

## ABSTRACT

Title of Dissertation: UNITED STATES HOUSEHOLDS CONSUMPTION,  
A COMPREHENSIVE ANALYSIS

Li Ding, Doctor of Philosophy, 2006

Dissertation directed by: Professor Seth Sanders  
Department of Economics

Consumption is perhaps the most important economic behavior of human beings. To it goes the lion's share of the country's annual product. This study is part of the ongoing efforts to give a reasonable description of how various factors affect household consumption decision. Those factors include the household's income, demographic characteristics, age structure, cohort characteristics, and commodity prices. The study starts with a cross section analysis based on a sample of about 5,000 households in 2000 U.S. Consumer Expenditure Survey (CES) to look at how income, demographic variables, and age structure affect the household's consumption decision. In the second step, 15 years of CES data (from 1986 to 2000) is used to construct 62 cohorts of households by the birth year of the head of the household, and then examine the impact of age, cohort, and year on the household's spending pattern. In the third and final step, the price effects are examined within the framework of a system of time series equations, incorporating results from the previous two steps.

This study enriches the current literature of consumption economics in two aspects. Firstly it builds a linkage so that the information of consumption behavior at

household level is summarized into one variable which becomes one of the key determinants to personal consumption expenditure at macro level. Secondly it constructs a set of cohort data and lay out a framework where the changes of consumption patterns caused by generation effects can be examined.

The dissertation is organized into five chapters. Following introduction in Chapter 1, Chapter 2 describes the cross section analysis of U.S. Household consumption pattern. Chapter 3 examines the issue from a cohort perspective. Chapter 4 builds the system of demand equations in time series and estimates the model. Chapter 5 concludes the study and explores possible directions for future work.

UNITED STATES HOUSEHOLDS CONSUMPTION,  
A COMPREHENSIVE ANALYSIS

By

Li Ding

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Advisory Committee:

Professor Seth Sanders, Chair/Advisor  
Professor Ingmar Prucha  
Dr. Ralph Monaco  
Professor John Chao  
Professor Suzanne Bianchi

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## PREFACE

The process of completing this Ph.D. thesis has been coinciding with a most difficult period in my life. In July 1999, when I was sweating through the lectures notes and problem sets in preparation for the August field exams in Advanced Micro and I. O. after finishing two years in the Ph.D. program at Econ Department, the government of People's Republic of China, the country where I came from, launched a nationwide political campaign against those who practice Falun Gong (a peaceful meditation rooted in traditional Chinese culture) that I picked up in March and found quite helpful for my insomnia problem. When people in China were facing a hard choice of giving up or being persecuted, I was also at a crossroad first time in my life.

That year, Chinese economy grew at 7.2%. This made me believe that economic boom can be uncorrelated with people's freedom in a country like China. From then on, I decided to work for both the spiritual freedom of my folks back in home country and people's economic welfare at the same time.

Time thus becomes a luxury good. While the killing and torture covered up by Chinese state media's propaganda intensified, I often found myself in a situation that after reading Econ papers for hours at midnight, I started to write a case report to be submitted to the United Nations. On the second day of Christmas in 1999, my wife and I were both arrested in Beijing during our honey-moon trip to China, just because we answered "yes" when the police stopped every pedestrian and checked if they practiced

Falun Gong. After we managed to return, I realized that I may not be able to see my parents again unless the persecution is ended. My parents in China were visited multiple times by National Security Bureau, the Chinese counterpart of KGB of former Soviet Union. These are but minor cases compared with those holding on to their belief in China. I always look to them when I fell short in courage to press on during those long nights.

During the last stage of the thesis, I need to do well in my full-time work at AVITAS, make timely progress on my thesis, and continue my fight for freedom of Chinese people. This thesis marks a nontrivial success in this multi-front cause.

As of today, it's reported that almost 3,000 have been tortured to death in this persecution and the toll is still growing. When I finished the last piece of the study, I want to thank everyone that has helped this thesis and those persecuted in China, and in particular Clopper's (my thesis advisor) words before my China trip: "You go, with my blessing!"

Li Ding

Vienna, Virginia

August 26, 2006

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I am deeply indebted to Clopper Almon, my thesis advisor till August of 2006, not only for his continuous encouragement and comprehensive advices on completing this study, but also for his patience and kindness that goes beyond academia. I am grateful to Seth Sanders, who promptly took over the responsibility as the advisor and gave much help at the final stage of my thesis when Professor Almon was under medical treatment. I am also grateful to Ralph Monaco, who gave me many valuable suggestions at the early stage of my thesis. I wish to thank Douglas Nyhus, Margaret McCarthy, and Douglas Meade, who helped me in many ways on my path toward an economics Ph.D. that is capable of conducting thorough empirical study with in-depth understanding of data and grasp of programming skills. I also wish to thank my former colleagues at INFORUM, Qisheng Yu, Qing Wang, Dan Wilson, Somprawin Manprasert, Ron Horst, and Barbara McNeill, who assisted me in many ways and made my days at INFORUM so memorable.

I wish to thank my colleagues in AVITAS, especially Dr. Adam Pilarski and Teresa Rothschild, for their understanding and encouragement.

Finally, I wish to thank my parents in China and my wife, Chunfang Yang, without whose support it is impossible to give birth to this thesis.

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## CHAPTER ONE INTRODUCTION

Consumption is perhaps the most important economic behavior of human beings. To it goes the lion's share of a country's annual product<sup>1</sup>. Because of that, generations of economists have studied the major elements that affect people's consumption pattern. This thesis is part of the ongoing efforts to give a reasonable description of how various factors affect household consumption decision.

The factors of interest include the household's income, demographic characteristics, age and cohort attributes, and commodity prices. As it is rather difficult to analyze all of them within single comprehensive framework, the study involves three steps.

Income is the most important factor that determines the level of household consumption and demographic characteristics shape the spending pattern of the families. The analysis in the first step (Chapter two) attempted to look at the roles of variables including household income, region of residence, family size, age structure, education level, and number of income earners in a cross-section fashion, using a sample of about 5,000 households in 2000 U.S. Consumer Expenditure Survey (CES).

The cross-section analysis answers the question of how a household makes decision on the purchase of goods and services at a particular point of time, however, it

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<sup>1</sup> According to Bureau of Economic Analysis of the U.S. Department of Commerce, 2003 U.S. Gross Domestic Products amounted to 10,983.9 billion dollars, while the Personal consumption expenditures was 7,752.3 Billion dollars, about 70% of GDP.

can not explain how things will change if we move the households along the time dimension. This naturally leads to our study in the second step (Chapter three) – cohort analysis. At this stage, we use 15 years of CES data (from 1986 to 2000) to construct 62 cohorts of households based on the birth year of the head of the household, and then examine the inter-cohort differences of households spending pattern.

In the third and final step (Chapter four), we complete the study within the framework of Almon’s Perhaps Adequate Demand System (PADS), a system of macroeconomic time series equations that tackle the relative price effects and incorporate information from the analysis of household data in the previous two steps.

The last chapter (Chapter five) of the thesis summarizes the key findings of the study and concludes.

## **SECTION 1 CROSS-SECTION ANALYSIS OF U.S. HOUSEHOLD CONSUMPTION (CHAPTER TWO)**

Income is the most important factor that influences personal consumption expenditure. It will to a large extent determine the level of consumption. Rich people usually spend more than poor people, and rich people can afford products that cannot be afforded by poor people.



Demographic variables also shape people's consumption habits. People living in the Northeast generally spend more on electricity because of the cold weather while elderly put a higher portion of their budget on health care than do young people. Region of residence, family size, age of the reference person<sup>2</sup>, education of the head, number of income earners, and age structure of the family members within a household are important factors that contribute to the variations in household consumption patterns across the country.

The cross-sectional study examines the effects of variables including income, demographic factors and age structure. We use the data from U.S. Consumer Expenditure Survey (CES) of the year 2000. The Consumer Expenditure Survey, conducted by Bureau of Labor Statistics of U.S. Department of Labor, collects information from U.S. households and families on their expenditure, income, and various characteristics. The data are collected in two independent surveys. One is the quarterly Interview survey and the other, the weekly Diary survey. Each survey has its own independent sample of approximately 5,000 households, and each collects data on household income and socioeconomic characteristics. The Interview survey includes monthly out-of-pocket expenditures such as housing, household durables, apparel, transportation, health care, insurance, and entertainment. The Diary survey includes weekly expenditures of frequently purchased items such as food and beverages, tobacco, personal care products, and nonprescription drugs and supplies. CES data files documented monthly expenditure on more than 500 expenditure items for each household in the sample for 5 quarters. We

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<sup>2</sup> The reference person generally coincides with the principal earner. To avoid repeated use of awkward phrase "reference person", we will use simply "head".

**Table 1.1 85 Consumption Categories Aggregated from CES**

1	Food at home	44	Health insurance premiums
2	Food away from home	45	Banking services
3	Alcoholic beverages at home	46	Life and other personal insurance
4	Alcoholic beverages away from home	47	Retirement, pension, social security
5	Tobacco and smoking supplies	48	Legal fees
6	Footwear	49	Funeral and burial services
7	Clothing for women and girls, 2 and over	50	Other personal business
8	Clothing for men and boys, 2 and over	51	New cars and trucks
9	Clothing for infants	52	Used Cars and trucks
10	Travel items	53	Other vehicles
11	Cleaning, laundering & repair of clothing	54	Tires and tubes, accessories and parts
12	Watch and jewelry	55	Maintenance and repairs of vehicles
13	Watch and jewelry repair, other clothing services	56	Vehicle rental and other charges
14	Personal care services for males and females	57	Vehicle financial charge
15	Personal care equipments	58	Vehicle license and registration
16	Owned dwellings	59	Gasoline and motor oil
17	Rented dwellings	60	Tolls on out-of-town trips
18	Other lodging	61	Vehicle insurance
19	Furniture	62	Local transportation (excl. taxis)
20	Kitchen and household appliances	63	Taxis
21	China, glassware and utensils	64	Intercity train fares on out-of-town trips
22	Floor coverings	65	Intercity bus fares on out-of-town trips
23	Other durable house furnishings; Writing equipments	66	Airline fares on out-of-town trips
24	Power and non-power tools	67	Ship fares on out-of-town trips
25	Household Textiles	68	Readings
26	Semi-durable house furnishings	69	Pets, pets supplies, and pet services
27	Cleaning and lighting supplies	70	Toys and playground equipments
28	Electricity	71	Bicycles
29	Natural gas	72	Cameras and films
30	Water and other public services	73	Guns, ammunition, sporting equipments
31	Fuel oil and other Fuels	74	Televisions, radios, and sound equipments
32	Telephone equipments and services	75	Home computers
33	Domestic services	76	Fresh flower or potted plants
34	Household insurance premiums	77	Live entertainment, sports and movie admissions
35	Other household operations	78	Fees for clubs or fraternal organizations
36	Prescription drugs, medicines, purchase and rental of medical supplies	79	Participant amusements and pari-mutual net receipts
37	Ophthalmic & orthopedic equipment	80	Other recreation
38	Physicians' services	81	Higher education
39	Dental care	82	Private and lower education
40	Other services by medical professionals	83	Other education and research
41	Other medical care services and medical care in retirement communities	84	Cash contributions
42	Hospital room and meals; Hospital services	85	Miscellaneous
43	Care in convalescent or nursing homes (net outlay)		

aggregate the more than 500 CES expenditure items into 85 consumption categories. (See the list of 85 consumption categories in Table 1.1) As a major purpose of this research is to provide an underpinning for the consumption equations of the *INFORUM LIFT*<sup>3</sup> model, the detailed CES expenditure items were aggregated to match the 92 LIFT consumption categories as closely as possible.

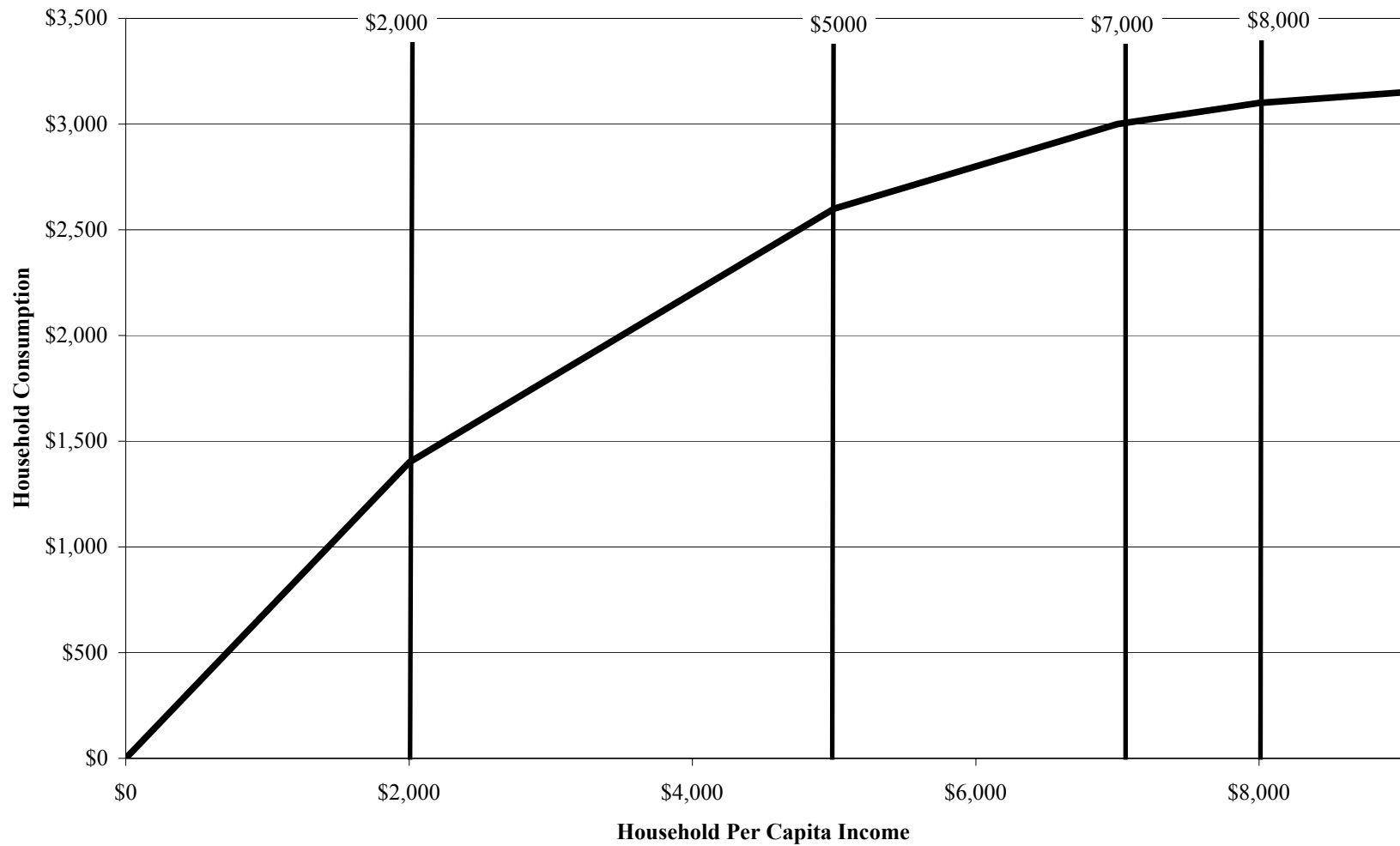
The household demand is the product of two components: the consumption per household member, and the size of the household. The consumption per household member is determined by the household's per capita income and demographic characteristics.

The relationship between consumption and income is described by Piecewise-Linear Engel Curve (PLEC). The per capita household income is partitioned into several income brackets. Within each bracket, we assume consumption responds linearly to income. However, households may change their consumption propensity over different brackets. By describing the reliance of consumption on income in this way, we allow for different properties of necessity goods and luxury goods. For example, over the lower income brackets, the family spends a substantial part of its budget on food and other necessary goods. However, spending on necessities will not increase proportionally on a higher income bracket; despite that some luxury goods are consumed, the overall ratio of household consumption to income is lower. An example of Piecewise-Linear Engel Curve (PLEC) is shown in Figure 1.1.

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<sup>3</sup> The *LIFT* model is an integrated interindustry macroeconomic model developed by *INFORUM*, Interindustry Forecasting at the University of Maryland.

**Figure 1.1 A Piecewise-Linear Engel Curve**



Household demographic characteristics linearly enter the PLEC polynomial equations. The characteristics include region of residence, family size, age and education of household head, and number of income earners in the family. Those factors are represented by zero-one dummy variables. To avoid the dummy variable trap, one group of each category is left out. The left-out group, or the reference group, is 3-4 member household in the Northeast region with two wage earners, and the head aged between 35 and 55, holding high school or associate degrees.

As the second component, the size of the household for that good is not a mere head counts of household members, but a weighted average of number of household members in each age group, with specific weights for each age group and each product. The weights are called Adult Equivalency Weights. To understand this formulation, think about the purchase of toys. A family with relatively more children will spend a fair amount of money on toys and other recreational commodities for youngsters, while a family without children will have few purchase of that type. It is therefore reasonable to assign weights to different age groups for the purchase of a specified good as to obtain an “effective” household size. We describe the age structure of the household by eight age groups. Each age group has a specific weight for certain product. These weights need to be estimated.

Survey data usually have many zero entries. In the 2000 CES data, among the 85 categories we are studying, 55 categories have zero expenditure for more than 50% of the households. One of the main reasons for the zero expenditure is infrequency of purchase.

For many durable goods, consumption of the good takes place everyday while expenditure occurs only once every few years. Thus, zero expenditure does not mean zero consumption. To deal with this problem, a nonlinear probability model estimation scheme is used for the cross-section analysis. The basic idea is to estimate first the probability of consumption from the expenditure using a probability model, and then apply nonlinear least squares on “expected consumption” to estimate the parameters. This is done for each of the 85 household consumption categories.

The estimation results show convergence of the nonlinear estimation for 82 equations. For each equation, we obtain estimates for Engel curve parameters, demographic dummy variable parameters, and Adult Equivalency Weights.

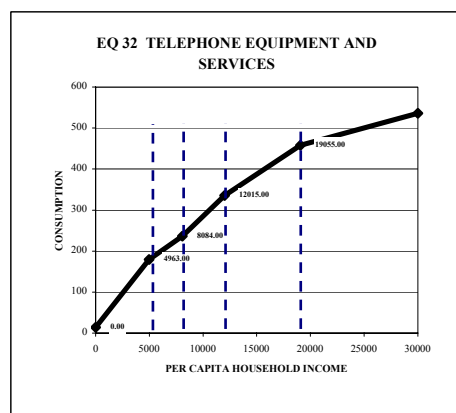
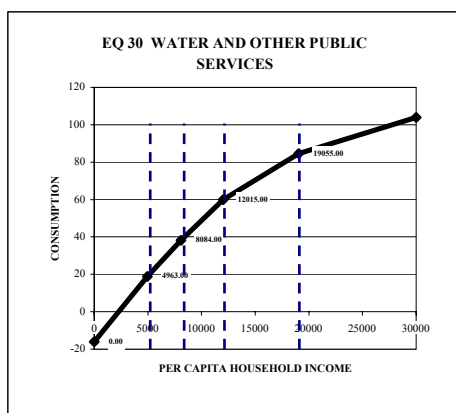
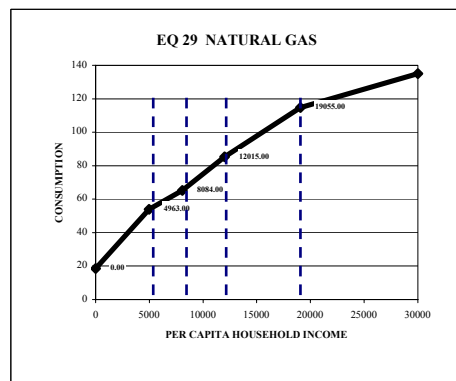
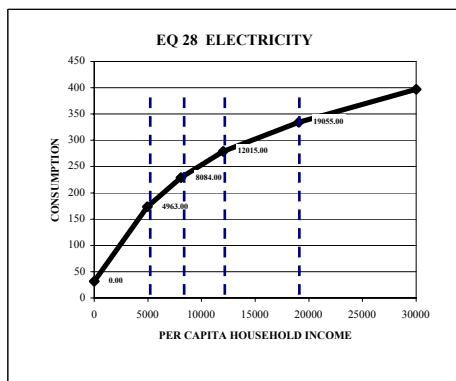
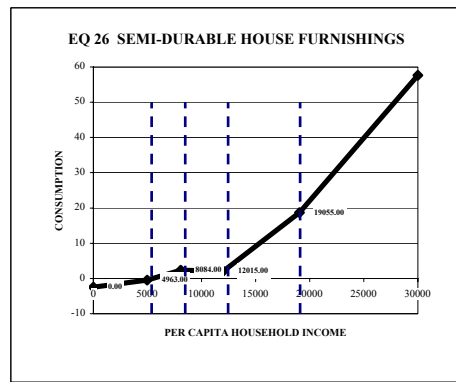
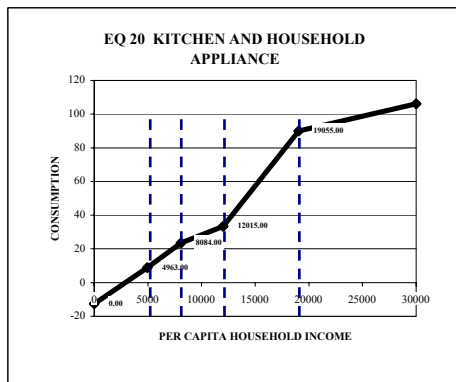
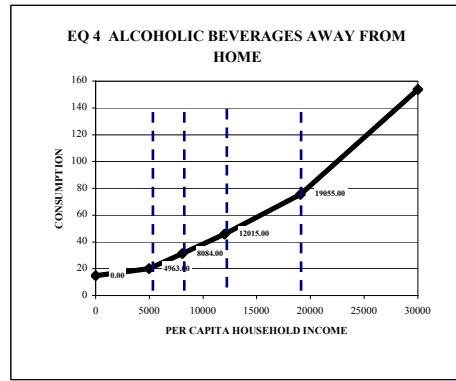
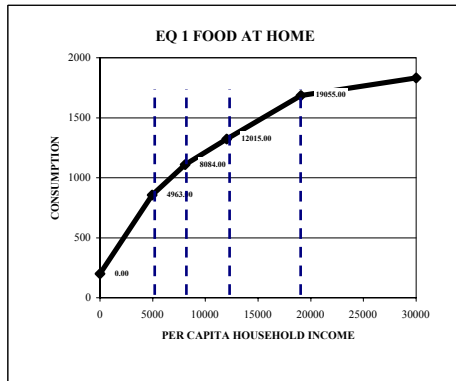
Plots of estimated Engel curves<sup>4</sup> (see Figure 1.2) show the characteristics of different commodities. Categories such as Food at home, Household utilities and some health care categories show patterns of necessities. The budget shares of those products are relatively high in the low income segment, and become lower when the household income level gets higher. For some consumption categories, the Engel curves exhibits properties of luxury goods. They include Alcoholic beverages away from home, house furnishing expenditure, spending on purchase of cars, travel and recreation expenditure.

Demographic characteristics have been found to affect consumption on many categories. For the 83 categories, region of residence has significant influences on household consumption decisions. For example, living in the Midwest and South has

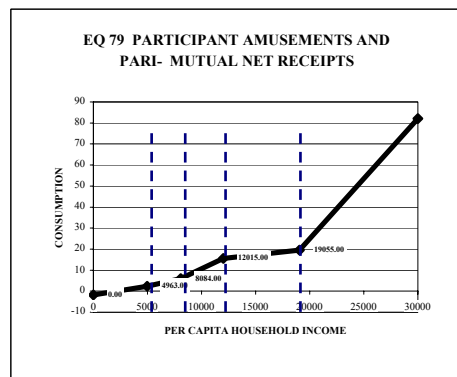
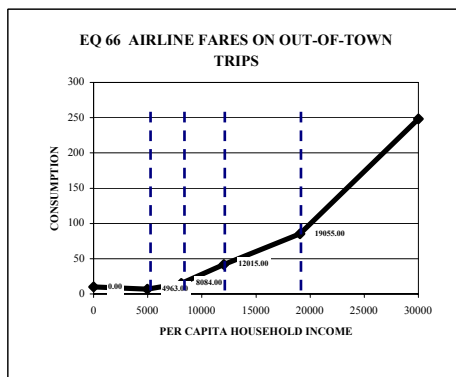
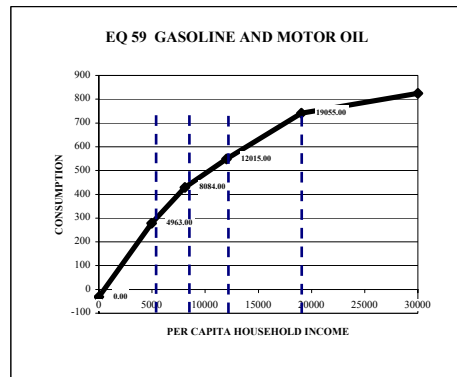
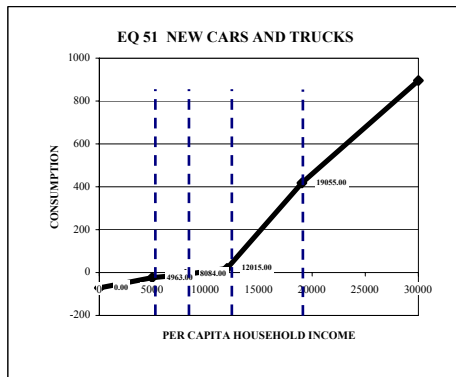
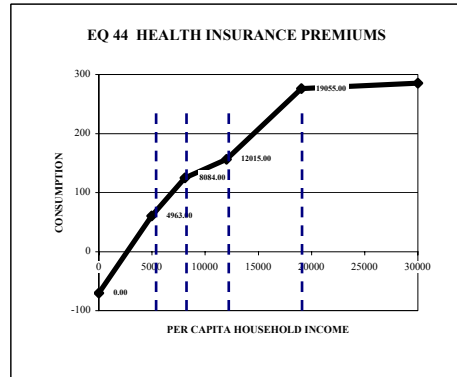
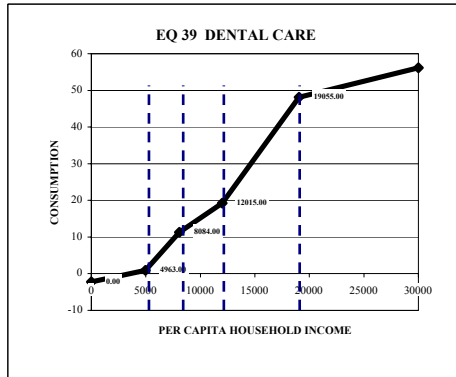
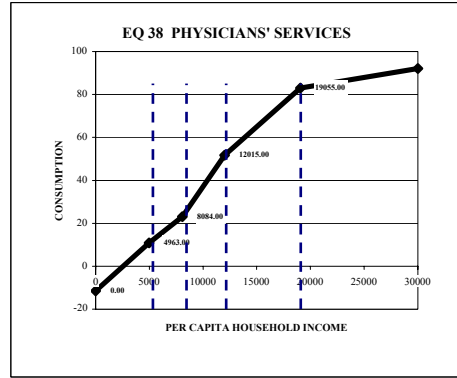
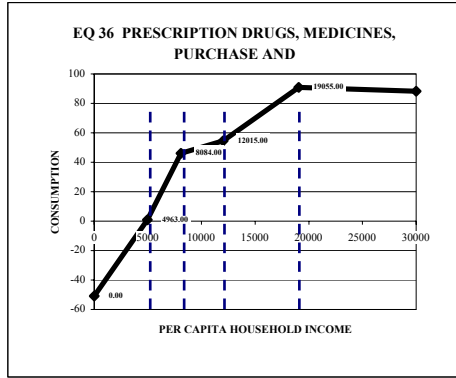
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<sup>4</sup> Engel curves are drawn for reference group.

**Figure 1.2 Estimated Engel Curves, Selected Consumption Categories**



**Figure 1.2 Estimated Engel Curves, Selected Consumption Categories (Continued)**





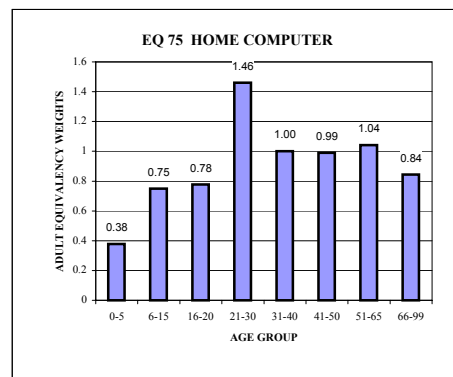
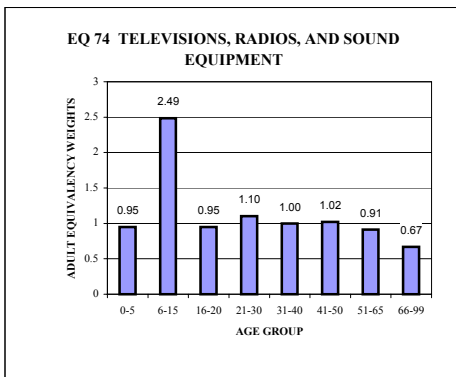
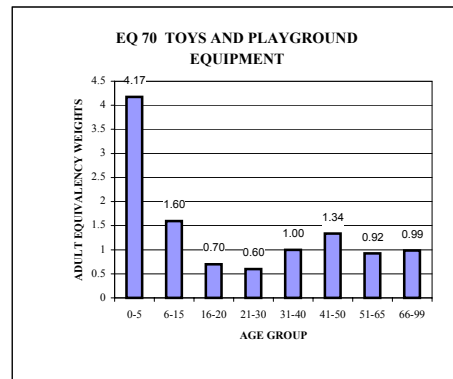
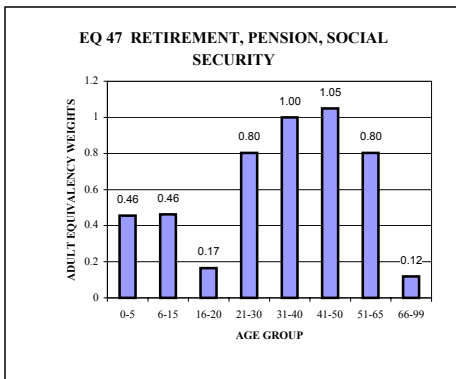
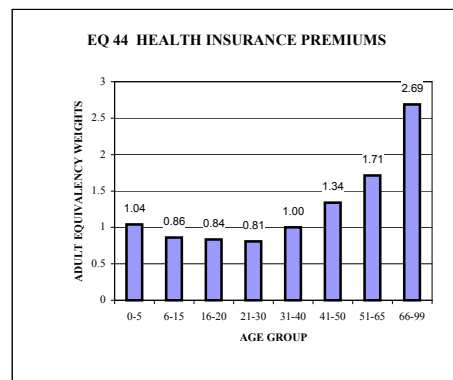
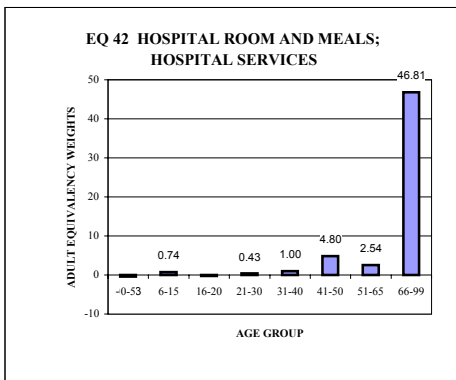
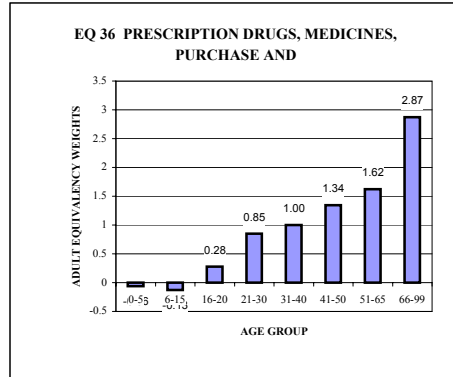
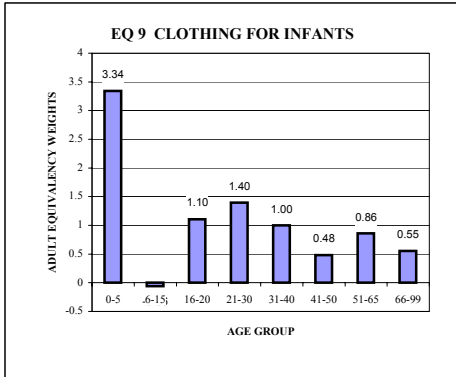
significant positive influence on usage of electricity, while living in the West has significant negative impacts.

Family size is another important element. The results, for example, show that family size of 1 or 2 has a positive significant effect on Telephone equipments and services, while family size of 5 and above has negative influence. Since the reference group is 3-4 family size, what it means is that the more family members, the less household consumption on telephone equipment and service. This is a typical example of economies of scale of consumption.

Age and education level of household head and number of wage earners have also proven influential. All 83 categories are significant for at least one category of age of household head. Our estimation results show that households with age of household head greater than 55 spend more on most health care items, including Prescription drugs, medicines, purchase and rental of medical supplies (36), Ophthalmic and orthopedic equipment (37) and Dental care (39).

The estimation of Adult Equivalency Weights shows that people from different age groups contribute to the consumption of goods and services in different ways (See Figure 1.3). The age group of 5 and below has the highest adult equivalency weights for infant clothing and toys, while age group of 66 and above has high adult equivalency weights for many of the health categories including Prescription drugs and medicines.

**Figure 1.3 Bar Charts of Adult Equivalency Weights, Selected Categories**



## SECTION 2 COHORT ANALYSIS OF U.S. HOUSEHOLD CONSUMPTION (CHAPTER THREE)

The cross-sectional investigation answers the question of how a household make decision on the purchase of various goods and services at a certain point of time. A natural question then arises: How will things change if we move along the time dimension? In other words, if there are two families with exactly the same income and demographic characteristics, but one family was living during World War II period, while the other is living in the 1990's, how will the two families' consumption pattern differ? This question leads to the next stage of our study – cohort analysis, an examination of the how the consumption behaviors change just because people are born at different time periods.

One year of Consumer Expenditure Survey data is insufficient to compare households spending at different times. As CES replaces twenty percent of the sample households every quarter, we can follow an individual household for only one year. However, with a time series of CES Interview surveys, we are able to construct cohort data to follow cohorts of households over 15 years.

“Cohort” in our context means a group of people born in the same year. Following a cohort over years would allow us to tell how the consumption behavior of households today differs from households of the same age and demographic characteristics during other time periods. More specifically, we try to look at three aspects of the time element: *age*, *year* and *cohort* effect. *Age* effect means the behavioral

pattern related with progression of one's life cycle; *year* effect refers to the changes brought by idiosyncratic events such as an oil shock that affect all cohorts in a particular year; it does not, however, represent a time trend. The *cohort* effect describes the inter-cohort or intergenerational differences.

Cohort data are constructed from the 15-year time series of CES Interview surveys from 1986 to 2000. Households with the head born in the same year are bundled together and their consumption information followed over time. For example, we look at the consumption of 25-year-olds in the 1986 survey, of 26-year-olds in the 1987 survey and so on. In this way, we constructed annual expenditure of 85 categories and aggregate household consumption for each household, and compute the average for each age group. And then follow each age group from 1986 through 2000 to construct cohort data. We eliminate households with heads either too old or too young<sup>5</sup>. We have 62 cohorts, each of whom has 15 years of expenditure data on 85 categories and aggregate expenditure.

The estimation technique is linear dummy variable estimation. With 48 age dummies (from 24 to 71), 62 cohort dummies (from 10 to 71), and 15 year dummies (from 1986 to 2000), the standard model can be written down as

$$x_i = \beta_i + A_{T,48}\alpha_i + C_{T,62}\gamma_i + Y_{T,15}\psi_i + u_i \quad (1.2.1)$$

---

<sup>5</sup> We eliminate observations with age of household head less than 11 and greater than 75.

where  $x_i$  is the stacked vector of natural logarithm of cohort expenditure for product  $i$ ;  $A_{T,48}$  is the matrix of age dummies with  $T$  (total number of observations) rows and 48 columns;  $C_{T,62}$  is the matrix of cohort dummies with  $T$  rows and 62 columns; and  $Y_{T,15}$  is the matrix of year dummies with  $T$  rows and 15 columns.  $\alpha_i$ ,  $\gamma_i$ , and  $\psi_i$  are vectors of coefficients of age, cohort, and year effects respectively.  $\beta_i$  is the vectors of intercepts.  $u_i$  is the disturbance term with the assumption that it is independently and identically distributed across cohort for the same product  $i$ . To avoid the dummy variable trap, one column from each of the three matrices is dropped.

However, there still exists a linear dependence between year, age and cohort by definition of the cohort. A constraint is put on the coefficients for year dummies so that the growth of consumption is attributed to age and cohort effects but not year, with the year effects averaging to zero in the long run. The analysis is focused on the age and cohort effects.

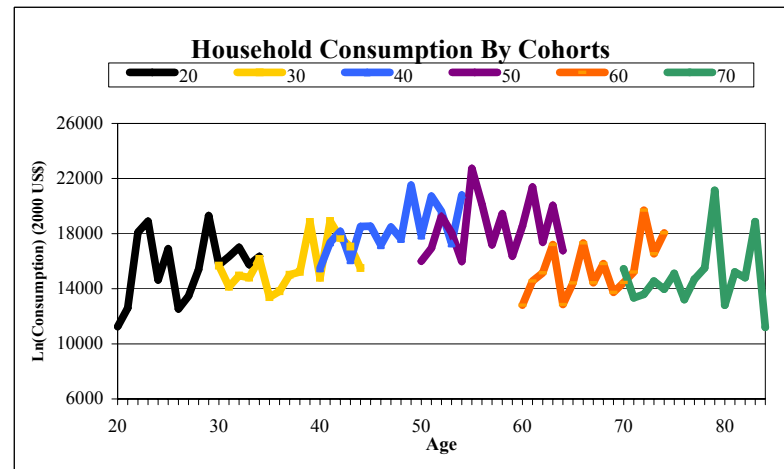
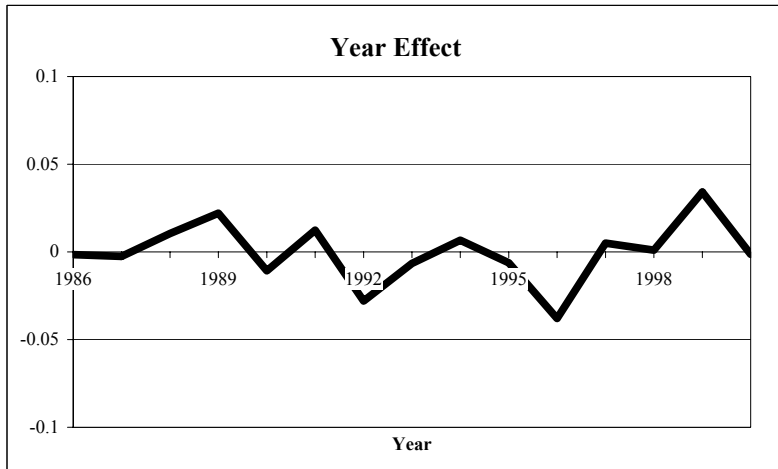
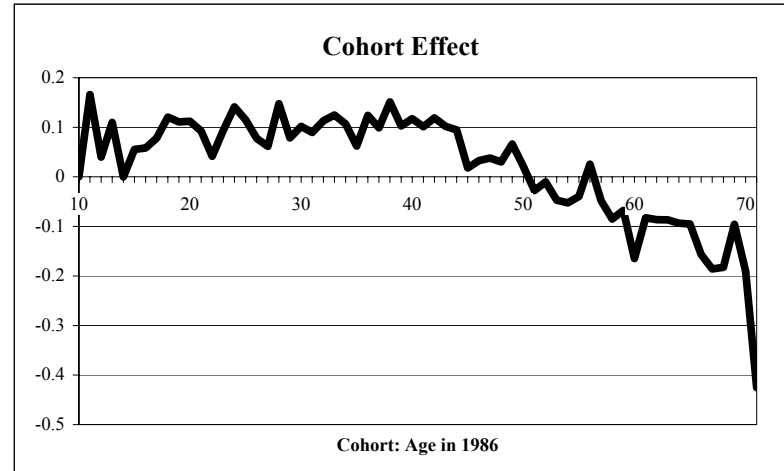
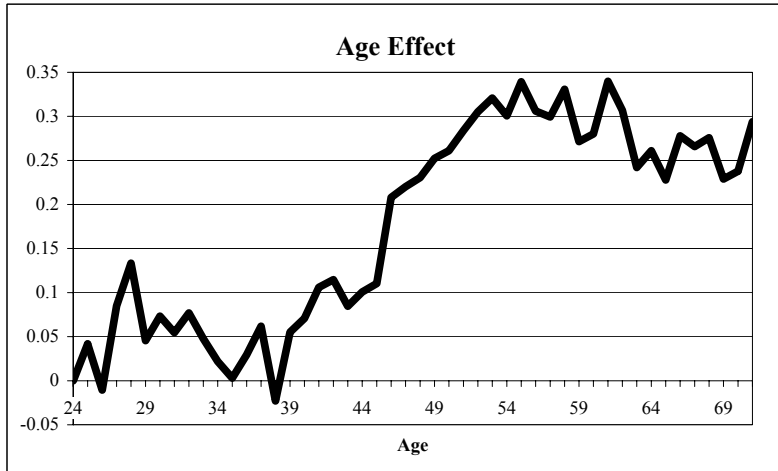
The cohort analysis finds that generally younger generations are spending more and presumably saving less than the elder generations, a sign of societal progress. However, the change is not monotonic from cohort to cohort. We may roughly divide the 62 cohorts into 2 categories: the younger generations (cohort 10 – 43 on Figure 1.4), and the elder generations (cohort 44 – 71 on Figure 1.4). For the younger generations, the cohort effects on the per capita aggregate household consumption is between 118% and 99.9% of the level of cohort 10, the reference cohort with the cohort effect coefficient 0.

Intuitively, the younger generations grew up in the post-war period, a period of relative peace and economic growth. There are no significant inter-cohort differences in the pattern of spending. For the elder generations (cohort 45 – 71), the cohort effects show patterns that cohorts born earlier spend less while those born later spend more. The intuitive reason is that most of the older cohorts lived through the Great Depression, World War I, and World War II. The spending level of the cohorts reflects the growth of economy and national income. The cohort effects on the per capita aggregate household consumption decreases from 110% to 65.3% of the reference cohort. However, the changes are not monotonic; there are several peaks (cohort 49, 56, and 69) on the declining path.

The age effects obtained from the analysis of the aggregate household consumption can be examined roughly in three phases (See Figure 1.4). The first phase is from 24 to 38, with the average consumption level about 105% of the level of the starting age. Comparing with the levels of later phases, the age effects are relatively low at this phase. The second phase is from 39 to 55, where the age effects rising from -0.023 to the peak of 0.339. However, the changes of age effects are not monotonic. The level of per capita aggregate household consumption climbs from 98% to 140% of the 24-year-old level, a substantial increase. The third phase is from 56 to 71, with the age effects gradually falling between 0.340 and 0.228. At the age of 61, the age effect achieves the highest level. Then the age effects slowly decrease. The magnitude of correspondent change in per capita aggregate household consumption is between 140% and 126% of the 24-year-old level.

Figure 1.4 Household Consumption by Cohorts and Decomposition, 1986 - 2000

Aggregate Household Consumption



We have also obtained the coefficients for age, year and cohort effects for each of the 81<sup>6</sup> consumption categories. Results of a few of them are shown here to illustrate our analysis. (See Figure 1.5)

The cohort effect panels of Food at home (1) and Food away from home (2) show that generally speaking, younger generations are spending less both on Food at home and away from home. Considering the income has grown over the generations, the panels imply that the share of food consumption has fallen in the younger generations.

Tobacco and smoking (5): from the graphs, we might conclude that people tend to smoke less when they get old, as can be shown from the panel of age effects. However, the reality is smokers don't get old! From the panel of cohort effects, young generations smoke less than old generations.

The age effects curves of Owned dwellings (16) and Rented Dwellings (17) fit quite well with everyday observations. Young people usually rent rather than purchase a house. When they reach work age, people usually buy house instead of renting. The age effects panels have shown this substitution effects between owned and rented dwellings.

The age effect curve of Retirement, pension, social security (47) exemplifies a life-cycle pattern of the payment of pension. When people are at working age, they spend

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<sup>6</sup> We are not able to obtain the coefficients for four consumption categories because there are not enough data points spanning 47 age categories, 13 year categories and 61 cohort categories. More detailed explanation is given in Chapter 3.

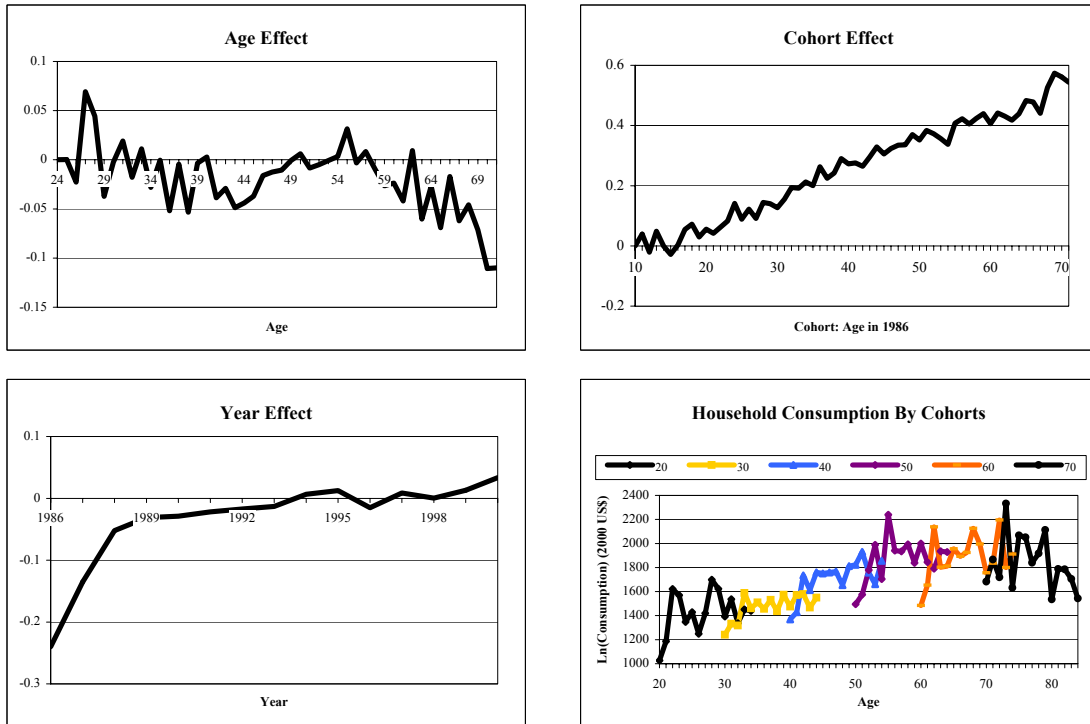


on retirement plan to save for the retired period. When they retire, they spend their savings.

