roast beef, pork chops, other pork, and poultry (Table 5.44). In Tables 5.41-5.45, there are some own and cross-price elasticities that had magnitudes too high in absolute value, although the specification of the formulas were corroborated, leaves as unique possible explanation that those magnitudes are the result of big rates of change at the mean points, in addition, we most consider the high level of censoring of the dependent variables and also that the values of imputed price variables are the average for the region.

5.6 Censored LinQuand Demand Systems Augmented with Household Size, Set II.

This section presents the results of the estimated censored LinQuad demand system augmented with one demographic variable, household size in the Amsterdam Scale. It has been acknowledged that household size is a significant variable that not only influences purchase decisions but also has effects on the quantities that consumer units are willing to buy in a particular period of time. For this research project weekly expenditures had been analyzed. In section 5.3, the effects of household size had been discussed in terms of the impact this has on purchase decisions. It was observed that household size has different effects on different

Table 5.40 Income Elasticities by Ethnic Groups, Set I.

Ethnic Group / Meat Product	Ground Beef	Roast Beef	Beef Steak	Other Beef	Bacon	Pork Chops	Ham	Other Pork	Poultry	Seafood
Hispanics	0.032922*	0.076275	-0.15769	0.451735	0.12466	-0.05812	0.042532	0.057627	0.099031	0.208667
	0.085**	0.1356	0.3434	0.4883	0.1678	0.2014	0.13	0.1337	0.0948	0.2852
Whites	0.075936	0.041444	-0.01634	0.302359	0.096183	-0.00634	0.098422	-0.06832	0.123522	0.006641
	0.0482	0.0978	0.146	0.2062	0.0687	0.0833	0.1626	0.1482	0.0433	0.0762
African Americans	0.148644	0.429414	0.508814	-0.05402	0.086165	-0.05832	-0.24553	0.065768	0.223131	0.30701
	0.1104	0.3388	0.2322	0.2563	0.1187	0.1107	0.1622	0.2049	0.1091	0.3208
Other Minorities	-0.08026	-0.12912	0.996536	-0.13465	0.018881	0.52312	0.374534	0.082421	0.002327	0.20242
	0.1423	0.2898	0.7088	1.1214	0.2291	0.3632	1.0425	0.2099	0.2046	0.1945
All Households	0.069809	0.055568	0.043008	0.354641	0.087224	0.027147	0.022823	-0.00892	0.13179	-0.02445
	0.0369	0.0737	0.1215	0.2024	0.053	0.0632	0.0811	0.0874	0.0328	0.0624

Source: Results from Basic Censored LinQuad Demand System.

* Estimate

** Standard error

Table 5.41 Own and Cross-Price Elasticities for Hispanic Households, Set I.

	Ground Beef	Roast Beef	Beef Steak	Other Beef	Bacon	Pork Chops	Ham	Other Pork	Poultry	Seafood
Ground Beef	-0.69475*	-0.23661	0.304755	-0.27526	-1.26829	0.141469	1.684932	-1.08987	-0.46279	0.083925
	1.9127**	1.9794	4.4506	2.9108	0.9951	1.0279	0.8984	0.7016	1.1451	2.0172
Roast Beef	-0.14448	2.378926	1.930614	2.334464	-0.8225	0.074202	2.838276	-0.40558	0.337642	3.209331
	1.1941	3.8067	2.9258	3.4111	1.7641	1.0659	1.3057	0.9516	1.2309	2.1233
Beef Steak	0.159086	1.636226	-10.1782	5.782912	2.852347	0.668288	-4.42326	-0.88915	0.198462	-2.68211
	2.2775	2.482	5.7102	3.3861	2.3498	1.5992	2.2947	1.3622	1.705	2.1975
Other Beef	-0.18983	2.612882	7.536118	-6.77485	-2.21181	-1.60858	2.754974	0.727414	-0.38796	-2.95207
	1.9492	3.7991	4.4204	6.6506	2.8952	1.8163	2.6066	1.5975	1.9933	2.828
Bacon	-1.98674	-2.12804	8.711753	-5.16005	-3.02057	-1.66771	2.340675	-0.40568	0.410683	-0.29148
	1.5583	4.5816	7.183	6.7676	4.5618	1.5547	2.1863	1.3818	1.5864	3.2072
Pork Chops	0.125661	0.109955	1.133486	-2.07288	-0.92753	-3.89194	-0.16658	-1.73806	-0.41413	2.571307
	0.8992	1.5461	2.7459	2.3681	0.8691	3.334	0.9661	1.1347	0.924	2.1273
Ham	2.086485	5.831683	-10.7085	5.100269	1.851889	-2.131	-0.23857	4.412799	-0.55242	-3.29394
	1.1127	2.681	5.5551	4.8184	1.7291	1.854	1.3693	1.6753	1.4869	2.7166
Other Pork	-0.90715	-0.55657	-1.44974	0.90476	-0.21587	-1.65645	1.432839	2.963419	-0.69942	2.265966
	0.5834	1.3118	2.2119	1.9837	0.7337	1.0787	2.3143	1.1251	0.8593	1.5939
Poultry	-0.34053	0.418332	0.271424	-0.4115	0.193474	-0.35387	-0.32783	-2.47617	-0.61663	-1.47816
	0.8412	1.4978	2.4443	2.1861	0.745	0.7764	0.8821	0.9674	0.7597	1.2646
Seafood	0.047845	3.20448	-3.16103	-2.64686	-0.11376	1.756857	-1.59883	1.635154	-1.21409	-5.32783
	1.211	2.1152	2.5776	2.5358	1.2289	1.4615	1.3172	1.1502	1.0334	6.4835

Source: Results from Basic Censored LinQuad Demand System.

* Estimate

** Standard error

Table 5.42 Own and Cross-Price Elasticities for Non-Hispanic White Households, Set I.

	Ground Beef	Roast Beef	Beef Steak	Other Beef	Bacon	Pork Chops	Ham	Other Pork	Poultry	Seafood
Ground Beef	-2.13992*	0.28634	0.076497	0.048745	-0.12232	0.341364	0.120505	0.115078	-0.20166	0.327059
	0.6268**	0.9758	1.1144	1.1463	0.582	0.5929	0.5934	0.4338	0.4453	0.7903
Roast Beef	0.195211	-0.87552	-0.34828	-0.26237	0.50596	0.195648	0.986239	1.491459	1.26281	-0.29355
	0.6651	2.2896	1.9041	1.4118	0.8766	1.3614	1.5165	0.5222	0.5718	0.817
Beef Steak	0.042793	-0.2669	-4.4877	1.441122	0.29291	-0.05284	1.090537	-0.96888	0.223971	0.755047
	0.5863	1.4709	1.5282	1.7814	1.4213	1.4148	1.9461	0.4642	0.4622	0.8507
Other Beef	0.028751	-0.25013	1.742494	-0.43718	-0.52348	-0.23122	-0.15828	-0.93786	-1.01127	-0.83528
	0.7363	1.3321	2.176	2.9974	0.9791	1.2827	1.1396	0.8884	0.7745	1.0929
Bacon	-0.19461	1.178371	0.877787	-1.29017	-1.7634	-0.83662	1.658077	0.739317	-0.06671	1.035884
	0.9245	2.0424	4.2897	2.4158	1.6846	0.8375	1.1022	0.7365	0.7164	1.2443
Pork Chops	0.344998	0.290118	-0.10124	-0.35316	-0.52913	-0.34364	-1.35289	-0.10546	-1.09215	-1.07699
	0.5964	2.0105	2.7037	2.0096	0.5308	1.3133	0.8204	0.6806	0.596	1.0297
Ham	0.11867	1.440918	2.059363	-0.24886	1.039861	-1.74645	-1.34142	1.865857	0.500857	0.332255
	0.5907	2.2178	3.6846	1.7629	0.6931	5.1252	0.8119	0.8503	0.5631	0.9167
Other Pork	0.088478	1.658154	-1.39004	-1.09956	0.353373	-0.07813	0.641513	1.418007	0.344106	-0.22886
	0.3291	0.5798	0.6686	1.0442	0.3514	0.5131	0.7445	0.6463	0.3829	0.4679
Poultry	-0.16291	1.490894	0.334966	-1.26321	-0.03388	-0.87584	0.406077	-0.87565	0.363645	0.898844
	0.3584	0.6753	0.7058	0.9695	0.3632	0.4767	0.4557	0.4872	0.406	0.4839
Seafood	0.258054	-0.33563	1.121967	-1.00423	0.512389	-0.8381	0.263767	-0.23921	0.878369	-3.66461
	0.6184	0.9387	1.2656	1.3296	0.6135	0.8008	0.7206	0.4845	0.4709	1.4115

Source: Results from Basic Censored LinQuad Demand System.

* Estimate

** Standard error

Table 5.43 Own and Cross-Price Elasticities for African American Households, Set I.

	Ground Beef	Roast Beef	Beef Steak	Other Beef	Bacon	Pork Chops	Ham	Other Pork	Poultry	Seafood
Ground Beef	0.443339*	-0.30283	-0.59931	-2.09534	-0.41325	0.571337	0.221501	-0.34438	0.514462	-0.51557
	1.7448**	2.5391	2.4851	3.6746	1.81	1.35	1.5682	0.7654	1.1717	1.8606
Roast Beef	-0.19107	7.23696	0.997291	-5.68512	-1.7046	1.136379	1.294136	0.120561	1.602904	0.957784
	1.5033	7.228	7.1638	5.6204	1.3968	1.5224	1.3121	1.0434	1.4563	2.57
Beef Steak	-0.31902	0.920793	-5.75655	2.765146	0.061495	1.339089	-2.12625	0.629125	-0.9685	-3.07984
	1.2976	6.2901	6.1874	8.8007	3.6727	1.6813	3.1613	1.5902	1.3225	1.7197
Other Beef	-1.7671	-8.11873	4.471607	5.740744	3.513181	-6.60564	-0.20933	-0.37238	-0.59467	3.639509
	3.0974	8.0115	14.2055	20.5621	8.2649	3.7859	6.1567	2.2896	2.7222	4.5648
Bacon	-0.6255	-4.359	0.203867	6.327478	-1.24991	-3.78285	1.837805	0.249579	-0.73383	4.987409
	2.7509	3.6004	10.6902	14.8862	6.3093	2.2371	4.4292	0.9657	2.2724	4.9196
Pork Chops	0.521046	1.74987	2.340727	-7.09904	-2.25444	-3.10247	2.309211	0.454967	1.356606	0.797754
	1.2242	2.3373	2.921	4.0679	1.3342	2.3421	1.3278	0.8231	1.4756	2.4397
Ham	0.202889	1.951187	-3.64726	-0.22243	1.089399	-4.11182	2.289034	-0.82408	-0.27296	-2.71348
	1.4074	1.9954	5.4255	6.5443	2.6138	2.7831	1.3144	1.0388	1.3367	2.7771
Other Pork	-0.27093	0.170371	0.954826	-0.34797	0.128493	0.393445	-0.16851	-0.72519	0.218835	0.121864
	0.6004	1.3908	2.3783	2.1339	0.501	0.7147	3.4072	0.9115	0.8147	1.6356
Poultry	0.387087	2.07114	-1.37932	-0.53214	-0.36605	1.121138	-0.23561	-1.56218	0.208866	-1.20798
	0.8816	1.8503	1.9054	2.4318	1.1252	1.2246	1.1207	1.024	0.7816	1.2065
Seafood	-0.33607	1.069922	-3.80368	2.780788	2.110776	0.562155	-1.95309	0.097435	-1.04191	-2.76104
	1.198	2.8031	2.1229	3.4912	2.0873	1.735	1.9959	1.3419	1.0324	3.7054

Source: Results from Basic Censored LinQuad Demand System.

* Estimate

** Standard error.

Table 5.44 Own and Cross-Price Elasticities for Households of Other Minorities, Set I.

	Ground Beef	Roast Beef	Beef Steak	Other Beef	Bacon	Pork Chops	Ham	Other Pork	Poultry	Seafood
Ground Beef	-1.57034*	-1.4252	-2.90993	3.478139	5.693177	-3.45602	-1.15697	2.672476	2.12778	-0.56335
	2.8878**	2.9857	5.5197	5.078	1.8186	2.7028	2.7053	1.3121	2.549	5.7852
Roast Beef	-0.8823	-6.88138	-8.80927	10.61091	2.232481	1.187047	-0.30126	0.81227	1.806586	6.040431
	1.8486	5.8037	4.2239	5.3087	1.899	2.7565	2.3942	1.813	1.6058	3.8684
Beef Steak	-1.74549	-8.52066	13.02749	1.048252	-1.36804	5.919473	-0.87323	-2.63413	-0.99095	-3.47863
	3.301	4.093	7.3612	6.2559	2.4642	3.0733	3.1845	1.3193	2.2358	4.2918
Other Beef	2.876939	14.17231	1.436725	-23.5058	-4.4876	-1.95141	2.479465	2.183073	1.462587	-2.55508
	4.198	7.0904	8.6511	16.0509	4.8991	5.9968	6.1631	3.3156	4.1088	7.7246
Bacon	9.135856	5.786669	-3.67764	-8.70885	1.486766	2.410466	-3.00216	-0.77401	-0.74334	-4.90828
	2.9182	4.9206	6.6162	9.5082	4.3263	3.8579	3.1927	2.2368	3.0675	5.6561
Pork Chops	-2.64134	1.444072	7.636544	-1.80343	1.147071	-5.98982	0.282546	-0.69304	0.477749	0.749353
	2.0595	3.3949	3.9444	5.4981	1.8338	12.301	2.8878	2.0858	1.5956	4.2479
Ham	-1.36229	-0.57529	-1.72543	3.531419	-2.19954	5.54276	0.405187	1.713755	-4.71626	-4.65849
	3.1821	4.5472	6.265	8.7701	2.3398	8.7858	4.4264	3.0258	3.6135	5.5503
Other Pork	1.938361	0.949688	-3.18439	1.915695	-0.34972	-0.6611	1.096891	1.059884	0.649566	1.633929
	0.9518	2.1248	1.5974	2.9127	1.0113	1.9816	1.4294	1.8687	1.2198	2.3391
Poultry	1.478476	2.02639	-1.13405	1.228187	-0.32194	0.442958	-2.78442	-2.62692	0.623536	0.84723
	1.7723	1.8031	2.5979	3.4569	1.3293	1.4528	2.1353	1.7778	1.1691	2.052
Seafood	-0.28752	4.922578	-2.90034	-1.56347	-1.54472	0.497757	-1.99309	1.138399	0.612694	-4.34168
	2.924	3.1581	3.6198	4.7206	1.7811	2.8134	2.3812	1.6288	1.4918	2.8049

Source: Results from Basic Censored LinQuad Demand System.

* Estimate

** Standard error

Table 5.45 Own and Cross-Price Elasticities for All Households, Set I.

