AN ANALYSIS OF THE MEAT DEMAND OF THE U.S. HISPANIC POPULATION

by

JOSE FRANCISCO DIAZ VALENZUELA

(Under the Direction of Jack E. Houston)

ABSTRACT

This thesis analyses the consumption behavior of the U.S. Hispanic population for high-valued foods in the meat categories with regard to select socioeconomic and demographic characteristics. The analysis was performed using data from the 2005 Consumer Expenditure Survey (CES). The issues with selectivity-bias problems due to households reporting zero consumption for a particular item are overcome using a two-step Heckman procedure. It was found that family size is more important than income in determining the likelihood of purchase and in the decision to increase expenditures on meats. Furthermore, being from different regions of origin affected the probability of purchase, as well as the expenditure decision. Other demographic characteristics were also found to affect the likelihood of purchasing meats and the decision of how much to spend, such as region, marital status, age and gender of the reference person in the household.

INDEX WORDS: U.S. Hispanic population, Demographic characteristics, Single expenditure equation, Meat consumption, Two-step Heckman.

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DEDICATION

This thesis is dedicated to my parents, Dr. Roman Diaz Garduño and Ms. Maria de Jesus Valenzuela Diaz, who have supported me all the way since birth, taught me the value of education, and whose tireless devotion and constant concern for every aspect of my life have make my life better.

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CHAPTER 1

INTRODUCTION

This thesis is devoted to the study of the consumption behavior of the U.S. Hispanic population for high-value foods in the meat categories with regard to selected socioeconomic and demographic characteristics. The statistics on the growth of the Hispanic population and the growth of their buying power motivated this study. Moreover, meats are one of the primary expenditures among Hispanics, and, in fact, Hispanics spent, on average, 16.4% more on meats than non-Hispanic consumer units in 2005 (U.S. Department of Labor, 2007b).

Consumption behavior here is analyzed using the 2005 Consumer Expenditure Survey (CES) and complements previous studies on food consumption behavior. The fact that cultural differences prevail among Hispanic communities and that these differences affect the meat consumption patterns are hypothesized. The Hispanic population groups that are studied are Mexican, Mexican-American, Puerto Rican, Central and South American, and other Hispanics. Description of the 2005 CES and the descriptive analysis of the U.S. Hispanic household's demographic and socioeconomic characteristics are presented.

This thesis also includes an introduction to the theoretical basis of the demand theory; The single expenditure demand equation is employed; the issues with selectivity-bias problems due to households reporting zero consumption for a particular item are overcome using a two-step Heckman procedure; probit and Ordinary Least Squares (OLS) estimation techniques are detailed. The double-logarithmic model is used to estimate expenditure elasticities; the direct linear model and the semilogarithmic model are also estimated to test the sensitivity of the results. The results of the econometric model are explained in detail in the last part of this thesis.

Motivation for Consumer Food Demand Analysis by Ethnic Origin: the Case of the U.S. Hispanic Community

The Hispanic population in the United States has grown significantly in the last 20 years. In the 1980s, the documented legal population accounted for more than six percent of the U.S. population; this percentage nearly doubled by the year 2000 (Paulin, 2003). According to the U.S. Census Bureau, in 2000 a total of 281.4 million residents were accounted for in the U.S. (excluding Puerto Rico and the U.S. Island Areas) of which 35.3 million (or 12.5 percent) were Hispanics. Citizens of Mexican origin represented 7.3 percent of the total U.S. population, Puerto Ricans 1.2 percent, Cubans 0.4 percent, and other Hispanics 3.6 percent of the population. The Hispanic population kept growing, and it actually reached around 40.4 million people in 2004; representing an increase of 14.5 percent from the period 2000 to 2004. More broadly speaking, the official report of the legal population for 2004 was 26.6 million Hispanics of Mexican origin, 3.84 million Puerto Ricans, 1.61 million Cubans, 3.16 million Central Americans, 2.11 million South Americans, and 3.07 other Hispanics (U.S. Census Bureau, 2004).

Two years later, in 2006, the Hispanic population retained its status as the largest minority group. In July 2006, it reached 44.3 million, which makes up 14.8 percent of the total U.S. population. Blacks are the second largest minority group with over 40.2 million people in the same year. The third largest minority is the Asian population with 14.9 million people (U.S. Census Bureau, 2007).

The Hispanic population can be separated into authorized/documented and unauthorized/undocumented categories. The Pew Hispanic Center, a nonpartisan research organization in Washington, previously estimated that from 11.5 million to 12 million

"unauthorized migrants" lived in the U.S. in 2006 (Selig Center for Economic Growth, 2003). It bases its estimate on the Current Population Survey (CPS)[1] published in 2005.

Before going into further detail, it is important to define the potentially ambiguous term Hispanic/Latino. The U.S. Census Bureau defines Hispanic as people who indicate that they were born in a Hispanic country or area, or have a heritage tracing back to a Hispanic country or area. These countries or areas include: Mexico, Puerto Rico, Cuba, Central or South America. This definition is also used for the 2005 CES.

The growth of the Hispanic population results from several different factors. For instance, the job opportunities offered by the U.S. have motivated the migration of people from all around the world. On the other hand, the economic problems and the political instability that people have experienced in other countries (especially the less developed countries), along with the lack of job opportunities and the poverty conditions in those countries, have increased immigration to the U.S. As has been shown, this recent wave of immigration is mainly represented by Hispanic groups.

In terms of economic perspective, Hispanic communities have earned their economic place within the U.S. society. A clear representation of this is the statistics of their buying power. According to the University of Georgia's Selig Center for Economic Growth, Hispanic buying power in 2000 was $5 billion dollars, and in 2007 it reaches around $9.27 billion dollars. This amount represents the largest buying power of all the minority groups. The buying power of blacks is over $8.12 billion, for American Indians $5.9 million, and for Asians $4.83 billion in the same year (Selig Center for Economic Growth, 2003). Figure 1.1 shows these trends.

[1] The Current Population Survey is a monthly survey of about 50,000 households conducted by the Bureau of the Census for the Bureau of Labor Statistics.

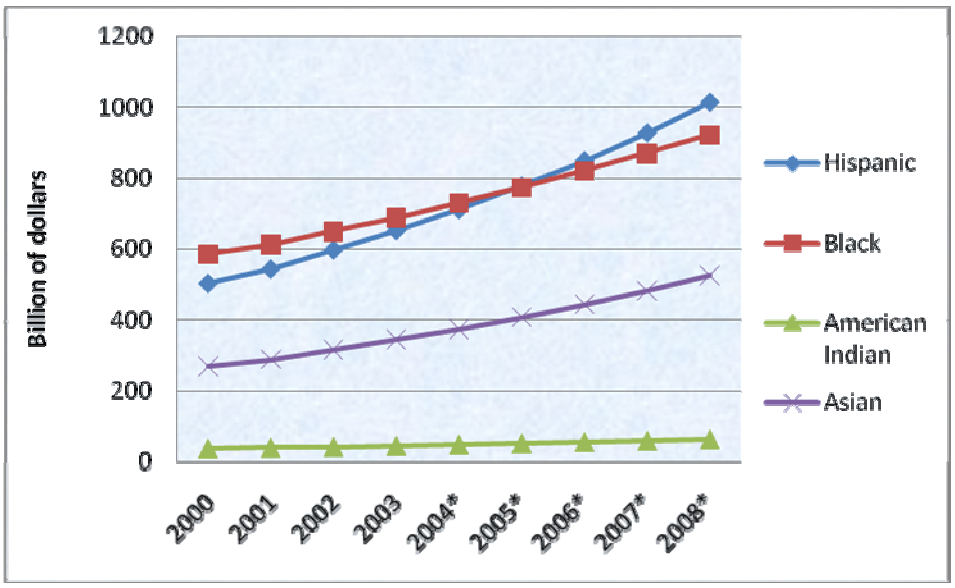

Figure 1.1. Buying power of minority groups, 2000-2007

Given this trend in the growth of Hispanic buying power, consumer spending among Hispanics has become an increasingly important segment of the economy (Paulin, 1998). In fact, the average annual expenditure for Hispanics is only 13.5 % below the average annual expenditure for all consumer groups. This percentage is based on the U.S. Bureau of Labor Statistics, which reported that the average annual expenditure for Hispanic households in 2005 was $40,123, whereas the average annual expenditure for all consumer groups is $46,409; this particular statistic represents a motivation in investigating the Hispanic households' consumer expenditure patterns. In more detail, the three main expenditure categories for Hispanics in 2005 were: housing ($14,338), transportation ($7,900), and food ($5,551). These three categories represent 69.3% of the average annual expenditures for Hispanics (U.S. Department of Labor, 2007b).

This research focuses on the third largest expenditure among Hispanics – food; the CES divides the food expenditures into three types:

(a) Food at home (FAH);

(b) Food away from home (FAFH); and

(c) Total food (TF).

The average annual expenditures on FAH are 91.6% higher than FAFH; in fact, the FAH average annual expenditures for Hispanics in 2005 were around $3,883, while the FAFH expenditures were $2,027, totaling a TF average annual expenditure of $5,910 (U.S. Department of Labor, 2007b). For the purpose of this study, the type of food expenditures to be considered is the FAH, focusing on meats.

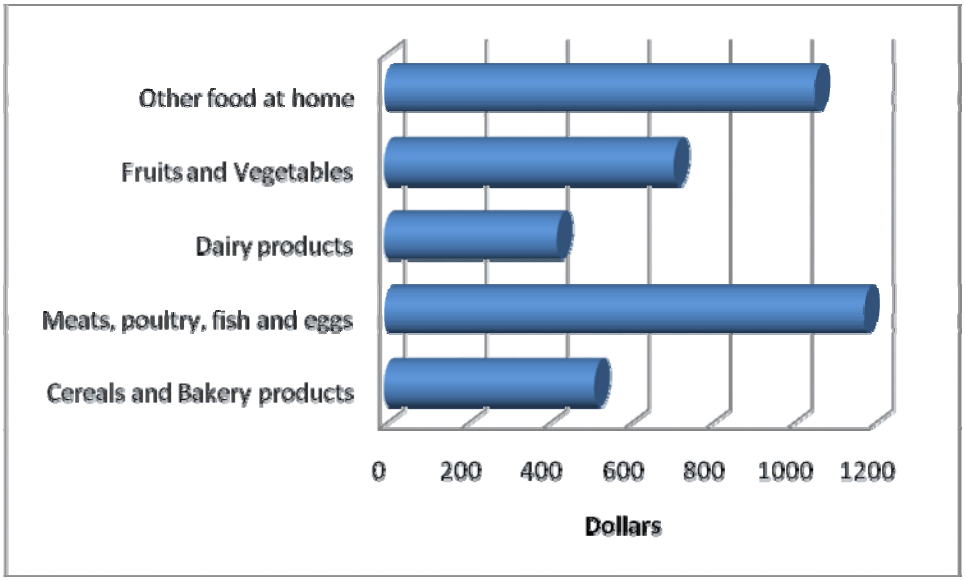

Figure 1.2. Average annual expenditures in food at home for Hispanics, 2005

As shown in figure 1.2, the primary FAH expenditures are meats, poultry, fish and eggs. This statistic shows the importance of meats in the diet of U.S. Hispanic households, just like the Irish consume potatoes or the Italians consume pasta; additionally, Hispanics spent on average 16.4% more on meat than non Hispanic consumer units in 2005. Those facts have motivated this

study to analyze the following FAH categories: beef, pork, poultry, fish and seafood, lamb and goat, and other meats.

Research Questions

Factors such as income, age of family members, geographic location, taste and personal preference influence expenditures. Even within groups with similar characteristics, the distribution of expenditures varies substantially (U.S. Department of Labor Bureau of Labor Statistics, 2007a). Using cross-sectional data, the present research examines the expenditure patterns of the U.S. Hispanic population, focusing on the demand of different types of meat, as well as consumption differences caused by Hispanic region of origin.

This study uses data from the 2005 CES and complements previous studies on food consumption behavior. More specifically, this study analyzes how the Hispanic groups allocate their expenditures on meat relative to income, socioeconomic and demographic characteristics. I hypothesize that cultural differences prevail among Hispanic communities and that these differences affect the meat consumption patterns for the focus group.

Variables such as income, household size, measures of poverty, marital status, educational attainment, age and gender of the household respondent are included in the analysis. In relation to the differences in Hispanic consumer patterns, this study accounts for that variation using region of Hispanic origin, such as Mexican, Mexican-American, Puerto Rican, Central and South American, and other Hispanics. The findings of this study represent an opportunity for producers, growers, and for the industry in general to understand what this segment of consumers want. Furthermore, the food industry must understand the Hispanic preferences for meats in order to harness the potential market opportunities that this segment of the population creates in the U.S. marketplace (García, 2006).

Objectives

The current research has four main objectives. The first objective is to provide the research framework that lays beneath the study of the consumer expenditure patterns within the Hispanic population. To accomplish this objective, a literature review chapter is provided containing studies of the aggregate expenditures and demand for meats among U.S. Hispanic groups.

The second objective is to provide information about U.S Hispanic households in terms of demographic and socioeconomic characteristics as well as their meat expenditures. To achieve this objective, a sample of Hispanic households was drawn from the 2005 CES.

A third objective is to analyze the consumption of meat among Hispanic groups through the analysis of their meat expenditures. Two main components underlie this objective. The first piece aims to supply the reader with the theoretical basis of the demand theory, the utility function maximization process, the expenditure functions and the econometric techniques of the two-step estimation procedure. The second component is to provide the reader with information of the construction and definition of the variables and the description of the empirical model to be estimated. The overall intention of this objective is to explain how the U.S. Hispanic groups allocate their food budgets given socioeconomic and demographic characteristics. Furthermore, including the region of origin helps us comprehend whether significant differences exist in consumption patterns of Hispanic groups by origin.

The fourth objective is the evaluation of Hispanic household responsiveness to each meat category with respect to changes in income and socioeconomic and demographic variables. This requires the analysis of the resulting estimations of the empirical model and providing industry and societal implications of that analysis.

Theory and Empirical Methods

The neoclassical consumer demand theory provides a basic theoretical framework for analyzing household budget allocation patterns using expenditure functions for goods and services. Given a budget constraint and a utility function representing consumer preferences, bundles of commodities that maximize consumer utility, which are subject to the budget constraint, are expressed as a function of relative prices of goods, household income, and household preferences (Deaton & Muellbauer, 1980).

This thesis offers an explanation of the theoretical basis of the demand theory, the utility function maximization process, and expenditure elasticities. The application of the theory to this research is presented throughout the analysis. The econometric and the estimation techniques are detailed for the single equation expenditure demand for meat; since the selectivity-bias problem due to households reporting zero consumption for a particular item is expected, a two-step estimation procedure is used; the theory behind this procedure is presented and complemented with information about the OLS technique and its assumptions. Different functional forms are used to estimate income elasticities: the direct linear model, the double-logarithmic model, and the semi-logarithmic model.

Organization of the Thesis

This study is organized as follows. Following this introductory chapter, the second chapter is devoted to a critical analysis of the literature. The prior research section is divided into two main groups: the first group includes studies that have analyzed aggregate expenditures among Hispanics, and the second group contains studies that specialize in the demand for meats. Both types of studies compare Hispanic with whites and Hispanics with other ethnic groups, such as blacks and other minorities and those which make comparisons within Hispanic groups –

using region/country of origin. After the discussion of the prior research, contributions are presented.

The third chapter includes the demographic profile of the Hispanic households and the meat expenditures characterization contained in the 2005 diary files. A comparison within Hispanic groups is presented. Chapter four focuses on the explanation of the theory, research methods, and description of the empirical model utilized in this thesis. The fifth chapter contains discussion of the estimation results. The sixth chapter contains the conclusions and implications of the research and suggestions for further research.

CHAPTER 2

REVIEW OF CONSUMER DEMAND STUDIES

The objective of this chapter is to show the reader how other authors have approached the phenomena on consumer expenditure patterns within the Hispanic population. As a matter of fact, understanding what people want and how demographic and socioeconomic characteristics affect consumer purchasing decisions is an important matter. The particular case of immigration in the U.S. has caught the attention of researchers in order to understand the patterns of consumption within those groups. Because of the tremendous growth of the Hispanic population in U.S. and their relative buying power, the understanding of their expenditure patterns within this group is a relevant issue.

Consumption Behaviors among Ethnic Groups

Despite the fact that ethnic groups in the U.S. share beliefs, culture, traditions and consumption habits, differences in their consumption behaviors have been shown in prior research. These differences among ethnic consumer groups are attributed to discrepancies in cultural, demographic and socioeconomic characteristics, tastes and preferences among other factors. The more frequent groups analyzed in the literature include whites, and minority groups such as Hispanics, blacks, and Asians.

In matters of consumption behavior, it is common to find studies that classify the U.S. Hispanics as a homogeneous group. This categorization is understandable, because it is well known that they share beliefs and behave in similar ways. However, this thesis hypothesizes that diversity within Hispanic communities makes a significant difference in their consumption

patterns. Thus, even when many characteristics are shared by Hispanics, no reason prevails to explain that Hispanic groups follow a homogenous demand for meats.

Prior research has approached the topic of the Hispanic household expenditure patterns in the U.S. in different ways. The current study on the demand for meats has divided prior research into two main groups. The first group includes studies which have analyzed aggregate expenditures among Hispanics. Within this type of studies are those which compare Hispanics with whites and Hispanics with other ethnic groups, such as blacks and other minorities and those which make comparisons within Hispanic groups – using region/country of origin. These types of studies will be analyzed to show the methods employed and to demonstrate the differences in consumption patterns among ethnic groups and within the Hispanic community for aggregate expenditures. Studies that specialize in the demand for meats are the second group reviewed. Within this group are also those that compare the Hispanic population with other races/ethnic groups and a few that conduct comparisons within Hispanic groups.

The description of prior research is focused on what these studies have examined: the ethnic/region of origin; the expenditures analyzed; the data sets used; a discussion of the methodology implemented; and the main conclusions. After the discussion of the prior research, my contributions are presented.