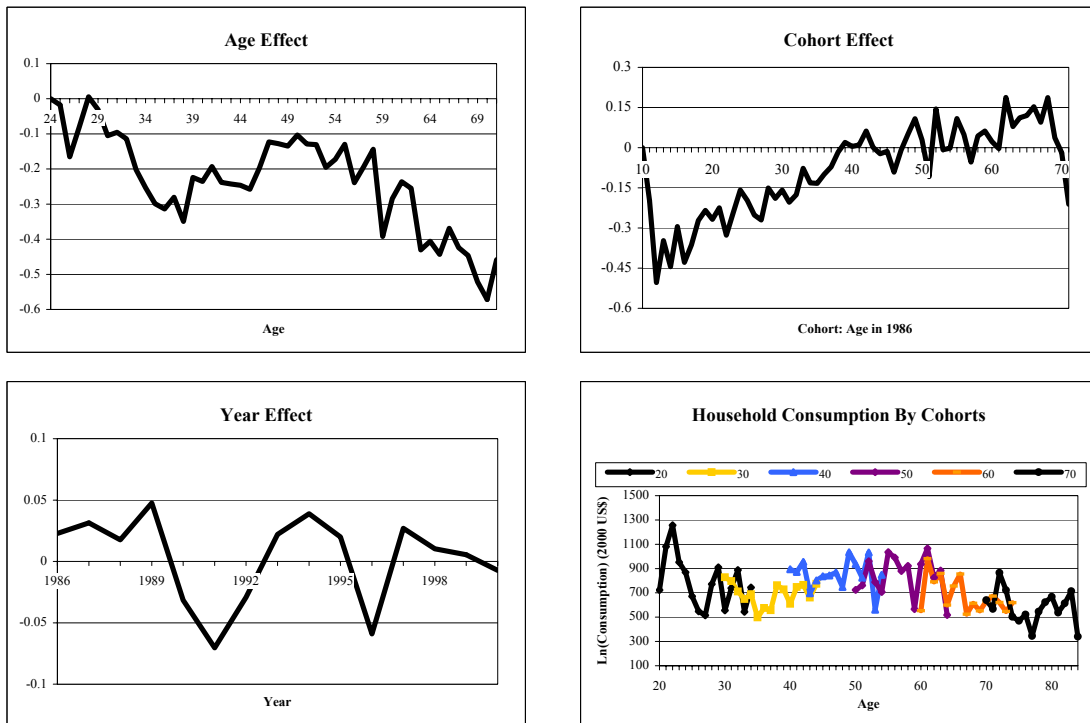
Cohort panels of New cars and trucks (51); Used cars and trucks (52) show that younger generations are spending more on cars and trucks, a reflection of growth of car industry and people's income.

**Figure 1.5 Selected Categories of Household Consumption by Cohorts and Decomposition, 1986 - 2000**

**1, Food At Home**

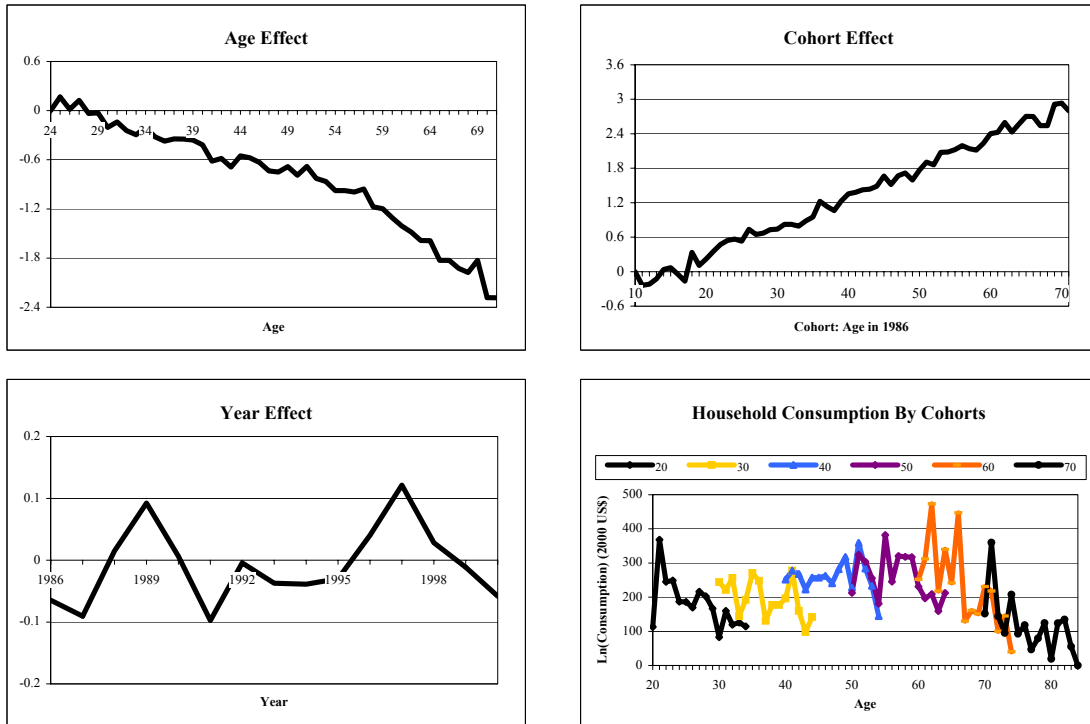


**2, Food Away from Home**

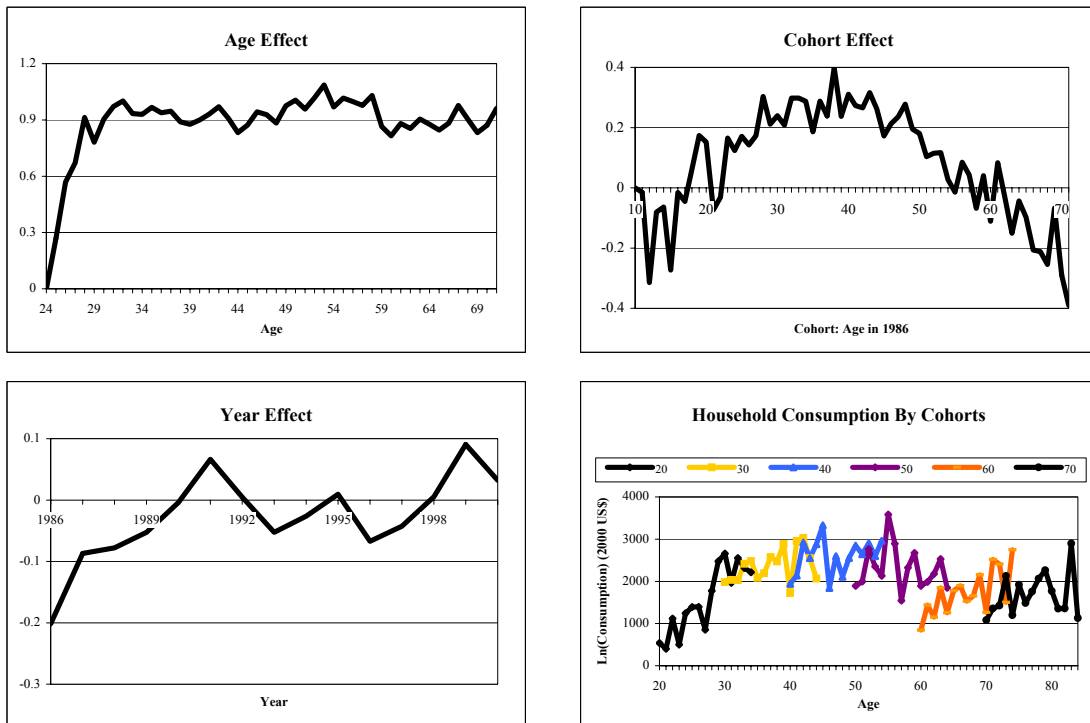


**Figure 1.5 Selected Categories of Household Consumption by Cohorts and Decomposition, 1986 - 2000 (Continued)**

**5, Tobacco and smoking supplies**

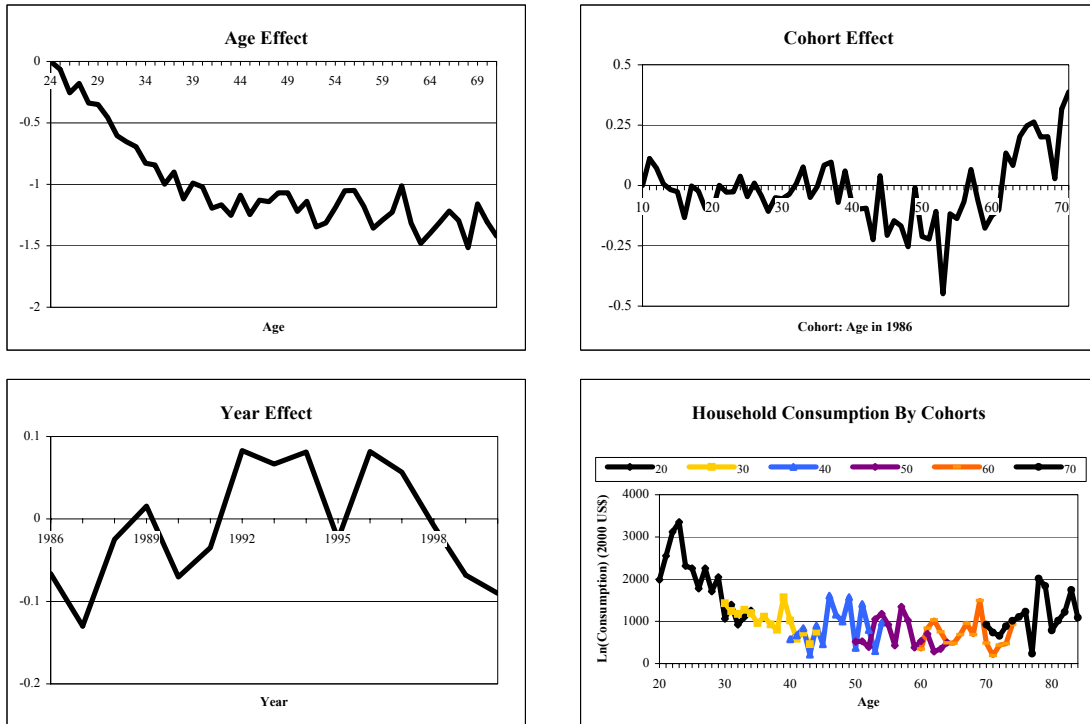


**16, Owned dwellings**

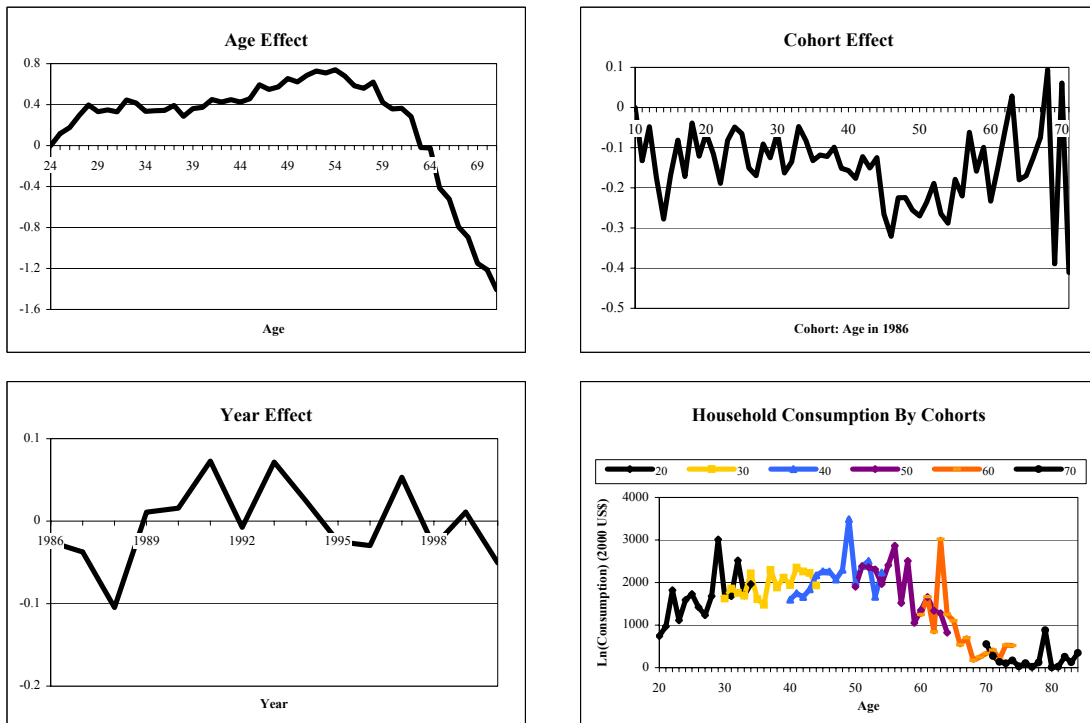


**Figure 1.5 Selected Categories of Household Consumption by Cohorts and Decomposition, 1986 - 2000 (Continued)**

**17, Rented dwellings**

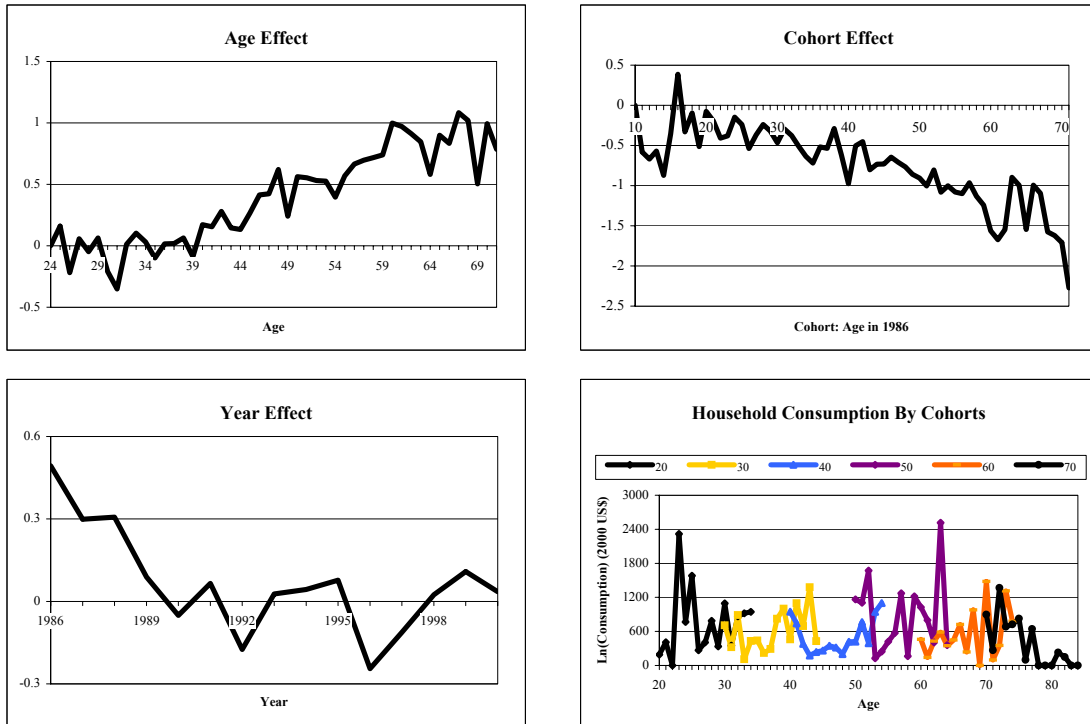


**47, Retirement, pension, social security**

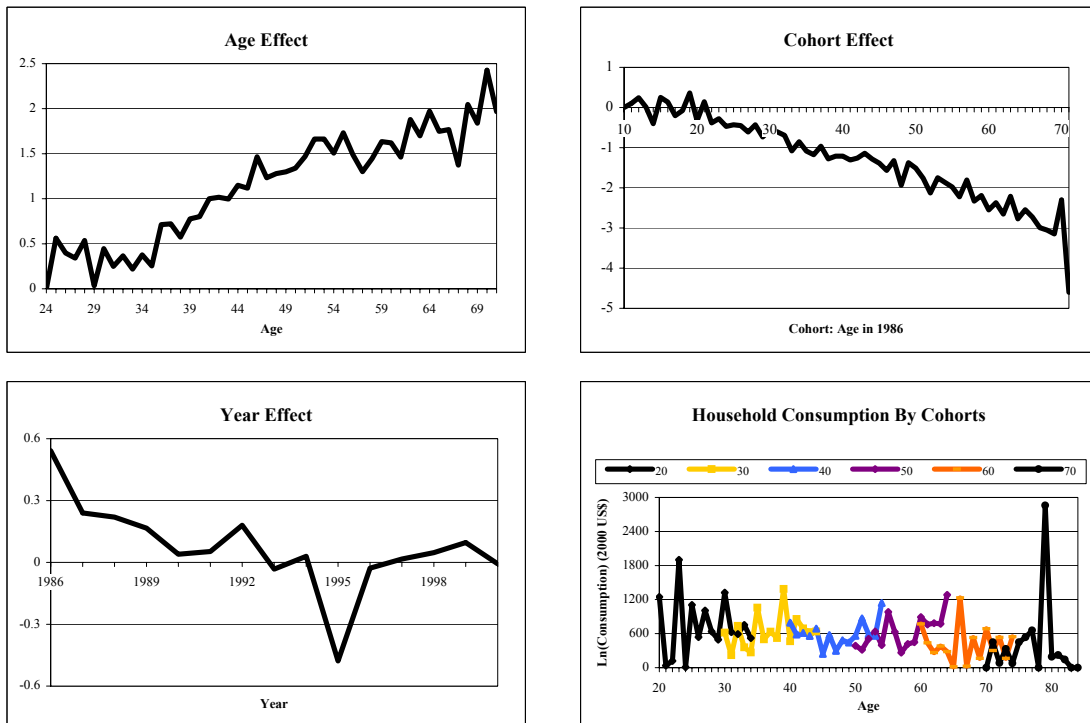


**Figure 1.5 Selected Categories of Household Consumption by Cohorts and Decomposition, 1986 - 2000 (Continued)**

**51, New cars and trucks**



**52, Used Cars and trucks**



### **SECTION 3 TIME SERIES CONSUMPTION FUNCTIONS (CHAPTER FOUR)**

In the cross-sectional analysis it is difficult to put in price term. With times series equations, however, we are able to see the variations in prices and their effects on consumption pattern. With multiple sectors, it is interesting to see how substitution and complementarity effects play their roles across different sectors. With the information we have obtained from cross-sectional analysis and cohort study, we are able to incorporate the information including income, age structure of the population, and demographic composition into the demand system. The system estimates 90 components of U.S. personal consumption expenditures in the National Income and Product Accounts, a complete list of which is shown in Table 1.2.

Before estimating this system, a time-series of weighted population is created for each consumption item using the Adult Equivalency Weights. The population totals for each of the eight age groups are obtained from the Current Population Reports published by the Census Bureau. The weighted populations for each of the 90 sectors are computed by summing the number of individuals in each age group weighted by the corresponding equivalency weight for that good over all the age groups.

A “prediction” of per adult equivalent expenditure of each good is created by incorporating the information of income, demographic composition and cohort effects. A linear system of equations on 15-year time series of CES surveys is used to obtain this

**Table 1.2 PCE Consumption Sectors for PADS Estimation**

1	Meat	46	Ophthalmic & orthopedic equipment
2	Dairy products	47	Physicians
3	Poultry and eggs	48	Dentists
4	Fresh fruit and vegetables	49	Other professional medical
5	Processed fruit and vegetables	50	Hospitals
6	Cereal and bakery products	51	Nursing homes
7	Fats and oils	52	Health insurance premiums
8	Sugar and sweets	53	Brokerage & invest counsel
9	Nonalcoholic beverages	54	Bank service charges
10	Other prepared food	55	Imputed service charges
11	Fish and seafood	56	Expense of handling life insurance
12	Pet food	57	Legal services
13	Alcohol for off-premise consumption	58	Funeral & burial expenses
14	Purchased meals, food furnished employee and on farms	59	Other personal business
15	Tobacco	60	New autos
16	Footwear	61	Net purchases of used autos
17	Clothing, women's & girls	62	Other motor vehicles
18	Clothing, men's & boys' and military	63	Tires & tubes, accessories and parts
19	Luggage	64	Automobile repair, rental, leasing
20	Cleaning, laundering, & repair of clothing and shoes	65	Gasoline & oil
21	Jewelry & watches	66	Tolls
22	Watch repair and misc personal services	67	Net auto insurance premiums
23	Toilet articles & preps	68	Mass transit
24	Barbershops, beauty & health clubs	69	Taxicab
25	Owner occupied non-farm space	70	Intercity rail
26	Tenant occupied non-farm space	71	Intercity bus
27	Other housing	72	Airline
28	Furniture	73	Other transportation services
29	Kitchen & household appliances	74	Books & maps, magazines and newspapers
30	China & glassware, tableware & utilities	75	Toys, dolls, & games
31	Floor coverings	76	Bicycles, motorcycles
32	Other durable house furnishings, writing eq.	77	Cameras, film, and processing
33	Hand tools	78	Guns, ammunition, sporting equipment
34	Semi-durable house furnishings	79	Electronic entertainment and musical instruments
35	Cleaning, lighting, paper supplies	80	Home computers
36	Stationery, writing supplies	81	Flowers seeds & potted plants
37	Electricity	82	Live entertainment, sports, movie admission
38	Natural gas	83	Clubs & fraternal organization
39	Water & sanitary services	84	Participant amusements, pari-mutuel net receipts
40	Fuel oil & coal	85	Other recreation
41	Telephone & telegraph	86	Higher education
42	Domestic services	87	Private lower education
43	Household Insurance premiums	88	Other education & research
44	Other household operation	89	religious & welfare
45	Drug preparations and sundries	90	Foreign travel, and purchases abroad

“prediction”, for which we assume that income, demographic variable, cohort, and a simple price term are the only factors that affect consumption.

The demographic component of the “predictions” is calculated by summing over the population proportion for each demographic category in a given year weighted by the corresponding cross-section coefficients. In a similar fashion, the cohort component is computed by summing over the proportion of each cohort in a given year weighted by the corresponding cohort coefficients. For the income component, we use the average per capita income of the households in the 15-year surveys to represent the national average.

The weighted population and “prediction” of per adult equivalent expenditure of each good, combined with personal consumption expenditure, and price indices for the 15 years, are input into the Perhaps Adequate Demand System (PADS) to examine the price effects. In this demand system, per adult equivalent demand for goods depends upon the “prediction”, and prices of its own and all other goods. To simplify the analysis, we group the commodities into groups and subgroups. A commodity can be a strong complement or substitute for other items in its own group while having less strong price interactions with goods in other groups. The construction of subgroups helps to achieve greater flexibility for the price interaction patterns. A list of the groups and subgroups for the system is shown in Table 1.3.



**Table 1.3 Groups and Subgroups in PADS Estimation**

Sector	Subgroup	Group
1, Meat 2, Dairy products 3, Poultry and eggs 4, Fresh fruit and vegetables 5, Processed fruit and vegetables 6, Cereal and bakery 7, Fats and oils 8, Sugar and sweets 9, Nonalcoholic bever 10, Other prepared food 11, Fish and seafood	Subgroup 1, Food and alcohol at home	Group 1: FOOD AND ALCOHOL
13, Alcohol off premium 14, Purchased meals and food	Subgroup 2, Food and alcohol away from home	
17, Clothing, women's 18, Clothing, men's & Boys	Subgroup 3, Clothing	Group 2: CLOTHING, ACCESSORIES, AND PERSONAL CARE
16, Footwear 19, Luggage 21, Jewelry & watches	Subgroup 4, Accessories	
20, Cleaning, laundry 22, Watch repair; misc 23, Toilet articles & preps 24, Barbershops, beauty & health clubs	Subgroup 5, Personal care items	
28, Furniture 29, Kitchen & household appliance	Subgroup 6, Major household durables	
30, China & glassware 31, Floor coverings 32, Other durable hous 33, Hand tools 34, Semi-durable house	Subgroup 7, Minor household durables	
35, Cleaning, lighting 41, Telephone & telegraph	Subgroup 0 Subgroup 0	Group 4: HOUSEHOLD OPERATION
39, Water & sanitary services 42, Domestic services 43, Household Insurance 44, Other household operations	Subgroup 8, Services and insurance	
25, Owner occupied space 26, Tenant occupied space 27, Other housing	Subgroup 9, Housing	
37, Electricity 38, Natural gas 40, Fuel oil & coal	Subgroup 10, Housing utilities	
47, Physicians 48, Dentists 49, Other professional medical services 50, Hospitals	Subgroup 11, Physicians and hospitals	Group 6: MEDICAL EQUIPMENT AND SERVICES
45, Drug preparations 46, Ophthalmic & orthopedic equipment 51, Nursing homes 52, Health insurance premium	Subgroup 12, Drugs and equipments	

**Table 1.3 Groups and Subgroups in PADS Estimation**

53, Brokerage & investment	Subgroup 13, Banking services	Group 7: PERSONAL BUSINESS SERVICES
54, Bank service charges		
55, Imputed service charges		
56, Expense of handling life insurance	Subgroup 14, Other personal services	
57, Legal services		
58, Funeral & burial expenses		
59, Other personal business		
65, Gasoline & oil	Subgroup 0	Group 8: TRANSPORTATION
60, New autos		
61, Net purchases of used autos	Subgroup 15, Durable purchases	
62, Other motor vehicles		
63, Tires & tubes, accessories	Subgroup 16, Maintenance expenses except gasoline	
64, Automobile repair		
67, Net auto insurance		
66, Tolls	Subgroup 17, Public transportation	
68, Mass transit		
69, Taxicab		
85, Other recreation	Subgroup 0	Group 9: RECREATION AND TRAVEL
90, Foreign travel and purchase abroad	Subgroup 0	
70, Intercity rail		
71, Intercity bus	Subgroup 18, Travel expenses	
72, Airline		
73, Other transportation		
12, Pet food		
75, Toys, dolls, & games		
76, Bicycles, motorcycles	Subgroup 19, Recreational nondurables and durables	
77, Cameras, film, and processing		
78, Guns, ammunition, sport equipment		
79, Electronic entertainment		
81, Flowers seeds & potted plants		
82, Live entertainment		
83, Clubs & fraternal organizations	Subgroup 20, Admissions	
84, Participant amusement		
86, Higher education		Group 10: READING AND EDUCATION
87, Private lower education	Subgroup 21, Education and religious	
88, Other education & research		
89, religious & welfare		
36, Stationery, writing equipment		
74, Books & maps, Magazines	Subgroup 22, Readings	
15, Tobacco	Subgroup 0	Group 0
80, Home computers	Subgroup 0	Group 0

The estimation process was done with a computer estimation program. The input of the program includes time series data of personal consumption expenditure, the “prediction” variable, weighted population, price, grouping information and a time trend. Output of the program includes estimated income parameters and price parameters, income elasticity, own and cross price elasticity, fitted value of personal consumption expenditure, and other diagnostic statistics. Using soft constraints on income and price parameters, the program produces fairly satisfactory estimates.

Except for two sectors, majority of the own price elasticity are either negative or close to zero. For income parameters, all but two sectors have positive income elasticity. 89 out of the 90 consumption categories have standard error of estimates less than 10 percent of the 2000 value.

The program also produces estimates for group and subgroup price parameters. Categorizing the consumption sectors into groups and subgroups not only decreases the number of parameters for price terms in the PADS, but allows us to look at the substitution and complementary relationship between two goods. Table 1.4 shows results of PADS estimation for two selected groups: group 5: Housing and Household Utilities, and group 6: Medical Equipment and Service.

In group 5: Housing and Household Utilities, there are two subgroups. Within the first subgroup of Housing, there are significant substitution effects between the three housing items. When price of Owner occupied space (25) increases, the purchase of

Tenant occupied space falls, and vice versa. However, the purchase of Owner occupied space (25) and Tenant occupied space (26) is not responsive to the price change in Other housing (27). The cross price elasticities also tells that housing utilities, the second subgroup, responds negatively and significantly to the price change of Owner occupied space (25), but insignificantly to Tenant occupied space (26) and Other housing (27).

Another example is group 6: Medical Equipment and Service. The cross price elasticities of subgroup of Physicians and hospitals show significant substitution effects between the four items within this subgroup. For the second subgroup of Drugs and equipments, the cross price elasticities show insignificant substitution effects between the items within this subgroup. There is also a complementarity effects between some of the consumption items in the two subgroups. Purchases of Physicians (47), Dentists (48) and Hospitals (50) have negative price elasticities in response to the price change of Drug preparations (45) and Health insurance premium (52). Purchases of Drugs preparations (45), Ophthalmic & orthopedic equipment (46) and Health insurance premium (52) are negatively affected by the prices of Physicians (47), Dentists (48) and Hospitals (50).

Fitted values of personal consumption expenditures are also generated by the PADS program. In Figure 1.6, fitted and historic values of the personal consumption expenditures are plotted on the same chart for a few selected sectors. A complete exhibition of the estimation results are shown in Chapter 4 in detail.

**Table 1.4 Results of PADS Estimation, By Group and Subgroup**

**Group 5: HOUSING AND HOUSEHOLD UTILITIES**

Equation	SUBGRP	LAMBDA	SHARE	IncElas	OwnElas	Mu	Nu
25, Owner occupied space	9	0.06	0.10	0.37	-0.23	-0.55	0.99
26, Tenant occupied space	9	0.42	0.03	0.00	-0.84		
27, Other housing	9	-0.09	0.01	0.15	-0.45		
37, Electricity	10	0.42	0.02	1.38	-0.06		0.08
38, Natural gas	10	0.53	0.01	0.30	-0.17		
40, Fuel oil & coal	10	1.01	0.00	1.46	-0.66		

**PRICE ELASTICITIES**

	<u>25</u>	<u>26</u>	<u>27</u>	<u>37</u>	<u>38</u>	<u>40</u>	
<u>25</u>	-0.23	0.15	0.02	-0.04	-0.01	0.00	
<u>26</u>	0.44	-0.84	0.03	-0.03	-0.01	0.00	
<u>27</u>	0.39	0.15	-0.45	-0.04	-0.01	0.00	
<u>37</u>	-0.29	-0.06	-0.02	-0.06	0.01	0.01	
<u>38</u>	-0.28	-0.06	-0.02	0.03	-0.17	0.01	
<u>40</u>	-0.23	-0.05	-0.02	0.03	0.02	-0.66	

**SUBGROUP**                    9        Housing  
    10        Housing Utilities

**Table 1.4 Results of PADS Estimation, By Group and Subgroup (Continued)**

**Group 6: MEDICAL EQUIPMENT AND SERVICES**

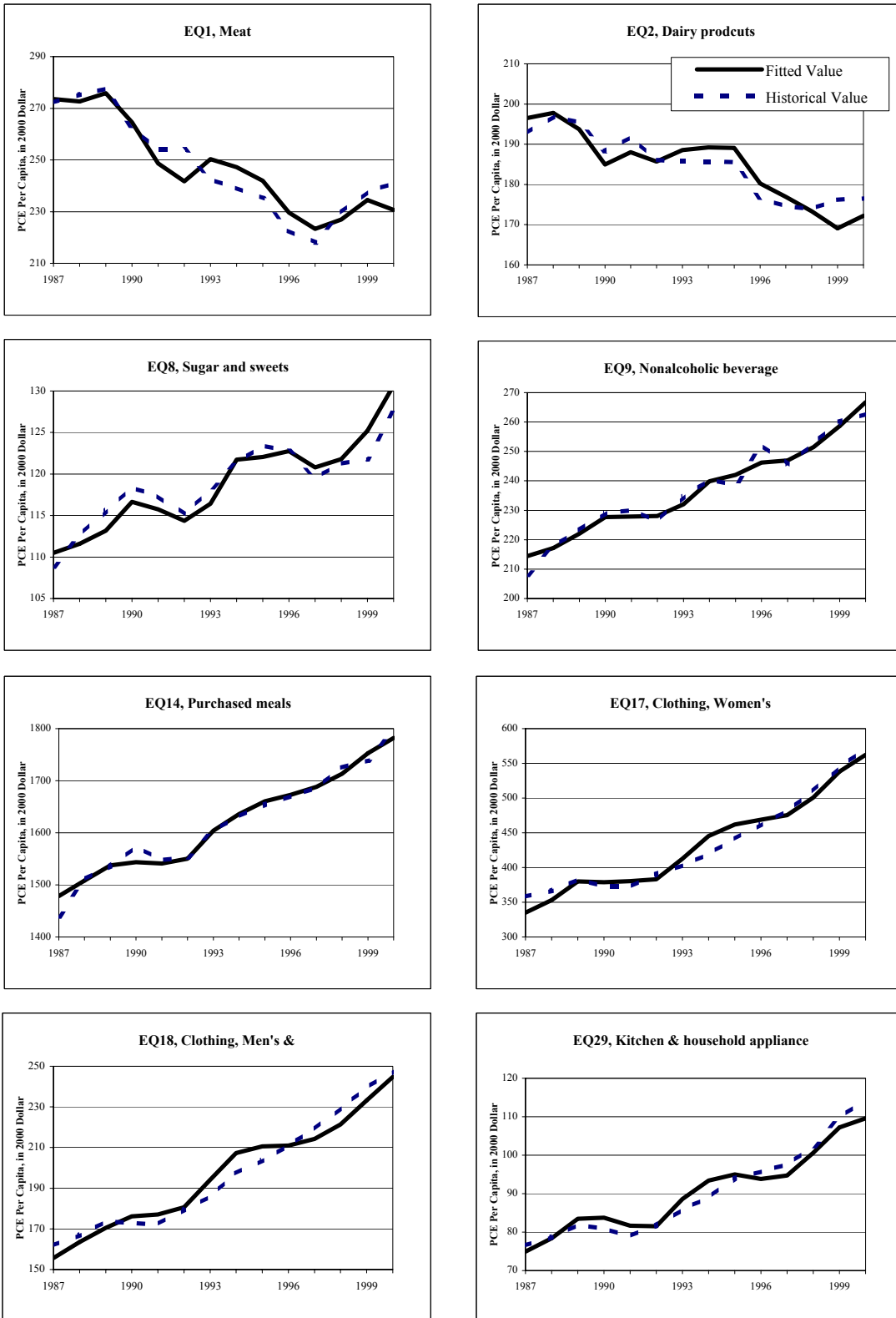
Equation	SUBGRP	LAMBDA	SHARE	IncElas	OwnElas	Mu	Nu
47, Physicians	11	-0.41	0.036	0.01	-1.15	-0.11	2.11
48, Dentists	11	-1.01	0.009	0.58	-0.98		
49, Other professional	11	0.45	0.021	0.25	-2.20		
50, Hospitals	11	-0.80	0.058	0.21	-0.46		
45, Drug preparations	12	0.14	0.023	3.92	-0.19		0.07
46, Ophthalmic & orthop	12	0.03	0.003	1.67	-0.10		
51, Nursing homes	12	2.37	0.012	0.29	-2.38		
52, Health insurance p	12	-0.09	0.010	1.23	0.02		

**PRICE ELASTICITIES**

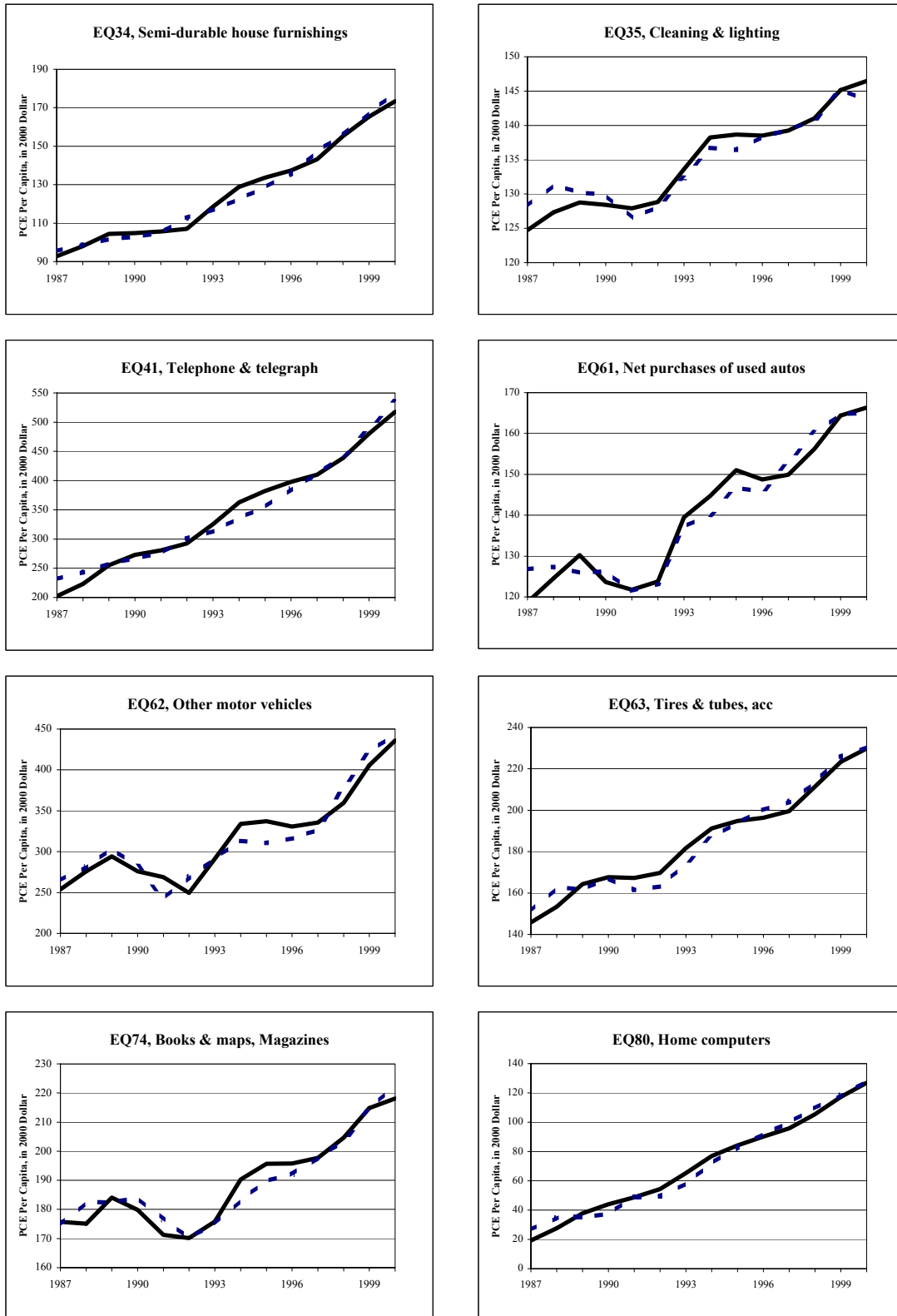
	<u>47</u>	<u>48</u>	<u>49</u>	<u>50</u>	<u>45</u>	<u>46</u>	<u>51</u>
<u>47</u>	-1.15	0.12	0.36	0.78	-0.02	0.00	0.04
<u>48</u>	0.51	-0.98	0.35	0.75	-0.03	-0.01	0.04
<u>49</u>	0.56	0.13	-2.20	0.83	0.00	0.00	0.05
<u>50</u>	0.52	0.12	0.36	-0.46	-0.03	0.00	0.04
<u>45</u>	-0.05	-0.02	0.01	-0.12	-0.19	0.00	0.09
<u>46</u>	-0.05	-0.02	0.01	-0.13	0.03	-0.10	0.09
<u>51</u>	0.03	0.00	0.05	0.01	0.08	0.01	-2.38
<u>52</u>	-0.06	-0.03	0.00	-0.14	0.02	0.00	0.09
	<u>52</u>						
<u>47</u>	-0.01						
<u>48</u>	-0.02						
<u>49</u>	0.00						
<u>50</u>	-0.02						
<u>45</u>	0.01						
<u>46</u>	0.00						
<u>51</u>	0.03						
<u>52</u>	0.02						

**SUBGROUP**                      11            Physicians and Hospitals  
    12            Drugs and Equipments

**Figure 1.6 Results of PADS Estimation, Personal Consumption, Selected Sectors**



**Figure 1.6 Results of PADS Estimation, Personal Consumption, Selected Sectors**





The structure of rest of the dissertation is as follows: Chapter Two describes the cross-sectional analysis of U.S. Household consumption pattern. Chapter Three examines the issue from a cohort perspective. Chapter Four builds the system of demand equations in time series, estimates the model, and discusses the results. Chapter Five concludes the thesis and gives directions for future researches.

## **CHAPTER TWO      A CROSS-SECTION ANALYSIS OF U.S. HOUSEHOLD CONSUMPTION**

### **SECTION 1   STRUCTURE OF CROSS-SECTION CONSUMPTION FUNCTIONS**

The purpose of the cross-section analysis on household consumption is to study how income and demographic characteristics such as ages of household members, region of residence, education level of household head, and number of income earners affect household consumption behavior. Assuming that all households face the same prices for one particular year, we attribute the differences in the consumption behaviors to the above-mentioned factors.

We use a Piecewise-Linear Engel Curve (PLEC) to describe the relationship between income and consumption. A household's income is partitioned into several brackets. Within each income bracket, we assume that the household's consumption responds linearly to its income. However, the relationship between consumption and income may vary from one income bracket to another. For example, the household's propensity to consume food out of additional unit of income at a high income level is different from that at a low income level.

Among the demographic factors, the age structure of the household plays an important role. Young family members may spend substantially on education, while old people may want to put a good amount of money into health insurance. For a particular

consumption item, households with same income level but different age structures may have a different spending pattern.

We write down a cross-section household consumption function as

$$\text{Household consumption of product } i = (f_i(\text{household's per capita income}) + g_i(\text{demographic factors})) * (\text{family size for product } i) \quad (2.1.1)$$

where  $f_i$  and  $g_i$  are product specific equations.

Before we examine each component of the function, a specific form is introduced, namely

$$C_i^h = (b_{i0} + \sum_j b_{ij} Y_j^h + \sum_k d_{ik} D_k^h) (\sum_g w_{ig} n_g^h) + u_i \quad (2.1.2)$$

where

$C_i^h$  is the household  $h$ 's consumption of good  $i$ ;

$Y_j^h$  is the amount of the household  $h$ 's per capita income within the  $j^{\text{th}}$  income

bracket which will be shortly discussed in detail;

$D_k^h$  is the  $k^{\text{th}}$  demographic category represented by a zero-one dummy variable;

$n_g^h$  is the number of family members in age group  $g$  in household  $h$ ,

$u_i$  is the disturbance term with the assumption that  $u_i$  is independently and

identically distributed across households for the same product  $i$ , and

$b_{ij}$ 's,  $d_{ik}$ 's and  $w_{ig}$ 's are the coefficients to be estimated.

In equation (2.1.2), the household's consumption on a specific good is determined by two components. The first component is average consumption of household members,

or the consumption of a representative member; the second component is the weighted family size for the good in question. The consumption of a representative household member is linearly determined by the household's income and demographic factors. The family size is not a simple summation of number of household members. Rather, the  $n_g^h$ 's describe the age structure of the household, and the  $w_{ig}$ 's show the importance of the family member of different age for consumption of good  $i$ .

### 1.1 The Piecewise-Linear Engel Curve

An Engel curve shows the relationship between income and consumption of a good. Brown and Deaton (1972) surveyed functional forms of Engel curves. However, none of those functional forms is as flexible enough as Piecewise-Linear Engel Curve (PLEC) to represent the demand for luxuries, necessities, and inferior goods. The income is divided into several brackets. Within each income bracket, the expenditure is linear in income, but the slope or *marginal propensity to consume* may be different in different brackets. The functional form can be written as:

$$f_i(Y^h) = b_{i0} + \sum_j b_{ij} Y_j^h \quad (2.1.3)$$

where  $Y_j^h$  is defined as the amount of household income in each bracket for household  $h$ .

More precisely, if  $B_0, B_1, B_2, \dots, B_n$  are the bracket bounds, and  $Y^h$  is the household  $h$ 's per capita income, then

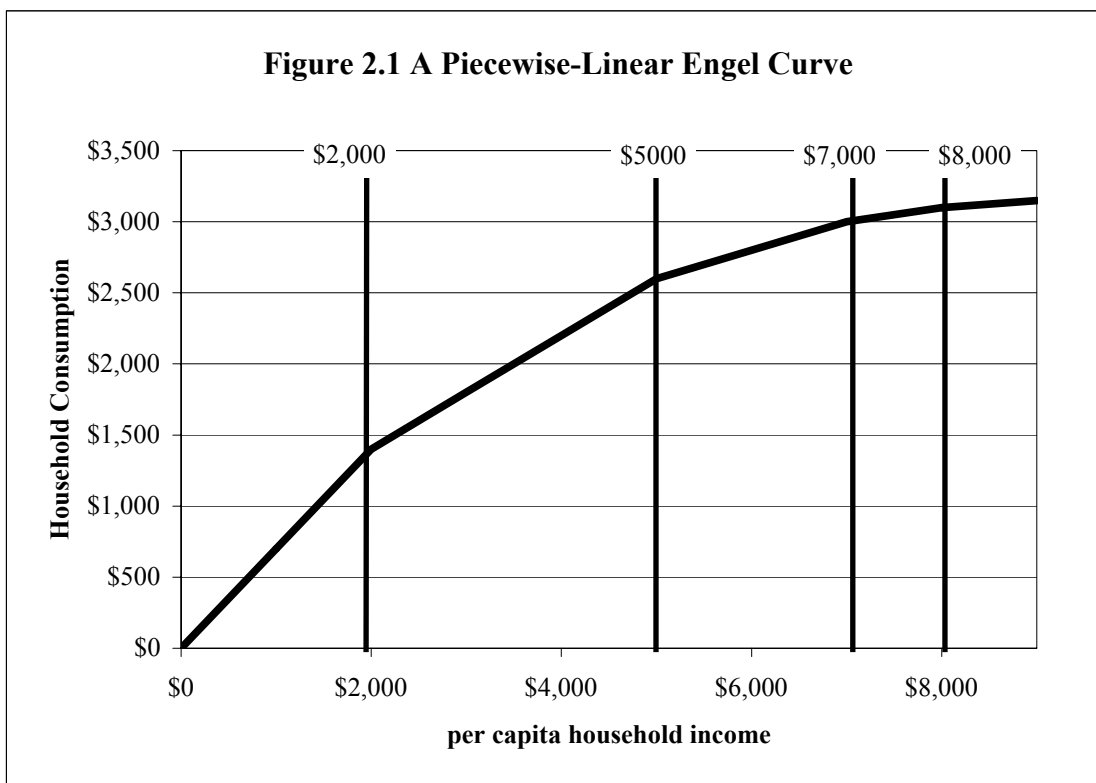
$$\begin{aligned}
Y_j^h &= B_j - B_{j-1} && \text{if } Y^h \geq B_j \\
&= Y^h - B_{j-1} && \text{if } B_j > Y^h \geq B_{j-1} \\
&= 0 && \text{if } B_{j-1} \geq Y^h
\end{aligned} \tag{2.1.4}$$

In equation (2.1.3),  $b_{i0}$  is the constant term and the other  $b_{ij}$ 's are *marginal propensity to consume* for each bracket. If the household's per capita income  $Y^h$  is greater than the bound  $B_k$  but lower than the next bound  $B_{k+1}$ , then the household's per capita income in all the income brackets below  $B_k$  is equal to the width of that bracket, while the household's per capita income in  $k+1^{\text{th}}$  bracket is the amount of the excess of  $Y^h$  over  $B_k$ , and its income in all of the higher brackets is zero. Table 2.1 gives several numerical examples. Suppose the value of the bounds are as follows:  $B_0 = \$0$ ,  $B_1 = \$2,000$ ,  $B_2 = \$5,000$ ,  $B_3 = \$7,000$ ,  $B_4 = \$8,000$ ,  $B_5 = \infty$ . Household A's per capita income is \$1,500, which falls below  $B_1$ . Its  $Y_j^h$ 's are:  $Y_1^h = Y^h - B_0 = \$1,500$ ,  $Y_2^h = Y_3^h = Y_4^h = Y_5^h = \$0$ . Household B's per capita income is \$3,500, which falls between  $B_0$  and  $B_1$ . Its  $Y_j^h$ 's are:  $Y_1^h = B_1 - B_0 = \$2,000$ ,  $Y_2^h = Y^h - B_1 = \$1,500$ ,  $Y_3^h = Y_4^h = Y_5^h = \$0$ . The per capita income of household C, D, and E is allocated in the same way.