	Ground Beef	Roast Beef	Beef Steak	Other Beef	Bacon	Pork Chops	Ham	Other Pork	Poultry	Seafood
Ground Beef	-2.44575*	0.3871	0.364518	-0.45636	-0.23087	-0.00991	0.548632	0.188624	0.072565	0.620408
	0.5496**	0.7607	1.0119	1.0251	0.4518	0.4675	0.4615	0.3266	0.3774	0.6757
Roast Beef	0.253585	-0.92245	-0.61893	1.086178	0.164975	0.699333	1.150529	1.049929	0.9141	0.179744
	0.4988	1.7036	1.549	1.3245	0.6606	0.9546	1.0519	0.3929	0.4531	0.7202
Beef Steak	0.193303	-0.4964	-4.28608	2.281692	0.531292	-0.0256	0.119797	-0.77044	0.19547	-0.0384
	0.5339	1.2467	1.6941	1.7154	1.0437	1.1007	1.3946	0.4288	0.4133	0.7267
Other Beef	-0.31256	1.112285	2.900447	-0.3097	-0.57775	-0.7371	-0.09999	-0.85594	-0.69903	-0.43596
	0.6902	1.3611	2.1896	3.1193	1.0503	1.0267	1.0331	0.7161	0.6837	0.9823
Bacon	-0.36475	0.39747	1.588045	-1.34574	-1.59595	-0.96322	1.301497	0.744187	-0.25543	0.919154
	0.7136	1.5911	3.1267	2.4594	1.4067	0.6616	0.8613	0.5395	0.6116	1.0759
Pork Chops	-0.00861	1.018035	-0.04609	-1.03326	-0.58079	-0.73012	-0.72466	-0.42453	-0.64131	0.026806
	0.4455	1.3881	1.9884	1.4531	0.3994	0.9481	0.5589	0.4799	0.4499	0.8729
Ham	0.566796	1.813075	0.23408	-0.15027	0.851525	-2.30713	-0.78551	1.688196	0.136136	-0.45416
	0.4767	1.6575	2.7324	1.5828	0.5637	1.2307	0.6055	0.636	0.4915	0.8207
Other Pork	0.146075	1.236916	-1.12705	-0.97773	0.364184	-0.3435	0.732395	1.261822	0.165212	-0.42103
	0.2525	0.4625	0.6281	0.8204	0.2639	0.389	0.5494	0.4753	0.3026	0.4161
Poultry	0.056023	1.088065	0.284733	-0.80017	-0.1265	-0.52696	0.10253	-1.59407	0.166008	0.370501
	0.2945	0.5394	0.6105	0.7918	0.3023	0.3684	0.3714	0.3766	0.3054	0.4214
Seafood	0.44255	0.197827	-0.04733	-0.43786	0.414738	0.021466	-0.31049	-0.38666	0.343364	-6.02987
	0.4785	0.7783	0.9771	1.0309	0.4827	0.6487	0.5629	0.382	0.3827	1.2243

Source: Results from Basic Censored LinQuad Demand System.

* Estimate

** Standard error

ethnic groups. Consequently, the inclusion of household size is very important not only for the estimation of the impact of demographics on demand of a particular commodity or market, but also to discern how the preferences for food change and how the responsiveness to pricing and income changes affects demand. The inclusion of the size of the household also helps to examine how different ethnic groups react to their dynamics in their demographics, and since demographics is tied to the geographic location of consumers, different marketing strategies can be used when targeting consumers in the marketplace.

Full Information Maximum Likelihood (FIML) and Iterative Seemingly Unrelated Regression (ITSUR) were used. The parameters and elasticities from Full Information Maximum Likelihood had bigger standard errors, even when same estimates were achieved under equal starting values and convergence criteria. Refer to appendix G for details. The following discussion presents the results from the ITSUR procedure.

The magnitude and sign of the estimates changed when household size was included in the LinQuad model, in some cases the sign change was accompanied with slight or abrupt changes in the absolute value of the elasticity. The addition of household size in the basic censored Linquad demand caused changes in the estimates of income elasticities, own price elasticities, and cross price elasticities. When own and cross-price elasticities were compared with the basic LinQuad model (model include prices and income), it was observed that most of the relationships of substitution and complementarity hold. As mentioned earlier, a few estimates changed from elastic to inelastic and from substitute to complement, and vice versa. The goodness of fit remained almost the same. The gains in explaining the variation in demand are marginal. The test outcomes for normality of the error terms and homocedasticity remained the same.

Significant income elasticities were found for all households in the demand equations of ground beef and poultry with magnitudes of 0.07 and 0.08; therefore, an increase of one percent in weekly household income increased demand of the products by 0.07% and 0.08%, respectively. Only White households presented significant income elasticities on ground beef and poultry products (Table 5.46).

Hispanic households had positive household size elasticities for roast beef (1.24) and other beef (86.42). The remaining household size elasticities were positive and insignificant, with the exception of beef steak which had an inelastic, negative response with a magnitude of -0.07 (Table 5.46) and was found statistically significant at 5% level of significance.

White households had insignificant positive household size elasticities. This was not the case for demand of ground beef, other pork, and seafood products since they had negative signs. The magnitudes of household size elasticities remained in absolute value between 0.03 and 0.66, indicating less sensitivity in consumption of meat products when the number of members increases in the household, whereas the demand of other beef had a remarkable high positive household size elasticity of more than 1500, but it was significant only at the 20% level of significance (Table 5.46).

African American households had, in general, positive household size; only beef steak, other beef, and pork chops had negative sign. African Americans had a very elastic and negative response to increase in household size, whereas for non-Hispanic White households were more inelastic (Table 5.46).

The effect of increases in household size in other minorities was different compared to Hispanics, Whites, and African Americans. First, they had negative household size elasticity for demand of roast beef, other pork, and seafood. Second, the magnitudes of the household size

elasticity were in the range of 0.3 up to 6.67 in absolute value, with the exception of other beef which had positive response of 1172 (Table 5.46). It can be inferred that all households of ethnic groups increase their consumption of other beef products when their household increase, contrary to the case of African American households.

Overall, the effect of household size for all households was positive and inelastic. As can be seen in Table 5.66, household size elasticities for all ethnic groups ranged between 0 and 1 in absolute value. The U.S. market demand for other beef products increase as the household size increases. We can conclude that as household size increases, its effect is more significant in the decision to consume than the quantities demanded for non-Hispanic White households (Tables 5.33, 5.46). After the decision to purchase is made, for some meat items, the effect of elasticity is negative in terms of the quantities demanded, although the marginal effect on the probability to consume was significantly positive, this phenomenon can be seen when examining the marginal effects and income elasticities of White households. Take for example ground beef, other pork, and seafood (Tables 5.33, 5.46). In Hispanic households, the same process can be seen in the demand for beef steak; curiously, household size had a negative effect in both decision to purchase and the level of quantities demanded.

For Hispanic households, the results are mixed. Household size had significant effects on the decision to purchase ground beef at the 99% level of confidence (Table 5.31) but not significant effects on quantities demanded (Table 5.46). In the case of roast beef consumption, the effect of household size was insignificant in the decision to purchase but significant in quantities demanded. The consumption of other beef products was affected significantly at the 5% level of significance for the decision to purchase and quantities demanded. The remaining

household size elasticities were insignificant, although the positive marginal effect of the probability to consume pork chops, ham and other pork was significant.

When household size was included in the demand system, income elasticities for Hispanics had bigger p-values and standard errors, and changes in magnitudes and signs occurred; Beef products changed from necessities to luxurious goods; contrary was the case of other beef products whose classification changed from necessity to luxurious good (Table 5.46). In the case of other pork, the change in magnitude and sign of the income elasticity and the inclusion of household size in the model changes its classification from necessity to inferior. When only prices are included in the demand system the income elasticity of other pork is 0.06, this elasticity changed to -0.06 when the demand system included household size. The same phenomenon was observed in seafood products, the income elasticity changed from 0.2 to -0.007.

When household size was included in the model, significant income elasticities were found in ground beef and poultry; when only prices are modeled, the income elasticity for poultry products was significant at the 5% level of significance. Hispanic households did not have a single income elasticity that was significant under the two described scenarios of estimation (Tables 5.40, 5.46).

White households had significant income elasticities in the demand of ground beef and poultry at the 10% level of significance when household size was included in the model. The LinQuad as a function of only price variables produced significant income elasticities on poultry products at the 5% level of significance, and the income elasticity of demand of roast beef and other beef was significant at the 15% level of significance. In the probability to purchase beef steak, income had significant positive marginal effects; although, the effect of income in

quantities demanded was negative. The marginal probability of consumption of pork chops decrease significantly at the 10% level of significance, but the income elasticity of demand was negative and insignificant.

African American and households of other minorities did not have significant income elasticities under the two scenarios of estimation (prices and income – prices, income, and household size), but African Americans had significant income elasticity in the demand for chicken at the 5% level of significance when the LinQuad model was estimated only with the series of prices and income.

Under the two scenarios of estimation (LinQuad in function of prices and income only – and LinQuad in function of prices, income, and household size), Hispanic households hold the relationships of substitution and complementarity although the magnitudes of the estimates changed slightly in both directions. The following exceptions were observed. The own price elasticity of ground beef estimated only under prices and income was negative and inelastic and changed to positive and elastic. In the case of bacon, only a change in sign from negative to positive occurred. When household size was included in the model the cross price elasticity of ham with respect to pork chops suggested a change in the relationship of both commodities from complement to substitute goods, more consistent relationship among pork products.

White households had the same pattern of Hispanics with respect to own price elasticities and cross-price elasticities under the two scenarios of estimation (Table 5.48). Own price elasticities of roast beef change from negative to positive, and the magnitude changed from being inelastic to elastic. The own price elasticity of beef steak changed from elastic to inelastic, contrary was the case for other beef products. The own price elasticity of bacon changed from negative to positive when household size was included in the model. Cross-price elasticities

revealed that when household size was included, other pork products changed the relationships from substitution to complementarity with ham; in the case of other beef products, the relationship changed from complementarity to substitution with ham. Other beef products, bacon, and pork chops had changes in the relationship from complementarity to substitution.

African American households had negative own price elasticity for bacon, it changed to positive when household size was added in the model (Table 5.49). For households of other minorities, the demand of ground beef changed from elastic to inelastic according to the own price elasticity (Table 5.50). According to the cross price elasticities, African American households had 3 relationships that changed from complementarity to substitution and 6 relationships that changed from substitution to complementarity (Tables5.43 5.49). Households of other minorities had 6 relationships that change from complementarity to substitution and 1 relationship change from substitution to complementarity (Tables 5.44, 5.50).

When all households were evaluated under the two scenarios of estimation, it was observed that according to the cross-price elasticities 10 relationships between commodities changed from complementarity to substitution and 5 relationships changed from substitution to complementarity (Tables 5.45, 5.51). The econometric results suggest that when household size is included in the econometric model, there were changes in the magnitudes of elasticities and standard errors, most of the relationships of substitution and complementarity hold, although more relationships of substitution are produced and the results are more consistent with economic theory. Therefore, the exclusion of household size in the modeling of demand of commodities at the household level might provide inconsistent results.

The increase in household size had the greater effect o the demand for other beef products, most of the magnitudes of the household size elasticities were above 86, a possible

explanation is the high level of censoring, for all ethnic groups non-purchasers accounted for more than 90% of the consumer units (Table 5.14). In addition, we have to consider that other beef products were among the meat products that had the highest price variation in the four regions (Tables 5.26-5.29) and high variation of expenditures in other beef products was also found for all households (Table 5.21) in comparison with the remaining meat products. Multicollinearity was discarded since household size presented lower levels of multicollinearity in comparison with the series of prices.

5.7 Censored Linquad Demand Systems Augmented with Demographic Variables, Set III.

The following section discusses the results from Censored LinQuad Demand Systems augmented with the set of demographic variables proposed in chapter four. The modeling of this chapter followed a different approach compared to the previous demand systems that had been discussed in sections 5.4-5.7. The difference lies in the modeling of the purchase decision, the first step of the estimation in which the Probit regressions are used for producing instrumental variables for censoring the LinQuad demand system. Three approaches were followed for the first step of the estimation. In the first case, the Probit regressions were estimated with only household size and the logarithm of household income. In the second case, the Probit regressions were estimated as a function of household size, logarithm of household income, and the 10 price variables. The Probit regressions were estimated with household size, logarithm of household income, the 10 price variables, and the complete set of demographic variables that were proposed in chapter four. For the three cases, after estimating the Probit regressions, the standard normal density function and the standard normal cumulative distribution function were calculated for each household and ethnic group. Thereafter, five Censored LinQuad Demand Systems were

Table 5.46 Income and Household Size Elasticities by Ethnic Groups, Set II.

Ethnic Group	Type	Ground Beef	Roast Beef	Beef Steak	Other Beef	Bacon	Pork Chops	Ham	Other Pork	Poultry	Seafood
Hispanics	IE	-0.04894*	-0.49457	-0.19673	1.376846	0.380846	-0.04159	0.148128	-0.0643	0.089167	-0.00692
		0.1735**	0.3076	0.3559	1.6707	0.3103	0.3318	0.274	0.1751	0.0935	0.2864
	HSE	0.462891	1.245909	-0.07013	86.45438	-0.37325	0.116248	0.600508	2.073285	0.423588	0.231081
		0.7504	0.5868	0.3495	18.0799	0.3344	0.8081	1.1103	1.6252	0.823	0.18
Whites	IE	0.065383	-0.02454	0.171384	0.018033	-0.00687	-0.02605	0.172532	-0.0207	0.101898	-0.05906
		0.0394	0.0826	0.1542	0.0379	0.1843	0.0822	0.1531	0.0561	0.0543	0.073
	HSE	-0.25583	0.447118	0.209876	1517.539	0.357848	0.034677	0.215075	-0.66566	0.152215	-0.09072
		0.4579	0.6638	0.4213	1055.6	0.8011	0.3918	0.244	0.5062	0.485	0.2086
African Americans	IE	0.056863	0.264795	0.402409	0.000442	-0.04294	-0.09876	-0.18613	-0.0499	0.115063	0.169464
		0.1117	0.2328	0.3014	0.0597	0.1504	0.1183	0.1996	0.141	0.1328	0.18
	HSE	0.044182	0.56869	-0.00319	-1459.89	0.558682	-0.42126	0.029744	0.046694	0.159401	0.077301
		0.4177	1.9166	0.3814	1531.7	0.5851	2.642	0.2546	0.3298	0.259	0.1682
Other Minorities	IE	-0.25828	-0.00418	0.772258	-0.04235	-0.27415	0.130608	0.696443	0.216469	0.039529	0.075499
		0.3462	0.223	0.7447	0.0734	0.431	0.3123	0.8451	0.2393	0.1601	0.186
	HSE	0.412432	-6.67566	0.97701	1172.811	1.059956	1.995611	0.144782	-2.33918	0.307672	-0.92409
		0.4777	5.6802	0.7232	1612.9	1.363	1.1507	0.4809	1.8507	0.2885	1.7588
All Households	IE	0.07557	0.005866	0.040798	0.041635	0.066923	0.098057	0.095424	0.00905	0.084412	-0.09097
		0.0388	0.0582	0.1083	0.0587	0.1129	0.0938	0.0946	0.0516	0.0463	0.0792
	HSE	-0.31394	0.663574	0.049202	1037.03	0.089032	-0.15251	-0.33975	-0.60537	0.210312	-0.07279
		0.2544	0.405	0.3897	686.5	0.4353	0.355	0.572	0.4854	0.2508	0.1791

Source: Results from Censored LinQuad Demand System augmented with household size.

