ECONOMIC TRADEOFF BETWEEN PURCHASE OF MEDICAL CARE AND OTHER COMMODITIES IN THE USA

By

KUMAR MUKHERJEE

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To my Parents, Uncle and Aunty.
Thank you.
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Abstract of Dissertation Presented to the Graduate School of the University of Florida in Partial Fulfillment of the Requirements for the Degree of Doctor of Philosophy

ECONOMIC TRADEOFF BETWEEN PURCHASE OF MEDICAL CARE AND OTHER COMMODITIES IN THE USA

By

Kumar Mukherjee

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In the area of medication use decision making, little research using an economic framework is available to understand what kind of tradeoffs people make when deciding whether to purchase medication as well as the nature of economic constraints and choices that influence the trade-off process. The objective of the study is to understand how people allocate their budget between different groups of goods they use for daily living, given the assumption that the allocation helps them to achieve maximum utility or satisfaction. Another purpose is to understand how people belong to different socioeconomic groups respond to the change in price of different commodities.

Our study analyzed out-of-pocket expenditure from Consumer Expenditure Survey along with Consumer Price Index from 1996 until 2005 to understand how the demand was influenced by change in price of commodities and consumers’ income. The sample size of 89,945 consumer units represented the households belonging to non-institutional, civilian U.S. population. Multiple OLS regressions analysis and Tobit regressions were used as statistical tools for analysis.
Major finding includes with the increase in own price, compensated demand decreased.

Food, housing, apparel, transportation, medical care, recreation, education are normal goods. Medical care demand was inelastic and had low income elasticity. All goods except transportation were complement to medical care. Analysis of subgroups revealed that demand of medical care increased with age and Caucasians had a higher demand compared to African-Americans. Poor people were found to be most sensitive to increase in the price of medical care for basic necessities like food, housing and medical care. If demand for medical care can act as a proxy to access and availability of medical care, it could be inferred that based on out-of-pocket expenditure (including health insurance premium) poor people most affected by price increase, which could influence their health outcomes. As lack of nutrition, good housing and medical care influence health outcomes in negative way, reduction of income inequality could increase affordability of basic necessities to indigent population and could create better health outcomes at population level.
CHAPTER 1
INTRODUCTION

Need for Study

Healthcare costs have been escalating in the USA in recent years. During 2004, the US spent 16% of GDP for national health.\(^1\) Since 1997, the out-of-pocket expense for healthcare services by patients increased from $162 billion in 1997 to $236 billion ($178.5 billion in real terms of 1997, which is equivalent to 10.21% growth) in the year 2004.\(^2\) Using data from MEPS researchers found that in 2003, 48.8 million civilian, non-institutionalized American individuals living in families spent 10% of their family income on healthcare.\(^2\) High out-of-pocket expense by individuals for healthcare might act as a deterrent to receive necessary medical care. Further a number of studies have revealed that many chronically ill adult patients reduce their medication intake due to cost.\(^3\) As people cannot always afford to pay for their necessary medicines, they likely make difficult trade-offs to satisfy their need for medicine.

Since the economic resources of an individual or a group of people (e.g., a family) are limited, spending for medicine involves a tradeoff between medicine and other goods. However, in the area of medication use decision making, little research using an economic framework is available to understand what kind of tradeoffs people make when deciding whether to purchase medication as well as the nature of economic constraints and choices that influence the trade-off process. This is the primary motivation behind the present study.

Based on the use of an economic framework, one way to understand the tradeoff process is to evaluate consumers’ expenditure pattern across different commodities. According to the economic theory of consumer behavior, consumers’ expenditure for a certain commodity depends on the income of the consumer and the prices of the specific commodity and all other commodities available in the market place. The purpose of the present work is to understand how
people allocate their budget between different groups of goods they use for daily living, given the assumption that the allocation helps them to achieve maximum utility or satisfaction. Another purpose is to understand how people belong to different socioeconomic group respond to the change in price of different commodities. Thus this study is intended:

1. To measure, understand and interpret the effect of price changes of available goods in the marketplace on the expenditure pattern for medical care.

2. To measure, understand and interpret the impact of change in price of medical care on expenditure pattern for different goods like food and beverages, housing shelter and utilities, education, transportation, clothing, recreation.

3. To measure, understand and interpret the effect of change in the price of prescription drugs on the expenditure for prescription drugs.

4. To measure, understand and interpret the effect of change in consumers’ income on the expenditure across different commodities.

5. To measure, understand and interpret how people belong to different socio-economic group respond differently to change in price of commodities.

**Significance of the Study**

Understanding the budget allocation process of a consumer unit (CU) (a single consumer or a group of people considered as a single unit or a household) has been a very important research agenda in policy designing and analysis. First of all, it helps to estimate and forecast the demand for different commodities in an aggregate level. It can help to identify the group of people in society who are most price-responsive. This in turn may help policy makers to design different kind of support systems, such as a subsidy, targeted to the specific populations. Information on how people belonging to different socio-economic groups spend their money can also help to monitor the welfare and quality of life (QOL) of various groups in society. Further, analysis of expenditure data also helps to keep track of who is gaining how much from different social programs and policy interventions. Finally, it also helps to understand how people respond
Research Questions and Hypotheses

The first research question is descriptive and addresses the demand for specific types of commodities that may be found in expenditure patterns for Americans facing medical care expenses.

**Research question 1:** What are the demands for the following group of commodities: food, housing, medical care, apparel, transportation, education, recreation?

The second research question was designed to help identify which commodities were considered “luxuries” (income elasticity greater than one) and which were considered “necessities” (income elasticity less than one)?

**Research question 2:** What are the income effect and subsequently income elasticity for different expenditure categories: food, housing, medical care, apparel, transportation, education, recreation?

**Research hypothesis 2a:** The null hypothesis was that the income elasticity of demand for medical care was equal to one. The alternate hypothesis was that the income elasticity of medical care was not equal to one.

**Research hypothesis 2b:** The null hypothesis was that the income elasticity of demand for prescription drugs was equal to one. The alternate hypothesis was that the income elasticity of prescription drugs was not equal to one.

The third research question concerns the calculation of cross-price elasticity between medicine and all other group of commodities. This will help to understand how a change in price of medical care affects the demand for other goods like food, housing, utilities, clothing, education, recreation, transportation. It will also help to understand whether change in price of
any other commodities affect the demand of medical care. It is expected that when the price of medical care increases, the corresponding expenditure for food, housing, recreation, transportation, education, clothing decreases. This project wants to explore this cross-price effect.

**Research question 3**: What are the effects of change in price of medical care on demand of different goods?

**Research hypothesis 3a**: The null hypothesis states that change in price of medical care does not have any effect on demand for food. The alternative hypothesis states that change in price of medical care does have an effect on demand for food.

**Research hypothesis 3b**: The null hypothesis states that change in price of medical care does not have any effect on demand for housing. The alternative hypothesis states that change in price of medical care does have an effect on demand for housing.

**Research hypothesis 3c**: The null hypothesis states that change in price of medical care does not have any effect on demand for apparel. The alternative hypothesis states that change in price of medical care does have an effect on demand for apparel.

**Research hypothesis 3d**: The null hypothesis states that change in price of medical care does not have any effect on demand for transportation. The alternative hypothesis states that change in price of medical care does have an effect on demand for transportation.

**Research hypothesis 3e**: The null hypothesis states that change in price of medical care does not have any effect on demand for education. The alternative hypothesis states that change in price of medical care does have an effect on demand for education.
Research hypothesis 3f: The null hypothesis states that change in price of medical care does not have any effect on demand for recreation. The alternative hypothesis states that change in price of medical care does have an effect on demand for recreation.

The fourth research question wants to explore whether people belong to different socio-economic and demographic characteristics (age, income and ethnicity) respond differently to change in price of different commodities. To understand this responsiveness to price three basic necessities of life were considered: a) food, b) housing, c) medical care.

Research question 4a: How people belonging to different age groups (less than 40 years, between 40 and less than 65 years, 65 years and above) respond differently for change in price of food, housing and medical care?

Research hypothesis 4a: The null hypothesis states that there is no difference in price responsiveness for food, housing and medical care among consumers in different age groups. The alternative hypothesis states that there is difference in price responsiveness for food, housing and medical care among consumers belong to different age groups.

Research question 4b: How people belong to different ethnicity (Caucasian, African-American) respond differently for change in price of food, housing and medical care?

Research hypothesis 4b: The null hypothesis states that there is no difference in price responsiveness for food, housing and medical care among consumers from different ethnicities. The alternative hypothesis states that there is difference in price responsiveness for food, housing and medical care among consumers belonging to different ethnic groups.

Research question 4c: How people belong to different income groups FPL, between 100% and less than 200% of FPL, between 200% and less than 300% of FPL, on and above 300% of FPL respond differently for change in price of food, housing and medical care?
Research hypothesis 4c: The null hypothesis states that there is no difference in price responsiveness for food, housing and medical care among consumers from different income groups. The alternative hypothesis states that there is difference in price responsiveness for food, housing and medical care among consumers belong to different income groups.

Rationale and Theoretical Framework

The fundamental approach to understand behavior of consumer is based on the premise that people act as if they are maximizing their utility. In microeconomic theory of consumer behavior a typical consumer can be represented in various ways such as a family of indifference curves, preference ordering and a utility function. It is assumed that a typical consumer generates utility directly from consumption of goods. The budget allocation problem faced by a consumer can be defined mathematically as follows:

(1) Let a consumer has an economic resource (income) which is represented by M.

(2) A consumer buys goods $X_i$ ($i = 1, 2, \ldots, n$) and good $X_i$ has price $P_i$.

(3) A typical consumer’s utility ($U$) maximization problem can be described as:

Objective function: Maximize $U(X_1, X_2, \ldots, X_n)$ \ldots (1.1)

Subject to the budget constraint: $P_1 X_1 + P_2 X_2 + \ldots + P_n X_n \leq M$ \ldots (1.2)

$X_i \geq 0$ for all $i = 1, 2, \ldots, n$ \ldots (1.3)

The solution to the above mentioned optimization problem will produce the Walrasian demand correspondence for all commodities $X_i$ in terms of price of all commodities and the individual’s income or wealth. For a given vector of prices and an income (or wealth) level greater than zero, the optimal set of goods $X(P, M)$ may have more than one element and hence it is called a correspondence. When for all price and income, $X(P,M)$ is single valued it is referred to as the Walrasian demand function.\(^4\) The demand for a good depends on its own price and also on prices of all other goods available in the market place and consumer’s income (or wealth). So
income and prices of goods can explain consumers’ expenditure pattern between different commodities. An analysis of consumer expenditure data will help to estimate the demand for different goods. The first research question addressed in this study will be answered by analyzing the consumer expenditure data of the United States from 1995 through 2004.

From the previous discussion it was understood that consumers’ income influence the expenditure. Income elasticity of an expenditure category is defined as the percentage change in the expenditure of a commodity due to a 1% change in income. If a good has a negative income elasticity, it is called an “inferior” good, as the expenditure for this type of good decreases as income of consumer increases. Normal goods are with positive income elasticity. If the good is normal with an income elasticity is between zero and one, then the good is said to be inelastic. If income elasticity is greater than 1, then it is called elastic good. This implies that the change in the expenditure is highly responsive to the change in income. Those goods which are income inelastic are also called “necessities”, while goods which are income elastic are called “luxuries”.

Suppose the income of the consumer is denoted by \(M\) and expenditure for i-th commodity is denoted by \(e_i\). Also let the price of the i-th commodity is \(P_i\) and the quantity demanded is \(X_i\) then the total expenditure will be \(e_i = P_i \times X_i\).

Income elasticity of the demand for good (\(\eta\)) is defined by:

\[
\eta = \frac{\partial X_i}{\partial M} \frac{M}{X_i} \quad \cdots (1.4)
\]

This will also help to evaluate the MPC for different goods. MPC for a good can be defined as the percentage of an additional dollar a consumer will spend on that particular good. The MPC for i-th good can be expressed as:
\[ MPC = \frac{\partial e_i}{\partial M} \quad \text{(1.5)} \]

So the income elasticity of expenditure is the product of MPC and inverse of expenditure share \( \left( \frac{e_i}{M} \right) \) for a particular good. Thus the income elasticities for all commodities including medical care and prescription drugs are evaluated based on the theoretical discussion mentioned above. The magnitude of income elasticity will differentiate between necessities and luxuries.

Classical demand theory also suggests that the demand for i-th good is influenced by the price of j-th good. The change in the demand of i-th good due to change in the price of j-th good can be summarized by the generalized Slutsky equation \(^4,5\):

\[ \frac{\partial x_i}{\partial p_j} = \left( \frac{\partial x_i}{\partial p_j} \right)^c - x_j \frac{\partial x_i}{\partial M} \quad \text{(1.6)} \]

The left hand side of the above equation represents the cross price effect, which implies the change in demand of i-th good due to a change in the price of j-th good. The right hand side of the equation has two components. The first term denotes the change in compensated demand of i-th commodity due to a change in the price of j-th commodity. This is called the “substitution effect”. The second term on the right hand side indicates the “income effect”. In his seminal paper Slutsky showed that the sign of the income effect was ambiguous in nature. If i-th good is a normal good then an increase in income will increase the demand of i-th good. On the other hand if i-th good is an inferior one, then an increase in income will reduce the demand of it. So one can not be sure about the sign of the term \( \frac{\partial x_i}{\partial M} \). Change in the compensated demand of i-th commodity due to a change in price of j-th commodity can be either positive or negative. If two goods are net substitutes then the compensated substitution effect is positive and if two goods are net complements then compensated substitution effect is negative. So if the i-th good is a normal
good and the compensated substitution effect is negative or if positive, at least smaller in absolute value than income effect, then it can be argued that an increase in the price of j-th good will reduce the demand of i-th good. This complex effect of price of a good on the demand of other goods motivates the exploration of the effect of change in price of medical care on demand of different goods like food, housing, clothing, education, recreation, transportation.

Different studies explored the influence of demographic variables on expenditure pattern of households. Studies found that ethnicity influenced households' expenditure pattern. Researchers also explored the difference in expenditure pattern between older consumers and younger consumers. Previous research also showed some significant relationship between expenditure for certain goods and household composition (e.g., number of children, marital status). Highest education level attained by household members, their employment status and the region of residence are also found to influence expenditure pattern of families. In congruence with the past literature socio-demographic variables like age, household composition, highest education level attained by household member, ethnicity, region of residence are also included in evaluation of demand system to understand the effect of these variables on expenditure pattern of households.

A schematic representation of the dependent variable and independent variables selected for this study is as follows:
Dependent variable

1) Quantity for food (at home and outside home)
2) Quantity for housing and utility
3) Quantity for medical care
4) Quantity for education
5) Quantity for transportation
6) Quantity for apparel
7) Quantity for recreation

Independent variable

1) Price of food, housing and utilities, apparel, medical care, education, transportation, recreation. All price data obtained from consumer price index (CPI)
2) Socio-demographic characteristics of consumer unit like age, ethnicity, education, composition of consumer unit or type of family, region of residence. This information will be obtained from Consumer expenditure survey (CES). (I will consider the information from characteristics of the household. If a consumer unit has a single person, who is also the respondent, the characteristics of the consumer unit and the response person will be same).
3) Income of the consumer unit

Figure 1-1. List of dependent and independent variables used in the study
CHAPTER 2
LITERATURE REVIEW

This chapter begins with a historical review of the empirical work related to household expenditure, and then describes the development of the National Consumer Expenditure Survey (CES). Then the literature review moves on to a critical review of the findings about the effect of socio-demographic variables on demand of medical care. The chapter then concludes with a discussion about the consumer price index (CPI).