**Table 2.1 Numerical Examples of Income Brackets**

Household	per capita Income(Y)	B1=\$2,000 Y1	B2=\$5,000 Y2	B3=\$7,000 Y3	B4=\$8,000 Y4	B5=Infinity Y5
A	\$1,500	\$1,500	\$0	\$0	\$0	\$0
B	\$3,500	\$2,000	\$1,500	\$0	\$0	\$0
C	\$5,500	\$2,000	\$3,000	\$500	\$0	\$0
D	\$7,500	\$2,000	\$3,000	\$2,000	\$500	\$0
E	\$9,000	\$2,000	\$3,000	\$2,000	\$1,000	\$1,000

**Figure 2.1 A Piecewise-Linear Engel Curve**



The coefficient of  $Y_j^h$ ,  $b_{ij}$ , is the slope of Engel curve on income bracket  $j$ . Figure 2.1 shows a particular example of Piecewise-Linear Engel Curve with the income level of household E in the examples of Table 2.1. The slopes differ over different income levels. Thus it is possible that we can show that a certain good which is a necessity for some households may be a luxury for others.

In our analysis, the income brackets are determined so that each bracket contains exactly one fifth of the total households in our sample. Our sample has 5061 households, with each bracket containing 1012 households. More specifically, the boundaries of income brackets are:

$$B_0 = \$0$$

$$B_1 = \$8,154$$

$$B_2 = \$12,557$$

$$B_3 = \$17,929$$

$$B_4 = \$26,496$$

$$B_5 = \$\infty$$

## 1.2 Household Characteristics

The household characteristics include region of residence, family size, age and education of the household head, number of income earners, and age structure of the household. The main data source for the cross-section analysis in this chapter is 2000 Consumer Expenditure Survey (CES). The CES is by far the most comprehensive and detailed U.S. data source for analyzing demographic effects on household consumption.

### Region of Residence:

CES divides the whole country into four regions: Northeast, Midwest, South, and West. Expenditures vary among regions because of many factors: prices, income, population characteristics, climate, consumer tastes, and so on. For example, in 2000, households in Midwest owned an average of 2.2 vehicles, compared with only 1.6 for those in the Northeast. Home ownership was most common in the Midwest and least prevalent in the West. Transportation, the second largest item, accounted for approximately one-fifth of a household's budget, ranging from 17.1 percent in the Northeast to 20.8 percent in the South. The definition of the regions is given in Appendix 2.1.

### Family Size:

We classify family size into four categories: one person, two persons, three or four persons, and five or more persons. Consumption of a household usually increases with more family members joining the family; however, it might not linearly depend on the family size. Usually the size of family grows due to having more children. The family



may move from an apartment to a single family house. The parents may purchase a van instead of a sedan. Some expenditure on children, such as education, increases linearly with the number of children, but some other expenditure, such as housing, automobiles, or furniture, grows at a diminishing rate. This phenomenon is an exhibition of “economy of scale” in household expenditure.

#### Age of Household Head:

The age of household head is studied at three levels: under 35, between 35 and 55, and above 55. The lifestyles of young people differ from elderly people. The household with the head in the above 55 group usually spends a higher portion of income on health care than does a family with a young household head.

#### Education of Household Head:

The education of the household head is classified into three categories: twelfth grade and lower, high school degree and associates’ degree, bachelor’s degree or higher. Educated people may spend more on education and reading materials.

#### Number of Income Earners:

The number of income earners affects certain types of household expenditures. In the early 1950’s, about 30% of women were wage earners. In 2000, however, the labor force participation rate of women reached 60%. With more women leaving home and going to work, the household may spend more on women’s clothing, domestic services, laundry services and other household operations. At the same time, the decline of the

labor force participation of men has contributed to shift the decision-making structure of the household to reflect the demands of women. We look at the number of income earners at three levels: one wage earner, two wage earners, and more than two wage earners.

The above demographic factors are represented by zero-one dummy variables. Suppose there are  $K$  demographic categories, the dummy variables are defined as follows:

$$D_k^h = 1 \text{ if the household belongs to demographic group } j \\ = 0 \text{ otherwise}$$

where  $k = 1, \dots, K$

To avoid collinearity, one group in each demographic category is left out. The left-out group, or the reference group, is three-or-four-member households in the Northeast region with two wage earners, and with a head aged between 35 and 55, with high school or associate degrees. The definition of the dummy variables is as follows:

**Region (Northeast = base)**

$D_1$ : Region = Midwest

$D_2$ : Region = South

$D_3$ : Region = West

**Family size (3 - 4 = base)**

$D_4$  : Family size = 1

$D_5$  : Family size = 2

$D_6$  : Family size  $\geq 5$

**Age of household head(35 - 55 = base)**

$D_7$  : age < 35

$D_8$  : age > 55

**Education of household head(high school or associate degree = base)**

$D_9$  : education lower than high school

$D_{10}$  : education higher than high school

**Number of wage earners(2 = base)**

$D_{11}$  : only one wage earner

$D_{12}$  : more than two wage earners

Age Structure of the Household:

To study how the age structure affect the household consumption, we divide the whole family into eight age groups and record the number of family members in each group for household  $h$  as  $n_g^h$ , with  $g = 1, \dots, 8$ . The unweighted family size,  $n^h$ , therefore, is

$$n^h = \sum_g n_g^h \quad (2.1.5)$$

For each good, we wish to find how much a family member in each age group contributes to the consumption of that good relative to the person in the reference group, which is the group of age between 31 and 40. Then we have

$$n_i^{h*} = \sum_g w_{ig} n_g^h \quad (2.1.6)$$

Where  $n_i^{h*}$  is the weighted family size of household  $h$  for good  $i$ , and  $w_{ig}$  is the weight of age group  $g$  for good  $i$ . Unweighted family size is a special case of the weighted one with the weights equal to 1.

We describe the age structure of the household with eight age groups:

- group 1: age 0 ~ 5*
- group 2: age 6 ~ 15*
- group 3: age 16 ~ 20*
- group 4: age 21 ~ 30*
- group 5: age 31 ~ 40*
- group 6: age 41 ~ 50*
- group 7: age 51 ~ 65*
- group 8: age 66 ~ 99*

Now, the final form of our household consumption function for cross-section analysis, which contains Piecewise-Linear Engel Curve, household demographic factors, and age structure, is as follows:

$$C_i^h = (b_{i0} + \sum_j b_{ij} Y_j^h + \sum_k d_{ik} D_k^h) (\sum_g w_{ig} n_g^h) + u_i \quad (2.1.7)$$

where

$C_i^h$  is the household  $h$ 's consumption of good  $i$  ;

$Y_j^h$  is the amount of the household  $h$ 's per capita income within the  $j^{th}$  income

bracket which will be shortly discussed in detail;

$D_k^h$  is the  $k^{th}$  demographic category represented by a zero-one dummy variable;

$n_g^h$  is the number of family members in age group  $g$  in household  $h$ ,

$u_i$  is the disturbance term with the assumption that  $u_i$  is independently and

identically distributed across households for the same product  $i$ , and

$b_{ij}$  's,  $d_{ik}$  's and  $w_{ig}$  's are the coefficients to be estimated.

However this equation is under-identified. If we multiply the coefficients in first bracket by any arbitrary number  $k$  , and divide the coefficients in the second bracket by  $k$  at the same time, the equation still holds. Therefore, to obtain a unique solution, the weight of the reference age group, aged 31-40, is set to be 1 for each of product  $i$  .

### 1.3 Zero Expenditure

Many of our surveyed households reported zero expenditure on many consumption categories. From Table 2.2, we can see how pervasive this phenomenon is.

**Table 2.2 Cross-Section Consumption Items: Percentage of Zero Observations**

	<b>Consumption Categories</b>	<b>Zero%</b>
1	Food at home	0.1
2	Food away from home	6.9
3	Alcoholic beverages at home	52.0
4	Alcoholic beverages away from home	55.6
5	Tobacco and smoking supplies	67.7
6	Footwear	35.9
7	Clothing for women and girls, 2 and over	23.0
8	Clothing for men and boys, 2 and over	31.0
9	Clothing for infants	70.9
10	Travel items	92.8
11	Cleaning, laundering, repair of clothing and shoes	40.4
12	Watches and jewelry	66.1
13	Watches and jewelry repair, other clothing services	87.6
14	Personal care services for males and females	11.2
15	Personal care equipment	89.0
16	Owned dwellings	25.1
17	Rented dwellings	72.2
18	Other lodging	58.6
19	Furniture	68.8
20	Kitchen and household appliances	57.2
21	China, glassware and utensils	73.9
22	Floor coverings	90.3
23	Other durable house furnishings and writing equipment	78.7
24	Power and non-power tools	86.8
25	Household textiles	58.4
26	Semi-durable house furnishings	69.9
27	Cleaning and lighting supplies	90.5
28	Electricity	4.0
29	Natural gas	39.7
30	Water and other public services	27.7
31	Fuel oil and other fuels	83.9
32	Telephone equipment and services	1.3
33	Domestic services	54.8
34	Household insurance premiums	54.3
35	Other household operations	70.3
36	Prescription drugs, medicines, purchase and rental of medical supplies	30.2
37	Ophthalmic & orthopedic equipment	76.7
38	Physicians' services	45.3
39	Dental care	62.1
40	Other services by medical professionals	66.7
41	Other medical care services and medical care in retirement communities	96.8
42	Hospital room, meals, and services	89.9
43	Care in convalescent or nursing homes (net outlay)	99.4

**Table 2.2 Cross-Section Consumption Items: Percentage of Zero Observations  
(Continued)**

	<b>Consumption Categories</b>	<b>Zero%</b>
44	Health insurance premiums	26.4
45	Banking services	63.9
46	Life and other personal insurance	49.1
47	Contribution to retirement, pension, social security	34.7
48	Legal fees	92.9
49	Funeral and burial services	92.1
50	Other personal business	78.7
51	New cars and trucks	94.4
52	Used cars and trucks	87.7
53	Other vehicles	99.5
54	Tires and tubes, accessories, and parts	55.7
55	Maintenance and repairs of vehicles	21.5
56	Vehicle rental and other charges	61.5
57	Vehicle financial charge	64.5
58	Vehicle license and registration	39.6
59	Gasoline and motor oil	7.2
60	Tolls on out-of-town trips	80.3
61	Vehicle insurance	23.6
62	Local transportation (excl. taxis)	73.2
63	Taxis	79.7
64	Intercity train fares on out-of-town trips	86.0
65	Intercity bus fares on out-of-town trips	84.9
66	Airline fares on out-of-town trips	71.7
67	Ship fares on out-of-town trips	89.1
68	Readings	21.9
69	Pets, pets supplies, and pet services	55.4
70	Toys and playground equipment	56.9
71	Bicycles	94.7
72	Cameras and films	51.3
73	Guns, ammunition, sporting equipment, boats and aircrafts	72.5
74	Televisions, radios, and sound equipment	9.6
75	Home computers	56.4
76	Fresh flower or potted plants	60.1
77	Live entertainment, sports, and movie admissions	37.8
78	Fees for clubs or fraternal organizations	75.4
79	Participant amusements and pari-mutual net receipts	67.0
80	Other recreation	42.7
81	Higher education	87.9
82	Private lower education	84.8
83	Other education and research	86.8
84	Cash contributions	32.1
85	Miscellaneous	72.6

Among the 85 categories we are studying, 55 categories have zero expenditure for more than 50% of the households.

According to Bardazzi and Barnabani (1996), there are four types of reason for reporting zero expenditure: (1) infrequency of purchase, (2) economic decision, (3) conscientious abstention, and (4) misreporting.

Before we look into the first reason, we need to differentiate the two concepts: **consumption** and **expenditure**. Consumption refers to how much of a product, in monetary terms, is consumed, while expenditure means how much the family spends on certain product. For example, a person who drives everyday, consumes his automobile everyday, however, he only spends on a new car only several times during his lifetime. For most of durable goods, consumption of the good takes place everyday while expenditure occurs only once every several years.

Our cross-section analysis aims to explain the variable consumption; however, we only observe expenditures. For frequently purchased items, consumption is reflected by expenditures; however, for infrequently purchased items, zero expenditure does not mean zero consumption. The fact that a family reports zero expenditure on a refrigerator does not mean that the family does not consume the services provided by a refrigerator, but that the consumption of the services from the refrigerator is spread outside the time when the expenditure occurs.

Zero expenditure on durable goods is usually due to infrequency of purchase. Economic decision refers to zero expenditure corresponding to zero consumption on the



basis of economic variables such as income and price. An ocean cruise vacation might be a good example. Conscientious abstention refers to the fact that some household will not consume certain item at any price or income level. The decision is based on culture, personal preference, religious or other factors. Typical examples include cigarettes, alcohol and meat.

For the situation of infrequency of purchases, if we use zero as the dependent variables, the real consumption will be misrepresented. In section 3, we will discuss the process of how nonlinear probability model estimation is adopted to tackle the existence of zero expenditure.

## SECTION 2 DATA

The main data source for the cross-section analysis in this chapter is the 2000 Consumer Expenditure Survey (CES). The CES is by far the most comprehensive and detailed U.S. data source for analyzing demographic effects on household consumption. We will first discuss the main features of the Survey and compare the consumption part of the Survey data with the Personal Consumption Expenditures (PCE) data, a component of the National Income and Product Accounts (NIPA) system. Then the process of aggregating more than 500 expenditure items in CES into 85 categories is explained.

### 2.1 Consumer Expenditure Survey

The Consumer Expenditure Survey (CES) collects detailed information of United State households on their expenditures, income, and various characteristics. The surveys have been conducted annually since 1980 and at approximately 10-year intervals before then. They target the total noninstitutionalized population (urban and rural) of the United States in 1980, 1984 and annually thereafter, and only the urban noninstitutionalized population in 1981 through 1983. The population excludes persons in the military living on post.

The data are collected in two independent surveys. One is the quarterly Interview survey and the other, the weekly Diary survey. Each survey has its own independent sample of approximately 5,000 households, and each collects data on household income and socioeconomic characteristics. The Interview survey includes monthly out-of-pocket expenditures such as housing, household durables, apparel, transportation, health care,

insurance, and entertainment. The Diary survey includes weekly expenditures of frequently purchased items such as food and beverages, tobacco, personal care products, and nonprescription drugs and supplies. These data on expenditure are supplemented by a rich set of economic, demographic and sociological variables, including income.

In an Interview panel survey, each consumer unit<sup>7</sup> (CU) in the sample is interviewed once every 3 months over five consecutive quarters to obtain a year's worth of data. New panels are initiated every quarter of the year. The quarterly Interview survey is designed to collect data on major items of expense which respondents can be expected to recall for 3 months or longer. In practice, the Interview survey collects detailed data on an estimated 60 to 70 percent of total household expenditures. In addition, estimates of total expenditure for food and other selected items are obtained. These aggregate estimates account for an additional 20 to 25 percent of total expenditures. The Interview survey does not collect expenses for housekeeping supplies, personal care products, and nonprescription drugs, which contribute about 5 to 15 percent of total expenditures. Thus, 85 to 95 percent of total expenditures are covered in the Interview survey.

Demographic and family characteristics data pertain to age, gender, race, marital status, education, and CU relationship for each CU member. This information is updated at each subsequent interview. Expenditures are for the three months prior to the interview. Expenditure data from the first interview are not on these files since they are

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<sup>7</sup> A consumer unit comprises either: (1) all members of a particular household who are related by blood, marriage, adoption, or other legal arrangements; (2) a person living alone or sharing a household with others or living as a roomer in a private home or lodging house or in permanent living quarters in a hotel or motel, but who is financially independent; or (3) two or more persons living together who use their income to make joint expenditures. Financial independence is determined by the three major expense categories: housing, food, and other living expenses. To be considered financially independent, at least two of the three major expense categories have to be provided entirely or in part by the respondent.

not included in expenditure estimation. The second through fifth interviews use uniform questionnaires to collect expenditure information from the previous three months.

Each quarter, 20 percent of the sample is new households introduced for the first time. They replace the one-fifth of the sample that completed its final interview in the previous quarter. This rotating procedure with overlap is designed to provide more efficient and uniform data collection without excessive burdens on any subgroup of the sample.

## **2.2 Comparison with Personal Consumption Expenditures**

One of the major purposes of this study is to examine how the household-level spending data improves the consumption equations in *INFORUM*'s LIFT model, which is based on the Personal Consumption Expenditures (PCE), a component of the National Income and Product Accounts (NIPA) system. In this section, we will match the CES household consumption items as close as possible to the 92-LIFT PCE sectors. Therefore, it is necessary to compare definitions and levels of consumption items of CES with those of PCE.

The PCE data represents the market value of goods and services purchased by the entire personal sector of the U.S. economy and by parts of the institutional population. Included in PCE are purchases of goods and services by individuals; operating expenses of nonprofit institutions; and the value of goods, fuel, clothing, rented dwellings, and financial services received in kind by individuals. The primary sources of information for

PCE are Census Bureau data, such as data from the Census of Manufactures, Census of Retail Trade, and Census of Service Industries.

Expenditures constructed using CES data do not match exactly the NIPA definitions for various reasons. First, the CES is an interview survey based on recall questions, and it is well known that such surveys usually underestimate consumption expenditure. Second, some consumption items are defined differently, the most important being health and housing expenditure. For the first, health expenditure, the CES provides information only on out-of-pocket expenses while the PCE includes expenditures paid by consumers plus governments, commercial insurance companies, and other third parties. For the later, housing expenditure, the PCE includes imputed rent for owner occupied housing, while no attempt is made to construct a similar estimate for the CES.

While these are serious problems, they do not undermine the use of CES to study consumption behavior. The first issue listed in the previous paragraph has been studied by Branch (1994) who compared CES with other independent sources, including PCE. He showed that the under-reporting in consumption is roughly constant over time for most consumption categories.

Table 2.3 is from Branch (1994). It compares selected components of CES and PCE for 1989 through 1992. The ratio indicate that CES estimates for almost all categories of consumption are lower than PCE estimates, however the relationship between the two series is fairly consistent over time for most comparable category estimates, and level of several CES estimates compares well with PCE. For example,

**Table 2.3 Comparison of the Consumer Expenditure Survey (CEX) with Personal Consumption Expenditure (PCE), selected expenditure categories, 89-92**

Expenditure Category	CEX (In billions)				Ratio of CEX to PCE			
	1989	1990	1991	1992	1989	1990	1991	1992
Food	\$390	\$408	\$410	\$420	0.78	0.76	0.75	0.75
Food at home	229	240	259	264	0.71	0.70	0.74	0.74
Food away from home <sup>1</sup>	161	168	151	156	0.89	0.87	0.76	0.77
Alcoholic beverages	27	28	29	30	0.40	0.39	0.38	0.39
Rent, utilities, and public services <sup>2</sup>	285	297	305	328	0.95	0.95	0.93	0.96
Rented dwellings, total	163	171	171	192	1.05	1.04	1.00	1.08
Utilities, fuels, and public services	176	183	195	198	0.89	0.90	0.91	0.89
Telephone	54	57	61	62	1.05	1.07	1.08	1.06
Household operations <sup>3</sup>	22	21	22	24	0.95	0.85	0.92	0.89
Household furnishings and equipment	143	148	159	160	0.88	0.68	0.71	0.67
Household textiles	10	10	10	9	0.49	0.45	0.45	0.39
Furniture	30	30	29	32	0.81	0.82	0.78	0.79
Floor coverings	7	9	11	7	0.59	0.76	0.99	0.59
Major appliances	16	18	15	16	0.63	0.62	0.57	0.58
Small appliances and miscellaneous household equipment <sup>4</sup>	80	83	94	95	0.69	0.68	0.74	0.71
Apparel and services	155	160	171	172	0.82	0.81	0.85	0.80
Transportation	379	378	387	399	0.85	0.81	0.87	0.84
Vehicle purchases <sup>5</sup>	196	182	187	194	1.04	0.99	1.11	1.04
Gasoline and motor oil	94	102	97	97	1.00	0.95	0.97	0.96
Other vehicle expenses <sup>6</sup>	63	67	74	80	0.52	0.53	0.58	0.58
Public transportation	25	27	28	28	0.60	0.59	0.63	0.61
Entertainment	130	129	136	141	0.67	0.61	0.62	0.61
Fees and admissions	36	36	37	38	0.86	0.77	0.76	0.72
Televisions, radios, and sound equipment	41	44	46	49	0.63	0.63	0.61	0.62
Pets, toys, and playground equipment	24	27	26	27	0.69	0.07	0.67	0.68
Other entertainment supplies and equipment	57	44	54	53	0.54	0.40	0.48	0.44
Personal care products and services	35	35	39	39	0.63	0.59	0.64	0.61
Reading	19	19	20	21	0.50	0.46	0.48	0.46
Tobacco product and smoking supplies	25	27	27	27	0.62	0.61	0.06	0.54
Miscellaneous <sup>7</sup>	33	33	31	34	0.34	0.32	0.29	0.30

1, Excludes school lunches and meals as pay.

2, Includes rent for tenant-occupied dwelling units and lodging away from home and at school. Rent in the CEX survey is contract rent, which includes utilities for some renters. The CEX survey covers direct costs of utilities and fuels by homeowners and renters. In PCE, data are for space rent, which excludes charges for utilities. PCE data cover total expenditures for utilities and fuels, even if paid by landlords.

3, Excludes amounts for babysitting, day care centers, and care of invalids or the elderly.

4, Various subcategories are combined to approximate equivalent content.

5, The PCE estimates are derived using estimates of dealer margin on good purchased by persons (a concept that cannot be matched with vehicle purchases as measured in the CEX survey) and the wholesale value of net transactions between persons and other sectors such as government or nondealer businesses. CEX data on vehicle purchases and trade-ins were combined to approximate the total value of new vehicle purchases. CEX data on used vehicle purchases, trade-ins, sales, and losses were combined to approximate the value of net transactions of used vehicles.

6, Includes vehicle rentals, maintenance repairs, and other vehicle charges. Excludes aircraft rentals, vehicle licenses, vehicle inspection, and vehicle registration."

7, CEX estimates excludes expenditures for other properties.

NOTE: Sums may not equal totals due to rounding. Expenditures estimates for home ownership, insurance, capital improvements, health care, finance charges, education, and cash contributions are excluded from comparisons.

SOURCE: For information on the CEX survey, see Consumer Expenditure Survey, 1990-1991, Bulletin 2425 (Bureau of Labor Statistics, September 1993). PCE data that are used in the comparisons are from unpublished detailed tabulations of the Bureau of Economic Analysis as of September 1993. These data are based on 1982 benchmark estimates. For more information on PCE, see National Income and Product Accounts of the United States:

Volume 2, 1959-88 (Bureau of Economic Analysis, 1992) and Survey of Current Business (Bureau of Economic Analysis, August 1993.)"

CES estimates 93 percent or more of PCE for rent, utilities, and public services, as well as gasoline and motor oil. Also, CES estimates are at least 80 percent of PCE estimates for apparel and services, transportation, and household operation. In Section 2.3, I compare the 15 years of CES consumption with PCE data for CES sectors that match aggregated PEC categories. (Please see Figure 2.2)

In Table 2.4, I compare the rate of growth of total expenditures and total income as reported in the CES and the PCE. For the CES aggregates, I use the average published in the Bureau of Labor Statistics Bulletin. I do not aggregate from the detailed expenditures from Interview Survey, because the averages published by the BLS are based on observations that are not top-coded<sup>8</sup>. The table contains the rate of growth of income and consumption at constant dollars for the aggregated CES data and for NIPA data<sup>9</sup>. The correlation coefficient between real consumption growth in the CES data and in the PCE is about 0.41. The correlation coefficient between real disposable income growths is about 0.26. The largest discrepancies between the PCE and CES data for consumption are in the years 87, 90 and 92. The largest discrepancies between the PCE and CES data for income are in the years 90, 92 and 2000. In general, the aggregate CES series are more volatile than the corresponding PCE series, probably reflecting the estimation error induced by relatively small samples.

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<sup>8</sup> Sensitive CU data are changed so that users will not be able to identify CUs who participated in the survey. Topcoding refers to the replacement of data in cases where the value of the original data exceeds prescribed critical values. Critical values for each variable containing sensitive data are calculated in accordance with Census Disclosure Review Board guidelines. Each observation that falls outside the critical value is replaced with a topcoded value that represents the mean of the subset of all outlying observations.

<sup>9</sup> The NIPA data are from “National Income and Product Accounts Tables” from Bureau of Economic Analysis. (<http://www.bea.gov/bea/dn/nipaweb/SelectTable.asp?Selected=N>) NIPA data contains both income and consumption data in current and constant dollars. CES data from Bureau of Labor Statistics only contains the income and consumption data in current dollars. I deflate the CES data in the same that NIPA data was deflated and calculate the growth rate.

**Table 2.4 Comparison of Growth Rate of CES aggregated and NIPA data**

Year	NIPA% (PEC)	CES% (Cons.)	Diff (Cons.)	NIPA% (Income)	CES% (Income)	Diff (Income)
1987	2.41%	-1.31%	-3.72%	1.58%	3.55%	1.97%
1988	3.11%	1.84%	-1.27%	2.72%	0.29%	-2.43%
1989	1.85%	2.47%	0.62%	2.38%	4.66%	2.28%
1990	0.95%	-3.18%	-4.13%	0.60%	-3.37%	-3.97%
1991	-0.90%	0.13%	1.03%	-1.16%	2.02%	3.17%
1992	2.11%	-2.16%	-4.27%	2.02%	-3.06%	-5.08%
1993	2.24%	-0.15%	-2.39%	0.24%	0.00%	-0.24%
1994	2.73%	0.80%	-1.92%	1.93%	1.17%	-0.76%
1995	1.73%	-1.12%	-2.85%	2.12%	-0.78%	-2.89%
1996	2.48%	1.75%	-0.73%	2.81%	0.02%	-2.79%
1997	2.79%	0.71%	-2.08%	3.30%	2.67%	-0.62%
1998	4.08%	0.49%	-3.59%	5.42%	2.65%	-2.77%
1999	4.16%	1.86%	-2.31%	2.46%	3.31%	0.85%
2000	1.15%	-0.51%	-1.65%	1.87%	-1.72%	-3.59%
Corr(cons.)			0.41	Corr(inc.)		0.26
Var(CES,cons)			0.03%	VAR(CES, income)		0.06%
VAR(NIPA, PCE)			0.02%	VAR(NIPA, income)		0.02%



### **2.3 Matching LIFT Categories with CES data**

Consumer Expenditure Survey has four main data files.

The “Consumer Unit Characteristics and Income” file, also referred to as the “FMLY” file, contains CU characteristics, CU income, and characteristics and earnings of the reference person and of the spouse. Summary expenditure variables in this file can be combined to derive quarterly estimates for broad consumption categories.

Demographic characteristics, such as family size, refer to the CU status on the date of the interview. Income variables contain annual values. Income data are collected in the second and fifth interviews only and cover the 12 months prior to the date of interview. Income data collected in the second interview are copied to the third and fourth interviews.

The FMLY file provides expenditures on about 60 categories for each consumer unit. Table 2.5 lists the categories where the data were provided by FMLY file of 1999 CES. Unfortunately, one cannot find such level of detail in FMLY files of CES before 1994. Table 2.6 lists the 26 categories that provided by FMLY file of 1986 CES. From 1986 through 1993, the FMLY file provided only a very broad categorization of household expenditure.

The “Monthly Expenditures” file, also referred to as the “MTAB” file, records the monthly purchases that were made during the three-month period prior to the month of the interview. Each expenditure item is identified by a Universal Classification Code (UCC), which is a six-digit code that designates a very detailed item. For instance, UCC

**Table 2.5 Expenditure Category in 1999 Consumer Expenditure Survey**

<b>Food</b>	Clothing for women and girls
Food at home	Clothing for women, 16 and over
Food away from home	Clothing for girls, 2 to 15
Meal as pay	Clothing for children under 2
Food away excluding meal as pay	Footware
<b>Alcoholic Beverages</b>	Other apparel products and services
<b>Housing</b>	<b>Transportation</b>
Shelter	Cars and trucks, new
Owned dwellings	Cars and trucks, used
Mortgage interest	Other vehicles
Property taxes	Gasoline and motor oil
Maintenance, repairs, insurance, and other expenses	Vehicles finance charges
Rented dwelling	Maintenance and repairs
Rent excluding rent as pay	Vehicle insurance
Rent as pay	Vehicle rental, lease, license, and other charges
Other lodging	Public transportation
Utilities, fuels and public services	Public transportation on tirps
Natural gas	Local public transportation
Electricity	<b>Health Care</b>
Fuel oil and other fuels	Health Insurance
Fuel oil	Medical services
Other fuels	Prescription drugs
Telephone services	Medical supplies
Water and other public services	<b>Entertainment</b>
Household operations	Fees and admissions
Domestic services	Televisions, radios, and sound equipment
Domestic services excluding child care	Other equipment and services
Babysitting and child day care	Pets, tyos, and playground equipment
Other household expenses	Other entertainment
Housefurnishings and equipment	<b>Personal Care</b>
Household textiles	<b>Reading</b>
Furniture	<b>Education</b>
Floor covering	<b>Tobacco and smoking supplies</b>
Major appliances	<b>Miscellaneous expenditures</b>
Small appliances	Miscellaneous expenditures 1
Miscellaneous household equipment	Miscellaneous expenditures 2
<b>Apparel and Service</b>	<b>Cash contributions</b>
Clothing for men and boys	<b>Personal Insurance and pensions</b>
Clothing for men, 16 and over	Life and other personla insurance
Clothing for boys, 2 to 15	Retirement, pensions, Social Security

**Table 2.6 Expenditure Category in 1986 Consumer Expenditure Survey**

<b>Food</b>	Vehicles
<b>Alcoholic Beverages</b>	Gasoline and motor oil
<b>Housing</b>	Other vehicle expenses
Shelter	Public transportation
Owned dwellings	<b>Health Care</b>
Mortgage interest	<b>Entertainment</b>
Property taxes	<b>Personal Care</b>
Maintenance, repairs, insurance, and other expenses	<b>Reading</b>
Rented dwelling	<b>Education</b>
Other lodging	<b>Tobacco and smoking supplies</b>
Utilities, fuels and public services	<b>Miscellaneous expenditures</b>
Household operations	<b>Cash contributions</b>
Housefurnishings and equipment	<b>Personal Insurance and pensions</b>
<b>Apparel and Service</b>	Life and other personal insurance
<b>Transportation</b>	Retirement, pensions, Social Security

360110 represents “Men's suits”, and 360120 represents “Men's sport coats”. There are more than 500 UCC’s in MTAB files. The expenditures on broad categories provided by FMLY are aggregated and estimated by BLS from detailed expenditures from the MTAB file.

The “Member Characteristics and Income” file, also referred to as the “MEMB” file, contains selected characteristics for each CU member, including identification of relationship to the reference person. Demographic characteristic data, such as age of CU member, refer to the member status on the date of the interview.

The “Income” file, also referred to as the “ITAB” file, contains CU characteristics and income data. This file is created directly from the FMLY file and contains the same annual and point-of-interview data in a monthly format. It was created to facilitate computer processing when linking CU income and characteristics data with MTAB expenditure data. As such, the file structure is similar to MTAB. Each characteristic and income item is identified by UCC.

The four major data files in CES are linked by CU identification.

Since a major purpose of this research is to provide an underpinning for the consumption equations of the *INFORUM* LIFT model, we need to match the LIFT consumption categories as closely as possible with CES data. This matching required using the data in the detailed UCC codes in the MTAB file. Even with this level of data, however, it was not possible to match exactly the 92 LIFT categories. Instead, 85 categories of CES expenditures were defined giving a matching to the 92 LIFT sectors, which ranges from quite exact in some places to only a proximate to others. And for

some categories, there is no match. To define the 85 categories of CES expenditures, it was necessary to know the precise definition of the 92 LIFT categories in terms of the detailed PCE categories in the NIPA. These are given by Table 2.7. The 85 sectors for the LIFT-like aggregation of CES and their LIFT correspondents are shown in Table 2.8.

FMLY files in CES provides about 60 categorized expenditure details for year 1994 and after, for year 1993 and before, a broader categorization is adopted. We could not use the summary expenditure data in FMLY file but had to go to the much more detailed micro expenditure data in MTAB files to construct our data set.

There are several reasons why CES cannot match LIFT exactly. Firstly, for some categories in CES, the UCC level category is already broader than LIFT category. For example, the “Food at Home” in CES covers first 11 categories of LIFT system, and there is no way to split the “Food at Home” into the 11 subcategories. Secondly, for some categories in PCE, there is no corresponding item in CES. The “Foreign travel, and purchases abroad” is in PCE, but we cannot find a similar item in CES. Thirdly, we need to caution against about the difference in definition between CES and NIPA system, as mentioned in Section 2.

Figure 2.2 shows a comparison between personal consumption per capita based on CES sample and that based on PCE. We have found that: 1) personal consumption based on CES is generally lower than that based on PCE; 2) For a few categories including Food, Electricity, Natural gas, Gasoline and oil, Airline, Electronic entertainment and musical instruments, the two series are quite close to each other; 3)

most of the ratios of personal consumption based on CES to that based on PCE are not volatile over time. There are a few ratios of CES to PCE that are either very low ( $<0.5$ ) or very high ( $>2$ ) on average. However, this does not prevent us from using micro evidence in studying total demand for specific products.

**Table 2.7 92 LIFT Consumption Categories with Corresponding NIPA-PCE Classification**

LIFT Categories		NIPA-PCE Classification	
1	Meat	c06u105	Beef & veal
		c06u106	Pork
		c06u107	Other meats
2	Dairy products	c06u111	Fresh milk & cream
		c06u112	Processed dairy products
3	Poultry and eggs	c06u108	Poultry
		c06u110	Eggs
4	Fresh fruit and vegetables	c06u113	Fresh fruits
		c06u114	Fresh vegetables
5	Processed fruit and vegetables	c06u115	Processed fruits & vegetables
6	Cereal and bakery products	c06u103	Cereals
		c06u104	Bakery products
7	Fats and oils	c06u118	Fats & oils
8	Sugar and sweets	c06u119	Sugar & sweets
9	Nonalcoholic beverages	c06u116	Juices & nonalcoholic drinks
		c06u117	Coffee, tea & bev materials
10	Other prepared food	c06u120	Other foods
11	Fish and seafood	c06u109	Fish & seafood
12	Pet food	c06u121	Pet food
13	Alcohol for off-premise consumption	c06u122	Alcoholic beverages purchased for off-premise consumption
14	Purchased meals, food furnished employee and on farms	c06u126	Purchased meals and beverages (4)
		c06u135	Food furnished to employees (including military)
15	Tobacco	c06u165	Tobacco products (7)
16	Footwear	c06u141	Shoes (12)
17	Clothing, Women's & girls	c06u143	Clothing & sewing for females
18	Clothing, Men's & boys' and military	c06u149	Men's and boys'
19	Luggage	c06u147	Luggage for females
		c06u153	Luggage for males
20	Cleaning, laundering, & repair of clothing and shoes	c06u313	Shoe repair
		c06u314	Cleaning, laundering, & c
21	Jewelry & watches	c06u97	Jewelry and watches (18)
22	Watch repair; misc personal services	c06u320	Other (19)
23	Toilet articles & preps	c06u166	Toilet articles and preparations (21)
24	Barbershops, beauty, & health clubs	c06u317	Barbershops, beauty parlors, and health clubs (22)
25	Owner occupied nonfarm space	c06u198	Owner-occupied nonfarm dwellings--space rent (24)
26	Tenant occupied nonfarm space	c06u201	Tenant-occupied nonfarm dwellings--rent (25)
27	Other housing	c06u205	Rental value of farm dwellings (26)
		c06u206	Other (27)
28	Furniture	c06u59	Furniture, including mattresses and bedsprings (29)
29	Kitchen & household appliances	c06u60	Kitchen and other household appliances (30)
30	China & glassware, tableware & utilities	c06u63	China, glassware, tableware, and utensils (31)
31	Floor coverings	c06u77	Floor coverings

**Table 2.7 92 LIFT Consumption Categories with Corresponding NIPA-PCE Classification (Continued)**

LIFT Categories		NIPA-PCE Classification	
32	Other durable house furnishings; Writing equipment	c06u78 c06u81	Durable housefurnishings nec Writing eqpt
33	Hand toolss	c06u82	Hand tools
34	Semi-durable house furnishings	c06u170	Semidurable house furnishings (33)
35	Cleaning, lighting, paper supplies	c06u171	Cleaning and polishing preparations, and miscellaneous
36	Stationery, writing supplies	c06u184	Stationery and writing supplies (35)
37	Electricity	c06u215	Electricity (37)
38	Natural gas	c06u216	Gas (38)
39	Water & sanitary services	c06u218	Water and other sanitary services (39)
40	Fuel oil & coal	c06u159	Fuel oil and coal (40)
41	Telephone & telegraph	c06u221	Telephone and telegraph (41)
42	Domestic services	c06u228	Domestic service (42)
43	Household Insurance premiums	c06u234	Hh insurance premiums
44	Other household operation	c06u232	Moving & storage
		c06u236	Rug & furniture cleaning
		c06u237	Electrical repair
		c06u238	Reupholstery & furniture repair
		c06u239	Postage
c06u240	Household op svcs nec		
45	Drug preparations and sundries	c06u175	Drug preparations and sundries (45)
46	Ophthalmic & orthopedic equipment	c06u86	Ophthalmic products and orthopedic appliances (46)
47	Physicians	c06u263	Physicians (47)
48	Dentists	c06u264	Dentists (48)
49	Other professional medical	c06u265	Other professional services (49)
50	Hospitals	c06u271	Hospitals
51	Nursing homes	c06u275	Nursing homes
52	Health insurance premiums	c06u278	Health insurance (56)
53	Brokerage & invest counsel	c06u324	Brokerage charges and investment counseling (61)
54	Bank service charges	c06u332	Bank service charges, trust services, and safe depos
55	Imputed service charges	c06u337	Services furnished without payment by financial inte
56	Expense of handling life insurance	c06u340	Expense of handling life insurance and pension plans
57	Legal services	c06u341	Legal services (65)
58	Funeral & burial expenses	c06u342	Funeral and burial expenses (66)
59	Other personal business	c06u343	Other (67)
60	New autos	c06u45	New autos (70)
61	Net purchases of used autos	c06u48	Net purchases of used autos (71)
62	Other motor vehicles	c06u52	Other motor vehicles (72)
63	Tires & tubes, accessories and parts	c06u55	Tires, tubes, accessories, and other parts (73)
64	Automobile repair, rental, leasing	c06u243	Repair, greasing, washing, parking, storage, rental,
65	Gasoline & oil	c06u156	Gasoline and oil (75)
66	Tolls	c06u252	Bridge, tunnel, ferry, and road tolls
67	Net auto insurance premiums	c06u253	Insurance



**Table 2.7 92 LIFT Consumption Categories with Corresponding NIPA-PCE Classification (Continued)**

LIFT Categories		NIPA-PCE Classification	
68	Mass transit	c06u255	Mass transit systems (79)
69	Taxicab	c06u256	Taxicab (80)
70	Intercity rail	c06u258	Railway (82)
71	Intercity bus	c06u259	Bus (83)
72	Airline	c06u260	Airline (84)
73	Other transportation services	c06u261	Other (85)
74	Books & maps, Magazines and newspapers	c06u98	Books and maps (87)
		c06u192	Magazines, newspapers, and sheet music (88)
75	Toys, dolls, & games	c06u181	Toys, dolls, & games
76	Bicycles, motorcycles	c06u92	Bicycles
		c06u93	Motorcycles
77	Cameras, film, and processing	c06u91	Photographic eqpt
		c06u183	Film & photo supplies
		c06u301	Film developing
78	Guns, ammunition, sporting equipment, boats, aircraft	c06u89	Guns
		c06u90	Sporting eqpt
		c06u94	Pleasure boats & aircraft
		c06u182	Sport supplies, including ammo
79	Electronic entertainment and Musical instruments	c06u66	Tvs, vcrs, videotapes
		c06u69	Audio eqpt, media, instruments
		c06u288	Radio and television repair
80	Home computers	c06u73	Computers, peripherals, and software (93)
81	Flowers seeds & potted plants	c06u195	Flowers, seeds, and potted plants (95)
82	Live entertainment, sports, movie admissions	c06u283	Admissions to specified spectator amusements (96)
83	Clubs & fraternal organization	c06u289	Clubs and fraternal organizations
84	Participant amusements and pari-mutuel net receipts	c06u296	Pari-mutuel net receipts
85	Other recreation	c06u297	Other
		c06u301	Film developing
86	Higher education	c06u352	Higher education (105)
87	Private lower education	c06u355	Nursery, elementary, and secondary schools (106)
88	Other education & research	c06u358	Other (107)
89	religious & welfare	c06u361	Religious and welfare activities (108)
90	Foreign travel, and purchases abroad	c06u370	Foreign travel by U Sresidents (110)
		c06u189	Govt expenditures abroad
		c06u190	Other private services
		c06u191	Less: Personal remittances in kind to nonresidents
91	Less: exp in U.S. by foreigners	c06u374	Less: Expenditures in the United States by nonreside
92	Less: HH insurance benefits	c06u235	Less: Hh insur benefits paid

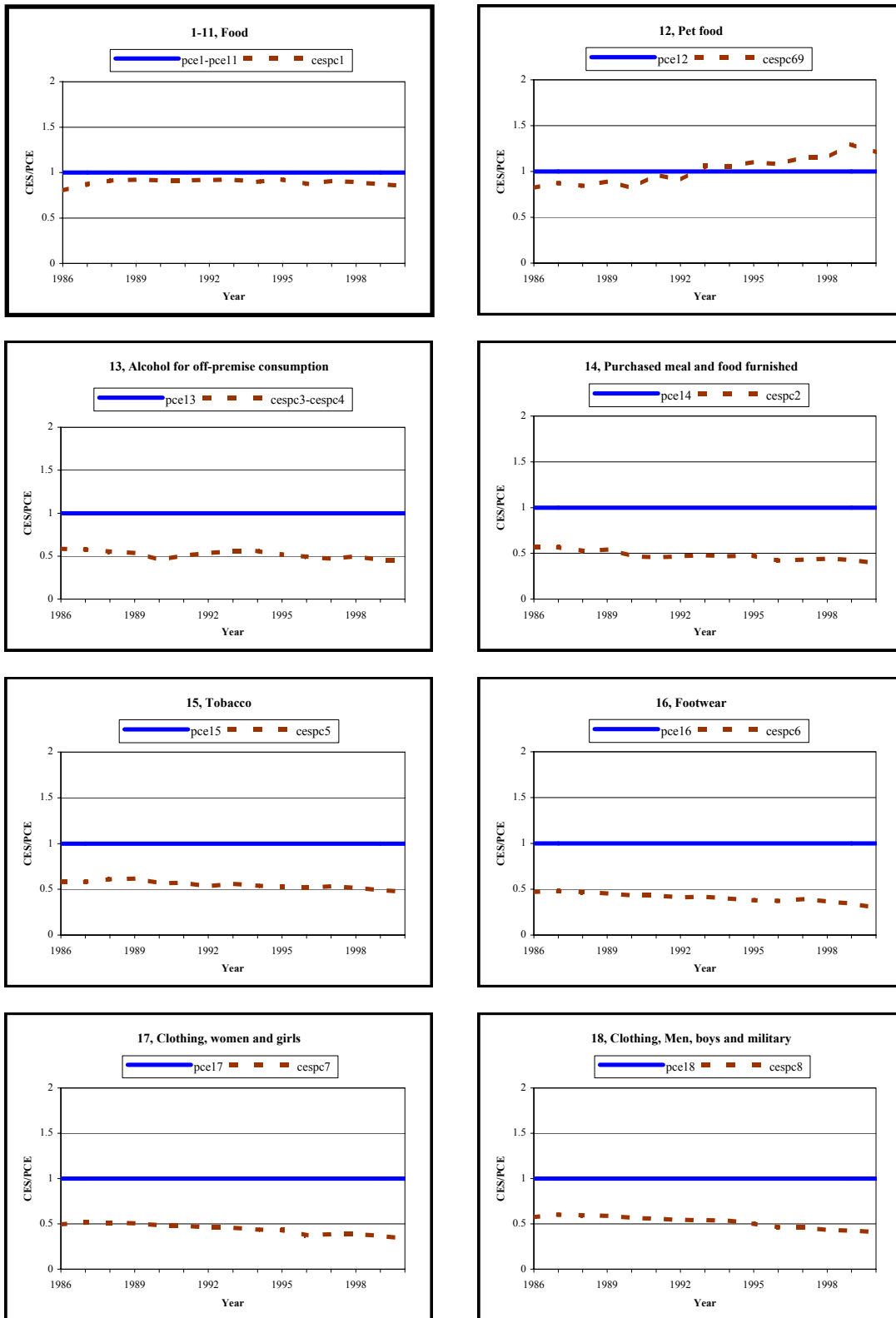
**Table 2.8 Matching of 85 CES Expenditure Categories and 92 LIFT Categories**

92 LIFT Categories		85 CES Categories	
1	Meat	1	Food at home
2	Dairy products		
3	Poultry and eggs		
4	Fresh fruit and vegetables		
5	Processed fruit and vegetables		
6	Cereal and bakery products		
7	Fats and oils		
8	Sugar and sweets		
9	Nonalcoholic beverages		
10	Other prepared food		
11	Fish and seafood		
12	Pet food	69	Pets, pet supplies, and pet services
13	Alcohol for off-premise consumption	3	Alcoholic beverages at home
		4	Alcoholic beverages away from home
14	Purchased meals, food furnished for employee and on farms	2	Food away from home
15	Tobacco	5	Tobacco and smoking supplies
16	Footwear	6	Footwear
17	Clothing, Women's & girls	7	Clothing for women and girls, 2 and over
18	Clothing, Men's & boys' and military	8	Clothing for men and boys, 2 and over
19	Luggage	10	Travel items
20	Cleaning, laundering, & repair of clothing and shoes	11	Cleaning, laundering, repair of clothing and shoes
21	Jewelry & watches	12	Watches and jewelry
22	Watch repair; misc personal services	13	Watches and jewelry repair, other clothing services
23	Toilet articles & preps	(not in Interview Survey)	
24	Barbershops, beauty, & health clubs	14	Personal care services for males and females
25	Owner occupied nonfarm space	16	Owned dwellings, expenses on mortgage, taxes, repairs, etc.
		17	Rented dwellings
26	Tenant occupied nonfarm space	18	Other lodging
27	Other housing	19	Furniture
28	Furniture	20	Kitchen and household appliances
29	Kitchen & household appliances	21	China, glassware and utensils
30	China & glassware, tableware & utilities	22	Floor coverings
31	Floor coverings	23	Other durable house furnishings and writing equipment
32	Other durable house furnishings; Writing equipment	24	Power and non-power tools
33	Hand tools	25	Household textiles
34	Semi-durable house furnishings	26	Semi-durable house furnishings
		27	Cleaning and lighting supplies
35	Cleaning, lighting, paper supplies	(not in Interview Survey)	
36	Stationery, writing supplies	28	Electricity
37	Electricity	29	Natural gas
38	Natural gas	30	Water and other public services
39	Water & sanitary services	31	Fuel oil and other fuels
40	Fuel oil & coal	32	Telephone equipment and services
41	Telephone & telegraph	33	Domestic services
42	Domestic services	34	Household insurance premiums
43	Household Insurance premiums	35	Other household operations
44	Other household operation	36	Prescription drugs, medicines, purchase and rental of medical supplies
45	Drug preparations and sundries	37	Ophthalmic & orthopedic equipment
46	Ophthalmic & orthopedic equipment	38	Physicians' services
47	Physicians	39	Dental care
48	Dentists		