* Estimate

** Standard error

Table 5.47 Own and Cross-Price Elasticities for Hispanic Households, Set II.

	Ground Beef	Roast Beef	Beef Steak	Other Beef	Bacon	Pork Chops	Ham	Other Pork	Poultry	Seafood
Ground Beef	1.166448*	-0.42274	0.260952	-0.08038	-1.1999	0.02976	1.78425	-0.93989	-0.58863	0.133103
	3.5647**	1.9849	4.4404	2.9602	1.0191	1.035	0.9063	0.705	1.1384	2.0353
Roast Beef	-0.24883	17.45395	1.99936	2.906208	-0.57386	0.200199	2.832424	-0.77689	0.234478	3.567922
	1.197	8.5186	2.9233	3.5576	1.7826	1.0798	1.316	0.9203	1.2347	2.1356
Beef Steak	0.130044	1.597174	-10.4562	5.593867	2.735163	0.557634	-4.38947	-0.61755	0.137778	-2.63075
	2.2751	2.4788	5.1028	3.4109	2.3458	1.5958	2.3298	1.3277	1.6972	2.1984
Other Beef	-0.08943	2.916866	6.847891	-15.2582	-2.42647	-1.5523	2.808618	0.882638	-0.07163	-3.54622
	1.9802	4.2251	4.2798	13.7387	2.8569	1.848	2.5744	1.5877	2.0076	2.8802
Bacon	-1.87462	-1.34387	8.344491	-6.25297	1.128462	-1.43289	2.197687	-0.22386	0.589437	-0.78045
	1.5983	4.648	7.1739	6.7253	6.1829	1.6392	2.1947	1.4369	1.6136	3.2007
Pork Chops	0.024376	0.25411	0.945382	-1.9118	-0.79409	-2.64288	-0.19857	-1.55596	-0.47447	2.621277
	0.9068	1.6206	2.7333	2.4573	0.9221	13.1356	0.9501	1.0999	0.9279	2.1633
Ham	2.211567	5.879141	-10.6265	4.951632	1.736619	0.730284	-0.28513	4.55873	-0.63937	-3.23972
	1.1234	2.7069	5.6354	4.8413	1.7371	6.3147	1.3486	1.7264	1.5177	2.7465
Other Pork	-0.77643	-0.99515	-0.9525	0.941004	-0.14889	-1.47279	12.06094	3.046727	-0.58313	2.365412
	0.587	1.2628	2.1732	1.8922	0.7614	1.053	9.6522	1.1498	0.8742	1.6059
Poultry	-0.43204	0.311349	0.188624	-0.19346	0.279121	-0.40176	-0.37756	-0.99421	-0.50268	-1.56175
	0.8363	1.503	2.4329	2.1935	0.7588	0.7799	0.9015	3.1765	0.7781	1.2721
Seafood	0.078363	3.524903	-3.0975	-3.10582	-0.29193	1.799208	-1.5672	1.704201	-1.27258	-9.27104
	1.2219	2.1098	2.577	2.5385	1.227	1.4862	1.3324	1.1656	1.041	6.4072

Source: Results from Censored LinQuad Demand System augmented with household size.

* Estimate

** Standard error

Table 5.48 Own and Cross-Price Elasticities for Non-Hispanic White Households, Set II.

	Ground Beef	Roast Beef	Beef Steak	Other Beef	Bacon	Pork Chops	Ham	Other Pork	Poultry	Seafood
Ground Beef	-2.75224*	0.183528	0.577903	-0.52799	-0.21235	0.30576	0.275732	0.087583	-0.14969	0.268342
	1.4858**	0.9823	1.1396	1.1685	0.6295	0.6053	0.6343	0.4405	0.4418	0.7909
Roast Beef	0.124496	2.430435	-1.10893	0.128845	0.627819	0.135819	0.898604	1.521494	1.167242	-0.20264
	0.6694	4.8003	1.7464	1.5102	0.8232	1.4517	1.373	0.5844	0.5879	0.8494
Beef Steak	0.300968	-0.85246	-0.24571	0.354592	0.271874	-0.04858	1.558977	-1.1453	0.412304	0.532557
	0.5972	1.3502	3.8109	1.6266	1.4699	1.4157	1.8635	0.4589	0.4781	0.8978
Other Beef	0.422312	-0.2978	4.229206	-8.57932	-0.70893	-0.50229	1.3314	-1.00883	0.342813	-1.47074
	0.9053	1.5994	1.8418	7.6432	1.0257	1.2061	1.9374	1.1115	0.8952	1.1853
Bacon	-0.33757	1.462923	0.817597	-1.62641	0.755574	-0.72502	1.437238	0.79997	-0.0714	1.056909
	0.9989	1.9165	4.4489	2.7276	6.8842	0.823	1.1904	0.6929	0.7277	1.248
Pork Chops	0.309294	0.199367	-0.08734	-0.31351	-0.45975	-0.15895	-1.36939	-0.13672	-1.18267	-1.02213
	0.6092	2.1452	2.7103	1.8099	0.5217	3.3838	0.7847	0.6609	0.5953	1.0279
Ham	0.267581	1.320217	2.932083	-1.06605	0.903206	5.384185	-1.35732	1.97371	0.539457	0.355295
	0.6297	2.0127	3.5174	2.0342	0.7462	8.527	0.7765	0.8307	0.5704	0.9186
Other Pork	0.069248	1.688432	-1.63485	-0.8115	0.381163	-0.10352	-3.07491	1.504964	0.408536	-0.29472
	0.3335	0.6497	0.6544	0.9604	0.3278	0.4986	2.9687	0.6306	0.3874	0.468
Poultry	-0.12187	1.380762	0.633055	-1.41799	-0.0357	-0.94784	0.443302	-0.25576	0.428871	0.89691
	0.3555	0.6937	0.7348	0.9784	0.3692	0.4763	0.4625	2.1326	0.4116	0.4845
Seafood	0.213911	-0.23567	0.805957	-0.71886	0.520637	-0.79521	0.282777	-0.30286	0.87823	-5.29601
	0.6184	0.9737	1.3289	1.3507	0.6154	0.8002	0.7221	0.4842	0.4717	3.1308

Source: Results from Censored LinQuad Demand System augmented with household size.

* Estimate

** Standard error

Table 5.49 Own and Cross-Price Elasticities for African American Households, Set II.

	Ground Beef	Roast Beef	Beef Steak	Other Beef	Bacon	Pork Chops	Ham	Other Pork	Poultry	Seafood
Ground Beef	0.623669*	-0.83694	-0.99805	-0.81929	-0.39936	0.653602	0.26729	-0.38181	0.44785	-0.57988
	2.0588**	2.5489	2.4852	3.704	1.8547	1.3785	1.6056	0.8211	1.1773	1.869
Roast Beef	-0.50862	20.2234	-2.3247	-0.5524	-1.34602	1.143651	2.264351	0.415858	1.38196	0.631335
	1.5121	50.9457	9.2311	6.3642	1.3077	1.5032	2.0891	1.3885	1.4575	2.5677
Beef Steak	-0.52626	-1.92769	-5.96049	7.787133	-0.10119	1.741865	-1.66978	0.275369	-1.33639	-3.38035
	1.2955	7.8159	7.6476	9.6024	3.9224	1.7155	3.6308	1.4284	1.3704	1.6691
Other Beef	-1.51622	-7.28718	1.40502	6.981586	3.434441	-5.47108	0.461966	0.062877	-1.98801	1.006609
	3.418	8.6617	15.5095	30.5653	8.7428	3.4568	5.2759	2.0237	3.8426	5.3982
Bacon	-0.60846	-3.49028	-0.32032	5.449309	4.924433	-3.47818	1.686747	0.432295	-0.59984	5.072144
	2.8209	3.3516	11.4434	14.7108	10.6004	2.1732	3.9231	1.1683	2.2569	4.8922
Pork Chops	0.596596	1.744602	3.061423	-7.57676	-2.07805	-6.77894	2.187226	0.599623	1.568637	0.796201
	1.2498	2.283	2.9902	3.8888	1.2962	16.9698	1.3158	0.7792	1.4739	2.4992
Ham	0.242733	3.383344	-2.86395	-2.70852	0.991379	-4.68873	2.173386	-0.40055	-0.19067	-2.72795
	1.442	3.0588	6.2283	5.5307	2.3191	3.4011	1.3	1.0696	1.3361	2.7332
Other Pork	-0.29852	0.549141	0.433933	-0.79908	0.222063	0.52048	-1.30887	-0.35595	0.083192	-0.19421
	0.6454	1.7998	2.1498	2.8485	0.6046	0.6774	5.6228	0.9427	0.7998	1.649
Poultry	0.336464	1.802608	-1.91456	0.204904	-0.29489	1.294382	-0.16418	-1.22668	0.075	-1.25435
	0.8857	1.8372	1.9812	2.5501	1.1174	1.2246	1.1206	1.1561	0.7685	1.1869
Seafood	-0.37522	0.749369	-4.16288	3.682636	2.155034	0.555717	-1.96559	-0.16543	-1.0758	-3.62073
	1.2047	2.7957	2.0661	3.472	2.0755	1.7832	1.9642	1.3531	1.0167	2.762

Source: Results from Censored LinQuad Demand System augmented with household size.

* Estimate

** Standard error

Table 5.50 Own and Cross-Price Elasticities for Households of Other minorities, Set II.

	Ground Beef	Roast Beef	Beef Steak	Other Beef	Bacon	Pork Chops	Ham	Other Pork	Poultry	Seafood
Ground Beef	-0.05469*	-1.21645	-2.76263	3.025632	5.988434	-3.55803	-1.34877	2.816762	2.225749	-0.17177
	3.4069**	3.0294	5.5898	5.1548	1.8153	2.713	2.6686	1.3254	2.579	5.7291
Roast Beef	-0.81426	-33.9054	-7.22976	10.61354	2.468872	0.850239	0.230636	1.525439	2.114742	6.278883
	1.8557	25.7307	3.7334	5.4568	1.7582	3.0259	2.5205	1.8296	1.6139	3.8439
Beef Steak	-1.64102	-7.27882	13.48365	-1.20308	-1.80041	5.930185	-0.64023	-2.63852	-1.27077	-3.14727
	3.3377	3.7717	7.261	6.8419	2.3712	2.9932	3.1786	1.3396	2.134	4.3583
Other Beef	0.216615	14.12923	9.756238	-30.8688	-6.36509	-3.86794	6.636261	4.33336	1.957331	-2.20085
	4.4933	7.8955	12.43	18.5436	6.0714	6.4818	6.2911	3.6469	4.5812	8.9134
Bacon	9.619891	6.503609	-4.90294	-9.41812	6.759828	3.598463	-4.36361	-1.64676	-0.69273	-5.41881
	2.9117	4.5742	6.3429	9.9555	7.2585	3.6428	3.5934	2.3628	3.0529	5.5485
Pork Chops	-2.80042	0.994492	8.008931	-4.9809	1.654081	-50.5982	0.777723	0.05041	0.762323	1.097491
	2.0577	3.6733	4.0644	5.8475	1.7323	29.9935	2.9247	2.1067	1.6195	4.2769
Ham	-1.57149	0.172475	-1.28237	1.99168	-3.17091	9.484358	0.877348	1.333803	-5.10853	-4.98236
	3.1362	4.7469	6.2714	9.1686	2.6331	8.8215	4.2908	3.0651	3.5608	5.4765
Other Pork	2.032111	1.704871	-3.12574	1.484799	-0.7471	-0.04135	-3.85096	0.86087	0.581024	1.045407
	0.9612	2.1497	1.6016	2.8587	1.0671	1.9656	3.8754	1.8827	1.2299	2.314
Poultry	1.546563	2.359557	-1.46977	1.222803	-0.29973	0.678191	-3.01572	-1.86527	0.555195	0.720431
	1.7925	1.813	2.4796	3.3913	1.3228	1.4591	2.1027	2.0262	1.1802	2.0278
Seafood	-0.09868	5.095007	-2.59386	-2.15523	-1.71225	0.701512	-2.10947	0.736842	0.52582	-8.3065
	2.893	3.1532	3.6596	4.695	1.748	2.7923	2.3418	1.6104	1.4729	6.7567

Source: Results from Censored LinQuad Demand System augmented with household size.

* Estimate

** Standard error

Table 5.51 Own and Cross-Price Elasticities for All Households, Set II.

	Ground Beef	Roast Beef	Beef Steak	Other Beef	Bacon	Pork Chops	Ham	Other Pork	Poultry	Seafood
Ground Beef	-3.44619*	0.289892	0.690587	-0.68174	-0.27741	0.074765	0.566097	0.183011	0.095844	0.510711
	1.0867**	0.7687	1.0274	1.0665	0.4829	0.4748	0.4799	0.3272	0.3764	0.6762
Roast Beef	0.186627	5.215601	-1.17451	1.17383	0.201783	0.554649	1.26393	1.157212	0.842252	0.291967
	0.5036	3.6507	1.4596	1.4277	0.6568	1.008	0.9724	0.4145	0.4616	0.7408
Beef Steak	0.364373	-0.94196	-2.79441	2.020333	0.603562	0.221107	0.27464	-0.82504	0.309344	-0.17606
	0.54	1.177	3.0743	1.6463	1.0737	1.0975	1.2984	0.4215	0.4208	0.756
Other Beef	0.174367	1.284916	3.231253	-6.24359	-0.33623	0.032663	0.336864	-0.81702	0.196187	-1.37109
	0.7871	1.5295	2.097	7.8268	1.0146	0.9997	1.1443	0.8554	0.7392	1.1331
Bacon	-0.43912	0.490508	1.80578	-1.62132	-0.74599	-0.95147	1.232205	0.756798	-0.27539	0.999281
	0.7632	1.5786	3.2119	2.5479	5.717	0.6641	0.8994	0.5292	0.6221	1.0805
Pork Chops	0.071129	0.813272	0.399066	-1.17417	-0.5736	-2.05354	-0.84784	-0.46849	-0.66786	0.055503
	0.4522	1.4649	1.9909	1.4677	0.4013	2.8429	0.5677	0.4411	0.4514	0.8743
Ham	0.585365	1.99823	0.538119	-0.67077	0.807303	-5.92649	-0.91772	1.715274	0.13465	-0.54135
	0.4947	1.5307	2.5344	1.6347	0.588	5.9419	0.6149	0.6313	0.4929	0.8266
Other Pork	0.143817	1.363654	-1.20523	-1.04624	0.371507	-0.37593	-2.4763	1.284933	0.182694	-0.47184
	0.253	0.4893	0.6139	0.8069	0.258	0.3582	2.5905	0.4709	0.303	0.4191
Poultry	0.073624	1.008425	0.456214	-0.82426	-0.13601	-0.54824	0.099643	-0.91002	0.180853	0.406264
	0.2937	0.5489	0.6245	0.7997	0.3078	0.3696	0.3732	0.9616	0.3064	0.4215
Seafood	0.367644	0.30993	-0.2301	-0.30417	0.450775	0.049019	-0.36342	-0.42814	0.375297	-7.38362
	0.4787	0.7983	1.0121	1.0375	0.4851	0.6498	0.566	0.3842	0.3828	2.6992

Source: Results from Censored LinQuad Demand System augmented with household size.