Aggregate Expenditures among Hispanics

Within the category of studies using aggregate expenditures and comparing Hispanics with other ethnic groups, Paulin (1998) did a useful investigation explaining this particular topic. In the first part of his study, the spending patterns of Hispanics are examined and why these patterns differ from those of whites and blacks is explored; Paulin questioned whether ethnicity plays an important role in expenditure decisions or whether factors such as income, age, and

family size dominate. Regression techniques were used to analyze the following major expenditure categories: food at home, shelter and utilities, apparel and services, transportation, recreation, and related expenditures (Paulin, 1998). Using the interview component of the 1994-95 Consumer Expenditure Survey (CES), Ordinary Least Square (OLS) regression analysis was used to understand how income, family size and ethnicity are related and how they affect the consumer spending patterns. Through the regression, the marginal propensity to consume (MPC) was obtained to estimate income elasticity. Box-Cox transformation to reduce heterocedasticity was also implemented. Three demographic characteristics significantly affected expenditure patterns: income, family size, and age. Additionally, ethnicity was identified as a factor that influences one's tastes and preferences.

Another practical study was conducted by Fan and Zuiker (1998) in which the differences in household budget allocation patterns between Hispanic households and non-Hispanic white households were examined. These authors considered the following expenditures: food at home, food away from home, shelter, fuel and utilities, household equipment, apparel, entertainment, education, health care, alcohol, tobacco, and personal care. Fan and Zuiker (1998) performed their analysis of the consumption patterns of the Hispanic population by using 13 years of data (1980-92) from the interview component of the CES; they also used the Consumer Price Index (CPI) from the same years and the American Chamber of Commerce Researchers Association (ACCRA) Cost of Living Index (1990). A linear demand system with 23 demographic variables was estimated; a linear approximation form, LA/AIDS of the Almost Ideal Demand System (AIDS) first introduced by Deaton and Muellbauer was estimated. Results showed that, compared to non-Hispanic/White households, Hispanic households allocate significantly more of their budget to food at home, shelter, and apparel, while they spend less on food away from

home, entertainment, education, health care, and tobacco. Also, differences in income, prices, and demographic characteristics other than ethnicity explained part of the budget allocation differences between Hispanic and non-Hispanic allocations (Fan & Zuiker, 1998).

Fan (1998) conducted another study in which the relationships between expenditure differences and race, ethnicity, and cultural beliefs were investigated. The groups that were studied were whites, Asians, blacks and Hispanics. Data from the CES for 1980-92 were collected with adjustments for the CPI. The categories used are the same as Fan and Zuiker (1998). However, to identify household expenditure patterns, cluster analysis was employed to find natural groupings with households with similar expenditure patterns (Fan, 1998). An unordered multinomial logit analysis, along with chi-square statistics and two-category logit analyses models were used to analyze the expenditures patterns. The results showed that the shelter-dominated cluster budgeted 38.5 % to shelter and was comprised of Asian (43.7%), Hispanic (35.2%), black (26.2 %), and white (27.9%) households. Shelter and service dominated expenditures (household operations, equipment, and furnishings) and were greater in households that were, on average, younger, better educated, and more financially secure. This group included over 25% of the white households that were sampled. Hispanics households, when compared to the white households, had over a 20% greater probability of being in the shelter-dominated cluster or the food-and-utilities cluster and 35% less probability of being in the health-care-dominated cluster (Fan, 1998).

On the other hand, a good example of a study that focuses on Hispanic groups specifically is the second part of Paulin's study (1998). In this part, aggregate expenditures were observed, but Paulin explored spending patterns within the Hispanic community to discern if major differences existed by geographic origin. In this study, the Hispanics were divided

(following the division of CES 1994-95) into five geographic groups: Mexican, Puerto Rican, Cuban, Central or South American and other Spanish. The aggregate categories, data and model are the same as in the first part of Paulin's 1998 study. The MPC was obtained in the same manner and was used to estimate income elasticity as well. The author found that ethnicity is a factor that influences one's tastes and preferences, so differences existed in expenditure patterns across the Hispanic subgroups that were studied.

Another study that focuses on Hispanic groups is the first part of Lanfranco's (1999) thesis in which the food expenditure patterns on total food (TF), food at home (FAH) and food away from home (FAFH) of the Hispanic population in the U.S. were investigated. Hispanic groups analyzed included: Mexican, Puerto Rican, Cuban, other Hispanic origin. Lanfranco (1999) addresses how Hispanic households allocate their food budget in response to income and household size through their respective expenditure elasticities. To do so, the USDA 1994-96 continuing survey of food intakes by individuals was used. As is common among these studies, this research was based on consumer demand theory and used its foundations for constructing Engel curves for the analysis of the expenditure and demand patterns. The Engel curves were estimated using four functional forms: double-logarithmic, semi-logarithmic, quadratic and the Working-Leser model. The income and household size elasticities were also estimated. Engel's law was verified for Hispanic households in the U.S. Hispanic households were shown to devote a significantly different proportion of their budget when compared with non-Hispanic American households.

Paulin (2003) examined whether changes in expenditure patterns are due to changes in income or to changes in underlying preferences. Paulin studied differences within the Hispanic community rather than comparing Hispanics as a whole to other groups. The geographic origin

and the expenditures examined are the same as in his 1998 previous work. The interview component of the CES in 2000-1 was employed. Paulin (2003) studied the share of expenditures allocated to each category using the Engel analysis. Major expenditure categories were examined using OLS. One of the main conclusions showed that neither group differed in a statistically significant way from Mexican families; this conclusion indicated homogeneity by origin for food at home expenditures. This conclusion shows opposite results to Paulin's 1998 study, which used data from CES 1994-95.

To date, aggregate expenditure studies have shown that a difference in consumption patterns, or at least in tastes and preferences, exist among ethnic groups (Fan, 1998; Fan & Zuiker, 1998; Paulin, 1998) and within the Hispanic population (Lanfranco, 1999; Paulin, 1998). However, the study conducted by Paulin in 2003 indicates homogeneity by Hispanic origin for food at home expenditures. The discrepancy in expenditure behavior within Hispanics in prior research motivated the current analysis of how Hispanic groups behave in disaggregated categories.

Hispanics' Demand for Meat

The studies presented below are more closely related to the present thesis. They are focused on demand for meat. The following section presents studies which compare Hispanic populations with other ethnic groups. One example is the study conducted by Lanfranco, Ames, and Huang (2002) which estimated a system of demand equations for disaggregated meat products. Non-Hispanic whites and other minority groups, such as Hispanic Americans and African Americans, were analyzed. The analysis is focused on 10 meat products: 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). Using the 1998 CES data, the incomplete demand systems approach, developed by LaFrance and Hanemann (1989), was adopted to derive and specify a demand equation for empirical estimation. Furthermore, the original LinQuad form was estimated using a two-step estimation procedure for a system of censored equations. These authors concluded that Hispanic households have different food consumption patterns compared to other ethnic groups in the U.S. The results also showed that the size of the household had a positive effect on the probability of consuming a particular meat product. However, once a household chose to consume, household size had a negative effect on the amount of money spent on that item, especially among the higher-priced meats. On the other hand, the demand for ground beef and chicken appeared to be least responsive to changes in household income (Lanfranco, Ames, & Huang, 2002).

A recent study on the demand for meat by U.S. Hispanics is the thesis conducted by Garcia (2006). The method he employed is similar to prior research. He used the censored incomplete demand systems of the LinQuad form. This method was employed for recognizing the consumption patterns of Hispanics and comparing them with those of whites, African Americans, and other minorities. Using the 2003 CES, three sets of demand systems were presented and elasticities were estimated for the following groups of meats: ground beef, roast beef, beef steak, other beef, bacon, pork chops, ham, other pork, poultry, and seafood. The conclusions showed the responsiveness to changes in demand were due to changes in own prices, cross prices, income, and household size for each ethnic group. 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 other minorities, respectively (García, 2006).

A study focusing on demand for food among the Hispanic population in the U.S. is the second part of Lanfranco's (1999) thesis. Lanfranco observed the same Hispanic groups as in the first part of his thesis: Mexican, Puerto Rican, Cuban, and other Hispanic. The same data set was also employed (USDA's 1994-96 Continuing Survey of Food Intakes by Individuals) in exploring nine main food groups: grains, vegetables, fruits, milk, meat, legumes, fats, sugar and beverages; furthermore, most interesting are the three meat subgroups: beef, pork and chicken. Engel functions were estimated using both the Heckman Two-Step (TS) procedure and the Two-Part model (TP) in order to estimate income and household size elasticities. The demand analysis was limited to physical quantities consumed in grams per week. On average, the demand for particular food groups appeared to be relatively inelastic with respect to income and moderately to unitarily elastic with respect to household size. The national origin of the Hispanic household was important in explaining the demand for some specific food groups (Lanfranco, 1999).

Recent work has shown that food consumption behavior of the Hispanic community differs from that of other ethnic groups in the U.S. (García, 2006; Lanfranco, Ames, & Huang, 2002). The income, price, cross price and household size elasticities also diverged in these studies. Furthermore, the only research that has studied meat groups within the U.S. Hispanic community is Lanfranco's (1999). He found that national origin plays an important role in the demand for specific food groups. Both facts, the division of Hispanics by origin and the estimation of beef, pork and chicken demands, allow me to compare the results of the current study with those calculated by Lanfranco (1999) and to determine if substantive changes have occurred in the factors that influence Hispanic demand for meat.

In terms of methodology, prior research has based its analysis in a neoclassical approach using consumer demand theory. The Almost Ideal Demand System (AIDS), first introduced by

Deaton and Muellbauer, and the Two-Step (TS) Heckman decision process are the major methods used. Engel analysis, MPC analysis, and category logit analyses are also employed. Most previous studies include a vast explanation of the application of the methods. Prior research will serve as a powerful tool in applying the methodology for this thesis. In reference to data sets, most studies used the CES of the U.S. Bureau of Labor Statistics for different years. Lanfranco (1999) based his analysis on a different data set the USDA 1994-96 Continuing Survey of Food Intakes by Individuals.

One matter not included in the literature review is the variables. Since most of the prior studies have used the CES, a coincidence in demographic and socioeconomic variables exists among the literature reviewed. Those variables are income, expenditure (for different categories), household size, national/region of origin, region (West, Northeast, South, Midwest), education, age, marital status and income transfer payments.

Contribution

The current research aims to provide a new analysis by using a recent CES, complementing previous studies on food consumption behavior. In this respect, the current thesis has two main contributions. The first is related to the geographic origin of Hispanics, since differences in consumption patterns among ethnic groups have been demonstrated, and divergence in expenditure behavior within Hispanics also exists. The current analysis contributes to this field by estimating a single equation expenditure demand equation for meat within the Hispanic population with regard to region/country of origin. The second contribution is related to food expenditures. Many meat groups have been analyzed; however, goat and lamb, two relevant meats in the diet of Hispanics, have not been included as a separate meat group. Moreover, the current thesis uses the recent CES from 2005.

We may think that several reasons account for differences between prior studies of demand for meats and the current thesis. For instance, tastes and preferences could change. This change could result from the fact that the Hispanic population could eventually adapt themselves to the food supplies in the U.S. They can incorporate some American products in their daily consumption as well. On the other hand, the growth of Latino food suppliers and Hispanic food restaurants has broadened food options for the Hispanic population. Through the present study, I can verify if there have been any substantive changes in the meat consumption patterns within the U.S. Hispanic community by comparing my results with those shown in the past. Another reason why I might find differences between the estimation of my research and prior estimations may be due to changes in the demographic characteristics, especially the growth of the U.S. Hispanic population and the growth of U.S. Hispanics' buying power.

CHAPTER 3

DESCRIPTIVE ANALYSIS OF THE 2005 CES

This chapter is dedicated to the description of the 2005 Consumer Expenditure Survey (CES), the United States' Hispanic household's demographic and socioeconomic characteristics and the meat expenditures. General information about the CES is provided in the first part of this chapter. An explanation of how the data were managed is presented so that the reader can have a better idea of the data sources and the demographic information. The second part of this chapter is devoted to the descriptive statistics of the U.S. Hispanic households drawn from the sample from the 2005 CES.

Demographic characteristics, such as the number of households of Hispanic origin and their different regions of origin, regional distribution, location, household size, and economic characteristics such as income, and indicators of poverty, are presented in this chapter. The discussion about the differences in demographic and economic characteristics among the Hispanic groups is emphasized throughout this section. The next portion of this chapter is dedicated to the description of the meat expenditures and income; explanation about the treatment of outliers in the data and the final consideration concerning the sample are presented. Tables containing information discussed through this chapter are available at the end of this chapter.

2005 Consumer Expenditure Survey

The current Consumer Expenditure (CE) program began in 1980. Its principal objective is to collect information on the buying habits of U.S. consumers. The survey, which is conducted by the U.S. Census Bureau for the Bureau of Labor Statistics, consists of two components: 1) a

diary, or recordkeeping survey, completed by participating consumer units for two consecutive 1-week periods, and the sample is surveyed across a 12-month period; and 2) an interview survey, in which expenditures of consumer units are obtained in five interviews conducted at 3-month intervals. Each component of the survey queries an independent sample of consumer units that is representative of the U.S. population. For the Diary Survey, about 7,500 consumer units are sampled each year. Each consumer unit keeps a diary for two 1-week periods, yielding approximately 15,000 diaries a year. The interview sample, selected on a rotating panel basis, surveys about 7,500 consumer units each quarter. Each consumer unit is interviewed once per quarter for five consecutive quarters. Data are collected on an ongoing basis in 105 areas of the United States.

The diary component of the 2005 CES is the one utilized in this thesis. It is designed to capture expenditures on small, frequently purchased items that normally are difficult for respondents to recall. Detailed records of expenses are kept for food and beverages. The diary also provides national representation and detailed socioeconomic, cross-sectional, market segment data, relating the expenditures and incomes of consumers to the characteristics of those consumers. Furthermore, the 2005 CES contains information on the Hispanic population by region of origin (a fundamental characteristic of the population for this study).

The diary component of the CES for the 2005 database contains microdata files which present detailed expenditure and income data. They include weekly expenditure files (EXPN), annual income files (DTAB), and imputed income files (DTAB-IMPUTE); the data in these files are categorized by a Universal Classification Code (UCC). The consumer unit characteristics and income file (FMLY) and the consumer unit characteristics and income file of members (MEMB) present data on the characteristics and demographics of consumer units and consumer unit

members. A consumer unit is defined for the 2005 CES as either (1) all members of a particular household who are related by blood, marriage, adoption, or other legal arrangements, or (2) a person living alone or sharing a household with others or living as a renter in a private home or lodging house or in permanent living quarters in a hotel or motel, but who is financially independent; or (3) two or more persons living together who pool their incomes to make joint expenditure decisions (U.S. Department of Labor, 2007a). For the purpose of this thesis, the terms consumer unit and household are used as synonyms.

The FMLY, MEMB, EXPN, DTAB and DTAB_IMPUT files are organized by the quarter of the calendar year in which the data were collected. There are four quarterly data sets for each of these files (U.S. Department of Labor Bureau of Labor Statistics, 2007a).

The data were managed using a program created in the Statistical Analysis Software (SAS) 9.1. The program is available upon request. The quarterly data were merged into one file that contains the information for the four quarters. The diary contains a variable called NEWID or "consumer unit identification number" from which the matching among files was done. Since the interest of this study is the U.S. Hispanic population, the information for Hispanics was pulled from files indicating the reference person of the reporting household was of Hispanic origin. The Hispanic household was defined as a household where the reference person is of Hispanic origin; it was coded by sorting on the variable HORREF1 from the FMLY indicating Hispanic origin. From this set, a subset was constructed identifying the Hispanic household by origin. The information that identifies the Hispanic origin contains eight categories: Mexican, Mexican-American, Chicano, Puerto Rican, Cuban, Cuban-American, Central and South American, and Other Hispanic. For my purposes, the categories Cuban, Cuban-American, and Chicano were grouped into the category Other Hispanics.

The sample contained 222, 207, 236, and 212 households of Hispanic origin in the first, second, third, and fourth quarters, aggregated to 877 Hispanic households. Demographic information about these households is contained in the diary. The tables containing information about Hispanic demographic and economic characteristics are presented in the following sections. The tables showing the descriptive statistics related to each Hispanic group are also shown and discussed.

Demographic Profile of the Hispanic Households

The percentage *distribution by Hispanic ethnicity* in the sample was found to be distributed as follows: 35% were Mexican households, 29% Mexican-American households, 14% other Hispanic households, 12% Central and South American households, and 9% Puerto Rican households (Table 3.1). The fact that Mexicans were the group with the highest presence in the sample was expected, since the statistics of the U.S. Census Bureau show basically the same trend.

Tabla 3.1 Region of origin of Hispanic households in the U.S., 2005

Region of origin	Frequency	Percent
Mexican	310	35.35
Mexican-American	253	28.85
Puerto Rican	83	9.46
Central or South American	107	12.2
Other Hispanic	124	14.14
Total	877	100

Source: 2005, CES sample.

Regarding the *geographic distribution*, Hispanics are mainly located in the South and West; in fact, these two regions accounted for 74% of Hispanics in the sample. Some differences can be found in the geographic distribution among groups. While more than 47% of Mexicans and Mexican-Americans are located in the West, more than 56% of Puerto Ricans are located in the Northeast. Moreover, while more than 70% of Central and South Americans are mainly located in the South and West, more than 73% of other Hispanics are mainly located in the Northeast and South (Table 3.2). Additionally, 97% of the sample lives in urban areas.

Table 3.2. Regional distribution of Hispanic household in the in the U.S. by Hispanic origin, 2005

Region Frequency Col Percent	Mexican	Mexican-American	Puerto Rican	Central or South American	Other Hispanic	Total
Northeast	15	4	47	26	37	129
	4.84	1.58	56.63	24.3	29.84	14.71
Midwest	46	28	8	6	11	99
	14.84	11.07	9.64	5.61	8.87	11.29
South	93	101	22	39	54	309
	30	39.92	26.51	36.45	43.55	35.23
West	156	120	6	36	22	340
	50.32	47.43	7.23	33.64	17.74	38.77
Total	310	253	83	107	124	877
	35.35	28.85	9.46	12.2	14.14	100

Source: 2005, CES sample.