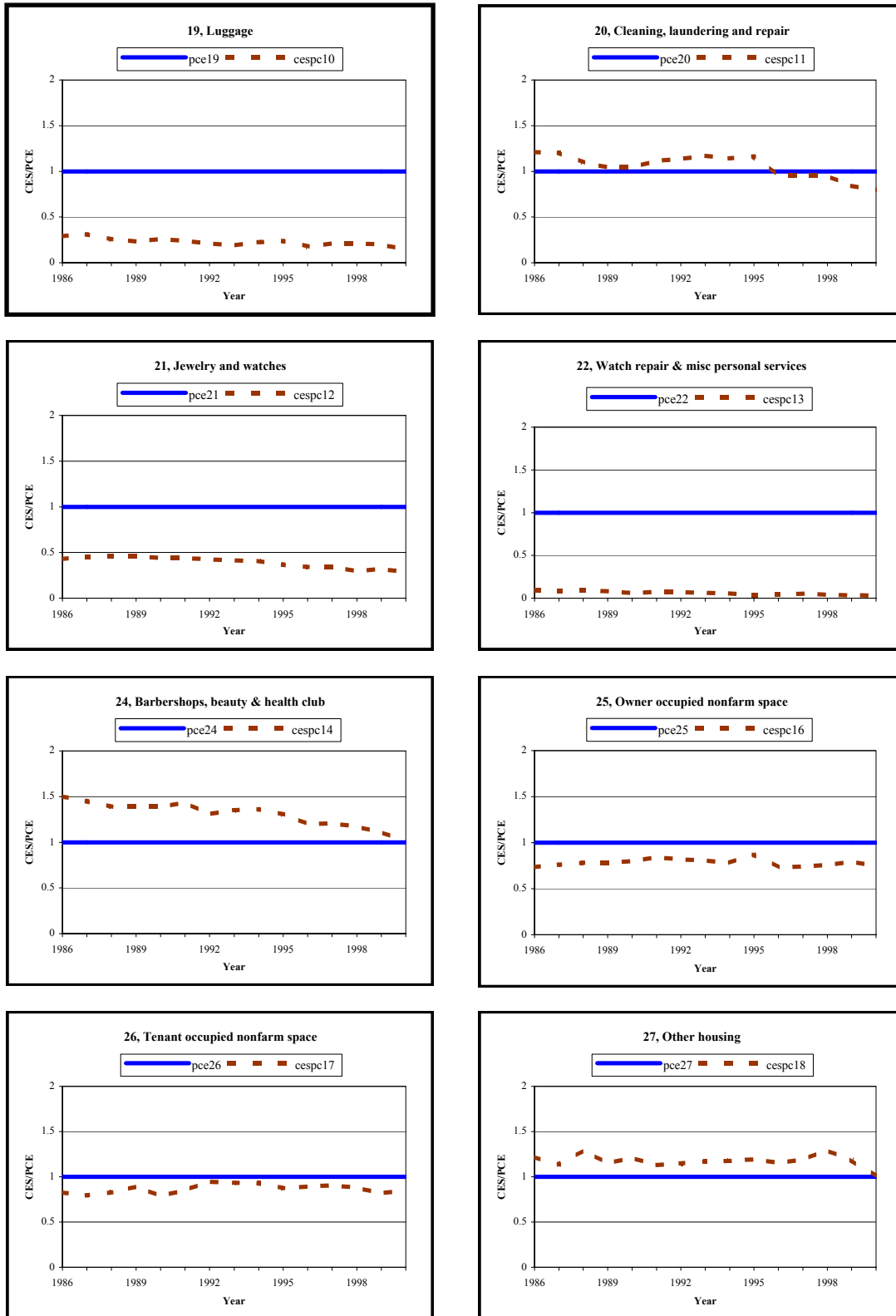
**Table 2.8 Matching of 85 CES Expenditure Categories and 92 LIFT Categories**

92 LIFT Categories		85 CES Categories	
49	Other professional medical	40	Other services by medical professionals
50	Hospitals	41	Other medical care services and medical care in retirement community
51	Nursing homes	42	Hospital room, meals, and services
52	Health insurance premiums	43	Care in convalescent or nursing home
53	Brokerage & invest counsel	44	Health insurance premiums (not in Interview Survey)
54	Bank service charges	45	Banking services (not in Interview Survey)
55	Imputed service charges	46	Life and other personal Insurance
56	Expense of handling life insurance	48	Legal fees
57	Legal services	49	Funeral and burial services
58	Funeral & burial expenses	50	Other personal business
59	Other personal business	51	New cars and trucks
60	New autos	52	Used cars and trucks
61	Net purchases of used autos	53	Other vehicles
62	Other motor vehicles	54	Tires and tubes, accessories, and parts
63	Tires & tubes, accessories and parts	55	Maintenance and repairs of vehicles
64	Automobile repair, rental, leasing	56	Vehicle rental, and other charges
65	Gasoline & oil	59	Gasoline and motor oil
66	Tolls	60	Tolls on out-of-town trips
67	Net auto insurance premiums	61	Vehicle insurance
68	Mass transit	62	Local transportation (excl. taxis)
69	Taxicab	63	Taxis
70	Intercity rail	64	Intercity train fares on out-of-town trips
71	Intercity bus	65	Intercity bus fares on out-of-town trips
72	Airline	66	Airline fares on out-of-town trips
73	Other transportation services	67	Ship fares on out-of-town trips
74	Books & maps, Magazines and newspapers	68	Readings
75	Toys, dolls, & games	70	Toys and playground equipment
76	Bicycles, motorcycles	71	Bicycles
77	Cameras, film, and processing	72	Cameras and films
78	Guns, ammunition, sporting eq, boats, aircraft	73	Guns, ammunition, sporting eq, boats, aircraft
79	Electronic entertainment and Musical instruments	74	Televisions, radios, and sound Equipment
80	Home computers	75	Home computers
81	Flowers seeds & potted plants	76	Fresh flower or potted plants
82	Live entertainment, sports, movie admissions	77	Live entertainment, sports, movie admissions
83	Clubs & fraternal organization	78	Fees for clubs or fraternal organizations
84	Participant amusements and pari-mutuel net receipts	79	Participant amusements and pari-mutual net receipts
85	Other recreation	80	Other recreation
86	Higher education	81	Higher education
87	Private lower education	82	Private lower education
88	Other education & research	83	Other education and research
89	religious & welfare	84	Cash contributions
90	Foreign travel, and purchases abroad		(not in Interview Survey)
91	Less: exp in U.S. by foreigners		
92	Less: HH insurance benefits		
	(No correspondents in PCE-NIPA)	85	Miscellaneous
		9	Clothing for infants
		15	Personal care equipment
		47	Contribution to retirement pension, social security
		57	Vehicle financial charge
		58	Vehicle license and registration

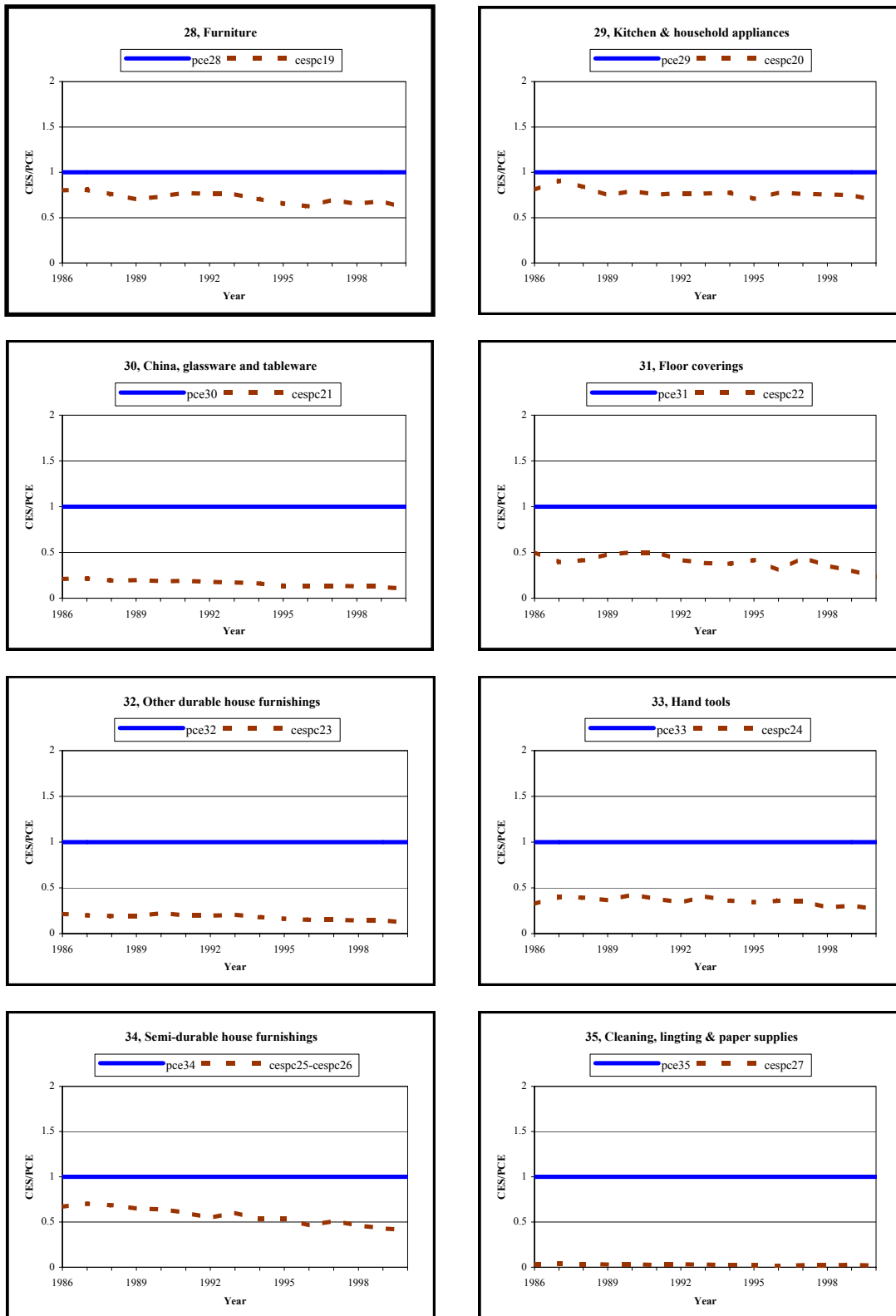
**Figure 2.2 Personal consumption per capita (in 2000 constant dollar), ratio of CES to PCE (equals to 1), selected categories**



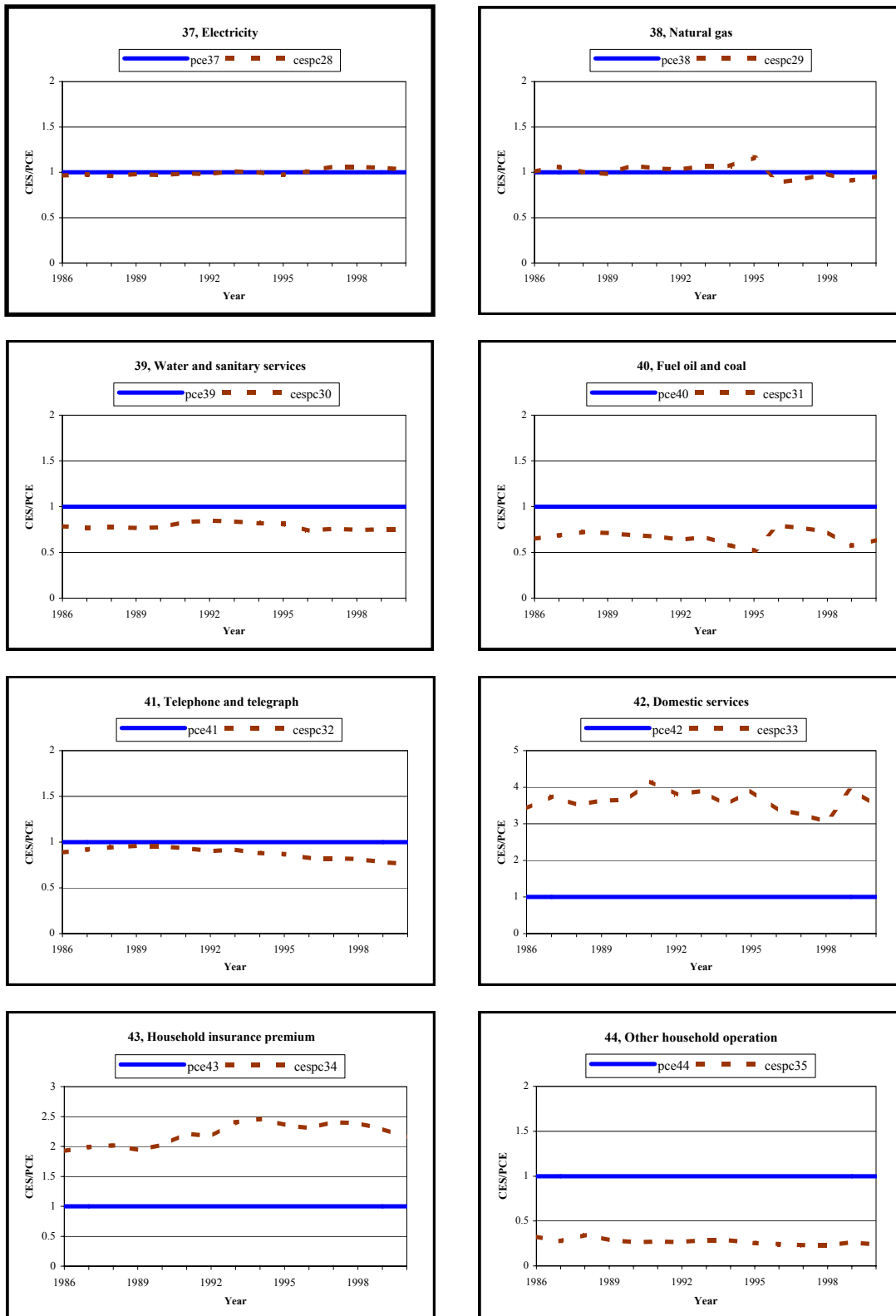
**Figure 2.2 Personal consumption per capita (in 2000 constant dollar), ratio of CES to PCE (equals to 1), selected categories**



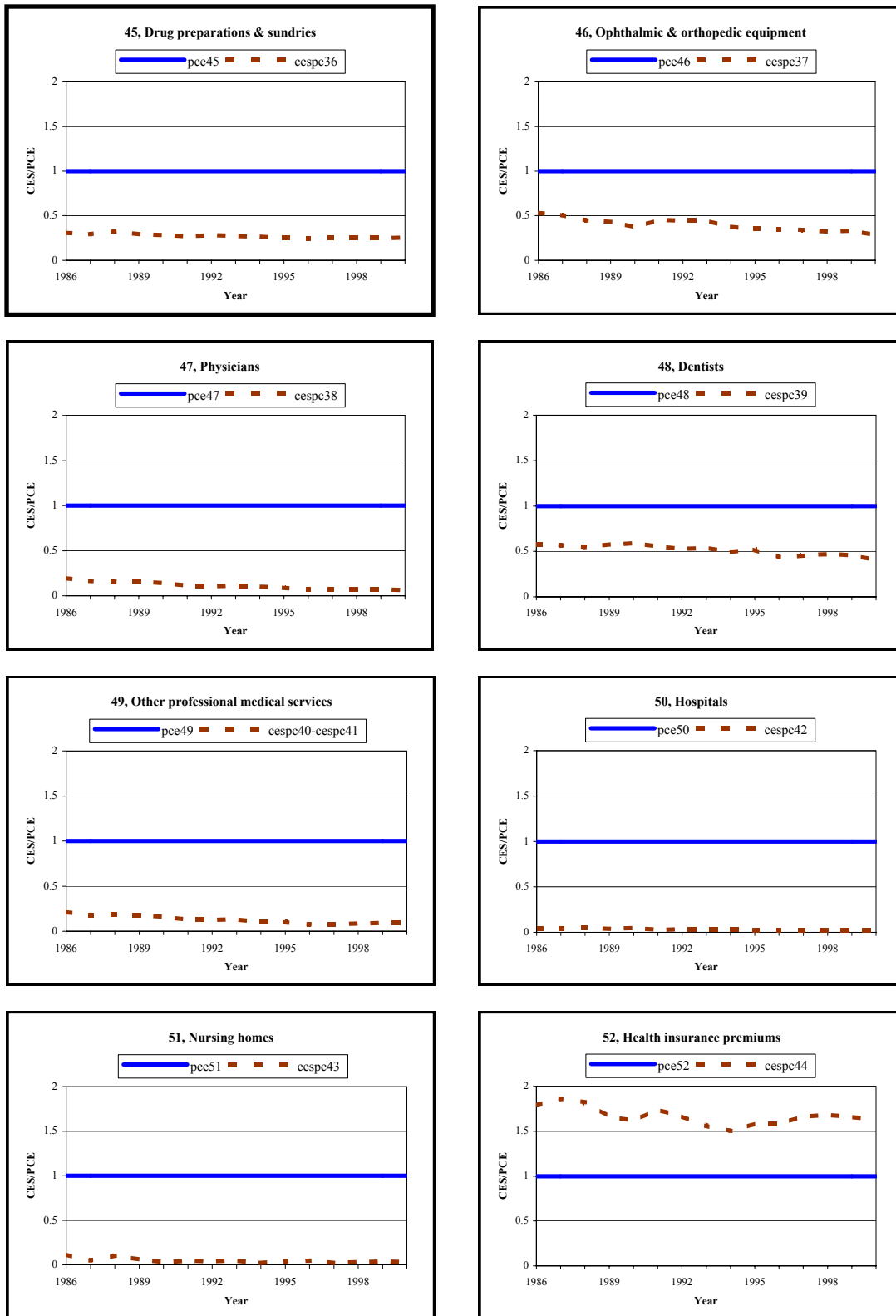
**Figure 2.2 Personal consumption per capita (in 2000 constant dollar), ratio of CES to PCE (equals to 1), selected categories**



**Figure 2.2 Personal consumption per capita (in 2000 constant dollar), ratio of CES to PCE (equals to 1), selected categories**

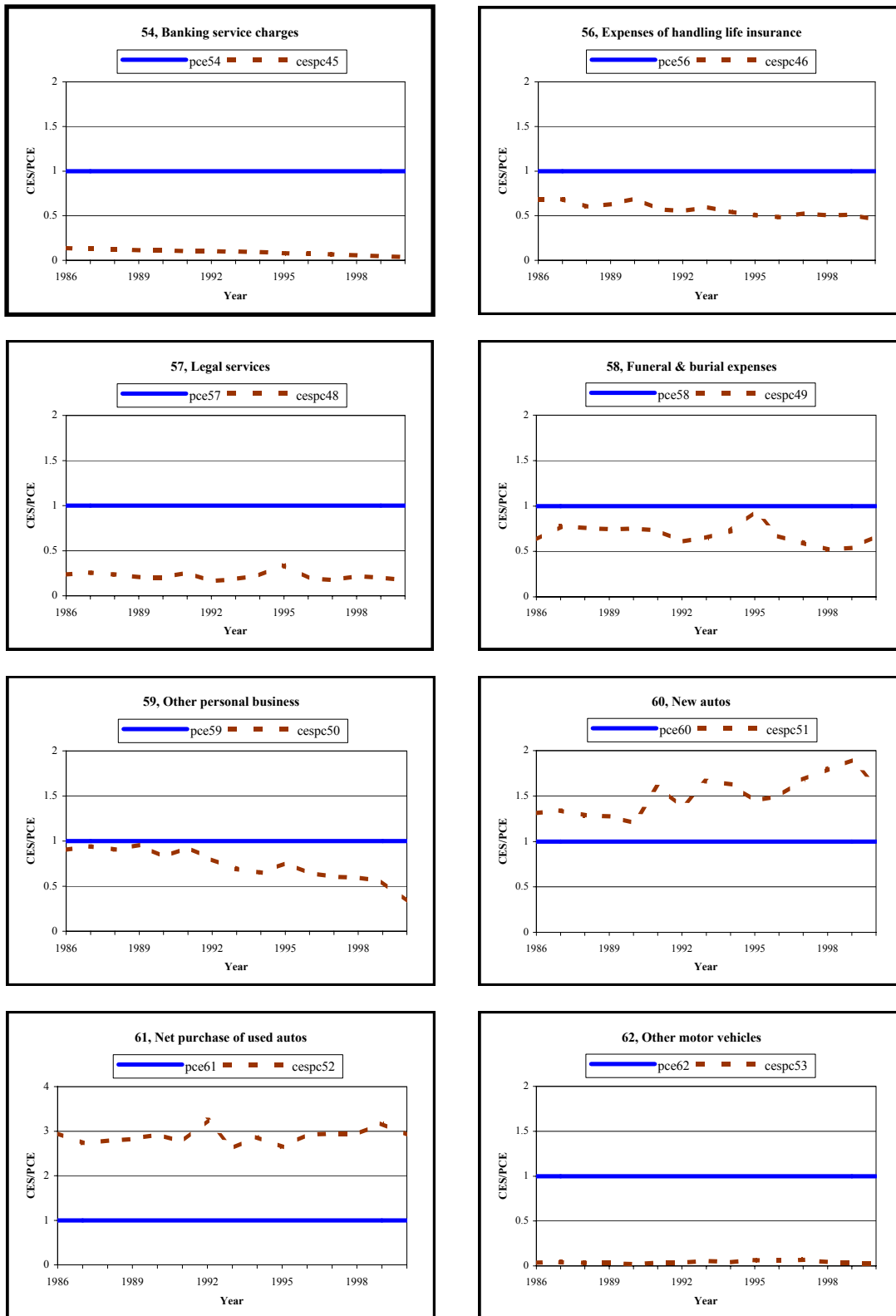


**Figure 2.2 Personal consumption per capita (in 2000 constant dollar), ratio of CES to PCE (equals to 1), selected categories**

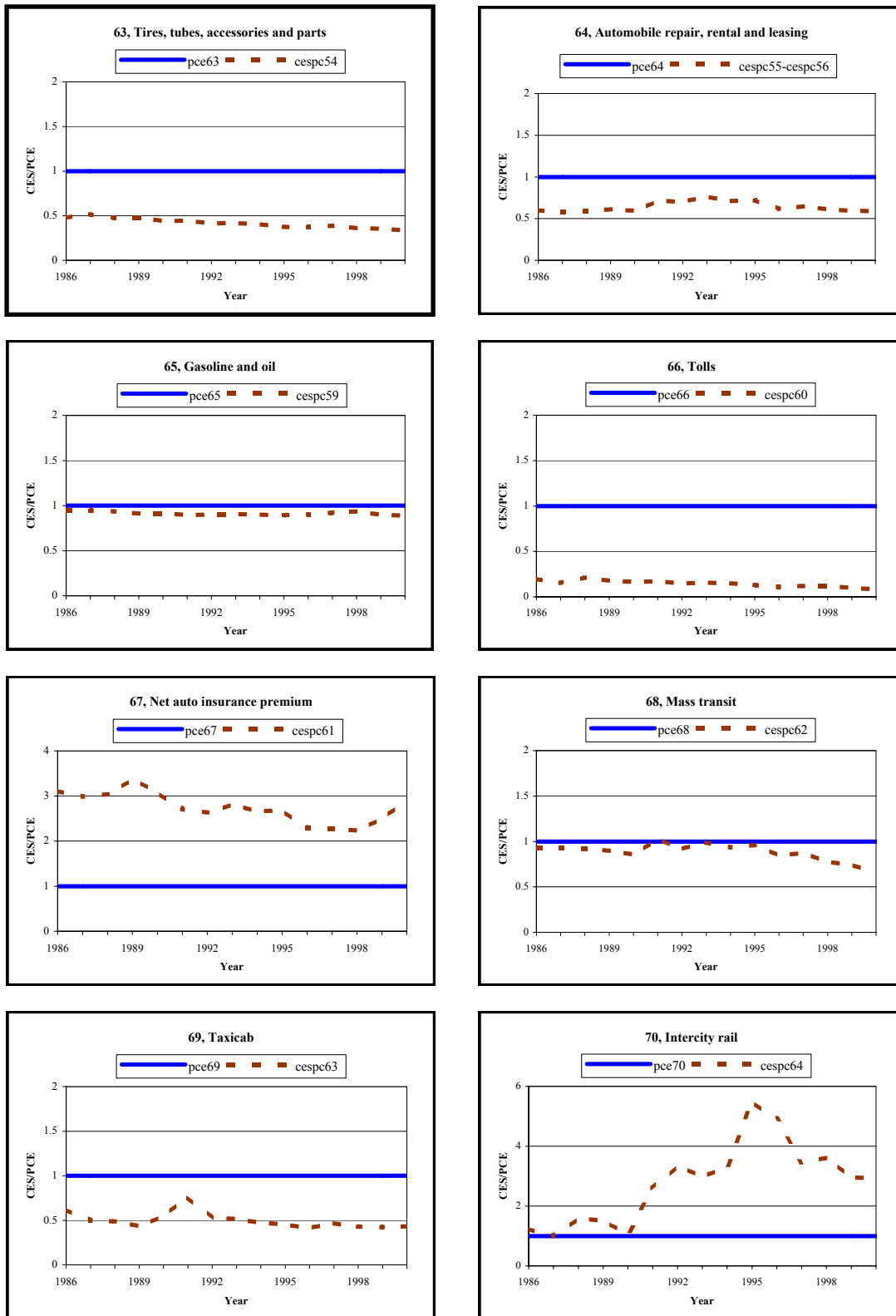




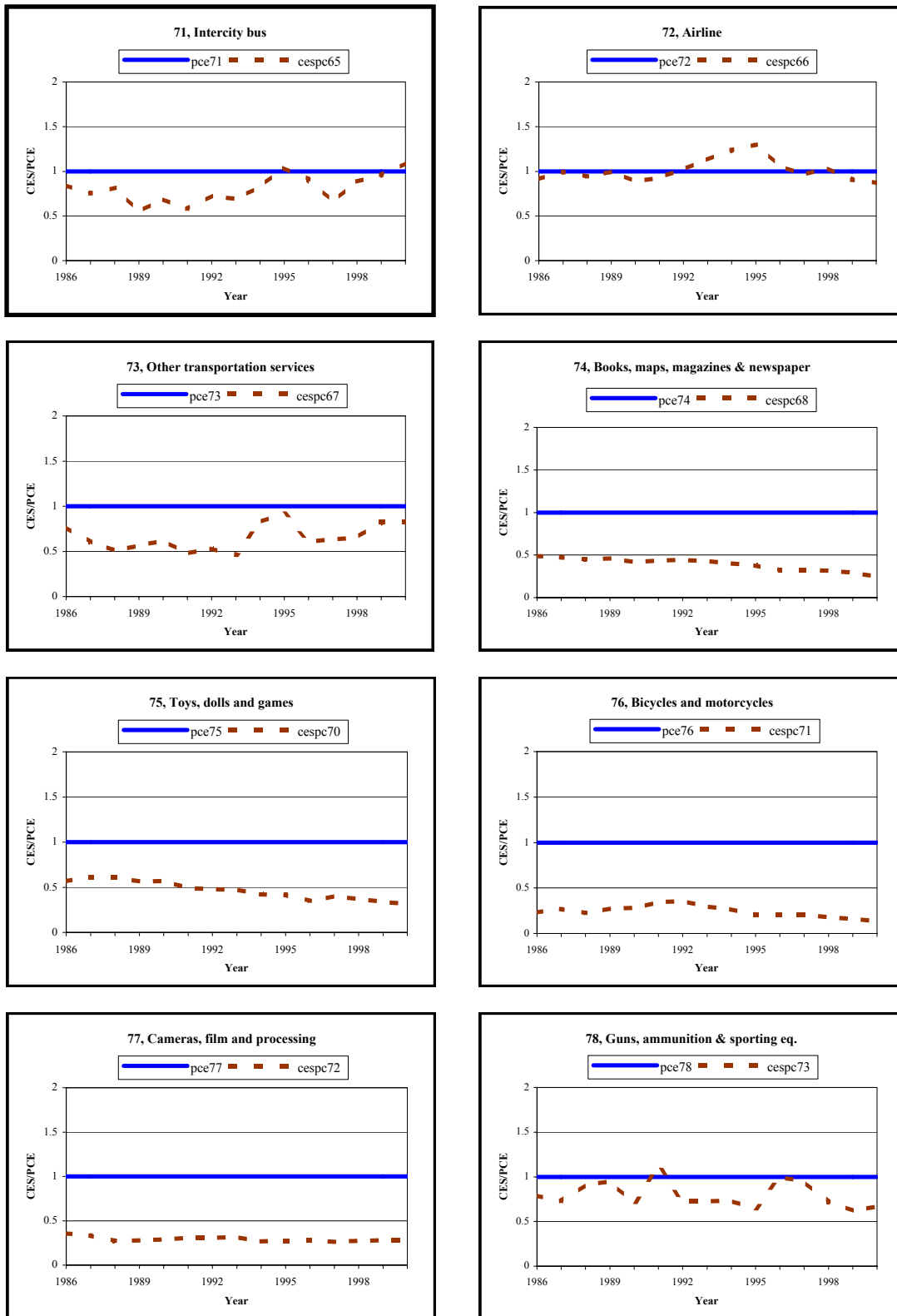
**Figure 2.2 Personal consumption per capita (in 2000 constant dollar), ratio of CES to PCE (equals to 1), selected categories**



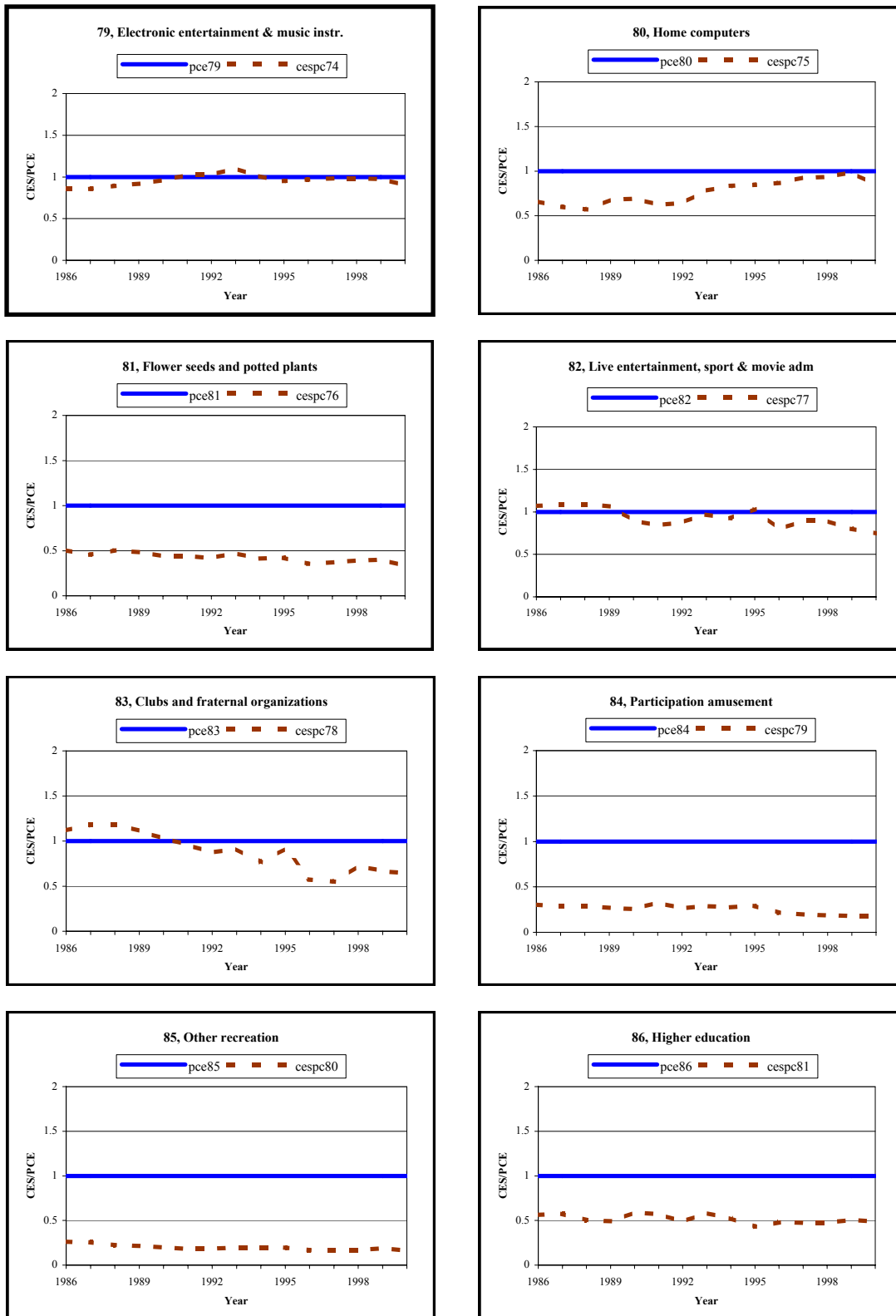
**Figure 2.2 Personal consumption per capita (in 2000 constant dollar), ratio of CES to PCE (equals to 1), selected categories**



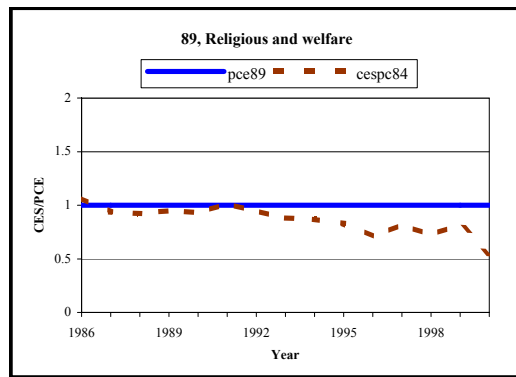
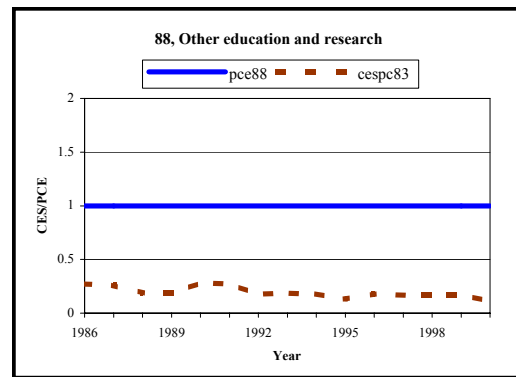
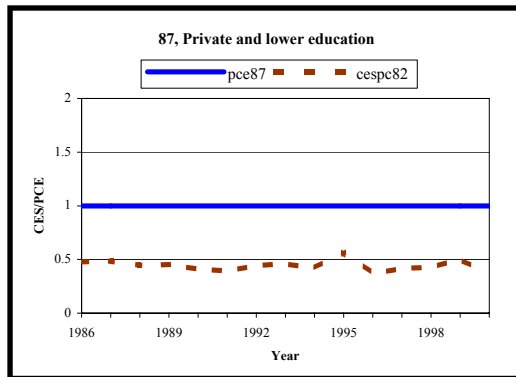
**Figure 2.2 Personal consumption per capita (in 2000 constant dollar), ratio of CES to PCE (equals to 1), selected categories**



**Figure 2.2 Personal consumption per capita (in 2000 constant dollar), ratio of CES to PCE (equals to 1), selected categories**



**Figure 2.2 Personal consumption per capita (in 2000 constant dollar), ratio of CES to PCE (equals to 1), selected categories**



## SECTION 3 ESTIMATION SCHEME

### 3.1 Nonlinear least-squares estimation

Equation (2.1.6) is a nonlinear equation, which cannot be estimated by ordinary least-squares directly. An iterative method is used to accomplish the estimation. To illustrate this procedure, let  $F$  be the function of a vector of independent variables  $X$  and a vector of parameters  $\beta$  so that  $Y = F(X, \beta)$ , where  $Y$  is the vector of observations of dependent variables. Thus the Taylor series expansion around an initial guess,  $\beta_0$ , of the parameters is

$$F(X, \beta) = F(X, \beta_0) + F'(X, \beta_0)(\beta - \beta_0) \quad (2.3.1)$$

where  $F'(X, \beta_0)$ , the gradient of  $F(X, \beta)$ , is the first derivatives of  $F(X, \beta)$  with respect to the elements of  $\beta$  evaluated at  $\beta_0$ . Or we can write equation (2.3.1) as the following:

$$Y = F(X, \beta_0) + M_0 * \Delta\beta_0 \quad (2.3.2)$$

where  $M_0 = F'(X, \beta_0)$  and  $\Delta\beta_0 = \beta - \beta_0$ . Or

$$e_0 = M_0 * \Delta\beta_0 \quad (2.3.3)$$

where  $e_0 = Y - F(X, \beta_0)$ .

Since  $Y$  is the vector of observations of dependent variables,  $F(X, \beta_0)$  and  $M_0$  are observable with initial guess of  $\beta_0$ , equation (2.3.3) is a standard ordinary least-squares model with independent variable  $M_0$ , dependent variable  $e_0$ , and parameter  $\Delta\beta_0$ . We solve the model iteratively until  $\Delta\beta_0$  is small enough, i.e. by solution of ordinary least-squares,

$$\Delta\beta_0 = (M_0' M_0)^{-1} (M_0' e_0) \quad (2.3.4)$$

In our case, the model is

$$C_i^h = (b_{i0} + \sum_j b_{ij} Y_j^h + \sum_k d_{ik} D_k^h) (\sum_g w_{ig} n_g^h) + u_i \quad (2.3.5)$$

If we do Taylor series expansion around an initial guess of the parameters, we have

$$\Delta C_i^{h0} = N_0^h \Delta b_{i0}^0 + N_0^h \sum_j Y_j^h \Delta b_{ij}^0 + N_0^h \sum_k D_k^h \Delta d_{ik}^0 + L_0^h \sum_g n_g^h \Delta w_{ig}^0 \quad (2.3.6)$$

where

$$L_0^h = (b_{i0}^0 + \sum_j b_{ij}^0 Y_j^h + \sum_k d_{ik}^0 D_k^h)$$

$$N_0^h = \sum_g w_{ig}^0 n_g^h$$

$$\Delta C_i^{h0} = C_i^h - C_i^{h0} = C_i^h - L_0^h * N_0^h$$

$$\Delta b_{i0}^0 = b_{i0} - b_{i0}^0, \Delta b_{ij}^0 = b_{ij} - b_{ij}^0, \Delta d_{ik}^0 = d_{ik} - d_{ik}^0, \Delta w_{ig}^0 = w_{ig} - w_{ig}^0$$

$b_{i0}^0, b_{ij}^0, d_{ik}^0, w_{ig}^0$  are initial guesses of parameters.

Thus we can do ordinary least-squares estimation on model (2.3.6) iteratively until  $\Delta b_{i0}^0, \Delta b_{ij}^0, \Delta d_{ik}^0$  and  $\Delta w_{ig}^0$  are small enough.

### 3.2 Statistical models to handle zero expenditures

The problem of zero entries we mentioned in Section 1 is a case where limited dependent variable models can be applied. Bardazzi and Barnabani (1996) explained several statistical models with comparative empirical applications.

#### A) The Tobit model

A widely used model to interpret consumption behavior when there are many zero expenditures is Tobit model, also known as censored regression model. It is specified as the following:

$$c_i^h = \begin{cases} q_i^h & \text{if } q_i^h > 0 \\ 0 & \text{if } q_i^h \leq 0 \end{cases} \quad (2.3.7)$$



where  $c_i^h$  is the observed household  $h$ 's consumption of product  $i$ ,  $q_i^h$  is a latent variable generated by

$$q_i^h = g(X^h, \gamma_i) + \varepsilon_i \quad (2.3.8)$$

where  $X^h$  is the vector of independent variables (in our case the income, demographic dummies, and age structures) of household  $h$ ;  $\gamma_i$  is a vector of coefficients; and  $\varepsilon_i$  is independently and normally distributed across all households with mean zero and  $\sigma_i^2$ .  $q_i^h$  might be thought of as the desired acquisition of a commodity and  $c_i^h$  as actual acquisition. If  $q_i^h$  should be negative, the variable that is actually observed,  $c_i^h$ , is zero. When  $q_i^h$  is positive,  $c_i^h$  is equal to  $q_i^h$ . The probability that  $c_i^h$  is zero is

$$f(c_i^h = 0 | X^h) = F(-g(X^h, \gamma_i) / \sigma_i) \quad (2.3.9)$$

and the density function for positive values of  $c_i^h$  is

$$f(c_i^h | X^h) = (2\pi)^{-1/2} \sigma_i^{-1} \exp\{-c_i^h - g(X^h, \gamma_i)^2 / 2\sigma_i^2\} \quad (2.3.10)$$

where  $F$  is the cumulative unit normal distribution function.

The Tobit model may be seen as a one-step procedure where the decision to buy and the amount to spend is simultaneous. The variables that determines whether to buy and how much to buy are the same in the model.

## B) The Cragg Double-Hurdle model

In some situations the decision to purchase and the amount to purchase might not be dependent upon same set of variables. Factors such as search, information, and transaction cost may inhibit the carrying out of desired plans. In such cases, the zero expenditures may arise either because the latent variable  $q_i^h$  is negative or because other factors preventing the purchase while  $q_i^h$  is positive. Cragg (1971) extended the Tobit model to accommodate for this situation.

The probability that  $c_i^h$  is zero is the sum of the probability that  $q_i^h$  is negative plus the probability that inhibition will be effective when  $q_i^h$  is positive:

$$f(c_i^h = 0 | X_1^h, X_2^h) = F(-g_1(X_1^h, \gamma_i) / \sigma_i) + F(g_1(X_1^h, \gamma_i) / \sigma_i) F(-g_2(X_2^h, \beta_i)) \quad (2.3.11)$$

where  $X_1^h$  is now the vector of independent variables that determines the latent variable  $q_i^h$ ,  $X_2^h$  is the vector of independent variables that determines whether purchase takes place when  $q_i^h$  is positive.  $X_1^h$  and  $X_2^h$  can be different set of variables.  $\gamma_i$  and  $\beta_i$  are corresponding vectors of coefficients. Function  $g_1$  is equivalent to function  $g$  in (2.3.8);

function  $g_2$  is the function that determines the second-step decision. As the household must overcome two hurdles for the consumption to be positive, the Cragg model is called Double-Hurdle model.

### C) The Nonlinear Probability model

This model may be seen as a three-step approach where in the first step the probability to consume is computed, then the expected expenditure is estimated with a nonlinear regression model for the sub-sample for which the consumption is positive, and finally the expected consumption is calculated and the model is estimated for the whole sample. More specifically, the probability of consumption is estimated using a probit model, following the notation used in Tobit model:

$$\Pr(c_i^h = 0 | X^h) = F(-g(X^h, \gamma_i) / \sigma_i) \quad (2.3.12)$$

and the expected consumption is calculated as

$$E(c_i^h | c_i^h > 0) * (1 - \Pr(c_i^h = 0 | X^h)) \quad (2.3.13)$$

Bardazzi and Barnabani (1996) conducted empirical analysis on 1993 Italian Household Expenditure Survey, grouping 76 commodities into 11 categories. On each of the categories, the above three estimation methods were applied together with a single-step nonlinear regression that neglects the zero expenditure problem. For categories with

a large portion of zero expenditures, the estimation results from single-step nonlinear regression are significantly different from the above three schemes. However, the results are not sensitive to the methods of handling zero expenditure problem. I choose the nonlinear probability method which is practically simpler to estimate.

### **3.3 Nonlinear probability model estimation**

We can suppose that the households go through a two-step decision making process. In the first step, the household decides whether to purchase certain product. In the second step, if the household decided to buy, it decides on how much to spend.

The estimation is carried out in three steps. Firstly, a *probit* model is used to estimate the probability of purchase as part of first decision making stage; secondly, a nonlinear least-squares estimation is applied on the non-zero observations so as to predict the expenditure in the second decision making stage; thirdly, expected value of consumption is calculated with the probability and predicted expenditure obtained in step one and two, a nonlinear least-squares estimation is applied with expected value of consumption as the dependent variable. Here we assume that both steps of decision-making are based on same set of independent variables, including income and demographic factors, although that assumption is not necessary to the two-step method.

The second and third step has been described in section 3.1. In what follows, we will discuss the estimation of probability of purchase.

We specify a *probit* analysis model as follows:

$$C_i^h = (b_{i0} + \sum_j b_{ij} Y_j^h + \sum_k d_{ik} D_k^h) (\sum_g w_{ig} n_g^h) + u_i \quad (2.3.14)$$

with  $c_i$  unobservable variable, and an observable dummy variable  $I_i$  is defined by

$$\begin{aligned} I_i &= 1 \quad \text{if } c_i > 0 \\ &= 0 \quad \text{if } c_i \leq 0 \end{aligned}$$

With this formulation,

$$\begin{aligned} Prob(I_i = 1) &= Prob \left[ u_i > -(b_{i0} + \sum_j b_{ij} Y_j^h + \sum_k d_{ik} D_k^h) (\sum_g w_{ig} n_g^h) \right] \\ &= \Phi_i \left[ (b_{i0} + \sum_j b_{ij} Y_j^h + \sum_k d_{ik} D_k^h) (\sum_g w_{ig} n_g^h) \right] \end{aligned} \quad (2.3.15)$$

where  $\Phi_i$  is a cumulative distribution function of  $u_i$  with mean zero and variance  $\sigma^2$ . We choose normal distribution for the probability density function. Based on the method of maximal likelihood, we have the following log likelihood function:

$$\ln L(\gamma) = \sum_{i=1}^N I_i \ln P(I_i = 1) + \sum_{i=1}^N (1 - I_i) \ln [1 - P(I_i = 1)] \quad (2.3.16)$$

Newton-Raphson iterative procedure is used to maximize equation (2.3.16).

## SECTION 4 ESTIMATION RESULTS

The estimation of the regressions equation converged except for three equations<sup>10</sup>. The details of the estimation results are shown in Table 2.9. The figures in parentheses are the absolute value of  $t$  statistics. For adult equivalency weights, the  $t$  values are calculated with respect to the deviations from 1.0, the reference adult equivalent.

### 4.1 Observations on Engel Curves

The plots of the estimated Engel curve are presented in Figure 2.3. The curves are drawn for the reference household, which is 3-4 member households in the Northeast region with two wage earners, and with a head aged between 35 and 55, with higher school or associate degrees. In Figure 2.3, the consumption expenditure per adult equivalent on the vertical axis is plotted against per capita household income on the horizontal axis. In what follows, we summarize the results of the estimation.