* Estimate

** Standard error

estimated under each case, a system for each ethnic group and a system for all households that served as benchmark for comparisons. The second and third cases, produced magnitudes that were not in accord with the sets of systems that were discussed in sections 5.5 and 5.6. The relationships of complementarity and substitution did not change dramatically. The magnitudes and signs of own price elasticities were affected. In some systems, more than 8 out of 10 own price elasticities were positive, and it was more common to find magnitudes greater than 10 in absolute value.

From the results of case two and three, it can be seen that the insertion of insignificant variables in the first step produced bigger standard errors in the estimated elasticities than in the second step of the estimation; and the number of significant effects of demographic variables were lower. The elasticities for these systems are not presented for the sake of brevity, and they are available upon request. The following discussion continues with the estimates of the first case, in which only household size and the logarithm on income was used in the first step, where Probit regressions were used to calculate the instrumental variables that help the estimation of censored LinQuad Demand systems.

Income elasticities for Hispanic households indicated that most meat items were inferior goods since their signs were negative, with the exceptions of other beef products that had a income elasticity of 1.64 indicating that as income goes up, holding other factors constant, Hispanics tend to eat more of the items in this category. Positive income elasticities were found in bacon (0.38), ham (0.07), poultry (0.06) and seafood (0.03) (Table 5.52). Compared with the results of the basic LinQuad demand System (Table 5.40), it can be observed that magnitudes of the income elasticities of roast beef and other pork changed from positive to negative. When the

results are compared with the LinQuad demand system augmented with household size (Table 5.46), only the income elasticity for seafood products changed from -0.00692 to 0.003.

The household size elasticities of Hispanics were in the range of 0 and 1 in absolute value, with the exception of other beef with a magnitude of -2.38 (Table 5.52). Compared with the results of LinQuad demand system that was augmented with only household size, only beef steak changed from -0.07 to 0.27 and other beef products changed from 86.45 to -2.38. In general, household size elasticities did not change as much as the income elasticities when more demographic variables were included in the model. Furthermore, the inclusion of demographic variables provided more consistent estimates, especially for household size elasticities of other beef products.

The income elasticities for Whites had more changes in sings and magnitudes when the LinQuad system was estimated with the complete set of demographics compared with the first two scenarios of estimation presented in sections 5.5 and 5.6. The income elasticities and household size elasticities for African Americans and households of other minorities did not change greatly as the estimated for Whites and all households (Tables 5.46 and 5.52).

The results presented in table 5.52 contrast those found by Lanfranco (2001) and Stegelin (2002). Most of their household size elasticities were negative. Only household size elasticities for all households had negative signs as were reported. Neither Lanfranco (2001) nor Stegelin reported elasticities for all households. In the case of income elasticities, they found more income elasticities with positive signs with the exception of the estimates for White households that presented almost 50% of the elasticities with negative signs. The differences in magnitudes and sings of household size and income elasticities may be due to sample size, criteria used in the extraction of the dataset from the survey, differences in the level of zero values in the

dependent variables and dynamics in habit formation processes that consumers face through their preferences and characteristics of the consumers.

Own price elasticities for Hispanics reveal that the only price-inelastic demand was found for ham (-.67) and poultry products (-0.50). Positive own price elasticities were found for ground beef, roast beef, bacon, and other pork (Table 5.53).

In the LinQuad system for Hispanic households, estimated with only prices and income (Table 5.41), only roast beef and other pork presented positive income elasticities with magnitudes of 2.4 and 2.96, respectively. When the Linquad demand system was augmented with household size, the model presented similar results to the system augmented with the complete set of demographic variables (Tables 5.41, 5.47, 5.53); the same can be said for the rest of households. Also, it was observed that when demand systems were augmented with demographic variables, as the sample size decreases the number of positive own price elasticities increases. Therefore, the inclusion of demographic variables in the estimated censored LinQuad demand systems caused a redistribution of the effects, making it more difficult to discern the effect of own prices in the demand of meat items; the level of aggregation expenditures that were used to estimate the demand systems must be considered in addition to the level of censoring and different sources of the values for the price variables.

With regard to cross price elasticities, for the case of Hispanic households, a few relationships changed when demographics are added in the augmented LinQuad demand system with household size (Table 5.47). Two relationships changed from complementary to substitution and 6 relationships from substitution to complementarity. Other ethnic groups presented similar patterns (Table 5.53). White households presented 1 change of relationship from complementarity to substitution and 3 changes from substitution to complementarity.

Most demographic variables presented insignificant effects on the demand of meat items. No single marginal effect of household size was significant for all ethnic groups (Tables 5.58-5.61). Unlike any other ethnic group, Hispanic households had negative and significant effect of number of persons over 64 years old at the 90% level of confidence in the demand for beef steak. White households present negative and significant effect of persons over 64 years old in the demand of ham at the 5% level of significance. Households of other minorities had negative effects on this demographic variable in the demand for ground beef and bacon at the 1% and 10% level of significance, respectively (Tables 5.61).

The number of persons under 18 years old had a negative effect on white households for the demand pork chops and positive effect for the demand of ground beef in African American households at the 10% and 1% level of significance, respectively (Tables 5.59-5.60).

Age of the reference person had positive effects on the demand for meat items. Hispanic households had positive and significant effects of age of reference person on the demand for poultry products at the 10% level of significance (Table 5.58). For White households at the 1% level of significance, positive effects of age were found in the demand for ham and seafood products (Table 5.59). African American households had negative effects of age on the demand for ground beef at the 5% level of significance (5.60).

Sex of the reference person did not presented significant effects on the demand of meat items. Only Hispanic households with male reference persons were found to have negative effect on the demand for ground beef at the 10% level of significance (Table 5.61); the same result was found for all households (Table 5.62).

Hispanic and African American households who are recipients of food stamps did not present significant differences in the consumption of meat products compared with non-

recipients (Tables 5.58, 5.60). Households of other minorities who are recipients of food stamps presented positive and significant difference in the demand for other pork at the 1% level of significance (Table 5.61). Recipients of food stamps within the group of White households presented negative differences in the demand for other beef and bacon at the 5% and 10% level of significance; recipients had positive differences in the demand for pork chops and ham at 10% and 5% levels of significance, respectively.

Urban households of Hispanic origin compared with rural households, presented significant and positive differences in the demand for ham and poultry products at the 5% level of significance (Table 5.58); at the same level of significance, White households presented significant and negative difference in the demand for ground beef (Table 5.59). In the case of African Americans, households residing in urban areas present significant and positive differences in the demand for beef steak and seafood products compared with rural households (Table 5.60); households of other minorities presented positive and significant differences in the demand for other beef, pork chops, and other pork (Table 5.61).

Two variables related to education were inserted into the model for discerning statistical and significant differences in the demand for meat items. The two dummy variables were compared with households who had primary school. The education level did not produce significant differences in the demand for meat items, with the exemption of the demand for other pork products (Table 5.58).

White households which had reference persons with high school degree as the maximum level of education were found to have positive and significant differences in the demand for ground beef, beef steak, other beef, and seafood compared with households who have reference persons with primary school; negative and significant differences were found on the demand for

bacon (Table 5.59); reference persons with some college were found to have positive and significant differences in the demand for other beef and seafood products, and negative differences for the demand of bacon. As the educational attainment increases for the reference persons of African Americans and households of other minorities, the effects on demand for meat items are positive (Tables 5.60, 5.61).

The effects of demographic variables in the censored LinQuad demand systems evaluated in this section are very similar with those of Lanfranco (2001) in terms of the signs and levels of significance. Although the sample size was bigger than that of Lanfranco (2001), the number of demographic variables that were found significant was lower, a possible cause would be due to high levels of censoring and differences in the levels of multicollinearity of the demographic variables.

Table 5.52 Income and Household Size Elasticities by Ethnic Groups, Set III.

		Ground Beef	Roast Beef	Beef Steak	Other Beef	Bacon	Pork Chops	Ham	Other Pork	Poultry	Seafood
Hispanics	IE	-0.07445*	-0.43193	-0.25035	1.641775	0.388513	-0.04458	0.069495	-0.11199	0.065798	0.035567
		0.1892**	0.3888	0.3907	1.7717	0.3229	0.3693	0.2531	0.1817	0.1043	0.3045
	HSE	0.675436	0.857105	0.269726	-2.38327	-0.55904	0.257011	0.523985	2.311285	0.356906	0.177623
		0.8083	0.7644	0.614	2.5791	0.3767	0.8212	1.0539	1.7526	0.7896	0.2443
Whites	IE	0.146545	0.050018	-0.03038	0.492672	0.188455	0.118048	0.192963	-0.04464	0.13066	-0.035
		0.0751	0.1844	0.4567	0.5515	0.1227	0.1966	0.181	0.1851	0.0492	0.1425
	HSE	-0.47142	0.686659	0.175802	1.208886	0.008772	-0.05016	0.411817	-0.64655	-0.09385	0.10842
		0.6011	0.9492	0.4788	1.712	0.5896	0.6636	0.3318	0.5542	0.483	0.2781
African Americans	IE	0.162204	0.616987	0.735137	-0.45673	-0.15462	-0.07997	-0.07434	0.257804	0.173914	0.264826
		0.2159	0.3816	0.3879	0.8712	0.302	0.1557	0.4292	0.2312	0.2669	0.3316
	HSE	-0.39495	0.595119	-0.12677	-0.3724	0.611814	-1.00046	0.221605	0.133618	0.067384	0.034232
		0.4608	2.1479	0.3826	2.5605	1.1718	2.5642	0.5408	0.4887	0.5033	0.2462
Other Minorities	IE	-0.63187	-0.17397	0.39213	0.44322	-0.29992	0.075385	0.027031	0.156758	0.205047	0.146958
		0.3526	0.3187	0.7303	1.2941	0.4963	0.4497	1.1314	0.3029	0.282	0.3705
	HSE	0.838457	-6.62282	0.018469	0.350535	1.047639	1.930233	0.084616	-1.40141	0.401571	-1.8185
		0.5259	4.4002	0.4673	0.6038	1.5624	1.2745	0.4993	1.9716	0.3629	2.9342
All Households	IE	0.143163	0.032198	-0.04533	0.36859	0.14588	0.062547	0.1109	0.03779	0.13169	-0.03
		0.0589	0.1299	0.2553	0.2436	0.0726	0.154	0.0994	0.1027	0.0554	0.1197
	HSE	-0.43306	0.824444	-0.18256	-0.09901	-0.04856	0.076677	-0.026	-0.57595	-0.01868	0.17218
		0.328	0.7024	0.3962	1.1652	0.3719	0.5287	0.6576	0.4972	0.286	0.2353

Source: Results from Censored LinQuad Demand System augmented with demographics.

* Estimate

** Standard error

Table 5.53 Own and Cross-Price Elasticities for Hispanic Households, Set III.

	Ground Beef	Roast Beef	Beef Steak	Other Beef	Bacon	Pork Chops	Ham	Other Pork	Poultry	Seafood
Ground Beef	2.479979	-0.16785	-0.27812	0.127514	-1.18927	0.00255	2.084872	-0.73965	-0.56908	0.357906
	3.8103	2.0759	4.8161	3.1199	1.0592	1.0767	0.9406	0.7324	1.1725	2.1017
Roast Beef	-0.0947	18.14105	2.183739	2.574948	-0.41245	0.009324	2.589176	-0.83116	0.267743	3.810577
	1.252	10.0534	3.0341	3.4332	1.7025	1.1157	1.3737	0.9081	1.239	2.2152
Beef Steak	-0.15016	1.741833	-9.42247	5.196744	2.585269	0.691285	-4.45714	-0.52952	0.077864	-2.95495
	2.4698	2.5668	5.0008	3.5046	2.4709	1.5612	2.4137	1.2546	1.79	2.2911
Other Beef	0.109874	3.334026	6.625167	-17.55	-2.67959	-1.47795	2.958113	0.762151	-0.14585	-3.63314
	2.0984	4.0962	4.5092	14.5888	2.9478	1.8612	2.6889	1.519	2.0327	2.926
Bacon	-1.85276	-0.92545	7.889074	-6.37656	0.368832	-1.42871	2.297935	-0.2289	0.52503	-1.0173
	1.6604	4.4172	7.5528	6.9021	6.443	1.6331	2.2437	1.443	1.6332	3.334
Pork Chops	-0.00081	-0.0222	1.169861	-1.85062	-0.79114	-2.66346	-0.47125	-1.68234	-0.53084	2.534566
	0.9438	1.6718	2.676	2.4031	0.9194	13.6749	0.9381	1.1452	0.9542	2.2315
Ham	2.584032	5.347039	-10.785	5.434708	1.816246	-0.08282	-0.66941	4.842195	-0.67447	-2.62028
	1.1658	2.8237	5.8404	4.9939	1.7757	5.8068	1.3305	1.7726	1.5545	2.8124
Other Pork	-0.60762	-1.08947	-0.78758	0.641038	-0.15583	-1.59026	13.36201	3.243965	-0.58371	2.494851
	0.6105	1.2471	2.0764	1.8437	0.7676	1.1035	10.4965	1.1849	0.8875	1.6665
Poultry	-0.41717	0.344787	0.104448	-0.15862	0.248462	-0.44857	-0.39937	-1.08138	-0.50581	-1.4679
	0.8615	1.5062	2.5657	2.2261	0.7678	0.8013	0.9229	3.0652	0.7871	1.323
Seafood	0.214471	3.795038	-3.4767	-3.22493	-0.38588	1.738941	-1.26932	1.804595	-1.19853	-7.41519
	1.2622	2.1935	2.6884	2.6163	1.2779	1.5321	1.3642	1.2116	1.0819	6.6098

Source: Results from Censored LinQuad Demand System augmented with demographics.

* Estimate

** Standard error

Table 5.54 Own and Cross-Price Elasticities for White Households, Set III.