Early Studies with Household Expenditure

One of the surveys of empirical research analyzing household expenditure data was conducted by George Stigler in 1954. The general life of poor people and the difference in the consumption of poor and rich people motivated early investigations using expenditure data. The earliest quantitative study reported was conducted in 1797 by Sir Frederick Morton Eden in England, who was enthused by “the difficulties, which the laboring classes experienced, from the high price of grain, and of provisions in general, as well of clothing and fuel, during the years 1794 and 1795”. Sir Eden’s major contribution was a documentation of an extensive compilation of workingmen’s budgets. During the same period, an English clergy man named Reverend David Davies collected budget from 127 poor families, which led to his proposal that a minimum-wage law be enacted. About fifty years later, the spread of socialism in Europe in the mid-19th century led to an increased focus on the life of working class people. In 1855, Edouard Ducpetiaux, a liberal-catholic lawyer published a study that examined almost 153 family budgets in Belgium, which was later analyzed by famous German statistician and economist, Ernst Engel. Based on this analysis, Engel proposed a law of consumption relating food expenditure and economic well-being of families. Engel’s law stated that
“the poorer a family, the greater the proportion of its total expenditure that must be devoted to the provision of food”. This was one of the first efforts to state some generalized result based on expenditure data. Based on the Belgian data, Engel also estimated the consumption of three classes of families a) families depend upon public assistance, b) families just able to live without such assistance, c) families in comfortable circumstances. In the year 1875, the Commissioner of Labor Statistics in Massachusetts, Carroll Wright, used the same idea of Engel and analyzed the expenditure of three socio-economic classes of families (classified by expenditure ranges: $225 to $300, $450 to $600, $750 to $1000) in Prussia. He proposed that: a) the families with higher income spend a smaller percentage of their income for subsistence, b) the percentage of outlay for clothing is independent of income, c) the percentage of outlay for lodging or rent and for fuel and light does not depend on income, d) the percentage of outlay for “sundries” increase as income increases. Herman Schwabe analyzed the salary and rent data for public employees in Germany. He classified German public employees in two groups: a) 4,281 public employees receiving less than 1,000 thaler a year and b) 9,741 public employees with income more than 1,000 thaler. Schwabe found that as income increased, the percentage of income spent on rent declined. In the United States, the first similar study reported was conducted by Carroll Wright, who surveyed 397 families of workingmen in Massachusetts. He found a relationship between families’ income and savings, noting that the higher the income of a family, the greater is the savings in actual and proportional terms. William Ogburn later analyzed the budget data of 200 families in the District of Columbia in 1916. He explored the relationship between the proportion of each expenditure category to total expenditure, family income and family size. From his
study, a list of income elasticities of various expenditure categories was estimated. Ogburn found that food, rent, fuel and light, medical expenditure (sickness), liquor and tobacco were income inelastic in nature, while the expenditure for clothing, furniture, amusement, education were income elastic.\textsuperscript{6}

**Development of National Consumer Expenditure Survey in USA**

The first national expenditure survey was done in the year 1888 till 1891 in the USA. The objective of this survey was to establish tariff negotiations between the USA and European countries. This survey also emphasized workers’ role as producers instead of consumers. Rapid increase in the price of living cost motivated the household expenditure survey at the beginning of twentieth century. A food price index was developed with the help of the survey conducted in 1901, which collected detailed expenditure of food purchased by workers. A later survey conducted between 1917–1919 focused on the wage earners and salaried workers of urban areas. Based on this survey, the BLS of the USA developed the first cost-of-living index (COLI), which was a precursor of the consumer price index (CPI). During the years 1943 to 1936, the market basket of goods and services for CPI was revised with the help of a survey. This survey collected information about income and expenditure of a representative population in both urban and rural USA. The unique feature of this survey was that it made an attempt to make an inference about the economic condition and consumption habits of the whole American population, not just the surveyed families. According to the National Resources Planning Board this was the first study conducted in USA that offered a comparable evidence of the expenditures of different sociodemographic groupings representing the American population. During the period of the Second World War, a survey of the non-institutionalized civilian population was conducted to evaluate the
impact of governmental decisions. Because of the restrictions on purchases made during wartime, this study found abnormal consumption patterns.

A survey was conducted in 1950 to collect expenditure data from consumers living in urban areas. The data were collected from respondents by the method of annual recall and the survey also included a supplementary questionnaire which asked all consumer units about their expenditures for food, household supplies, tobacco, drugs and personal care items during a seven day period before the completion of the survey. The average length of the interview was eight hours. This survey was the first to define the term “consumer unit”. A “consumer unit” was defined as:

1. A family of two persons or more dependent on a common or pooled income for their major items of expense or,

2. A single consumer – a person who is financially independent of any family group, living alone or in a household with others. According to this definition, a household can accommodate more than one CU.

A survey conducted during 1960 and 1961 included not only urban dwelling CUs but also those living in rural areas. This survey was used to revise the market basket weights in the calculation of CPI. The basic methodology of data collection remained same compared to old surveys. However with the 1960 survey, researchers made a change in the data collection method. Notably until the 1960s the basic expenditure data collection procedure was based on the annual recall procedure by consumer units. However researchers found that compared to annual recall procedure, frequent interviewing of consumers produced more reliable estimates of expenditures. Researchers also decided to use a diary survey extensively for more frequently purchased items.

The expenditure survey conducted during 1972 to 1973 consisted of two parts: a) a quarterly interview panel survey and b) a diary survey. These two components used
different sample of CUs. The basic methodology of data collection for the interview survey included a visit by an interviewer to a consumer unit once every three months over a 12-month period. In the diary survey, the consumer unit was asked to keep track of expenditures for two consecutive one-week periods. The interview survey collected expenditure data on major items, family income, family characteristics, assets and liabilities. The diary survey was designed to collect expenditure data on items like food, housekeeping and personal care. The diary survey also collected data on income and family characteristics. To avoid duplicate reporting of the same major item purchases in multiple periods, responses obtained during the previous quarter were contained in the questionnaire.

The sample selection procedure in the 1972-1973 survey was probabilistic in nature. If any consumer unit moved from an address before completing five interviews, then their data were discarded. The new consumer unit that moved to the same address was considered as a sample unit. A particular consumer unit characteristic was used to integrate the data from interview and diary survey. Until the 1972 – 1973 survey, the expenditure survey was conducted every ten years. However, the oil crisis in late 1973 created a demand for more information about how various consumer groups reacted to the crisis. This called for more frequent administrations of the expenditure surveys. This called for more frequent administrations of the expenditure survey. As a result, the next expenditure survey was conducted in 1979, using the same methodology as the 1972-1973 survey but with a smaller sample. In the 1979 survey, 5,000 CUs were interviewed once each quarter for five consecutive quarters and another 5,000 CUs participated in the diary survey. From this survey onwards, a rotating panel design was included in the
consumer expenditure survey. According to the rotating panel design, twenty percent of 
the respondents were replaced at the end of every quarter. This implied that twenty 
percent of respondents completed their fifth interview and were excluded from sample, 
while another twenty percent joined the sample. Normally data collected from a 
household during the first interview were not included in the final estimation. However, it 
was used to bounding purpose. This survey also introduced the term “reference person” 
which was defined as the “first member of the consumer unit mentioned by the 
respondent as an owner (or renter) of the premises at the time of initial interview”.

Since the data were collected through both interview and diary surveys, the 
integration of these two surveys were necessary to report an accurate estimate of 
expenditures. Initially, only those components which were unique to the diary survey 
were collected from it. Expenditure information about the rest of the components were 
collected from the interview survey. However, a careful examination of the 1972-1973 
survey and the 1980-1981 survey indicated that estimates of some items (beside those 
that are unique to the diary survey) in diary survey were closer to estimates obtained from 
other surveys such as the Personal consumption Expenditure (PCE) component of the 
National Income and Product Accounts (NIPA). This observation brought a change in the 
methodology of how the diary and interview surveys were integrated. Researchers started 
calculating Mean Square Error (MSE) using five years of data to select the best source 
between diary and interview survey. They considered the mean expenditure obtained 
from PCE as a proxy for true population mean. At present the data produced by interview 
survey averaged about 95% of total estimated expenditure. 7
The consumer expenditure survey is now conducted every year. The diary survey contains two questionnaires: a) a household characteristics questionnaire and b) a record of daily expenses. The household characteristic questionnaire provides information about age, sex, race, marital status, family composition, work experience and earning of each family member of the consumer unit. The diary is divided into day of purchase and collects expenditure information for two consecutive one-week periods about food and beverage at home and outside of the home, housekeeping supplies and services, non-prescription drugs, personal care products and services. At the end of the first week, the interviewer then visits the consumer unit and collects the diary and reviews entries. It is to be noted that each week of a consumer unit’s participation in diary survey is considered as a separate incident.

In the interview survey, a uniform questionnaire is used to collect expenditure information for each quarter. Two types of questions are used to collect expenditure data: a) a set of questions asking for the month of in which a particular purchase took place and b) the quarterly amount of expenditures. The interview survey collects information about expenditures related to property, automobiles, appliances, rent, utility bills, insurance premiums, prescription drug, transportation, education, and healthcare. Additionally, this survey also collects socio-demographic and income information about the consumer unit. The sample housing units normally receive notification in advance about the intention of the survey and about the future visit by the interviewer. The interviewer normally contacts the respondent to make sure that an adult person is available for interview. If an adult is unavailable, the interviewer collects proxy responses form any eligible household member who is at least sixteen years old. The income information include
unemployment compensation, income from royalties, dividends, estates, alimony and child support. Normally a twelve months recall period is used to collect information about income and asset.

Once data are collected, they are edited, coded and checked by the U.S. census bureau. Beginning in April 2003, the census field representatives began to collect quarterly interview data using a Computer Assisted Personal Interview (CAPI), which allowed investigation of question, skip patterns and data confirmation of high expenditure values.

**Effect of Socio-Demographic Variables on Demand of Medical Care**

This present research explores how the demand of three basic commodities—food, housing and medical care—were impacted by the change in price of medical care and how these impacts varied across different socioeconomic grouping based on age, income, and race/ethnicity. The underlying theme of this analysis was to explore whether people who belong to different socio-economic groups are hit equally by a change in the price of medical care and, if not then who is worst hit and what are the probable policy implications of the finding.

At this point a brief discussion is offered to explain why this exploration of “equally hit or not by price increase” is important. The concept of equity has been a major area of concern among many social scientists, economists and philosophers. In the fifth Henry Simons lecture, Professor James Tobin argued that some specific scarce commodities should be distributed less unequally than a person’s ability to pay for it. He coined this as “specific egalitarianism” and asked the question of whether there was any possibility for removing the necessities of life, such as nutrition, basic shelter, and access to medical care from the list of all commodities in such a way that given an unequal
income distribution in the society those crucial commodities would be distributed less unequally than the market would distribute those based on ability to pay. In his keynote address to the Third Conference of the International Health Economics Association on “The Economics of Health: Within and Beyond Health Care” Professor Sen argued that “health is among the most important conditions of human life and a critically significant constituent of human capabilities which we have reason to value”. He further argued that equity in the achievement and distribution of health was a very important constituent of understanding the broad area of social justice.

Researchers over the last two centuries also documented a relationship between health and various correlates of socioeconomic status such as income, wealth, education, and social class. The relationship between health and income was referred to as a “gradient”. This gradient implied that health improved with income throughout the income distribution. It was also interesting to observe that there was a two-way causal relationship between income and health. Using National Longitudinal Mortality Study (NLMS) data and controlling for years of schooling, Deaton and Paxson showed that for people between 25 and 59 years of age, when income was doubled, the probability of death was reduced by 27% during the first-year of follow-up. It was also difficult for poor people to demonstrate good health behavior like conforming to complicated and time-intensive treatment strategies. Harmful health behavior was negatively associated with income and education. Researchers, who had a viewpoint that health was socially produced, also argued that risky health behavior was a result of low education and income.
The key issue in research exploring the relationship between income and health was whether absolute income or relative income (in other words income inequalities) was the major reason for health disparity at population level. From a policy perspective this was an important issue. If absolute income was the major reason for a disparity, then an optimal policy should be designed to increase absolute income of population without providing much attention to income disparity. On the other hand, if it was not absolute income but relative income within a society that was the major reason for health disparity, then to improve population health the effective policy should concentrate on reducing income inequality.

A wide range of literature is available that describes the relationship between income inequality and health outcomes of population. (See Macinko et. al.\textsuperscript{12} for an excellent review of this literature). This area of research found that absolute level of income had a positive correlation with better health outcomes. Similarly, societies with equitable income distribution had a better health outcome compared to those with more unequal distribution of income. In fact, the association between change in absolute income level and changes in mortality rate over time was low.\textsuperscript{13} This led to the development of a consensus that considering relative income is an indicator for health outcomes. Citing data from the National center for Health Statistics, James Smith mentioned that between 1979 and 1989, the average life expectancy for Caucasians in the United States with family income below $10,000 was 6.6 years lower than Caucasians with family income more than $25,000; while for the same income groups, the difference in average life expectancy was 7.4 years among African-Americans. When specific causes of deaths were estimated, it was observed that during the same period of time,
families with low income had a higher death rate from chronic diseases compared to families with higher income. Across industrialized nations, health outcomes indicators such as average mortality have a strong relationship with income inequality within countries, rather than average income difference between countries. In his editorial comment in the British Medical Journal, George Smith argued that whatever be the absolute material standards of living in a country, the inequality in income was bad for national health. Smith cited Wilkinson’s argument based on psychological principles that “instead of direct material standards, health effects of income distribution involve social and cognitive processes”.

While examining the relationship between health outcomes and inequality in income in the United States, Kaplan et al found that income inequality was significantly associated with age specific mortality and other health outcomes such as low birth weight. They suggested that if economic policies like taxation, transfer payments, job creation, and differential growth decay of various sectors of economy are supportive of increasing income inequality in a society then it could be detrimental to the population health.

By using income, household size, and poverty data from the 1990 United States census and mortality adjusted for age Kennedy et.al. found that income inequality was positively associated with total mortality and cause specific mortality adjusted for age. They argued that income distribution might act as an indicator for the degree of investment in human capital in a society. Those societies which tolerate a high degree of income inequality might be those with less investment in human capital like education and access to medical care. The authors further argued that income inequality could
produce higher mortality by not providing sufficient access to treatable causes of mortality and policies should be designed to reduce income disparity and to create positive impact on population level health.\textsuperscript{17}

Examining the association between income inequality and mortality in 282 metropolitan areas in the USA, Lynch et al found that depending on the measure of inequality of income the mortality for area with high income disparity was more by 64.7 to 95.8 deaths per 100,000 compared to areas with low income inequality. They also found that for areas with low average income and high income inequality the mortality was more by 139.8 deaths per 100,000 compared to areas with low income inequality and high average income. They suggested that public and private sector initiatives should be taken to reduce the prevailing income inequality in the USA, which might reduce the high burden of mortality.\textsuperscript{18}

Although the debate between the importance of absolute income and income inequality for determining health outcomes has not been resolved there is a significant literature that documents the effect of income inequality on health outcomes.

The level of education people achieve has also been reported to affect their health. In a direct way, educational attainment affects the potential earning opportunity of a person and her opportunity to have access to material resources like healthcare, food, housing, which influenced health. Education also helps a person to develop her cognitive ability to understand and value health outcomes. Using the NLMS data for 1979 till 1985, Elo and Preston showed that college graduates in the United States tend to have a lower mortality than high school graduates and educational attainment had a significant effect on adult mortality in different age groups across male and females.\textsuperscript{19}
Location and neighborhood of residence has also been reported to have some relationship with health status of people. Studying the mortality pattern by county and race in the USA between 1965 and 1994, Murray et al found that Caucasians in the ten “healthiest” counties in the U.S. had a life expectancy more than 76.4 years, while African-American living in the ten least healthy counties had an average life-expectancy of around 60 years. This huge difference in life expectancy was pretty similar to the difference between a developed economy and a poor economy.20

By analyzing mortality among African-Americans in selected areas of New York city, Detroit, Los Angeles and Alabama and among Caucasians in areas of New York city, metropolitan Detroit, Kentucky and Alabama, Geronimus et al concluded that poverty rate and location of stay for a group are important factors for excess mortality beside the relationship between race and excess mortality.21

Other literature reported that different ethnic groups have different expenditure patterns. Fan and Lewis compared budget allocation pattern for thirteen expenditure categories among Caucasians and African-Americans. They used the 1980 – 1992 consumer expenditure survey along with the Consumer Price Index (CPI). They found that out of thirteen different expenditure categories, after controlling for other socioeconomic and demographic characteristics, African-American households significantly differ from Caucasians in nine expenditure categories; further six of thirteen expenditure categories were significantly different between African-Americans and Hispanic households. The researchers found that African-Americans on average spent less on health care compared to Caucasians and Asian-Americans at low level of total expenditure. They cited lack of access to private health insurance as the major reason for
lower health expenditure by poor African-Americans. They also found that at high level of total expenditure the difference in expenditure for health among African-Americans and other ethnic groups vanished and demand for healthcare among African-Americans was more income elastic than other ethnic groups. They concluded that ethnicity affected a household’s need and preference and in turn influences the affects the budget allocation pattern, but within an ethnic group like African-Americans the expenditure pattern differed among high income and low income group.22

**Consumer Price Index**

The Consumer Price Index (CPI) is a measure of average change over time in prices paid by urban consumers for a selected basket of goods and services. CPI reflects the spending pattern of all urban consumers and urban wage earners and clerical workers, which constitute almost 87% of the entire population. CPI does not capture spending patterns of persons living in rural metropolitan areas, farm families, persons in armed force, or persons who are institutionalized. CPI constitutes two indexes: a traditional CPI for all urban consumers (CPI-U) and a Chained Consumer Price Index for all urban consumers (C-CPI-U). The detailed expenditure information provided by families and households in the CES were used in the calculation of the CPI. Normally the weights of the CPI for 200 different items are calculated by using expenditure information from more than 30,000 individuals and families.

Most of the CPIs were based on the reference year 1982 to 1984. This implies that the average index level for three years 1982, 1983 and 1984 is 100. It has to be kept in mind that CPI does not offer any comparison of price changes between areas; rather it offers the change in price over time in a particular area.
CPI has certain limitations. As CPI-U reflects the expenditure pattern for a urban population, extending those estimates to rural population may not be accurate. Two types of error normally take place during measurement of the CPI – sampling and non sampling error. CPI is based on a sample of items, and it does not consider all retail purchases made by all consumers in the index population. An increase in the sample size could potentially increase accuracy. Non-sampling errors could cause consistent bias in CPI estimates. Non-sampling error could arise from problems of price data collection, logistical lags in conducting surveys, difficulties in handling the problem of quality change. To provide continuous improvement, CPI has a dedicated group of researchers who conduct research and evaluation to make sure the index was appropriate.