#### A. Food, Alcohol, and Tobacco

Food at home (1) is a typical necessary good. The slope of the consumption of Food at home (1) monotonically decreases over the per capita income brackets. Richer households tend to spend a smaller portion of their income on Food at home (1) than do poorer households. However, the Engel curve for Food away from home (2) tells us a different story. The slope does not show a clear pattern of increasing or decreasing. The slope over the second income level (US\$ 4963 ~ US\$ 8084) is greater than over the first

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<sup>10</sup> They are Equation 41 (Other medical care services and medical care in retirement community), Equation 43 (Care in convalescent or nursing home) and Equation 53 (Other vehicles).

income level (US\$ 0 ~ US\$ 4963), however it drops over the third income level (US\$ 8084 ~ US\$12015). Overall the curve is quite linear. The reason is because Food away from home is not necessary to a family, while Food at home is. Dining outside is more expensive and thus can be afforded by richer families. On the other hand, Food away from home is not necessarily a luxury because of the existence of many low cost restaurants, such as McDonald's, KFC, and other fast-food stores. For low-income households, dining in those places does not seem a luxurious way of spending. However, compared with Food at home (1), Food away from home (2) constitutes a smaller budget share over lower income levels. Spending on Food at home (1) for a household with per capita income of US\$ 4963 is US\$ 856, while its spending on Food away from home (2) is US\$ 150; a household with per capita income of US\$ 19055 spends US\$ 1685 on Food at home (1) compared with US\$ 795 on Food away from home (2). In the former (lower income) household, spending on Food away from home (2) is less than one fifth of the spending on Food at home (1), while in the latter (higher income) household, spending on Food away from home (2) is almost half of the spending on Food at home (1).

The comparison between Alcoholic beverages at home (3) and Alcoholic beverages away from home (4) is also of interest. The Engel curve for Alcoholic beverages away from home (4) shows a clear pattern of luxury good, with the slope of consumption increasing over the income brackets. The Engel curve for Alcoholic beverages at home (3) would also show the pattern of a luxury good if there were no drop of slope over the fourth income bracket (US\$ 12015 ~ US\$ 19055). One major non-economic factor in the decision making on spending of Alcoholic products is addiction or

conscientious abstention. The negative slope of the Engel curve of Alcoholic beverages at home (3) over the fourth income bracket seems a rather non-economic decision. A possible explanation is that there is relative large portion of non-alcoholic consumers in households of that income range.

Tobacco and smoking supplies (5) are not necessary goods, but the Engel curve shows a pattern of necessary goods. A possible reason is that higher income families are usually better educated and thus abstained from smoking, while Tobacco and smoking supplies (5) are indeed necessary for addicts.

#### B. Apparel, Luggage, and Jewelry and Watches

The plots of Footwear (6), Clothing for women (7) and Clothing for men (8) keep a relatively constant slope of Engel curves through all the brackets since footwear and clothing have both qualities of necessities and luxuries. Comparing the consumption of Clothing for women (7) and Clothing for men (8), we find that on average women spend more on clothing than men. Over lower income brackets, the Engel curve of Clothing for infants (9) shows a pattern of necessity, except that the slope goes up over the fourth income bracket (US\$12015 ~ US\$19055). It's hard to image that a low-income household will spend much money on Clothing for infants (9). The spending on infants clothing is an approximate indicator for number of infants. Therefore, the Engel curve for spending on Clothing for infants (9) shows the relationship of a family's decision on number of children to have and household income. Over lower income brackets, the



household cannot afford many children; when the household has more income, the parents may decide to have more babies; however when the household's income reaches an even higher level, the family have to consider other elements on the cost side, such as moving to a bigger house, buying a bigger car, etc.

Travel items (10) are luxury goods. People travel only when the basic living needs are satisfied. Travel items such as luggage do not include major traveling expenditures such as air tickets and hotels. The higher the household income, traveling become a more frequent way of relaxation and entertainment. Cleaning, laundering & repair of clothing (11) exhibit similar pattern to Clothing. The Engel curve is almost linear, since the cost of Cleaning, laundering & repair of clothing (11) is usually proportional to the cost of clothing.

Watches and jewelry (12) are luxuries. The spending keeps very low in the first four income brackets, while it skyrockets over the highest income bracket. The repair for watches and jewelry (13) constitute a very low share of the household budget. Personal care services (14) include services such as haircuts. It is necessary part of living expenditure, but sometimes the spending on Personal care services (14) can be costly. Therefore the Engel curve exhibit a mixed pattern of both necessity and luxury goods. Expenditure on Personal care equipment (15) is much smaller than that on Personal care services (14).

### C. Shelter

Most household own their residence instead of rent, as can be seen from the magnitude of spending on Owned dwellings (16) and Rented dwellings (17). By the fact that buying a house has become cheaper with tax relief and other government programs to encourage people's purchase of houses, low income families spend a major part of their household income in buying houses. Of course, higher income families often spend more on house purchase. This explains why the Engel curve of Owned dwellings (16) is almost linear. The inverse V-shape of Engel curve for Rented dwellings (17) over the first and second income brackets seems to reflect the trend of house purchase from the other side. Only when the household has a very low income will they consider renting. Starting from the second income bracket, more and more money is spent on buying instead of renting. Other lodging (18) shows a pattern of luxuries.

#### D. House Furnishings and Equipment

House furnishing and equipment includes sector (19) - (27). The Engel curve for Furniture (19) indicates a necessity good in lower income brackets, and luxury goods in higher income brackets. For households in the first four income brackets, the spending on Furniture (19) does not exceed US\$ 50, while it increases in the last income bracket to over US\$ 250 for a household with per capita income of US\$ 30,000. This relates to the nature of the good of Furniture (19), which is necessary to a household, but can be a luxury good as well. Similar products include China, Glassware and Utensils (21), Other durable house furnishings (23), Household textiles (25), Semi-durable house furnishings (26), Cleaning and lighting supplies (27).

#### E. Utilities

All the utility expenditures, including Electricity (28), Natural gas (29), Water and other public sanitary services (30), Fuel oil and other fuel (31) and Telephone equipment and services (32) show the pattern of necessities.

F. Household Operations

Household insurance premium (34) shows a decreasing marginal propensity to consumption with the growth of household income. Spending on Domestic services (33) and Other household operations (35) exhibit the pattern of luxury goods.

G. Health Care

On the whole, the health care categories show the pattern of necessities. The expenditure of many health care sectors shows a “two-stage” response to income levels, i.e. the Engel curve is concave in both lower-income bracket and higher-income bracket, but the slope of Engel curves jumps in the juncture. For example, the slope of Engel curve of spending on Prescription drug (36) drops in the third income bracket compared with in the first and second income bracket. In the fourth income bracket, the slope exceeds the third income bracket, but finally falls down in the fifth income bracket. A possible explanation of this phenomenon is as follows: when a family has a low income and does not have health insurance, household members restrict the visits of doctors and only spend on necessary Prescription drugs (36); when the household income gets higher and more household member are eligible for health insurance, the spending on Prescription drugs (36) jumps. However the health insurance plans usually set limits for spending on Prescription drugs (36). When it reaches a certain level, the spending pattern

cannot continue, and its budget share has to fall down. Similar patterns appear in Ophthalmic and orthopedic equipment (37), Physician's services (38), Dental care (39), Other services by medical professionals (40), Hospital Room And Meals (42). We have not been able to achieve convergence for Other medical care services (41) and Care In Convalescent Or Nursing Home (43).

#### H. Personal Business and Life Insurance

This broad category includes several types of services such as Banking services (45), Life and other personal insurance (46), Contribution to retirement and pension (47), Legal services (48), Funeral and burial services (49), and Other personal business (50). Most of the categories show declining of the slopes of Engel curves in higher income brackets with only the exception of Legal services (48). In the fifth income bracket, the Engel curve rise rapidly relative to its slopes in other income brackets. It has to do with the nature of legal services, which is usually expensive and only affordable by high income families.

#### I. Transportation

New cars (51) are luxuries to most families, and its Engel curve shows the characteristic of luxury goods over most income brackets. The slope decreased a little in the fifth income bracket as compared with the slope in the fourth, but on average, spending on new cars takes up a greater share of the household budget when family income rises.

Spending on used cars and trucks (52), on the contrary, shows the pattern of a necessity good. The slope of its Engel curve falls from the lowest to the highest income bracket.

Comparing the Engel curves of New cars (51) and of Used cars (52), we find the family spending on New cars (51) are very low in the first three income brackets. The spending on New cars (51) in the fourth income bracket is also lower than the spending on Used cars (52). It rapidly increases in the fifth income bracket, and occupies a higher budget share than the spending on Used cars (52). These observations reflect the facts that used cars are low-cost but inferior substitutes for new cars.

Other car maintenance and miscellaneous charges such as Tires and tubes (54), Maintenance and repair (55), Vehicle financial charges (57), Vehicle license registration (58) shows characteristics of necessity goods. For Maintenance and repair (55), the Engel curve is almost a straight line. Low-income families most likely would have used cars, and usually don't spend much on maintenance. When a family gets richer and buys new cars, it is willing to pay for the maintenance.

Vehicle rental (56) usually goes with travel and shows the characteristics of a luxury good. Gasoline and motor oil (59), and Vehicle insurance (61) shows the typical pattern of necessity goods.

For spending on local and intercity travel fares, Taxis (63), Airline fares (66), and Ship fares (67) are likely to be luxuries. The slope of the Engel curve of Taxi (63) moves up rapidly on the fifth income bracket.

Intercity train fares (64) and intercity bus fares (65) show similar patterns. The spending on these two goods is relatively low in lower-income brackets, while the slope increases rapidly in the high income bracket.

#### J. Reading and Entertainment

The family budget share on Readings (68) is increasing over the first four income brackets, but it drops in the fifth income bracket. Toys and playground equipment (70) on the other hand, has its Engel curve decreasing in the first four income brackets, and it rises in the fifth income bracket. Spending on Bicycles (71) does not show any specific pattern. Camera and film (72) expenditures has a pattern similar to that of Readings (68).

Among other recreation categories, Fresh flowers or potted plants (76), Fees for clubs or fraternal organizations (78), and Participant amusements (79) show characteristics of luxury goods.

Expenditure on Home computers (75) has been an almost constant portion of household budget, and has the slope of its Engel curve decreasing over the highest income bracket. With the decline of the price of personal computers and the increase of household income in recent years, Home computers have claimed a smaller portion of the family budget.

#### K. Education and Cash Contribution

Higher education (81) takes up growing share of the household budget as family income increases over the first four income brackets. The slope of the Engel curve drops

a little in the fifth income bracket. Private lower education (82) shows a similar pattern to Higher education (81). The pattern of Other education (83) is not as clear as Higher education (81), but on average it shows the characteristics of luxury goods. Cash contribution (84) is a luxury except for the decrease of marginal propensity to consume in the fourth income bracket.

## **4.2 Effects of Demographic Variables**

The effects of demographic variables on each consumption item are shown in Table 2.10. They are indicated by (+) or (-) if the sign of demographic factors have a significant positive or negative impact on the magnitude of a given consumption category at 0.05 significance level.

### **A. Region**

Estimation results have shown that for all 83 categories are significant at .05 level for at least one category of region of residence. For Owned dwellings (16), the region of residence in Midwest and South has significant negative effects on the budget shares of the two consumption categories. Region of residence in West does not significantly affect the household consumption. We could reasonably infer that since Northeast is the region of reference group, households in Northeast have the highest budget share on owned dwellings.

Let us look at some categories of utility usage. For Electricity (28), living in the Midwest and South has significant positive influences on usage of electricity, while

living in the West has significant negative influences. We could infer that people living in the West have the lowest expenditure on electricity. Using the similar analysis on Natural gas (29), Midwest households have the highest usage of natural gas in terms of consumption expenditures.

## B. Family Size

All 83 categories are significant at .05 level for at least one category of family size. The effects of family size usually relates with the phenomenon of economies of scales in consumption. Let's take Telephone equipment and services (32) as an example. Estimation results show that family size of 1 or 2 has positive significant impacts on Telephone equipment and services (32), while family size of 5 and above has negative significant influences. Since the family size of the reference group is 3-4 family members, our results show that the more family members, the less household consumption on this category. Recall the specification of our model:

$$C_i = (b_{i0} + \sum_j b_{ij} Y_j + \sum_k d_{ik} D_k) (\sum_g w_{ig} n_g) \quad (2.4.1)$$

Holding the terms in the second bracket constant, the increase on household consumption means the increase in the consumption per adult equivalency weight. Or simply put, the more family members, the less consumption expenditure on Telephone equipment and services (32) for each member. This is a typical example of economies of scale of consumption. For consumption categories that have the property that the consumption could be shared among the household members, we can see similar results. Other items falling into this category includes Rented dwellings (17), Furniture (19), Semi-durable



house furnishings (26), Electricity (28), and Televisions, radios, and sound equipment (74).

C. Age of Household Head

At least one of the three dummies for age of household head is significant for each of the 83 expenditure categories. Our estimation results show that households with age of household head greater than 55 spend more on most health care items, including Prescription drugs, medicines, purchase and rental of medical supplies (36), Ophthalmic and orthopedic equipment (37), Dental care (39). Those household also spend more on Domestic services (33), Household insurance (34), Life and other personal insurance (46).

D. Education of Household Head

At least one of the three dummies for education of household head is significant for each of the 83 expenditure categories. Families with education of household head higher than high school spend less on Tobacco and smoking supplies (5).

The level of education has influenced household's consumption on certain categories of goods. More educated people spend more on Reading (68), Private and lower education (82), and Other education and research (83).

E. Number of Wage Earners

At least one of the three dummies for number of wage earners is significant for each of the 83 expenditure categories. Our reference household has two income earners in

the family. Our results show that the expenditure of Food at home (1) increases with only one income earner in the family and decreases with more than 2 income earners. This is explained by the facts that with more people working in the family, family members may find less time to eat at home and would more likely to eat outside to save time.

The household income is usually higher with more people working in one family, and this has been reflected on the housing expenditure. Our result shows that households spend more on Rented dwellings (17) with only one income earner and would spend less with more than 2 working family members. Since household with higher income would like to buy a house instead of renting an apartment.

The estimation result on Domestic services (33) is not what we anticipated. With more people working, the household should spend more on Domestic services (33) because of the limited time budget for family members. Our results show that 2-working-member families spend more on domestic service than one-working-member families, but when a household has more than 2 working members, the expenditure on this category decreases.

### **4.3 Observations on Adult Equivalency Weights**

The estimated adult equivalency weights are presented in the bar charts of Figure 2.4. The charts show that people of different ages contribute to the consumption of goods and services in different ways. In what follows, we give a summary of the results by age groups.

A. Age group 1: 0~5

The effects of children under 5 years old on adult equivalency weights are prominent in several consumption categories. Clothing for infants (9) has the relatively highest adult equivalency weight for age group 0~5. For Domestic services (33), this group also has the highest adult equivalency weights as compared with other age groups because this category includes services of babysitting or child care. Toys and playground equipment (70) has the highest adult equivalency weight for age group 0~5 and the second highest for age group 6~15.

B. Age group 2: 6~15

This age group has the highest adult equivalency weights on Footwear (6), Clothing for women and girls (7), and Clothing for men and boys (8). The reason might be the fact that children of this age group are growing very fast and the parents have to spend more on their shoes and apparel than any other age groups.

This age group ranks the second in the adult equivalency weights for Toys and playground equipment (70), since children between 6 and 15 spend less than toys than kids between 0 and 5, but more than any other age groups.

For consumption on recreational goods such as Televisions, radios, and sound equipment (74) and Other recreation (80), this age group also spends more than other age groups.

C. Age group 3: 16~20

This age group also spends a lot on Footwear (6), Clothing for women and girls (7) and Clothing for men and boys (8). For Vehicle insurance (61), this age group has the highest adult equivalency weight. This may be attributed to the fact that car insurance companies usually charge higher premiums for drivers of this age group than other age groups. This age group ranks the second in the adult equivalency weight for Higher education (81).

D. Age group 4: 21~30

People between 21 and 30 have the highest weights on Home computers (75). During this age period a person may drink more than other periods in his lifetime, so this age group has the highest adult equivalency weight in Alcoholic beverages away from home (4).

Most people of this age, who usually live away from their parents, don't earn enough to afford a house, therefore the adult equivalency weight for Rented dwellings (17) is the highest for this age group. Young people within this age group also pay high car insurance (61), with the adult equivalency weight only second to that of age group 16~20.

E. Age group 6: 41~50

For most of the household consumption items, the adult equivalent weights of this age group exhibits similar pattern to the reference group, age 30~41. Compared with the

reference group, people of age in 40s' spent less on recreation, less on food and beverages away from home, more on medical care expenditures.

F. Age group 7: 51~65

The adult equivalency weights for this group are close to the eldest age group, age 66~99. For health insurance, hospital services and prescription drugs, the adult equivalency weights are lower, while they are higher for Ophthalmic & Orthopedic Equipment (37) and Physician's services (38).

G. Age group 8: 66~99

This age group has the highest adult equivalency weights for many of the health categories such as Prescription drugs, medicines, purchase and rental of medical supplies (36), Dental care (39), Hospital Room and Meals, hospital Services (42) and Health insurance premiums (44). It also has the highest weights on Funeral and burial services (49), Personal care services (14), Household insurance premiums (34) and Other household operation (35).

#### **4.4 Estimation results of probit analysis**

The model of probit analysis is designed particularly for the consumption items that are not frequently purchased by the households. We expect that for the frequently purchased consumption categories, the results from non-linear least-squares estimation and the probit analysis are not much different. We ran the regression for all the equations, and show the results in Table 2.11, which compares the coefficients estimated by the two

methods. The first column shows the coefficients from probit analysis, and the second contains those from the least-squares method. Except for three equations<sup>11</sup>, all the equations converge.

In our probit analysis, the dependent variable is created by multiplying the results from non-linear least-squares estimation on non-zero observations and probability of purchase estimated from probit model. Then the created dependent variables are regressed on the set of income and demographic variables to obtain the coefficients.

For categories that are frequently purchased, the estimation results from the two methods are close to each other. The estimated coefficients for Food at home (1), which has 0.1% zero observations, from the two methods are very close. Similar situations are found for other food, apparel, and utility consumption categories.

For infrequently purchased items such as New cars and trucks (51) and Watches and jewelry (12), the results from the two methods are different. The major difference lies in the income effect, i.e. the marginal propensity to consume estimated from the probit method is less than that from least-squares method. In another word, the increase in the expected amount spent out of an additional dollar in household income estimated by the probit method is less than the marginal increase in spending estimated by the least-squares method. It's reasonable since the probit method is to calculate the "consumption" instead of "expenditure". For seldom purchased items, after the probability of purchase is calculated, the expected consumption is computed by multiplying the probability of purchase with the expected consumption estimated from non-linear least-squares

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<sup>11</sup> They are Equation 41 of Other medical care services and medical care in retirement community, Equation 43 of Care In Convalescent Or Nursing Home (Net Outlay) and Equation 53 of Other vehicles.

estimation on non-zero observations. Therefore, the probit method, to a certain extent, evens out the “expenditure” and produced the expected “consumption”. The estimated slopes of Engel curves are flatter than the least-squares method does.

For demographic effects, majority of the estimated coefficients have the same sign from the two approaches with different magnitudes.

### **Table 2.9 Estimated Coefficients by Least-Squares Estimation**

Coefficients List:

$inc_0$  - Constant

$inc_1$  - coefficient for income bracket \$0 ~ \$4,963

$inc_2$  - coefficient for income bracket \$4,963 ~ \$8,084

$inc_3$  - coefficient for income bracket \$8,084 ~ \$12,015

$inc_4$  - coefficient for income bracket \$12,015 ~ \$19,055

$inc_5$  - coefficient for income bracket \$19,055 ~ infinity

$reg_1$  - coefficient for dummy variable representing households residing in the Midwest

$reg_2$  - coefficient for dummy variable representing households residing in the South

$reg_3$  - coefficient for dummy variable representing households residing in the West

$siz_1$  - coefficient for dummy variable representing households with one family member

$siz_2$  - coefficient for dummy variable representing households with two family members

$siz_3$  - coefficient for dummy variable representing households with five or more family members

$age_1$  - coefficient for dummy variable representing households with age of household head less than 35

$age_2$  - coefficient for dummy variable representing households with age of household head greater than 55

$edu_1$  - coefficient for dummy variable representing households with household head's education below high school

$edu_2$  - coefficient for dummy variable representing households with household head's education above high school

$wag_1$  - coefficient for dummy variable representing households with one wage earner

$wag_2$  - coefficient for dummy variable representing households with two or more wage earners

$aw_1$  - adult equivalency weight for age group 0~5

$aw_2$  - adult equivalency weight for age group 6~15

$aw_3$  - adult equivalency weight for age group 16~20

$aw_4$  - adult equivalency weight for age group 21~30

$aw_5$  - adult equivalency weight for age group 31~40 (set to 1.00)

$aw_6$  - adult equivalency weight for age group 41~50

$aw_7$  - adult equivalency weight for age group 51~65

$aw_8$  - adult equivalency weight for age group 66~99

Numbers in the parentheses are  $t$ -statistics for the corresponding coefficients.



<b>Equation 1 Food at home</b>									
<b>inc0</b>	<b>inc1</b>	<b>inc2</b>	<b>inc3</b>	<b>inc4</b>	<b>inc5</b>	<b>reg1</b>	<b>reg2</b>	<b>reg3</b>	<b>siz1</b>
200.35	0.13	0.08	0.05	0.05	0.01	-93.63	-32.88	-15.94	164.84
(615.78)	(1709.09)	(1067.11)	(835.38)	(1391.89)	(1350.00)	(555.51)	(206.00)	(99.39)	(458.72)
<b>siz2</b>	<b>siz3</b>	<b>age1</b>	<b>age2</b>	<b>edu1</b>	<b>edu2</b>	<b>wag1</b>	<b>wag2</b>		
21.19	12.02	0.76	47.40	65.18	-65.28	110.30	-41.64		
(99.72)	(79.58)	(3.03)	(231.54)	(414.04)	(472.74)	(753.94)	(264.82)		
<b>aew1</b>	<b>aew2</b>	<b>aew3</b>	<b>aew4</b>	<b>aew5</b>	<b>aew6</b>	<b>aew7</b>	<b>aew8</b>		
0.72	0.93	0.87	0.85	1.00	1.06	1.04	1.00		
(641.11)	(184.62)	(309.47)	(544.49)	0.00	(246.92)	(148.87)	(9.69)		

<b>Equation 2 Food away from home</b>									
<b>inc0</b>	<b>inc1</b>	<b>inc2</b>	<b>inc3</b>	<b>inc4</b>	<b>inc5</b>	<b>reg1</b>	<b>reg2</b>	<b>reg3</b>	<b>siz1</b>
-24.78	0.04	0.05	0.03	0.05	0.03	59.88	26.85	19.63	86.31
(22.51)	(227.74)	(272.05)	(217.39)	(617.24)	(958.06)	(155.81)	(85.76)	(49.61)	(165.64)
<b>siz2</b>	<b>siz3</b>	<b>age1</b>	<b>age2</b>	<b>edu1</b>	<b>edu2</b>	<b>wag1</b>	<b>wag2</b>		
72.07	-19.65	14.03	-48.27	-32.94	41.58	8.47	27.11		
(196.03)	(83.31)	(31.38)	(118.04)	(85.33)	(145.11)	(30.73)	(88.50)		
<b>aew1</b>	<b>aew2</b>	<b>aew3</b>	<b>aew4</b>	<b>aew5</b>	<b>aew6</b>	<b>aew7</b>	<b>aew8</b>		
0.48	0.93	0.81	0.91	1.00	1.01	0.94	0.80		
(281.45)	(37.81)	(101.53)	(81.55)	0.00	(1.88)	(68.75)	(211.17)		

<b>Equation 3 Alcoholic beverages at home</b>									
<b>inc0</b>	<b>inc1</b>	<b>inc2</b>	<b>inc3</b>	<b>inc4</b>	<b>inc5</b>	<b>reg1</b>	<b>reg2</b>	<b>reg3</b>	<b>siz1</b>
13.93	0.00	0.00	0.00	0.00	0.01	-7.52	-12.41	-0.66	-2.63
(21.26)	(21.97)	(24.56)	(26.52)	(11.29)	(127.71)	(23.63)	(30.76)	(1.42)	(18.73)
<b>siz2</b>	<b>siz3</b>	<b>age1</b>	<b>age2</b>	<b>edu1</b>	<b>edu2</b>	<b>wag1</b>	<b>wag2</b>		
6.07	0.58	4.21	-20.19	-1.54	4.94	-9.13	-6.04		
(25.33)	(2.22)	(4.33)	(73.53)	(11.30)	(3.48)	(21.79)	(12.32)		
<b>aew1</b>	<b>aew2</b>	<b>aew3</b>	<b>aew4</b>	<b>aew5</b>	<b>aew6</b>	<b>aew7</b>	<b>aew8</b>		
0.28	0.31	0.16	1.03	1.00	1.07	1.06	1.88		
(35.45)	(58.38)	(39.94)	(3.43)	0.00	(3.30)	(13.28)	(57.91)		

<b>Equation 4 Alcoholic beverages away from home</b>									
<b>inc0</b>	<b>inc1</b>	<b>inc2</b>	<b>inc3</b>	<b>inc4</b>	<b>inc5</b>	<b>reg1</b>	<b>reg2</b>	<b>reg3</b>	<b>siz1</b>
14.87	0.00	0.00	0.00	0.00	0.01	-4.41	-24.36	-9.91	11.10
(8.14)	(14.74)	(22.24)	(26.33)	(49.36)	(165.68)	(12.87)	(52.88)	(21.31)	(28.51)
<b>siz2</b>	<b>siz3</b>	<b>age1</b>	<b>age2</b>	<b>edu1</b>	<b>edu2</b>	<b>wag1</b>	<b>wag2</b>		
-1.57	-1.19	11.66	-11.43	2.25	8.22	-8.03	-8.31		
(12.66)	(6.13)	(39.36)	(31.50)	(16.91)	(6.65)	(6.42)	(21.30)		
<b>aew1</b>	<b>aew2</b>	<b>aew3</b>	<b>aew4</b>	<b>aew5</b>	<b>aew6</b>	<b>aew7</b>	<b>aew8</b>		
-0.54	0.04	-0.04	1.44	1.00	0.91	0.62	0.87		
(147.38)	(134.23)	(95.88)	(29.22)	0.00	(5.82)	(49.33)	(17.09)		

<b>Equation 5 Tobacco and smoking supplies</b>									
<b>inc0</b>	<b>inc1</b>	<b>inc2</b>	<b>inc3</b>	<b>inc4</b>	<b>inc5</b>	<b>reg1</b>	<b>reg2</b>	<b>reg3</b>	<b>siz1</b>
-13.96	0.02	0.01	0.00	0.00	0.00	1.86	-2.76	-36.06	17.12
(3.17)	(71.43)	(32.06)	(14.35)	(39.86)	(9.23)	(1.09)	(4.15)	(50.44)	(41.79)
<b>siz2</b>	<b>siz3</b>	<b>age1</b>	<b>age2</b>	<b>edu1</b>	<b>edu2</b>	<b>wag1</b>	<b>wag2</b>		
11.80	7.58	2.45	-29.89	28.86	-81.88	5.23	12.17		
(35.18)	(1.15)	(2.14)	(65.16)	(28.80)	(130.97)	(12.72)	(4.00)		
<b>aew1</b>	<b>aew2</b>	<b>aew3</b>	<b>aew4</b>	<b>aew5</b>	<b>aew6</b>	<b>aew7</b>	<b>aew8</b>		
-0.11	0.11	0.38	0.78	1.00	0.88	0.59	0.17		
(67.90)	(77.03)	(36.39)	(18.28)	0.00	(0.04)	(14.85)	(33.91)		

<b>Equation 6 Footwear</b>									
<b>inc0</b>	<b>inc1</b>	<b>inc2</b>	<b>inc3</b>	<b>inc4</b>	<b>inc5</b>	<b>reg1</b>	<b>reg2</b>	<b>reg3</b>	<b>siz1</b>
0.80	0.00	0.00	0.00	0.00	0.00	-1.53	1.12	0.53	-1.57
(72.29)	(106.67)	(209.17)	(85.00)	(224.62)	(295.10)	(89.74)	(7.77)	(26.89)	(74.40)
<b>siz2</b>	<b>siz3</b>	<b>age1</b>	<b>age2</b>	<b>edu1</b>	<b>edu2</b>	<b>wag1</b>	<b>wag2</b>		
-2.52	2.37	3.22	-3.20	-0.21	0.87	0.00	0.88		
(7.29)	(42.04)	(88.13)	(42.00)	(10.97)	(72.53)	(12.99)	(15.05)		
<b>aew1</b>	<b>aew2</b>	<b>aew3</b>	<b>aew4</b>	<b>aew5</b>	<b>aew6</b>	<b>aew7</b>	<b>aew8</b>		
0.71	1.87	1.41	1.21	1.00	1.05	0.98	0.73		
(90.17)	(101.22)	(93.40)	(46.06)	0.00	(12.13)	(14.08)	(122.35)		

<b>Equation 7 Clothing for women and girls, 2 and over</b>									
<b>inc0</b>	<b>inc1</b>	<b>inc2</b>	<b>inc3</b>	<b>inc4</b>	<b>inc5</b>	<b>reg1</b>	<b>reg2</b>	<b>reg3</b>	<b>siz1</b>
2.77	0.01	0.01	0.01	0.01	0.01	-11.18	-0.51	-1.53	-28.63
(14.29)	(107.96)	(122.76)	(124.32)	(170.59)	(334.48)	(63.20)	(9.71)	(14.19)	(114.62)
<b>siz2</b>	<b>siz3</b>	<b>age1</b>	<b>age2</b>	<b>edu1</b>	<b>edu2</b>	<b>wag1</b>	<b>wag2</b>		
8.39	7.29	-6.16	7.08	-5.52	6.99	-5.45	7.23		
(62.34)	(33.47)	(31.58)	(51.48)	(12.69)	(37.09)	(21.34)	(51.37)		
<b>aew1</b>	<b>aew2</b>	<b>aew3</b>	<b>aew4</b>	<b>aew5</b>	<b>aew6</b>	<b>aew7</b>	<b>aew8</b>		
1.30	1.84	1.34	1.02	1.00	1.04	1.16	0.58		
(14.34)	(93.52)	(28.98)	(11.84)	0.00	(2.21)	(1.49)	(246.60)		

<b>Equation 8 Clothing for men and boys, 2 and over</b>									
<b>inc0</b>	<b>inc1</b>	<b>inc2</b>	<b>inc3</b>	<b>inc4</b>	<b>inc5</b>	<b>reg1</b>	<b>reg2</b>	<b>reg3</b>	<b>siz1</b>
4.47	0.01	0.00	0.01	0.00	0.01	-10.70	-12.07	-9.85	-51.23
(48.03)	(116.17)	(53.75)	(191.18)	(68.65)	(357.14)	(78.08)	(77.06)	(69.90)	(25.27)
<b>siz2</b>	<b>siz3</b>	<b>age1</b>	<b>age2</b>	<b>edu1</b>	<b>edu2</b>	<b>wag1</b>	<b>wag2</b>		
-4.29	2.92	-1.29	7.89	-0.25	10.09	-1.35	5.37		
(35.08)	(19.08)	(21.75)	(68.08)	(6.69)	(95.22)	(10.30)	(52.20)		
<b>aew1</b>	<b>aew2</b>	<b>aew3</b>	<b>aew4</b>	<b>aew5</b>	<b>aew6</b>	<b>aew7</b>	<b>aew8</b>		
1.47	2.83	2.04	1.33	1.00	0.98	0.98	0.45		
(50.73)	(184.09)	(118.15)	(75.36)	0.00	(6.37)	(15.05)	(273.23)		

<b>Equation 9 Clothing for infants</b>									
<b>inc0</b>	<b>inc1</b>	<b>inc2</b>	<b>inc3</b>	<b>inc4</b>	<b>inc5</b>	<b>reg1</b>	<b>reg2</b>	<b>reg3</b>	<b>siz1</b>
-3.64	0.00	0.00	0.00	0.00	0.00	0.31	-0.75	-1.86	-11.98
(20.85)	(78.00)	(29.29)	(46.92)	(73.75)	(22.70)	(12.35)	(8.22)	(39.70)	(57.76)
<b>siz2</b>	<b>siz3</b>	<b>age1</b>	<b>age2</b>	<b>edu1</b>	<b>edu2</b>	<b>wag1</b>	<b>wag2</b>		
-3.46	2.61	4.92	0.69	-0.87	-1.63	0.88	-2.70		
(26.71)	(53.78)	(80.34)	(6.16)	(3.17)	(49.27)	(24.15)	(70.91)		
<b>aew1</b>	<b>aew2</b>	<b>aew3</b>	<b>aew4</b>	<b>aew5</b>	<b>aew6</b>	<b>aew7</b>	<b>aew8</b>		
7.25	-0.52	0.87	1.88	1.00	0.28	1.05	0.20		
(74.60)	(150.41)	(6.78)	(34.98)	0.00	(72.41)	(16.58)	(52.52)		

<b>Equation 10 Travel items</b>									
<b>inc0</b>	<b>inc1</b>	<b>inc2</b>	<b>inc3</b>	<b>inc4</b>	<b>inc5</b>	<b>reg1</b>	<b>reg2</b>	<b>reg3</b>	<b>siz1</b>
-0.38	0.00	0.00	0.00	0.00	0.00	0.26	-0.03	0.47	-0.54
(0.24)	(0.75)	(4.75)	(19.94)	(2.28)	(63.49)	(9.79)	(5.33)	(12.59)	(5.16)
<b>siz2</b>	<b>siz3</b>	<b>age1</b>	<b>age2</b>	<b>edu1</b>	<b>edu2</b>	<b>wag1</b>	<b>wag2</b>		
-0.37	0.16	-0.35	0.37	0.00	1.38	0.16	0.39		
(1.26)	(8.68)	(0.01)	(9.49)	(3.29)	(36.14)	(2.87)	(5.30)		
<b>aew1</b>	<b>aew2</b>	<b>aew3</b>	<b>aew4</b>	<b>aew5</b>	<b>aew6</b>	<b>aew7</b>	<b>aew8</b>		
-0.09	-0.36	0.96	0.83	1.00	0.75	0.52	0.11		
(3.51)	(45.13)	(3.26)	(8.95)	0.00	(9.12)	(18.69)	(17.77)		

<b>Equation 11 Cleaning, laundering, repair of clothing and shoes</b>									
<b>inc0</b>	<b>inc1</b>	<b>inc2</b>	<b>inc3</b>	<b>inc4</b>	<b>inc5</b>	<b>reg1</b>	<b>reg2</b>	<b>reg3</b>	<b>siz1</b>
-0.42	0.00	0.00	0.00	0.00	0.00	-11.31	-4.37	-0.91	7.18
(6.55)	(74.26)	(48.70)	(51.09)	(128.89)	(338.33)	(118.37)	(46.77)	(10.47)	(75.82)
<b>siz2</b>	<b>siz3</b>	<b>age1</b>	<b>age2</b>	<b>edu1</b>	<b>edu2</b>	<b>wag1</b>	<b>wag2</b>		
-0.97	0.89	0.19	-1.40	4.25	11.76	2.04	0.28		
(12.88)	(8.52)	(9.79)	(13.46)	(80.03)	(105.97)	(33.71)	(5.35)		
<b>aew1</b>	<b>aew2</b>	<b>aew3</b>	<b>aew4</b>	<b>aew5</b>	<b>aew6</b>	<b>aew7</b>	<b>aew8</b>		
0.65	0.68	0.62	1.24	1.00	1.08	0.85	0.45		
(75.57)	(106.04)	(99.37)	(43.39)	0.00	(15.76)	(75.73)	(291.94)		

<b>Equation 12 Watches and jewelry</b>									
<b>inc0</b>	<b>inc1</b>	<b>inc2</b>	<b>inc3</b>	<b>inc4</b>	<b>inc5</b>	<b>reg1</b>	<b>reg2</b>	<b>reg3</b>	<b>siz1</b>
-2.66	0.00	0.00	0.00	0.00	0.01	-1.98	-4.50	-5.04	-34.23
(12.39)	(19.31)	(4.82)	(49.47)	(3.38)	(185.88)	(19.87)	(23.57)	(16.72)	(9.12)
<b>siz2</b>	<b>siz3</b>	<b>age1</b>	<b>age2</b>	<b>edu1</b>	<b>edu2</b>	<b>wag1</b>	<b>wag2</b>		
3.07	2.95	-1.02	-3.29	2.27	0.05	-1.30	6.66		
(26.57)	(1.34)	(2.43)	(2.33)	(29.75)	(9.33)	(8.41)	(62.13)		
<b>aew1</b>	<b>aew2</b>	<b>aew3</b>	<b>aew4</b>	<b>aew5</b>	<b>aew6</b>	<b>aew7</b>	<b>aew8</b>		
-1.18	5.13	-0.16	0.62	1.00	0.22	0.42	0.41		
(9.66)	(124.16)	(86.53)	(27.63)	0.00	(107.97)	(119.34)	(202.48)		

<b>Equation 13 Watches and jewelry repair, other clothing services</b>									
<b>inc0</b>	<b>inc1</b>	<b>inc2</b>	<b>inc3</b>	<b>inc4</b>	<b>inc5</b>	<b>reg1</b>	<b>reg2</b>	<b>reg3</b>	<b>siz1</b>
-0.09	0.00	0.00	0.00	0.00	0.00	-0.15	-0.16	-0.12	-0.61
(12.44)	(33.46)	(15.83)	(54.67)	(11.16)	(59.61)	(9.42)	(18.03)	(5.67)	(21.61)
<b>siz2</b>	<b>siz3</b>	<b>age1</b>	<b>age2</b>	<b>edu1</b>	<b>edu2</b>	<b>wag1</b>	<b>wag2</b>		
0.17	0.17	-0.06	0.17	-0.04	0.12	-0.01	0.07		
(40.16)	(24.92)	(8.68)	(9.07)	(20.82)	(6.11)	(3.97)	(2.39)		
<b>aew1</b>	<b>aew2</b>	<b>aew3</b>	<b>aew4</b>	<b>aew5</b>	<b>aew6</b>	<b>aew7</b>	<b>aew8</b>		
2.09	2.24	4.81	0.62	1.00	0.93	1.26	0.54		
(3.27)	(0.12)	(31.12)	(15.74)	0.00	(14.75)	(7.02)	(12.95)		

<b>Equation 14 Personal care services for males and females</b>									
<b>inc0</b>	<b>inc1</b>	<b>inc2</b>	<b>inc3</b>	<b>inc4</b>	<b>inc5</b>	<b>reg1</b>	<b>reg2</b>	<b>reg3</b>	<b>siz1</b>
15.61	0.01	0.01	0.00	0.01	0.00	-15.02	-1.23	-9.31	11.24
(202.14)	(218.80)	(314.07)	(133.18)	(592.86)	(492.23)	(275.94)	(3.24)	(179.90)	(180.33)
<b>siz2</b>	<b>siz3</b>	<b>age1</b>	<b>age2</b>	<b>edu1</b>	<b>edu2</b>	<b>wag1</b>	<b>wag2</b>		
9.42	-4.46	-1.44	2.76	-1.48	15.90	-2.08	1.80		
(164.40)	(94.82)	(39.99)	(26.97)	(51.22)	(266.07)	(25.20)	(21.21)		
<b>aew1</b>	<b>aew2</b>	<b>aew3</b>	<b>aew4</b>	<b>aew5</b>	<b>aew6</b>	<b>aew7</b>	<b>aew8</b>		
0.74	1.06	1.14	1.18	1.00	1.18	1.12	1.37		
(156.21)	(29.75)	(56.73)	(130.71)	0.00	(139.10)	(92.73)	(202.33)		

<b>Equation 15 Personal care equipment</b>									
<u>inc0</u>	<u>inc1</u>	<u>inc2</u>	<u>inc3</u>	<u>inc4</u>	<u>inc5</u>	<u>reg1</u>	<u>reg2</u>	<u>reg3</u>	<u>siz1</u>
-0.09	0.00	0.00	0.00	0.00	0.00	0.05	0.04	0.09	-0.28
(5.52)	(18.36)	(13.29)	(11.75)	(16.32)	(50.90)	(8.87)	(7.09)	(27.52)	(13.24)
<u>siz2</u>	<u>siz3</u>	<u>age1</u>	<u>age2</u>	<u>edu1</u>	<u>edu2</u>	<u>wag1</u>	<u>wag2</u>		
-0.15	0.02	0.01	0.01	-0.05	-0.10	0.05	0.06		
(18.83)	(4.84)	(8.39)	(22.93)	(21.57)	(17.96)	(18.73)	(10.51)		
<u>aew1</u>	<u>aew2</u>	<u>aew3</u>	<u>aew4</u>	<u>aew5</u>	<u>aew6</u>	<u>aew7</u>	<u>aew8</u>		
1.58	4.20	1.23	3.18	1.00	1.20	1.18	0.18		
(15.76)	(0.30)	(7.02)	(19.31)	0.00	(5.64)	(1.57)	(26.31)		

<b>Equation 16 Owned dwellings</b>									
<u>inc0</u>	<u>inc1</u>	<u>inc2</u>	<u>inc3</u>	<u>inc4</u>	<u>inc5</u>	<u>reg1</u>	<u>reg2</u>	<u>reg3</u>	<u>siz1</u>
-15.15	0.13	0.14	0.14	0.18	0.09	-62.87	-116.78	-87.73	-780.02
(1.82)	(52.77)	(49.52)	(51.26)	(111.59)	(147.88)	(20.26)	(28.12)	(1.77)	(17.49)
<u>siz2</u>	<u>siz3</u>	<u>age1</u>	<u>age2</u>	<u>edu1</u>	<u>edu2</u>	<u>wag1</u>	<u>wag2</u>		
-157.42	98.91	-247.42	188.14	-133.36	325.54	-84.75	-6.79		
(7.80)	(3.80)	(27.70)	(7.90)	(14.61)	(55.95)	(3.59)	(6.20)		
<u>aew1</u>	<u>aew2</u>	<u>aew3</u>	<u>aew4</u>	<u>aew5</u>	<u>aew6</u>	<u>aew7</u>	<u>aew8</u>		
0.93	1.07	0.47	0.75	1.00	1.05	0.94	0.65		
(31.66)	(5.32)	(65.65)	(29.34)	0.00	(10.80)	(35.36)	(96.41)		

<b>Equation 17 Rented dwellings</b>									
<u>inc0</u>	<u>inc1</u>	<u>inc2</u>	<u>inc3</u>	<u>inc4</u>	<u>inc5</u>	<u>reg1</u>	<u>reg2</u>	<u>reg3</u>	<u>siz1</u>
91.33	0.02	-0.02	-0.01	0.00	0.00	-159.22	-175.41	45.88	1503.27
(11.28)	(16.03)	(7.54)	(5.34)	(12.13)	(1.32)	(36.46)	(37.31)	(12.29)	(78.33)
<u>siz2</u>	<u>siz3</u>	<u>age1</u>	<u>age2</u>	<u>edu1</u>	<u>edu2</u>	<u>wag1</u>	<u>wag2</u>		
196.91	-111.93	219.81	-120.61	141.02	-30.78	162.93	6.45		
(23.21)	(28.89)	(49.52)	(34.38)	(21.79)	(2.38)	(36.30)	(6.11)		
<u>aew1</u>	<u>aew2</u>	<u>aew3</u>	<u>aew4</u>	<u>aew5</u>	<u>aew6</u>	<u>aew7</u>	<u>aew8</u>		
0.44	0.44	1.11	1.30	1.00	0.53	0.28	0.23		
(34.87)	(40.54)	(19.92)	(4.73)	0.00	(25.00)	(50.73)	(57.92)		

<b>Equation 18 Other lodging</b>									
<u>inc0</u>	<u>inc1</u>	<u>inc2</u>	<u>inc3</u>	<u>inc4</u>	<u>inc5</u>	<u>reg1</u>	<u>reg2</u>	<u>reg3</u>	<u>siz1</u>
5.10	0.00	0.00	0.01	0.01	0.01	-0.50	-7.02	-11.01	-58.65
(12.50)	(1.95)	(25.00)	(47.88)	(69.75)	(100.33)	(4.84)	(9.97)	(23.86)	(49.55)
<u>siz2</u>	<u>siz3</u>	<u>age1</u>	<u>age2</u>	<u>edu1</u>	<u>edu2</u>	<u>wag1</u>	<u>wag2</u>		
-9.14	5.30	-9.44	7.15	-4.82	31.30	-2.55	1.40		
(14.44)	(14.11)	(26.48)	(13.92)	(24.83)	(67.82)	(8.38)	(0.35)		
<u>aew1</u>	<u>aew2</u>	<u>aew3</u>	<u>aew4</u>	<u>aew5</u>	<u>aew6</u>	<u>aew7</u>	<u>aew8</u>		
2.08	1.03	2.44	1.12	1.00	1.91	2.59	2.14		
(15.41)	(20.06)	(32.47)	(2.37)	0.00	(42.74)	(56.79)	(50.93)		

<b>Equation 19 Furniture</b>									
<u>inc0</u>	<u>inc1</u>	<u>inc2</u>	<u>inc3</u>	<u>inc4</u>	<u>inc5</u>	<u>reg1</u>	<u>reg2</u>	<u>reg3</u>	<u>siz1</u>
-7.38	0.00	0.00	0.01	-0.01	0.02	3.35	-1.03	6.00	-32.53
(0.75)	(18.22)	(7.69)	(49.33)	(51.70)	(131.96)	(0.38)	(8.48)	(19.16)	(13.88)
<u>siz2</u>	<u>siz3</u>	<u>age1</u>	<u>age2</u>	<u>edu1</u>	<u>edu2</u>	<u>wag1</u>	<u>wag2</u>		
1.41	0.31	2.22	6.92	3.73	6.34	-2.02	-1.74		
(25.24)	(17.72)	(0.49)	(23.89)	(14.61)	(28.66)	(31.27)	(12.47)		
<u>aew1</u>	<u>aew2</u>	<u>aew3</u>	<u>aew4</u>	<u>aew5</u>	<u>aew6</u>	<u>aew7</u>	<u>aew8</u>		
6.14	5.02	3.00	0.94	1.00	0.63	0.49	0.24		
(82.14)	(82.45)	(33.22)	(5.80)	0.00	(7.08)	(56.23)	(186.83)		

<b>Equation 20 Kitchen and household appliances</b>									
<u>inc0</u>	<u>inc1</u>	<u>inc2</u>	<u>inc3</u>	<u>inc4</u>	<u>inc5</u>	<u>reg1</u>	<u>reg2</u>	<u>reg3</u>	<u>siz1</u>
-12.53	0.00	0.00	0.00	0.01	0.00	3.61	1.00	1.52	-35.38
(30.90)	(68.86)	(49.06)	(35.56)	(121.13)	(110.91)	(21.42)	(10.06)	(2.07)	(57.36)
<u>siz2</u>	<u>siz3</u>	<u>age1</u>	<u>age2</u>	<u>edu1</u>	<u>edu2</u>	<u>wag1</u>	<u>wag2</u>		
-11.72	4.74	-9.27	12.91	2.64	-7.04	3.97	3.88		
(17.23)	(7.01)	(62.28)	(61.73)	(36.71)	(39.41)	(18.65)	(3.20)		
<u>aew1</u>	<u>aew2</u>	<u>aew3</u>	<u>aew4</u>	<u>aew5</u>	<u>aew6</u>	<u>aew7</u>	<u>aew8</u>		
1.58	0.85	0.50	1.15	1.00	1.44	1.32	0.87		
(35.60)	(27.56)	(46.77)	(19.83)	0.00	(40.62)	(23.74)	(15.23)		