	Ground Beef	Roast Beef	Beef Steak	Other Beef	Bacon	Pork Chops	Ham	Other Pork	Poultry	Seafood
Ground Beef	-3.54292	0.282254	0.162257	-0.12983	-0.1899	0.394018	0.047769	0.031937	-0.0672	0.185242
	1.9461	0.9854	1.1273	1.2037	0.5905	0.5953	0.6036	0.4214	0.4534	0.8011
Roast Beef	0.189194	4.585296	-0.51395	-0.53122	0.429994	0.031496	0.944942	1.635494	1.166332	-0.21341
	0.6724	6.6664	1.5915	1.4537	0.7669	1.3469	1.5381	0.4908	0.5696	0.8419
Beef Steak	0.092465	-0.39431	-3.67153	1.45084	0.234576	-0.03026	1.174635	-1.0831	0.172279	0.761205
	0.5811	1.2316	6.3847	1.6544	1.2698	1.4273	1.7223	0.4216	0.4524	0.8998
Other Beef	-0.11148	-0.4997	1.738317	10.74789	-0.36811	-0.12246	-0.01853	-0.91473	-0.9736	-0.89433
	0.7949	1.3787	2.0306	19.3154	1.0373	1.1932	1.1022	0.9419	0.7814	1.1066
Bacon	-0.3033	1.006905	0.691137	-0.86237	-0.57696	-0.8215	1.473931	0.672801	0.187486	1.063963
	0.9397	1.7808	3.7845	2.5829	5.2643	0.8267	1.1154	0.6651	0.7299	1.2523
Pork Chops	0.392618	0.048278	-0.06716	-0.17698	-0.52294	-1.62777	-1.12977	-0.17037	-1.03358	-1.0039
	0.6003	1.9874	2.7374	1.8491	0.5249	5.0177	0.7795	0.5895	0.5891	1.0308
Ham	0.042938	1.385568	2.208408	0.004254	0.922784	2.701545	-1.11734	1.746625	0.465072	0.32023
	0.5961	2.2535	3.231	1.702	0.6992	9.1862	0.7696	0.8431	0.5653	0.9253
Other Pork	0.033616	1.820288	-1.55775	-1.04102	0.328105	-0.12179	-4.07227	1.337979	0.345041	-0.24026
	0.3222	0.5452	0.5906	1.1328	0.3177	0.4429	3.3739	0.6406	0.3788	0.4685
Poultry	-0.05474	1.381416	0.251766	-1.18347	0.095517	-0.82374	0.378955	-0.95221	0.355993	0.710364
	0.3644	0.6721	0.7042	0.9675	0.3694	0.4697	0.4585	2.1538	0.3988	0.4793
Seafood	0.150985	-0.24328	1.133236	-1.06817	0.529169	-0.77709	0.258342	-0.24787	0.697327	-4.09923
	0.6268	0.9656	1.3231	1.3503	0.6187	0.8009	0.7277	0.4858	0.4663	4.3002

Source: Results from Censored LinQuad Demand System augmented with demographics.

* Estimate

** Standard error

Table 5.55 Own and Cross-Price Elasticities for African American Households, Set III.

	Ground Beef	Roast Beef	Beef Steak	Other Beef	Bacon	Pork Chops	Ham	Other Pork	Poultry	Seafood
Ground Beef	0.758849	-0.30554	-1.06347	-1.7574	-0.45038	0.839087	0.727667	-0.29893	0.484502	-0.73019
	2.5304	2.5804	2.925	4.0466	2.0192	1.388	1.6591	0.7868	1.2412	2.0482
Roast Beef	-0.20355	19.96422	0.131298	-5.46939	-1.43896	0.855669	1.457583	0.370724	1.562974	0.925997
	1.5563	54.1315	9.5524	6.2222	1.3982	1.6035	2.1408	1.1178	1.564	2.6321
Beef Steak	-0.55221	0.311275	-2.66025	2.90002	0.008082	1.457946	-1.97219	0.458621	-1.10283	-3.24488
	1.5094	7.6941	7.606	9.374	4.352	1.6143	3.8373	1.6046	1.4472	1.8543
Other Beef	-1.47838	-7.88824	4.743038	-5.37795	3.130039	-6.76813	-0.68162	-0.1586	-0.19655	4.204751
	3.4643	8.7405	15.7062	45.3383	9.2686	3.4684	5.3075	2.5003	2.8721	4.7664
Bacon	-0.68325	-3.72884	0.04139	5.639466	4.063739	-3.46769	1.456402	0.086496	-0.76313	6.097733
	3.0791	3.5232	12.8092	16.6838	14.3524	2.205	4.3103	1.1674	2.3332	5.0366
Pork Chops	0.773422	1.374469	2.644235	-7.31214	-2.07574	-10.3623	2.177829	0.745923	1.523583	0.361071
	1.2613	2.4216	2.8792	3.7558	1.3125	16.2206	1.3721	0.8517	1.5249	2.5643
Ham	0.647864	2.162098	-3.43198	-0.70527	0.863361	-3.53198	2.164504	-0.77386	-0.19791	-2.91977
	1.4901	3.1846	6.5888	5.6779	2.5464	4.9599	1.3659	1.0669	1.3291	2.8599
Other Pork	-0.23284	0.571382	0.703874	-0.1648	0.041744	0.624162	1.528257	-0.67098	0.131425	0.070654
	0.6225	1.6615	2.383	2.3969	0.6131	0.7343	6.4783	0.935	0.833	1.6987
Poultry	0.370134	2.067104	-1.54845	-0.19939	-0.38225	1.246773	-0.16264	-1.35566	0.133351	-1.09694
	0.9315	1.9389	2.0869	2.499	1.1484	1.2574	1.1085	1.6577	0.7987	1.2379
Seafood	-0.46626	1.103867	-3.9774	3.189326	2.582438	0.231629	-2.09145	0.062185	-0.94522	-2.94127
	1.3114	2.8346	2.2917	3.5852	2.1267	1.8175	2.046	1.3848	1.0579	3.9711

Source: Results from Censored LinQuad Demand System augmented with demographics.

* Estimate

** Standard error

Table 5.56 Own and Cross-Price Elasticities for Households of Other Minorities, Set III.

	Ground Beef	Roast Beef	Beef Steak	Other Beef	Bacon	Pork Chops	Ham	Other Pork	Poultry	Seafood
Ground Beef	0.997364	-1.47117	-4.14762	6.048236	5.053557	-1.7371	-2.25153	1.679841	1.848408	-1.35669
	3.6729	3.0694	6.3711	6.0153	1.9858	2.9011	2.9293	1.3471	2.7183	6.0046
Roast Beef	-1.11656	-32.0729	-7.77486	12.26629	1.810669	-0.06582	-0.25675	0.916883	1.94021	6.948735
	1.8953	19.0081	5.3255	6.7435	2.0184	2.9777	2.4179	2.0962	1.7573	4.3229
Beef Steak	-2.41643	-7.68825	10.69418	-0.12309	-1.36159	5.709114	-0.70517	-3.20751	-0.46533	-2.94797
	3.7686	5.1921	7.86	7.1337	2.6865	3.1602	3.6234	2.1267	2.4691	4.8552
Other Beef	4.927286	16.11423	-0.01868	-21.9414	-3.68273	-3.09457	2.9731	3.682494	1.05871	-3.24203
	4.9423	9.0198	10.0297	18.5544	5.5971	6.4457	6.4601	4.3689	4.3195	8.0256
Bacon	8.16283	4.874253	-3.75961	-7.151	5.362093	3.198748	-3.80827	-1.37046	-0.97462	-5.20645
	3.1747	5.3396	7.2305	10.7669	7.0668	4.0958	3.5175	2.6826	3.3183	5.9695
Pork Chops	-1.54756	-0.22006	7.520242	-2.67383	1.457275	-43.4018	1.290083	0.182494	0.293845	1.709863
	2.2001	3.5642	4.3132	5.7629	1.9289	36.0202	3.1118	2.1989	1.6959	4.1433
Ham	-2.60911	-0.48457	-1.42266	4.192564	-2.77839	0.628995	1.972075	1.710035	-4.44006	-5.38004
	3.4248	4.677	7.1792	9.0947	2.5813	9.7059	4.5543	3.1199	3.7894	5.6271
Other Pork	1.176982	0.973522	-3.82128	3.245785	-0.6239	0.107571	-1.89334	1.064815	0.724663	1.39311
	0.9683	2.4707	2.589	3.8226	1.2024	2.0562	4.0321	1.9315	1.2803	2.4519
Poultry	1.270313	2.064314	-0.49066	0.874072	-0.41581	0.175186	-2.61326	-0.87586	0.680558	1.377181
	1.874	1.9569	2.8601	3.6054	1.4298	1.5	2.2283	2.7465	1.2238	2.1357
Seafood	-0.7284	5.57449	-2.42094	-1.96558	-1.64435	1.072006	-2.30197	0.971217	1.015948	-10.9871
	3.0077	3.5689	4.0649	4.8512	1.8771	2.6494	2.4046	1.7008	1.551	11.0187

Source: Results from Censored LinQuad Demand System augmented with demographics.

* Estimate

** Standard error

Table 5.57 Own and Cross-Price Elasticities for All Households, Set III.

	Ground Beef	Roast Beef	Beef Steak	Other Beef	Bacon	Pork Chops	Ham	Other Pork	Poultry	Seafood
Ground Beef	-3.40469	0.354241	0.356128	-0.50996	-0.27467	0.05541	0.51776	0.144779	0.166986	0.418647
	1.3191	0.7652	0.9801	1.0421	0.4542	0.4777	0.4755	0.3209	0.3807	0.6811
Roast Beef	0.221436	8.155759	-1.12856	1.108871	0.176166	0.622598	1.293275	1.106004	0.860947	0.225435
	0.5018	5.915	1.4375	1.4449	0.636	0.9648	1.0545	0.3786	0.4545	0.7217
Beef Steak	0.19336	-0.91114	-4.85641	2.299286	0.508794	-0.01596	0.056378	-0.82035	0.08708	-0.03615
	0.5136	1.1662	3.916	1.6727	0.9711	1.1189	1.2802	0.4117	0.4138	0.7344
Other Beef	-0.35386	1.179105	2.918001	0.435673	-0.54665	-0.64646	-0.07548	-0.83076	-0.54501	-0.31966
	0.709	1.4975	2.1309	12.6699	1.1227	0.9941	1.0055	0.7623	0.695	0.9922
Bacon	-0.43598	0.440316	1.514086	-1.27387	-0.84179	-0.9032	1.265718	0.653639	-0.09411	0.934597
	0.7195	1.5303	2.8957	2.638	4.7971	0.6676	0.8791	0.5102	0.626	1.0782
Pork Chops	0.05361	0.912795	-0.03392	-0.90464	-0.54413	-0.46436	-0.7472	-0.5175	-0.59129	0.034891
	0.4554	1.3987	2.0288	1.4001	0.4031	3.8215	0.5528	0.4252	0.4469	0.8756
Ham	0.534841	2.050568	0.102269	-0.10401	0.829134	-3.73923	-0.81031	1.663624	0.146583	-0.37246
	0.4886	1.6661	2.5008	1.5407	0.5745	6.7784	0.5986	0.6363	0.4907	0.8283
Other Pork	0.116967	1.308556	-1.20682	-0.92761	0.323301	-0.41692	-3.15604	1.247199	0.158244	-0.44273
	0.2488	0.4466	0.5954	0.8775	0.2498	0.3439	2.6931	0.4751	0.3005	0.4176
Poultry	0.129407	1.039826	0.119742	-0.62077	-0.04579	-0.4853	0.110053	-1.49205	0.153474	0.284783
	0.297	0.5402	0.6143	0.801	0.3099	0.366	0.3722	1.073	0.3037	0.4219
Seafood	0.301598	0.241885	-0.04936	-0.31993	0.422245	0.028402	-0.25168	-0.40315	0.264157	-4.87095
	0.4827	0.7779	0.98	1.0432	0.484	0.6494	0.5674	0.3831	0.383	3.3601

Source: Results from Censored LinQuad Demand System augmented with demographics.

* Estimate

** Standard error

Table 5.58 Effect of Demographic Variables for Hispanic Households, Set III.

Meat Product	Household Size	Persons Under 18	Persons Over 64	Age	Sex	Food Stamp Participation	Urban Status	Education Level I	Education Level II
Ground Beef					-				
Roast Beef									
Beef Steak			-						
Other beef									
Bacon									
Pork Chops									
Ham							++	++	
Other pork									
Poultry				+			++		
Seafood									

+++ Positive and Significant Effect at 1% level of significance; ++ Significant at 5 %; + Significant at 10%.
- - - Negative and Significant Effect at 1% level of significance; - - Significant at 5 %; - Significant at 10%.
Blank: Not significant.

Table 5.59 Effect of Demographic Variables for White Households, Set III.

Meat Product	Household Size	Persons Under 18	Persons Over 64	Age	Sex	Food Stamp Participation	Urban Status	Education Level I	Education Level II
Ground Beef							--	++	
Roast Beef									
Beef Steak								+	
Other beef						--		+++	++
Bacon								-	---
Pork Chops		-				+			
Ham			--	+++					
Other pork									
Poultry						++			
Seafood				+++				+++	+++

+++ Positive and Significant Effect at 1% level of significance; ++ Significant at 5 %; + Significant at 10%.
- - - Negative and Significant Effect at 1% level of significance; - - Significant at 5 %; - Significant at 10%.
Blank: Not significant.

Table 5.60 Effect of Demographic Variables for African American Households, Set III.

Meat Product	Household Size	Persons Under 18	Persons Over 64	Age	Sex	Food Stamp Participation	Urban Status	Education Level I	Education Level II
Ground Beef		+++		--					
Roast Beef								++	
Beef Steak							+		
Other beef									
Bacon								++	++
Pork Chops									
Ham									
Other pork								++	+
Poultry									+
Seafood							++		

+++ Positive and Significant Effect at 1% level of significance; ++ Significant at 5 %; + Significant at 10%.
- - - Negative and Significant Effect at 1% level of significance; - - Significant at 5 %; - Significant at 10%.
Blank: Not significant.

Table 5.61 Effect of Demographic Variables for Households of Other Minorities, Set III.

Meat Product	Household Size	Persons Under 18	Persons Over 64	Age	Sex	Food Stamp Participation	Urban Status	Education Level I	Education Level II
Ground Beef			---						
Roast Beef									
Beef Steak									
Other beef							++	++	+
Bacon			-						
Pork Chops							+		
Ham									
Other pork						+++	++	+	
Poultry								+++	
Seafood									+++

+++ Positive and Significant Effect at 1% level of significance; ++ Significant at 5 %; + Significant at 10%.
- - - Negative and Significant Effect at 1% level of significance; - - Significant at 5 %; - Significant at 10%.
Blank: Not significant.

Table 5.62 Effect of Demographic Variables for All Households, Set III.