CPI for medical care has two components – CPI for medical care commodities and CPI for medical care services. The medical care commodities group includes prescription drugs and non-prescription drugs and medical supplies, while medical care services group includes professional services, hospital services and health insurance. The prescription drugs index is comprised of drugs purchased by prescription at a retail, mail order or internet pharmacy. The sample selected for forming the index for prescription drugs is based on a streamline sampling method. The field staff obtains a list of the last twenty prescriptions dispensed, which normally serves as a proxy for all prescription drugs dispensed at the pharmacy. The price for each of these twenty prescriptions is collected and this price includes both out of pocket payment by patient and the payment by insurance company. The probability of a drug being selected for the index depends on its frequency of appearance in the “last 20 list” and also how expensive it is. This item selection procedure is carried out in every outlet. Even after a prescription drug becomes
available over the counter, the CPI for that drug is still considered part of the prescription
drug index instead of considering it under non-prescription drug index. So if the price of
the drug was changed it is reflected in the prescription drug index.23
CHAPTER 3
METHODOLOGY

This chapter describes the methods and procedures that were used in this study to answer the research questions. It provides information about the secondary databases – Consumer Expenditure Survey (CES) and Consumer Price Index (CPI) – that will be used in this study. The population and the sample used in this study as well as an explanation for how the expenditure data from the CES is validated are also described. In addition, this chapter describes how different databases were combined and how the dependent and independent variables used in this study were operationalized. This chapter ends with a description of the statistical method used to analyze the database and the underlying assumptions of the statistical tests.

Database Information

Two major data sources were used in this study. These are the CES and CPI for the year 1996 till 2005. The CES collects data annually and provides data on expenditures for various groups of commodities by the non-institutionalized, civilian US population. It also provides the socio-demographic characteristics and detailed income information of the population. CES is the only available database which documents expenditure information related to various categories (medical care and all other type of goods such as food, housing etc.) of commodities from consumer units and also their socioeconomic information. No other database in the United States report expenditure information related to both medical care and other commodities as collected from consumer units. Given the research questions explored in this study, CES was the only choice.

The CPI is a “measure of the average change over time in the prices paid by urban consumers for a market basket of consumer goods and services”.

The BLS published
the CPI data from the year 1913. It is consistent to use the CPI along with the CES because the expenditure weights to calculate the CPI are obtained from the CES database. Most of the specific CPI indexes were calculated based on the year of reference as 1982 – 1984. This implies that the BLS sets the average index level as 100 for the period of thirty-six months covering the years 1982, 1983 and 1984. CPI for various groups of commodities can be reported as percent change or change in index points. It is to be noted that the CPI can only measure the changes in price level over time in a certain place and it can not be used to compare the price level between two different places. For the purpose of the present investigation, the CPI provides the necessary price data for the following group of commodities:

1. Food and Beverages
2. Housing
3. Utilities
4. Apparel
5. Transportation
6. Education
7. Medical Care
8. Recreation (Entertainment, Travel on out-of-town trip)

**Sample Selection**

The pool of subjects for this research was individuals who participated in the yearly interview survey conducted by the BLS from 1996 to 2005. This research considers only expenditures by consumers beginning in 1996 because of the following reasons. There have been substantial changes in the definition of various variables recorded in the CES from the year 1996 compared to the year 1995. The sampling frame of 1996 survey was also different from the 1995 survey. As a result, the BLS suggested that for any micro-level longitudinal analysis, researchers should not link consumer units whose participation spanned over the period of 1995 and 1996. The final year considered in this
study was 2005 as that was the most recent year for which data were available publicly at
the time this study was carried out. The CES is a national probability sample of
households that represents the non-institutional, civilian U.S. population. This includes
population living in group quarters like boarding houses, condominiums, housing
facilities apartments and group quarters like dormitories, staff units in hospitals and
homes for aged, infirm or needy, permanent living quarters in hotels and motels, and
mobile home parks. Thus the sample for this study included all consumer units that
participated in either interview survey or diary survey conducted by the BLS between
1996 and 2005 who reported an after tax income greater than zero. Those consumer units
for whom only one quarter of expenditure data was available were also not considered for
analysis. According to the BLS, a “consumer unit” is defined as

1. All members of a particular housing unit who are related by blood, marriage,
adoption, or some other legal arrangement, such as foster children;

2. A person living alone or sharing a household with others, or living as a roomer in
a private home, lodging house, or in permanent living quarters in a hotel or motel,
but who is financially independent;

3. Two or more unrelated persons living together who pool their income to make
joint expenditure decisions.

4. Students living in university-sponsored housing are also included in the sample as
separate consumer units.

Validation of Consumer Expenditure Survey

This section reports findings about the validity of the expenditure data obtained
from the CES. One concern about the validity of the data is related to the time
constraints associated with the completion of the questionnaire and survey. As previously
mentioned, because the BLS collects expenditure data from diary and interview surveys,
another relevant issue to the survey’s validity is characterization of errors in response to
different consumption categories in both types of surveys. The other issue relates to the level of accuracy of expenditure data in the CES compared with expenditure data obtained from other sources such as the MEPS or PCE of NIPA. The BLS follows standard international practice of collecting expenditure information for more durable items through the recall method using interview survey, while using the diary survey method to collect information about non-durable small items. When expenditure data are available from both interview and diary survey, the BLS determines their reliability by comparing data obtained from these two sources with data from other reliable sources like PCE.

Since both the interview and diary survey are designed to represent the same population of the USA, one way to check the validity of the sample is comparing the work related information and characteristics of the consumer unit who participated in different surveys. In comparing the work related information and consumer unit characteristics during the year 1982 to 2001, Battistin found that during the year 1986 to 1996, the diary survey oversampled more educated households than the interview survey. This study by Battistin also found that in the interview survey the amount of weeks worked per year by the reference person and the distribution of total family income were significantly lower compared to diary survey. A comparison of aggregate expenditure on non-durable goods over the 1990s revealed that CES data depicted a different trend in expenditure when compared to PCE data. Another study by Walden et al. compared the estimates of out-of-pocket health care expenditures from 1987 NMES and the 1987 CES. The researchers found that the overall CES estimated mean consumer unit out of pocket healthcare expenditure ($631.42) in 1987 was three-fourths of the mean out-of-pocket
expenditure obtained from the NMES ($846.81). The general pattern of out-of-pocket expense was the same for both CES and NMES. As the age of reference person increased, the out-of-pocket expenditure increased.

Branch computed ratios of CES estimates of aggregate expenditures with other sources like PCE by matching detailed estimates from two sources during the year 1989 through 1992. The analysis showed that for aggregate expenditure categories like food, transportation, apparel, household operations, household furnishing and equipment, rent utilities and public services, entertainment, personal care products and services, the estimates obtained from the CES are lower compared to PCE estimates. However, for most comparable categories the relationship between the two series was consistent. If the CES to PCE ratio is too small it might be due to the differences in content of expenditure category, or the methodological differences between two surveys. While the detailed estimates of food expenditures from the diary component of the CES were compared with the PCE and two food trade association sources like “Supermarket Business” and “Progressive Grocer”, the author found that the CES estimates lie between the PCE estimate and the trade association estimates. While comparing with the Residential Energy Consumption Survey (RECS) for the years 1984, 1987 and 1990, it was found that the CES estimates of the combined energy sources (natural gas, electricity and fuel oil) are close to the estimates from RECS. The author also compared the estimates of out-of-pocket healthcare expenditures (over the counter drugs, prescription drugs, medical equipment, professional medical care services, hospital care not covered by third party payers, any other co-payment and deductible) in CES with the National Health Accounts (NHA) over the 1988 to 1992 period. It was found that the total medical care expenditure
from the CES in 1992 was approximately 70 percent of the NHA, which reflected the lower estimates for drugs, supplies and professional services in the CES. However over the years the ratios of CES to NHA for total and major components of medical care expenditure were consistent. This difference between NHA estimates and CES estimates are due to the fact that CES data are obtained from households while NHA data was administrative in nature and also the difference in population covered by two sources. When the income estimates from 1988 to 1991 were compared between current population survey (CPS) and CES, the total income before taxes for CES was approximately 85 percent to 90 percent of the CPS reported income. Except for the component titled as property income, all major income components were comparable between the CPS and CES. Though there are methodological and intentional difference in data collection between these disparate government and private sources, CES still performs well when compared to other sources. In general the CES estimates are lower compared to NIPA estimates because of differences in definition, methods, and population coverage.25

Another study by Slesnick compared the aggregate expenditure from CES with the PCE in NIPA from 1961 through 1989. He considered five groups of expenditures: a) energy (electricity, natural gas, heating oil, gasoline), b) food (all food products, including tobacco and alcohol) c) consumer goods (all nondurable goods), d) capital services (service flow from consumer durables and housing), e) consumer services (car repairs, medical services, education, entertainment). The NIPA total expenditure levels were higher compared to CES levels because of the expanded definition of consumption used in NIPA and the larger population considered. However, the ratio of per capita
expenditure in the CES to expenditure in PCE was decreasing over time. He found that for capital services and energy the ratio of per capita CES to NIPA expenditure was relatively constant (from 0.9 to 1.09) over time, while the same ratios for food expenditures were not constant over time and deviated substantially from one. There was also a substantial difference between the CES and PCE estimates on consumer services. This lack of consensus in expenditure between the two sources could be explained by the differences in the definition of consumption. The CES included only out-of-pocket expenditures while NIPA estimates included the receipts from business. However, one also should be careful about using the PCE as the benchmark for comparing CES. In an article published in Monthly Labor Review in 1987, Gieseman found that food expenditures reported in CES were closer to alternative independent estimates than PCE estimates.26

To ensure the accuracy of collected data, the BLS uses a highly trained group of field representatives for the data collection purpose. Field representatives ask the respondents to use bills, receipts, and check books whenever possible. However, a lot of times the respondents fail to do so. If an expense or other financial data provided by the respondent does not sound correct, the representatives are instructed to prod the respondent further about the response. Recently, the BLS has used a CAPI instrument which has its own edits with outliers so when the field representative records the data provided the “edit” pops up asking the representative whether the recorded expense is correct. After interviewers complete data collection, the preliminary survey data processing is carried out by the Bureau of Census. These data processing activities include keying the data from questionnaires, clerical data editing, and correcting for
inconsistencies in the collected data. The Bureau of Census also corrects the missing sections of questionnaires, inconsistencies and identifies errors. The collected data are also passed through basic quality checks of missing values. The BLS also has its own set of “edits” once the data is transmitted to the BLS consumer expenditure program office for analysis. The BLS conducts an extensive review of counts, weighted means, and unweighted means by region, family relationship coding inconsistencies, selected extreme values for expenditure, and income categories. In the case of extreme data values, the BLS conducts an investigation by reviewing questionnaires on microfilm. Errors identified in this process are corrected prior to the release of microdata files.

Researchers in the BLS also make continuous effort to improve the quality of expenditure data obtained from CES. Various research projects are undertaken for this purpose within the BLS to develop alternate methodologies to obtain accurate data from respondents. The development of a CAPI instrument was a significant step in that direction in recent years. Researchers also are undertaking projects to improve the data processing procedures. One such project examined the expenditure data collected by electronic scanner from A.C. Nielsen to identify their possible use in improving data processing procedures and also supplementing data collected in diary survey. Research to make the diary-survey more user friendly has also been undertaken. The National Opinion Research Corporation also investigated the feasibility of using multiple numbers of diaries instead of a single one as it is currently practiced.27

As it was apparent from the above discussions, the researchers in the BLS have made significant efforts to improve the data collection procedure in the CES and enhance the quality of collected expenditure data. Researchers try to validate the data by
comparing it with external but similar sources. Since, this survey is used for periodic revision of the CPI, analyzing the demand of different commodities, studying the impact of policy changes on welfare of particular consumer groups, reliability and validity of the CES estimates is an extremely important aspect of the agenda of the BLS.

**Description of Variables**

This section describes in detail all the expenditure variables, income variable and other socio-demographic variables used in this study.\(^{28–37}\)

Income: The BLS collects income information about the consumer unit with the help of a questionnaire during the interview survey or the diary survey. The income information is very comprehensive in nature. It combines the income of all consumer unit members aged fourteen years and above during the twelve months preceding the interview. It includes all wages, salaries, commissions, tips, allowances, teaching fellowships, armed forces pay, and severance pay. It also includes any income or loss from non-farm business, partnership, professional practice, own farm, social security benefits, railroad benefits, supplemental security income (SSI) payments, any interest on bank account, financial investments, any income from dividend, trusts, estates or royalties, retirement, disability and survivor pensions from private companies, military, government, IRA, unemployment compensation, workers’ compensation, veteran’s benefits, public assistance or welfare (excluding non-monetary assistance like food stamps), value of all food stamps or electronic benefits, net income or loss from any rental type of room or units, income from child support, alimony, or any other person outside the consumer unit, lump sum payments from insurance, estates, trusts, royalties, alimony, prizes, games of chances like lotteries, money received from sale of household furnishings, equipment, clothing, jewelry, pets or other belongings (excluding sale of
vehicle or real estates), other income from scholarships, fellowships, stipends. If the responder can not provide the exact amount received by all members of the consumer unit, then the interviewer asks the respondent to select a category of income. It is to be noted that income from wage and salary, self-employment (non-farm) income, farm income, social security benefits, railroad retirement benefits, SSI benefits are collected for each individual of the consumer unit, while the rest of the income information is collected for the consumer unit as a whole. Sometimes, the consumer unit failed to report all the relevant income from different sources. As a result, the BLS introduces a variable to segregate the complete income reporters from incomplete income reporters. The BLS defines a consumer unit as a complete income reporter if:38

1. “The reference person reports a non-zero amount for one of the six income sources

2. At least one other CU member reports a non-zero amount for a major income source and report valid zeros for all major income sources for the reference person

3. The CU reports a non-zero amount for at least one other income source and valid zeroes for all major sources for all members.”

A consumer unit can be identified as a complete income reporter, but it does not need to report income from all sources. Prior to the year 2004, the BLS did not provide any income imputation to predict income for households who reported receiving a particular type of income, but failed to report a specific value.

Sometimes income data are top-coded which implies replacement in cases where the value of original income data exceeded some critical values. These critical values were determined in accordance with Census Disclosure Review Board guidelines. Any observation outside the critical value was replaced by the top-coded value that represented the mean of subset of all outlying observations. Some income variables are
constructed by various components. In this case, the variables’ components are summed up normally and if one of the component variables was topcoded, then the variable was also topcoded. Due to topcoding, income value on public use data may be either below or above the actual reported value.

**Expenditure Variables**

Food Expenditure: The BLS collects information related to food expenditure from both the interview and the diary survey. It covers food and drinks for home consumption and for away from home consumption. Food and Drinks away from home includes any expense incurred in fast-food restaurants (where payment is done before eating/drinking), full service places (payment done after eating/drinking), vending machine or mobile vendors, employer and school cafeterias (includes elementary school pre-payments). Food and drinks away from home includes any tax and tips paid. Food and drinks for home consumption includes payment for all grain products, bakery products, beef, pork, poultry, other meats, fish, seafood, oils fat and dressings, eggs and dairy products, fruits and juices, sugar, sugar substitute and sweets, vegetables, other food items (baby food, pet food, frozen foods, sauces, seasonings, soups etc.) non-alcoholic beverages, alcoholic beverages, food and beverages purchased as a gift for someone not belonging to the consumer unit. Food and drinks for home consumption does not include any sales tax. Any discounts or coupons received are also excluded and the original amount paid was only noted. This study considered the reported food expenditure from interview survey.

Apparel Expenditure: The information related to expenditure for apparel (clothing and sewing materials) includes any expense for clothing of male and female (including children and infants) members of the consumer unit. It includes any expense for sportswear, formal wear, uniforms (for which cost is not reimbursed), footwear,
accessories, dresses, coats, jackets, pants, jeans and nightwear purchased for any member of the consumer unit or for any member outside consumer unit. It also includes expenses for infant clothing, watches, jewelry and hairpieces. In the diary survey, the respondents are asked to report the cost of clothing, shoes, jewelry and accessories without tax.

Housing and Utilities Expenditure: This includes the expense related to rented living quarters, owned living quarters and other real estates owned, construction, repairs, alterations, and maintenance of property, expense for appliances, household equipments and other items, expenditure related to repair of household equipment and furniture, any service contracts, furniture repair and reupholstering, home furnishing and related items. Expenditure related to the rented living quarters include any payment for rental charges of the sample unit and other units including garage or parking facilities, receipt of any reduced or free rent. The owned living quarters and other owned living estate collects payment information about mortgages (principal and interest amount, duration, interest rate, frequency of mortgage payment, number of mortgages, any change in mortgages payment), any payment for property tax, property insurance, mortgage guarantee insurance, lump sum home equity loans. The ownership costs include amount paid during three months for land or ground rent, any payment to homeowner’s association, payment made to cooperatives for various maintenance activities. Construction, repairs, alterations, and maintenance of property include any expense for building, finishing or remodeling any part of the property, painting, electrical work, insulation, roofing, siding, heating or air-conditioning, flooring, roofing, rent for tools or equipment used, cost of labor, purchase of any materials for future maintenance jobs. Expense for appliances, household equipments and other selected items include the purchase price (after any
trade-in allowance) or rent for those items and extra installation charges for those equipments. Expenditure for home furnishing and related household items include purchase price of furniture for living, dining, recreation, family room, bedroom, outdoor, household decorative items, utensils, and dinnerware, floor and window coverings. This will also include the cost of rental, leasing or repair of the furniture. The expenditure category for utilities lists the expenses incurred for owned and rented properties. This includes any expense for telephone, pagers, pre-paid phone cards, public pay phone, electricity, natural or utility gas, fuel oil, kerosene, wood, coal, bottled or tank gas, piped-in-water, trash/garbage collection, sewerage maintenance, water softening services, septic tank cleaning, internet connection, cable television. This study considers housing and utilities expenditure together.