The Hispanic reference person of the consumer unit was almost equally distributed between *male* (49.12%) and *female* (50.86%). This distribution is also relatively balanced for Hispanic groups. The *average age* of the reference person was 42.4 years for Hispanic

households. The youngest group, on average, was Mexican households, with a mean of 40.4 years, in contrast to other Hispanic households with a mean of 44.6 years.

Educational attainment was another characteristic reviewed for the sample. About 66% of the reference persons of Hispanic households had up to high school education, while 17% of the Hispanic reference persons were college drop-outs. Only 11% of the Hispanic household reference persons had college and post college studies. The reference person of Mexican and Puerto Rican households had lower bachelor degree attainment, with 11% and 7%, respectively, in contrast to Mexican-American and Central and South American households, with 21% and 17% respectively. Neither Mexican nor Puerto Rican households had a reference person with graduate studies (Table 3.3).

Almost 78% of Hispanic households had a reference person receiving *earnings* working for private companies, businesses and individuals; 13% received their earnings as government employees and 8% for being self-employed in their own business, professional practice or farm (Table 3.7). Regarding the Hispanic groups, 31% of Puerto Rican households had a reference person receiving earnings working as a government employee; this percentage is two times greater than for Mexican-Americans, Central and South Americans and other Hispanics. More than 9.5 % of Mexican, Central and South American and other Hispanics households had a reference person receiving earnings from being self-employed in business, professional practice, or farm, in contrast with 1.75% of Puerto Ricans (Table 3.4).

Table 3.3. Educational attainment of the reference person by Hispanic origin, 2005

Education Frequency Col Percent	Mexican	Mexican-American	Puerto Rican	Central or South American	Other Hispanic	Total
Never attended school	8	1	0	1	1	11
	2.58	0.4	0	0.93	0.81	1.25
First through eighth grade	91	31	13	17	10	162
	29.35	12.25	15.66	15.89	8.06	18.47
Ninth through twelfth grade (No H.S. Diploma)	74	49	10	11	32	176
	23.87	19.37	12.05	10.28	25.81	20.07
High school graduate	80	69	27	26	30	232
	25.81	27.27	32.53	24.3	24.19	26.45
Some college, not college graduate	39	53	19	20	21	152
	12.58	20.95	22.89	18.69	16.94	17.33
Associate's degree (occupational/vocational or academic)	7	18	7	7	10	49
	2.26	7.11	8.43	6.54	8.06	5.59
Bachelor's degree	11	21	7	19	16	74
	3.55	8.3	8.43	17.76	12.9	8.44
Master's, Professional, or Doctoral degree	0	11	0	6	4	21
	0	4.35	0	5.61	3.23	2.39
Total	310	253	83	107	124	877
	35.35	28.85	9.46	12.2	14.14	100

Source: 2005, CES sample.

Table 3.4. Employment type of the reference person by Hispanic origin, 2005

Employment type Frequency Col Pct	Mexican	Mexican-American	Puerto Rican	Central or South American	Other Hispanic	Total
Private company, business, or individual	187	146	38	63	63	497
	83.11	79.78	66.67	70	75	77.78
Self-employed in own business, professional practice or farm	25	9	1	1	8	55
	11.11	4.92	1.75	13.33	9.52	8.61
Government employees (local, state, federal)	13	28	18	15	13	87
	5.78	15.3	31.58	16.67	15.48	13.62
Total	225	183	57	90	84	639
	35.21	28.64	8.92	14.08	13.15	100

Source: 2005, CES sample. Missing observation 238

Income is one of the most useful characteristics in describing consumption behavior. The income categories start with less than $9,999 up to $70,000 and over. Eleven percent of Hispanics are in the very low income category; almost 35% are in the mid range from $10,000 up to $29,999; another 36% of the Hispanic households are in the range from $30,000 to $69,999, and almost 18% are in the highest income category of $70,000 and over. Differences were found among Hispanic groups. The Hispanic group with fewer households in the very low income category was Central and South Americans with only 5%, in contrast to Puerto Ricans, who had almost 17% of the households in this income category. Mexican-Americans, Central and South Americans and other Hispanics had almost 21% of their household in the higher income category (Table 3.5).

Table 3.5. Household average annual income by Hispanic origin, 2005

Income Frequency Col Pct	Mexican	Mexican-American	Puerto Rican	Central or South American	Other Hispanic	Total
Less than $9,999	33	32	14	6	12	97
	10.65	12.65	16.87	5.61	9.68	11.06
$10,000 to $19,999	54	51	10	13	25	153
	17.42	20.16	12.05	12.15	20.16	17.45
$20,000 to $29,999	69	32	16	15	19	151
	22.26	12.65	19.28	14.02	15.32	17.22
$30,000 to $39,999	40	26	8	11	21	106
	12.9	10.28	9.64	10.28	16.94	12.09
$40,000 to $49,999	37	22	14	15	5	93
	11.94	8.7	16.87	14.02	4.03	10.6
$50,000 to $69,999	33	37	9	25	16	120
	10.65	14.62	10.84	23.36	12.9	13.68
$70,000 and over	44	53	12	22	26	157
	14.19	20.95	14.46	20.56	20.97	17.9
Total	310	253	83	107	124	877
	35.35	28.85	9.46	12.2	14.14	100

Source: 2005, CES sample.

Indicators of *poverty* are also relevant factors for consumption. Poverty thresholds (U.S. Census Bureau, 2008) have become the basis for the official statistics on the extent of poverty in the United States. The statistics of the sample show that more than 21.5% of the Hispanic households were below the poverty threshold[2] and 78.5% above it. The only group who had a different relative proportion of households below the poverty threshold was Central and South American with only 10% below the threshold (Table 3.6). On the other hand, the Food Stamp Program helps low-income people and families buy the food they need for good health, increasing the recipients' purchasing power and as a result increasing the expenditures in meat

[2] Poverty thresholds are calculated based on the size of family and number of related children under 18 years. The poverty threshold for a family of one person was $9,973; the poverty thresholds are updated each year to reflect changes in the Consumer Price Index for all urban consumers.

groups. In the sample, more than 12% of the Hispanic households were recipients of food stamps. Mexican and Central and South American households were below average recipients of food stamps (Table 3.7). A big gap was found between those who were below the poverty threshold and those who receive food stamps. In fact, 44% of those who are classified below the poverty threshold do not receive food stamps.

Table 3.6. Households below the poverty threshold by Hispanic origin, 2005

Poverty Threshold Frequency Col Pct	Mexican	Mexican-American	Puerto Rican	Central or South American	Other Hispanic	Total
Yes	72	62	19	11	24	188
	23.23	24.6	22.89	10.28	19.35	21.46
No	238	190	64	96	100	688
	76.77	75.4	77.11	89.72	80.65	78.54
Total	310	252	83	107	124	876
	35.39	28.77	9.47	12.21	14.16	100

Source: 2005, CES sample. Missing observation 1

Table 3.7. Recipients of food stamps in the household by Hispanic origin, 2005

Food Stamps Frequency Col Pct	Mexican	Mexican-American	Puerto Rican	Central or South American	Other Hispanic	Total
Yes	28	36	13	6	23	106
	9.49	15.06	17.11	5.83	19.33	12.74
No	267	203	63	97	96	726
	90.51	84.94	82.89	94.17	80.67	87.26
Total	295	239	76	103	119	832
	35.46	28.73	9.13	12.38	14.3	100

Source: 2005, CES sample. Missing observation 45

Housing tenure provides additional information about the housing profile of the sample. About 48% of Hispanic households rented, 35% owned their residence with a mortgage, 11% owned without a mortgage, and 5% had other housing tenure. Mexican-Americans and Central and South Americans had the highest housing ownership, with 54% and 52% of the households owning a house, respectively. In contrast, almost 58% of Puerto Rican and 56% of Other Hispanic households were renting (Table 3.8).

Table 3.8. Household housing tenure by Hispanic origin, 2005

Housing Tenure Frequency Col Pct	Mexican	Mexican-American	Puerto Rican	Central or South American	Other Hispanic	Total
Owned with mortgage	107	92	23	52	37	311
	34.52	36.36	27.71	48.6	29.84	35.46
Owned without mortgage	34	45	4	4	12	99
	10.97	17.79	4.82	3.74	9.68	11.29
Rented	155	102	48	48	70	423
	50	40.32	57.83	44.86	56.45	48.23
Other housing tenure	14	14	8	3	5	44
	4.52	5.53	9.64	2.8	4.03	5.02
Total	310	253	83	107	124	877
	35.35	28.85	9.46	12.2	14.14	100

Source: 2005, CES sample.

Mexicans had the largest *household size,* in contrast to Puerto Ricans, who held the smallest household size. On average, Mexicans had 3.8 members followed by Central or South Americans with 3.3, Mexican-Americans with 3.0, and other Hispanics with 2.9 members per

household (Table 3.9). The majority of all Hispanic households had between one and four members. Actually, 79% of the households in the sample are in this range, while 20% had between five and seven members. Less than 2% of households were found having more than seven and fewer than 13 members (Table 3.10).

Table 3.9. Average Hispanic household size, 2005

Household size	Mean	Std Deviation
Mexican	3.8	1.9
Mexican-American	3	1.6
Puerto Rican	2.61	2.6
Central or South American	3.3	1.5
Other Hispanic	2.9	1.7
Total	3.1	1.9

Source: 2005 CES sample.

Table 3.10. Hispanic household size, 2005

Household size	Frequency	Percent
1	145	16.53
2	189	21.55
3	172	19.61
4	187	21.32
5	95	10.83
6	55	6.27
7	18	2.05
More than 7 and less than 14	16	1.81
Total	877	100

Source: 2005 CES sample.

The *family composition* of Hispanics showed the highest proportion of households under the category single person or husband and wife family type. In fact, 28% of the sample was under these two categories. Seventeen percent households with husband and wife with oldest child between 6 and 17 years old were found in the sample. One parent, male, with at least one child under 18 years old was the least frequent family type, accounting for only 1% of the Hispanic households. Regarding the Hispanic groups, Mexican households had the highest proportion under the category husband and wife, with an oldest child between 6 and 17 years old in contrast to Puerto Ricans. Puerto Ricans also had the highest proportion of households under the single category in contrast to Mexican households (Table 3.11).

Table 3.11. Family composition of Hispanic households, 2005

Family type Frequency Col Pct	Mexican	Mexican-American	Puerto Rican	Central or South American	Other Hispanic	Total
Husband and wife(H/W) only	24	36	10	13	21	104
	7.74	14.23	12.05	12.15	16.94	11.86
H/W, own children only, oldest child under 6 years old	20	22	3	13	2	60
	6.45	8.7	3.61	12.15	1.61	6.84
H/W, own children only, oldest child 6 to 17 years old	81	35	5	15	15	151
	26.13	13.83	6.02	14.02	12.1	17.22
H/W, own children only, oldest child over 17 years old	31	23	4	8	9	75
	10	9.09	4.82	7.48	7.26	8.55
All other H/W CUs	40	14	7	16	10	87
	12.9	5.53	8.43	14.95	8.06	9.92
One parent, male, own children only, at least one child age under 18 years old	3	6	0	0	0	9
	0.97	2.37	0	0	0	1.03
One parent, female, own children only, at least one child age under 18 years old	16	25	10	5	14	70
	5.16	9.88	12.05	4.67	11.29	7.98
Single persons	34	47	26	16	22	145
	10.97	18.58	31.33	14.95	17.74	16.53
Other CUs	61	45	18	21	31	176
	19.68	17.79	21.69	19.63	25	20.07
Total	310	253	83	107	124	877
	35.35	28.85	9.46	12.2	14.14	100

Source: 2005, CES sample.

Regarding the age of the Hispanic household members, 46% of the households had no persons under 18 years in the household, and almost 52% had between 1 and 4 members under 18 years old (Table 3.12). Moreover, an interesting characteristic in the sample is the fact that almost 42% of the Hispanic households had no children. 23% of the households had children up to 11 years old. Around 10% of the households had a child older than 17 years old living in the household. Among the Hispanic groups, Puerto Ricans had around 60% of the households with no children in contrast to Mexicans with almost 32%. (Table 3.13)

Table 3.12. Household members under 18 years old by Hispanic origin, 2005

Person under 18 years Frequency Col Pct	Mexican	Mexican-American	Puerto Rican	Central or South American	Other Hispanic	Total
0	113	123	50	46	75	407
	36.45	48.62	60.24	42.99	60.48	46.41
1 to 4	187	126	32	60	47	452
	60.32	49.8	38.55	56.07	37.9	51.54
5 or more	10	4	1	1	2	18
	3.23	1.58	1.2	0.93	1.61	2.05
Total	310	253	83	107	124	877
	35.35	28.85	9.46	12.2	14.14	100

Source: 2005, CES sample.

Table 3.13. Household child age, 2005

Child Age	Frequency	Percent
No children	366	41.73
All children less than 6	103	11.74
Oldest child between 6 and 11 and at least one child less than 6	62	7.07
All children between 6 and 11	42	4.79
Oldest child between 12 and 17 and at least one child less than 12	100	11.4
All children between 12 and 17	51	5.82
Oldest child greater than 17 and at least one child less than 17	63	7.18
All children greater than 17	90	10.26
Total	877	100

Source: 2005, CES sample.

The family composition of Hispanics had the highest proportion of households under the category married, with 57% belonging to it, followed by never married with 21% and divorced with 11%. Mexicans and Central and South Americans had the highest proportion under the married category, with more than 65%, in contrast to Puerto Ricans, with only around 36%. Puerto Ricans had the highest proportion of household never married, with almost 41% (Table 3.14).

Table 3.14. Marital status of the reference person by Hispanic origin, 2005

Marital status Frequency Col Pct	Mexican	Mexican-American	Puerto Rican	Central or South American	Other Hispanic	Total
Married	206	137	30	70	59	502
	66.45	54.15	36.14	65.42	47.58	57.24
Widowed	14	18	3	4	7	46
	4.52	7.11	3.61	3.74	5.65	5.25
Divorced	23	35	8	10	25	101
	7.42	13.83	9.64	9.35	20.16	11.52
Separated	15	6	8	6	4	39
	4.84	2.37	9.64	5.61	3.23	4.45
Never married	52	57	34	17	29	189
	16.77	22.53	40.96	15.89	23.39	21.55
Total	310	253	83	107	124	877
	35.35	28.85	9.46	12.2	14.14	100

Source: 2005, CES sample.

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Description of Expenditures and Income

The EXPN file contains a summary of expenditure data. For the purpose of this study, the type of food expenditure to be considered is the Food at Home (FAH), focusing on meats. It was found that 57 households of Hispanic origin did not report any expenditures; this finding limited the sample of useful observations to 820 households.

The meat categories studied are: beef, pork, poultry, fish and seafood, lamb and goat, and other meats. The components of these meat categories are presented below (those with the symbol * means excluded canned):

($_b$) Beef (ground beef*, chuck roast*, round roast*, other beef roast*, round steak*, sirloin steak*, other steak*, and other beef*);

($_{pk}$) Pork (bacon, pork chops, ham*, other pork*, pork sausage*, and canned ham)

($_{Pl}$) Poultry (fresh and frozen whole chicken, fresh and frozen chicken parts, other poultry);

($_{f}$) Fish (canned fish, seafood and shellfish, fresh fish and shellfish, frozen fish and shellfish);

($_{l\&g}$) Lamb & Goat (lam and organ meats*, mutton, goat and game)

($_{o}$) Other meat (frankfurters*, bologna*, liverwurst*, salami*, other lunch meat)

The diaries of expenditures are recorded for two 1-week periods. For the purpose of this research, the expenditures are presented on a weekly basis. Thus, meat expenditures of consumer units that reported two weeks were averaged to one week.

Meat expenditures among Hispanic consumer units had high variation, measured in terms of the standard deviation. Beef, pork and seafood expenditures presented amounts further away from their expected means. This can be due to systematic error or it can simply be the case that some expenditure happens to be a long way from the center of the data. These three categories were limited to observations using only expenditures within three standard deviations from their mean. After the removal of outliers, the mean expenditures were $4.94, $2.69, $3.40, $0.24, $1.75 and $1.69 for beef, pork, poultry, lamb and goat, seafood, and other meats respectively; the mean, standard deviation and minimum and maximum statistics calculations for the meat categories are presented in Table 3.15.

Table 3.15. Weekly meat expenditures, 2005

Expenditure	Mean	SD	Min	Max
Beef	4.94	6.15	0	31.34
Pork	2.69	3.86	0	19.17
Poultry	3.4	4.43	0	28.29
Lamb & Goat	0.24	1.16	0	14.61
Sea food	1.75	3.23	0	16.95
Other Meat	1.69	2.6	0	18.55

Source: 2005 CES sample.

The sample also shows the Hispanic preference for the type of meats purchased, with 484 households consume beef during the two-week period they filled out the diary, 456 households consumed some poultry, 408 households consumed some pork, 397 households consumed some other meats, 280 households consumed some fish and sea food, and 50 households consumed some lamb and goat in the period.

The maximum amount of household income was reported to be $436,587, with a mean of $45,096 and a standard deviation of $44,311. The sample used was limited to consumer units within three standard deviations from the mean income. Thus, after removing outliers, the mean income was $40,912, the standard deviation was $31,788 and the maximum income was $174,777. The resulting data set contained 770 consumer units. Although removing outliers of the data further limited the sample size, the final data set provided more uniformity and robustness in the implications of the model.

Summary of Descriptive Analysis

As shown above, the demographic profile of the Hispanic groups demonstrated that Hispanics are not a homogeneous group. Outstanding differences were found in variables such as geographic distribution, age, household size, income, education, and family composition. In terms of geographic distribution, Mexicans and Mexican-Americans are mainly located in the West, Puerto Ricans in the Northeast, Central and South American and other Hispanics are mainly located in the South. The youngest household reference person group was Mexican households, with a mean of 40.4 years. Mexicans had the biggest household size, in contrast with Puerto Ricans holding the smallest household size.