Meat Product	Household Size	Persons Under 18	Persons Over 64	Age	Sex	Food Stamp Participation	Urban Status	Education Level I	Education Level II
Ground Beef		+			-		-	+++	
Roast Beef		++							
Beef Steak									
Other beef									
Bacon		+		++			---		
Pork Chops		-		-				+	
Ham				++					
Other pork									
Poultry						++	++	+	
Seafood						++	+++	+	+++

+++ Positive and Significant Effect at 1% level of significance; ++ Significant at 5 %; + Significant at 10%.
- - - Negative and Significant Effect at 1% level of significance; - - Significant at 5 %; - Significant at 10%.
Blank: Not significant.

Chapter 6

Summary, Conclusions, Future Research

6.1 Summary

The discovery of America in 1492 by Cristóbal Colón, a trader, established the beginning of the Hispanic presence on the continent. Spaniards colonized mainly the Caribbean, Central and South America, and they also had a presence in the southern United States that extended from California to Florida. Currently, the demographics of the United States are changing and its population has become very diverse, composed of Whites (Caucasians), African Americans, Asians, Hispanics (Latinos), and other racial groups from around the world. Hispanics are shaping the diverse U.S. marketplace that is in a state of constant evolution.

The 2000 U.S. Census reported 281.4 million residents in the United States, from which 35.3 million were Hispanics, making the U.S. the third largest Hispanic speaking country in the world. It was predicted that by the year 2050, more than half of the U.S. population will be composed of ethnic minorities, and one fourth of the population will be of Hispanic origin. Humphreys (2003) reported that Hispanics, by 2008, will record $1,014.2 billion in purchasing power, an increase of 357% from $222 billion estimated in 1990. The simultaneous increase in population and income of Hispanics in the U.S. is attractive to food companies, and made more relevant the study of consumer behavior patterns for discovering market opportunities.

Nevaer (2004) expressed that U.S. Hispanics are a diverse market fragmented by demographic, economic and social conditions; divided also by language, acculturation levels, and income levels; nevertheless, they also present unlimited opportunities accompanied by a myriad of challenges that marketers need to address. The impact of Hispanics on the U.S. food market

has also been recognized in the scientific community (Kisilbash and Garman (1975); Fan and Solis (1994, 1998); Holcomb, Park and Capps (1995); Fan and Lewis (1999); Lanfranco (2001); Food Marketing Institute, (2002); Lanfranco et al. (2002a, 2002b); Perkins, (2004); Zamora (2004); Ford, (2005); Kasarda and Johnson (2006)).

Hispanics have their own culture, traditions and food consumption habits. The growth of the U.S. Hispanic market will have impacts on the demand for food, specifically on meats, one of the main components of their diet and share of total food expenditures.

This research project analyzed the demand for meats among various ethnic groups in the U.S., assessing differences in consumption of Hispanics when compared with that of other ethnic groups. The study is based on a system of censored demand equations of the LinQuad form for disaggregated meat products using data from the "2003 Consumer Expenditure Survey" released by the U.S. Department of Labor. In each demand system, consumption patterns were recognized by the computation of elasticities for each ethnic group and estimator evaluated.

This study has also prepared a comprehensive and extensive survey of literature on U.S. Hispanics, and it is depicted in chapter 2, this chapter focused on literature related to food consumption. Different sources of information useful in studying Hispanic consumers were documented. A strategic framework was utilized. Previous studies of the U.S. Hispanic market included scientific and popular literature. Lists of resources for understanding and researching the Hispanic food market are presented. It is divided into four lists that included books, commercial reports, marketing research companies, retailers and wholesalers of ethnic foods. Databases for potential use in consumer demand analysis for foods were described, and cross-sectional data was emphasized. Lastly, chapter 2 exposed the examination of demand analysis

for food products by ethnic groups, providing a comprehensive understanding of the consumer behavior for foods, emphasizing the consumption of meats by U.S. Hispanics.

The extracted dataset was divided by ethnicity, and the expenditures were aggregated at the household level. The sample contained 821 households of Hispanic origin, 4,118 Non-Hispanic White, 664 African American, and 316 households belonging to other minorities. The average values of the demographic variables are similar to those from the 2000 U.S. Census, thus, the extracted dataset closely represents the U.S. population; in fact, the objective of the Consumer Expenditure Survey is to represent the consumption patterns of the U.S. market as a whole. The average annual income for the households was $36,310.00, $45,209.00, $33,906.00, and $42,758.00 for Hispanics, Non-Hispanic White, African Americans, and households of other minorities, respectively.

More Hispanic households were located in the Western and Southern region, in contrast with White and African American households who were located mainly in the South and Midwest. Most households were located in urban areas, varying with the size of the population. More than 60% of Hispanics households were found in areas with a population greater than 1.2 million people. The same proportions were observed in African American households. Hispanic households had the biggest household size, on average they had 3.49 members followed by African Americans with 2.90 members per household. The household size had the same proportion in terms of the Amsterdam scale. Hispanic households had by far more younger members, in contrast with White households who had a greater number of older members. The average age of the reference person was 51.63 years for White households, in contrast with Hispanics, the average age was 43.79 years.

The average weekly expenditures on total food were $130.66 for Hispanics and $127.04 for White households. White households lead average weekly expenditures on food away from home, and Hispanics lead total food at home, spending on average $93.61 per week. Not surprisingly, Hispanics had the highest average weekly expenditures on meats followed by other minorities and trailed by African American households.

Average weekly budget shares reveal that Hispanics, Whites, African Americans and households of other minorities spend on average 18.71%, 14.61%, 15.61%, and 14.65% of the average weekly income in total food products, respectively. Hispanic households allocated in average 3.52% of the average weekly income in meat expenditures representing 18.82% of total food expenditures. Hispanics allocated 22.2% and 17% of meat expenditures on poultry and beef steak products respectively.

Differences in average weekly budget shares on meat expenditures illustrated that Hispanic households allocated less for bacon and ground beef products and more for beef steak products compared to White households. With respect to African American households, Hispanics spend less on bacon and pork chops and more on other beef and beef steak products. In comparison with other minorities, Hispanic households spend less on seafood and other pork and more on ham and beef products.

The estimation of censored demand equations of the LinQuad form required the estimation of Probit regressions that analyzed the decision to purchase meat items, thereafter, it allowed the calculation of the standard normal distribution and cumulative distribution function for each household. The new variables were used for eliminating selectivity bias when zero values appeared in the dependent variables, which it is a common problem in cross-sectional

data. The Probit regressions also allowed for performing calculations of marginal effect in the probability to consume meat items, the effects of income and household size were evaluated.

There was high demand for computing power when all the demographic variables are included in the censored LinQuad demand system. For example, when all the proposed demographic variables are included in the demand system, SAS® required 1.5 Gygabites of RAM memory for the case of the Hispanic dataset which contained records for 821 households. Hence, the number of variables was reduced in the demand systems. The first set of results consisted of demand systems that were estimated as a function of only price and income. The second set of results consisted of demand systems that were estimated as a function of price, income, and household size. The third set of results came from demand systems that are as a function of price, income and the complete set of demographics proposed in chapter four. Elasticities were calculated for each demand system that corresponded to each ethnic group (own, cross-price, income, and household size elasticities).

The third set of demand systems followed a different approach. Three approaches were followed for the first step of the estimation. In the first case, the Probit regressions were estimated with only household size and the logarithm of household income. In the second case, the Probit regressions were estimated as a function of household size, logarithm of household income, and the 10 price variables. In the last and third case, the Probit regressions were estimated with household size, logarithm of household income, the 10 price variables, and the complete set of demographic variables that were proposed in chapter four. Given the inconsistencies of the results from the second and third cases, results from the first case were discussed.

6.2 Conclusions

Two estimators were considered, Full Information Maximum Likelihood and Iterative Seemingly Unrelated Regression. The first estimator did not produce as many significant differences in consumption as the second. Dummy variables were used for comparing significant differences in meat consumption by ethnic groups with respect to Hispanics.

Under the same starting values generated by SUR, and same convergence criteria, FIML produced almost the same magnitudes in the parameters and elasticities compared with those generated by ITSUR, albeit the standard errors were bigger. Interpretations of parameters and elasticities were accomplished from the estimates produced by ITSUR.

The inclusion of demographic variables in the demand system required more computing power as the number of bvariables increased in the models. It was observed that the inclusion of household size in Amsterdam scale produced elasticities more consistent with economic theory, by producing more substitute relationships among the meat items that were analyzed. The number of substitute relationships increased as the sample increased. The same took place with own price elasticities; more elasticities were produced with negative signs.

The decision to purchase was modeled in order to correct for selectivity bias, although many combinations of variables and transformations were considered; the procedures of Lanfranco were followed, since the deletion or inclusion of variables produced slight variations in the classification tables, Likelihood Ratio tests for the parameters included in the probit regressions were the same, and no single mean probability was significantly different from the estimates produced by the complete set of variables in the demand system compared with the estimates generated with household size and logarithm of income as the independent variables for explaining the probability of positive expenditures. More research needs to be done for

addressing the functional form of the variables that must be used in the Probit regression, since its estimates are used to calculate the standard and normal cumulative functions that eliminate selectivity bias that comes from zero values in the dependent variables in the demand system.

More significant marginal effects of household size were found compared to marginal effects of income, across all ethnic groups. Hispanic households were less likely to be influenced by income in their purchase decisions when compared to White, African American and households of other minorities. Hispanic households were influenced more by household size than income in their decisions to purchase meat products; when they were compared with other ethnic groups.

It is widely known that as sample size increases the number of significant parameters increase. This was the case of censored LinQuad demand systems, not only did the number of significant parameters increase but also the number of significant elasticities that were estimated under high levels of censoring.

Hispanic households consume more beef products, pork products and chicken with respect to other ethnic groups. Hispanics consume less ground beef compared to White and African American households, and they consume significantly more with respect to other minorities at the 10% level of significance. White households consume less beef products compared to Hispanics, significant differences were found in beef steak at the 5% level of significance. Consumption of pork products by White households was in general lower when compared to Hispanics, with the exception of bacon. At the 5% level of significance, White households consume significantly less chicken and seafood products compared to Hispanic households.

Positive and significant differences in consumption of meats between Hispanics and African Americans were found only on ground beef, bacon, and chicken, using a 10% level of significance. Households of other minorities in general allocated less expenditures for meat products compared to Hispanics; negative and statistically significant differences were found in beef steak and ham and ground beef; positive and significant differences were found in other pork and seafood products. The responsiveness to changes in demand due to changes in own prices, cross prices, income, and household size was presented for each ethnic group. In each set of results, a demand system for all households was performed; by doing so, not only can comparisons among ethnic groups that represent U.S. society be made but also comparisons with the results of the market as a whole.

If the interest of the researcher is to find the effects of prices on demand for goods under high levels of censoring, it is questionable whether or not one should make interpretations from demand systems that include demographic variables since most of the effects of demographic variables were insignificant across ethnic groups and also the inclusion of demographic variables produced inconsistent own price elasticities, and the estimated parameters and elasticities are sensitive to the number of variables used in the first step of the Probit regressions as well. As a result, the use of disaggregated data that keeps the linkage between prices, quantities of the goods consumed, and socioeconomic characteristics of the consumer is recommended.

Given that on average Hispanics consume more meat products, although there are differences in income, the higher rate of their population will make it even more attractive for the food industry to target this group of consumers. The food industry must understand the food preferences for meats of Hispanics in order to harness the potential market opportunities that this segment of the population is likely to create in the U.S. marketplace. Researchers, corporations,

agribusinesses, governmental agencies and businesses in general may benefit from the results that this study produces.

Louisiana farmers, the U.S. food industry, and in particular the meat industry may endeavor to develop marketing strategies and competitive advantages by determining the food needs of Hispanics and fulfilling them by providing healthier products for consumers. In the end, those endeavors will bring more revenue to American farmers and food corporations, and a greater well-being to the served markets.

6.3 Future Research

The econometric specification of the Probit regressions of the two-step estimation procedure should be of future research interest. Current practice is to include variables in an ad hoc manner. Formal model specification tests in the censored LinQuad framework should be developed. In addition, future research must consider multivariate modeling of the decision to purchase.

Another topic that can be addressed in future research is the comparison of the LinQuad demand system and the Almost Ideal System, using scanner data and data that present high levels of censoring. Similarly, an evaluation of willingness to pay and the perception and consumer acceptance of meat products that appeal to Hispanics should be investigated.

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Appendix A

Sub-set of Keywords Used in the Survey of Literature

Filtering Criteria: Hispanic Food Market
Languages Used: English, Español, Português

Hispanic
Hispanic history
Hispanic culture
Hispanic health
Hispanic meat
Hispanic meat preferences
Hispanic nutrition
Eating habits
Hispanic Food consumption
Hispanic consumer behavior
Hispanic marketing
Hispanic food
Hispanic food market
Hispanic consumption behavior
Latinos
Latin food market
Comida Latina
Comida hispana
Mercado latino de alimentos
Mercado hispano de alimentos
Meat demand systems
Meat demand
Meat consumption
Resources Hispanic market
U.S. Hispanic Market
Consumer expenditures patterns
Hispanic food expenditures
Hispanic Food preferences
Ethnic good marketing
Multicultural marketing
Ethnic expenditures
Ethnic food expenditures
Hispanic buying power
Hispanic purchasing power

Appendix B

Search Engines and Websites Used in the Survey of Literature

Search Engines:

http://www.google.com/
http://print.google.com/
http://scholar.google.com
http://search.yahoo.com/
http://search.msn.com/
http://vivisimo.com/
http://www.alltheweb.com/
http://www.altavista.com/
http://www.ask.com/
http://www.metacrawler.com
http://www.hotbot.com/
http://www.copernic.com/
http://www.webcrawler.com/
http://searchenginewatch.com/facts/
http://www.lycos.com/

Directories:

http://directory.google.com/
http://www.barnesandnoble.com/
http://www.amazon.com
http://www.ers.usda.gov/
AgEcon Search http://agecon.lib.umn.edu /
Repec http://repec.org/

Resources from the LSU Libraries

Library http://www.lib.lsu.edu
Electronic Journals http://www.lib.lsu.edu/epubs/ejournals.html
Dissertations Abstracts http://wwwlib.umi.com/dissertations/search
Jstor http://www.jstor.org

Appendix C

List of Books about the Hispanic Market

Hispanic Marketing

Aguilar, C.M. Analysis of marketing procedures to Hispanic Americans in the U.S. ASIN: B0006P9R08

Ancona, G., Alma, F., Campoy, I. 2005. Mis Comidas: Somos Latinos, My Foods: We Are Latinos. 32 p.

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Campbell, R.C. 2003. Two Eagles in the Sun: A Guide to U.S. Hispanic Culture. 3rd. ed. Two Eagles Pr. 343 p.

Cartagena, C. 2005. Latino Boom! : Everything You Need to Know to Grow Your Business in the U.S. Hispanic Market. Ballantine Books. 256 p.