Transportation Expenditure: This expenditure category includes the expense for owned vehicles, rented and leased vehicles and vehicle operating expenses. This information is collected from interview survey. The interviewer records the amount of net payment (after deducting any business expenses, reimbursed or paid by others) incurred for renting or leasing a car during the reference period. It also records the amount of each payment done during the reference period, any cash down payment, any extra fees incurred at the termination of lease. Under the section entitled as “owned vehicle”, the interviewer collects information related to month and year of purchase of the vehicle, receipt of trade-in allowance, any amount paid by the employer, source of credit, amount of each payment, time period covered for each payment. Interview survey also collects expenditure information related to the vehicle maintenance, repair, parts, equipment, licensing, registration, inspection of vehicles. Expenditure related to average monthly
gasoline consumption, parking fees, towing charges, docking and landing fees, auto repair service policies, automobile service clubs are also collected using the interview survey.

Educational Expenditure: Information related to educational expenses is collected using interview survey. This includes any payment for recreational lessons or other instruction for CU members or other persons, nursery schools or child day care, tuition, housing while attending school, food or board while attending school, private school bus, purchase of school books, supplies.

Medical Care: Information related to any payment for eye care, dental care, inpatient hospital care, service by medical professionals (physicians and other professionals), other medical services, medical and surgical supplies, total amount paid for health and hospitalization insurance (including payroll deductions), and prescription drugs are collected from the interview survey. Any subsequent reimbursement received for the above items are also reported in the interview survey. The net expenditure (payment – reimbursement) will be considered for the analysis. The expense for non-prescription drugs are collected from the diary survey.

Recreation: This includes any payment for any subscription or membership of books, periodicals, magazines, theater, concert, opera, musical series, season ticket for sporting events, compact-discs, videos, records, any expense for country club, health club, swimming pool, tennis club, social or other recreational organizations, civic, service or fraternal organizations, any single admission fees paid to sporting event, entertainment event, any payment for film processing. This section also includes all the payment for vacations and trips. This consists of payment for package trip, gasoline, oil, diesel fuel
and tolls, spending for hotel, motel, cottages, lodging and meals, snacks, drinks at restaurants, bars or fast food places, food beverage at grocery store, convenience store or liquor store, any fees to play sports or exercises during the trip or vacation. Expenses for local overnight stays during holidays are also reported in expenditure survey.

**Inclusion and Exclusion Criteria**

A single database was created by combining observations for a single consumer unit from different consumer unit characteristics and income file (FMLY). At first the FMLY files from the first quarter of the year 1996 through the last quarter of the year 2005 were combined. The unique consumer identification number was used to link all these quarterly FMLY files. These FMLY files contain the socio-demographic characteristics and expenditure information for various CU. The quarterly expenditure (price multiplied by quantity) for a specific category of commodity was divided by the average of not-seasonally adjusted CPI for that commodity during the last quarter to obtain the quantity demanded. The total nominal income of the consumer unit was divided by the unadjusted CPI for the year to obtain the real income. All those observations which have either a total income or a total expenditure less than zero were excluded from analysis. Those consumer units who do not have any expenditure reported for food or housing during the interview period were excluded from the analysis. We also excluded those observations which have either a total healthcare expenditure or a total expenditure for prescription drug or a total expenditure for medical service or medical supplies less than zero. Also those consumer units with the age of reference person less than 18 years old are excluded from the analysis. After adjusting for the above mentioned exclusion criteria, the total number of consumer units retained was 89,945.
The Model and the Statistical Method

The expenditure of a commodity is a function of price of all available commodities, income of the consumer unit and also other demographic characteristics of the consumer unit. Let us assume the following:

1. \( i \) denotes the \( i \)-th consumer unit.
2. \( j \) denotes the \( j \)-th commodity. \( j = 1, 2, \ldots, 7 \)
3. \( e \) denotes expenditure for a single group of commodity
4. \( E_i \) denotes total expenditure by \( i \)-th consumer unit
5. \( M_i \) denotes total nominal income of the consumer unit
6. \( Q_{ij} \) denotes the quantity demanded by \( i \)-th consumer unit for \( j \)-th commodity.
7. \( P_j \) denotes the price of the \( j \)-th commodity.
8. \( \Omega_t \) represents the aggregate consumer price index for all commodities for \( t \)-th year.
9. \( \eta_j \) denotes the income elasticity of expenditure for \( j \)-th commodity.
10. \( \Pi_{jk} \) denotes the price elasticity of demand of \( j \)-th commodity with respect to price change of \( k \)-th commodity. If \( j = k \) then it represents own price elasticity.

Therefore the expenditure of \( j \)-th product by \( i \)-th consumer unit is equal to \( e_{ij} \).

The total expenditure by \( i \)-th consumer unit is equal to \( E_i = \sum_{j=1}^{7} e_{ij} \)

The BLS uses the first interview just for bounding purpose only, not for estimation of expenditure. By bounding here it is implied that the BLS does not want the consumer to report from an indefinite time period. As a result, the BLS does not publish the expenditure information collected in the first interview of a consumer unit. So if a consumer unit completes all the interviews, it is possible to obtain the expenditure information at most for four consecutive quarters. The dollar value of expenditure for a
specific commodity incurred in a quarter by a consumer unit was divided by the quarter specific CPI for that commodity \( (P_j) \) to get the quantity demanded. Then these quantity demanded in every quarter was added to obtain the total estimate of quantity demanded by a consumer unit for that specific commodity. This level of aggregating quarterly data can help to reduce the number of observations having “zero expenditure” in the expenditure dataset. When the expenditure files from different quarters are combined together by the unique consumer identification number, the average of all quarterly demand for a specific commodity by a specific CU was calculated. These averages of quarterly demand for a specific commodity by a specific CU were dependent variables in the study. The total expenditure share for j-th commodity by i-th consumer unit is equal to:

\[
W_{ij} = \frac{e_{ij}}{E_i} \quad (3.1)
\]

The quantity demanded of j-th commodity by i-th consumer unit is equal to:

\[
Q_{ij} = \frac{e_{ij}}{P_j} \quad (3.2)
\]

This \( Q_{ij} \) is the dependant variable in the regression model. The fundamental regression to estimate demand for j-th commodity for i-th consumer unit \( (Q_{ij}) \) is:

\[
Q_{ij} = a + \sum_{j=1}^{7} \alpha_j \frac{P_j}{\Omega_j} + \sum_{k=1}^{6} \beta_k d_k + \gamma \frac{M_i}{\Omega_i} + u \quad (3.3)
\]

In the above equation, the coefficient \( \alpha_j \) represents price effect of different commodities on the demand for j-th commodity. The coefficient \( \beta_k \) represents the effect
of k-th demographic variable ($d_k$) on the demand for j-th commodity. So \( \frac{P_j}{\Omega} \)
represents the relative price of j-th commodity for t-th time period. The following
demographic variables are considered in the regression:

\[ d_1 = \text{Age of the consumer unit reference person} \]

\[ d_2 = \text{Ethnicity of the reference person (Four groups: White, Black, American Indian or Aleut or Eskimo, Asian or Pacific Islander). Due to reclassification of the ethnicity variable during the period of the study, we considered only three groups (Caucasian or white, black and others). This was represented by incorporating two dummy regressors in the regression considering “others” as the reference category, which will have zero values for both the dummy regressors. Let the dummy regressors be A_1 and A_2, which are defined in table 3.2.} \]

\[ d_3 = \text{Highest level of education attained (Nine groups: 1) Never attended school, 2) First through eighth grade, 3) Ninth through twelfth grade (no High school diploma), 4) High school graduate, 5) Some college, less than college graduate, 6) Associate degree, 7) Bachelor’s degree, 8) Master’s degree, 9) Professional/ Doctorate degree). This variable was considered as a continuous variable where number of years of schooling will represent the different level of education. The average of number of years of schooling for reference person and his/her spouse was calculated.} \]

\[ d_4 = \text{Household composition (total number of members in the household or family size)} \]
\(d_5\) = Area of living of a consumer unit (urban or rural area). This will be represented by a dummy variable (B) which will take value equal to zero if the consumer unit belongs to rural area and equal to one if the consumer unit belongs to urban area.

So \(B = 1\) if the consumer unit belongs to urban area

\(B = 0\) if the consumer unit belongs to rural area

\(d_6\) = Region of living (Northeast, Midwest, South, West). This variable will be represented by three dummy variables while considering “South” as the reference category which will have value equal to zeroes for all three dummy regressors. Let the dummy variables be \(G_1, G_2, G_3\). The variables are defined in table 3-1.

The regression equation (3.3) can be rewritten in the following form (including all dummy variables):

\[
Q_{ij} = a + \sum_{j=1}^{\gamma} \alpha_j \frac{P_{ij}}{\Omega} + \beta_1 d_1 + \beta_2 A_1 + \beta_3 A_2 + \beta_4 d_3 + \beta_5 d_4 + \beta_6 B + \beta_7 G_1 + \beta_8 G_2 + \beta_9 G_3 + \gamma \frac{M_i}{\Omega} + u
\]

The coefficient \(\gamma\) represents the effect of income on the demand for j-th commodity. Here the real income of the household is considered. Real income can be obtained by dividing the nominal income of the household in a specific year by the consumer price index for that year. The term \(a\) represents the intercept of the regression. The term \(u\) represents the error.

The price variable corresponding to different commodities was calculated in the following way. The unadjusted nominal price of a commodity was divided by not seasonally adjusted CPI for all items to obtain the relative price of the commodity. One
example will clarify this calculation. If the month of the interview of the CU is June in
the year 2002, the CU reports expenditure for the month of March, April and May of
2002. At first the mean of the unadjusted nominal price of a commodity for the months of
March, April and May in the year 2002 was calculated. This unadjusted mean price of
that commodity was then divided by the mean of not seasonally adjusted CPI for all items
during those three months of 2002 to obtain relative price of that commodity. The natural
logarithms of relative prices were then calculated.

From the interview survey, one can obtain the month of interviews for a specific
consumer unit by observing the value of variable (QINTRVMO) and the calendar quarter
of the interview. So, if the value of the variable QINTRVMO in the first calendar quarter
of the year 2002 is equal to “2”, it implies that the interview was conducted in the month
of February 2002.

In many cases applying standard OLS regression technique to expenditure data
does not produce consistent and efficient estimates. This is because of the characteristics
of expenditure data. Few salient characteristics of expenditure data those make the OLS
estimator inconsistent and inefficient include:39

1. The expenditure data are normally non-negative
2. Expenditure data are right-skewed.
3. In many instances a significant percentage of expenditure data is equal to zero.
4. Sometimes expenditure data are also right censored (or censored from above). .

To overcome the problem that a significant percentage of expenditure data is equal
to zero, a two-part modeling approach will be used. One of the pioneering model called
Tobit model, was developed by James Tobin (1958), who applied it to the individual
expenditures on consumer durable goods.40 This model is actually a censored normal
regression model, where censoring is done from below at zero. Another assumption is
that the latent variable \((y^*)\) is linear in regressors with additive error which is normally distributed and homoskedastic in nature.

The Tobit model can be described as: 
\[ y^* = X'\beta + \varepsilon, \text{ where the error } \varepsilon \sim N[0, \sigma^2]. \]

The latent variable \(y^*\) follows a normal distribution \(y^* \sim N[X'\beta, \sigma^2]\). The observed \(y\) can be defined as:

\[
y = y^* \text{ if } y^* > 0
\]
\[
y = \_ \text{ if } y^* \leq 0 \text{ [this means that } y \text{ is observed to be missing]}\]

One of the fundamental problems with Tobit model is its heavy dependence on the distributional assumptions. If the error is heteroskedastic or not normal then the maximum likelihood estimator of Tobit model is inconsistent.\(^{41}\) To avoid this problem heteroskedastic robust standard error will be used in regression.

The expenditure data are right skewed. Hence the quantity demand are also right skewed. This problem with skewness can be tackled by taking logarithm of quantity demanded for all commodities. Logarithm of real income was also calculated.

The income elasticity of demand for \(j\)-th commodity can be calculated from the regression equation 3.3. The income elasticity of demand for \(j\)-th commodity is defined by:

\[
\eta = \frac{\partial Q_j}{\partial M} \cdot \frac{M}{Q_j} = \gamma \frac{M}{Q_j} \quad \text{--- (3.4)}
\]

For practical purpose, in regression models the quantity demanded and post-tax real income will be expressed in logarithmic form and the regression coefficient corresponds to post-tax real income will measure the income elasticity.
The price elasticity of demand for j-th commodity can also be calculated from the regression equation 3.3. The elasticity of demand for j-th commodity with respect to price of r-th commodity is defined by:

\[ \Pi_{jr} = \frac{\partial Q_j}{\partial P_r} \cdot \frac{P_r}{Q_j} = \alpha_{jr} \cdot \frac{P_r}{Q_j} \quad (3.5) \]

This study also explored how people having different socio-economic and demographic characteristics respond differently to price change of necessities (food, housing and health care). It was explored whether people who belong to different age groups, different ethnicities (Caucasian, African-American and Others), and different income groups respond differently to change in price of food, housing and medical care. Age was classified in the following categories: a) 18 to less than 40 years old, b) 40 to less than 65 years old and c) At least 65 years old. One of the rationales for creating such a classification was people’s demand for health varied substantially across different age groups. According to the American Heart Association there is a 49% chance for men to develop coronary heart disease after the age 40. Also people who are above 65 years of age were covered under federal programs like Medicare. Tobit regression model would be used to understand the significance of different independent variables.

To measure the responsiveness of price for the demand of food, housing and healthcare across different age group the following regression would be performed across three above mentioned age groups:

\[
Q_{ij} = a + \sum_{j=1}^{3} \alpha_j \frac{P_j}{\Omega} + \sum_{k=1}^{4} \beta_k d_k + \gamma \frac{M_i}{\Omega_r} + u \quad (3.6)
\]
Here \( Q_{ij} \) represents the quantity demanded of food, housing and healthcare in three different regression equations. The dollar value of expenditure incurred in a quarter by a household for a specific commodity will be divided by the quarter specific CPI for that commodity \( (P_j) \) to get the quantity demanded. Then these quantities demanded in every quarter will be added to obtain the yearly estimate of quantity demanded by a household for that specific commodity. The suffix \( j \) represents these three categories of items.

The price variable \( \frac{P_j}{\Omega_t} \) indicates the relative price of \( j \)-th commodity in \( t \)-th year.

\[ d_1 = \text{Highest level of education attained by the reference person of consumer unit.} \]

This will be treated as a categorical variable. The three groups are a) Never completed a high school diploma, b) completed at least a high school degree but did not complete bachelor degree, c) completed at least a bachelor degree. This three categories classification will be represented in the regression equation by introducing two dummy regressors \( D_1 \) and \( D_2 \). Here we are assuming that the rate of change of quantity demanded remains unchanged across three groups of educational attainment. The category titled “never completed a high school diploma” serves as a baseline category as it is coded zero for both dummy regressors. The variables \( D_1 \) and \( D_2 \) are defined in Table 3.3.

\[ d_2 = \text{Post-tax real income level as a percentage of Federal Poverty Threshold of consumer unit for a specific year.} \]

The after-tax income of the consumer unit will be divided by the CPI of the corresponding year to obtain the real income.

\[ d_3 = \text{Family size of the consumer unit.} \]

This will be a treated as a continuous variable.
\( d_4 \) = Race of the consumer unit. There are three groups a) Caucasian, b) African-American, c) others. This three categories classification will be represented in the regression equation by introducing two dummy regressors R1 and R2. Here we are assuming that the rate of change of quantity demanded remains unchanged across three groups of race. The category titled “others” serves as a baseline category as it is coded zero for both dummy regressors. The variables R1 and R2 are defined in table 3.4.

After the inclusion of dummy variables the regression 3.5 will take the following form:

\[
Q_{ij} = a + \sum_{j=1}^{3} \alpha_j \frac{P_j}{\Omega} + \beta_1 D_1 + \beta_2 D_2 + \beta_3 d_3 + \beta_4 d_4 + \gamma_1 R_1 + \gamma_2 R_2 + \frac{\gamma M_i}{\Omega} + u
\]

How demand for food, housing and medical care among consumer units belong to different income groups changes with increase in price would be measured with the help of a multiple regression. In accordance with the National Healthcare Disparities Report the survey sample will be divided in four after-tax income groups as a percentage of federal poverty thresholds: a) Below federal poverty level for a specific yea (poor group), b) between 100% and less than 200% of federal poverty level, (near poor group) c) Between 200% and less than 300% of federal poverty level (middle income group) d) On and above 300% of poverty threshold (rich group). The following regression (3.7) would be performed for each commodity group across four different income groups.

\[
Q_{ij} = a + \sum_{j=1}^{3} \alpha_j \frac{P_j}{\Omega} + \beta_1 D_1 + \beta_2 D_2 + \beta_3 H_1 + \beta_4 H_2 + \beta_5 d_3 + \gamma_1 R_1 + \gamma_2 R_2 + u
\]

This study also analyzed how demand for food, housing and medical care among consumers belong to different ethnicities differ due to an increase in price. The following
regression (3.8) would be performed for each commodity group across Caucasian and African-American and others.

\[ Q_{ij} = a + \sum_{j=1}^{3} \alpha_j \frac{P_{ij}}{\Omega} + \beta_1 D_1 + \beta_2 D_2 + \beta_3 H_1 + \beta_4 H_2 + \beta_5 d_3 + \beta_6 d_4 + \gamma \frac{M_i}{\Omega} + u(3.9) \]

Whether the price effects in these different regressions are statistically significantly different would be evaluated using Chow test\(^{42}\). For example when the effect of increase in the price of medical care on food demand were evaluated in four different income groups, four different price effects would be obtained. Chow test would be used to evaluate whether these four coefficients are statistically significantly different.