The Hispanic group with the fewest households in the very low income category was Central and South Americans. Furthermore, this group and Other Hispanics group had almost 21% of their households in the highest income category. In regard to education, Mexican and Puerto Rican households reference persons had the lowest percentage of bachelor degree attainment. Neither one of these groups had a reference person with graduate studies. Central and South Americans had the highest proportion of reference persons with college and post college studies.

The indicators of poverty also showed differences among groups. Mexican and Central and South American households were below average recipients of Food Stamps. Dissimilarities among Hispanic groups may thus justify the differentiation in the Hispanic category by ethnic origin. These differences found in economic and demographic characteristic among Hispanic groups may affect consumption behavior. Whether these differences affect consumption behavior on selected meats will be tested in chapter five through the analysis of meat expenditures.

Hispanic household expenditures and income had high variation measured in terms of the standard deviation. Beef, pork and sea food were treated for outlier observations, using only expenses within three standard deviations from their mean. The sample was also limited to consumer units within three standard deviations from the mean income. The resulting data set contained 770 consumer units.

Several demographic characteristics presented in this chapter will be included in the estimation model, and they are tested in order to see the influence on the likelihood of purchase and in the actual consumption of meat categories. Further explanation and model specification is offered in detail in chapter 4.

CHAPTER 4

THEORY, METHODOLOGY AND EMPIRICAL MODEL

This chapter is committed to the explanation of the theory, the research methods and the empirical model that underline this thesis. The first part of the chapter includes the explanation of the theoretical basis of demand theory, the utility function maximization process, and the expenditure functions. How the theory is applied to this research is presented throughout this part of the chapter. Henceforward, the econometric and the estimation techniques are presented for the single expenditure equation for meat; Ordinary Least Square (OLS) technique and its assumptions are explained. Since the selectivity-bias problem due to households reporting zero consumption for a particular item is expected, a two-step estimation procedure is used; the theory behind this procedure is briefly explained. The construction and definitions of the variables used in the analysis are presented and information about the questionnaire is also offered. Once the variables are described, the description of the empirical model to be estimated is presented and discussed.

Consumer Demand Theory

In economics, market relations between prospective sellers and buyers of a set of different commodities are described by supply and demand. The suppliers and buyers interact in the market to determine price and quantity sold. The current research focuses on one side of market equilibrium – the demand. The neoclassical consumer demand theory provides a basic theoretical framework for analyzing household budget allocation patterns using expenditure function for particular goods. The investigation of consumer preferences for different commodity

sets is based on models that describe consumer behavior. These models are based on a consumer preference relation expressed in utility functions. Given these preferences, utility functions defining the power of commodities to satisfy consumers' wants can be specified (Wetzstein, 2005, p. 21). The intention of the utility function is to derive the demand for different commodities. For the purpose of the current research, the expenditure functions include different meat groups.

The quantities purchased by a consumer are assumed to be optimal quantities determined by maximizing the consumer's utility function under a budget constraint (Phlips, 1983, p. 16). The preferences of consumers for various food categories and non-food categories can be illustrated in terms of a utility function. At another stage of the utility maximization, the consumer also maximizes utility for food expenditures, such as vegetables, meat, fruit, and other foods. The interest of this thesis is the utility maximization for different types of meat, such as beef, pork, poultry, fish and seafood, lamb and goat, and other meats among U.S. Hispanic groups. This utility function expresses the amount of satisfaction the U.S. Hispanic consumers receive from the consumption of meat under some economic constraints, and under other socio-cultural constraints expressed by the differentiation of the Hispanic groups.

The budget constraint defines the consumer's ability to buy different types of meat among Hispanic groups; it relates the prices of food categories and incomes of Hispanics. The process of utility maximization for meat groups given a budget constraint is expressed in the equation 4.1 below:

$$\max U = \max U\left\langle m(b, pk, pl, f, l \,\&\, g, o,) \middle| preferences \right\rangle \qquad (4.1)$$

s.t. Budget constraint: $I_j = p_i q_i$

m= expenditures on meat groups
b= beef

pk=pork
pl= poultry
f= fish
l&g= lamb and goat
o= other meats
I= income
p= price of the $_i$ meat category
q= quantities of the $_i$ meat category
$_i$ refers to meat category
$_j$ refers to each individual

Given this stage of the utility maximization, one assumption needs to be held. For our purpose, it must be assumed that the consumer spends a fixed portion of his income only on meat consumption. This proportion of income is assumed to be fixed when using single equations. Once the utility function and budget constraint are specified, the single demand function can be derived.

Without a doubt, demand is one of the most fundamental concepts in economics and provides a powerful analysis of markets (García, 2006). The concept of demand helps one to understand the consumer behavior patterns and can be defined as how much of a commodity consumers are willing and able to purchase at a given price. The demand can be illustrated in demand curves, and they illustrate the inverse relationship between price and quantity demanded (Wetzstein, 2005, p. 84). The single expenditure demand equation represents the quantity of a commodity that is consumed as a function of its own price, prices of substitutes and complementary goods, household income, and demographics.

One assumption that underlies the consumer demand theory is that consumers have the capacity to order or rank their preferences. Also, it is assumed that consumers can choose a preferred consumption bundle. These assumptions imply rationality on the part of the consumers. Other assumptions held in this research are certainty in preferences and perfect information. From the assumed economic conditions, demand curves are derived through utility theory in

uncompensated and compensated forms, namely Hicksian and Marshallian demand curves. Hicksian demand curves are produced by minimizing expenditures for a given level of utility (García, 2006), and the Marshallian demand function expresses the relationship between prices and income for a demanded set of commodities. Each Marshallian demand function defines the rules by which the consumer decides how much to purchase of each good as a function of a vector of prices and total expenditures (Lanfranco, 1999).

The Consumer Expenditure Survey (CES) only reports expenditures and does not provide prices or physical quantities. This limitation in the data lead this research to analyze the demand for meat among Hispanics through the analysis of their meat expenditures.

The expenditure function represents the relationship between the expenditures for each meat category (Exp_i) and: income (I_j), household size ($HHsize_j$), consumer preferences influenced by Hispanic origin ($Hisorigin_j$), and demographic characteristics (dch_{jk}). This relationship is shown in equation 4.2:

$$Exp_i = f(I_j, HHsize_j, Hisorigin_j, dch_{jk}) \quad (4.2)$$

$_i$ refers to each meat category
$_j$ refers to each consumer unit
$_k$ refers to reference person

Engel Curves

The relationship between quantities and income, holding all prices fixed, is commonly referred to as an Engel curve. If the quantities (q_i) are multiplied by price (p_i), we obtain expenditures (p_iq_i), and these too can be called Engel curves (Deaton & Muellbauer, 1980, p.15). If the share of total expenditures allocated to food has decreased for a specific group over time, presumably, it is not because they are eating less food, but rather because prices for food have fallen or income has risen, or both, (Paulin, 2003).

A change in household income results in a change in the purchasing power. The increase in income results in an expected increase in purchases; this is represented by parallel shifts in the budget lines. The income levels are used to derive the income expansion path which represents the Engel curve. From the Engel curve, the classification of the goods into normal goods (luxuries & necessities) and inferior goods can be derived using income elasticities. For a normal good, an increase in income results in purchasing more of the commodity; for an inferior good, an increase in income results in purchasing less of the commodity (Wetzstein, 2005, p. 92).

As mentioned before, quantities of goods and services consumed by people are affected by variables such as income, price, and prices of other goods, among other factors. With regard to the changes of quantity demanded because of a change in income, this response can be measured using income elasticities.

The concepts and definitions of elasticities turn out to be very helpful in characterising the demand situation in markets. Income elasticity of demand measures the percentage change in quantity to a percentage change in income (Wetzstein, 2005, p. 149). For instance, if the income elasticity of demand for beef is 3, a 1% increase in Hispanic household income would result in a 3% increase in demand for beef. The income elasticities are classified as follows:

Normal goods:

$\eta_Q = (\partial Q / \partial Q)(I / Q) = \partial \ln Q / \partial \ln I > 1$, luxuries

$\eta_Q = (\partial Q / \partial Q)(I / Q) = \partial \ln Q / \partial \ln I < 1$, necessities

Inferior goods:

$\eta_Q = (\partial Q / \partial Q)(I / Q) = \partial \ln Q / \partial LnI < 0$, inferior goods

As mentioned above, CES only reports expenditure; having said that, the income elasticities serve as a reference for this thesis. To determine the responsiveness of the

expenditure on each meat category with respect to changes in income, this research accedes to the analysis of the expenditure elasticities:

$$\eta_{Exp} = (\partial Exp / \partial Exp)(I / Exp) = \partial \ln Exp / \partial LnI$$

The term (Exp) refers to the expenditure ($p_i q_i$) on the product. The expenditure elasticities are defined as the percentage change in expenditure per one percent change in income and measure the proportionate change in spending on the product as income changes.

Econometric techniques are used for the estimation of the elasticities. Elasticities are easily understood, they are conveniently dimensionless, and they can be directly measured as the parameters of a regression linear equation in the logarithms of purchases, outlay and prices (Deaton & Muellbauer, 1980, p. 61). The regression techniques and the model to be estimated are presented below. Further information about other types of elasticities such as elasticity of demand, as well as own price, and cross price elasticities are included in the appendix in the last section of this thesis.

Methodology

Econometric and estimation techniques

The equation (4.2) above describes the economic model, but it needs to be turned into an econometric estimation model. The econometric model can be used to study the relationship between two or more variables (Wooldridge, 2006, p. 24). Equation 4.3 represents an example of a simple econometric model, called Classical Linear Regression (CLR):

$$Y_t = \beta_0 + \beta_1 X_{2t} + \beta_2 X_{3t} + \ldots + \beta_k X_{kt} + \varepsilon_t \qquad (4.3)$$

Equation 4.3 represents the relationship between Y_t (dependent variable) and X_{kt} (independent variables): $\beta_0 + \beta_1 X_{kt}$ represents the population regression line; the intercept β_0 and the slope β_k represent the coefficients of the regression line. These parameters are unknown; however, we can

use data and econometric techniques to estimate them. The error term ε_t contains all the other factors besides X_{kt} that determine the value of the dependent variable.

Ordinary Least Squares (OLS) is the most common technique used to estimate models of this nature, because it chooses the regression coefficients so that the estimated regression line is as close as possible to the observed data (Stock & Watson, 2006, p. 98). The CLR model is based on several assumptions: 1.The probability distribution of ε_t is normal (normality in errors implies normality in β's); 2. Error terms are independent and identically distributed; 3. The mean of the probability distribution is zero; 4. Error terms have the same variance (homoskedasticity); 5. X_{kt}'s are non-stochastic (not random variables); 6) X_{kt} are full rank (all the X_{kt}'s are lineally independent for each other). The first four assumptions are summarized in the equation 4.4 below:

$$\varepsilon_t \overset{iid}{\approx} N(0, \sigma^2) \tag{4.4}$$

If these assumptions are held, OLS is the Best Linear Unbiased Estimator (BLUE); that is, the OLS estimators have the smallest variance of all unbiased estimators (Stock & Watson, 2006, pp. 102-107).

OLS econometric estimation techniques are used to estimate demand for different food commodities. The most common methods employed are the Almost Ideal Demand System (AIDS) (Fan & Zuiker, 1998; García, 2006; Lanfranco, Ames & Huang, 2002); the Single Equation (SE) for different functional forms using Engel analysis (Byrne, Capps, & Williams, 1993; Lanfranco, 1999; Okunade, 1992; Paulin, 2003), and the regression to obtain the Marginal Propensity to Consume (MPC) to estimate income elasticity and Box-Cox transformation (Paulin, 1998).

The single demand equation modeling framework for different functional forms is the method employed in this thesis for two main reasons. It is straightforward in the estimation, and it provides a basis for comparison with studies that estimated the demand for meat groups among the Hispanic population in the U.S. With respect to the single demand equation approach, Okunade (1992) mentioned that the consumption analysis of aggregate U.S. data for a single non-durable agricultural commodity, such as meat or coffee, has typically proceeded with the single-equation framework. The single equation approach for a "representative" consumer is a reasonably appropriate methodology, since prices and incomes are taken as exogenous (Okunade, 1992).

In the estimation of demand equations using micro-data, one issue arises that needs to be addressed. This issue is the censored-response problem and is due to individuals reporting zero consumption for a particular item in a specific period of time. The expenditures in the CES are presented on a weekly basis. Thus, it is expected that some Hispanic individuals do not consume all meat categories during the week they were interviewed. For instance, an individual could consume pork and beef during one week but not consume fish and lamb. However, this does not mean that this individual does not consume fish and lamb at all. Zero consumption is assumed to be due to sample selection. There is a decision process that has to be taken into account which in turn has to be modeled separately (Lanfranco, 1999). Not accounting for this issue will yield biased estimates. In this respect, Tobin (1958) stated that when estimating relations, the accumulation of observations with zero values, the OLS estimator produces inconsistent estimates (García, 2006). Then, the use of the OLS estimation techniques is no longer useful, given the selectivity bias problem derived from zero consumption unless we account for this

issue. To overcome the difficulty with self selectivity bias, a Two Step (TS) procedure developed by Heckman (1979) is implemented.

Two step Heckman procedure

The zero consumption is also known as the issue of Limited Dependent Variable (LDV). The LDV is broadly defined as a dependent variable whose range of values is substantively restricted (Wooldridge, 2006, p. 582). To respond to this situation, the TS procedure is employed to estimate the probability of purchase and to adjust for those who did not consume from a certain meat category on the days they answered the survey but who may consume from it on another day. The TS procedure was followed by Lanfranco (1999), Lanfranco, Ames and Huang (2002), and Garcia (2006).

Zero consumption reflects the lack of homogeneity among the surveyed Hispanic participants. In the first step of the Heckman procedure, the selection process, which is responsible for selection bias problems, is studied with the so-called selection model. The bias is caused by the existence of differences between those who consume and those who do not consume meat, and it is necessary to compare these groups. The representation of the willingness of each individual to consume one meat category can be represented as a Linear Probability Model (LPM). Equation 4.5 shows the LPM:

$$Y_t^* = \beta_k X_{kt} + \varepsilon_t \tag{4.5}$$

Y_t^* is an underlying continuous dependent variable, and it is unobserved. Instead, we observed the binary realization Y_t , which takes the value Y_t =1 (yes) when $Y_t^* > 0$, and Y_t = 0 (no) when $Y_t^* <$ 0. The LPM has two main disadvantages. First, the fitted probabilities can be less than zero or greater than one, and second, the partial effect of any explanatory variable is constant (Wooldridge, 2006, p. 582).

Equation 4.5 represents the response probability, where *X* denotes the full set of independent variables that affect the consumption dependent variable *Y*.

$$P(Y=1|X)=P(Y=1|X_1,X_2,...,X_k) \tag{4.5}$$

To avoid the LPM limitations, one can consider a class of binary response models of the form in the equation 4.6 as shown in Wooldridge (2006, pp. 583-584):

$$P(Y=1|X)=G(\beta_0+\beta_1X_1+...+\beta_kX_k)=G(\beta_0+X\beta) \tag{4.6}$$

Note that: $X\beta=(\beta_1X_1+...+\beta_kX_k)$

where G is a function taking values strictly between zero and one and states for the standard normal cumulative distribution function (cdf), which describes the probability distribution of a real valued random variable; it is expressed as the integral below:

$$G(z)=\Phi(z)\equiv\int_{-\infty}^{z}\phi(v)dv \tag{4.7}$$

where $\phi(z)$ is the standard normal density

$$\phi(z)=(2\pi)^{-1/2}\exp(-z^2/2) \tag{4.8}$$

The choice of G again ensures that equation 4.6 is strictly between zero and one for all variables.

Heckman (1979) proposed a method for dealing with the issue of zero expenditure, modeling the participation decision using a probit model that determines the response probability. In the first step, the probit equation models the process of buying or not buying a specific commodity as a binary decision. A probit regression is computed in order to estimate the probability that a given household consumes an *i* meat category.

The estimation of nonlinear binary response models, maximum likelihood estimation, is indispensable. Following Wooldridge (2006), to obtain the maximum likelihood estimator

conditional on the explanatory variables, we need the density of Y_t given X_t. We can write this as:

$$f(Y \mid X_t;\beta) = \left[G(X_t\beta)\right]^{y}\left[1-G(X_t\beta)\right]^{1-y}, Y = 0,1 \tag{4.9}$$

From this equation we can see that when $Y = 1$, we get $G(X_t\beta)$ and when $Y = 0$, we get $1-G(X_t\beta)$. Taking logs of equation 4.9, we obtain the following probit log-likelihood function, which is the specification used to estimate equation 4.9:

$$\ell_t(\beta) = Y_t \log\left[G(X_t\beta)\right] + (1-Y_t)\log\left[1-G(X_t\beta)\right] \tag{4.10}$$

So far, the estimates of the probit model do not tell about the effect of the unmeasured characteristics of the respondents on the consumption decision. This information is not available in the coefficients of the explanatory variables. Heckman (1979) noted that when self-selectivity exists, there is an omitted variable bias in the OLS estimates, with a magnitude given by the so-called Inverse Mills Ratio (IMR). If this omitted variable was included in the regression, then OLS is consistent (Lanfranco, 1999). In the Heckman procedure, the selection equation (probit model) is used to construct a selection bias control factor, which is called Heckman's Lambda or IMR:

$$\hat{\lambda} = \lambda(x_1'\hat{\beta}) = \frac{\phi(x_1'\hat{\beta}/\sigma_e)}{\Phi(x_1'\hat{\beta}/\sigma_e)} \tag{4.11}$$

IMR represents the ratio of the probability density function ϕ over the cumulative distribution function Φ. In fact, this factor is a summarizing measure which reflects the effects of all unmeasured characteristics that are related to the consumption. Then, the final equation that is estimated is augmented with the IMR (it is actually added to the data file as an additional

variable) for correcting the selectivity bias in the demand equation. This is shown in the equation 4.12.

$$Exp = f(\beta X) + \lambda \frac{\phi(x_1' \hat{\beta} / \sigma_e)}{\Phi(x_1' \hat{\beta} / \sigma_e)} \quad (4.12)$$

Following García (2006), $q = f(\beta X)$ is the equation of interest and $\frac{\phi(x_1' \hat{\beta} / \sigma_e)}{\Phi(x_1' \hat{\beta} / \sigma_e)}$ is the instrumental variable called IMR. In the final estimation, when only observations with non-limit responses are used, the IMR becomes a variable that links the participation decision and with the equation that represents the quantity demanded (García, 2006).