Chapa, J., Burillo, C., Crane, K.R., Flores, I., Millard, A.V. 2005. Apple Pie & Enchiladas: Latino Newcomers in the Rural Midwest. University of Texas Press. 276 p.

Clavin,T. 1995. Food and Cooking. Rourke Pub Group. 48 p.

Clavin,T. 1995. Comida Y Cocina: Vida Latina. Rourke Pub Group

Davies, C. 2002. The Companion to Hispanic Studies. Arnold Publishers. 224 p.
Falcon, R. 1998. Salsa: A Taste of Hispanic Culture. Praeger Publishers 192 p.

Del Valle, E. 2004. Hispanic Marketing & Public Relations: Understanding and Targeting America's Largest Minority. Poyeen Publications. 435 p.

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Food Marketing Institute. 2005. El Mercado 2005. http://www.fmi.org/forms/store/ProductFormPublic/search?action=1&Product_productNumber=2056

Food Marketing Institute. 2005. U.S. Grocery Shopper Trends 2005 - PDF Download http://www.fmi.org/forms/store/ProductFormPublic/search?action=1&Product_productNumber=2077

Ford, J. 2005. Latino Cuisine And Its Influence On American Foods: The Taste Of Celebration. Mason Crest Publishers. 112 p.

Gonzales , M. G. 1999. Mexicanos: A History of Mexicans in the United States Indiana University Press. 322 p.

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Maclean, J.T. 1984. Hispanic contributions to U.S. food & agriculture: Selected references. U.S. Dept. of Agriculture.

Marin, G., Marin, V. 1991. Research with Hispanic Populations. SAGE Publications. 144 p.

Conejo, C. A. Motivating Hispanic Employees: A Practical Guide to Understanding and Managing Hispanic Employees.2nd. Ed. Multicultural Press. 246 p.

Martínez, Z., Schulberg, B. 1995. Food from My Heart: Cuisines of Mexico Remembered and Reimagined. John Wiley & Sons. 368 p.

Maxwell, B., Jacobson, M. 1989. Marketing Disease to Hispanics: The Selling of Alcohol, Tobacco, and Junk Foods. Center for Science in the Public Interest 100 p.

National Mail Order Association. 2004. Hispanic/Latino Market Advertising Guide. MarketResearch.com. 69 p.

Ramirez Payides, M. 1986. The Hispanic market: Voices of the future. University of Texas at El Paso. ASIN: B00071UTE4.

Risso, R. 1991. "Perceptions of the Hispanic market by Hispanic advertising creative directors" Dissertation. Manship School of Mass Communication. Louisiana State University.

Ross, C. 2003. Market trends: Hispanic Americans and food. Packaged Facts. 70 p.

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Strategy Research Corporation. 2000. U.S. Hispanic Market

Valdes, M.I. 2002. Marketing to American Latinos: A Guide to the In-Culture Approach, Part II. Paramount Market Pub. 368 p.

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McDaniel, J. 2002. The Food of Mexico : Our Southern Neighbor Mexico. Mason Crest Publishers. 63 p.

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Multicultural Marketing

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Halter, M. 2000. Shopping for Identity : The Marketing of Ethnicity. Schocken. 256 p.

Ogden, J. 2002. The Psychology of Eating: From Healthy to Disordered Behavior. Blackwell Publishers. 304 p.

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General Ethnic Food Marketing

Berry, W. 2004. The meat you eat: how corporate farming has endangered America's food supply. St. Martin's Press. 240 p.

Civitello, L. 2003. Cuisine and Culture : A History of Food & People. Wiley. 384 p

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Hall, S. 2005. From Kitchen to Market : Selling Your Gourmet Food. 4th ed. Kaplan Publishing 288 p.

Lee, H.G. 2003. All About Food: Its History and Traditions. Hildesign Press. 288 p.

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Wansink, B. 2005. Marketing Nutrition: Soy, Functional Foods, Biotechnology, and Obesity. University of Illinois Press. 206 p.

Demographic Analysis

Office of National Statistics. 2005. Family Spending: A Report on the 2003-2004 Expenditure and Food Survey. Palgrave Macmillan. 216 p.

Cartagena, C. 2005. Latino Boom! : Everything You Need to Know to Grow Your Business in the U.S. Hispanic Market. Ballantine Books. 256 p.

Russell, C. 2002. Demographics of the U.S.: Trends and Projections, 2nd ed. New Strategist. 453 p.

Paramount Books:

- Generation X
- The Baby Boom
- Older Americans
- The American Marketplace Demographics and Spending Patterns, 7th edition
- AMERICAN GENERATIONS: Who They Are and How They Live, 5th ed.
- American Health
- Americans and Their Homes
- The Millennials
- Marketing to the Mindset of Boomers and Their Elders
- 2004 U.S. Hispanic Market Report
- American Generations Series
- The Complete Economic and Demographic Data Source (CEDDS) 2005 Edition

Appendix D

Commercial Reports about the Hispanic Food Market

Title	Source
The U.S. Market for Hispanic Food: Volume 1 in the series, The U.S. Market for Ethnic Foods. Hard Copy Format	http://www.just-food.com
The U.S. Market for Ethnic Foods, Volumes 1-3. June 1, 2003 , 468 Pages, Pub ID: LA798231	http://www.packagedfacts.com
The U.S. Hispanic Market, 6th Edition October 1, 2005 , 262 Pages Pub ID: LA1079261	http://www.packagedfacts.com
The U.S. Market for Hispanic Food: Volume 1 in the series March 1, 2003 , 218 Pages, Pub ID: LA797658	http://www.packagedfacts.com
The U.S. Market for Hispanic Foods and Beverages, 2nd Edition November 1, 2004 , 200 Pages, Pub ID: LA968910	http://www.packagedfacts.com
The U.S. Hispanic Economy in Transition: Facts, Figures, and Trends" 2005 Edition Eight additional reports are available.	https://secure.hbinc.com/product/
Ethnic Food Market Research Reports: 110	http://www.marketresearch.com/browse.asp?categoryid=489
Reports related to Hispanics: 503 clustered by subject	http://www.marketresearch.com/search/results.asp?sid=50798898-334348484-283828726&query=hispanics 159 in Agricultural Food
The U.S. Market for Hispanic Food: Volume 1 in the series There are 47 additional reports related to the Hispanic market.	http://www.the-infoshop.com/study/pf124800_hispanic_food_toc.html
The Hispanic Market in 2010. By Lynn Franco	http://www.conference-board.org/publications/describe.cfm?id=884
Insights Into Tomorrow's Ethnic Food & Drink Consumers	http://www.food-business-review.com/research.asp?guid=DMCM2363
2004 U.S. Hispanic Market Report, 11th. ed. Item #: 2368, Book and CD-ROM	http://www.paramountbooks.com/prodpage.cfm?cat_selected=search&searchstring=hispanic&startrow=1&product_selected=53
2004 Meat Update	http://store.vnuemedia.com/digitalmall/store/product_view.jsp?product_id=17046&category_name=Retail:%20Food

Appendix E

Multicultural Marketing Research Companies

Company	Website
Ethnic Marketing Associates	http://www.ethnicmarketingassociates.com
Euro RSCG Latino	http://www.eurorscglatino.com
The San Jose Group	http://www.thesanjosegroup.com
Rios Group	http://www.riosgroup.com/
Ahorre	http://www.ahorre.com
Garcia Research	http://www.garciaresearch.com
AmbiCultural	http://www.ambicultural.com
Hispanic Business Research	http://www.hispanicbusiness.com/research/
Hispanic Research	http://www.hispanic-research.com/home
Infinata	http://www.infinata.com
La Verdad Marketing	http://www.laverdadmarketing.com
Isabel Valdes Consulting	http://www.isabelvaldes.com
One Real World	http://www.onerealworld.com
Hispanic Mkt. and Adv. Group	http://www.hispmag.com
Multicultural	http://www.multicultural.com
The W Group	http://www.thewgrouppr.com
Rincon & Associates	http://www.rinconassoc.com
MRSI Hispanic Research	http://enfoque.mrsi.com
Zyman M2H	http://www.zyman.com/solutions/marketingHispanics.asp
Korzenny	http://www.korzenny.com

Appendix F

Retailers and Wholesalers of Ethnic Foods

Company	Website
Goya Foods	http://www.goya.com/english
El Mercado Grande	http://www.elmercadogrande.com
MexGrocer.Com	http://www. mexgrocer.com
La Tienda	http://www.tienda.com
EthnicGrocer.com	http://www.ethnicgrocer.com
Spanish Delicacies	http://www.spanishdeli.us
Economical Trop. Foods Ltd.	http://www.economictropicalfoods.com
Novamex	http://www.jarritos.com/distribution.sstg
AsianFoodGrocer.Com	http://www.asianfoodgrocer.com
AsiaMex.Com	http://www.asiamex.com
Monster Marketplace	http://www.monstermarketplace.com/Food/Category280-1.html
Tropical Traditions	http://www.tropicaltraditions.com/virgin_coconut_oil.htm

Appendix G
Results for Censored LinQuad Demand Systems that Use the FIML Estimator

Income and Household Size Elasticities by Ethnic Groups.

Ethnic Group	Type	Ground Beef	Roast Beef	Beef Steak	Other Beef	Bacon	Pork Chops	Ham	Other Pork	Poultry	Seafood
Hispanics	IE	-0.04894*	-0.49457	-0.19673	1.376846	0.380846	-0.04159	0.148128	-0.0643	0.089167	-0.00692
		0.1873**	0.8908	0.3813	1.3267	0.2795	0.2561	0.2398	0.1934	0.0796	0.3711
	HSE	0.462891	1.245909	-0.07013	86.45438	-0.37325	0.116248	0.600508	2.073285	0.423588	0.231081
		0.9717	1.6608	0.4709	71.2976	0.3496	0.922	1.0456	1.3912	0.5841	0.2082
Whites	IE	0.065383	-0.02454	0.171384	0.018033	-0.00687	-0.02605	0.172532	-0.0207	0.101898	-0.05906
		0.0556	0.0907	0.1355	0.0767	0.048	0.061	0.0781	0.184	0.0371	0.0567
	HSE	-0.25583	0.447118	0.209876	1517.539	0.357848	0.034677	0.215075	-0.66566	0.152215	-0.09072
		0.5271	0.6887	0.4948	638	0.2967	0.2994	0.2966	1.2238	0.4132	0.1916
Af. Americans	IE	0.056864	0.264796	0.402411	0.000442	-0.04294	-0.09876	-0.18613	-0.04989	0.115064	0.169465
		0.1308	0.41	0.4733	0.073	0.1391	0.1089	0.3409	0.1655	0.1372	0.2149
	HSE	0.044181	0.568691	-0.00319	-1459.88	0.558683	-0.42126	0.029745	0.046694	0.1594	0.077301
		0.4203	1.8623	1.1461	1649.1	0.6722	1.72	0.4456	0.2909	0.3095	0.2088
Other Minorities	IE	-0.25828	-0.00419	0.772259	-0.04235	-0.27415	0.130608	0.696444	0.21647	0.03953	0.075499
		0.4207	0.4498	0.943	0.101	0.537	0.4428	0.9593	0.3477	0.196	0.2824
	HSE	0.412433	-6.67567	0.97701	1172.808	1.059956	1.995609	0.144781	-2.33918	0.307672	-0.92409
		0.7004	10.6772	0.4835	1278.2	2.093	2.2766	0.7389	3.7601	0.2943	3.2414
All Households	IE	0.075571	0.005865	0.040798	0.041635	0.066924	0.098057	0.095424	0.00905	0.084413	-0.09097
		0.0595	0.1035	0.1574	0.1247	0.0426	0.0624	0.0516	0.0973	0.0334	0.0651
	HSE	-0.31394	0.663575	0.0492	1037.019	0.089031	-0.15252	-0.33975	-0.60537	0.210309	-0.07279
		0.3234	0.6216	0.4434	484.2	0.2396	0.2428	0.5583	0.7214	0.1892	0.1492

Source: Results from Censored LinQuad Demand System augmented with household size.
* Estimate ** Standard error

Own and Cross-Price Elasticities for Hispanic Households.

	Ground Beef	Roast Beef	Beef Steak	Other Beef	Bacon	Pork Chops	Ham	Other Pork	Poultry	Seafood
Ground Beef	1.166448*	-0.42274	0.260952	-0.08038	-1.1999	0.02976	1.78425	-0.93989	-0.58863	0.133103
	4.0814**	1.7933	2.9055	2.5847	0.991	1.0328	1.2174	1.0203	1.112	1.4057
Roast Beef	-0.24883	17.45395	1.99936	2.906208	-0.57386	0.200199	2.832424	-0.77689	0.234478	3.567922
	1.0784	23.6391	3.9118	5.3193	1.119	1.7223	1.4056	1.9513	1.2887	2.2031
Beef Steak	0.130044	1.597174	-10.4562	5.593867	2.735163	0.557634	-4.38947	-0.61755	0.137778	-2.63075
	1.4863	3.2873	6.2227	3.9944	1.2637	1.4787	1.4451	1.4961	1.1898	1.9846
Other Beef	-0.08943	2.916866	6.847891	-15.2582	-2.42647	-1.5523	2.808618	0.882638	-0.07163	-3.54622
	1.7372	6.2094	5.5084	14.4883	1.78	2.2835	1.7217	2.3012	1.7176	3.1858
Bacon	-1.87462	-1.34387	8.344491	-6.25297	1.128462	-1.43289	2.197687	-0.22386	0.589437	-0.78045
	1.5509	2.8955	3.866	4.1443	4.9845	1.5991	1.628	1.3273	1.2359	2.0744
Pork Chops	0.024376	0.25411	0.945382	-1.9118	-0.79409	-2.64288	-0.19857	-1.55596	-0.47447	2.621277
	0.9019	2.5284	2.5213	2.9267	0.8981	13.2096	1.0062	1.1345	0.9285	1.5174
Ham	2.211567	5.879141	-10.6265	4.951632	1.736619	0.730284	-0.28513	4.55873	-0.63937	-3.23972
	1.5093	2.8693	3.4974	3.1046	1.2875	4.699	1.4239	0.8502	1.1453	2.2043
Other Pork	-0.77643	-0.99515	-0.9525	0.941004	-0.14889	-1.47279	12.06094	3.046727	-0.58313	2.365412
	0.8507	2.6617	2.4502	2.8467	0.7053	1.085	7.0691	0.5799	0.7816	1.5267
Poultry	-0.43204	0.311349	0.188624	-0.19346	0.279121	-0.40176	-0.37756	-0.99421	-0.50268	-1.56175
	0.8167	1.5655	1.7079	1.876	0.5802	0.7785	0.6802	2.4699	0.6891	1.115
Seafood	0.078363	3.524903	-3.0975	-3.10582	-0.29193	1.799208	-1.5672	1.704201	-1.27258	-9.27104
	0.8429	2.2018	2.3295	2.7514	0.7947	1.0436	1.069	1.0991	0.9085	8.7986

Source: Results from Censored LinQuad Demand System augmented with household size.