In the regression model if the income and expenditure data are not normally distributed it can cause bias in the regression results. A suitable transformation procedure would be used to convert distribution of these variables approximately normal. Based on a classic article by G.E.P. Box and D.R. Cox, Box-Cox transformation might be used in the case of violation of normality.\(^{43}\) If such a transformation will be used, it will be discussed in the appendices in detail.
### Table 3-1. Defining dummy variables for region of living

<table>
<thead>
<tr>
<th>Categories</th>
<th>G₁</th>
<th>G₂</th>
<th>G₃</th>
</tr>
</thead>
<tbody>
<tr>
<td>Northeast</td>
<td>1</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Midwest</td>
<td>0</td>
<td>1</td>
<td>0</td>
</tr>
<tr>
<td>West</td>
<td>0</td>
<td>0</td>
<td>1</td>
</tr>
<tr>
<td>South</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
</tbody>
</table>

### Table 3-2. Dummy variables for ethnicity

<table>
<thead>
<tr>
<th>Categories</th>
<th>A₁</th>
<th>A₂</th>
</tr>
</thead>
<tbody>
<tr>
<td>White</td>
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<td>0</td>
</tr>
<tr>
<td>Black</td>
<td>0</td>
<td>1</td>
</tr>
<tr>
<td>Others</td>
<td>0</td>
<td>0</td>
</tr>
</tbody>
</table>

### Table 3-3. Dummy variables for educational attainment

<table>
<thead>
<tr>
<th>Categories</th>
<th>D₁</th>
<th>D₂</th>
</tr>
</thead>
<tbody>
<tr>
<td>Completed at least a Bachelor’s degree</td>
<td>1</td>
<td>0</td>
</tr>
<tr>
<td>Completed at least High School degree but did not complete Bachelor’s degree</td>
<td>0</td>
<td>1</td>
</tr>
<tr>
<td>Never Completed a High School Diploma</td>
<td>0</td>
<td>0</td>
</tr>
</tbody>
</table>

### Table 3-4. Dummy variables for race

<table>
<thead>
<tr>
<th>Categories</th>
<th>R₁</th>
<th>R₂</th>
</tr>
</thead>
<tbody>
<tr>
<td>Caucasian</td>
<td>1</td>
<td>0</td>
</tr>
<tr>
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CHAPTER 4
RESULTS

This chapter depicts the sociodemographic characteristics of the CU and also the results of the regressions exploring the effect of price changes and impact of socio-demographic variables.

**Sociodemographic Characteristics of Consumer Units**

The sample included 47,613 (52.94%) males and 42,332 (47.06%) females. Most respondents were Caucasian (74,548; 82.88%), followed by African-American (10,437; 11.6%), and Others (4,960; 5.5%). The category “others” included Native Americans, Asian, Pacific Islander, and Hispanics. There were 14,892 (16.56%) CUs from the Northeast, 20,829 (23.16%) from the Midwest, 30,437 (33.84%) from the South and 23,787 (26.45%) from the West. Most CU’s lived in urban areas (82,008; 91.18%). The highest level of educational attainment of the sample is as follows: 13,984 (15.55%) of the CU did not have a high school diploma, 52,454 (58.32%) finished high school but did not have a Bachelor’s degree, and 23,507 (26.13%) had at least a Bachelor’s degree. Out of the total sample 36,519 (40.6%) were between 18 and 40 years old, 35,566 (26.13%) were between 40 and 65 years old, 9,217 (10.25%) were between 65 and 74 years old, and 8,643 (9.61%) were more than 75 years old. Some measures of central tendency and dispersion statistics about the sample are presented in Table 4-1.

To estimate the effect of CU’s income and price of different commodities on the quantity demanded for different products, a set of regressions are performed. The prices of different commodities are considered as independent variables in the regression along with socio-demographic variables. However the correlation coefficient of prices of
different commodities was measured to ensure there was no multicollinearity problem. The Pearson’s correlation coefficients between relative prices are described in table 4.2.

As identified in Table 4-2, the correlation coefficients between various price categories are substantially high: the correlation coefficient between relative prices of apparel and medical care (-0.99), apparel and recreation (0.82), apparel and education (-0.86), apparel and tobacco (-0.91), health and recreation (-0.8) health and education (0.87). If all these prices are included in the regression model for measuring price and income effect then it would cause collinearity problem. Since the primary interest of this research is to measure the cross price effect between medical care and the other groups of commodities, only own prices of commodities and price of medical care are included in the regression model along with the sociodemographic variables. Among sociodemographic variables, age of reference person of the consumer unit, family size of the consumer unit, average year of schooling of reference person and his/her spouse, region of household, location, and ethnicity are considered as independent variables in the regression analysis.

**Effect of Change in Own-Price, Price of Medical Care, and Real Income on the Demand of Food, Housing, Medical Care, Apparel, Transportation, Education and Recreation**

To measure the effect of change in own-price, price of medical care and the real income regressions were estimated. To measure the price and income effect on food and housing demand, OLS regression was performed with heteroskedastic robust standard errors. For the rest of the commodities such as apparel, transportation, medical care, recreation, and education, the dependent variables can take only non-negative values including zero. The dependent variables are censored at the lower limit equal to zero. As only positive outcomes are completely observed in this case, the analysis of these
quantities demanded would be performed by using Tobit model after Tobin (1958), who applied this kind of model to understand the individual expenditures on consumer durable goods.40

There were 7,142 (8%) CUs for which apparel demand was equal to zero, while 14,113 (15.7%) CUs reported zero medical care expenditure. For transportation demand, there were 3,456 (3.8%) left censored observations and almost 62,993 (70%) of CUs reported zero expenditure for education. There are 4,145 (4.6%) households with zero expenditure for recreation in the sample. The logarithm of quantity demanded was considered as the dependent variable in each regression. The independent variables were log of relative price of the respective commodity (for example in estimating the effect on food demand, log of relative price of food was considered as an independent variable) and log of relative price of medical care, log of real income, average year of schooling, family size, age of reference person of CU, region of household (a dummy variable with four categories including “south” as the base category), location (a binary variable with “rural” as the base category), ethnicity (three categories are white, black and others where “others” is considered as the base category). Table 4-3 summarizes the estimates of effects of own-price and price of medical care and real income on demand of various commodities and their statistical significance. The first number indicates the magnitude and sign of the regression coefficient. Beneath each coefficient estimate are two estimates within each parenthesis reflecting the t-statistics and the corresponding p-value of statistical significance.
Own-Price Effect

The coefficients corresponding to own-price effect for all commodities are negative, which indicates that as the price of a specific commodity increased, quantity demanded for the commodity decreased. The coefficients corresponding to own-price effect also represent the own-price elasticity for that particular commodity. The own-price elasticity for food was equal to 1.105, which indicated that for a 10% increase in price of food, the demand of food decreased by 11%. Similarly, a 10% increase in the price of housing would decrease housing demand by 0.96%, while a 10% increase in price of medical care would reduce the demand for medical care by 7.2%, and a 10% increase in price of apparel would reduce the demand for apparel by almost 5.3%. Also it was observed that a 10% increase in the price of transportation would reduce the demand for transportation by almost 16.7%, while a 10% increase in price of education would reduce the demand for education by 3.73%, and a 10% increase in price of recreation would reduce the demand of recreation by 2.2%.

Effect of Price of Medical Care

The effect of change in the price of medical care on demand for all other commodities except for transportation was negative. All the commodities except for transportation were complements to medical care as when the price of medical care increased the demand of other commodities also decreased. A 10% increase in price of medical care would reduce demand of food by 9.3%, demand of housing by 2.3%, demand of apparel by 28%, demand of education by 2% and demand of recreation by 9.2%. Transportation was a substitute to the medical care as the demand for transportation increased with the price increase in medical care. A 10% increase in the price of medical care increased the demand of transportation by almost 38%. The effect
of price of medical care on demand of all commodities except for education was also statistically significant ($p \leq 0.05$).

**Income Effect**

The income elasticities for all commodities were also positive. A 10% increase in income increases the demand of food by 1.6%, demand of housing by 2.7%, demand of medical care by 1.3%, demand of apparel by 1.7%, demand of transportation by 3.3%, demand of education by 0.3% and demand of recreation by 1.95%. All goods were normal goods as their demand increased as the income increased. This small positive income elasticity of medical care was also consistent with findings in other studies. As many CUs have some form of health insurance, it is expected that a small change in the income level will not have a large effect on the demand of medical care.

**Effect of Socio-Economic Variables on Demand for Food, Housing, Medical care, Apparel, Transportation, Recreation, Education**

The next section reports the results of seven regressions estimating the effect of sociodemographic variables on the demand for food, housing, medical care, apparel transportation, education and recreation. Table 4-4 shows the effects of educational attainment (average year of schooling), age, family size and ethnicity on demand. From the regression analysis, we found that the average years of schooling had a statistically significant positive effect on the demand of all commodities. A year of schooling increased the demand for food by 3.8%, demand of housing by 8%, demand for medical care by 4.6%, demand for apparel by 5.4%, demand of transportation by 8%, demand of education by 15% and demand of recreation by 7.7%. Age had a statistically significant positive effect on food, housing, and medical care, and a statistically significant negative effect on apparel, transportation, and education. A plausible reason for this was at young
age consumers normally spend more on apparel and education, while as age increases, consumers’ spending for health, housing increased. The effect of age on recreation was not statistically significant. As the number of family members increased, demand for all commodities also increased and this effect was also statistically significant. If the number of family members increased by one, the demand for food increased by almost 20%, demand of housing increased by 15%, demand of medical care by 7.6%, demand of apparel by 11.3%, demand of transportation by 17.7%, demand of education by 25%, and demand of recreation by 7%. Compared to the ethnic category “others,” Caucasians had a significantly higher demand for all commodities except for education. Caucasians had a 8% higher demand for food, 5% higher demand for housing, 15% higher demand for medical care, 11% higher demand for apparel, almost 19% higher demand for transportation, 22% higher demand for recreation, and 7% less demand for education compared to ethnic category “others.” Compared to the ethnic category “others,” African-Americans have significantly less demand for food (8%), medical care (10.5%), transportation (15.2%), education (24.6%), and recreation (5.4%).

Table 4-5 describes the effects of region and location on demand of different commodities. Consumer units from the Northeast had a significantly higher demand for food (2.7%), housing (12.2%), apparel (13.2%), education (6%), and recreation (8%) compared to CUs from the South. Consumer units in the West also have a higher demand for all commodities except for medical care compared to CUs in the South. On the other hand, the demand for medical care in the South is significantly higher compared to the Northeast and the West. Compared to CUs in the South, the Northeast region had 9% and the West region had 8% less demand for medical care and these differences were
There was no statistically significant difference between Midwest and the South as far as demand for medical care was concerned. Consumer units in urban areas had statistically significant greater demand for food (5%), housing (24.6%), apparel (11.5%), education (16.6%), and recreation (4%) compared to rural areas. It has to be noted that housing in urban areas are more expensive than rural areas. However, urban consumer units demonstrated less demand for medical care (7.2%) and transportation (16%) compared to rural CUs. The lower demand for transportation among urban CUs might be due to the greater availability of public transportation in those areas compared to rural areas.

The price, income and sociodemographic variables explain approximately 40 percent of the variation in the demand of food and 36 percent of the variation in the demand of housing. The McFadden pseudo R-square reported for the regression describing demand of apparel was 0.13 and demand of medical care was 0.17.

**Effect of Price Change of All Commodities on Demand of Medical Care**

Increase in price of housing, transportation, and education influenced the demand for medical care. An increase in the price of transportation by 10% caused a significant decrease in demand by 6.3% for medical care. A further subgroup analysis revealed that this decrease in demand of medical care due to an increase in the price of transportation was not evenly distributed across different income groups. The effect was larger and statistically significant for those who are below federal poverty line (-2.53, t stat= 8.39) and who belong to the near poor category (-0.99, t-stat=3.83), while the effect was not statistically significant for those who belong to the middle income group (-0.70, t-stat= 2.52) and the wealthy group (-0.10, t stat = -0.59).
Responses of Different Socio Economic Groups to Price Changes in Food, Healthcare, and Housing

Previously we found that there was a strong relationship between the demand for food, housing and medical care and the age, educational level attainment (average year of schooling), ethnicity, and total income level of a consumer unit. However, this finding does not address which age groups or income groups were most responsive to the change in the price of food, medical care or housing. In the following section, the findings related to this issue are examined.

There were a total of 36,519 CUs which included a reference person less than 40 years of age. Of these 36,519 CUs, 4,270 (11.69%) did not finish high school, 22,671 (62.08%) finished high school but did not finish a Bachelor’s degree, and 9,578 (26.23%) completed at least a bachelor’s degree. Within the age group of less than 40 years, there were 29,552 (80.92%) Caucasians, 4,552 (12.46%) African-Americans, and 2,415 (6.61%) belonged to other races. The other socioeconomic attributes of this group of people are described in Table 4-6. There are total 35,566 consumer units with the reference person between 40 and less than 65 years of age. There are 29,474 (82.87%) Caucasians, 4,208 (11.83%) African-Americans, 1,884 (5.30%) who belong to the ethnic category “others”. There are 4,715 (13.26%) CUs where the reference person did not finish a high school diploma, 20,260 (56.96%) CUs where the reference person finished a high school but did not complete a bachelor’s degree and 10,591 (29.78%) completed at least a Bachelor’s degree. The other socioeconomic attributes of this group of people were tabulated in Table 4-7.

There were a total of 17,860 consumer units with the reference person above 65 years of age. There are 15,522 (86.91%) Caucasians, 1,677 (9.39%) African-Americans,
and 661 (3.70%) belong to ethnic category “others”. There are 4,999 (27.99%) CUs where the reference person did not finish a high school diploma, 9,523 (53.32%) CUs where the reference person finished a high school but did not complete a bachelor’s degree, and 3,338 (18.69%) completed at least a Bachelor’s degree. The other socioeconomic attributes of this group of people were tabulated in Table 4-8.

One of the interests of this research was to identify how people in different income groups respond to a change in price of food, housing and healthcare. A further interest was to see whether CUs below or close to FPL behave differently compared to those who were above the poverty threshold. At first, the total nominal income of a CU was divided by the FPL for that particular year in which the CU was interviewed to obtain the CUs total income as a percentage of FPL. A variable “povthre1” was created which indicates the CUs total income as a percentage of FPL for that year in which CU was interviewed by BLS. If “povthre1” was less than 100.0 then the CU was below the poverty line. In accordance with the National Health Disparities Report, we made four classifications based on the value of the variable “povthre1” and these groups were as follows:

1. if “povthre1<100.0” the CU was termed as “Poor” group
2. 100.0 <= povthre1 <200.0 (near poor)
3. 200.0 <= povthre1 <300.0 (middle income)
4. povthre1>=300.0 (high income)

A total of 19,320 (21.48%) CUs were below the FPL. There were 20,809 (23.14%) CUs belong to “near poor” group and 15,675 (17.43%) CUs belong to “middle income” group. The “high income” group had 34,141 (37.96%) CUs, whose total income was at least 300% of FPL. Some measures of central tendency and dispersion statistics of total annual income in dollars of the four groups are provided in Table 4-9. Table 4-10 shows the distribution of different ethnicity across the four income groups.
The mean age of consumers was 45.52 (SD = 20.75), 49.26 (SD =20.27), 47.34 (SD=17.73) and 47.06 (SD = 14.39) for poor, near poor, middle income, and high income group respectively. The age distributions of four groups are presented in Table 4-11.

To measure the responsiveness of different sociodemographic groups to the price changes of food, housing and medical care regressions were performed. For food and housing, OLS regressions with heteroskedastic robust standard error were performed, while for the medical care Tobit regression with heteroskedastic robust standard error was the selected procedure. The dependent variables for these regressions are logarithm of quantity demanded of food, housing and medical care. The independent variables are logarithm of own relative price, logarithm of real income and other socio-demographic variables. The statistical significance was measured at an alpha level of 0.05.

Table 4-12 depicts the effects of logarithm of relative food price, logarithm of relative price of medical care and logarithm of real income on the demand of food across three age categories, two ethnic groups (Caucasian and African-American) and four income groups (poor, near poor, middle income and high income). The values of the coefficients along with the t-statistics were given in table 4-12.