Empirical Model

Construction of the variables

The set of dependent and explanatory variables employed in the empirical model was constructed based on the economic and demographic profile provided in chapter three[3]. Most of the prior studies of demand for food, and specifically demand for meat, have used the CES. Having said that, the variables employed in this thesis are consistent with those used in prior research and they also follow the theory reviewed in the early section of this chapter.

The dependent variables are the expenditures on meat categories. The first step models the decision to purchase and the second step models the level of expenditures. To accomplish both steps, each meat category was coded in three different ways. For the first step, binary/dummy variables were created for defining positive expenditures, coded as value of 1, so that the contrast is made with those who did not report weekly expenditures on meat. For the

[3] Information about the questionnaire is available on the web page of the Bureau of Labor Statistics at http://www.bls.gov/cex/ced/csxsection1.htm

second step, two different variables were used, the expenditure and the log of expenditure on the $_i$ meat category. Table 4.1 shows the list of dependent variables.

Table 4.1. List of dependent variables

Variable	Description
Beef	Beef weekly expenditure
BeefD	Beef binary, 1 if consumed and 0 otherwise
LNBeef	Log of beef expenditure
Pork	Pork weekly expenditure
PorkD	Pork binary, 1 if consumed and 0 otherwise
LNPork	Log of pork expenditure
Poultry	Poultry weekly expenditure
PoultryD	Poultry binary, 1 if consumed and 0 otherwise
LNPoultry	Log of poultry expenditure
Fish&Sf	Sea food weekly expenditure
Fish&SfD	Sea food binary, 1 if consumed and 0 otherwise
LNFish&SfD	Log of sea food expenditure
Lam&Go	Mutton, lamb and goat weekly expenditure
Lam&GoD	Mutton, lamb and goat binary, 1 if consumed and 0 otherwise
LNLam&Go	Log of mutton, lamb and goat expenditure
OthM	Other meat weekly expenditure
OthMD	Other meat binary, 1 if consumed and 0 otherwise
LNOthM	Log of other meat expenditure

The CES provides consumer unit characteristics, characteristics of the reference person of the consumer unit/household and characteristics of the members of the consumer unit; these three types of consumer characteristics represent the explanatory variables of the single equation model. The consumer unit economic and demographic characteristics employed in this thesis are

household income, family size, Hispanic origin, and the region where the U.S. Hispanic respondents live. The characteristics of the reference person of the household and members of the consumer unit used refer to benefits from Food Stamp program, educational attainment, gender, and age.

The variable *income*[4] identifies the amount of the consumer unit's income before taxes in the past 12 months. This variable was coded as a continuous variable, and log transformations were also implemented on this variable. The variable *FamSize* provides information about the number of members in the consumer unit and was coded as a continuous variable. The variables representing the Hispanic origin groups are *Mex* (Mexican), *Mex-Am* (Mexican-American), *PR* (Puerto Rican), *C&SA* (Central and South American), and *OHisp* (Other Hispanic); these groups were coded as dichotomous variables. The categories Cuban, Cuban-American, and Chicano were grouped into the category Other Hispanic due to few observations in the data set. These categories allow taking into account differences in expenditures among Hispanic groups.

Accounting for the region[5] where the U.S. Hispanic respondents live, the survey includes

[4] The variable *Income* includes unemployment compensation, income from workers' compensation or veterans' benefits, including education benefits, but excluding military retirement, income from public assistance or welfare including money received from job training grants such as Job Corps, income from interest on savings accounts or bonds, income from dividends, royalties, estates, or trusts, income from pensions or annuities from private companies, military, Government, IRA, or Keogh, income or loss was received from roomers or boarders, income or loss was received from payments from other rental units, income from child support payments in other than a lump sum amount, income from regular contributions from alimony and other sources such as from persons outside the CU, other money income including money received from cash scholarships and fellowships, stipends not based on working, or from the care of foster children, annual value of Food Stamps received, wage and salary income before deductions, income or loss from nonfarm business, partnership or professional practice, income or loss from own farm, Social Security and Railroad Retirement income prior to deductions for medical insurance and Medicare Amount of Supplemental Security Income from all sources.

[5] *Midwest:* Illinois, Indiana, Iowa, Kansas, Michigan, Minnesota, Missouri, Nebraska, North Dakota, Ohio, South Dakota, and Wisconsin; *Northeast*: Connecticut, Maine, Massachusetts, New Hampshire, New Jersey, New York, Pennsylvania, Rhode Island, and Vermont; *South*: Alabama, Arkansas, Delaware, District of Columbia, Florida, Georgia, Kentucky, Louisiana, Maryland, Mississippi, North Carolina, Oklahoma, South Carolina, Tennessee, Texas, Virginia, and West Virginia. *West:*Alaska, Arizona, California, Colorado, Hawaii, Idaho, Montana, Nevada, New Mexico, Oregon, Utah, Washington, and Wyoming.

the four regions that constitute the U.S. territory; they are *Northeast*, *Midwest*, *South*, and *West*. These variables were coded as dichotomous.

The variable *FSrec* was constructed by identifying whether any members of the consumer unit received food stamps during the past 12 months, coded as value of 1 so that the contrast is made with those who did not receive that benefit.

The different levels of *education* of the household's reference person were grouped into the variable *HSedu*; this variable represents a range of respondent's education from never having attended school to high school education coded as value of 1, so that the contrast is made with those who reported to had more than high school education. The marital status was grouped into the category *Married*; thus, this variable takes a binary value comparing married reference persons, coded as value of 1, being the default of the contrast to widowed, divorced, separated, or never married. Table 4.2 shows the list of explanatory variables.

Table 4.2. List of independent variables

Variable	Description
Income	Income
FamSize	Family Size
Mex	Origin. 1 if Mexican and 0 otherwise
Mex-Am	Origin. 1 if Mexican American and 0 otherwise
PR	Origin. 1 if Puerto Rican and 0 otherwise
C&SA	Origin. 1 if Central and South American and 0 otherwise
OHisp	Origin. 1 if other Hispanic and 0 otherwise
South	Region. 1 if from the South and 0 otherwise
Midwest	Region. 1 if from the Midwest and 0 otherwise
West	Region. 1 if from the West and 0 otherwise
Northeast	Region. 1 if from the Northeast and 0 otherwise
HSedu	Education. 1 if from never attended school to high school graduate and 0 otherwise
FSrec	Food stamps. 1 if food stamps received and 0 otherwise
Married	1 if married and 0 if widowed, divorced, separated, or never married
Age	Age of the reference person
Male	Gender. 1 if male and 0 otherwise
λ_j	IMR= $\frac{\phi(x_1'\hat{\beta}/\sigma_e)}{\Phi(x_1'\hat{\beta}/\sigma_e)}$

Description of the empirical model

Two equations were estimated for each meat category. In the first step, a probit model was estimated using binary expenditure variables as dependent variables. Probit equations were complemented by the socioeconomic and demographic characteristics to test the influence of

these variables on the probability of purchase. The IMR variable was computed from this equation. Equation 4.13 shows the probit model estimated:

$$ExpD_i = \beta_0 + \beta_1 I_j + \beta_2 FamSize_j + \beta_3 Mex - Am_j + \beta_4 PR_j + \beta_5 C\ \&\ SA_j + \beta_6 OHisp_j + \beta_7 West_j + \beta_8 Midwest_j + \beta_9 Northeast_j + \beta_{10} Married_k + \beta_{11} HSedu_k + \beta_{12} FSrec_K + \beta_{13} Age + \beta_{14} Male + \mu_{ijk} \quad (4.13)$$

$_i$ refers to each meat category
$_j$ refers to each consumer unit
$_k$ refers to reference person

In the second step, two different dependent variables were used on the $_i$ meat category, the expenditure and the log of expenditure. Single expenditure equations were also complemented by socioeconomic and demographic characteristics and with the IMR. The inclusion of those factors makes it possible to know their influence on the demand of meat; in fact, equation 4.14 tells how much Hispanic groups consume meats given the likelihood to purchase. Equation 4.14 was estimated using OLS:

$$Exp_i = \beta_0 + \beta_1 I_j + \beta_2 FamSize_j + \beta_3 Mex - Am_j + \beta_4 PR_j + \beta_5 C\ \&\ SA_j + \beta_6 OHisp_j + \beta_7 West_j + \beta_8 Midwest_j + \beta_9 Northeast_j + \beta_{10} Married_k + \beta_{11} HSedu_k + \beta_{12} FSrec_K + \beta_{13} Age + \beta_{14} Male + \beta_{15} \lambda_{jk} + \mu_{ijk} \quad (4.14)$$

$_i$ refers to each meat category
$_j$ refers to each consumer unit
$_k$ refers to reference person

In equations 4.13 and 4.14, variables *Mexican* and *South* serve as comparison groups and were omitted in the estimation in order to avoid colliniarity problems. The conventionally estimated standard errors for the coefficients obtained by OLS in this case are not consistent estimates. Better estimates can be obtained, however, by using the heteroskedastic-consistent

standard errors (Hall & Cummins, 2006). To account for this fact, the ROBUST option in OLS was employed. Sample statistics can be seen at the end of this chapter in tables 4.3 and 4.4.

The expenditure elasticities were estimated from the model in equation 4.14. In this respect, Engel curves regress expenditures of a particular commodity as a function of income, holding all prices fixed; different functional forms have been used to estimate Engel curves. The functional forms followed for this research are the Direct Linear model (LM), Semi-Logarithmic model (SL), and the Double-Logarithmic model (DL). Following Lanfranco (1999), these three functional forms can be specified as follows:

$$Exp_j = \alpha_j + \beta_i y \qquad \text{(LM)}$$

$$Exp_j = \alpha_j + \beta_i \ln y \qquad \text{(SL)}$$

$$\ln Exp_j = \alpha_j + \beta_i \ln y \qquad \text{(DL)}$$

Sadoulet and Janvry (1995) indicate that these three models have been commonly used in empirical work (Lanfranco, 1999). To estimate Engel curves, Lanfranco (1999) used the above particular forms in his research. The use of these three different forms also allows the researcher to test the sensitivity of the results.

The expected signs in the above model are stated under the *ceteris paribus* condition; in the first step, a positive sign indicates an increase in the likelihood of purchase. A positive sign in the second step indicates an increase in the decision of how much to consume. As far as *income* is concerned either a positive or a negative sign can be expected; a positive sign will refer to a normal good, and a negative sign will refer to an inferior good. Moreover, a negative

sign means income is associated with a reduction in probability to consume meat or reduction in expenditures.

For the *family size*, a positive sign is expected, because as household members increase, an increase in meat consumption is also expected. As far as the *region of origin* goes, the expected sign can be either negative or positive, depending on the preferences of each group of origin of Hispanics. For instance, a negative (positive) sign in the variable $Mex - Am_j$ will mean that compared to Mexicans, Mexican-Americans consume less (more) of the *i* meat category. With respect to *marital status*, a positive sign is expected for the reference group married, contrasting never married, widowed, divorced, or separated.

In regards to *food stamps*, the expected sign is positive for beef, pork, and poultry, because the food stamp program helps low-income people buy the food they need for good health, increasing the recipients' purchasing power and as a result increasing the expenditures in meat groups. As far as *education* goes, the outcome can be either positive or negative; a negative sign means education is associated with a reduction in consumption and may be associated with health perceptions. A positive sign means education is associated with an increase in purchasing power, resulting in an increase in meat consumption. Age and gender of the household reference person, as well as the region of domicile, have an indeterminate expectation on direction of probability of purchase and levels of expenditures.

In the next chapter, results of the econometric estimation are presented. Discussion of inferences and comparisons to previous studies are also presented.

Table 4.3. Sample statistics (dependent variables)

Variable	N	Mean	Std Dev	Minimum	Maximum
Beef	770	4.94569	6.15613	0	31.34
LNBeef	770	1.11516	1.06618	-3.5066	3.4449
BeefD	770	0.62857	0.4835	0	1
Pork	770	2.69822	3.86901	0	19.1734
LNPork	770	0.70921	0.88096	-2.8134	2.95352
PorkD	770	0.52987	0.49943	0	1
Poultry	770	3.40661	4.43063	0	28.295
LNPoultry	770	0.88294	0.9203	-0.6349	3.34269
poultD	770	0.59221	0.49174	0	1
Lam&Go	770	0.24872	1.16204	0	14.61
LNLam&Go	770	0.07228	0.33063	-1.0642	2.68171
Lam&GoD	770	0.06494	0.24657	0	1
Fish&Sf	770	1.75566	3.23281	0	16.95
LNFish&Sf	770	0.45068	0.79831	-1.1712	2.83027
Fish&SfD	770	0.36364	0.48136	0	1
OthM	770	1.69955	2.60982	0	18.55
LNOthM	770	0.4611	0.72104	-1.8643	2.92047
OthMD	770	0.51558	0.50008	0	1

Table 4.4. Sample statistics (independent variables)

Variable	N	Mean	Std Dev	Minimum	Maximum
Income	770	40912	31788	11	174777
LNInc	770	10.2714	0.97442	2.3979	12.07127
FamSize	770	3.28442	1.76098	1	13
Mex	770	0.36623	0.48209	0	1
Mex-Am	770	0.28571	0.45205	0	1
OHisp	770	0.13896	0.34613	0	1
PR	770	0.08961	0.28581	0	1
C&SA	770	0.11948	0.32456	0	1
Married	770	0.57662	0.49442	0	1
South	770	0.35195	0.47789	0	1
Northeast	770	0.14675	0.35409	0	1
Midwest	770	0.1	0.30019	0	1
West	770	0.4013	0.49048	0	1
HSedu	770	0.59221	0.49174	0	1
FSrec	770	0.13117	0.3378	0	1
Age	770	42.1701	15.088	17	86
Male	770	0.48052	0.49995	0	1

CHAPTER 5

EMPIRICAL RESULTS

In this chapter, I discuss the results obtained from the econometric models (equations 4.13 and 4.14) described in chapter IV. The first section presents broad considerations and general discussion about the estimations. Some thoughts about the income variable and expenditure elasticities are presented. The second part shows the results obtained for each meat category in the First Step (FS) of the Heckman procedure, the likelihood of purchase equations for the six meat categories proposed, then the results obtained in the Second Step (SS) from the Double-Logarithmic model (DL), Direct Linear model (LM), and Semi-Logarithmic model (SL) in terms of the decision to consume the six meat categories proposed. The last part of this research communicates the comparison of my results with prior research.

General Considerations

The econometric models for the First Step (FS) and the Second Step (SS) for each meat category were estimated using the software Time Series Processor (TSP) version 5.0. The TSP is a general-purpose computer language for econometric and statistical data processing and estimation. SAS 9.1 was utilized to create the Excel spread sheet from which TSP computed the estimations. Both TSP and SAS programs are available upon request.

The overall intention of the estimation procedure was to explain how the U.S. Hispanic groups allocate their food budgets given socioeconomic and demographic characteristics. Then, factors such as income, family size, Hispanic origin, geographic location, and other demographics variables were tested to check their influence on the likelihood of purchase and the propensity to consume meat.

In regards to general results, the SS results showed a considerable number of explanatory variables not statistically significant at the standard levels of significance, principally in the cases of pork, lamb and goat, fish and seafood, and other meats. However, some of the explanatory variables in those expenditure estimates were found to be statistically significant in the likelihood to purchase. The same number of variables in the FS and in the SS was used for the six meat categories. Tomek and Robinson (1990) recommend retaining variables with *t-values* of one or larger; this is a common criterion for adding or dropping variables. This standard is based on the notion that variables that are deemed logical in the model should not be dropped on stringent statistical grounds (Tomek and Robinson, 1990).

The discussion of the results presented in this chapter includes those variables that are statistically significant at less than 10%, and those that show a *t-value* greater than one; in either case, the levels of significance are specified through the discussion. In both cases, the expenditure of beef and poultry performed better in both steps. Before going into further detail of the FS and SS estimates, some thoughts are presented about the income variable and expenditure elasticities.

Expenditures on Meat Groups

The sign of the income variable was found to be negative in the first step and in the DL estimates of second step for beef, pork, poultry, lamb and goat, fish and sea food. These results for the DL would generally imply that these meat categories are inferior goods for U.S. Hispanics, meaning that as U.S. Hispanics' incomes increase, they consume less meat. The opposite results were found when using the LM estimations; LM showed income with a positive sign for pork, poultry, fish and seafood, and other meats, revealing these expenditures appeared to be normal goods and meaning that, as income increases, U.S. Hispanics consume more of

those meats. However, the income variable was found to be not statistically significant at 10% in most of these DL and LM estimations. So, to consider these meat categories as inferior or as normal goods for this sample is not possible, at least statistically speaking. Hispanic household expenditures and income had high variation, measured in terms of the standard deviation. Outliers for beef, pork and sea food expenditures were removed, using only expenditures within three standard deviations from their mean. Even so, plots of the income and expenditures showed that there is no consistent pattern in the relationship between these two variables.

Given the low levels of significance in the income variable, it is difficult to make inferences about the expenditure elasticities, at least given the expenditures utilized. A scatter diagram was made to confirm the negative relation between the log of income and the log of meat expenditures. As with the plot of the relation between expenditures and income, the plot of log of income and log of expenditures showed no clearly positive or negative consistent pattern. This may be one of the reasons why the income variable was found to be not significant and with a negative sign in DL model. These graphs are shown in appendix B.

Another point to keep in mind is the fact that these meat expenditures are the sum of other sub-categories. As an example, the beef expenditure includes other beef sub-categories such as ground beef, chuck roast, round roast, other beef roast, round steak, sirloin steak, other steak, and other beef. In the components of the beef category, there are some expenditures generally considered normal goods ($\eta_Q > 0$), such as steak (sirloin and other steak), and inferior goods ($\eta_Q < 0$), such as ground beef and chuck roast. The interaction among these beef categories could cancel out the effects between the categories. This may cause the income variable to be not significant at the standard levels for the meat categories proposed in the DL and LM. In this respect, Lanfranco (1999) pointed out that one possible explanation in not

finding precise estimates in the elasticities occurs when using broad categories with different quality characteristics, which are lost when estimated as aggregate commodities (Lanfranco, 1999).