* Estimate

** Standard error

Own and Cross-Price Elasticities for White Households.

	Ground Beef	Roast Beef	Beef Steak	Other Beef	Bacon	Pork Chops	Ham	Other Pork	Poultry	Seafood
Ground Beef	-2.75224*	0.183528	0.577903	-0.52799	-0.21235	0.30576	0.275732	0.087583	-0.14969	0.268342
	1.6892**	0.8097	1.087	1.5113	0.4546	0.5155	0.5881	0.4508	0.4819	0.6303
Roast Beef	0.124496	2.430435	-1.10893	0.128845	0.627819	0.135819	0.898604	1.521494	1.167242	-0.20264
	0.5516	5.9114	2.0623	1.9894	0.5403	0.8037	1.0759	0.9969	0.5506	0.9239
Beef Steak	0.300968	-0.85246	-0.24571	0.354592	0.271874	-0.04858	1.558977	-1.1453	0.412304	0.532557
	0.5721	1.5908	3.2865	3.3311	0.4539	0.6103	0.7262	1.1465	0.4421	0.6632
Other Beef	0.422312	-0.2978	4.229206	-8.57932	-0.70893	-0.50229	1.3314	-1.00883	0.342813	-1.47074
	1.1124	2.4718	3.3276	15.7888	0.7795	1.0767	1.0494	2.0508	0.7719	1.1588
Bacon	-0.33757	1.462923	0.817597	-1.62641	0.755574	-0.72502	1.437238	0.79997	-0.0714	1.056909
	0.7218	1.2591	1.3709	1.5609	2.4024	0.669	0.6934	0.4983	0.567	0.7917
Pork Chops	0.309294	0.199367	-0.08734	-0.31351	-0.45975	-0.15895	-1.36939	-0.13672	-1.18267	-1.02213
	0.5188	1.1868	1.1682	1.2874	0.424	2.3847	0.7143	0.6047	0.452	0.675
Ham	0.267581	1.320217	2.932083	-1.06605	0.903206	5.384185	-1.35732	1.97371	0.539457	0.355295
	0.5854	1.5717	1.373	1.4436	0.4347	8.9758	0.7078	0.5205	0.5443	0.7683
Other Pork	0.069248	1.688432	-1.63485	-0.8115	0.381163	-0.10352	-3.07491	1.504964	0.408536	-0.29472
	0.3387	1.1062	1.6442	2.2709	0.2374	0.4555	7.5754	0.3953	0.2493	0.4304
Poultry	-0.12187	1.380762	0.633055	-1.41799	-0.0357	-0.94784	0.443302	-0.25576	0.428871	0.89691
	0.3879	0.6502	0.6763	0.7402	0.2877	0.3616	0.4401	1.7095	0.2649	0.4505
Seafood	0.213911	-0.23567	0.805957	-0.71886	0.520637	-0.79521	0.282777	-0.30286	0.87823	-5.29601
	0.4933	1.0612	0.9854	1.0986	0.3903	0.5248	0.6033	0.4438	0.4382	2.7132

Source: Results from Censored LinQuad Demand System augmented with household size.

* Estimate

** Standard error

Own and Cross-Price Elasticities for African American Households.

	Ground Beef	Roast Beef	Beef Steak	Other Beef	Bacon	Pork Chops	Ham	Other Pork	Poultry	Seafood
Ground Beef	0.623664*	-0.83694	-0.99805	-0.81929	-0.39936	0.653602	0.26729	-0.38181	0.44785	-0.57988
	3.107**	2.4668	2.6369	3.357	1.6918	1.5824	1.3711	1.0351	1.3762	2.1193
Roast Beef	-0.50862	20.22341	-2.3247	-0.5524	-1.34602	1.14365	2.264351	0.415857	1.38196	0.631335
	1.4635	31.8156	4.5874	8.0471	1.6399	2.0789	2.3647	1.9315	1.5124	2.6214
Beef Steak	-0.52626	-1.92768	-5.96047	7.787128	-0.10119	1.741864	-1.66978	0.275368	-1.33639	-3.38035
	1.3771	3.9353	8.305	7.4556	1.3257	1.5698	2.0053	1.3295	1.2795	2.5699
Other Beef	-1.51622	-7.28718	1.405021	6.981585	3.434442	-5.47109	0.461966	0.062877	-1.98801	1.006612
	3.1447	6.972	7.6733	15.7551	2.6483	3.2455	3.4033	2.9437	2.9743	5.0962
Bacon	-0.60846	-3.49028	-0.32032	5.449308	4.924447	-3.47818	1.686746	0.432295	-0.59984	5.072145
	2.5714	4.1971	3.8688	4.7182	8.0437	2.4633	2.2488	1.6834	2.227	3.0106
Pork Chops	0.596596	1.7446	3.061422	-7.57676	-2.07805	-6.77896	2.187226	0.599623	1.568636	0.796201
	1.4343	3.1685	2.738	3.0702	1.468	11.7341	1.6658	1.4659	1.176	2.2712
Ham	0.242732	3.383342	-2.86395	-2.70852	0.991378	-4.68872	2.173386	-0.40055	-0.19067	-2.72795
	1.2305	3.5202	3.4477	4.8179	1.3291	4.6844	1.6489	1.6133	1.2526	2.3727
Other Pork	-0.29853	0.54914	0.433932	-0.79908	0.222063	0.52048	-1.30887	-0.35595	0.083192	-0.19421
	0.815	2.5498	2.0087	3.4892	0.8709	1.2715	4.1161	1.4119	0.868	1.6335
Poultry	0.336464	1.802608	-1.91456	0.204905	-0.29489	1.294382	-0.16418	-1.22669	0.075	-1.25435
	1.0359	1.9118	1.8474	2.432	1.1031	0.979	1.0516	1.8243	0.8285	1.6628
Seafood	-0.37522	0.749368	-4.16288	3.682637	2.155034	0.555717	-1.96559	-0.16543	-1.0758	-3.62072
	1.3671	2.8274	3.1757	3.8603	1.2769	1.6187	1.7048	1.3382	1.4249	4.2299

Source: Results from Censored LinQuad Demand System augmented with household size.

* Estimate

** Standard error

Own and Cross-Price Elasticities for Households of other minorities.

	Ground Beef	Roast Beef	Beef Steak	Other Beef	Bacon	Pork Chops	Ham	Other Pork	Poultry	Seafood
Ground Beef	-0.05468*	-1.21645	-2.76263	3.025634	5.988435	-3.55803	-1.34877	2.816763	2.225749	-0.17177
	5.139**	4.142	6.2913	6.9365	2.5325	2.6407	3.4074	2.1916	2.0593	4.0732
Roast Beef	-0.81426	-33.9054	-7.22977	10.61355	2.468872	0.85024	0.230636	1.52544	2.114742	6.278882
	2.566	42.5348	8.0591	7.9849	2.8136	2.9956	4.1845	2.9452	2.3816	4.8647
Beef Steak	-1.64102	-7.27883	13.48366	-1.20308	-1.80041	5.930185	-0.64023	-2.63852	-1.27077	-3.14727
	3.7631	7.6697	13.3377	9.5022	3.2652	3.7855	5.6025	3.7412	2.7358	5.0953
Other Beef	0.216613	14.12922	9.756231	-30.8688	-6.36508	-3.86793	6.636254	4.333359	1.957333	-2.20085
	6.2877	11.1207	13.1763	18.6458	6.918	7.2332	7.7969	7.0158	4.5357	9.3199
Bacon	9.619892	6.50361	-4.90293	-9.41813	6.759825	3.598463	-4.36361	-1.64676	-0.69273	-5.41881
	4.0671	7.3193	8.779	11.7006	13.3692	4.2463	5.1853	3.81	2.8045	5.4289
Pork Chops	-2.80042	0.994493	8.008931	-4.9809	1.654081	-50.5982	0.777723	0.05041	0.762323	1.097491
	2.0263	3.7027	4.7936	6.4728	1.9898	67.8485	3.7772	3.1209	1.867	3.5987
Ham	-1.57149	0.172474	-1.28237	1.991682	-3.17091	9.484364	0.877348	1.333803	-5.10853	-4.98236
	4.0059	8.0515	10.997	11.2397	3.7979	14.6732	5.9575	4.7872	3.6236	7.4907
Other Pork	2.032112	1.704872	-3.12574	1.484797	-0.7471	-0.04135	-3.85097	0.86087	0.581024	1.045407
	1.5879	3.4083	4.5664	5.1375	1.7231	2.9196	8.9985	2.9461	1.2977	3.0075
Poultry	1.546563	2.359557	-1.46977	1.222802	-0.29973	0.678191	-3.01572	-1.86527	0.555195	0.720431
	1.4321	2.6626	3.1786	3.6605	1.2152	1.7165	2.1427	2.2484	1.2397	2.8771
Seafood	-0.09868	5.095006	-2.59386	-2.15523	-1.71225	0.701512	-2.10947	0.736842	0.52582	-8.30649
	2.0578	3.9636	4.2995	5.2184	1.7107	2.4352	3.2125	2.087	2.0899	12.2441

Source: Results from Censored LinQuad Demand System augmented with household size.

* Estimate

** Standard error

Own and Cross-Price Elasticities for All Households.

	Ground Beef	Roast Beef	Beef Steak	Other Beef	Bacon	Pork Chops	Ham	Other Pork	Poultry	Seafood
Ground Beef	-3.44619*	0.289892	0.690586	-0.68173	-0.27741	0.074764	0.566096	0.183011	0.095845	0.510711
	1.2761**	0.6817	0.9108	1.1607	0.3841	0.4166	0.4698	0.3209	0.3892	0.5265
Roast Beef	0.186626	5.215612	-1.17451	1.173833	0.201783	0.55465	1.263931	1.157212	0.842252	0.291967
	0.4473	6.2649	1.7029	1.8072	0.4429	0.6276	0.8194	0.8364	0.4368	0.7786
Beef Steak	0.364373	-0.94196	-2.79443	2.02034	0.603562	0.221106	0.274638	-0.82504	0.309344	-0.17606
	0.4802	1.3687	3.1803	2.0646	0.4033	0.4918	0.5947	0.6797	0.3836	0.649
Other Beef	0.174367	1.284911	3.231248	-6.24361	-0.33623	0.032658	0.336857	-0.81702	0.196186	-1.37109
	0.9012	2.3774	2.8453	14.4225	0.6634	0.9439	0.8494	1.2298	0.668	1.0929
Bacon	-0.43912	0.490508	1.80578	-1.62132	-0.746	-0.95147	1.232206	0.756798	-0.27539	0.999281
	0.6066	1.0666	1.2081	1.3798	2.9598	0.5842	0.595	0.4265	0.4753	0.717
Pork Chops	0.071128	0.813272	0.399063	-1.17416	-0.5736	-2.05355	-0.84784	-0.46849	-0.66786	0.055502
	0.3971	0.9116	0.8883	1.0667	0.3531	2.0804	0.5253	0.5026	0.3511	0.5459
Ham	0.585364	1.998231	0.538115	-0.67077	0.807304	-5.92649	-0.91772	1.715274	0.13465	-0.54135
	0.4848	1.2916	1.1653	1.2377	0.389	6.3568	0.5688	0.4192	0.4491	0.7321
Other Pork	0.143817	1.363653	-1.20523	-1.04624	0.371507	-0.37593	-2.4763	1.284933	0.182693	-0.47184
	0.2472	0.9842	0.9938	1.2641	0.2084	0.4065	4.0269	0.313	0.2159	0.4169
Poultry	0.073624	1.008425	0.456214	-0.82426	-0.13601	-0.54824	0.099643	-0.91003	0.180853	0.406264
	0.3037	0.5197	0.5675	0.6489	0.2352	0.2875	0.3392	0.7141	0.2181	0.379
Seafood	0.367644	0.30993	-0.2301	-0.30417	0.450774	0.049019	-0.36342	-0.42814	0.375297	-7.38363
	0.3726	0.8418	0.8701	0.9529	0.3219	0.4057	0.5019	0.3824	0.3439	2.3076

Source: Results from Censored LinQuad Demand System augmented with household size.

* Estimate

** Standard error

Vita

Carlos Ignacio García was born in Guatemala. His first lessons in agriculture were taught by uncles and his grandfather Saturnino García Castillo, a hard working and self-reliant man. His interest in public policy and economics was initiated by his father Carlos García y García, with whom he has long and everlasting dialogs about the subjects. Carlos Ignacio received a technical degree in animal husbandry in 1992; his college education started in 1995 in animal husbandry at the Universidad de San Carlos de Guatemala from which he received a scholarship. At the same time, Carlos Ignacio was a distributor of dairy products and volunteered time inspecting livestock and meat products for public consumption.

As soon as the civil war ended in Guatemala, Carlos Ignacio moved to Honduras in 1997. He received a scholarship from Asociación Guatemalteca para la Educación Agrícola (AGROBECA) and was able to study at Pan American School of Agriculture El Zamorano; Carlos Ignacio received an Associate Degree in Agriculture in 1999. Later, he worked on a project as an extension agent that helped farmers affected by Hurricane Mitch. He taught apiculture and agribusiness management; in November 2001, Carlos Ignacio published a most needed manual titled *Advice and Guide for the Estimation of Costs and Returns of Apicultural Projects in Honduras*. Financial support for his endeavor was awarded by USAID/Honduras-Centro de Políticas Agrícolas. In May 2002, he received the degree of Agricultural Engineering majoring in agricultural economics from El Zamorano. His thesis focused on the evaluation of profitability of two beekeeping systems.

One month later after his graduation, Carlos Ignacio came to Louisiana State University to pursue a master's degree in agricultural economics. Before starting his studies, he spent a year preparing for the TOEFL and GRE while doing an internship in the Departments of Horticulture

and Entomology; after he past the mentioned tests, a tuition waiver was awarded by the LSU Graduate School and a Graduate Research Assistantship by the LSU Agricultural Center which helped him to complete the master's degree in the Department of Agricultural Economics and Agribusiness.

During his first Christmas vacations as a graduate student at LSU, Carlos Ignacio published a popular manual titled *Research Opportunities and Financial Aid for Graduate Studies in the United States of America in the New Millennium,* which is updated voluntarily every summer and posted on the internet. It is read mainly by professionals from Latin American countries, interested in pursuing higher education. In early Spring 2004, Carlos Ignacio co-founded and became Vice-president of Zamorano Agricultural Society at LSU, a student organization that fosters leadership and seeks students with potential of doing high quality agricultural research at Louisiana State University.

In the fall of 2004, Carlos Ignacio received the Gamma Sigma Delta award for academic performance. In November 5th, 2005, he received the Outstanding Master of Science Student Award. Currently, Carlos Ignacio is member of the Food Distribution Research Society and the American Marketing Association.