The results of regression showed that the food price elasticity for demand of food were -0.99, -0.77 and -0.75 for the three age groups and these effects were not statistically significant at alpha level of 0.05. The price elasticities were negative, which indicated that demand of food decreased as the price increased. The food price elasticity was also negative and statistically significant for Caucasians; however for African-Americans the elasticity was positive and not statistically significant. The price elasticity for food demand was also negative and statistically significant for poor, middle income
and rich consumer units, however there was a positive and non-statistically significant effect in case of near poor consumer unit. It was also found that the effect of an increase in the price of food had the largest impact on poor consumer units.

The effect of an increase in the price of medical care on food demand was negative and statistically significant for all age groups, for all income groups, and for Caucasians and African-Americans. As the price of medical care increased, the demand for food decreased. The result further demonstrated that the effect of an increase in the price of medical care had the largest effect on poor people. For a 10% increase in price of medical care, the demand of food decreased by 22% for poor people, while for the near poor and the middle income groups, the demand of food decreased by 10.5%. As expected, the rich consumers faced much less of an effect of an increment in price of medical care. The demand of food decreased by only 5.4% for rich consumers when medical care price increased by 10%. Chow test confirmed that the medical care price elasticities for food demand was statistically significantly different between poor and near poor consumer units, poor and middle income consumer units, poor and high income consumer units.

As expected, the income effect was positive for all age groups and for Caucasians and African-Americans and these income effects were statistically significant.

Table 4-13 depicted the effects of logarithm of relative housing price, logarithm of relative price of medical care and logarithm of real income on the demand of housing across three age categories, two ethnic groups (Caucasian and African-American) and four income groups (poor, near poor, middle income and high income). The results of the regression showed that the housing price elasticity for demand of housing was -0.095, -0.093 and -0.096 for three age groups and these effects were statistically significant at the
alpha level of 0.05. The price elasticities were negative and inelastic, which indicated that demand of housing decreased as the price increased. The housing price elasticity was also negative and statistically significant for Caucasians and African-Americans. A 10% increase in housing price caused a decrease in demand of housing by 0.9% for Caucasians and 1.55% for African-Americans. African-American households faced a larger impact due to the increase in price. The price elasticity for housing demand was also negative and statistically significant for all four income groups. It was also found that the effect of an increase in the price of housing had its largest impact on the poor and the near poor consumer units compared to middle income and high income groups. While for poor and near poor consumer units the housing price elasticities were around (-0.19) for middle income group and high income group it was around -0.13.

The effect of an increase in the price of medical care on housing demand was negative and statistically significant for people below 40 years and for elderly people, while for middle aged group of people the effect was positive and statistically significant. An increase in the price of housing caused a decrease in demand among Caucasians, while we could not find any statistically significant effect among African-Americans. The result further demonstrated that the effect of increase in price of medical care had largest effect on housing demand among poor people. A 10% increase in price of medical care decreased the demand of housing by 15.5% among poor people, 3.5% among near poor and 1% among middle income groups. We did not find any decrease in demand of housing among high income group. Chow test confirmed that the medical care price elasticities for housing demand was statistically significantly different between poor and near poor, poor and middle income and between poor and high income consumer units.
As expected effect of income on housing demand was positive for all age groups and for Caucasians and African-Americans and these income effects were statistically significant.

Table 4-14 depicted the effects of logarithm of relative price of medical care and logarithm of real income on the demand of medical care across three age categories, two ethnic groups (Caucasian and African-American) and four income groups (poor, near poor, middle income and high income).

Tobit regression was used for analyzing demand of medical care. Among those belonging to the 18 to 40 years age group; there were 9,866 (27%) CUs with health demand equal to zero. Among those belonging to the 40 to less than 65 years age group; there were 3,959 (10.3%) CUs with health demand equal to zero. Among those who belonged to the 65 years and above age group; there were 288 (1.6%) CUs with health demand equal to zero. The results of regression showed that the own-price elasticity for demand of medical care was -1.09, -0.38 and -0.32 for the three age groups and these effects were statistically significant at the alpha level of 0.05. As expected, the demand for medical care was elastic for the younger group of people, while for the people above 40 and for the elderly, demand was inelastic. A plausible reason for this is that people belonging to the 40 to less than 65 years age group and the 65 years and older age group suffer from more ailments compared to the younger (between 18 and less than 40 years old) group. As a result, the demand for health in the older age group had lower responsiveness to the increase in price. The price elasticities for medical care demand were negative and inelastic for both Caucasians and African-Americans; however the price increment had a larger effect on African-Americans compared to Caucasians. Chow
test confirmed that these effects on Caucasians and African Americans were statistically significantly different. A 10% increase in price of medical care caused a decrease in demand of medical care by 6.5% for Caucasians and 9.1% for African-Americans. The own-price elasticity for medical care was equal to (-0.46) for the ethnic group titled as “others”. There are 6,093 (31.5%), 3634 (17.46%), 1872 (11.94%) and 2514 (7.36%) CUs with zero medical expenditure across poor, almost poor, moderate income group and high group respectively. It is interesting to observe that for the higher income group the proportion of CUs with zero medical expenditure was smaller. No causal explanation for this observation was attempted because there could be multiple reasons for zero medical expenditure (e.g., no sickness at all, lack of access, federal Medicare or state Medicaid or some other insurance plan covers the whole cost) and this study did not have access to all information to explore a causal relationship. The price elasticity for medical care demand was also negative and statistically significant for poor, near poor and middle income groups, while there was a positive statistically non-significant effect among high income group. It was also found that the effect of an increase in the price of medical care had its largest impact on poor consumer units. A 10% increase in the price of medical care decreased the demand of medical care by 15.4% among poor people, 12.2% among near poor and 8.3% among middle income groups. Chow test confirmed that the own-price elasticities for medical care was statistically significantly different between poor and near poor, poor and middle income, poor and high income consumer units.

As expected, the income effect on medical care demand was positive for all age groups and for all three ethnic groups Caucasians, African-Americans and “others” and these income effects are statistically significant. The income effect was lower in
magnitude for elderly people compared to middle aged and younger people. A significant part of medical care expense was covered by Medicare for elderly people, and as a result of which the income effect was lower.

**Effect of Other Socio-Demographic Variables on Demand of Food, Housing and Medical Care among Different Age-Groups, Ethnic Groups and Income Groups**

Sociodemographic variables such as size of the consumer unit, highest level of educational attainment, region of housing, and location (urban or rural) also were considered as independent variables in estimating demand for food, housing and medical care. Size of consumer unit was statistically significant in predicting demand for food for all age groups and for every member increment in the family, the food demand increased by almost 17% for people between 18 and less than 40 years old and for those between 40 and less than 65 years old. For people above 65 years age, the food demand increased by 29% for every person increase in the size of consumer unit. Among those between 18 and 40 years age, compared to ethnic category “others”, Caucasians exhibited 6.6% more demand of food, while African-Americans exhibited a demand of food less by 3% and these differences are statistically significant. Among those between 40 and less than 65 years old, compared to the ethnic category “others”, the Caucasians had a 10.5% more and African-Americans had a 12% less quantity demanded for food. The elderly Caucasians had a 7% more demand for food compared to ethnic category “others”, while the African-Americans demanded a 10% less quantity of food.

If the number of family member increased by one, the demand for medical care increased by 9.6%, 5.4% and 8% for the people less than 40 years old, between 40 and less than 65 years old and for elderly people respectively. Compared to rural areas, people living in urban areas exhibited a lower demand (9%, 8.1% and 4.3%) for medical
care in the three age groups respectively. Within all three age groups, Caucasians exhibited a greater demand (7.8%, 22.8% and 27.3% respectively in the ascending order of age groups) for healthcare, while African-Americans had a lower demand (11.5%, 8% and 8.6% respectively in ascending order of age groups) compared to the ethnic category “others”. The effect of ethnicity on demand of medical care was statistically significant.

In the case of housing demand, we found that for all age groups CUs in urban area experienced a significantly greater housing demand than rural areas. For the youngest age group, the difference in housing demand between urban and rural area was 18.5%, while for the middle age group it was 31% and for elderly people it was 28%. Among the youngest age group, the demand for housing was almost 5% greater in the Northeast and 11% higher in the West compared to the South; while the demand for housing was not significantly different between the South and the Midwest. For those belonging to 40 to less than 65 years old category, the demand for housing was almost 18.5% greater in the Northeast and 20.5% higher in the West; and 6.4% more in Midwest compared to the South and these differences were statistically significant. For the elderly, housing demand in the Northeast and West was 16.88% higher compared to the South, while the demand in the Midwest was 8% higher compared to the South. Among the people less than 40 years old, difference in ethnicity did not have a significant influence on the demand of housing. Among the people between 40 and 65 years old, Caucasians had a significantly higher (7.6%) demand for housing compared to ethnic group “others”, while there is no significant difference between ethnic group African-Americans and “others”. For the elderly, both Caucasians and African-Americans had a statistically significant higher demand (17% and 14% respectively) for housing than the ethnic category “others”.

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As expected, demand for health increased with each increment in age across all ethnic groups. For all three ethnic groups, the age-group belonging to “18 to less than 40 years old” was considered as the base category. Among Caucasians, the demand for health among people belonging to the “40 to less than 65 years old” category was greater by 48% compared to the base age category, while for the elderly (>= 65 years old) the demand was greater by 161% (the coefficient value was 0.96 and it was exponentiated). Among African-Americans, the demand for health for people belong to “40 to less than 65 years old” was greater by 35% compared to the base age category, while for the elderly (>= 65 years old) the demand was greater by 120% (the coefficient value was 0.79 and it was exponentiated) compared to the base age category.

Among the ethnic category “others”, the demand for health for people belong to “40 to less than 65 years old” was greater by 27% compared to the base age category, while for the elderly (>= 65 years old) the demand was greater by 116% (the coefficient value was 0.77 and it was exponentiated) compared to the base age category. Across all three ethnicities, demand for health increased with family size. When other variables were held constant, for each one person increase in the family size, the demand for health increased by 8%, 3% and 5.8% for Caucasians, African-Americans and the ethnic group “others” respectively. It was also found that educational attainment had a significant impact on the demand for health. For educational attainment, the people “who did not have a high school diploma” was considered as the base category. People who finished a high school degree but did not finish a bachelor’s degree had on average 26.7%, 16.2% and 20.8% higher demand for health compared to the base category among Caucasians, African-Americans and the “others” ethnic groups respectively. Those who finished a
bachelor’s degree had on average 49%, 34.7% and 34.6% higher demand for health compared to the base category of educational attainment among Caucasians, African-Americans and the “others” ethnic groups respectively. Overall it was found that as the educational attainment increased, the demand for medical care increased across all ethnic groups.

It was also interesting to observe that across all ethnic groups, the demand for medical care by people living in the South was statistically significantly higher compared to those residing in the Northeast and the West. The demand for medical care in the Northeast was 7.5%, 12.2% and 10.5% lower compared to the South among Caucasians, African-Americans and “others” respectively. The demand for health in the West was 7%, 14.5% and 8.6% lower compared to the South among Caucasians, African-Americans and “others” respectively. Among Caucasians and African-Americans, the demand for health among urban people was statistically significantly less compared to people in rural areas.

Increase in family size increased the food demand for all ethnic groups. If the number of members in a CU increased by one, food demand increased by 20%, 18% and 15% for Caucasians, African-Americans and the ethnic category “others” respectively. As the highest level of educational attainment increased, the demand for food also increased for all ethnic groups.

Among all ethnic groups, as the level of educational attainment became higher, the demand for housing also increased. For educational attainment, those “who did not have a high school diploma” were considered as the base category. People who finished a high school degree but did not finish a bachelor’s degree had on average 25%, 19.7% and 22%
higher demand for housing compared to the base category among Caucasians, African-Americans and the “others” ethnic groups respectively. Those who finished a bachelor’s degree had on average 81%, 65% and 70% higher demand for housing compared to the base category of educational attainment among Caucasians, African-Americans and the “others” ethnic groups respectively. Across all three ethnic groups, the CUs in urban area experienced a higher demand compared to rural area. The demand in urban area was higher by 24.6%, 18.5% and 37.7% among Caucasians, African-Americans and the “others” ethnic groups respectively. Irrespective of ethnicity, CUs who lived in the Northeast or the West had a statistically significant higher demand for housing compared to those staying in South.

Various demographic variables have also impacted demand for medical care, food and housing among different income groups. Across all four income groups, as the highest level of education attained increased, the demand for health increased. Those who finished at least a high school degree but did not complete a bachelor’s degree had a 17.7%, 14%, 14.7%, and 12.7% higher demand for health compared to those who did not have a high school degree for poor, almost poor, moderate income group and rich group respectively. Those who finished at least a Bachelor’s degree had 55.6%, 33.6%, 28.4%, 24.6% higher demand of medical care compared to those who did not even have a high school degree for poor, almost poor, moderate income group and rich group respectively. For all income groups, as age increased demand for health also increased. Elderly people (at least 65 years old) had a 160%, 125%, 114% and 99% higher demand for health compared to youngest group (between 18 and less than 40 years old) among poor, almost poor, moderate income group and high income group respectively. Those who were
between the age of 40 and 65 had a 66%, 42%, 34% and 35% higher demand for health compared to youngest group among poor, almost poor, moderate income group and rich group respectively. Caucasians had a significantly higher demand for health compared to African-American and the ethnic group “others” across all the four income groups. African-Americans had approximately 10% less demand of health compared to the ethnic group “others” for almost poor and moderate income group, while in the rich group African-American had almost 16% less demand. Consumer units located in urban areas also had a significantly less demand for health compared to CUs in rural areas across four groups.

Sociodemographic variables also impacted the demand for food and housing across different income groups. Highest level of educational attainment had a somewhat different impact on demand for food compared to medical care. For the poor and near poor groups, the demand of food was lower among those who finished at least a high school degree but did not complete a bachelor’s degree by 7% and 2% compared to those who did not have a high school degree. Those who finished at least a bachelor’s degree had a 28%, 11%, 3.4%, and 19.7% higher demand for food compared to those who did not have a high school degree for poor, almost poor, moderate income group and high income group respectively. The middle age group had a statistically significant higher demand of food compared to those below 40 years old, while the elderly group had a statistically significant lower demand compared to the youngest group. The middle age group had a 22%, 7%, 6%, 15% higher demand of food compared to the youngest group while the elderly people had a 8.2%, 29%, 16%, 9.2% less demand for food compared to youngest group across poor, near poor, middle income and rich group respectively.
Among those with incomes below the FPL, there was no statistically significant difference in food demand between different ethnic groups. However, for the other three income groups African-Americans had a significantly lower demand of food compared to the Caucasians and “other” ethnic groups. Food demand for African-Americans was 8%, 18% and 22% less compared to ethnic group “others”, for near poor, middle income and high income groups respectively.

Except for poor households below FPL, for all other income groups the housing demand was significantly more in the Northeast and the West compared to the South. For the near poor group, the demand for houses was 18% and 15% more in the Northeast and the West compared to the South. For the middle income group, the demand for houses was 16% and 20% more in the Northeast and the West compared to the South, while among rich people the demand for houses was 13.6% and 18.5% more in the Northeast and the West compared to the South. For all income groups, the demand of house was more in urban areas compared to rural areas. Demand of house was more by 8%, 21%, 23% and 32% among consumer units in urban area compared to rural area for poor, near poor, middle income and rich income group. As the educational attainment increased, demand for housing also increased among all income groups. Among poor consumer units, those who finished at least bachelor’s degree had a 82% more demand of housing than who did not finish a high school. For “near poor” consumer units the demand of housing was 11% more for those who finished a high school but did not have a bachelor’s degree and 45% more for those with at least bachelors degree compared to those who did not have a high school degree. For middle income consumer units, demand for housing was higher by 16% for those who finished a high school but did not have a bachelor’s
degree and 42% more for those who finished a bachelor’s degree compared to those who did not have a high school degree; while among rich consumers the corresponding percentages were 21% and 58%.

**Effect of Price of Prescription Drugs, Income and Other Socio-Demographic Variables on the Demand of Prescription Drugs**

This research also examined the effect of price of prescription drugs and non-prescription drugs and other sociodemographic variables on the demand for prescription drugs. However, it was found that the correlation between relative price of prescription drugs and non–prescription drugs (-0.94) was statistically significant. As a result of this, if both price variables were used in the regression model together, there could be a potential multicollinearity problem. To overcome this potential problem, the price for prescription drug and non-prescription drug were not included together in the regression model.

Tobit regression with heteroskedastic robust standard error was used to evaluate the effect of price change of prescription drug on demand for prescription drug. A total of 37,695 (41.68%) of the sample reported zero expenditure for prescription drugs. The regression results showed that as the price of prescription drugs increased demand decreased. For a 10% increase in the price of prescription drugs, demand decreased by 0.8% and this effect was statistically significant (t = -3.42, p<0.05) at the alpha level of 0.05. The small price elasticity coefficient confirmed the fact that demand of prescription drug was inelastic in nature. It was also found that the income elasticity for prescription drugs was equal to 0.04 (t = 28.92, p<0.05), which indicated that a 10% increase in income caused an increase in demand by 0.4%. The income effect was also statistically
significant at alpha level of 0.05. A plausible reason for this small income effect was that most insurance plans cover prescription drug costs.