<b>Equation 21 China, glassware and utensils</b>									
<u>inc0</u>	<u>inc1</u>	<u>inc2</u>	<u>inc3</u>	<u>inc4</u>	<u>inc5</u>	<u>reg1</u>	<u>reg2</u>	<u>reg3</u>	<u>siz1</u>
-0.32	0.00	0.00	0.00	0.00	0.00	-0.10	-0.35	0.56	-0.21
(13.97)	(17.47)	(3.19)	(35.58)	(22.29)	(66.00)	(1.72)	(8.68)	(28.91)	(9.26)
<u>siz2</u>	<u>siz3</u>	<u>age1</u>	<u>age2</u>	<u>edu1</u>	<u>edu2</u>	<u>wag1</u>	<u>wag2</u>		
1.43	-0.03	-0.11	0.65	0.00	0.42	0.30	0.32		
(42.77)	(0.07)	(21.62)	(9.83)	(4.90)	(22.51)	(24.65)	(21.48)		
<u>aew1</u>	<u>aew2</u>	<u>aew3</u>	<u>aew4</u>	<u>aew5</u>	<u>aew6</u>	<u>aew7</u>	<u>aew8</u>		
4.87	4.59	0.66	1.77	1.00	0.80	0.92	0.11		
(45.79)	(37.11)	(6.04)	(20.96)	0.00	(6.94)	(9.97)	(9.80)		

<b>Equation 22 Floor coverings</b>									
<u>inc0</u>	<u>inc1</u>	<u>inc2</u>	<u>inc3</u>	<u>inc4</u>	<u>inc5</u>	<u>reg1</u>	<u>reg2</u>	<u>reg3</u>	<u>siz1</u>
-0.59	0.00	0.00	0.00	0.00	0.00	0.98	0.06	-0.59	-2.75
(1.39)	(10.39)	(1.50)	(31.18)	(2.86)	(37.08)	(2.43)	(13.79)	(24.83)	(24.38)
<u>siz2</u>	<u>siz3</u>	<u>age1</u>	<u>age2</u>	<u>edu1</u>	<u>edu2</u>	<u>wag1</u>	<u>wag2</u>		
-0.92	0.24	-0.39	0.10	-0.49	0.59	0.16	2.10		
(22.34)	(17.42)	(11.85)	(15.10)	(26.03)	(7.43)	(8.51)	(26.35)		
<u>aw1</u>	<u>aw2</u>	<u>aw3</u>	<u>aw4</u>	<u>aw5</u>	<u>aw6</u>	<u>aw7</u>	<u>aw8</u>		
1.70	0.92	0.00	1.17	1.00	1.09	0.88	0.37		
(6.58)	(12.41)	(19.89)	(25.94)	0.00	(23.83)	(6.67)	(0.22)		

<b>Equation 23 Other durable house furnishings and writing equipmen</b>									
<u>inc0</u>	<u>inc1</u>	<u>inc2</u>	<u>inc3</u>	<u>inc4</u>	<u>inc5</u>	<u>reg1</u>	<u>reg2</u>	<u>reg3</u>	<u>siz1</u>
-0.37	0.00	0.00	0.00	0.00	0.00	2.28	-0.83	2.74	-13.64
(5.60)	(6.66)	(29.79)	(25.06)	(10.87)	(127.93)	(29.03)	(10.29)	(40.45)	(40.19)
<u>siz2</u>	<u>siz3</u>	<u>age1</u>	<u>age2</u>	<u>edu1</u>	<u>edu2</u>	<u>wag1</u>	<u>wag2</u>		
-2.56	1.36	-1.24	-1.08	0.80	0.87	-0.26	-1.88		
(4.51)	(7.41)	(12.02)	(13.11)	(10.51)	(14.31)	(1.09)	(25.18)		
<u>aw1</u>	<u>aw2</u>	<u>aw3</u>	<u>aw4</u>	<u>aw5</u>	<u>aw6</u>	<u>aw7</u>	<u>aw8</u>		
2.51	0.15	-0.79	0.23	1.00	0.73	0.72	0.33		
(39.99)	(76.77)	(44.62)	(35.83)	0.00	(2.85)	(18.94)	(172.22)		

<b>Equation 24 Power and non-power tools</b>									
<u>inc0</u>	<u>inc1</u>	<u>inc2</u>	<u>inc3</u>	<u>inc4</u>	<u>inc5</u>	<u>reg1</u>	<u>reg2</u>	<u>reg3</u>	<u>siz1</u>
-0.71	0.00	0.00	0.00	0.00	0.00	0.29	-0.21	0.33	-1.74
(17.32)	(41.43)	(2.42)	(50.32)	(91.43)	(6.97)	(2.08)	(1.02)	(20.58)	(34.86)
<u>siz2</u>	<u>siz3</u>	<u>age1</u>	<u>age2</u>	<u>edu1</u>	<u>edu2</u>	<u>wag1</u>	<u>wag2</u>		
-0.36	0.62	-0.28	0.14	-0.26	-0.41	0.02	0.29		
(2.63)	(26.81)	(20.46)	(23.00)	(29.13)	(8.55)	(8.19)	(27.45)		
<u>aw1</u>	<u>aw2</u>	<u>aw3</u>	<u>aw4</u>	<u>aw5</u>	<u>aw6</u>	<u>aw7</u>	<u>aw8</u>		
1.75	1.81	0.16	1.60	1.00	1.24	1.32	0.59		
(15.75)	(19.22)	(38.51)	(5.22)	0.00	(33.05)	(26.02)	(45.74)		

<b>Equation 25 Household Textiles</b>									
<u>inc0</u>	<u>inc1</u>	<u>inc2</u>	<u>inc3</u>	<u>inc4</u>	<u>inc5</u>	<u>reg1</u>	<u>reg2</u>	<u>reg3</u>	<u>siz1</u>
0.17	0.00	0.00	0.00	0.00	0.01	9.69	-8.36	-2.43	-48.61
(1.37)	(15.31)	(16.38)	(25.33)	(7.75)	(260.78)	(31.15)	(22.90)	(4.80)	(40.73)
<u>siz2</u>	<u>siz3</u>	<u>age1</u>	<u>age2</u>	<u>edu1</u>	<u>edu2</u>	<u>wag1</u>	<u>wag2</u>		
-16.70	2.49	-11.06	14.83	0.55	2.44	4.84	3.48		
(32.38)	(14.55)	(50.79)	(34.88)	(2.74)	(7.58)	(9.34)	(0.03)		
<u>aw1</u>	<u>aw2</u>	<u>aw3</u>	<u>aw4</u>	<u>aw5</u>	<u>aw6</u>	<u>aw7</u>	<u>aw8</u>		
1.45	0.07	0.41	0.22	1.00	0.18	0.25	0.04		
(5.27)	(195.55)	(78.35)	(132.40)	0.00	(213.18)	(292.77)	(293.69)		

<b>Equation 26 Semi-durable house furnishings</b>									
<u>inc0</u>	<u>inc1</u>	<u>inc2</u>	<u>inc3</u>	<u>inc4</u>	<u>inc5</u>	<u>reg1</u>	<u>reg2</u>	<u>reg3</u>	<u>siz1</u>
-2.43	0.00	0.00	0.00	0.00	0.00	0.77	0.36	1.85	-10.03
(1.04)	(7.78)	(10.95)	(6.52)	(37.84)	(123.24)	(9.50)	(4.63)	(22.51)	(3.50)
<u>siz2</u>	<u>siz3</u>	<u>age1</u>	<u>age2</u>	<u>edu1</u>	<u>edu2</u>	<u>wag1</u>	<u>wag2</u>		
5.48	0.65	0.12	0.22	-0.87	2.82	0.63	1.04		
(49.85)	(4.27)	(13.80)	(6.82)	(14.88)	(26.48)	(0.73)	(8.58)		
<u>aw1</u>	<u>aw2</u>	<u>aw3</u>	<u>aw4</u>	<u>aw5</u>	<u>aw6</u>	<u>aw7</u>	<u>aw8</u>		
2.18	1.29	0.73	0.52	1.00	0.54	0.68	0.05		
(47.92)	(8.82)	(18.02)	(23.19)	0.00	(9.19)	(19.56)	(10.32)		

<b>Equation 27 Cleaning and lighting supplies</b>									
<u>inc0</u>	<u>inc1</u>	<u>inc2</u>	<u>inc3</u>	<u>inc4</u>	<u>inc5</u>	<u>reg1</u>	<u>reg2</u>	<u>reg3</u>	<u>siz1</u>
-0.01	0.00	0.00	0.00	0.00	0.00	0.05	0.01	0.02	0.00
(0.64)	(2.00)	(7.83)	(4.55)	(55.00)	(51.58)	(31.25)	(9.57)	(1.95)	(3.93)
<u>siz2</u>	<u>siz3</u>	<u>age1</u>	<u>age2</u>	<u>edu1</u>	<u>edu2</u>	<u>wag1</u>	<u>wag2</u>		
0.02	0.01	-0.02	0.01	0.00	-0.01	-0.01	-0.03		
(10.53)	(11.92)	(6.67)	(10.83)	(1.20)	(42.14)	(3.42)	(30.77)		
<u>aw1</u>	<u>aw2</u>	<u>aw3</u>	<u>aw4</u>	<u>aw5</u>	<u>aw6</u>	<u>aw7</u>	<u>aw8</u>		
1.78	34.72	8.27	1.27	1.00	2.70	4.32	0.84		
(10.05)	(43.32)	(36.11)	(25.08)	0.00	(7.61)	(7.74)	(7.12)		

<b>Equation 28 Electricity</b>									
<u>inc0</u>	<u>inc1</u>	<u>inc2</u>	<u>inc3</u>	<u>inc4</u>	<u>inc5</u>	<u>reg1</u>	<u>reg2</u>	<u>reg3</u>	<u>siz1</u>
31.51	0.03	0.02	0.01	0.01	0.01	3.44	96.00	-39.78	48.42
(110.80)	(334.52)	(212.05)	(170.00)	(211.58)	(511.82)	(3.69)	(495.61)	(219.77)	(210.25)
<u>siz2</u>	<u>siz3</u>	<u>age1</u>	<u>age2</u>	<u>edu1</u>	<u>edu2</u>	<u>wag1</u>	<u>wag2</u>		
14.67	3.45	9.27	10.02	1.49	-27.08	8.18	-18.39		
(86.16)	(22.48)	(34.87)	(34.47)	(32.22)	(182.22)	(67.83)	(92.34)		
<u>aw1</u>	<u>aw2</u>	<u>aw3</u>	<u>aw4</u>	<u>aw5</u>	<u>aw6</u>	<u>aw7</u>	<u>aw8</u>		
0.73	0.77	0.82	0.91	1.00	1.15	1.31	1.21		
(126.73)	(124.53)	(85.54)	(61.73)	0.00	(104.53)	(207.47)	(137.73)		

<b>Equation 29 Natural gas</b>									
<b>inc0</b>	<b>inc1</b>	<b>inc2</b>	<b>inc3</b>	<b>inc4</b>	<b>inc5</b>	<b>reg1</b>	<b>reg2</b>	<b>reg3</b>	<b>siz1</b>
18.48	0.01	0.00	0.01	0.00	0.00	30.69	-44.17	-17.35	5.57
(67.28)	(59.66)	(37.05)	(37.44)	(73.38)	(83.16)	(30.72)	(142.27)	(114.37)	(59.11)
<b>siz2</b>	<b>siz3</b>	<b>age1</b>	<b>age2</b>	<b>edu1</b>	<b>edu2</b>	<b>wag1</b>	<b>wag2</b>		
-7.54	12.49	-3.63	13.62	-1.54	4.73	3.07	-6.52		
(9.20)	(28.86)	(17.33)	(26.90)	(14.04)	(3.20)	(17.81)	(17.28)		
<b>aew1</b>	<b>aew2</b>	<b>aew3</b>	<b>aew4</b>	<b>aew5</b>	<b>aew6</b>	<b>aew7</b>	<b>aew8</b>		
0.47	0.73	0.42	0.94	1.00	1.07	0.98	1.03		
(33.04)	(14.46)	(41.03)	(7.39)	0.00	(12.56)	(18.22)	(28.23)		

<b>Equation 30 Water and other public services</b>									
<b>inc0</b>	<b>inc1</b>	<b>inc2</b>	<b>inc3</b>	<b>inc4</b>	<b>inc5</b>	<b>reg1</b>	<b>reg2</b>	<b>reg3</b>	<b>siz1</b>
-16.05	0.01	0.01	0.01	0.00	0.00	17.86	27.07	24.67	-11.34
(21.36)	(88.58)	(62.21)	(73.11)	(84.60)	(134.29)	(86.82)	(129.33)	(132.25)	(39.00)
<b>siz2</b>	<b>siz3</b>	<b>age1</b>	<b>age2</b>	<b>edu1</b>	<b>edu2</b>	<b>wag1</b>	<b>wag2</b>		
-1.41	4.89	-6.93	11.77	-11.77	3.90	-1.39	-1.52		
(12.14)	(3.03)	(21.45)	(43.84)	(42.69)	(13.18)	(2.67)	(20.07)		
<b>aew1</b>	<b>aew2</b>	<b>aew3</b>	<b>aew4</b>	<b>aew5</b>	<b>aew6</b>	<b>aew7</b>	<b>aew8</b>		
0.89	1.19	0.97	0.91	1.00	1.37	1.47	1.50		
(57.29)	(3.76)	(14.01)	(15.00)	0.00	(32.35)	(42.80)	(49.61)		

<b>Equation 31 Fuel oil and other fuels</b>									
<b>inc0</b>	<b>inc1</b>	<b>inc2</b>	<b>inc3</b>	<b>inc4</b>	<b>inc5</b>	<b>reg1</b>	<b>reg2</b>	<b>reg3</b>	<b>siz1</b>
14.60	0.00	0.00	0.00	0.00	0.00	-20.25	-21.05	-22.10	-2.86
(45.67)	(31.70)	(7.98)	(6.99)	(30.77)	(10.25)	(71.40)	(72.44)	(72.82)	(0.59)
<b>siz2</b>	<b>siz3</b>	<b>age1</b>	<b>age2</b>	<b>edu1</b>	<b>edu2</b>	<b>wag1</b>	<b>wag2</b>		
-0.56	1.39	-1.07	0.56	-0.29	-1.65	0.88	0.74		
(13.70)	(12.58)	(0.51)	(17.65)	(1.86)	(14.77)	(16.77)	(1.89)		
<b>aew1</b>	<b>aew2</b>	<b>aew3</b>	<b>aew4</b>	<b>aew5</b>	<b>aew6</b>	<b>aew7</b>	<b>aew8</b>		
0.92	0.48	1.20	0.58	1.00	1.76	2.18	2.46		
(37.02)	(58.09)	(9.65)	(26.34)	0.00	(15.91)	(20.87)	(25.28)		

<b>Equation 32 Telephone equipment and services</b>									
<b>inc0</b>	<b>inc1</b>	<b>inc2</b>	<b>inc3</b>	<b>inc4</b>	<b>inc5</b>	<b>reg1</b>	<b>reg2</b>	<b>reg3</b>	<b>siz1</b>
13.94	0.03	0.02	0.03	0.02	0.01	-10.98	14.30	-22.49	173.04
(92.35)	(627.45)	(345.10)	(543.48)	(661.54)	(858.40)	(92.75)	(145.07)	(193.74)	(660.38)
<b>siz2</b>	<b>siz3</b>	<b>age1</b>	<b>age2</b>	<b>edu1</b>	<b>edu2</b>	<b>wag1</b>	<b>wag2</b>		
30.01	-2.86	1.98	1.76	9.71	2.48	33.51	0.26		
(222.64)	(57.48)	(38.46)	(9.74)	(103.60)	(21.92)	(327.95)	(8.58)		
<b>aew1</b>	<b>aew2</b>	<b>aew3</b>	<b>aew4</b>	<b>aew5</b>	<b>aew6</b>	<b>aew7</b>	<b>aew8</b>		
0.66	0.68	0.96	1.04	1.00	0.90	0.86	0.67		
(328.02)	(391.34)	(28.31)	(69.94)	0.00	(192.90)	(268.23)	(696.82)		

<b>Equation 33 Domestic services</b>									
<b>inc0</b>	<b>inc1</b>	<b>inc2</b>	<b>inc3</b>	<b>inc4</b>	<b>inc5</b>	<b>reg1</b>	<b>reg2</b>	<b>reg3</b>	<b>siz1</b>
15.14	0.00	0.00	0.00	0.01	0.01	-0.86	4.15	7.11	15.10
(34.76)	(19.25)	(24.14)	(34.73)	(94.31)	(100.80)	(0.79)	(31.18)	(41.05)	(37.38)
<b>siz2</b>	<b>siz3</b>	<b>age1</b>	<b>age2</b>	<b>edu1</b>	<b>edu2</b>	<b>wag1</b>	<b>wag2</b>		
-18.83	-8.88	-5.06	2.15	0.57	15.91	-13.62	-11.17		
(29.64)	(62.29)	(37.92)	(6.69)	(15.68)	(58.66)	(77.50)	(42.75)		
<b>aew1</b>	<b>aew2</b>	<b>aew3</b>	<b>aew4</b>	<b>aew5</b>	<b>aew6</b>	<b>aew7</b>	<b>aew8</b>		
16.91	2.20	1.35	-0.14	1.00	0.97	1.01	2.23		
(89.70)	(24.84)	(3.55)	(87.42)	0.00	(7.62)	(1.92)	(43.03)		

<b>Equation 34 Household insurance premiums</b>									
<b>inc0</b>	<b>inc1</b>	<b>inc2</b>	<b>inc3</b>	<b>inc4</b>	<b>inc5</b>	<b>reg1</b>	<b>reg2</b>	<b>reg3</b>	<b>siz1</b>
-16.87	0.01	0.00	0.01	0.00	0.00	7.85	16.15	5.85	-20.52
(29.90)	(59.54)	(33.81)	(71.53)	(57.03)	(134.40)	(37.19)	(79.32)	(37.54)	(1.68)
<b>siz2</b>	<b>siz3</b>	<b>age1</b>	<b>age2</b>	<b>edu1</b>	<b>edu2</b>	<b>wag1</b>	<b>wag2</b>		
-5.82	5.87	-5.23	22.29	-7.48	1.28	-9.27	-6.07		
(6.00)	(10.49)	(21.89)	(61.26)	(30.22)	(3.43)	(28.82)	(34.90)		
<b>aew1</b>	<b>aew2</b>	<b>aew3</b>	<b>aew4</b>	<b>aew5</b>	<b>aew6</b>	<b>aew7</b>	<b>aew8</b>		
0.66	0.63	1.09	0.46	1.00	1.26	1.48	1.19		
(43.07)	(50.64)	(2.50)	(41.30)	0.00	(18.86)	(33.59)	(43.20)		

<b>Equation 35 Other household operations</b>									
<b>inc0</b>	<b>inc1</b>	<b>inc2</b>	<b>inc3</b>	<b>inc4</b>	<b>inc5</b>	<b>reg1</b>	<b>reg2</b>	<b>reg3</b>	<b>siz1</b>
-4.07	0.00	0.00	0.00	0.00	0.00	0.97	4.94	5.70	-9.21
(15.40)	(22.02)	(8.63)	(58.62)	(47.54)	(111.43)	(5.55)	(49.53)	(57.10)	(9.42)
<b>siz2</b>	<b>siz3</b>	<b>age1</b>	<b>age2</b>	<b>edu1</b>	<b>edu2</b>	<b>wag1</b>	<b>wag2</b>		
-5.31	-0.03	-0.53	5.38	-1.20	4.68	-1.00	-0.97		
(30.87)	(19.84)	(13.34)	(57.00)	(20.27)	(54.45)	(19.16)	(19.01)		
<b>aew1</b>	<b>aew2</b>	<b>aew3</b>	<b>aew4</b>	<b>aew5</b>	<b>aew6</b>	<b>aew7</b>	<b>aew8</b>		
1.07	1.82	0.75	0.71	1.00	1.27	1.26	1.70		
(65.67)	(10.35)	(46.00)	(44.39)	0.00	(6.48)	(2.23)	(6.63)		

<b>Equation 36 Prescription drugs, medicines, purchase and rental of medical supplies</b>									
<u>inc0</u>	<u>inc1</u>	<u>inc2</u>	<u>inc3</u>	<u>inc4</u>	<u>inc5</u>	<u>reg1</u>	<u>reg2</u>	<u>reg3</u>	<u>siz1</u>
-50.82	0.01	0.01	0.00	0.01	0.00	15.90	29.13	-3.48	-31.08
(58.99)	(61.45)	(106.18)	(3.35)	(93.33)	(3.11)	(51.63)	(111.12)	(3.25)	(50.25)
<u>siz2</u>	<u>siz3</u>	<u>age1</u>	<u>age2</u>	<u>edu1</u>	<u>edu2</u>	<u>wag1</u>	<u>wag2</u>		
-12.86	13.25	-5.31	26.69	19.13	-9.89	18.33	-3.88		
(36.00)	(37.33)	(18.89)	(86.28)	(98.51)	(43.55)	(82.93)	(21.23)		
<u>aw1</u>	<u>aw2</u>	<u>aw3</u>	<u>aw4</u>	<u>aw5</u>	<u>aw6</u>	<u>aw7</u>	<u>aw8</u>		
0.04	-0.12	0.14	0.69	1.00	1.43	1.86	3.75		
(123.62)	(204.60)	(77.30)	(18.34)	0.00	(39.26)	(60.07)	(102.96)		

<b>Equation 37 Ophthalmic &amp; orthopedic equipment</b>									
<u>inc0</u>	<u>inc1</u>	<u>inc2</u>	<u>inc3</u>	<u>inc4</u>	<u>inc5</u>	<u>reg1</u>	<u>reg2</u>	<u>reg3</u>	<u>siz1</u>
-3.87	0.00	0.00	0.00	0.00	0.00	1.84	1.00	0.20	-6.81
(30.82)	(53.49)	(24.14)	(35.31)	(152.90)	(62.03)	(39.89)	(17.93)	(4.29)	(28.83)
<u>siz2</u>	<u>siz3</u>	<u>age1</u>	<u>age2</u>	<u>edu1</u>	<u>edu2</u>	<u>wag1</u>	<u>wag2</u>		
-1.59	2.18	-0.85	2.20	-0.45	2.92	-0.84	1.26		
(3.70)	(30.86)	(19.70)	(38.43)	(6.66)	(73.02)	(29.48)	(29.16)		
<u>aw1</u>	<u>aw2</u>	<u>aw3</u>	<u>aw4</u>	<u>aw5</u>	<u>aw6</u>	<u>aw7</u>	<u>aw8</u>		
-0.22	1.28	1.21	0.85	1.00	1.09	1.28	0.75		
(134.31)	(97.69)	(54.74)	(82.90)	0.00	(32.21)	(9.76)	(36.87)		

<b>Equation 38 Physicians' services</b>									
<u>inc0</u>	<u>inc1</u>	<u>inc2</u>	<u>inc3</u>	<u>inc4</u>	<u>inc5</u>	<u>reg1</u>	<u>reg2</u>	<u>reg3</u>	<u>siz1</u>
-11.48	0.00	0.00	0.01	0.00	0.00	2.03	6.85	1.30	-40.16
(36.70)	(69.40)	(32.29)	(84.13)	(104.00)	(88.33)	(40.41)	(66.68)	(41.82)	(88.03)
<u>siz2</u>	<u>siz3</u>	<u>age1</u>	<u>age2</u>	<u>edu1</u>	<u>edu2</u>	<u>wag1</u>	<u>wag2</u>		
-13.81	7.11	-0.08	6.08	-7.06	-1.63	8.82	-9.67		
(69.62)	(52.20)	(7.94)	(11.82)	(39.31)	(19.20)	(61.70)	(85.59)		
<u>aw1</u>	<u>aw2</u>	<u>aw3</u>	<u>aw4</u>	<u>aw5</u>	<u>aw6</u>	<u>aw7</u>	<u>aw8</u>		
0.14	0.35	0.97	0.80	1.00	0.91	1.04	0.66		
(176.11)	(166.19)	(4.58)	(14.41)	0.00	(13.96)	(13.50)	(0.32)		

<b>Equation 39 Dental care</b>									
<u>inc0</u>	<u>inc1</u>	<u>inc2</u>	<u>inc3</u>	<u>inc4</u>	<u>inc5</u>	<u>reg1</u>	<u>reg2</u>	<u>reg3</u>	<u>siz1</u>
-2.21	0.00	0.00	0.00	0.00	0.00	-2.10	-0.88	2.23	-9.30
(3.59)	(25.23)	(50.08)	(47.88)	(64.76)	(93.45)	(17.07)	(3.75)	(25.92)	(12.56)
<u>siz2</u>	<u>siz3</u>	<u>age1</u>	<u>age2</u>	<u>edu1</u>	<u>edu2</u>	<u>wag1</u>	<u>wag2</u>		
-2.85	4.86	-3.03	4.62	-4.26	8.55	0.40	-2.20		
(14.53)	(30.43)	(29.21)	(21.82)	(37.83)	(53.72)	(3.32)	(28.31)		
<u>aw1</u>	<u>aw2</u>	<u>aw3</u>	<u>aw4</u>	<u>aw5</u>	<u>aw6</u>	<u>aw7</u>	<u>aw8</u>		
0.05	3.79	2.62	0.99	1.00	1.78	2.56	3.14		
(36.47)	(41.89)	(23.08)	(11.98)	0.00	(26.17)	(50.11)	(61.69)		

<b>Equation 40 Other services by medical professionals</b>									
<u>inc0</u>	<u>inc1</u>	<u>inc2</u>	<u>inc3</u>	<u>inc4</u>	<u>inc5</u>	<u>reg1</u>	<u>reg2</u>	<u>reg3</u>	<u>siz1</u>
-6.13	0.00	0.00	0.00	0.00	0.00	-0.52	-1.80	-0.09	-7.54
(27.98)	(22.99)	(6.69)	(43.23)	(15.89)	(60.59)	(15.19)	(2.26)	(7.54)	(19.49)
<u>siz2</u>	<u>siz3</u>	<u>age1</u>	<u>age2</u>	<u>edu1</u>	<u>edu2</u>	<u>wag1</u>	<u>wag2</u>		
-4.02	3.61	1.53	5.44	-0.82	5.13	4.09	2.22		
(36.34)	(32.37)	(24.13)	(31.00)	(2.06)	(46.54)	(32.07)	(13.92)		
<u>aw1</u>	<u>aw2</u>	<u>aw3</u>	<u>aw4</u>	<u>aw5</u>	<u>aw6</u>	<u>aw7</u>	<u>aw8</u>		
-0.29	1.10	4.21	1.09	1.00	3.00	2.59	1.17		
(48.83)	(13.55)	(32.37)	(10.01)	0.00	(37.58)	(35.40)	(39.85)		

<b>Equation 41 Other medical care services and medical care in retirement communities</b>									
<u>inc0</u>	<u>inc1</u>	<u>inc2</u>	<u>inc3</u>	<u>inc4</u>	<u>inc5</u>	<u>reg1</u>	<u>reg2</u>	<u>reg3</u>	<u>siz1</u>
2.08	0.00	0.00	0.00	0.00	0.00	0.88	0.83	0.41	-2.05
(7.52)	(4.96)	(5.85)	(4.07)	(6.86)	(7.66)	(3.15)	(6.49)	(0.19)	(6.91)
<u>siz2</u>	<u>siz3</u>	<u>age1</u>	<u>age2</u>	<u>edu1</u>	<u>edu2</u>	<u>wag1</u>	<u>wag2</u>		
-1.47	-1.23	0.01	-2.17	0.11	0.73	-0.22	-1.44		
(6.71)	(7.56)	(7.72)	(7.65)	(5.25)	(4.25)	(3.70)	(7.17)		
<u>aw1</u>	<u>aw2</u>	<u>aw3</u>	<u>aw4</u>	<u>aw5</u>	<u>aw6</u>	<u>aw7</u>	<u>aw8</u>		
-0.02	0.64	-0.41	0.86	1.00	2.74	1.33	10.02		
(10.07)	(1.32)	(4.37)	(4.98)	0.00	(5.93)	(3.85)	(7.52)		

<b>Equation 44 Health insurance premiums</b>									
<u>inc0</u>	<u>inc1</u>	<u>inc2</u>	<u>inc3</u>	<u>inc4</u>	<u>inc5</u>	<u>reg1</u>	<u>reg2</u>	<u>reg3</u>	<u>siz1</u>
-70.14	0.03	0.02	0.01	0.02	0.00	35.68	62.24	-2.10	-34.65
(42.21)	(94.77)	(80.07)	(39.83)	(130.72)	(41.60)	(51.87)	(90.73)	(12.31)	(14.97)
<u>siz2</u>	<u>siz3</u>	<u>age1</u>	<u>age2</u>	<u>edu1</u>	<u>edu2</u>	<u>wag1</u>	<u>wag2</u>		
-5.97	1.89	-3.39	80.50	-19.90	-9.65	5.56	-3.25		
(13.28)	(4.49)	(8.06)	(100.45)	(43.04)	(36.31)	(21.05)	(17.17)		
<u>aw1</u>	<u>aw2</u>	<u>aw3</u>	<u>aw4</u>	<u>aw5</u>	<u>aw6</u>	<u>aw7</u>	<u>aw8</u>		
1.11	0.70	0.72	0.72	1.00	1.36	1.70	3.38		
(3.45)	(15.30)	(16.49)	(29.44)	0.00	(45.03)	(77.19)	(115.53)		

<b>Equation 45 Banking services</b>									
<u>inc0</u>	<u>inc1</u>	<u>inc2</u>	<u>inc3</u>	<u>inc4</u>	<u>inc5</u>	<u>reg1</u>	<u>reg2</u>	<u>reg3</u>	<u>siz1</u>
-0.29	0.00	0.00	0.00	0.00	0.00	0.22	0.78	0.91	0.70
(5.67)	(65.09)	(91.82)	(24.60)	(147.58)	(38.21)	(2.83)	(51.77)	(82.19)	(105.98)
<u>siz2</u>	<u>siz3</u>	<u>age1</u>	<u>age2</u>	<u>edu1</u>	<u>edu2</u>	<u>wag1</u>	<u>wag2</u>		
-0.39	0.13	-0.13	-0.47	-0.38	-0.50	-0.39	-0.41		
(9.07)	(7.71)	(9.40)	(45.37)	(42.52)	(60.70)	(44.09)	(76.79)		
<u>aew1</u>	<u>aew2</u>	<u>aew3</u>	<u>aew4</u>	<u>aew5</u>	<u>aew6</u>	<u>aew7</u>	<u>aew8</u>		
0.69	1.13	1.28	1.39	1.00	1.52	1.29	1.17		
(58.25)	(42.01)	(5.23)	(27.20)	0.00	(38.04)	(24.81)	(6.77)		

<b>Equation 46 Life and other personal insurance</b>									
<u>inc0</u>	<u>inc1</u>	<u>inc2</u>	<u>inc3</u>	<u>inc4</u>	<u>inc5</u>	<u>reg1</u>	<u>reg2</u>	<u>reg3</u>	<u>siz1</u>
-4.02	0.01	0.01	0.00	0.01	0.00	-0.43	4.61	-9.37	-50.02
(0.37)	(35.56)	(27.12)	(26.61)	(52.36)	(57.59)	(6.12)	(3.34)	(30.16)	(45.82)
<u>siz2</u>	<u>siz3</u>	<u>age1</u>	<u>age2</u>	<u>edu1</u>	<u>edu2</u>	<u>wag1</u>	<u>wag2</u>		
-18.31	6.01	-14.57	11.28	-0.56	5.72	-6.20	-1.90		
(34.67)	(8.43)	(35.01)	(13.05)	(10.76)	(21.41)	(19.50)	(5.45)		
<u>aew1</u>	<u>aew2</u>	<u>aew3</u>	<u>aew4</u>	<u>aew5</u>	<u>aew6</u>	<u>aew7</u>	<u>aew8</u>		
3.25	1.70	1.43	1.01	1.00	2.23	3.54	1.70		
(26.76)	(18.60)	(2.56)	(8.88)	0.00	(30.47)	(42.70)	(42.61)		

<b>Equation 47 Contribution to retirement, pension, social security</b>									
<u>inc0</u>	<u>inc1</u>	<u>inc2</u>	<u>inc3</u>	<u>inc4</u>	<u>inc5</u>	<u>reg1</u>	<u>reg2</u>	<u>reg3</u>	<u>siz1</u>
-29.63	0.09	0.12	0.14	0.16	0.12	146.03	162.06	230.99	-259.28
(7.88)	(28.34)	(36.72)	(49.13)	(90.84)	(204.98)	(23.96)	(18.77)	(26.02)	(13.57)
<u>siz2</u>	<u>siz3</u>	<u>age1</u>	<u>age2</u>	<u>edu1</u>	<u>edu2</u>	<u>wag1</u>	<u>wag2</u>		
-141.33	84.47	29.91	-258.73	-86.58	196.09	-468.97	19.36		
(12.50)	(10.70)	(5.49)	(40.15)	(13.02)	(53.43)	(80.02)	(6.39)		
<u>aew1</u>	<u>aew2</u>	<u>aew3</u>	<u>aew4</u>	<u>aew5</u>	<u>aew6</u>	<u>aew7</u>	<u>aew8</u>		
0.49	0.46	0.11	0.81	1.00	1.08	0.70	0.02		
(63.78)	(84.96)	(113.42)	(36.94)	0.00	(10.27)	(49.57)	(311.13)		

<b>Equation 48 Legal fees</b>									
<u>inc0</u>	<u>inc1</u>	<u>inc2</u>	<u>inc3</u>	<u>inc4</u>	<u>inc5</u>	<u>reg1</u>	<u>reg2</u>	<u>reg3</u>	<u>siz1</u>
-0.47	0.00	0.00	0.00	0.00	0.00	0.09	0.09	0.22	-0.40
(16.71)	(16.55)	(6.89)	(4.80)	(24.74)	(24.58)	(6.16)	(10.37)	(20.41)	(12.84)
<u>siz2</u>	<u>siz3</u>	<u>age1</u>	<u>age2</u>	<u>edu1</u>	<u>edu2</u>	<u>wag1</u>	<u>wag2</u>		
-0.07	0.36	-0.10	-0.19	-0.05	-0.04	0.31	0.00		
(10.93)	(19.25)	(12.53)	(21.31)	(21.87)	(20.50)	(16.61)	(15.27)		
<u>aew1</u>	<u>aew2</u>	<u>aew3</u>	<u>aew4</u>	<u>aew5</u>	<u>aew6</u>	<u>aew7</u>	<u>aew8</u>		
8.56	15.52	16.00	0.01	1.00	4.26	9.75	35.24		
(35.72)	(5.87)	(1.76)	(23.42)	0.00	(10.70)	(18.60)	(20.08)		

<b>Equation 49 Funeral and burial services</b>									
<u>inc0</u>	<u>inc1</u>	<u>inc2</u>	<u>inc3</u>	<u>inc4</u>	<u>inc5</u>	<u>reg1</u>	<u>reg2</u>	<u>reg3</u>	<u>siz1</u>
-2.08	0.00	0.00	0.00	0.00	0.00	2.17	-0.38	-0.35	-2.36
(7.36)	(3.09)	(13.16)	(15.45)	(22.05)	(22.50)	(10.14)	(18.30)	(19.58)	(21.28)
<u>siz2</u>	<u>siz3</u>	<u>age1</u>	<u>age2</u>	<u>edu1</u>	<u>edu2</u>	<u>wag1</u>	<u>wag2</u>		
0.11	2.47	-2.01	0.10	0.26	-0.88	2.00	2.89		
(12.57)	(7.00)	(13.03)	(7.75)	(14.18)	(18.70)	(11.99)	(15.12)		
<u>aew1</u>	<u>aew2</u>	<u>aew3</u>	<u>aew4</u>	<u>aew5</u>	<u>aew6</u>	<u>aew7</u>	<u>aew8</u>		
0.00	-0.18	-0.82	-0.65	1.00	1.19	1.26	13.59		
(6.43)	(28.33)	(20.91)	(27.42)	0.00	(6.71)	(2.61)	(19.61)		

<b>Equation 50 Other personal business</b>									
<u>inc0</u>	<u>inc1</u>	<u>inc2</u>	<u>inc3</u>	<u>inc4</u>	<u>inc5</u>	<u>reg1</u>	<u>reg2</u>	<u>reg3</u>	<u>siz1</u>
-0.29	0.00	0.00	0.00	0.01	0.00	-1.94	-5.90	1.58	-10.80
(0.02)	(9.20)	(20.32)	(16.69)	(61.27)	(80.23)	(4.03)	(16.70)	(6.30)	(10.74)
<u>siz2</u>	<u>siz3</u>	<u>age1</u>	<u>age2</u>	<u>edu1</u>	<u>edu2</u>	<u>wag1</u>	<u>wag2</u>		
-6.07	5.51	1.28	4.89	2.14	-7.07	-7.74	-4.95		
(16.15)	(14.89)	(16.91)	(21.14)	(14.03)	(22.23)	(37.86)	(25.98)		
<u>aew1</u>	<u>aew2</u>	<u>aew3</u>	<u>aew4</u>	<u>aew5</u>	<u>aew6</u>	<u>aew7</u>	<u>aew8</u>		
0.69	0.07	-0.22	0.39	1.00	1.36	1.02	0.43		
(8.75)	(45.29)	(35.13)	(36.50)	0.00	(31.85)	(4.80)	(8.01)		

<b>Equation 51 New cars and trucks</b>									
<u>inc0</u>	<u>inc1</u>	<u>inc2</u>	<u>inc3</u>	<u>inc4</u>	<u>inc5</u>	<u>reg1</u>	<u>reg2</u>	<u>reg3</u>	<u>siz1</u>
-71.04	0.01	0.00	0.01	0.06	0.04	7.40	25.46	6.09	-372.20
(7.17)	(5.24)	(5.12)	(8.06)	(34.51)	(48.80)	(1.36)	(4.87)	(1.66)	(19.26)
<u>siz2</u>	<u>siz3</u>	<u>age1</u>	<u>age2</u>	<u>edu1</u>	<u>edu2</u>	<u>wag1</u>	<u>wag2</u>		
-65.63	12.60	35.41	42.51	-27.32	-128.65	43.22	36.36		
(9.39)	(4.29)	(3.16)	(2.33)	(3.11)	(23.22)	(8.03)	(10.40)		
<u>aew1</u>	<u>aew2</u>	<u>aew3</u>	<u>aew4</u>	<u>aew5</u>	<u>aew6</u>	<u>aew7</u>	<u>aew8</u>		
2.11	2.35	0.91	1.16	1.00	0.26	0.70	0.37		
(5.54)	(3.80)	(4.57)	(2.25)	0.00	(17.04)	(9.92)	(10.11)		

<b>Equation 52 Used cars and trucks</b>									
<u>inc0</u>	<u>inc1</u>	<u>inc2</u>	<u>inc3</u>	<u>inc4</u>	<u>inc5</u>	<u>reg1</u>	<u>reg2</u>	<u>reg3</u>	<u>siz1</u>
-114.80	0.02	0.04	0.04	0.03	0.01	99.53	17.90	-49.58	-287.65
(8.98)	(13.33)	(11.29)	(20.19)	(17.14)	(37.55)	(6.64)	(2.84)	(4.30)	(18.37)
<u>siz2</u>	<u>siz3</u>	<u>age1</u>	<u>age2</u>	<u>edu1</u>	<u>edu2</u>	<u>wag1</u>	<u>wag2</u>		
-133.57	61.86	21.18	-45.38	67.94	-197.61	-14.22	-4.83		
(10.99)	(8.22)	(6.96)	(3.86)	(7.73)	(26.41)	(4.07)	(0.31)		
<u>aw1</u>	<u>aw2</u>	<u>aw3</u>	<u>aw4</u>	<u>aw5</u>	<u>aw6</u>	<u>aw7</u>	<u>aw8</u>		
0.88	0.47	1.85	1.54	1.00	0.19	0.61	0.08		
(10.76)	(6.58)	(16.76)	(8.29)	0.00	(14.04)	(11.31)	(14.00)		

<b>Equation 54 Tires and tubes, accessories, and parts</b>									
<u>inc0</u>	<u>inc1</u>	<u>inc2</u>	<u>inc3</u>	<u>inc4</u>	<u>inc5</u>	<u>reg1</u>	<u>reg2</u>	<u>reg3</u>	<u>siz1</u>
-18.79	0.01	0.01	0.00	0.00	0.00	-3.41	8.09	3.66	-18.13
(35.77)	(87.23)	(98.66)	(60.30)	(153.33)	(13.64)	(25.58)	(39.50)	(26.58)	(6.94)
<u>siz2</u>	<u>siz3</u>	<u>age1</u>	<u>age2</u>	<u>edu1</u>	<u>edu2</u>	<u>wag1</u>	<u>wag2</u>		
-5.23	11.62	1.15	2.88	-10.92	-10.87	7.69	9.34		
(0.19)	(52.44)	(19.08)	(51.32)	(72.58)	(95.21)	(76.78)	(55.61)		
<u>aw1</u>	<u>aw2</u>	<u>aw3</u>	<u>aw4</u>	<u>aw5</u>	<u>aw6</u>	<u>aw7</u>	<u>aw8</u>		
0.26	0.16	1.04	0.57	1.00	0.84	0.82	0.45		
(150.12)	(194.02)	(18.78)	(69.25)	0.00	(17.17)	(39.05)	(170.80)		

<b>Equation 55 Maintenance and repairs of vehicles</b>									
<u>inc0</u>	<u>inc1</u>	<u>inc2</u>	<u>inc3</u>	<u>inc4</u>	<u>inc5</u>	<u>reg1</u>	<u>reg2</u>	<u>reg3</u>	<u>siz1</u>
-4.38	0.03	0.03	0.02	0.04	0.03	-41.42	-63.21	-21.83	-122.69
(22.33)	(133.93)	(149.36)	(113.00)	(309.68)	(602.00)	(130.14)	(168.71)	(76.18)	(68.90)
<u>siz2</u>	<u>siz3</u>	<u>age1</u>	<u>age2</u>	<u>edu1</u>	<u>edu2</u>	<u>wag1</u>	<u>wag2</u>		
-46.87	15.85	-10.14	33.58	-9.02	62.67	-13.04	15.76		
(71.03)	(19.12)	(25.68)	(67.68)	(11.88)	(147.98)	(17.66)	(29.41)		
<u>aw1</u>	<u>aw2</u>	<u>aw3</u>	<u>aw4</u>	<u>aw5</u>	<u>aw6</u>	<u>aw7</u>	<u>aw8</u>		
0.51	0.69	0.78	1.33	1.00	0.83	0.71	0.55		
(178.21)	(146.43)	(105.12)	(137.36)	0.00	(110.20)	(228.08)	(393.05)		

<b>Equation 56 Vehicle rental and other charges</b>									
<u>inc0</u>	<u>inc1</u>	<u>inc2</u>	<u>inc3</u>	<u>inc4</u>	<u>inc5</u>	<u>reg1</u>	<u>reg2</u>	<u>reg3</u>	<u>siz1</u>
-0.59	0.00	0.00	0.00	0.00	0.00	-0.98	-0.45	4.68	-9.40
(8.71)	(22.57)	(37.31)	(40.14)	(118.22)	(176.47)	(6.28)	(9.30)	(48.40)	(5.81)
<u>siz2</u>	<u>siz3</u>	<u>age1</u>	<u>age2</u>	<u>edu1</u>	<u>edu2</u>	<u>wag1</u>	<u>wag2</u>		
-0.66	1.32	-2.51	3.10	-1.23	7.75	-1.39	-0.53		
(4.63)	(8.30)	(17.24)	(11.66)	(9.60)	(79.24)	(28.13)	(9.27)		
<u>aw1</u>	<u>aw2</u>	<u>aw3</u>	<u>aw4</u>	<u>aw5</u>	<u>aw6</u>	<u>aw7</u>	<u>aw8</u>		
1.68	0.98	1.16	0.98	1.00	1.26	0.81	0.36		
(5.00)	(37.92)	(3.99)	(29.62)	0.00	(1.36)	(48.13)	(42.80)		

<b>Equation 57 Vehicle financial charge</b>									
<u>inc0</u>	<u>inc1</u>	<u>inc2</u>	<u>inc3</u>	<u>inc4</u>	<u>inc5</u>	<u>reg1</u>	<u>reg2</u>	<u>reg3</u>	<u>siz1</u>
-14.85	0.01	0.01	0.01	0.01	0.00	29.23	37.99	15.11	-65.35
(7.82)	(44.93)	(43.05)	(39.69)	(66.23)	(73.27)	(57.80)	(70.85)	(33.64)	(27.14)
<u>siz2</u>	<u>siz3</u>	<u>age1</u>	<u>age2</u>	<u>edu1</u>	<u>edu2</u>	<u>wag1</u>	<u>wag2</u>		
-17.29	-4.77	12.57	-11.19	-21.40	-33.65	-20.80	1.41		
(2.69)	(27.54)	(24.37)	(28.84)	(28.61)	(52.24)	(45.46)	(6.80)		
<u>aw1</u>	<u>aw2</u>	<u>aw3</u>	<u>aw4</u>	<u>aw5</u>	<u>aw6</u>	<u>aw7</u>	<u>aw8</u>		
0.56	0.58	0.37	1.36	1.00	0.86	0.77	0.10		
(35.06)	(16.75)	(39.24)	(25.21)	0.00	(11.20)	(8.85)	(59.04)		

<b>Equation 58 Vehicle license and registration</b>									
<u>inc0</u>	<u>inc1</u>	<u>inc2</u>	<u>inc3</u>	<u>inc4</u>	<u>inc5</u>	<u>reg1</u>	<u>reg2</u>	<u>reg3</u>	<u>siz1</u>
-15.37	0.00	0.00	0.00	0.01	0.00	13.62	3.82	17.89	-10.88
(48.17)	(76.14)	(21.17)	(48.21)	(125.61)	(84.90)	(98.39)	(37.51)	(128.74)	(11.24)
<u>siz2</u>	<u>siz3</u>	<u>age1</u>	<u>age2</u>	<u>edu1</u>	<u>edu2</u>	<u>wag1</u>	<u>wag2</u>		
1.13	3.53	4.42	-1.68	-5.36	-10.10	-2.27	0.50		
(24.00)	(15.94)	(26.98)	(20.39)	(46.57)	(79.95)	(19.24)	(13.22)		
<u>aw1</u>	<u>aw2</u>	<u>aw3</u>	<u>aw4</u>	<u>aw5</u>	<u>aw6</u>	<u>aw7</u>	<u>aw8</u>		
0.44	0.67	0.77	0.61	1.00	0.90	1.13	0.92		
(83.32)	(58.87)	(12.25)	(58.58)	0.00	(23.42)	(9.47)	(5.06)		