As an example showing that these effects could cancel each other, an estimation using two groups from the beef category was performed. The SS for ground beef and chuck roast showed Hispanics consume less of these two expenditures as income increases (inferior goods); the second step for sirloin and other steak showed that Hispanics consume more of these two expenditures as income increases (normal goods).

The FS models the likelihood of purchase; the variables used in this stage are determinants of whether the Hispanics buy or not buy the meat categories proposed. The variables used in the SS are determinants of Hispanic expenditures on meats consumption given the likelihood to purchase

The goodness-of-fits of the equations were low, with R^2 ranging from 0.03 to 0.33. The high levels of censoring and left skewed distributions of expenditures are possible causes of this outcome. Additionally, fewer socio-economic variables had significant effects on the decision of how much to purchase than on the probability of purchasing meats. However, several variables were found to influence the consumption of beef, poultry, other meats and pork products.

With regard to the fish and seafood, and the lamb and goat expenditures, no socioeconomic or demographic characteristics were found to determine how much the Hispanic households spend for those categories. These results were to be expected for lamb and goat, since only 50 observations out of 770 were positive. For fish and seafood, there may be other variables related to taste and preference that affect the decision of how much to consume that

were not considered for this study. The empirical results of the decision to purchase beef, pork, poultry, and other meats for the DL are discussed below.

The following sections discuss the results of the probability of purchase of meat group and the expenditure decision estimations in the second stage. The tables showing these results accompany these discussions.

Beef Consumption

Starting with *beef*, some variables were found to have statistical significance at less than 10%; For instance, it was found that income affects the probability of buying this meat category. In fact, the higher the income, the less the likelihood of beef consumption (5%). The results also show that, as family size increases, Hispanics are more likely to consume beef (1%).

There was a significant difference (at 5%) in the likelihood of beef consumption among Puerto Ricans and Mexicans. In fact, Puerto Ricans were less likely to consume beef than Mexicans. Hispanic households living in the Midwest were found to be more likely to consume beef than those living in the South (5%). Households with married reference person were more likely to consume beef than households with unmarried, divorced, single or separated reference persons (1%).

High school education and age of the household's reference person were not statistically significant at 10% but their *t-value* was greater than 1. The effects of these variables showed that high school education decreases the likelihood of consuming beef, and the likelihood of purchasing beef is lower as age of the household's reference person is higher.

The beef expenditures model performed well in the Second Stage (SS). The results for beef in the DL model show that, as family size increases, the consumption on beef increases (5%). With regard to Hispanic origin, there is a significant difference (at 5%) in the decision on

how much beef to purchase among Puerto Ricans and Mexicans; whereby, Puerto Ricans consume less beef than Mexicans. Hispanic households in the Midwest (5%) and in the Northeast (1%) consume more beef than Hispanic households living in the South.

Households with married reference person consume more beef than households with unmarried, divorced, single or separate reference persons (5%). It was also found that households with a reference person with less than high school education consume less beef than one with more than high school (5%). On the other hand, households receiving food stamps (10%) tend to consume more beef. The same is true for the gender variable, since households with a male reference person were found to consume more beef than those with a female reference person (11%). The LM and SL results showed similar effects. The only discrepancy arose in terms of the levels of significance for recipients of food stamps, age and male. Table 5.1 shows these estimates.

Table 5.1. Beef: Parameter estimates of U.S. Hispanic meat consumption, 2005

Variable	Probit	DL	SL	LM
Income				-.908804E-05 (.262592E-04)
LNInc	-.147542 b (.060353)	-.118455 (.112115)	-.247736 (.813793)	
FamSize	.111839 a (.035296)	.183184 b (.081691)	.985812 c (.586039)	.977242 c (.578879)
Mex-Am	-.117351 (.123752)	-.151884 (.140175)	-.752074 (.964077)	-.702016 (.918168)
OHisp	.118290 (.165256)	.014400 (.118820)	.041699 (.996682)	.048789 (.997302)
PR	-.414244 b (.204176)	-.012245 b (.137709)	-.513641 c (1.05648)	-.594810 c (1.00368)
C&SA	-.044620 (.165473)	-.900838 (.381864)	-5.06950 (2.85624)	-5.02947 (2.79852)
Married	.285330 a (.109961)	.084146 b (.104644)	.482839 c (.824149)	.450859 d (.816291)
Northeast	.042426 (.164715)	.629225 a (.296696)	3.30993 c (2.40415)	3.19754 c (2.33623)
Midwest	.462104 a (.186457)	.310443 b (.113621)	1.61323 d (.901599)	1.60708 d (.908563)
West	-.077508 (.114230)	.530651 (.238577)	2.81472 (1.66220)	2.71379 (1.59441)
HSedu	-.107435 .103808	-.234690 b (.112319)	-1.51304 c (.830310)	-1.43397 c (.777620)
FSrec	.139674 (.157814)	.264023 c (.159039)	1.75035 d (1.25190)	1.59591 d (1.26801)
Age	-.392993E-02 (.331941E-02)	-.430907E-02 (.366304E-02)	-.013750 (.028544)	-.010839 (.025444)
Male	-.019132 (.097500)	.117106 d (.074497)	.623647 (.601575)	.680650 (.587104)
IMR		2.81275 b (1.40234)	14.3138 d (10.2474)	13.7803 d (9.91013)

Note: Std Errors in parenthesis. Significance: a -1% level; b -5% level; c -10% level; d -20% level. Probit (Fraction of correct predictions = 0.675);
DL (R^2=0.078); SL (R^2=0.059); LM (R^2=0.058)

Pork Consumption

The results for *pork* show that family size increases the probability of consuming pork (1%). There was a significant difference (at 10%) in the likelihood of consuming pork among Central and South Americans and Mexicans; that is, Central and South Americans were less likely to consume pork products than Mexicans. Households with married reference person were more likely to consume pork than households with unmarried, divorced, single or separated reference persons (1%). It was also found that as age increases, the likelihood of purchasing pork decreases (10%). Income and high school education of the household's reference person were found to be important, but they had less than a 20% level of significance. Likewise, income and high school education decrease the likelihood of purchasing pork.

Differences among Hispanic groups and regional differences were not significant at 10%, but their *t-value* was greater than 1. These results imply that Mexican Americans are less likely to consume beef than Mexicans, and Hispanic households living in the Midwest were found to be more likely to consume pork than those living in the South.

With regard to the SS, Hispanic origin was found to affect the consumption of pork products; however, this result was at less than 18% significance. Other Hispanics were found to consume more pork products than Mexicans. Table 5.2 shows these estimates.

Table 5.2. Pork: Parameter estimates of U.S. Hispanic meat consumption, 2005

Variable	Probit	DL	SL	LM
Income				.185470E-05 (.276713E-04)
LNInc	-.085492 d (.057595)	.023574 (.129839)	.101841 (.758981)	
FamSize	.085694 a (.033410)	.082529 (.119169)	.478856 (.718140)	.501385 (.754686)
Mex-Am	-.135843 (.120834)	-.206695E-03 (.233196)	.129172 (1.27592)	.096249 (1.19173)
OHisp	.102194 (.161209)	.273680 d (.202453)	1.30770 (1.17203)	1.32323 (1.23061)
PR	-.101622 (.200703)	.013630 (.230450)	.222518 (1.29201)	.182317 (1.27744)
C&SA	-.294970 b (.161723)	.057598 (.479471)	.201229 (2.79614)	.116380 (2.70795)
Married	.327086 a (.106913)	-.024994 (.522560)	-.018647 (2.99982)	.063205 (3.01743)
Northeast	-.466337E-02 (.161423)	.075252 (.139424)	.039877 (.711858)	.036169 (.717514)
Midwest	.214588 (.172457)	.089492 (.336736)	.934557 (1.94906)	.981262 (1.97916)
West	.054127 (.112056)	.089213 (.128963)	.123541 (.699396)	.121302 (.732001)
HSedu	-.147540 d (.100548)	-.096485 (.231038)	-.640870 (1.34605)	-.670912 (1.27645)
FSrec	-.023896 (.151264)	-.047131 (.128142)	-.122175 (.648511)	-.161533 (.637041)
Age	-.602326E-02 b (.325001E-02)	.599662E-02 (.987513E-02)	.029612 (.056138)	.027976 (.053015)
Male	.093387 (.095060)	058219 (.154611)	.440576 (.897938)	.455641 (.948698)
IMR		-.118125 (2.47169)	1.11446 (14.2702)	1.50169 (14.3451)

Note: Std Errors in parenthesis. Significance: a -1% level; b -5% level; c -10% level; d -20% level. Probit (Fraction of correct predictions = 0.593); DL (R^2=0.072); SL (R^2=0.064); LM (R^2=0.064)

Poultry Consumption

For poultry, results show that as family size increases, Hispanics are more likely to consume poultry products (1%). Income was also found to be significant in the purchasing decision; in fact, the higher the income, the less likelihood of poultry consumption (5%). There was a significant difference (at 1%) in the likelihood of poultry consumption among other Hispanics and Mexicans, that is, other Hispanics are more likely to consume poultry products than Mexicans (1%). Hispanic households living in the Midwest were found to be less likely to consume poultry than those living in the South (10%)

It was also found that households with married reference person are more likely to consume poultry than households with unmarried, divorced, single or separated reference persons; this effect was not significant at 10%, but their *t-value* was greater than 1. As age of the household's reference person is higher, the likelihood of purchasing poultry products increases. Households with a male reference person are more likely to purchase poultry products than those with female reference person. Age and gender of the household's reference person were not significant at less than 10%, but their *t-value* was greater than 1.

The results for poultry in the DL of the SS model show that, as family size increases, the consumption of poultry also increases (10%). Hispanic origin was also found to affect the consumption of poultry; there was a significant difference (at 5%) in the consumption of poultry products among Central and South Americans and Mexicans; with, Central and South Americans consuming more poultry products than Mexicans.

Gender (1%) also influences the consumption of poultry category, since households with a male reference person were found to consume more poultry products than those with a female reference person. The LM and SL results showed similar effects. On the other hand, the

Midwest, high school education, and food stamp recipients were not significant at 10%. However, their *t* estimated *value* was greater than 1. Table 5.3 shows these estimates.

Table 5.3. Poultry: Parameter estimates of U.S. Hispanic meat consumption, 2005

Variable	Probit	DL	SL	LM
Income				.111964E-05 (.152744E-04)
LNInc	-.116233 b (.058751)	-.055800 (.071562)	-.115119 (.487870)	
FamSize	.131493 a (.033995)	.129439 c (.076090)	.555559 (.522331)	.670142 d (.506874)
Mex-Am	-.115317 (.121463)	-.077053 (.124563)	-.329640 (.757642)	-.584676 (.727325)
OHisp	.459657 a (.168632)	.246888 (.276318)	.924860 (1.88666)	1.41028 (1.82724)
PR	-.072552 (.204354)	-.054060 (.159168)	-.054597 (1.06075)	-.277795 (1.01186)
C&SA	.153888 (.165325)	.308032 b (.144436)	1.60186 c (.964144)	1.74242 c (.981827)
Married	.160713 d (.107998)	.081487 (.129829)	.174308 (.861350)	.351690 (.842049)
Northeast	.142652 (.167231)	.123358 (.138918)	-.011579 (.958023)	.221489 (.947148)
Midwest	-.283516 c (.172629)	-.252764 (.228908)	-1.17472 (1.47945)	-1.55136 (1.44525)
West	-.027124 (.113005)	-.030509 (.085171)	-.332053 (.494855)	-.383818 (.495199)
HSedu	-.097172 (.101934)	-.115742 (.095094)	-.392763 (.610264)	-.621260 (.584991)
FSrec	-.036260 (.153656)	-.117968 (.104385)	-.659656 (.621634)	-.458353 (.618207)
Age	.343262E-02 (.329045E-02)	-.200211E-02 (.304741E-02)	-.929308E-02 (.018605)	-.305455E-02 (.019996)
Male	.106362 (.095964)	.263077 a (.085736)	1.29672 b (.552043)	1.40567 b (.565964)
IMR		.890604 (1.11671)	2.36728 (7.34842)	4.90798 (7.11231)

Note: Std Errors in parenthesis. Significance: a -1% level; b -5% level; c -10% level; d -20% level. Probit (Fraction of correct predictions = 0.637); DL (R^2=0.074); SL (R^2=0.061); LM (R^2=0.065)

Lamb and Goat Consumption

There is a significant difference (at 10%) in the likelihood of consuming lamb and goat among Puerto Ricans and Mexicans, that is, Puerto Ricans are less likely to consume lamb and goat than Mexicans. On the other hand, as age of the household's reference person is higher, the likelihood of purchasing lamb and goat increases (9%).

Hispanic households living in the Midwest were more likely to consume lamb and goat than those living in the South, but the differences, while perhaps important, were not significant at 10%. In terms of region of origin, there was a difference (at less than 20%) in the likelihood of consuming lamb and goat among Central and South Americans and Mexican Americans compared to Mexicans; whereby, Central and South Americans and Mexican Americans were less likely to consume lamb and goat than Mexicans. Households with a married reference person were more likely to consume lamb and goat than households with unmarried, divorced, single or separated reference persons (20%). Table 5.4 shows these estimates.

Fish and Sea Food Consumption

Northeast households were found to be more likely to consume fish and seafood than household in the South (5%). Households with a married reference person were more likely to consume fish and seafood than an unmarried, divorced, single or separated reference person (1%). The age and gender variables were also significant at less than 10%. In fact, as age increases, the likelihood of purchasing fish and seafood decreases (10%); males are more likely to purchase fish and seafood (10%). Puerto Ricans and Mexican Americans are less likely to consume fish and seafood than Mexicans, but the differences, while possibly important, were not significant at 10%. Table 5.5 shows these estimates.

Table 5.4.Lamb and goat: Parameter estimates of U.S. Hispanic meat consumption, 2005

Variable	Probit	DL	SL	LM
Income				-.248804E-03 (.379974E-03)
LNInc	-.114068 d (.085100)	-.152676 (2.46772)	-3.45138 (11.2287)	
FamSize	.014671 (.051431)	.109094 (.334556)	.742537 (1.38748)	1.43495 (1.57354)
Mex-Am	-.213651 (.189273)	-.695423 (4.60563)	-7.36229 (21.5271)	-13.3278 (20.3567)
OHisp	-.243415 (.253180)	-.802272 (5.26331)	-9.05771 (24.6451)	-15.6786 (23.3673)
PR	-.642017 c (.379237)	-2.03983 (13.8553)	-22.4622 (64.8772)	-41.3219 (62.6094)
C&SA	-.359444 d (.274150)	-.931578 (7.80864)	-11.7696 (36.6193)	-21.5190 (34.1214)
Married	.220257 d (.172519)	.366518 (4.73555)	6.63969 (22.2892)	12.5895 (20.4998)
Northeast	.104083 (.264596)	.474535 (2.31541)	4.52662 (10.8804)	7.75143 (10.5596)
Midwest	.311890 d (.237977)	1.01285 (6.65069)	10.8687 (31.3621)	19.2508 (29.5479)
West	-.178714 (.180930)	-.623270 (3.90233)	-6.03427 (18.4716)	-11.1311 (17.5976)
HSedu	-.117195 (.155634)	.031137 (2.52142)	-2.87425 (12.1745)	-5.44045 (10.5588)
FSrec	-.057157 (.237468)	-.296639E-02 (1.29134)	-1.64542 (5.97170)	-2.39152 (4.14844)
Age	.880908E-02 c (.512249E-02)	.015230 (.190291)	.256933 (.895377)	.548108 (.911820)
Male	.138914 (.148892)	.753751 (2.96844)	6.07405 (13.8311)	9.84825 (13.2993)
IMR		2.53190 (25.4308)	36.9997 (119.587)	70.1269 (113.397)

Note: Std Errors in parenthesis. Significance: a -1% level; b -5% level; c -10% level; d -20% level. Probit (Fraction of correct Predictions = 0.935); DL (R^2=0.332); SL (R^2=0.299); LM (R^2=0.317)

Table 5.5. Fish and seafood: Parameters estimates of U.S. Hispanic meat consumption, 2005

Variable	Probit	DL	SL	LM
Income				.106876E-04 (.463916E-04)
LNInc	-.062127 (.058606)	-.051528 (.205328)	.048315 (.948418)	
FamSize	.019390 (.033129)	.025760 (.085925)	.129752 (.376891)	.041686 (.476275)
Mex-Am	-.174088 d (.124982)	-.158853 (.636612)	.087921 (2.91482)	.664350 (2.58741)
OHisp	.089978 (.160951)	-.027319 (.390500)	-.378174 (1.72610)	-.759377 (1.94159)
PR	-.314726 d (.210029)	-.247445 (1.06926)	.244098 (4.81663)	1.30278 (4.50683)
C&SA	-.072042 (.164297)	.028052 (.312279)	.486807 (1.42139)	.683960 (1.16479)
Married	.422034 a (.110729)	.534450 (1.51767)	.522801 (6.88263)	-1.01649 (6.79280)
Northeast	.355884 b (.164352)	.606985 (1.19387)	.949882 (5.41962)	-.293075 (5.39506)
Midwest	-.050371 (.175265)	.865114E-02 (.268348)	-.077764 (1.19076)	.082558 (1.11158)
West	.835493E-02 (.114908)	-.076221 (.146766)	-.522406 (.598276)	-.576901 (.619648)
HSedu	.021106 (.102245)	.091945 (.125964)	.374391 (.543195)	.270951 (.707533)
FSrec	-.079573 (.154657)	.087875 (.352248)	.637422 (1.58365)	.949195 (1.73645)
Age	-.596397E-02 c (.337442E-02)	-.797185E-02 (.022487)	-.630330E-02 (.103016)	.014327 (.095002)
Male	.165634 c (.096612)	.163642 (.599249)	-.119670 (2.72001)	-.737614 c (2.72821)
IMR		1.30630 (5.11681)	-.536328 (23.2493)	-5.67704 (22.5219)

Note: Std Errors in parenthesis. Significance: a -1% level; b -5% level; c -10% level; d -20% level. Probit (Fraction of correct predictions = 0.658); DL (R^2=0.034); SL (R^2=0.038); LM (R^2=0.039)

Other Meats Consumption

Variables that were found to be significant at less than 10% were family size and male. These two variables increase the probability of consumption in the other meat category. Income and Hispanic households living in the West were not significant at less than 10%, but their parameters had a *t* estimated *value* greater than 1. Higher income was found to increase the probability of consuming other meats. Hispanic households living in the West were found to be less likely to consume other meats than those living in the South.