According to the regression results, the age of a person also affected the demand of prescription drugs. For an increase in age by one year, the demand for prescription drugs increased by 1%. As the number of family member increased, the demand for prescription drug increased by 2.5% and this effect was statistically significant. Ethnicity was also a significant variable in explaining the demand for prescription drugs. Compared to Caucasians, both African-Americans and the ethnicity “others” had a lower demand for prescription drugs. Both African-Americans and the ethnicity “others” had a 12% reduced demand of prescription drugs compared to Caucasians.
### Table 4-1. Measures of central tendency and dispersion for socio-demographic characteristics of sample

<table>
<thead>
<tr>
<th></th>
<th>Mean</th>
<th>Median</th>
<th>Standard Deviation</th>
<th>Maximum</th>
<th>Minimum</th>
</tr>
</thead>
<tbody>
<tr>
<td>Family Size</td>
<td>2.57</td>
<td>2</td>
<td>1.55</td>
<td>18</td>
<td>1</td>
</tr>
<tr>
<td># of earners</td>
<td>1.44</td>
<td>1</td>
<td>1.02</td>
<td>9</td>
<td>0</td>
</tr>
<tr>
<td>Age</td>
<td>47.29</td>
<td>45</td>
<td>17.96</td>
<td>94</td>
<td>18</td>
</tr>
<tr>
<td>Average year of schooling</td>
<td>13.2</td>
<td>13.5</td>
<td>2.78</td>
<td>21</td>
<td>1</td>
</tr>
<tr>
<td>Saving ($) (N=54710)</td>
<td>11985</td>
<td>300</td>
<td>62351</td>
<td>2848012</td>
<td>0</td>
</tr>
<tr>
<td>Total Income ($)</td>
<td>41217</td>
<td>29298</td>
<td>43266</td>
<td>811900</td>
<td>0.6667</td>
</tr>
</tbody>
</table>

### Table 4-2. Correlation between relative prices of broad commodities

<table>
<thead>
<tr>
<th>Relative prices of</th>
<th>Food</th>
<th>Housing</th>
<th>Apparel</th>
<th>Transportation</th>
<th>Medical care</th>
<th>Recreation</th>
<th>Education</th>
</tr>
</thead>
<tbody>
<tr>
<td>Food</td>
<td>1</td>
<td>.06</td>
<td>&lt;.0001</td>
<td>-.61</td>
<td>.003</td>
<td>0.17</td>
<td>-.06</td>
</tr>
<tr>
<td>Housing</td>
<td>1</td>
<td>-.35</td>
<td>&lt;.0001</td>
<td>-.23</td>
<td>.38</td>
<td>-.3</td>
<td>.262</td>
</tr>
<tr>
<td>Apparel</td>
<td>1</td>
<td>.37</td>
<td>&lt;.0001</td>
<td>-.99</td>
<td>.82</td>
<td>-.91</td>
<td>-.86</td>
</tr>
<tr>
<td>Transportation</td>
<td>1</td>
<td>-.41</td>
<td>&lt;.0001</td>
<td>.16</td>
<td>.80</td>
<td>-.80</td>
<td>.87</td>
</tr>
<tr>
<td>Medical care</td>
<td>1</td>
<td>-.80</td>
<td>&lt;.0001</td>
<td>&lt;.0001</td>
<td>&lt;.0001</td>
<td>&lt;.0001</td>
<td>&lt;.0001</td>
</tr>
<tr>
<td>Recreation</td>
<td>1</td>
<td>-.53</td>
<td>&lt;.0001</td>
<td>&lt;.0001</td>
<td>&lt;.0001</td>
<td>&lt;.0001</td>
<td>&lt;.0001</td>
</tr>
<tr>
<td>Education</td>
<td>1</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Table 4-3. Effect of own-price, price of medical care and income on demand of food, housing, medical care, apparel, transportation, education and recreation

<table>
<thead>
<tr>
<th>Log of quantity of demand</th>
<th>Own price effect</th>
<th>Price of medical care</th>
<th>Income effect</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>[-1.105, 0.001]</td>
<td>[-0.933, 0.000]</td>
<td>[0.163, 0.000]</td>
</tr>
<tr>
<td>Food demanded</td>
<td>[-3.21, 0.001]</td>
<td>[-24.78, 0.000]</td>
<td>[70.49, 0.000]</td>
</tr>
<tr>
<td>Housing demanded</td>
<td>[-0.096, 0.000]</td>
<td>[-0.233, 0.000]</td>
<td>[0.269, 0.000]</td>
</tr>
<tr>
<td>Medical care demanded</td>
<td>[-0.72, 0.000]</td>
<td>[-0.08, 0.000]</td>
<td>[0.13, 0.000]</td>
</tr>
<tr>
<td>Apparel demanded</td>
<td>[-0.527, 0.000]</td>
<td>[-2.83, 0.000]</td>
<td>[0.171, 0.000]</td>
</tr>
<tr>
<td>Transportation demanded</td>
<td>[-1.67, 0.000]</td>
<td>[3.82, 0.000]</td>
<td>[0.328, 0.000]</td>
</tr>
<tr>
<td>Education demanded</td>
<td>[-0.373, 0.000]</td>
<td>[-0.94, 0.000]</td>
<td>[0.034, 0.000]</td>
</tr>
<tr>
<td>Recreation demanded</td>
<td>[-0.22, 0.000]</td>
<td>[-0.92, 0.000]</td>
<td>[0.195, 0.000]</td>
</tr>
</tbody>
</table>

Note: * Tobit regression. N = 89945 for all regressions

Table 4-4. Effect of average year of schooling, age, family size, ethnicity on demand of food, housing, medical care, apparel, transportation, education and recreation

<table>
<thead>
<tr>
<th>Demand of</th>
<th>Average yr. Schooling</th>
<th>Age</th>
<th>Family Size</th>
<th>Caucasian</th>
<th>African-American</th>
</tr>
</thead>
<tbody>
<tr>
<td>Food</td>
<td>0.038</td>
<td>0.003</td>
<td>0.182</td>
<td>0.08</td>
<td>-0.08</td>
</tr>
<tr>
<td></td>
<td>(53.87)</td>
<td>(24.76)</td>
<td>(135.05)</td>
<td>(9.85)</td>
<td>(-8.36)</td>
</tr>
<tr>
<td>Housing</td>
<td>0.077</td>
<td>0.005</td>
<td>0.139</td>
<td>0.05</td>
<td>0.02</td>
</tr>
<tr>
<td></td>
<td>(80.12)</td>
<td>(29.44)</td>
<td>(77.53)</td>
<td>(4.44)</td>
<td>(1.58)</td>
</tr>
<tr>
<td>Medical care</td>
<td>0.045</td>
<td>0.02</td>
<td>0.073</td>
<td>0.144</td>
<td>-0.111</td>
</tr>
<tr>
<td></td>
<td>(52.34)</td>
<td>(168.97)</td>
<td>(45.75)</td>
<td>(14.66)</td>
<td>(-9.67)</td>
</tr>
<tr>
<td>Apparel</td>
<td>0.053</td>
<td>-0.005</td>
<td>0.107</td>
<td>0.104</td>
<td>0.143</td>
</tr>
<tr>
<td></td>
<td>(59.82)</td>
<td>(-39.98)</td>
<td>(66.79)</td>
<td>(10.32)</td>
<td>(11.88)</td>
</tr>
<tr>
<td>Transportation</td>
<td>0.077</td>
<td>-0.002</td>
<td>0.163</td>
<td>0.171</td>
<td>-0.165</td>
</tr>
<tr>
<td></td>
<td>(53.18)</td>
<td>(-10.91)</td>
<td>(64.42)</td>
<td>(11.40)</td>
<td>(-9.06)</td>
</tr>
<tr>
<td>Education</td>
<td>0.148</td>
<td>-0.023</td>
<td>0.226</td>
<td>-0.072</td>
<td>-0.282</td>
</tr>
<tr>
<td></td>
<td>(55.17)</td>
<td>(-59.39)</td>
<td>(59.60)</td>
<td>(-2.62)</td>
<td>(-8.77)</td>
</tr>
<tr>
<td>Recreation</td>
<td>0.074</td>
<td>-0.0001</td>
<td>0.069</td>
<td>0.197</td>
<td>-0.055</td>
</tr>
<tr>
<td></td>
<td>(85.42)</td>
<td>(-1.68)</td>
<td>(44.93)</td>
<td>(20.87)</td>
<td>(-5.08)</td>
</tr>
</tbody>
</table>
Table 4-5. Effect of region and location on demand of food, housing, medical care, apparel, transportation, education and recreation

<table>
<thead>
<tr>
<th>Demand of</th>
<th>Northeast</th>
<th>Midwest</th>
<th>West</th>
<th>Urban</th>
</tr>
</thead>
<tbody>
<tr>
<td>Food</td>
<td>0.027</td>
<td>-0.05</td>
<td>0.019</td>
<td>0.05</td>
</tr>
<tr>
<td></td>
<td>(5.17)</td>
<td>(-11.16)</td>
<td>(4.17)</td>
<td>(9.33)</td>
</tr>
<tr>
<td>Housing</td>
<td>0.115</td>
<td>0.031</td>
<td>0.135</td>
<td>0.22</td>
</tr>
<tr>
<td></td>
<td>(15.73)</td>
<td>(4.97)</td>
<td>(21.77)</td>
<td>(28.45)</td>
</tr>
<tr>
<td>Medical care</td>
<td>-0.092</td>
<td>0.005</td>
<td>-0.079</td>
<td>-0.075</td>
</tr>
<tr>
<td></td>
<td>(-14.58)</td>
<td>(1.01)</td>
<td>(-13.77)</td>
<td>(-10.08)</td>
</tr>
<tr>
<td>Apparel</td>
<td>0.124</td>
<td>0.038</td>
<td>0.067</td>
<td>0.109</td>
</tr>
<tr>
<td></td>
<td>(18.49)</td>
<td>(6.55)</td>
<td>(11.26)</td>
<td>(14.96)</td>
</tr>
<tr>
<td>Transportation</td>
<td>-0.112</td>
<td>-0.022</td>
<td>0.008</td>
<td>-0.174</td>
</tr>
<tr>
<td></td>
<td>(-11.14)</td>
<td>(-2.43)</td>
<td>(0.94)</td>
<td>(-15.27)</td>
</tr>
<tr>
<td>Education</td>
<td>0.059</td>
<td>0.129</td>
<td>0.152</td>
<td>0.154</td>
</tr>
<tr>
<td></td>
<td>(3.09)</td>
<td>(8.17)</td>
<td>(9.83)</td>
<td>(7.68)</td>
</tr>
<tr>
<td>Recreation</td>
<td>0.078</td>
<td>0.078</td>
<td>0.093</td>
<td>0.039</td>
</tr>
<tr>
<td></td>
<td>(13.0)</td>
<td>(14.43)</td>
<td>(16.5)</td>
<td>(5.37)</td>
</tr>
</tbody>
</table>

Table 4-6. Measure of central tendencies and dispersions of socio-demographic variables for people below 40 years of age

<table>
<thead>
<tr>
<th></th>
<th>Mean</th>
<th>Median</th>
<th>Standard Deviation</th>
<th>Maximum</th>
<th>Minimum</th>
</tr>
</thead>
<tbody>
<tr>
<td>Family Size</td>
<td>2.79</td>
<td>3</td>
<td>1.65</td>
<td>16</td>
<td>1</td>
</tr>
<tr>
<td># of earner</td>
<td>1.56</td>
<td>1</td>
<td>0.77</td>
<td>9</td>
<td>0</td>
</tr>
<tr>
<td>Average year of schooling</td>
<td>13.46</td>
<td>13.5</td>
<td>2.39</td>
<td>21</td>
<td>1</td>
</tr>
<tr>
<td>Total Income ($)</td>
<td>37748</td>
<td>28404</td>
<td>37700</td>
<td>547073</td>
<td>0.67</td>
</tr>
<tr>
<td>Total quarterly expenditure ($)</td>
<td>8710</td>
<td>7118</td>
<td>6515</td>
<td>174433</td>
<td>98</td>
</tr>
</tbody>
</table>
Table 4-7. Measure of central tendencies and dispersions of socio-demographic variables for people below 40 and less than 65 years of age

<table>
<thead>
<tr>
<th></th>
<th>Mean</th>
<th>Median</th>
<th>Standard deviation</th>
<th>Maximum</th>
<th>Minimum</th>
</tr>
</thead>
<tbody>
<tr>
<td>Family Size</td>
<td>2.74</td>
<td>2</td>
<td>1.55</td>
<td>18</td>
<td>1</td>
</tr>
<tr>
<td># of earners</td>
<td>1.78</td>
<td>2</td>
<td>1.06</td>
<td>9</td>
<td>0</td>
</tr>
<tr>
<td>Average year of schooling</td>
<td>13.48</td>
<td>13.5</td>
<td>2.80</td>
<td>21</td>
<td>1</td>
</tr>
<tr>
<td>Total Income ($)</td>
<td>52381.7</td>
<td>39900</td>
<td>50298.82</td>
<td>630321</td>
<td>0.75</td>
</tr>
<tr>
<td>Total quarterly expenditure ($)</td>
<td>11119.22</td>
<td>9022</td>
<td>8555.97</td>
<td>146952</td>
<td>250</td>
</tr>
</tbody>
</table>

Table 4-8. Measure of central tendencies and dispersions of socio-demographic variables for people above 65 years of age

<table>
<thead>
<tr>
<th></th>
<th>Mean</th>
<th>Median</th>
<th>Standard deviation</th>
<th>Maximum</th>
<th>Minimum</th>
</tr>
</thead>
<tbody>
<tr>
<td>Family Size</td>
<td>1.78</td>
<td>2</td>
<td>0.99</td>
<td>14</td>
<td>1</td>
</tr>
<tr>
<td># of earners</td>
<td>0.54</td>
<td>0</td>
<td>0.82</td>
<td>8</td>
<td>0</td>
</tr>
<tr>
<td>Average year of schooling</td>
<td>12.13</td>
<td>12</td>
<td>3.17</td>
<td>21</td>
<td>1</td>
</tr>
<tr>
<td>Total Income ($)</td>
<td>26080.11</td>
<td>17454.5</td>
<td>31328.78</td>
<td>811900</td>
<td>5</td>
</tr>
<tr>
<td>Total quarterly expenditure ($)</td>
<td>6652.40</td>
<td>5009</td>
<td>7194.18</td>
<td>441906</td>
<td>477.47</td>
</tr>
</tbody>
</table>

Table 4-9. Measure of central tendencies and dispersions of total annual income ($) for people above 65 years of age

<table>
<thead>
<tr>
<th></th>
<th>Mean</th>
<th>Median</th>
<th>Standard deviation</th>
<th>Minimum</th>
<th>Maximum</th>
</tr>
</thead>
<tbody>
<tr>
<td>Poor</td>
<td>6865.43</td>
<td>6366.96</td>
<td>5093.6</td>
<td>0.67</td>
<td>40006.5</td>
</tr>
<tr>
<td>Almost Poor</td>
<td>19984.52</td>
<td>17776.8</td>
<td>8809.2</td>
<td>7530</td>
<td>83253.3</td>
</tr>
<tr>
<td>Middle Income</td>
<td>33956.4</td>
<td>30542.3</td>
<td>12767.1</td>
<td>15075</td>
<td>117813.6</td>
</tr>
<tr>
<td>High Income</td>
<td>76932</td>
<td>63750</td>
<td>50523.9</td>
<td>23016</td>
<td>811900</td>
</tr>
</tbody>
</table>

Table 4-10. Distribution of different ethnic groups across four income groups

<table>
<thead>
<tr>
<th></th>
<th>Caucasians</th>
<th>African-American</th>
<th>Others</th>
</tr>
</thead>
<tbody>
<tr>
<td>Poor</td>
<td>14632 (75.73%)</td>
<td>3634 (18.81%)</td>
<td>1054 (5.46%)</td>
</tr>
<tr>
<td>Almost Poor</td>
<td>16875 (81.09%)</td>
<td>2761 (13.27%)</td>
<td>1173 (5.64%)</td>
</tr>
<tr>
<td>Middle Income</td>
<td>13167 (84%)</td>
<td>1675 (10.69%)</td>
<td>833 (5.31%)</td>
</tr>
<tr>
<td>High Income</td>
<td>29874 (87.5%)</td>
<td>2367 (6.93%)</td>
<td>1900 (5.57%)</td>
</tr>
</tbody>
</table>
Table 4-11. Distribution of different age groups across four income groups

<table>
<thead>
<tr>
<th></th>
<th>18 to &lt;40 yrs</th>
<th>40 to &lt;65 yrs</th>
<th>&gt;=65 yrs (elderly)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Poor</td>
<td>9200 (47.62%)</td>
<td>5691(29.46%)</td>
<td>4429 (22.92%)</td>
</tr>
<tr>
<td>Near Poor</td>
<td>8576 (41.21%)</td>
<td>6363 (30.58%)</td>
<td>5870 (28.21%)</td>
</tr>
<tr>
<td>Middle Income</td>
<td>6565 (41.88%)</td>
<td>5910 (37.7%)</td>
<td>3200 (20.41%)</td>
</tr>
<tr>
<td>High Income</td>
<td>12178 (35.67%)</td>
<td>17602 (51.56%)</td>
<td>4361 (12.77%)</td>
</tr>
</tbody>
</table>

Table 4-12. Effect of food price, medical care price and income on food demand across age groups, ethnicity and income groups