<b>Equation 59 Gasoline and motor oil</b>									
<u>inc0</u>	<u>inc1</u>	<u>inc2</u>	<u>inc3</u>	<u>inc4</u>	<u>inc5</u>	<u>reg1</u>	<u>reg2</u>	<u>reg3</u>	<u>siz1</u>
-31.77	0.06	0.05	0.03	0.03	0.01	76.99	90.51	63.85	-23.16
(10.81)	(243.25)	(187.40)	(145.93)	(230.77)	(213.14)	(120.68)	(156.36)	(102.34)	(25.78)
<u>siz2</u>	<u>siz3</u>	<u>age1</u>	<u>age2</u>	<u>edu1</u>	<u>edu2</u>	<u>wag1</u>	<u>wag2</u>		
5.67	10.27	-11.04	-31.98	-36.23	-73.24	-27.79	-5.47		
(24.96)	(4.12)	(16.33)	(56.33)	(50.70)	(170.12)	(40.66)	(8.65)		
<u>aw1</u>	<u>aw2</u>	<u>aw3</u>	<u>aw4</u>	<u>aw5</u>	<u>aw6</u>	<u>aw7</u>	<u>aw8</u>		
0.46	0.51	0.80	0.95	1.00	0.97	0.95	0.64		
(213.82)	(233.32)	(79.07)	(28.76)	0.00	(24.00)	(38.83)	(235.33)		



**Equation 60 Tolls on out-of-town trips**

<u>inc0</u>	<u>inc1</u>	<u>inc2</u>	<u>inc3</u>	<u>inc4</u>	<u>inc5</u>	<u>reg1</u>	<u>reg2</u>	<u>reg3</u>	<u>siz1</u>
0.61	0.00	0.00	0.00	0.00	0.00	-0.83	-0.89	-1.02	-0.52
(23.30)	(3.91)	(12.00)	(17.20)	(15.15)	(40.23)	(37.51)	(38.57)	(40.05)	(12.41)
<u>siz2</u>	<u>siz3</u>	<u>age1</u>	<u>age2</u>	<u>edu1</u>	<u>edu2</u>	<u>wag1</u>	<u>wag2</u>		
-0.14	0.12	-0.11	-0.07	0.00	0.28	0.11	0.00		
(3.60)	(9.51)	(15.65)	(14.44)	(3.66)	(23.52)	(16.65)	(5.57)		
<u>aew1</u>	<u>aew2</u>	<u>aew3</u>	<u>aew4</u>	<u>aew5</u>	<u>aew6</u>	<u>aew7</u>	<u>aew8</u>		
1.31	0.78	0.24	1.25	1.00	1.79	1.62	0.79		
(7.34)	(26.36)	(26.77)	(10.67)	0.00	(14.68)	(5.28)	(13.40)		

**Equation 61 Vehicle insurance**

<u>inc0</u>	<u>inc1</u>	<u>inc2</u>	<u>inc3</u>	<u>inc4</u>	<u>inc5</u>	<u>reg1</u>	<u>reg2</u>	<u>reg3</u>	<u>siz1</u>
6.64	0.03	0.03	0.03	0.02	0.00	-19.47	-1.13	-10.38	-77.52
(28.39)	(194.34)	(184.81)	(182.96)	(216.22)	(269.55)	(80.37)	(18.12)	(47.73)	(33.42)
<u>siz2</u>	<u>siz3</u>	<u>age1</u>	<u>age2</u>	<u>edu1</u>	<u>edu2</u>	<u>wag1</u>	<u>wag2</u>		
-31.92	12.89	-15.37	-15.04	-33.04	-31.43	8.08	9.34		
(34.77)	(27.24)	(32.27)	(45.13)	(71.50)	(113.09)	(51.98)	(18.20)		
<u>aew1</u>	<u>aew2</u>	<u>aew3</u>	<u>aew4</u>	<u>aew5</u>	<u>aew6</u>	<u>aew7</u>	<u>aew8</u>		
0.30	0.37	1.55	1.25	1.00	0.92	1.07	0.86		
(255.51)	(285.66)	(148.11)	(99.88)	0.00	(18.81)	(14.77)	(30.32)		

**Equation 62 Local transportation (excl. taxis)**

<u>inc0</u>	<u>inc1</u>	<u>inc2</u>	<u>inc3</u>	<u>inc4</u>	<u>inc5</u>	<u>reg1</u>	<u>reg2</u>	<u>reg3</u>	<u>siz1</u>
7.93	0.00	0.00	0.00	0.00	0.00	-11.51	-11.06	-9.14	1.64
(52.83)	(3.74)	(10.96)	(3.77)	(43.73)	(67.65)	(81.52)	(81.05)	(77.26)	(24.98)
<u>siz2</u>	<u>siz3</u>	<u>age1</u>	<u>age2</u>	<u>edu1</u>	<u>edu2</u>	<u>wag1</u>	<u>wag2</u>		
-0.87	0.65	0.62	-0.20	3.03	3.05	-0.03	1.72		
(4.50)	(3.95)	(15.48)	(6.27)	(39.22)	(38.08)	(15.03)	(29.32)		
<u>aew1</u>	<u>aew2</u>	<u>aew3</u>	<u>aew4</u>	<u>aew5</u>	<u>aew6</u>	<u>aew7</u>	<u>aew8</u>		
0.04	0.87	0.36	1.75	1.00	1.56	0.95	1.13		
(58.18)	(21.49)	(69.72)	(15.32)	0.00	(32.16)	(14.58)	(17.41)		

**Equation 63 Taxis**

<u>inc0</u>	<u>inc1</u>	<u>inc2</u>	<u>inc3</u>	<u>inc4</u>	<u>inc5</u>	<u>reg1</u>	<u>reg2</u>	<u>reg3</u>	<u>siz1</u>
0.62	0.00	0.00	0.00	0.00	0.00	-0.69	-0.87	-0.51	0.03
(21.53)	(2.59)	(3.38)	(14.19)	(10.47)	(73.54)	(43.03)	(52.28)	(31.78)	(16.68)
<u>siz2</u>	<u>siz3</u>	<u>age1</u>	<u>age2</u>	<u>edu1</u>	<u>edu2</u>	<u>wag1</u>	<u>wag2</u>		
-0.25	-0.21	0.12	-0.09	0.14	0.53	0.02	0.14		
(14.24)	(22.73)	(15.71)	(7.98)	(17.41)	(31.31)	(14.51)	(15.35)		
<u>aew1</u>	<u>aew2</u>	<u>aew3</u>	<u>aew4</u>	<u>aew5</u>	<u>aew6</u>	<u>aew7</u>	<u>aew8</u>		
-0.84	2.03	2.09	2.38	1.00	1.53	1.99	3.36		
(39.86)	(18.21)	(27.36)	(6.70)	0.00	(8.63)	(2.49)	(21.73)		

**Equation 64 Intercity train fares on out-of-town trips**

<u>inc0</u>	<u>inc1</u>	<u>inc2</u>	<u>inc3</u>	<u>inc4</u>	<u>inc5</u>	<u>reg1</u>	<u>reg2</u>	<u>reg3</u>	<u>siz1</u>
0.36	0.00	0.00	0.00	0.00	0.00	0.05	-0.33	0.01	-1.01
(3.85)	(2.22)	(17.75)	(16.95)	(5.95)	(54.94)	(5.99)	(17.39)	(4.73)	(24.58)
<u>siz2</u>	<u>siz3</u>	<u>age1</u>	<u>age2</u>	<u>edu1</u>	<u>edu2</u>	<u>wag1</u>	<u>wag2</u>		
-0.12	-0.36	0.38	0.48	0.10	0.64	-0.73	0.04		
(12.34)	(14.51)	(14.25)	(30.35)	(2.95)	(29.43)	(5.56)	(4.30)		
<u>aew1</u>	<u>aew2</u>	<u>aew3</u>	<u>aew4</u>	<u>aew5</u>	<u>aew6</u>	<u>aew7</u>	<u>aew8</u>		
-1.57	-0.54	2.63	1.47	1.00	2.14	1.57	4.16		
(56.63)	(36.46)	(31.10)	(1.83)	0.00	(30.01)	(16.57)	(29.95)		

**Equation 65 Intercity bus fares on out-of-town trips**

<u>inc0</u>	<u>inc1</u>	<u>inc2</u>	<u>inc3</u>	<u>inc4</u>	<u>inc5</u>	<u>reg1</u>	<u>reg2</u>	<u>reg3</u>	<u>siz1</u>
0.32	0.00	0.00	0.00	0.00	0.00	-0.17	-0.28	-0.12	-0.58
(0.09)	(10.09)	(17.25)	(6.68)	(24.94)	(65.73)	(12.71)	(11.90)	(0.80)	(12.96)
<u>siz2</u>	<u>siz3</u>	<u>age1</u>	<u>age2</u>	<u>edu1</u>	<u>edu2</u>	<u>wag1</u>	<u>wag2</u>		
-0.37	-0.23	-0.01	0.27	0.04	0.21	-0.50	0.04		
(33.27)	(9.09)	(4.73)	(32.05)	(5.24)	(12.01)	(22.18)	(8.44)		
<u>aew1</u>	<u>aew2</u>	<u>aew3</u>	<u>aew4</u>	<u>aew5</u>	<u>aew6</u>	<u>aew7</u>	<u>aew8</u>		
-1.15	0.15	2.98	1.86	1.00	2.13	1.71	4.49		
(47.88)	(19.42)	(37.11)	(5.19)	0.00	(27.38)	(2.94)	(27.88)		

**Equation 66 Airline fares on out-of-town trips**

<u>inc0</u>	<u>inc1</u>	<u>inc2</u>	<u>inc3</u>	<u>inc4</u>	<u>inc5</u>	<u>reg1</u>	<u>reg2</u>	<u>reg3</u>	<u>siz1</u>
9.91	0.00	0.00	0.01	0.01	0.01	-1.09	-11.95	17.01	-33.07
(1.73)	(9.42)	(18.05)	(31.47)	(51.79)	(145.19)	(4.26)	(29.60)	(23.83)	(5.84)
<u>siz2</u>	<u>siz3</u>	<u>age1</u>	<u>age2</u>	<u>edu1</u>	<u>edu2</u>	<u>wag1</u>	<u>wag2</u>		
-6.87	-0.85	-6.19	-2.70	-0.82	38.97	-9.33	-6.19		
(8.63)	(9.69)	(3.80)	(5.45)	(10.61)	(50.29)	(9.72)	(12.30)		
<u>aew1</u>	<u>aew2</u>	<u>aew3</u>	<u>aew4</u>	<u>aew5</u>	<u>aew6</u>	<u>aew7</u>	<u>aew8</u>		
0.31	0.32	0.89	0.93	1.00	0.72	0.73	1.21		
(20.39)	(67.79)	(34.09)	(7.59)	0.00	(9.61)	(36.09)	(27.40)		

**Equation 67 Ship fares on out-of-town trips**

<u>inc0</u>	<u>inc1</u>	<u>inc2</u>	<u>inc3</u>	<u>inc4</u>	<u>inc5</u>	<u>reg1</u>	<u>reg2</u>	<u>reg3</u>	<u>siz1</u>
1.64	0.00	0.00	0.00	0.00	0.00	-0.09	-0.65	-0.72	-0.86
(8.66)	(1.28)	(4.16)	(16.74)	(5.08)	(42.62)	(1.32)	(18.56)	(5.33)	(8.50)
<u>siz2</u>	<u>siz3</u>	<u>age1</u>	<u>age2</u>	<u>edu1</u>	<u>edu2</u>	<u>wag1</u>	<u>wag2</u>		
0.70	-0.66	-0.18	-0.80	0.19	0.28	-1.20	0.26		
(6.75)	(8.10)	(4.67)	(11.92)	(5.27)	(6.61)	(6.10)	(0.95)		
<u>aw1</u>	<u>aw2</u>	<u>aw3</u>	<u>aw4</u>	<u>aw5</u>	<u>aw6</u>	<u>aw7</u>	<u>aw8</u>		
-2.95	-0.65	3.09	2.74	1.00	1.22	2.52	8.47		
(29.33)	(15.07)	(12.02)	(16.42)	0.00	(5.54)	(12.07)	(29.30)		

**Equation 68 Readings**

<u>inc0</u>	<u>inc1</u>	<u>inc2</u>	<u>inc3</u>	<u>inc4</u>	<u>inc5</u>	<u>reg1</u>	<u>reg2</u>	<u>reg3</u>	<u>siz1</u>
3.04	0.00	0.00	0.00	0.01	0.00	-0.56	-8.16	-2.87	10.22
(17.69)	(31.78)	(81.49)	(83.25)	(212.59)	(164.58)	(1.82)	(72.72)	(18.29)	(104.98)
<u>siz2</u>	<u>siz3</u>	<u>age1</u>	<u>age2</u>	<u>edu1</u>	<u>edu2</u>	<u>wag1</u>	<u>wag2</u>		
4.40	1.84	-0.34	6.41	-6.31	20.71	0.56	0.49		
(59.49)	(18.61)	(8.76)	(70.44)	(58.68)	(200.86)	(11.25)	(0.55)		
<u>aw1</u>	<u>aw2</u>	<u>aw3</u>	<u>aw4</u>	<u>aw5</u>	<u>aw6</u>	<u>aw7</u>	<u>aw8</u>		
1.08	0.96	0.59	0.64	1.00	1.35	1.38	1.24		
(6.71)	(5.60)	(52.08)	(70.36)	0.00	(75.29)	(75.50)	(49.21)		

**Equation 69 Pets, pets supplies, and pet services**

<u>inc0</u>	<u>inc1</u>	<u>inc2</u>	<u>inc3</u>	<u>inc4</u>	<u>inc5</u>	<u>reg1</u>	<u>reg2</u>	<u>reg3</u>	<u>siz1</u>
-10.22	0.00	0.01	0.01	0.01	0.01	12.22	18.32	6.65	-91.95
(0.86)	(14.52)	(19.72)	(27.74)	(28.59)	(146.51)	(13.97)	(28.46)	(3.50)	(52.97)
<u>siz2</u>	<u>siz3</u>	<u>age1</u>	<u>age2</u>	<u>edu1</u>	<u>edu2</u>	<u>wag1</u>	<u>wag2</u>		
-47.90	-7.12	0.58	7.47	-11.81	5.80	12.35	-0.58		
(54.14)	(10.62)	(3.62)	(1.40)	(12.24)	(19.59)	(16.10)	(7.22)		
<u>aw1</u>	<u>aw2</u>	<u>aw3</u>	<u>aw4</u>	<u>aw5</u>	<u>aw6</u>	<u>aw7</u>	<u>aw8</u>		
-0.25	0.34	0.17	0.43	1.00	0.74	0.60	0.32		
(123.44)	(99.65)	(64.92)	(60.38)	0.00	(32.44)	(95.84)	(7.74)		

**Equation 70 Toys and playground equipment**

<u>inc0</u>	<u>inc1</u>	<u>inc2</u>	<u>inc3</u>	<u>inc4</u>	<u>inc5</u>	<u>reg1</u>	<u>reg2</u>	<u>reg3</u>	<u>siz1</u>
-5.16	0.00	0.00	0.00	0.00	0.00	1.13	0.10	-1.11	-18.91
(9.90)	(57.83)	(33.33)	(50.45)	(13.05)	(115.56)	(23.49)	(12.27)	(15.86)	(28.76)
<u>siz2</u>	<u>siz3</u>	<u>age1</u>	<u>age2</u>	<u>edu1</u>	<u>edu2</u>	<u>wag1</u>	<u>wag2</u>		
-1.77	4.08	1.69	3.09	-2.89	1.59	1.34	-2.36		
(3.70)	(47.83)	(21.67)	(34.56)	(26.45)	(13.62)	(1.10)	(41.48)		
<u>aw1</u>	<u>aw2</u>	<u>aw3</u>	<u>aw4</u>	<u>aw5</u>	<u>aw6</u>	<u>aw7</u>	<u>aw8</u>		
6.54	2.47	-0.04	0.46	1.00	0.90	0.81	0.25		
(71.92)	(29.10)	(17.13)	(36.90)	0.00	(27.48)	(8.52)	(1.57)		

**Equation 71 Bicycles**

<u>inc0</u>	<u>inc1</u>	<u>inc2</u>	<u>inc3</u>	<u>inc4</u>	<u>inc5</u>	<u>reg1</u>	<u>reg2</u>	<u>reg3</u>	<u>siz1</u>
-0.60	0.00	0.00	0.00	0.00	0.00	-0.17	-0.27	0.69	-1.40
(3.02)	(0.27)	(2.41)	(3.28)	(3.39)	(3.42)	(0.51)	(2.28)	(3.14)	(3.24)
<u>siz2</u>	<u>siz3</u>	<u>age1</u>	<u>age2</u>	<u>edu1</u>	<u>edu2</u>	<u>wag1</u>	<u>wag2</u>		
-0.53	0.52	0.41	-0.02	0.27	0.31	-0.11	-0.40		
(3.17)	(0.45)	(0.01)	(3.35)	(2.48)	(2.83)	(2.77)	(3.31)		
<u>aw1</u>	<u>aw2</u>	<u>aw3</u>	<u>aw4</u>	<u>aw5</u>	<u>aw6</u>	<u>aw7</u>	<u>aw8</u>		
1.72	1.06	0.30	0.19	1.00	0.08	0.38	-0.01		
(2.67)	(2.73)	(2.26)	(0.69)	0.00	(2.01)	(3.20)	(3.22)		

**Equation 72 Cameras and films**

<u>inc0</u>	<u>inc1</u>	<u>inc2</u>	<u>inc3</u>	<u>inc4</u>	<u>inc5</u>	<u>reg1</u>	<u>reg2</u>	<u>reg3</u>	<u>siz1</u>
-0.68	0.00	0.00	0.00	0.00	0.00	-1.21	-1.98	0.07	-9.52
(16.80)	(59.62)	(57.41)	(96.54)	(124.67)	(219.91)	(40.09)	(44.14)	(1.72)	(37.92)
<u>siz2</u>	<u>siz3</u>	<u>age1</u>	<u>age2</u>	<u>edu1</u>	<u>edu2</u>	<u>wag1</u>	<u>wag2</u>		
-1.52	0.58	0.15	0.17	-0.85	1.29	0.05	1.18		
(6.90)	(7.98)	(7.86)	(14.33)	(19.21)	(12.93)	(17.93)	(45.35)		
<u>aw1</u>	<u>aw2</u>	<u>aw3</u>	<u>aw4</u>	<u>aw5</u>	<u>aw6</u>	<u>aw7</u>	<u>aw8</u>		
2.33	1.55	0.91	0.53	1.00	0.90	1.19	0.40		
(52.43)	(1.76)	(50.40)	(116.74)	0.00	(32.81)	(1.62)	(236.75)		

**Equation 73 Guns, ammunition, sporting equipment, boats and aircrafts**

<u>inc0</u>	<u>inc1</u>	<u>inc2</u>	<u>inc3</u>	<u>inc4</u>	<u>inc5</u>	<u>reg1</u>	<u>reg2</u>	<u>reg3</u>	<u>siz1</u>
-32.77	0.00	0.00	0.00	0.01	0.01	17.93	5.07	16.03	-94.07
(15.94)	(14.66)	(2.40)	(15.92)	(17.99)	(32.80)	(13.32)	(5.80)	(10.54)	(26.09)
<u>siz2</u>	<u>siz3</u>	<u>age1</u>	<u>age2</u>	<u>edu1</u>	<u>edu2</u>	<u>wag1</u>	<u>wag2</u>		
-32.76	15.60	-2.32	5.51	-4.26	-16.63	14.63	7.07		
(23.46)	(18.34)	(4.37)	(6.93)	(1.58)	(23.86)	(15.52)	(2.38)		
<u>aw1</u>	<u>aw2</u>	<u>aw3</u>	<u>aw4</u>	<u>aw5</u>	<u>aw6</u>	<u>aw7</u>	<u>aw8</u>		
2.47	1.39	3.35	0.34	1.00	0.23	2.14	0.19		
(9.83)	(4.45)	(17.26)	(13.82)	0.00	(16.50)	(21.01)	(11.83)		

**Equation 74 Televisions, radios, and sound equipment**

<u>inc0</u>	<u>inc1</u>	<u>inc2</u>	<u>inc3</u>	<u>inc4</u>	<u>inc5</u>	<u>reg1</u>	<u>reg2</u>	<u>reg3</u>	<u>siz1</u>
9.02	0.01	0.01	0.01	0.02	0.01	16.21	-7.89	-1.42	113.33
(41.46)	(167.07)	(124.14)	(61.67)	(328.33)	(312.86)	(72.53)	(45.69)	(10.68)	(222.09)
<u>siz2</u>	<u>siz3</u>	<u>age1</u>	<u>age2</u>	<u>edu1</u>	<u>edu2</u>	<u>wag1</u>	<u>wag2</u>		
26.24	-25.14	6.20	18.81	0.94	10.58	-4.93	9.62		
(117.20)	(187.31)	(32.25)	(80.96)	(17.10)	(64.54)	(29.31)	(55.99)		
<u>aw1</u>	<u>aw2</u>	<u>aw3</u>	<u>aw4</u>	<u>aw5</u>	<u>aw6</u>	<u>aw7</u>	<u>aw8</u>		
0.92	2.47	0.92	1.11	1.00	1.03	0.92	0.62		
(9.80)	(225.97)	(11.85)	(35.90)	0.00	(8.78)	(41.44)	(174.50)		

**Equation 75 Home computers**

<u>inc0</u>	<u>inc1</u>	<u>inc2</u>	<u>inc3</u>	<u>inc4</u>	<u>inc5</u>	<u>reg1</u>	<u>reg2</u>	<u>reg3</u>	<u>siz1</u>
-4.50	0.00	0.01	0.01	0.01	0.00	4.16	5.83	6.47	-40.40
(9.63)	(43.93)	(53.00)	(55.55)	(99.05)	(64.83)	(20.70)	(33.35)	(36.42)	(8.39)
<u>siz2</u>	<u>siz3</u>	<u>age1</u>	<u>age2</u>	<u>edu1</u>	<u>edu2</u>	<u>wag1</u>	<u>wag2</u>		
-22.54	1.59	-7.00	-9.61	-14.33	16.92	3.67	6.01		
(30.36)	(3.53)	(22.19)	(35.75)	(45.68)	(22.66)	(6.06)	(7.27)		
<u>aw1</u>	<u>aw2</u>	<u>aw3</u>	<u>aw4</u>	<u>aw5</u>	<u>aw6</u>	<u>aw7</u>	<u>aw8</u>		
0.61	0.90	0.92	1.40	1.00	1.06	0.93	0.56		
(59.24)	(26.67)	(20.74)	(46.69)	0.00	(1.53)	(6.07)	(20.81)		

**Equation 76 Fresh flower or potted plants**

<u>inc0</u>	<u>inc1</u>	<u>inc2</u>	<u>inc3</u>	<u>inc4</u>	<u>inc5</u>	<u>reg1</u>	<u>reg2</u>	<u>reg3</u>	<u>siz1</u>
1.76	0.00	0.00	0.00	0.00	0.00	-1.87	-3.52	-1.27	-7.66
(10.03)	(12.69)	(65.38)	(60.29)	(135.71)	(182.55)	(23.95)	(47.16)	(4.29)	(21.12)
<u>siz2</u>	<u>siz3</u>	<u>age1</u>	<u>age2</u>	<u>edu1</u>	<u>edu2</u>	<u>wag1</u>	<u>wag2</u>		
0.71	0.73	-0.77	2.04	-0.72	2.59	-0.47	-0.15		
(34.22)	(21.16)	(5.75)	(41.08)	(11.87)	(57.26)	(8.31)	(18.07)		
<u>aw1</u>	<u>aw2</u>	<u>aw3</u>	<u>aw4</u>	<u>aw5</u>	<u>aw6</u>	<u>aw7</u>	<u>aw8</u>		
1.16	0.72	1.92	0.63	1.00	0.88	0.85	0.81		
(9.91)	(97.99)	(51.70)	(58.95)	0.00	(36.89)	(40.89)	(51.01)		

**Equation 77 Live entertainment, sports, and movie admissions**

<u>inc0</u>	<u>inc1</u>	<u>inc2</u>	<u>inc3</u>	<u>inc4</u>	<u>inc5</u>	<u>reg1</u>	<u>reg2</u>	<u>reg3</u>	<u>siz1</u>
-2.45	0.00	0.01	0.00	0.01	0.01	2.89	-7.58	-2.40	-10.98
(5.96)	(52.17)	(80.13)	(44.39)	(171.49)	(244.76)	(15.03)	(54.41)	(21.77)	(4.81)
<u>siz2</u>	<u>siz3</u>	<u>age1</u>	<u>age2</u>	<u>edu1</u>	<u>edu2</u>	<u>wag1</u>	<u>wag2</u>		
-7.52	2.58	-1.51	-3.92	-0.94	21.41	-1.12	1.63		
(18.92)	(15.22)	(8.65)	(10.39)	(7.99)	(140.02)	(1.12)	(5.40)		
<u>aw1</u>	<u>aw2</u>	<u>aw3</u>	<u>aw4</u>	<u>aw5</u>	<u>aw6</u>	<u>aw7</u>	<u>aw8</u>		
0.67	1.90	1.88	0.99	1.00	0.85	1.03	0.70		
(50.84)	(71.78)	(70.65)	(6.40)	0.00	(13.94)	(11.62)	(53.72)		

**Equation 78 Fees for clubs or fraternal organizations**

<u>inc0</u>	<u>inc1</u>	<u>inc2</u>	<u>inc3</u>	<u>inc4</u>	<u>inc5</u>	<u>reg1</u>	<u>reg2</u>	<u>reg3</u>	<u>siz1</u>
0.61	0.00	0.00	0.00	0.00	0.00	-0.48	-0.99	-0.61	-8.17
(6.51)	(1.60)	(15.11)	(7.85)	(19.39)	(70.00)	(0.43)	(9.45)	(5.57)	(16.51)
<u>siz2</u>	<u>siz3</u>	<u>age1</u>	<u>age2</u>	<u>edu1</u>	<u>edu2</u>	<u>wag1</u>	<u>wag2</u>		
0.55	0.52	-1.04	0.70	-0.05	4.85	-0.40	0.48		
(14.75)	(1.63)	(15.13)	(8.23)	(4.77)	(41.37)	(4.71)	(5.87)		
<u>aw1</u>	<u>aw2</u>	<u>aw3</u>	<u>aw4</u>	<u>aw5</u>	<u>aw6</u>	<u>aw7</u>	<u>aw8</u>		
3.45	3.23	2.01	1.78	1.00	1.00	1.46	1.31		
(31.92)	(10.02)	(36.30)	(34.50)	0.00	(33.39)	(33.39)	(7.74)		

**Equation 79 Participant amusements and pari-mutual net receipts**

<u>inc0</u>	<u>inc1</u>	<u>inc2</u>	<u>inc3</u>	<u>inc4</u>	<u>inc5</u>	<u>reg1</u>	<u>reg2</u>	<u>reg3</u>	<u>siz1</u>
-1.80	0.00	0.00	0.00	0.00	0.01	2.26	-1.88	2.23	-19.25
(8.11)	(16.67)	(13.47)	(22.56)	(31.28)	(114.56)	(4.97)	(2.09)	(21.91)	(24.22)
<u>siz2</u>	<u>siz3</u>	<u>age1</u>	<u>age2</u>	<u>edu1</u>	<u>edu2</u>	<u>wag1</u>	<u>wag2</u>		
-4.17	1.72	-1.30	-2.92	-1.55	10.89	-0.23	0.92		
(6.66)	(9.31)	(11.36)	(16.34)	(13.98)	(38.27)	(5.65)	(4.38)		
<u>aw1</u>	<u>aw2</u>	<u>aw3</u>	<u>aw4</u>	<u>aw5</u>	<u>aw6</u>	<u>aw7</u>	<u>aw8</u>		
0.17	1.76	0.73	0.80	1.00	0.86	0.86	1.92		
(44.90)	(6.65)	(33.08)	(7.63)	0.00	(14.69)	(7.55)	(47.66)		

**Equation 80 Other recreation**

<u>inc0</u>	<u>inc1</u>	<u>inc2</u>	<u>inc3</u>	<u>inc4</u>	<u>inc5</u>	<u>reg1</u>	<u>reg2</u>	<u>reg3</u>	<u>siz1</u>
1.09	0.00	0.00	0.00	0.00	0.00	1.34	-1.11	0.39	-15.71
(18.89)	(12.44)	(49.23)	(68.97)	(51.56)	(98.97)	(13.40)	(10.43)	(8.60)	(38.83)
<u>siz2</u>	<u>siz3</u>	<u>age1</u>	<u>age2</u>	<u>edu1</u>	<u>edu2</u>	<u>wag1</u>	<u>wag2</u>		
-3.82	-0.24	-0.97	-2.44	-0.88	9.50	-0.70	-0.39		
(22.25)	(17.22)	(20.13)	(16.60)	(21.36)	(80.99)	(15.81)	(10.05)		
<u>aw1</u>	<u>aw2</u>	<u>aw3</u>	<u>aw4</u>	<u>aw5</u>	<u>aw6</u>	<u>aw7</u>	<u>aw8</u>		
4.38	9.82	2.64	2.52	1.00	1.83	1.36	3.06		
(45.81)	(78.30)	(29.48)	(39.40)	0.00	(29.30)	(12.74)	(57.81)		

<b>Equation 81 Higher education</b>									
<u>inc0</u>	<u>inc1</u>	<u>inc2</u>	<u>inc3</u>	<u>inc4</u>	<u>inc5</u>	<u>reg1</u>	<u>reg2</u>	<u>reg3</u>	<u>siz1</u>
2.69	0.00	0.00	0.00	0.00	0.00	-5.91	-7.74	-6.80	-14.31
(1.64)	(6.77)	(5.52)	(13.12)	(20.18)	(20.36)	(13.04)	(17.01)	(17.13)	(15.94)
<u>siz2</u>	<u>siz3</u>	<u>age1</u>	<u>age2</u>	<u>edu1</u>	<u>edu2</u>	<u>wag1</u>	<u>wag2</u>		
-7.91	-0.52	3.07	-3.41	-0.78	3.24	2.42	4.60		
(17.77)	(6.65)	(16.32)	(16.63)	(7.69)	(16.59)	(12.36)	(13.43)		
<u>aw1</u>	<u>aw2</u>	<u>aw3</u>	<u>aw4</u>	<u>aw5</u>	<u>aw6</u>	<u>aw7</u>	<u>aw8</u>		
-3.43	-3.19	31.45	10.16	1.00	4.50	4.79	-0.20		
(21.10)	(35.78)	(17.07)	(12.60)	0.00	(15.55)	(14.22)	(28.51)		

<b>Equation 82 Private lower education</b>									
<u>inc0</u>	<u>inc1</u>	<u>inc2</u>	<u>inc3</u>	<u>inc4</u>	<u>inc5</u>	<u>reg1</u>	<u>reg2</u>	<u>reg3</u>	<u>siz1</u>
-0.33	0.00	0.00	0.00	0.00	0.00	0.43	0.46	0.09	-5.52
(4.42)	(13.15)	(3.53)	(3.79)	(24.29)	(8.47)	(2.50)	(1.35)	(2.61)	(35.86)
<u>siz2</u>	<u>siz3</u>	<u>age1</u>	<u>age2</u>	<u>edu1</u>	<u>edu2</u>	<u>wag1</u>	<u>wag2</u>		
-2.82	0.07	-0.33	-0.33	0.14	2.01	0.36	-0.77		
(39.80)	(7.26)	(3.95)	(14.95)	(0.10)	(27.30)	(22.87)	(23.24)		
<u>aw1</u>	<u>aw2</u>	<u>aw3</u>	<u>aw4</u>	<u>aw5</u>	<u>aw6</u>	<u>aw7</u>	<u>aw8</u>		
8.44	36.34	2.91	-0.82	1.00	10.03	0.22	-0.27		
(33.60)	(70.90)	(34.65)	(27.26)	0.00	(16.34)	(6.78)	(48.31)		

<b>Equation 83 Other education and research</b>									
<u>inc0</u>	<u>inc1</u>	<u>inc2</u>	<u>inc3</u>	<u>inc4</u>	<u>inc5</u>	<u>reg1</u>	<u>reg2</u>	<u>reg3</u>	<u>siz1</u>
-0.58	0.00	0.00	0.00	0.00	0.00	-0.30	-0.09	0.17	-2.57
(4.48)	(5.62)	(11.10)	(18.79)	(33.94)	(26.86)	(23.22)	(15.85)	(2.36)	(20.04)
<u>siz2</u>	<u>siz3</u>	<u>age1</u>	<u>age2</u>	<u>edu1</u>	<u>edu2</u>	<u>wag1</u>	<u>wag2</u>		
-1.05	0.44	-0.11	-0.17	-0.05	1.01	0.48	0.36		
(33.17)	(16.67)	(0.17)	(10.10)	(8.99)	(37.41)	(27.03)	(19.94)		
<u>aw1</u>	<u>aw2</u>	<u>aw3</u>	<u>aw4</u>	<u>aw5</u>	<u>aw6</u>	<u>aw7</u>	<u>aw8</u>		
1.52	12.42	11.28	2.51	1.00	3.41	0.21	0.11		
(40.39)	(4.77)	(5.05)	(3.04)	0.00	(10.93)	(14.03)	(29.75)		

<b>Equation 84 Cash contributions</b>									
<u>inc0</u>	<u>inc1</u>	<u>inc2</u>	<u>inc3</u>	<u>inc4</u>	<u>inc5</u>	<u>reg1</u>	<u>reg2</u>	<u>reg3</u>	<u>siz1</u>
-24.78	0.01	0.00	0.04	-0.04	0.09	16.79	-11.03	-22.67	-85.21
(14.62)	(33.50)	(12.45)	(73.70)	(113.21)	(151.11)	(14.21)	(14.72)	(22.11)	(60.46)
<u>siz2</u>	<u>siz3</u>	<u>age1</u>	<u>age2</u>	<u>edu1</u>	<u>edu2</u>	<u>wag1</u>	<u>wag2</u>		
-9.17	37.38	3.96	-16.52	1.97	11.07	0.72	-15.53		
(13.76)	(46.50)	(15.36)	(22.34)	(7.22)	(2.82)	(1.64)	(28.01)		
<u>aw1</u>	<u>aw2</u>	<u>aw3</u>	<u>aw4</u>	<u>aw5</u>	<u>aw6</u>	<u>aw7</u>	<u>aw8</u>		
2.19	0.53	8.08	0.53	1.00	3.20	2.32	8.43		
(29.12)	(41.52)	(117.34)	(34.75)	0.00	(93.16)	(76.48)	(130.93)		

<b>Equation 85 Miscellaneous</b>									
<u>inc0</u>	<u>inc1</u>	<u>inc2</u>	<u>inc3</u>	<u>inc4</u>	<u>inc5</u>	<u>reg1</u>	<u>reg2</u>	<u>reg3</u>	<u>siz1</u>
-19.40	0.00	0.01	0.00	0.01	0.00	22.40	25.17	9.24	-30.63
(12.40)	(2.88)	(40.05)	(3.67)	(48.69)	(119.03)	(56.51)	(59.41)	(19.26)	(29.90)
<u>siz2</u>	<u>siz3</u>	<u>age1</u>	<u>age2</u>	<u>edu1</u>	<u>edu2</u>	<u>wag1</u>	<u>wag2</u>		
-4.26	7.59	-4.32	0.22	-4.72	-9.63	0.57	9.94		
(8.50)	(7.65)	(12.52)	(13.37)	(8.13)	(8.47)	(6.82)	(19.20)		
<u>aw1</u>	<u>aw2</u>	<u>aw3</u>	<u>aw4</u>	<u>aw5</u>	<u>aw6</u>	<u>aw7</u>	<u>aw8</u>		
0.36	-0.34	-0.69	0.63	1.00	1.36	0.41	0.14		
(40.51)	(139.96)	(101.88)	(19.40)	0.00	(43.44)	(79.76)	(39.71)		

**Table 2.10 Cross-section Analysis, Effects of Demographic Variables**

		Region			Family Size			Age of Head		Education		# of Earners	
		Midwest	South	West	1	2	>5	<35	>55	< HS	> HS	1	>2
1	Food at home	(-)	(-)	(-)	(+)	(+)	(+)	(+)	(+)	(+)	(-)	(+)	(-)
2	Food away from home	(+)	(+)	(+)	(+)	(+)	(-)	(+)	(-)	(-)	(+)	(+)	(+)
3	Alcoholic bev. at home	(-)	(-)		(+)	(+)	(+)	(+)	(-)	(-)	(-)	(-)	(-)
4	Alcoholic bev. away	(-)	(-)	(-)	(+)	(-)	(-)	(+)	(-)	(+)	(+)	(-)	(-)
5	Tobacco & smoking sply		(-)	(-)	(+)	(+)		(-)	(-)	(+)	(-)	(+)	(+)
6	Footwear	(-)	(-)	(-)	(+)	(+)	(+)	(+)	(-)	(-)	(+)	(+)	(+)
7	Clothing for women	(-)	(-)	(-)	(+)	(+)	(+)	(-)	(+)	(-)	(+)	(-)	(+)
8	Clothing for men	(-)	(-)	(-)	(-)	(+)	(-)	(-)	(+)	(+)	(+)	(+)	(+)
9	Clothing for infants	(+)	(-)	(-)	(-)	(-)	(+)	(+)	(+)	(+)	(-)	(+)	(-)
10	Travel items	(+)	(+)	(+)	(+)		(-)	(-)	(-)	(-)	(+)	(-)	(+)
11	Cleaning & laundering	(-)	(-)	(-)	(+)	(+)	(-)	(+)	(-)	(+)	(+)	(+)	(-)
12	Watches & jewelry	(-)	(-)	(-)	(-)	(+)		(-)	(+)	(+)	(+)	(-)	(+)
13	Watch & jewelry repair	(-)	(-)	(-)	(-)	(+)	(+)	(-)	(+)	(-)	(-)	(-)	(+)
14	Personal care services	(-)	(+)	(-)	(+)	(+)	(-)	(-)	(+)	(-)	(+)	(-)	(-)
15	Personal care equipment	(+)	(+)	(+)	(-)	(-)	(-)	(-)	(-)	(-)	(-)	(+)	(+)
16	Owned dwellings	(-)	(-)		(-)	(-)	(+)	(-)	(+)	(-)	(+)	(-)	(-)
17	Rented dwellings	(-)	(-)	(+)	(+)	(+)	(-)	(+)	(-)	(+)	(-)	(+)	(-)
18	Other lodging	(-)	(-)	(-)	(-)	(-)	(+)	(-)	(+)	(-)	(+)	(+)	(-)
19	Furniture		(-)	(+)	(+)	(+)	(-)	(-)	(+)	(+)	(+)	(-)	(-)
20	Kitchen & hhd. app.	(+)	(+)	(+)	(-)	(-)	(+)	(-)	(+)	(+)	(-)	(+)	(+)
21	China & glassware		(-)	(+)	(+)	(+)		(-)	(+)	(-)	(+)	(+)	(+)
22	Floor coverings	(+)	(+)	(-)	(-)	(-)	(+)	(-)	(+)	(-)	(+)	(+)	(+)
23	Other durable appliance	(+)	(+)	(+)	(-)	(-)	(+)	(-)	(-)	(+)	(-)	(-)	(-)
24	Tools	(-)		(+)	(-)	(-)	(+)	(-)	(-)	(-)	(-)	(+)	(+)
25	Household textiles	(+)	(-)	(-)	(-)	(-)	(+)	(-)	(+)	(+)	(+)	(+)	
26	Semi-durable furnishings	(+)	(+)	(+)	(+)	(+)	(-)	(-)	(-)	(-)	(+)	(+)	(+)
27	Cleaning & lighting equ.	(+)	(+)		(+)	(+)	(+)	(-)	(+)	(-)	(-)	(+)	(-)
28	Electricity	(+)	(+)	(-)	(+)	(+)	(-)	(+)	(+)	(+)	(-)	(+)	(-)
29	Natural gas	(+)	(-)	(-)	(+)	(+)	(+)	(-)	(+)	(-)	(-)	(+)	(-)
30	Water & other pub. srvc.	(+)	(+)	(+)	(+)	(+)	(+)	(-)	(+)	(-)	(+)	(+)	(-)
31	Fuel oil & other fules	(-)	(-)	(-)	(-)	(-)	(+)	(-)	(+)	(-)	(-)	(+)	(-)
32	Telephone equipment	(-)	(+)	(-)	(+)	(+)	(-)	(+)	(+)	(+)	(+)	(+)	(+)
33	Domestic services		(+)	(+)	(+)	(-)	(-)	(-)	(+)	(+)	(+)	(-)	(-)
34	Household insurance	(+)	(+)	(+)		(-)	(+)	(-)	(+)	(-)	(-)	(-)	(-)
35	Other household oper.	(+)	(+)	(+)	(-)	(-)	(-)	(+)	(+)	(+)	(+)	(-)	(-)
36	Prescription drugs	(+)	(+)	(-)	(-)	(-)	(+)	(+)	(+)	(+)	(-)	(+)	(-)
37	Ophth. & orthoped. equ.	(+)	(+)	(+)	(-)	(+)	(+)	(-)	(+)	(-)	(+)	(-)	(+)
38	Physicians' services	(+)	(+)	(+)	(-)	(-)	(+)	(+)	(+)	(-)	(-)	(+)	(-)
39	Dental care	(-)	(+)	(+)	(-)	(-)	(+)	(-)	(+)	(-)	(+)	(+)	(-)
40	Other srvc. by med. pro.	(+)	(+)	(+)	(-)	(-)	(+)	(+)	(+)	(-)	(+)	(+)	(+)
42	Hospital services	(+)	(+)		(-)	(-)	(-)	(+)	(-)	(+)	(+)	(-)	(-)

**Table 2.10 Cross-section Analysis, Effects of Demographic Variables (Continued)**

	Region			Family Size			Age of Head		Education		# of Earners	
	Midwest	South	West	1	2	>5	<35	>55	< HS	> HS	1	>2
44 Health insurance	(+)	(+)	(-)	(-)	(+)	(-)	(+)	(+)	(-)	(-)	(+)	(-)
45 Banking services	(+)	(+)	(+)	(+)	(+)	(+)	(-)	(-)	(-)	(-)	(-)	(-)
46 Life & personal insur.	(-)	(+)	(-)	(-)	(-)	(+)	(-)	(+)	(+)	(+)	(-)	(-)
47 Contribution to pension	(+)	(+)	(+)	(-)	(-)	(+)	(-)	(-)	(-)	(+)	(-)	(-)
48 Legal fees	(+)	(+)	(+)	(-)	(-)	(+)	(-)	(-)	(+)	(+)	(+)	(-)
49 Funeral & burial services	(+)	(-)	(-)	(-)	(-)	(+)	(-)	(+)	(+)	(-)	(+)	(+)
50 Other personal business	(-)	(-)	(+)	(-)	(-)	(+)	(+)	(+)	(+)	(-)	(-)	(-)
51 New cars & trucks		(+)		(-)	(-)	(+)	(+)	(+)	(-)	(-)	(+)	(+)
52 Used cars & trucks	(+)	(+)	(-)	(-)	(-)	(+)	(+)	(-)	(+)	(-)	(-)	
54 Tires, tubes, & access.	(-)	(+)	(+)	(-)		(+)	(+)	(+)	(-)	(-)	(+)	(+)
55 Maintenance & repair	(-)	(-)	(-)	(-)	(-)	(+)	(-)	(+)	(-)	(+)	(-)	(+)
56 Vehicle rental & charges	(-)	(+)	(+)	(-)	(+)	(+)	(-)	(+)	(-)	(+)	(-)	(-)
57 Vehicle financial charges	(+)	(+)	(+)	(-)	(-)	(-)	(+)	(-)	(-)	(-)	(-)	(-)
58 Vehicle license & registr.	(+)	(+)	(+)	(+)	(+)	(+)	(+)	(-)	(-)	(-)	(-)	(-)
59 Gasoline & motor oil	(+)	(+)	(+)	(+)	(+)	(+)	(-)	(-)	(-)	(-)	(-)	(-)
60 Tolls	(-)	(-)	(-)	(-)	(-)	(+)	(-)	(-)	(-)	(+)	(+)	(+)
61 Vehicle insurance	(-)	(-)	(-)	(-)	(-)	(+)	(-)	(-)	(-)	(-)	(+)	(+)
62 Local transportation	(-)	(-)	(-)	(+)	(-)	(+)	(+)	(-)	(+)	(+)	(+)	(+)
63 Taxis	(-)	(-)	(-)	(+)	(-)	(-)	(+)	(-)	(+)	(+)	(+)	(+)
64 Intercity train fares	(-)	(-)	(+)	(-)	(-)	(-)	(+)	(+)	(+)	(+)	(-)	(+)
65 Intercity bus fares	(-)	(-)		(-)	(-)	(-)	(+)	(+)	(+)	(+)	(-)	(+)
66 Airline fares	(-)	(-)	(+)	(-)	(-)	(+)	(-)	(+)	(-)	(+)	(-)	(-)
67 Ship fares		(-)	(-)	(-)	(+)	(-)	(-)	(-)	(+)	(+)	(-)	
68 Reading		(-)	(-)	(+)	(+)	(+)	(-)	(+)	(-)	(+)	(+)	
69 Pets, pet supplies & srvc.	(+)	(+)	(+)	(-)	(-)	(-)	(+)	(-)	(-)	(+)	(+)	(-)
70 Toys & playground equ.	(+)	(+)	(-)	(-)	(-)	(+)	(+)	(+)	(-)	(+)	(-)	(-)
71 Bicycles		(-)	(+)	(-)	(-)			(-)	(+)	(+)	(-)	(-)
72 Cameras & film	(-)	(-)		(-)	(-)	(+)	(+)	(+)	(-)	(+)	(+)	(+)
73 Guns & sporting equ.	(+)	(+)	(+)	(-)	(-)	(+)	(-)	(+)	(-)	(-)	(+)	(+)
74 Televisions & sound equ.	(+)	(-)	(-)	(+)	(+)	(-)	(+)	(+)	(+)	(+)	(-)	(+)
75 Home computers	(+)	(+)	(+)	(-)	(-)	(+)	(-)	(-)	(-)	(+)	(+)	(+)
76 Fresh flower & plants	(-)	(-)	(-)	(-)	(+)	(+)	(-)	(+)	(-)	(+)	(-)	(-)
77 Live entertainment	(+)	(-)	(-)	(+)	(-)	(+)	(-)	(-)	(+)	(+)	(+)	(+)
78 Fees for clubs & orgs.		(-)	(-)	(-)	(+)		(-)	(+)	(-)	(+)	(-)	(-)
79 Participant amusements	(+)	(+)	(+)	(-)	(-)	(+)	(-)	(-)	(-)	(+)	(+)	(+)
80 Other recreation	(+)	(-)	(+)	(-)	(-)	(-)	(-)	(-)	(-)	(+)	(-)	(-)
81 Higher education	(-)	(-)	(-)	(-)	(-)	(-)	(+)	(-)	(+)	(+)	(+)	(+)
82 Private lower education	(-)		(-)	(-)	(-)	(+)	(-)	(-)	(-)	(+)	(+)	(-)
83 Other edu. & research	(-)	(-)	(+)	(-)	(-)	(+)		(-)	(-)	(+)	(+)	(+)
84 Cash contributions	(+)	(-)	(-)	(-)	(-)	(+)	(+)	(-)	(+)	(+)	(-)	(-)
85 Miscellaneous	(+)	(+)	(+)	(-)	(-)	(+)	(-)	(-)	(-)	(-)	(+)	(+)