Differences were found in consumption for Hispanic groups in the DL of the SS model. It was found that there is a relevant difference in the decision to consume other meats among Puerto Ricans (16%) and Central and South Americans (17%) compared to Mexicans; Puerto Ricans consume more and Central and South Americans consume less of other meat products than Mexicans. As age increases, the consumption of beef also increases (17%). However, the differences in consumption by Hispanic origin groups and age, while perhaps important, were not significant at 10 %. Table 5.6 shows these estimates.

Table 5.6. Other meats: Parameter estimates of U.S. Hispanic meat consumption, 2005

Variable	Probit	DL	SL	LM
Income				.138119E-04 d (.889745E-05)
LNInc	-.063622 (.056902)	.054189 (.071297)	.261498 (.280156)	
FamSize	.216098 a (.035569)	-.040913 (.135169)	-.096087 (.617205)	-.096856 (.689591)
Mex-Am	.357235E-02 (.122081)	-.037781 (.100002)	-.291936 (.356913)	-.404488 (.363498)
OHisp	.074772 (.160234)	.123836 (.145876)	.232082 (.621826)	.107941 (.615695)
PR	-.200535 (.202509)	.362780 d (.259309)	1.33222 (1.07063)	1.20634 (1.09897)
C&SA	-.082487 (.163836	-.212770 d (.157012)	-.567487 (.534185)	-.692390 d (.531420)
Married	.030766 (.107602)	-.895803E-02 (.100863)	.076012 (.343974)	.039119 (.340673)
Northeast	-.301455E-02 (.161895)	.077417 (.133026)	.223963 (.553842)	.131599 (.546582)
Midwest	.082857 (.172264)	-.013607 (.159352)	.137604 (.553746)	.102988 (.564672)
West	-.123708 (.112457)	-.091653 (.132317)	-.400063 (.518763)	-.490621 (.539774)
HSedu	-.015300 (.101290)	-.055704 (.087524)	-.167652 (.344420)	-.233293 (.349356)
FSrec	-.015390 (.151106)	-.124463 (.145076)	-.054046 (.476281)	.033653 (.456472)
Age	.118556E-02 (.326955E-02)	.396644E-02 d (.291888E-02)	.011975 (.980634E-02)	.918717E-02 (.010071)
Male	.154575 c (.095590)	.108148 (.133660)	.386373 (.542420)	.394909 (.596992)
IMR		-.667122 (1.12461)	-1.76604 (4.99322)	-1.38874 (5.55394)

Note: Std Errors in parenthesis. Significance: a -1% level; b -5% level; c- 10% level; d -20% level. Probit (Fraction of correct Predictions = 0.609); DL (R^2=0.066); SL (R^2=0.063); LM (R^2=0.073)

Comparison with Prior Research

Comparative results are provided to verify whether changes in consumption patterns within the U.S. Hispanic community exist with studies using datasets from earlier years and to determine whether different methodologies bring different outcomes. More details of the studies that will be compared can be found in chapter two.

In general, the above results are consistent with demand studies previously undertaken for the U.S. Hispanic population. Although it is difficult to compare the results of meat expenditures in the discussion of consumption patterns of aggregate expenditures, some outcomes can be compared. For instance, Paulin (1998) found that three demographic characteristics affected expenditure patterns: income, family size, and age. Paulin (1998) also found that ethnicity is a factor that influences one's tastes and preferences, so differences existed among expenditure patterns across the Hispanic subgroups. The current thesis supports Paulin's study in the sense that different patterns exist across Hispanic groups as well as the importance of family/household size in consumption patterns.

In regards to the studies of the demand for meat, my household size effect results support those estimated by Lanfranco, Ames and Huang (2002); that is household size had a positive effect on the probability of consuming particular meat products. Furthermore, these authors also found that the demand for chicken appeared to be least responsive to the changes in household income; the same result can be inferred from my study, since income was found to be not significant for poultry products. The results of the current thesis also agree with Lanfranco (1999), because national origin plays an important role in the demand for specific food groups.

On the other hand, there are some differences in my results with those found in the past. For instance, Paulin (2003) showed that neither Hispanic group differed in a statistically

significant way from Mexican families. This conclusion indicated homogeneity by origin for food at home expenditures. My conclusions from current results were different from his study (1998). In the current thesis, household size had a positive effect on beef and poultry. This differs from the outcomes of Lanfranco, Ames and Huang (2002), because they found that household size had a negative effect on the amount of money spent on that item, especially among the higher-priced meats.

Since Lanfranco (1999) conducted a study on the demand for food among the Hispanic population in the U.S. observing similar Hispanic groups, a more detailed comparison can be made. For instance, Lanfranco (1999) found that the only relevant variable for beef was household size. As shown in the current study, besides household size, there were other important variables in determining the consumption of beef, such as Hispanic origin, region (Midwest/Northeast), marital status, high school education, gender, and recipients of food stamps. Furthermore, Lanfranco's study (1999) found that household size was not very important as far as the consumption of pork and chicken was concerned. The current study agrees with Lanfranco's findings on pork consumption but disagrees with his conclusions about chicken, since household size was indeed important in consumption of poultry products.

Differences were also found in terms of the Hispanic origin. Lanfranco (1999) found that Cubans and Mexicans consume less pork than other meats. In the current thesis, Other Hispanics (Other Hispanic includes Cubans) consume more pork than Mexicans. So far as the regional effects go, Lanfranco (1999) found that the West region consumed more pork and chicken than the Northeast, the Midwest, and the South. According to my results, none of the regions were important in determining the consumption of pork. Also, while the West was not important for poultry products, the Midwest was.

There are several reasons why differences between the estimation of my research and prior estimations were found. These may be due to changes in the demographic characteristics, especially the growth of the U.S. Hispanic population and the growth of U.S. Hispanics buying power. Discrepancies with Lanfranco (1999) could arise from the fact that he used data from 1994.Furthermore, changes within Hispanic consumer preferences could have occurred in 11 years. Another fact to keep in mind is that he used a different classification of meat categories. Conclusions, implication and limitations of this study will be discussed in the next chapter.

CHAPTER 6

CONCLUSIONS, IMPLICATIONS, LIMITATIONS AND FUTURE RESEARCH

The overall objective of this thesis was to study the consumption behavior of the U.S. Hispanic population for high-valued foods in the meat categories with regard to income and selected socioeconomic and demographic characteristics. The meat categories studied included: beef, pork, poultry, fish and seafood, lamb and goat, and other meats. This study hypothesized that cultural differences prevail among Hispanic communities and that these differences affect their meat consumption patterns.

The analysis was performed using data from the 2005 Consumer Expenditure Survey (CES). The sample containing the socioeconomic and demographic profile comprised 877 Hispanic households. The demographic profile of the Hispanic groups showed Hispanics are not a homogeneous group. Outstanding differences were found in variables such as geographic distribution, age, household size, income, education, and family composition. The purpose in showing these dissimilarities in the socioeconomic and demographic characteristics of Hispanic groups is to help the food distribution industry in general when deciding marketing strategies in the future. These dissimilarities among Hispanic groups also justified the differentiation in the Hispanic category by ethnic origin in the analysis of their meat expenditures.

Hispanic household expenditures and income were found to have high variation, measured in terms of their standard deviations. Beef, pork and seafood consumption were estimated using only expenses within three standard deviations from their mean. The sample was also limited to consumer units within three standard deviations from the mean income. Although

this treatment of outliers in the data further limited the sample size, the final data set provided more uniformity and robustness in the implications of the model. The resulting data set contained 770 households.

Two equations were estimated for each meat category. In the first step, a probit model was estimated using binary expenditure variables as dependent variables. Probit equations included socioeconomic and demographic characteristics to test the influence of these variables on the probability of purchase. An Inverse Mills Ratio (IMR) variable was computed from this equation. In the second step, two different dependent variables were used, the expenditure and the log of expenditure. Single expenditure equations were also complemented by socioeconomic and demographic characteristics and with the IMR. The functional forms used in the second step were the Direct Linear model (LM), the Semi-Logarithmic model (SL), and the Double-Logarithmic model (DL). Based on the *t* statistics and goodness of fit measures, estimates of beef and poultry expenditures performed better in first and second steps than did the modeled expenditures on other meat categories.

The income variable was found to be negative in the first step and in the DL model of the second step for beef, pork, poultry, lamb and goat, fish and seafood. However, this variable was found not to be significant at 10% level in most of the DL and Linear Model (LM) estimations. The low levels of significance in the income variable did not allow making inferences about the expenditure elasticities (i.e, elasticities were not significantly different from zero, meaning no significant response to income). One thing to keep in mind in interpreting the significance household income is the fact that the expenditures on meat groups utilized broad categories.

The interaction of decision within these meat categories could offset the effects among the sub-categories. This was demonstrated for two subgroups of beef: ground beef and chuck

roast and sirloin and other steak. The first showed Hispanics consume significantly less ground beef and chuck roast as income increases (inferior goods); and the latter showed that Hispanics consume more sirloin and other steak as income increases (normal goods).

In terms of demographic results, it was found that family size is more important than income in determining the likelihood of purchase. Once a household chooses to consume, family size remains more important than income in the decision to increase expenditures on meats. In general, household size was remarkably important for all models and estimations.

As hypothesized in this thesis, being from different regions of origin affected the probability of purchase, as well as the expenditure decision. In terms of the probability of purchasing, for instance, it was found that Puerto Ricans are less likely to consume beef and lamb and goat that are Mexicans, Central and South Americans are less likely to consume pork, and other Hispanics are more likely to consume poultry products (in each case, the comparison group was Mexicans). In terms of the expenditure decision, beef, poultry and other meats were the meat categories significantly affected by region of origin. In this respect, Puerto Ricans spend less on beef and more on other meats than do Mexicans, and Central and South Americans spend more on poultry products than do Mexicans.

Being from different regions of the U.S. also affected the likelihood of purchase. For example, households in the Midwest are more likely to consume beef and lamb and goat; those in the Northeast are more likely to consume fish and seafood. In terms of the expenditure decision, households living in the Northeast consume more beef than those living in the South.

Other demographic characteristics were also found to affect the likelihood of purchasing meats, such as marital status, age and gender of the reference person in the household. In terms

of decision of how much to spend, region, marital status, gender and age were found to influence consumption.

Implications

The results in this study are intended to provide useful information to the meat production and processing industry in terms of meat consumption. The two-week sample drawn from the CES showed the Hispanic preference for the type of meats studied. Some meats are more likely to be consumed than others. The most consumed meat was beef, with 484 (62.9%) households reporting expenditures on that category, followed by 456 (59.2%) reporting poultry, 408 (53.0%) reporting pork, 397 (55.6%) reporting other meats, 280 (36.4%) reporting fish and sea food, and 50 (6.5%) reporting lamb and goat in the weekly time periods. These preferences, together with the fact that the particular region was found to affect the probability of purchase and magnitude of the expenditure decision, can be used for the industry in terms of meat distribution.

Although the specific case of lamb and goat observed only a few households consuming this meat category, some variables were found to influence the likelihood of consumption such as region of origin, age and marital status of the household respondent and region in the U.S. Factors affecting the likelihood to consume bring some possibilities for lamb and goat producers to reach the U.S. Hispanic population.

Being from different ethnicity within the Hispanics affected the probability of purchasing certain types of meat as well as the expenditure decision. The differences found in the consumption of meats by Hispanic groups could help producers locally identify the potential market opportunities that each segment of the population creates in their marketplace.

Limitations and Future Research

The general findings of this thesis are intended to serve as a way for producers, growers, and for the industry in general to understand what Hispanic consumers want. However, these findings do have some limitations. The current study does not account for seasonality. One may think there are seasonal effects on the consumption of meat. Likewise, there are some special occasions, such as Cinco de Mayo, Independence days of Latin American countries, Christmas, and other festivities associated to religions, where Hispanics could increase/reduce their consumption of meats. Future research could possibly use data that reflects Hispanics' preference for meat based on seasonality, special occasions, or holidays.

Interestingly enough, this research was performed using a two-week period. One may be skeptical about the findings, since they only reflect the preference for this two week sample period. Furthermore, when using cross-sectional data, it is not possible to get a trend over time. The consumption trend over time may be important for the food industry, for predictions and comparison results. Unfortunately, however, these trends could not be tested in the current thesis. Future research may consider using more than one period of the CES or using data sets that look at change in consumption over the time.

Another limitation is that this research does not incorporate price variations. This is because comparison between meat categories based on their price was not possible. Furthermore, this thesis was conducted using expenditures as the dependent variable. Another way to do this is by getting quantity (q) using prices (p). Since expenditures are defined by ($p*q$) one can divide the expenditures by the price to get the quantities. This will allow one to calculate price elasticities and cross price elasticities.

On the other hand, the current thesis was performed using single equation models. This brings some limitations, such as the assumption that households spend a fixed amount of income on meats. This assumption can be hard to believe, due the variability among household budgets. There are some other methodologies that help one to understand the consumption behavior. Chapter 2 showed different types of studies with different type of methodologies such as the Almost Ideal Demand System (AIDS), first introduced by Deaton and Muellbauer, the LinQuad demand system, the Engel analysis and MPC.

Future research could also use another dataset, such as the University of Georgia Selig Center of Economic Growth. Furthermore, a comparison of these results with those in countries of Latin America, to search for differences in consumption of meat in those countries with those in U.S. Hispanic population could also be an interesting study.