<table>
<thead>
<tr>
<th>Own Price</th>
<th>Medical Care Price</th>
<th>Income</th>
</tr>
</thead>
<tbody>
<tr>
<td>18 – 39 years</td>
<td>-0.99 (-1.83)</td>
<td>-1.00 (-16.84)</td>
</tr>
<tr>
<td>40 – 64 years</td>
<td>-0.77 (-1.50)</td>
<td>-1.04 (-18.89)</td>
</tr>
<tr>
<td>65 and above</td>
<td>-0.75 (-0.92)</td>
<td>-1.02 (-11.86)</td>
</tr>
<tr>
<td>Caucasian</td>
<td>-1.08 (-2.87)</td>
<td>-1.08 (-26.41)</td>
</tr>
<tr>
<td>African-American</td>
<td>0.108 (0.11)</td>
<td>-0.58 (-5.38)</td>
</tr>
<tr>
<td>Poor</td>
<td>-6.88 (-6.39)</td>
<td>-2.2 (-18.30)</td>
</tr>
<tr>
<td>Near Poor</td>
<td>0.62 (0.74)</td>
<td>-1.05 (-11.70)</td>
</tr>
<tr>
<td>Middle Income</td>
<td>-0.67 (-0.77)</td>
<td>-1.05 (-11.24)</td>
</tr>
<tr>
<td>High Income</td>
<td>-1.17 (-2.11)</td>
<td>-0.54 (-8.76)</td>
</tr>
</tbody>
</table>

Table 4-13. Effect of housing price, medical care price and income on housing demand across age groups, ethnicity and income groups

<table>
<thead>
<tr>
<th>Own price</th>
<th>Medical Care price</th>
<th>Income</th>
</tr>
</thead>
<tbody>
<tr>
<td>18 – 39 years</td>
<td>-0.095 (-2.37)</td>
<td>-0.39 (-3.92)</td>
</tr>
<tr>
<td>40 – 64 years</td>
<td>-0.093 (-2.91)</td>
<td>0.17 (2.21)</td>
</tr>
<tr>
<td>65 and above</td>
<td>-0.096 (-2.17)</td>
<td>-0.39 (-3.40)</td>
</tr>
<tr>
<td>Caucasian</td>
<td>-0.094 (-3.57)</td>
<td>-0.23 (-3.69)</td>
</tr>
<tr>
<td>African-American</td>
<td>-0.155 (-2.21)</td>
<td>0.002 (0.01)</td>
</tr>
<tr>
<td>Poor</td>
<td>-0.187 (-2.89)</td>
<td>-1.55 (-8.47)</td>
</tr>
<tr>
<td>Near Poor</td>
<td>-0.194 (-4.51)</td>
<td>-0.35 (-3.10)</td>
</tr>
<tr>
<td>Middle Income</td>
<td>-0.13 (-2.95)</td>
<td>-0.1 (-1.15)</td>
</tr>
<tr>
<td>High Income</td>
<td>-0.14 (-3.94)</td>
<td>0.78 (9.62)</td>
</tr>
</tbody>
</table>
Table 4-14. Effect of medical care price and income on medical care demand across age groups, ethnicity and income groups

<table>
<thead>
<tr>
<th></th>
<th>Medical care price</th>
<th>Income</th>
</tr>
</thead>
<tbody>
<tr>
<td>18 – 39 years</td>
<td>-1.09 (-14.34)</td>
<td>0.20 (42.85)</td>
</tr>
<tr>
<td>40 – 64 years</td>
<td>-0.38 (-4.82)</td>
<td>0.13 (31.11)</td>
</tr>
<tr>
<td>65 and above</td>
<td>-0.32 (-3.47)</td>
<td>0.10 (26.17)</td>
</tr>
<tr>
<td>Caucasian</td>
<td>-0.65 (-12.38)</td>
<td>0.15 (54.16)</td>
</tr>
<tr>
<td>African-American</td>
<td>-0.91 (-6.91)</td>
<td>0.16 (23.15)</td>
</tr>
<tr>
<td>Poor</td>
<td>-1.54 (-13.62)</td>
<td></td>
</tr>
<tr>
<td>Near Poor</td>
<td>-1.22 (-12.37)</td>
<td></td>
</tr>
<tr>
<td>Middle Income</td>
<td>-0.83 (-7.32)</td>
<td></td>
</tr>
<tr>
<td>High Income</td>
<td>0.14 (1.82)</td>
<td></td>
</tr>
</tbody>
</table>
CHAPTER 5
DISCUSSION

This chapter begins with a discussion of the effect of change in price of various commodities on their demand. The effect of consumers’ income on demand of different commodities is subsequently discussed. Then the effects of sociodemographic variables on demand for different commodities are discussed. Finally the finding that consumers who belong to different socioeconomic groups responded differently to change in price of basic necessities like food, housing and medical care is discussed.

Price Effect

The results obtained from analyzing expenditure survey data demonstrated that when the price of a particular commodity increased, the demand for that commodity decreased. This result is not surprising and is in accordance with the theory of demand, which states that compensated demand of a commodity decreases as the price of that commodity increases. It was found that for food and transportation, the magnitude of the coefficient of own price elasticities were greater than 1.00, while for housing, medical care, apparel, education, and recreation, the magnitude of the coefficient of own price elasticities were less than one. This implies that while food and transportation have an elastic demand, other commodities have an inelastic demand. The inelastic demand for medical care is consistent with the findings of other studies in literature. In a 1998 study published in the American Economic Review, using insurance claims data for those covered through a large employer and out-of-pocket cost as the price measure, Eichner found that the price elasticity for out-of-pocket medical expenditures was between -0.62 and -0.75.\textsuperscript{44} In the present study the own price elasticity coefficient of medical care is equal to 0.72, which is very similar to the Eichner study. The present study also
suggested that medical care is a necessity along with housing, apparel, education, and recreation. It was expected that food would also belong to necessities. However, the category food contained several different types of elements as a result of which the level of substitution between different items among the food category was higher. This was a probable reason why the magnitude of own price elasticity for food category was greater than one.

A price change in medical care also affected the demand of other commodities. For all commodities except transportation, as the price of medical care increased demand for these commodities decreased. The present study found that food, housing, apparel, education, and recreation are complements to medical care, while transportation is a substitute. When the effect of an increase in the price of other commodities on demand of medical care was evaluated, it was found that an increase in the price of housing, transportation, and education influenced the demand for medical care. An increase in the price of transportation caused a significant decrease in the demand for medical care. A further subgroup analysis revealed that this decrease in demand of medical care due to an increase in the price of transportation was not evenly distributed across different income groups. The effect was largest for those who are below federal poverty line. Those who belong to the near poor category were affected next, while the effect of increase in price of transportation on demand for medical care for middle income group and rich people were even less. This finding suggests that the higher cost of transportation could cause a barrier to access of medical care for the indigent population, while people who belong to the middle income or high income group experience no such problem.
A similar pattern was also found for the effect of a change in housing prices on medical care demand. An increase in the price of housing reduced demand for medical care by the largest amount for poor people. This effect was smaller for near poor people and even lower for the higher income groups. An increase in the price of housing may impact the demand for medical care in multiple ways. Cheap, unhealthy or not-so-good housing units in disadvantaged neighborhood may make residents’ health worse in the long run and make them more vulnerable to different diseases. A study on the role of neighborhood of residence in the incidence of coronary heart disease revealed that after controlling for personal income, education, and occupation, residents of disadvantaged neighborhood had a higher risk of coronary diseases compared to residents who lived in advantaged neighborhood.45 People with low income normally are residents of disadvantaged neighborhood. On the other hand, an increase in the price of housing and utilities is expected to reduce the disposable income available to poor consumers who in turn can not afford to purchase more medical care.

**Income Effect**

When the effects of consumers’ income on their demand for commodities were evaluated, it was found that all commodities had positive income elasticity, which implies an increase in demand with each increment in income of a consumer unit. This indicates that all goods are normal goods. The income elasticity of medical care expenditure is positive and small. Medical care was found to be a normal good as the income elasticity was positive. Some cross-sectional U.S. studies also showed a low positive income elasticity for medical care. The literature offers several arguments for this phenomenon. One such argument is that physicians and health care professionals have a certain fixed style of treating patients for a particular ailment irrespective of patients’ income. This
above reasoning was called the “norms” argument and it has limitations. Another argument behind low income elasticity of medical care is that many consumer units have medical insurance which covers a significant part of medical expenses. Thus, the availability of health insurance drives the money price of healthcare to a consumer towards zero and as a result the income elasticity also becomes less.46

**Effect of Socio-Economic Variables**

This study also found that controlling for all other factors, the educational attainment of a consumer unit has a positive impact on the demand for all commodities. Demand for food, housing and medical care increased with an increase in age, while the demand for apparel, transportation, and education decreased as age increased. Demands for all commodities also increased with an increase in the family size. Caucasians had significantly higher demand for food, medical care, transportation, education, and recreation compared to African-Americans. The demand for food, housing, apparel, education, and recreation were also higher in the Northeast compared to the South. Consumer units living in the South had a significantly higher demand for medical care compared to those residing in the Northeast or the West. The study also found that demand for medical care and transportation were lower for urban consumer units compared to rural consumers, while consumer units in residing in urban areas had a higher demand for food, housing, apparel, education, and recreation compared to consumer living in rural areas.

**Responsiveness of Different Socio-Economic Groups to Price Change of Food, Housing and Medical Care**

The change in the price of medical care did not have a uniform impact on the demand for food, housing, and medical care across various socioeconomic strata. It was
observed that the impact of an increase in the price of medical care was largest for poor people followed by those who are near-poor. The increase in price of medical care decreased the demand for food for poor people significantly more so compared to consumers who are middle income or high income. The effect of an increase in the price of medical care on demand of housing was non-uniformly distributed across income categories similar to the findings about the demand for food. An increase in the price of medical care decreased the demand for housing for poor people more so compared to those who are near poor, who in turn were more affected compared to middle income and rich consumer units. An increase in the price of medical care also impacted the medical care demand for different income group in a non-uniform way. It was observed that as the income increased, the proportion of consumer units with no medical expenditure became smaller. When the price of medical care increased, the demand for medical care decreased for the poor, near poor and middle income group in a descending order, while for rich consumer units the demand for medical care actually increased. Further, the demand for medical care decreased more for African-Americans compared to Caucasians due to an increase in price of medical care. It was also found that elderly people were less responsive to the price change of medical care compared to younger people. There can be multiple reasons accounted for this observation. One reason for this observation might be that a significant part of medical expenses for elderly people is covered by Medicare, which reduces the money price of medical care to the elderly people. Another possible reason is that younger people normally are in better health compared to older people. Younger people also demonstrate more risk-seeking behavior towards health compared to elderly people as a result of which younger people seek less medical attention. So when
there is an increase in price of medical care, demand for medical care decreases more for younger people compared to elderly people. The present study did not have sufficient information to determine which of the above reasons can explain this finding, thus representing one of the shortcomings of the present study.

In essence this study found that an increase in the price of medical care decreased demand for three basic necessities of life – food, housing and medical care – mostly for poor people compared to those who are wealthy. As described in the literature review, a significant number of studies explored the relationship between income inequality and health status at the population level and found that as income inequality increased, the health status of poor people become significantly worse compared to rich people. The present study also supported these findings by elucidating the fact that demand for food, housing, and medical care for consumer units below FPL are affected worst due to an increase in the price of medical care. The prior research was not definitive in determining how income inequality affects health outcomes. One possible explanation is that higher income helps people to gain access to material resources like medical care which is essential for generating good health outcomes. As Lynch et al mentioned “absolute and relative income differences may represent the unequal distribution of the material conditions that structure the likelihood of possessing and accessing health protective resources; of reducing negative health exposures; and of facilitating full participation in the society”.47 The finding in the present study that medical care demand decreased most for poor consumer units may support this pathway of reduced access for poor people. Unfortunately the database used in this study did not provide any personal health information; as a result any relationship with health outcomes cannot be established.
As researchers established a potential relationship between income inequality and adverse health outcomes at population level, it was also necessary to argue whether redistribution of income and wealth from rich to poor could cause potential improvement in the population health? Deaton raised some concern about this idea. In his article, he argued that though redistribution of wealth from rich to poor increased the wealth of poor and reduced the wealth of rich, however the absolute improvement in health outcomes for each dollar of income (gradient) remained same among rich and among poor people. He further argued that if income was the key variable affecting population health, then redistribution of income could only improve population health if additional income could have a less effect on health of rich people compared to health of poor people. Moreover, the redistribution of income through taxation implied “deadweight loss”, which meant that a rich person loses more than one dollar for every dollar taken away from him and given to the poor. From the perspective of increasing welfare of the society, Deaton emphasized the importance of a society to invest in education as a potential pathway to improvement of health. His argument was based on the fact that as neither health nor income only constituted welfare, rather both were integral part of welfare; improvement in one at the expense of other would not be a potential solution. This suggests that policy needs to be designed to improve both health and wealth simultaneously. One such policy could be to focus attention on education, which could improve both income and health. Increased educational qualification makes a person cognizant of health behaviors deleterious to health and promotes good health behavior. Also increased educational attainment could provide opportunities for more income which in turn helped the person to gain access to better nutrition, better housing and better healthcare.¹¹
The present study used out of pocket expenditure data to estimate the demand for different commodities. It is to be noted that if the total medial expenditure for a poor consumer unit is covered under insurance, then their out of pocket expenditure turns out to be equal to zero which in turn showed that the demand was equal to zero. However, this did not imply that the actual demand for medical care for the poor consumer unit was equal to zero. On the other hand, this also implied that even after the availability of insurance coverage, medical care demand for poor consumer units are worst affected due to change in price of medical care. This can bring attention of the policymakers to provide more support to indigent people through public programs or providing subsidies to improve access for medical care.

**Limitations**

This study used a database which collected expenditure information by using a survey. As the data was collected through survey, it was subjected to two types of error – sampling and non sampling error. Though BLS has a dedicated group of professionals to check the validity and reliability of expenditure estimates, there are still many chances for non-sampling errors. Non-sampling errors can arise due to a different interpretation of the survey questions by respondents, inability or unwillingness of respondents to provide appropriate information, or mistakes made by surveyor in recording or coding the data. Further, non-sampling errors might arise due to the data collection procedure, processing of data, or estimation of missing data. The expenditure information is collected predominantly from urban consumers in the U.S. Any extrapolation of findings to rural populations in the U.S. has to be done with caution. For a particular consumer unit only at most four observations were obtained, which did not allow the price of various commodities to vary much. If more observations were recorded for each consumer unit, it
would possibly capture a larger price effect on demand. From a methodological perspective, the present research did not include any individual household specific fixed effect in analysis to account for any household-specific characteristics. As savings data was not available for most of the consumer units, this study could not include savings as an independent variable in the analysis. Savings and other assets could act as a proxy for wealth of a consumer, which along with income could be a better predictor of expenditure. Due to the unavailability of any personal health information, this study could not explore any causal relationship between expenditure patterns and health status of people. For example, it might be interesting to explore how expenditure patterns of households vary when consumers suffer from a chronic disease compared to those households where medical care expenditure is centered around acute ailment.

**Conclusion**

In the field of social and administrative pharmacy, this study is unique in the sense that it uses consumer expenditure survey database to understand the impact of price change in medical care on demand of commodities used daily by general consumers. The key finding of the present study was that the change in the price of medical care had the largest impact on the daily life of poor people by reducing their demand for food, housing, and medical care as measured by out of pocket expenditure. The reduction in demand for medical care among indigent population might make them more vulnerable to worse health conditions. Similarly, the reduction in demand for food and housing among indigent populations might lead to under-nutrition and expose them to unhealthy housing environments which maybe detrimental to their health in long run. Suitable policy measures should be adopted to reduce income disparity among people to obtain better
health outcomes at the population level. Investment in human capital such as education and health can provide long term benefits towards improvement of national health.

**Recommendation for future research**

Future study can explore the possibility of relating health status and personal level health information of consumer unit with the expenditure pattern. This will help to understand preference of household in presence of different types of diseases. A prospective study can be designed to collect daily expenditure information, socio-demographic and health status information from households using a survey questionnaire. Regression models will be used to explore any causal relationship between health status and demand for different commodities.
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BIOGRAPHICAL SKETCH

Kumar Mukherjee was born in Calcutta, India. He is the only son of his parents. He grew up in a joint family with his parents, uncle, aunty, sister, and grandmother. He graduated from Hindu School, Calcutta and then pursued a Bachelor of Pharmacy degree from Jadavpur University, Calcutta. Upon completion of his B.Pharm. he moved to the southern part of India. He completed a post graduate diploma in management from T.A.Pai Management Institute, Manipal, India. He worked for a consumer durables company in India for two years as a junior level manager.

Kumar came to the USA in 2002 to pursue a M.S. in pharmacy administration from the University of Toledo. Upon completion of his M.S., Kumar joined the University of Florida as an Alumni Fellow in the department of Pharmaceutical Outcomes and Policy. His area of interest is application of economic principles in healthcare and to develop understanding of healthcare market and consumer behavior in healthcare using economic principles. Kumar is finishing his Ph.D. in the year 2008.

Upon completion of his Ph.D. program, Kumar will join the college of pharmacy in the Chicago State University as an Assistant Professor.