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APPENDIX A

INCOME AND MEAT EXPENDITURE RELANTIONSHIPS

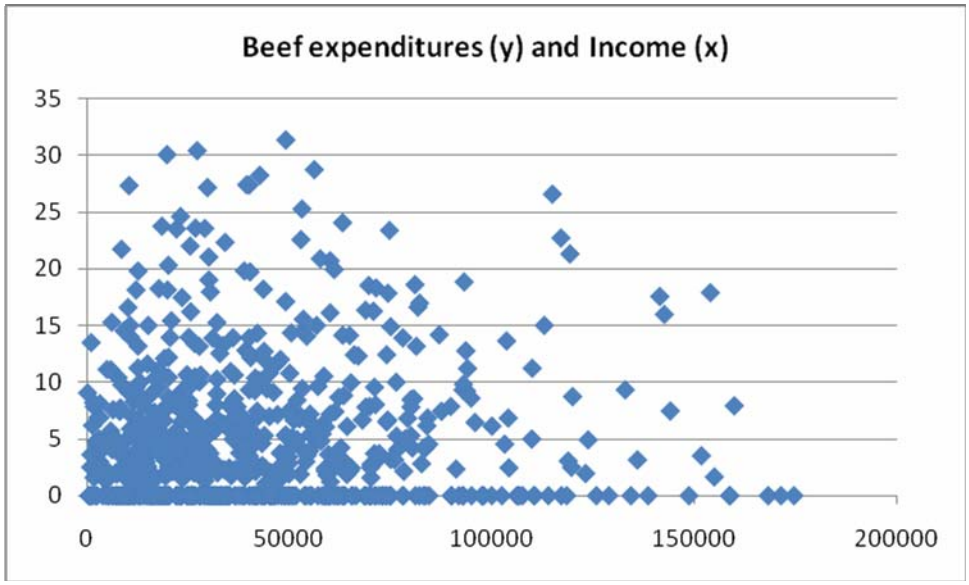

Figure A.1. Beef expenditures and income

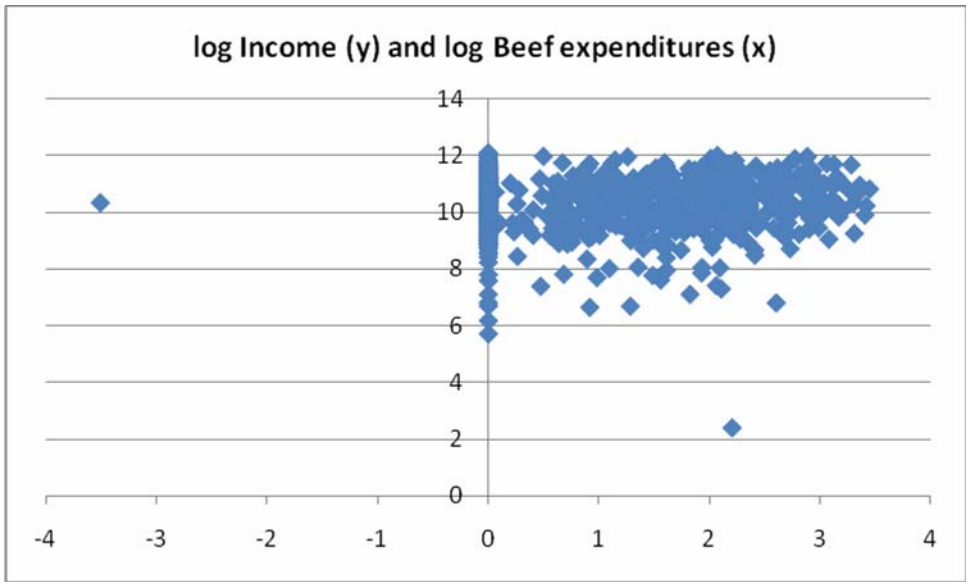

Figure A.2. Log beef expenditures and log income

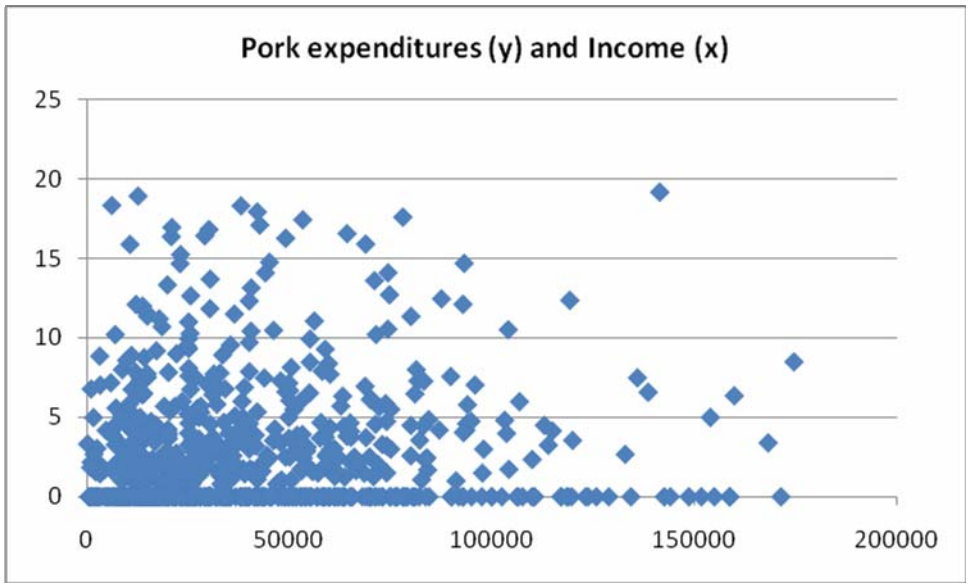

Figure A.3. Pork expenditures and income

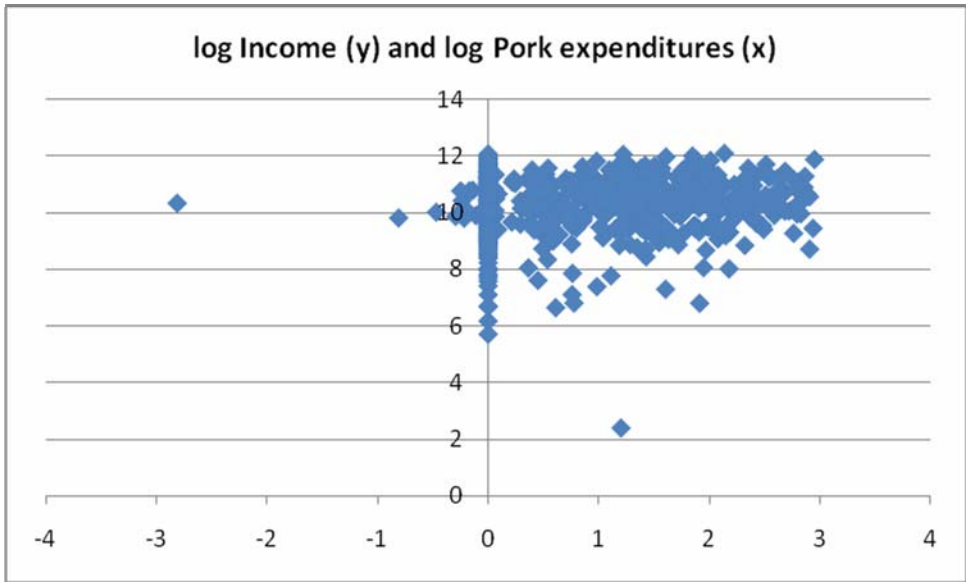

Figure A.4. Log pork expenditures and log income

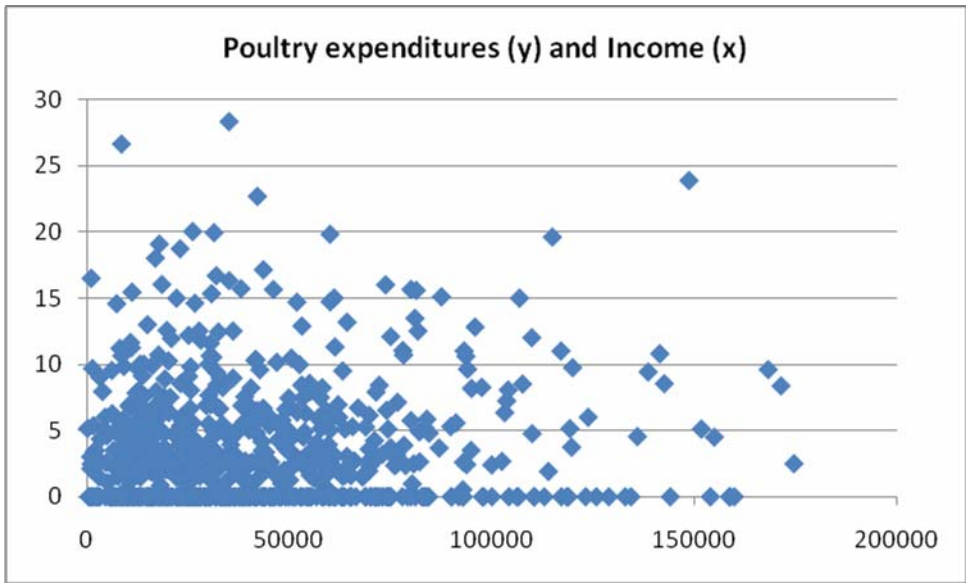

Figure A.5. Poultry expenditures and income

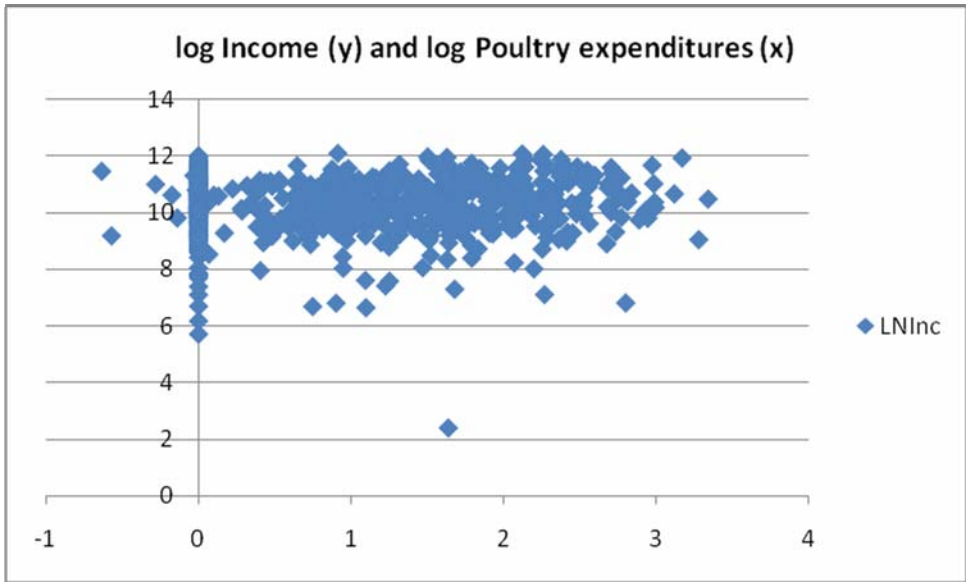

Figure A.6. Log poultry expenditures and log income

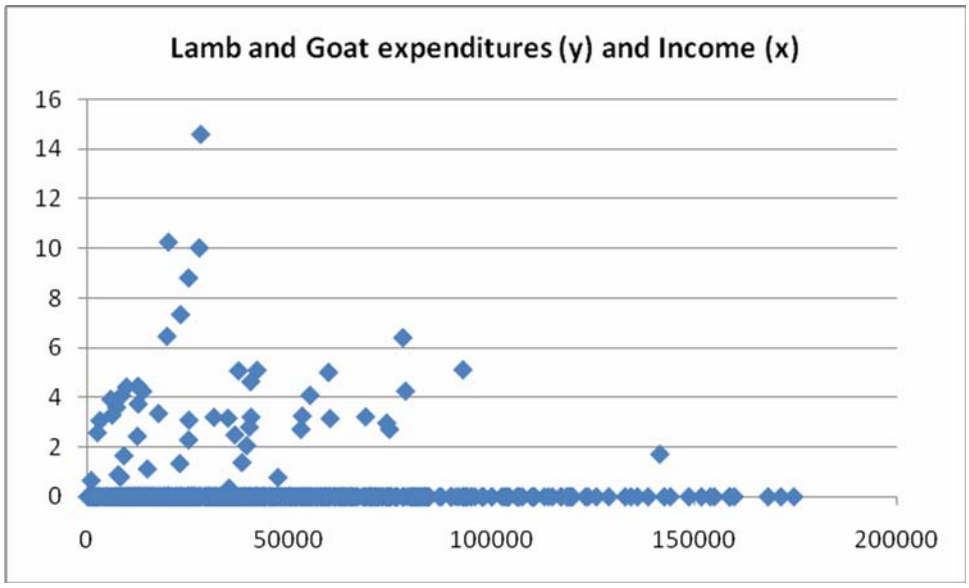

Figure A.7. Lamb and goat expenditures and income

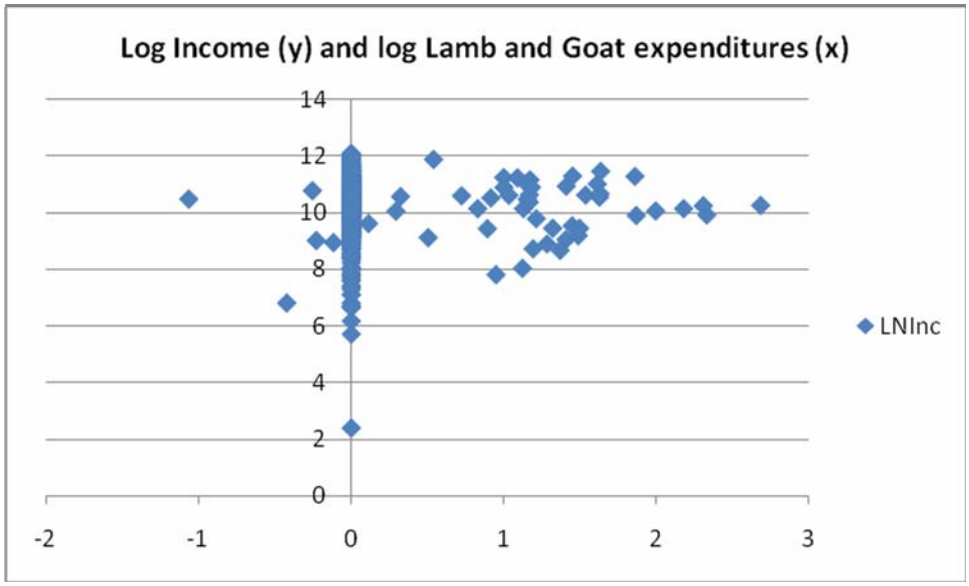

Figure A.8. Log lamb and goat expenditures and log income

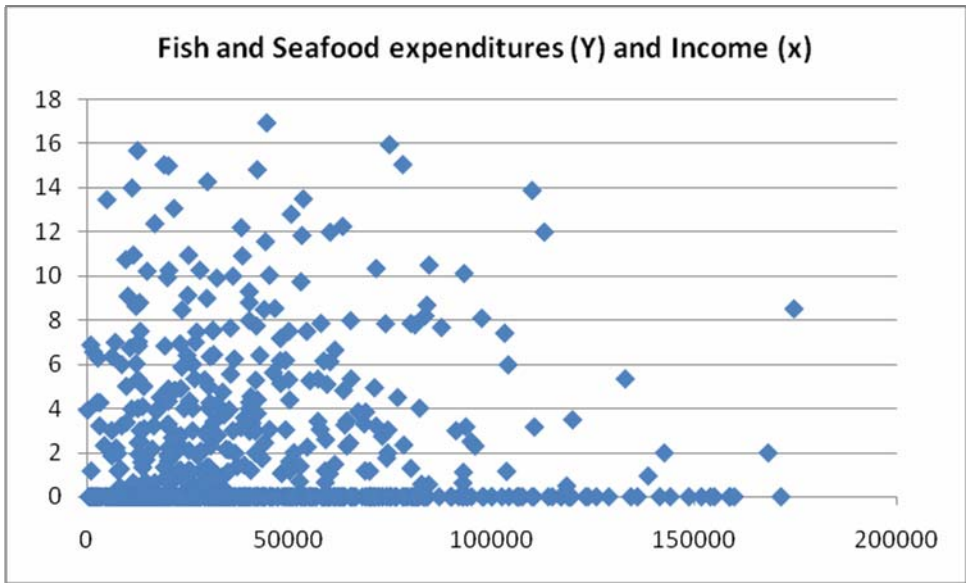

Figure A.9. Fish and seafood expenditures and income

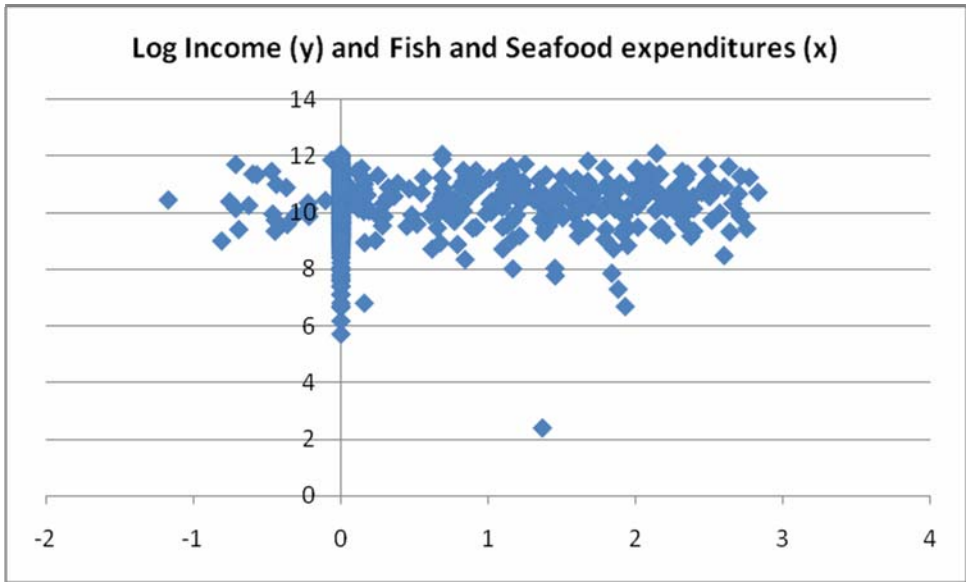

Figure A.10. Log fish and seafood expenditures and log income

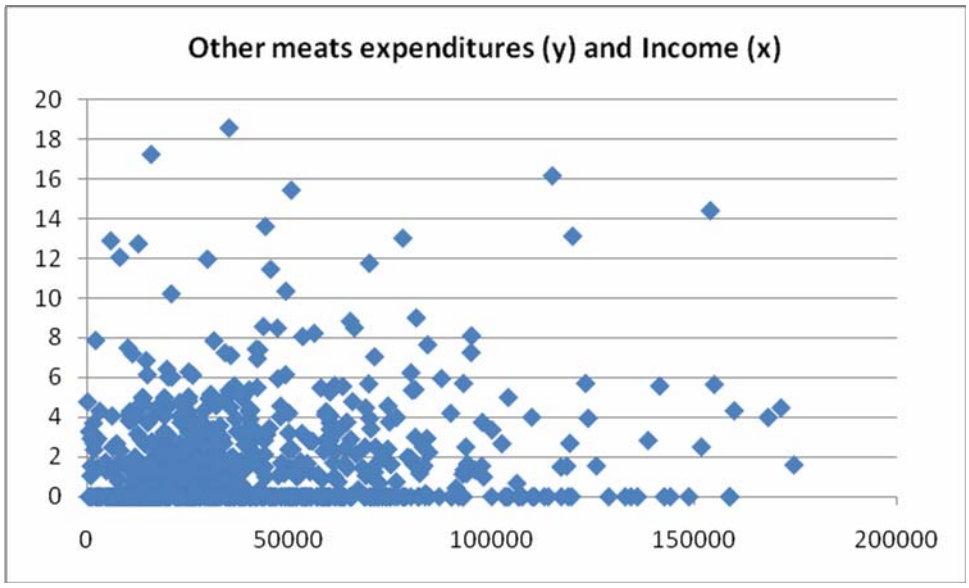

Figure A.11. Other meats expenditures and income

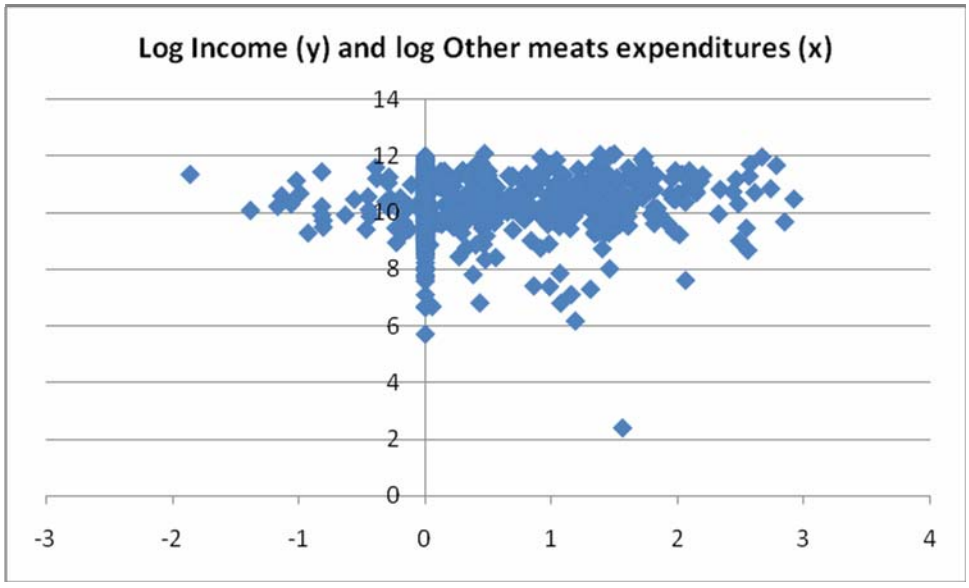

Figure A.12. Log other meats expenditures and log income