**Table 2.11 Comparison of Estimated Coefficients Between With and Without Probit Analysis**

Equation Independent Variables	1 Food at home		2 Food away from home		3 Alcoholic bev. at home		4 Alcoholic bev. away	
	Probit	Least Squares	Probit	Least Squares	Probit	Least Squares	Probit	Least Squares
Intercept	200.35	200.69	-24.78	-18.44	13.93	22.88	14.87	10.26
Incomes								
0-8154	0.1320	0.1319	0.0352	0.0355	0.0025	0.0043	0.0010	0.0044
8154-12557	0.0812	0.0811	0.0459	0.0440	0.0028	0.0046	0.0036	0.0064
12557-17929	0.0542	0.0545	0.0314	0.0302	0.0042	0.0043	0.0037	0.0045
17929-26496	0.0516	0.0513	0.0537	0.0533	-0.0019	-0.0011	0.0042	0.0061
26496-infinity	0.0135	0.0135	0.0300	0.0298	0.0057	0.0058	0.0072	0.0071
Region (Northeast=base)								
Midwest	-93.63	-93.46	59.88	56.78	-7.52	-11.14	-4.41	-7.44
South	-32.88	-32.68	26.85	30.01	-12.41	-12.87	-24.36	-29.53
West	-15.94	-16.34	19.63	17.59	-0.66	-0.12	-9.91	-13.22
Family Size (3-4 =base)								
1	164.84	171.83	86.31	128.53	-2.63	6.26	11.10	31.32
2	21.19	21.09	72.07	82.39	6.07	8.80	-1.57	-6.59
5+	12.02	11.39	-19.65	-22.48	0.58	-0.22	-1.19	-3.45
Age of Household Head (35-55 =base)								
35-	0.76	0.86	14.03	10.84	4.21	2.32	11.66	21.85
55+	47.40	47.15	-48.27	-41.73	-20.19	-30.70	-11.43	-14.90
Education (high school =base)								
lower than high school	65.18	65.31	-32.94	-28.60	-1.54	-2.77	2.25	9.99
higher than high school	-65.28	-64.08	41.58	40.95	4.94	2.14	8.22	2.10
Number of wage earners (2 =base)								
1	110.30	110.49	8.47	11.14	-9.13	-9.53	-8.03	-5.17
3+	-41.64	-40.58	27.11	28.27	-6.04	-3.93	-8.31	-11.26
Adult Equivalency Weights (31-40 =1)								
0-5	0.72	0.72	0.48	0.50	0.28	0.38	-0.54	-0.50
6-15	0.93	0.93	0.93	0.95	0.31	0.30	0.04	0.03
16-20	0.87	0.87	0.81	0.82	0.16	0.08	-0.04	-0.15
21-30	0.85	0.85	0.91	0.91	1.03	0.93	1.44	1.29
41-50	1.06	1.06	1.01	1.01	1.07	1.04	0.91	0.96
51-65	1.04	1.04	0.94	0.95	1.06	1.15	0.62	0.71
66-99	1.00	0.99	0.80	0.80	1.88	2.00	0.87	0.92

**Table 2.11 Comparison of Estimated Coefficients Between With and Without Probit Analysis (Continued)**

Equation Independent Variables	5 Tobacco & smoking sply.		6 Footwear		7 Clothing for women		8 Clothing for men	
	Probit	Least Squares	Probit	Least Squares	Probit	Least Squares	Probit	Least Squares
Intercept	-13.96	-10.47	0.80	6.82	2.77	7.59	4.47	15.42
Incomes								
0-8154	0.0181	0.0352	0.0019	0.0022	0.0098	0.0105	0.0070	0.0068
8154-12557	0.0088	0.0140	0.0045	0.0045	0.0140	0.0143	0.0030	0.0025
12557-17929	0.0012	0.0047	0.0015	0.0018	0.0118	0.0123	0.0130	0.0133
17929-26496	0.0014	0.0053	0.0026	0.0024	0.0116	0.0113	0.0025	0.0018
26496-infinity	-0.0002	-0.0001	0.0013	0.0014	0.0081	0.0090	0.0097	0.0102
Region (Northeast=base)								
Midwest	1.86	-4.21	-1.53	-3.28	-11.18	-13.84	-10.70	-12.15
South	-2.76	-11.13	1.12	1.05	-0.51	1.10	-12.07	-11.65
West	-36.06	-68.70	0.53	-0.37	-1.53	-0.74	-9.85	-10.95
Family Size (3-4 =base)								
1	17.12	68.34	-1.57	13.67	-28.63	64.59	-51.23	-4.17
2	11.80	34.82	-2.52	3.17	8.39	22.76	-4.29	3.46
5+	7.58	14.32	2.37	-0.03	7.29	3.79	2.92	-2.26
Age of Household Head (35-55 =base)								
35-	2.45	5.13	3.22	3.21	-6.16	-4.97	-1.29	-3.85
55+	-29.89	-2.76	-3.20	-2.61	7.08	5.87	7.89	13.48
Education (high school =base)								
lower than high school	28.86	45.57	-0.21	0.94	-5.52	-3.00	-0.25	0.14
higher than high school	-81.88	-147.77	0.87	2.12	6.99	7.65	10.09	11.82
Number of wage earners (2 =base)								
1	5.23	30.08	0.00	0.61	-5.45	-2.60	-1.35	0.08
3+	12.17	6.26	0.88	1.51	7.23	12.85	5.37	6.21
Adult Equivalency Weights (31-40 =1)								
0-5	-0.11	-0.04	0.71	0.64	1.30	1.27	1.47	1.50
6-15	0.11	0.13	1.87	1.75	1.84	1.76	2.83	2.87
16-20	0.38	0.35	1.41	1.36	1.34	1.28	2.04	2.01
21-30	0.78	0.77	1.21	1.16	1.02	0.98	1.33	1.37
41-50	0.88	0.89	1.05	1.06	1.04	1.06	0.98	1.00
51-65	0.59	0.62	0.98	1.01	1.16	1.17	0.98	1.02
66-99	0.17	0.23	0.73	0.66	0.58	0.58	0.45	0.41



**Table 2.11 Comparison of Estimated Coefficients Between With and Without Probit Analysis (Continued)**

Equation Independent Variables	9 Clothing for infants		10 Travel items		11 Cleaning & laundering		12 Watches & jewelry	
	Probit	Least Squares	Probit	Least Squares	Probit	Least Squares	Probit	Least Squares
Intercept	-3.64	-1.77	-0.38	-0.33	-0.42	1.31	-2.66	-6.82
Incomes								
0-8154	0.0015	0.0034	0.0000	-0.0001	0.0021	0.0035	0.0011	0.0026
8154-12557	0.0006	0.0003	0.0000	0.0004	0.0024	0.0028	0.0002	0.0004
12557-17929	0.0007	0.0014	0.0001	0.0008	0.0018	0.0019	0.0039	0.0070
17929-26496	0.0011	0.0013	0.0001	0.0001	0.0031	0.0036	-0.0005	-0.0019
26496-infinity	0.0001	0.0003	0.0001	0.0006	0.0039	0.0041	0.0125	0.0170
Region (Northeast=base)								
Midwest	0.31	2.04	0.26	0.36	-11.31	-13.71	-1.98	-7.36
South	-0.75	1.70	-0.03	0.09	-4.37	-3.35	-4.50	-7.72
West	-1.86	-2.78	0.47	1.45	-0.91	0.17	-5.04	-8.89
Family Size (3-4 =base)								
1	-11.98	-19.30	-0.54	1.55	7.18	18.78	-34.23	-15.23
2	-3.46	-4.14	-0.37	-1.05	-0.97	2.76	3.07	16.25
5+	2.61	2.92	0.16	0.36	0.89	-0.78	2.95	2.61
Age of Household Head (35-55 =base)								
35-	4.92	5.76	-0.35	-1.10	0.19	-0.90	-1.02	-4.08
55+	0.69	2.10	0.37	1.50	-1.40	-1.28	-3.29	-1.55
Education (high school =base)								
lower than high school	-0.87	-1.55	0.00	-0.67	4.25	8.94	2.27	10.13
higher than high school	-1.63	-4.01	1.38	4.99	11.76	10.62	0.05	1.94
Number of wage earners (2 =base)								
1	0.88	2.47	0.16	0.55	2.04	2.64	-1.30	-2.96
3+	-2.70	-5.38	0.39	0.49	0.28	0.08	6.66	15.70
Adult Equivalency Weights (31-40 =1)								
0-5	7.25	6.17	-0.09	0.25	0.65	0.65	-1.18	-0.85
6-15	-0.52	-0.58	-0.36	-0.30	0.68	0.67	5.13	5.15
16-20	0.87	0.82	0.96	0.76	0.62	0.48	-0.16	-0.32
21-30	1.88	1.69	0.83	1.25	1.24	1.22	0.62	0.66
41-50	0.28	0.40	0.75	0.83	1.08	1.07	0.22	0.22
51-65	1.05	1.11	0.52	0.67	0.85	0.88	0.42	0.44
66-99	0.20	0.26	0.11	0.21	0.45	0.42	0.41	0.32

**Table 2.11 Comparison of Estimated Coefficients Between With and Without Probit Analysis (Continued)**

Equation Independent Variables	13 Watch & jewelry repair		14 Personal care services		15 Personal care equipment		16 Owned dwellings	
	Probit	Least Squares	Probit	Least Squares	Probit	Least Squares	Probit	Least Squares
Intercept	-0.09	-0.89	15.61	23.27	-0.09	-0.20	-15.15	14.21
Incomes								
0-8154	0.0000	0.0005	0.0054	0.0054	0.0000	0.0001	0.1286	0.1655
8154-12557	0.0000	-0.0002	0.0091	0.0085	0.0000	0.0001	0.1432	0.1756
12557-17929	0.0002	0.0009	0.0026	0.0027	0.0000	0.0001	0.1402	0.1338
17929-26496	0.0000	0.0001	0.0082	0.0082	0.0000	0.0001	0.1802	0.2112
26496-infinity	0.0001	0.0001	0.0018	0.0019	0.0000	0.0002	0.0854	0.0909
Region (Northeast=base)								
Midwest	-0.15	-0.80	-15.02	-16.20	0.05	0.21	-62.87	-195.06
South	-0.16	-0.45	-1.23	0.15	0.04	0.15	-116.78	-229.06
West	-0.12	-0.03	-9.31	-10.00	0.09	0.35	-87.73	-63.73
Family Size (3-4 =base)								
1	-0.61	-1.64	11.24	23.58	-0.28	0.62	-780.02	-316.06
2	0.17	0.79	9.42	12.16	-0.15	0.24	-157.42	-101.02
5+	0.17	0.89	-4.46	-5.08	0.02	-0.06	98.91	21.82
Age of Household Head (35-55 =base)								
35-	-0.06	-0.27	-1.44	-1.38	0.01	-0.01	-247.42	-80.82
55+	0.17	0.13	2.76	1.58	0.01	0.17	188.14	66.84
Education (high school =base)								
lower than high school	-0.04	-0.29	-1.48	-1.55	-0.05	-0.21	-133.36	-116.85
higher than high school	0.12	0.36	15.90	14.24	-0.10	-0.32	325.54	345.89
Number of wage earners (2 =base)								
1	-0.01	-0.14	-2.08	-2.33	0.05	0.13	-84.75	-4.55
3+	0.07	0.18	1.80	-0.46	0.06	0.23	-6.79	-6.02
Adult Equivalency Weights (31-40 =1)								
0-5	2.09	1.02	0.74	0.73	1.58	1.16	0.93	0.94
6-15	2.24	0.73	1.06	1.05	4.20	4.66	1.07	1.01
16-20	4.81	1.84	1.14	1.14	1.23	0.60	0.47	0.40
21-30	0.62	0.42	1.18	1.17	3.18	2.63	0.75	0.78
41-50	0.93	0.90	1.18	1.18	1.20	1.04	1.05	1.00
51-65	1.26	1.38	1.12	1.12	1.18	1.00	0.94	0.88
66-99	0.54	1.17	1.37	1.36	0.18	0.28	0.65	0.60

**Table 2.11 Comparison of Estimated Coefficients Between With and Without Probit Analysis (Continued)**

Equation Independent Variables	17 Rented dwellings		18 Other lodging		19 Furniture		20 Kitchen & hhld. app.	
	Probit	Least Squares	Probit	Least Squares	Probit	Least Squares	Probit	Least Squares
Intercept	91.33	183.27	5.10	13.20	-7.38	-3.80	-12.53	-13.42
Incomes								
0-8154	0.0231	0.0597	0.0004	0.0009	0.0017	0.0034	0.0043	0.0082
8154-12557	-0.0158	0.0015	0.0039	0.0075	0.0011	0.0012	0.0047	0.0070
12557-17929	-0.0071	-0.0058	0.0080	0.0113	0.0073	0.0093	0.0025	0.0033
17929-26496	-0.0008	0.0100	0.0084	0.0101	-0.0069	-0.0085	0.0081	0.0101
26496-infinity	-0.0039	-0.0011	0.0084	0.0094	0.0250	0.0287	0.0015	0.0018
Region (Northeast=base)								
Midwest	-159.22	-257.95	-0.50	-3.62	3.35	2.44	3.61	5.40
South	-175.41	-241.45	-7.02	-6.31	-1.03	-3.36	1.00	3.01
West	45.88	169.84	-11.01	-14.70	6.00	7.65	1.52	-0.36
Family Size (3-4 =base)								
1	1503.27	2094.59	-58.65	-62.12	-32.53	78.90	-35.38	-32.53
2	196.91	412.04	-9.14	-3.11	1.41	24.95	-11.72	-6.38
5+	-111.93	-196.83	5.30	7.35	0.31	-5.40	4.74	3.22
Age of Household Head (35-55 =base)								
35-	219.81	290.62	-9.44	-17.74	2.22	-0.77	-9.27	-18.33
55+	-120.61	-254.99	7.15	9.33	6.92	11.21	12.91	24.63
Education (high school =base)								
lower than high school	141.02	193.51	-4.82	-12.42	3.73	8.48	2.64	10.81
higher than high school	-30.78	-51.90	31.30	38.24	6.34	9.39	-7.04	-8.11
Number of wage earners (2 =base)								
1	162.93	228.95	-2.55	2.44	-2.02	-5.07	3.97	5.25
3+	6.45	-50.98	1.40	2.32	-1.74	-2.16	3.88	0.66
Adult Equivalency Weights (31-40 =1)								
0-5	0.44	0.33	2.08	2.22	6.14	8.05	1.58	1.58
6-15	0.44	0.52	1.03	0.70	5.02	5.78	0.85	0.74
16-20	1.11	1.07	2.44	1.98	3.00	3.03	0.50	0.32
21-30	1.30	1.19	1.12	1.04	0.94	1.03	1.15	1.20
41-50	0.53	0.65	1.91	1.88	0.63	0.89	1.44	1.46
51-65	0.28	0.45	2.59	2.40	0.49	0.58	1.32	1.26
66-99	0.23	0.42	2.14	1.95	0.24	0.16	0.87	0.89

**Table 2.11 Comparison of Estimated Coefficients Between With and Without Probit Analysis (Continued)**

Equation Independent Variables	21 China & glassware		22 Floor coverings		23 Other durable appliance		24 Tools	
	Probit	Least Squares	Probit	Least Squares	Probit	Least Squares	Probit	Least Squares
Intercept	-0.32	-0.52	-0.59	-0.55	-0.37	0.33	-0.71	-4.99
Incomes								
0-8154	0.0001	0.0002	0.0001	0.0008	0.0001	-0.0003	0.0002	0.0017
8154-12557	0.0000	0.0000	0.0000	-0.0013	0.0011	0.0041	0.0000	0.0003
12557-17929	0.0005	0.0009	0.0009	0.0071	0.0010	0.0013	0.0003	0.0019
17929-26496	0.0000	0.0000	0.0002	-0.0002	-0.0006	-0.0010	0.0005	0.0016
26496-infinity	0.0008	0.0012	0.0001	0.0009	0.0026	0.0046	0.0000	0.0001
Region (Northeast=base)								
Midwest	-0.10	-0.12	0.98	6.54	2.28	6.88	0.29	0.29
South	-0.35	-0.33	0.06	2.43	-0.83	1.87	-0.21	-0.41
West	0.56	1.48	-0.59	-5.82	2.74	9.12	0.33	0.53
Family Size (3-4 =base)								
1	-0.21	5.00	-2.75	-5.15	-13.64	-25.53	-1.74	-4.67
2	1.43	5.11	-0.92	-1.08	-2.56	-0.32	-0.36	-0.14
5+	-0.03	-0.46	0.24	0.20	1.36	1.96	0.62	3.09
Age of Household Head (35-55 =base)								
35-	-0.11	-0.67	-0.39	-5.33	-1.24	-3.18	-0.28	-0.57
55+	0.65	2.04	0.10	-0.40	-1.08	-1.94	0.14	0.38
Education (high school =base)								
lower than high school	0.00	0.13	-0.49	-4.15	0.80	4.18	-0.26	-1.71
higher than high school	0.42	0.65	0.59	2.74	0.87	1.14	-0.41	-0.88
Number of wage earners (2 =base)								
1	0.30	0.52	0.16	-0.51	-0.26	-1.96	0.02	0.92
3+	0.32	0.63	2.10	14.56	-1.88	-5.65	0.29	2.36
Adult Equivalency Weights (31-40 =1)								
0-5	4.87	6.59	1.70	1.62	2.51	3.14	1.75	0.39
6-15	4.59	4.71	0.92	0.85	0.15	-0.06	1.81	0.92
16-20	0.66	0.29	0.00	-0.33	-0.79	-0.88	0.16	-0.17
21-30	1.77	1.82	1.17	1.03	0.23	0.21	1.60	0.84
41-50	0.80	1.08	1.09	0.85	0.73	0.95	1.24	0.88
51-65	0.92	1.20	0.88	0.73	0.72	0.83	1.32	1.27
66-99	0.11	0.20	0.37	0.47	0.33	0.16	0.59	0.52

**Table 2.11 Comparison of Estimated Coefficients Between With and Without Probit Analysis (Continued)**

Equation Independent Variables	25 Household textiles		26 Semi-durable furnishings		27 Cleaning & lighting equ.		28 Electricity	
	Probit	Least Squares	Probit	Least Squares	Probit	Least Squares	Probit	Least Squares
Intercept	0.17	3.39	-2.43	-2.69	-0.01	-0.04	31.51	40.08
Incomes								
0-8154	0.0015	0.0032	0.0004	0.0013	0.0000	0.0000	0.0286	0.0281
8154-12557	0.0032	0.0062	0.0009	0.0019	0.0000	0.0001	0.0178	0.0176
12557-17929	0.0025	0.0038	-0.0001	-0.0001	0.0000	-0.0001	0.0127	0.0120
17929-26496	0.0009	0.0009	0.0024	0.0031	0.0000	0.0008	0.0078	0.0076
26496-infinity	0.0108	0.0181	0.0036	0.0060	0.0000	0.0002	0.0057	0.0057
Region (Northeast=base)								
Midwest	9.69	25.81	0.77	-0.74	0.05	1.24	3.44	-0.55
South	-8.36	-13.65	0.36	0.06	0.01	0.26	96.00	94.69
West	-2.43	-3.25	1.85	2.64	0.02	0.25	-39.78	-40.97
Family Size (3-4 =base)								
1	-48.61	-70.06	-10.03	3.09	0.00	2.03	48.42	76.11
2	-16.70	-41.89	5.48	18.76	0.02	0.55	14.67	17.66
5+	2.49	4.45	0.65	-0.38	0.01	0.00	3.45	-2.84
Age of Household Head (35-55 =base)								
35-	-11.06	-27.02	0.12	-1.88	-0.02	-0.48	9.27	9.25
55+	14.83	30.81	0.22	3.52	0.01	0.38	10.02	8.65
Education (high school =base)								
lower than high school	0.55	5.24	-0.87	-2.76	0.00	-0.13	1.49	5.21
higher than high school	2.44	6.54	2.82	4.54	-0.01	-0.68	-27.08	-27.23
Number of wage earners (2 =base)								
1	4.84	8.07	0.63	2.52	-0.01	-0.11	8.18	10.84
3+	3.48	2.12	1.04	3.15	-0.03	-0.63	-18.39	-14.61
Adult Equivalency Weights (31-40 =1)								
0-5	1.45	1.06	2.18	2.35	1.78	0.70	0.73	0.74
6-15	0.07	-0.08	1.29	1.17	34.72	7.53	0.77	0.78
16-20	0.41	0.25	0.73	0.58	8.27	0.67	0.82	0.83
21-30	0.22	0.19	0.52	0.46	1.27	0.55	0.91	0.91
41-50	0.18	0.16	0.54	0.53	2.70	0.87	1.15	1.16
51-65	0.25	0.23	0.68	0.79	4.32	1.69	1.31	1.31
66-99	0.04	0.03	0.05	0.10	0.84	0.55	1.21	1.20

**Table 2.11 Comparison of Estimated Coefficients Between With and Without Probit Analysis (Continued)**

Equation Independent Variables	29 Natural gas		30 Water & other pub. svcs.		31 Fuel oil & other fuels		32 Telephone equipment	
	Probit	Least Squares	Probit	Least Squares	Probit	Least Squares	Probit	Least Squares
Intercept	18.48	44.76	-16.05	-6.74	14.60	38.92	13.94	21.10
Incomes								
0-8154	0.0071	0.0094	0.0070	0.0079	0.0013	0.0055	0.0334	0.0317
8154-12557	0.0036	0.0059	0.0062	0.0071	0.0004	0.0009	0.0181	0.0183
12557-17929	0.0051	0.0047	0.0056	0.0056	0.0002	0.0004	0.0252	0.0249
17929-26496	0.0042	0.0056	0.0035	0.0039	0.0008	0.0027	0.0175	0.0174
26496-infinity	0.0018	0.0020	0.0018	0.0017	0.0000	0.0000	0.0071	0.0071
Region (Northeast=base)								
Midwest	30.69	15.32	17.86	16.61	-20.25	-55.32	-10.98	-9.56
South	-44.17	-60.17	27.07	27.27	-21.05	-59.97	14.30	16.32
West	-17.35	-42.01	24.67	29.33	-22.10	-64.90	-22.49	-21.11
Family Size (3-4 =base)								
1	5.57	44.16	-11.34	17.98	-2.86	2.15	173.04	182.26
2	-7.54	1.36	-1.41	3.62	-0.56	-0.73	30.01	32.22
5+	12.49	8.44	4.89	-0.19	1.39	0.95	-2.86	-4.64
Age of Household Head (35-55 =base)								
35-	-3.63	-5.44	-6.93	-0.72	-1.07	-2.49	1.98	3.53
55+	13.62	22.88	11.77	6.05	0.56	-0.76	1.76	0.48
Education (high school =base)								
lower than high school	-1.54	-3.00	-11.77	-8.75	-0.29	0.68	9.71	11.32
higher than high school	4.73	-0.95	3.90	2.94	-1.65	-4.15	2.48	1.81
Number of wage earners (2 =base)								
1	3.07	6.77	-1.39	1.00	0.88	6.54	33.51	33.60
3+	-6.52	-1.68	-1.52	-0.54	0.74	1.27	0.26	1.10
Adult Equivalency Weights (31-40 =1)								
0-5	0.47	0.53	0.89	0.81	0.92	0.99	0.66	0.67
6-15	0.73	0.78	1.19	1.10	0.48	0.38	0.68	0.68
16-20	0.42	0.41	0.97	0.86	1.20	0.57	0.96	0.96
21-30	0.94	0.98	0.91	0.90	0.58	0.61	1.04	1.04
41-50	1.07	1.04	1.37	1.32	1.76	1.50	0.90	0.90
51-65	0.98	0.96	1.47	1.40	2.18	1.76	0.86	0.86
66-99	1.03	0.97	1.50	1.45	2.46	1.99	0.67	0.67

**Table 2.11 Comparison of Estimated Coefficients Between With and Without Probit Analysis (Continued)**

Equation Independent Variables	33 Domestic services		34 Household insurance		35 Other household oper.		36 Prescription drugs	
	Probit	Least Squares	Probit	Least Squares	Probit	Least Squares	Probit	Least Squares
Intercept	15.14	33.08	-16.87	-25.98	-4.07	-7.02	-50.82	-41.51
Incomes								
0-8154	0.0003	0.0024	0.0054	0.0109	0.0005	0.0018	0.0104	0.0108
8154-12557	0.0023	0.0031	0.0042	0.0054	0.0005	0.0012	0.0145	0.0160
12557-17929	0.0038	0.0052	0.0074	0.0104	0.0022	0.0045	0.0021	0.0017
17929-26496	0.0134	0.0174	0.0039	0.0046	0.0015	0.0021	0.0052	0.0052
26496-infinity	0.0069	0.0075	0.0017	0.0022	0.0015	0.0018	-0.0002	-0.0003
Region (Northeast=base)								
Midwest	-0.86	0.16	7.85	10.54	0.97	2.17	15.90	16.63
South	4.15	9.28	16.15	26.89	4.94	9.91	29.13	37.11
West	7.11	11.19	5.85	12.83	5.70	11.33	-3.48	-2.89
Family Size (3-4 =base)								
1	15.10	76.73	-20.52	11.50	-9.21	-2.10	-31.08	-11.61
2	-18.83	-10.44	-5.82	2.28	-5.31	-4.62	-12.86	-6.88
5+	-8.88	-21.76	5.87	1.38	-0.03	-2.64	13.25	11.56
Age of Household Head (35-55 =base)								
35-	-5.06	-13.89	-5.23	-2.29	-0.53	1.76	-5.31	-9.00
55+	2.15	-3.39	22.29	26.07	5.38	10.34	26.69	20.56
Education (high school =base)								
lower than high school	0.57	2.79	-7.48	-7.64	-1.20	-2.68	19.13	28.70
higher than high school	15.91	18.88	1.28	-2.36	4.68	8.20	-9.89	-12.56
Number of wage earners (2 =base)								
1	-13.62	-29.19	-9.27	-7.44	-1.00	-2.65	18.33	21.82
3+	-11.17	-17.32	-6.07	-7.51	-0.97	-2.18	-3.88	-3.90
Adult Equivalency Weights (31-40 =1)								
0-5	16.91	15.78	0.66	0.72	1.07	0.87	0.04	0.07
6-15	2.20	1.87	0.63	0.59	1.82	1.55	-0.12	-0.10
16-20	1.35	1.29	1.09	0.93	0.75	0.22	0.14	0.16
21-30	-0.14	-0.16	0.46	0.54	0.71	0.84	0.69	0.76
41-50	0.97	1.10	1.26	1.18	1.27	1.33	1.43	1.40
51-65	1.01	1.08	1.48	1.34	1.26	1.24	1.86	1.75
66-99	2.23	2.01	1.19	1.18	1.70	1.50	3.75	3.57

**Table 2.11 Comparison of Estimated Coefficients Between With and Without Probit Analysis (Continued)**

Equation Independent Variables	37 Ophth. & orthoped. equ.		38 Physicians' services		39 Dental care		40 Other srv. by med. pro.	
	Probit	Least Squares	Probit	Least Squares	Probit	Least Squares	Probit	Least Squares
Intercept	-3.87	-7.29	-11.48	-19.55	-2.21	-1.24	-6.13	-11.24
Incomes								
0-8154	0.0007	0.0033	0.0045	0.0080	0.0006	0.0021	0.0009	0.0021
8154-12557	0.0005	0.0010	0.0039	0.0043	0.0033	0.0061	0.0003	0.0004
12557-17929	0.0006	0.0018	0.0073	0.0085	0.0020	0.0030	0.0019	0.0044
17929-26496	0.0023	0.0045	0.0045	0.0052	0.0041	0.0055	0.0009	0.0008
26496-infinity	0.0002	0.0004	0.0008	0.0010	0.0007	0.0008	0.0013	0.0023
Region (Northeast=base)								
Midwest	1.84	3.52	2.03	7.20	-2.10	-4.76	-0.52	-2.53
South	1.00	2.17	6.85	13.49	-0.88	0.27	-1.80	-3.06
West	0.20	-2.24	1.30	6.62	2.23	5.27	-0.09	-2.20
Family Size (3-4 =base)								
1	-6.81	-4.37	-40.16	-35.92	-9.30	3.72	-7.54	-1.18
2	-1.59	0.40	-13.81	-12.21	-2.85	3.62	-4.02	-5.29
5+	2.18	2.78	7.11	10.62	4.86	4.97	3.61	7.16
Age of Household Head (35-55 =base)								
35-	-0.85	-1.90	-0.08	3.38	-3.03	-3.38	1.53	8.35
55+	2.20	3.76	6.08	4.91	4.62	3.20	5.44	9.19
Education (high school =base)								
lower than high school	-0.45	-1.31	-7.06	-10.44	-4.26	-7.52	-0.82	-1.42
higher than high school	2.92	6.11	-1.63	-4.55	8.55	12.11	5.13	12.54
Number of wage earners (2 =base)								
1	-0.84	-3.10	8.82	16.58	0.40	-1.69	4.09	8.92
3+	1.26	3.53	-9.67	-13.60	-2.20	-4.21	2.22	4.77
Adult Equivalency Weights (31-40 =1)								
0-5	-0.22	-0.28	0.14	0.03	0.05	-0.01	-0.29	-0.52
6-15	1.28	0.72	0.35	0.24	3.79	3.10	1.10	0.78
16-20	1.21	0.64	0.97	0.82	2.62	2.10	4.21	3.65
21-30	0.85	0.62	0.80	0.80	0.99	1.05	1.09	0.69
41-50	1.09	1.00	0.91	0.92	1.78	1.67	3.00	2.52
51-65	1.28	1.14	1.04	1.05	2.56	2.18	2.59	2.31
66-99	0.75	0.76	0.66	0.69	3.14	3.50	1.17	1.15



**Table 2.11 Comparison of Estimated Coefficients Between With and Without Probit Analysis (Continued)**

Equation Independent Variables	42 Hospital services		44 Health insurance		45 Banking services		46 Life & personal insur.	
	Probit	Least Squares	Probit	Least Squares	Probit	Least Squares	Probit	Least Squares
Intercept	2.08	-6.12	-70.14	-46.75	-0.29	0.44	-4.02	-1.66
Incomes								
0-8154	0.0001	0.0012	0.0263	0.0322	0.0002	0.0006	0.0050	0.0077
8154-12557	0.0002	0.0015	0.0207	0.0237	0.0005	0.0010	0.0054	0.0068
12557-17929	-0.0002	-0.0011	0.0080	0.0094	0.0001	0.0001	0.0031	0.0035
17929-26496	0.0004	0.0043	0.0170	0.0208	0.0004	0.0008	0.0075	0.0095
26496-infinity	0.0000	0.0003	0.0009	0.0006	0.0000	0.0000	0.0019	0.0025
Region (Northeast=base)								
Midwest	0.88	1.93	35.68	31.59	0.22	-0.17	-0.43	-7.14
South	0.83	13.15	62.24	61.04	0.78	1.00	4.61	-1.93
West	0.41	3.52	-2.10	-3.73	0.91	1.49	-9.37	-13.48
Family Size (3-4 =base)								
1	-2.05	-12.37	-34.65	-21.12	0.70	4.88	-50.02	-48.47
2	-1.47	-7.51	-5.97	3.16	-0.39	0.35	-18.31	-16.29
5+	-1.23	-1.68	1.89	-4.43	0.13	-0.04	6.01	4.22
Age of Household Head (35-55 =base)								
35-	0.01	5.15	-3.39	0.22	-0.13	0.01	-14.57	-16.46
55+	-2.17	-1.32	80.50	56.52	-0.47	-1.14	11.28	13.43
Education (high school =base)								
lower than high school	0.11	2.60	-19.90	-24.88	-0.38	-0.79	-0.56	1.38
higher than high school	0.73	8.31	-9.65	-21.58	-0.50	-0.89	5.72	5.85
Number of wage earners (2 =base)								
1	-0.22	-2.96	5.56	9.05	-0.39	-0.59	-6.20	-1.89
3+	-1.44	-6.07	-3.25	-11.60	-0.41	-1.32	-1.90	1.51
Adult Equivalency Weights (31-40 =1)								
0-5	-0.02	-0.70	1.11	1.14	0.69	0.63	3.25	3.37
6-15	0.64	2.12	0.70	0.69	1.13	0.97	1.70	1.65
16-20	-0.41	-1.91	0.72	0.73	1.28	1.09	1.43	1.14
21-30	0.86	0.74	0.72	0.79	1.39	1.28	1.01	1.14
41-50	2.74	5.27	1.36	1.35	1.52	1.37	2.23	2.31
51-65	1.33	1.77	1.70	1.56	1.29	1.28	3.54	3.60
66-99	10.02	3.75	3.38	3.09	1.17	1.14	1.70	1.92

**Table 2.11 Comparison of Estimated Coefficients Between With and Without Probit Analysis (Continued)**

Equation Independent Variables	47 Contribution to pension		48 Legal fees		49 Funeral & burial services		50 Other personal business	
	Probit	Least Squares	Probit	Least Squares	Probit	Least Squares	Probit	Least Squares
Intercept	-29.63	-44.16	-0.47	-22.36	-2.08	3.06	-0.29	-7.41
Incomes								
0-8154	0.0907	0.1116	0.0001	0.0031	0.0000	-0.0012	0.0012	0.0035
8154-12557	0.1177	0.1301	0.0000	-0.0009	0.0003	0.0023	0.0018	0.0066
12557-17929	0.1357	0.1434	0.0000	0.0031	0.0005	0.0033	0.0013	0.0033
17929-26496	0.1588	0.1515	0.0000	0.0024	0.0003	0.0007	0.0055	0.0088
26496-infinity	0.1176	0.1334	0.0001	0.0019	0.0000	-0.0001	0.0017	0.0028
Region (Northeast=base)								
Midwest	146.03	181.81	0.09	6.17	2.17	10.39	-1.94	-0.93
South	162.06	198.63	0.09	5.72	-0.38	-2.08	-5.90	-8.43
West	230.99	225.83	0.22	10.43	-0.35	-3.92	1.58	9.50
Family Size (3-4 =base)								
1	-259.28	26.96	-0.40	-1.40	-2.36	-10.83	-10.80	-2.76
2	-141.33	-115.65	-0.07	4.55	0.11	2.64	-6.07	-10.17
5+	84.47	72.84	0.36	5.47	2.47	11.12	5.51	14.17
Age of Household Head (35-55 =base)								
35-	29.91	17.27	-0.10	7.29	-2.01	-16.00	1.28	12.53
55+	-258.73	-33.14	-0.19	-0.50	0.10	-7.51	4.89	13.79
Education (high school =base)								
lower than high school	-86.58	-106.39	-0.05	2.58	0.26	0.04	2.14	13.02
higher than high school	196.09	275.47	-0.04	4.61	-0.88	-6.68	-7.07	-9.23
Number of wage earners (2 =base)								
1	-468.97	-473.88	0.31	9.45	2.00	9.33	-7.74	-22.24
3+	19.36	-9.28	0.00	-1.28	2.89	17.79	-4.95	-15.85
Adult Equivalency Weights (31-40 =1)								
0-5	0.49	0.45	8.56	-0.46	0.00	1.36	0.69	0.46
6-15	0.46	0.42	15.52	3.36	-0.18	0.18	0.07	-0.08
16-20	0.11	0.05	16.00	0.98	-0.82	-1.48	-0.22	-0.48
21-30	0.81	0.77	0.01	0.31	-0.65	-1.06	0.39	0.35
41-50	1.08	1.09	4.26	1.91	1.19	1.51	1.36	1.48
51-65	0.70	0.80	9.75	2.46	1.26	1.13	1.02	1.07
66-99	0.02	0.04	35.24	2.39	13.59	16.57	0.43	0.53

**Table 2.11 Comparison of Estimated Coefficients Between With and Without Probit Analysis (Continued)**

Equation Independent Variables	51 New cars & trucks		52 Used cars & trucks		54 Tires, tubes, & access.		55 Maintenance & repair	
	Probit	Least Squares	Probit	Least Squares	Probit	Least Squares	Probit	Least Squares
Intercept	-71.04	-177.96	-114.80	-246.57	-18.79	-11.74	-4.38	16.34
Incomes								
0-8154	0.0094	0.0282	0.0247	0.0891	0.0053	0.0077	0.0263	0.0302
8154-12557	0.0049	0.0378	0.0425	0.1028	0.0062	0.0083	0.0337	0.0339
12557-17929	0.0072	0.0704	0.0424	0.1437	0.0041	0.0040	0.0247	0.0238
17929-26496	0.0567	0.1750	0.0331	0.0550	0.0045	0.0057	0.0366	0.0365
26496-infinity	0.0436	0.1244	0.0144	0.0533	-0.0002	-0.0003	0.0289	0.0302
Region (Northeast=base)								
Midwest	7.40	46.51	99.53	169.52	-3.41	-8.07	-41.42	-60.74
South	25.46	80.21	17.90	61.57	8.09	5.89	-63.21	-79.75
West	6.09	50.49	-49.58	-100.82	3.66	1.86	-21.83	-29.71
Family Size (3-4 =base)								
1	-372.20	-751.74	-287.65	-677.33	-18.13	0.45	-122.69	-62.00
2	-65.63	-116.32	-133.57	-207.56	-5.23	0.97	-46.87	-40.42
5+	12.60	52.88	61.86	87.35	11.62	9.07	15.85	7.81
Age of Household Head (35-55 =base)								
35-	35.41	48.81	21.18	26.68	1.15	4.58	-10.14	-15.30
55+	42.51	122.52	-45.38	-87.10	2.88	9.40	33.58	39.31
Education (high school =base)								
lower than high school	-27.32	-107.50	67.94	163.58	-10.92	-16.51	-9.02	0.24
higher than high school	-128.65	-443.73	-197.61	-438.88	-10.87	-12.88	62.67	66.99
Number of wage earners (2 =base)								
1	43.22	102.78	-14.22	-28.72	7.69	13.36	-13.04	-7.44
3+	36.36	66.21	-4.83	-56.75	9.34	10.98	15.76	9.88
Adult Equivalency Weights (31-40 =1)								
0-5	2.11	1.28	0.88	0.87	0.26	0.33	0.51	0.49
6-15	2.35	1.68	0.47	0.45	0.16	0.15	0.69	0.65
16-20	0.91	0.44	1.85	1.81	1.04	0.95	0.78	0.75
21-30	1.16	1.27	1.54	1.28	0.57	0.60	1.33	1.31
41-50	0.26	0.57	0.19	0.25	0.84	0.91	0.83	0.81
51-65	0.70	0.84	0.61	0.91	0.82	0.89	0.71	0.70
66-99	0.37	0.38	0.08	0.27	0.45	0.50	0.55	0.53

**Table 2.11 Comparison of Estimated Coefficients Between With and Without Probit Analysis (Continued)**

Equation Independent Variables	56 Vehicle rental & charges		57 Vehicle financial charges		58 Vehicle license & registr.		59 Gasoline & motor oil	
	Probit	Least Squares	Probit	Least Squares	Probit	Least Squares	Probit	Least Squares
Intercept	-0.59	-1.03	-14.85	-12.08	-15.37	-16.83	-31.77	-12.19
Incomes								
0-8154	0.0002	0.0013	0.0080	0.0156	0.0043	0.0062	0.0626	0.0614
8154-12557	0.0013	0.0023	0.0121	0.0165	0.0027	0.0022	0.0482	0.0474
12557-17929	0.0015	0.0021	0.0063	0.0109	0.0026	0.0027	0.0304	0.0297
17929-26496	0.0042	0.0049	0.0085	0.0089	0.0051	0.0050	0.0274	0.0266
26496-infinity	0.0022	0.0026	0.0018	0.0040	0.0005	0.0006	0.0076	0.0075
Region (Northeast=base)								
Midwest	-0.98	-1.30	29.23	44.57	13.62	17.19	76.99	66.93
South	-0.45	1.25	37.99	56.53	3.82	5.19	90.51	78.92
West	4.68	6.92	15.11	25.39	17.89	25.19	63.85	53.48
Family Size (3-4 =base)								
1	-9.40	1.83	-65.35	-36.51	-10.88	-1.37	-23.16	33.54
2	-0.66	2.78	-17.29	-7.20	1.13	5.27	5.67	12.92
5+	1.32	0.25	-4.77	-10.83	3.53	0.97	10.27	2.83
Age of Household Head (35-55 =base)								
35-	-2.51	-4.04	12.57	8.63	4.42	7.41	-11.04	-11.48
55+	3.10	5.67	-11.19	-3.93	-1.68	-4.32	-31.98	-32.22
Education (high school =base)								
lower than high school	-1.23	-0.63	-21.40	-31.03	-5.36	-7.03	-36.23	-22.78
higher than high school	7.75	9.15	-33.65	-41.69	-10.10	-11.24	-73.24	-74.02
Number of wage earners (2 =base)								
1	-1.39	-3.27	-20.80	-20.58	-2.27	-2.41	-27.79	-17.32
3+	-0.53	-1.61	1.41	-5.49	0.50	-0.57	-5.47	-4.97
Adult Equivalency Weights (31-40 =1)								
0-5	1.68	1.71	0.56	0.47	0.44	0.37	0.46	0.47
6-15	0.98	0.86	0.58	0.52	0.67	0.62	0.51	0.51
16-20	1.16	0.96	0.37	0.31	0.77	0.81	0.80	0.81
21-30	0.98	0.99	1.36	1.36	0.61	0.61	0.95	0.96
41-50	1.26	1.29	0.86	0.88	0.90	0.90	0.97	0.97
51-65	0.81	0.84	0.77	0.88	1.13	1.13	0.95	0.94
66-99	0.36	0.48	0.10	0.22	0.92	0.97	0.64	0.64

**Table 2.11 Comparison of Estimated Coefficients Between With and Without Probit Analysis (Continued)**

Equation Independent Variables	60 Tolls		61 Vehicle insurance		62 Local transportation		63 Taxis	
	Probit	Least Squares	Probit	Least Squares	Probit	Least Squares	Probit	Least Squares
Intercept	0.61	1.43	6.64	40.14	7.93	19.02	0.62	2.35
Incomes								
0-8154	0.0000	0.0000	0.0268	0.0283	0.0002	0.0007	0.0000	0.0001
8154-12557	0.0000	0.0002	0.0306	0.0314	0.0002	0.0005	0.0000	0.0001
12557-17929	0.0001	0.0001	0.0256	0.0255	0.0004	0.0006	0.0001	0.0003
17929-26496	0.0001	0.0001	0.0171	0.0157	0.0008	0.0019	0.0000	0.0001
26496-infinity	0.0000	0.0001	0.0039	0.0044	0.0008	0.0011	0.0003	0.0005
Region (Northeast=base)								
Midwest	-0.83	-1.60	-19.47	-36.30	-11.51	-26.20	-0.69	-2.53
South	-0.89	-1.73	-1.13	-11.55	-11.06	-23.65	-0.87	-3.40
West	-1.02	-2.16	-10.38	-19.23	-9.14	-21.01	-0.51	-1.70
Family Size (3-4 =base)								
1	-0.52	-0.58	-77.52	-11.86	1.64	9.60	0.03	1.62
2	-0.14	-0.05	-31.92	-12.82	-0.87	-0.54	-0.25	-0.78
5+	0.12	0.13	12.89	3.86	0.65	0.47	-0.21	-1.20
Age of Household Head (35-55 =base)								
35-	-0.11	-0.30	-15.37	-15.95	0.62	2.90	0.12	1.05
55+	-0.07	-0.37	-15.04	-20.88	-0.20	-0.61	-0.09	-0.34
Education (high school =base)								
lower than high school	0.00	-0.08	-33.04	-21.22	3.03	8.22	0.14	0.86
higher than high school	0.28	0.46	-31.43	-29.88	3.05	5.62	0.53	1.61
Number of wage earners (2 =base)								
1	0.11	0.35	8.08	18.80	-0.03	1.25	0.02	0.65
3+	0.00	0.05	9.34	8.13	1.72	5.16	0.14	0.72
Adult Equivalency Weights (31-40 =1)								
0-5	1.31	1.01	0.30	0.26	0.04	0.05	-0.84	-0.43
6-15	0.78	0.43	0.37	0.35	0.87	1.04	2.03	1.44
16-20	0.24	-0.06	1.55	1.51	0.36	0.11	2.09	0.54
21-30	1.25	0.97	1.25	1.25	1.75	1.52	2.38	1.57
41-50	1.79	1.47	0.92	0.90	1.56	1.50	1.53	1.43
51-65	1.62	1.45	1.07	1.05	0.95	0.93	1.99	1.72
66-99	0.79	1.02	0.86	0.86	1.13	1.04	3.36	2.15

**Table 2.11 Comparison of Estimated Coefficients Between With and Without Probit Analysis (Continued)**

Equation Independent Variables	64 Intercity train fares		65 Intercity bus fares		66 Airline fares		67 Ship fares	
	Probit	Least Squares	Probit	Least Squares	Probit	Least Squares	Probit	Least Squares
Intercept	0.36	2.57	0.32	0.79	9.91	10.21	1.64	7.08
Incomes								
0-8154	0.0000	-0.0004	0.0000	0.0003	-0.0006	0.0036	0.0000	-0.0002
8154-12557	0.0001	0.0011	0.0001	0.0007	0.0027	0.0098	-0.0001	0.0005
12557-17929	0.0002	0.0005	0.0001	0.0001	0.0068	0.0128	0.0005	0.0021
17929-26496	-0.0002	0.0000	0.0000	0.0004	0.0062	0.0134	-0.0008	-0.0007
26496-infinity	0.0005	0.0009	0.0003	0.0006	0.0149	0.0167	0.0010	0.0021
Region (Northeast=base)								
Midwest	0.05	1.24	-0.17	-0.43	-1.09	4.01	-0.09	-0.11
South	-0.33	-1.17	-0.28	-0.84	-11.95	-23.45	-0.65	-4.76
West	0.01	1.41	-0.12	0.35	17.01	32.27	-0.72	-1.78
Family Size (3-4 =base)								
1	-1.01	-4.38	-0.58	-1.29	-33.07	-20.76	-0.86	-1.40
2	-0.12	-1.45	-0.37	-2.47	-6.87	-10.74	0.70	1.77
5+	-0.36	-2.34	-0.23	-0.89	-0.85	6.33	-0.66	-4.17
Age of Household Head (35-55 =base)								
35-	0.38	2.10	-0.01	-0.24	-6.19	-15.04	-0.18	1.60
55+	0.48	3.46	0.27	1.20	-2.70	-4.56	-0.80	-2.33
Education (high school =base)								
lower than high school	0.10	-0.03	0.04	0.20	-0.82	-7.71	0.19	1.93
higher than high school	0.64	3.09	0.21	0.75	38.97	55.71	0.28	1.85
Number of wage earners (2 =base)								
1	-0.73	-1.78	-0.50	-1.74	-9.33	-8.52	-1.20	-4.95
3+	0.04	-0.60	0.04	-0.23	-6.19	-18.60	0.26	0.16
Adult Equivalency Weights (31-40 =1)								
0-5	-1.57	-1.34	-1.15	-1.08	0.31	0.35	-2.95	-1.45
6-15	-0.54	0.20	0.15	0.50	0.32	0.17	-0.65	-0.02
16-20	2.63	0.20	2.98	0.17	0.89	0.56	3.09	0.58
21-30	1.47	1.03	1.86	1.20	0.93	0.93	2.74	1.69
41-50	2.14	2.22	2.13	1.92	0.72	0.78	1.22	1.49
51-65	1.57	1.12	1.71	1.17	0.73	0.68	2.52	1.72
66-99	4.16	2.32	4.49	2.43	1.21	1.13	8.47	4.36

**Table 2.11 Comparison of Estimated Coefficients Between With and Without Probit Analysis (Continued)**

Equation Independent Variables	68 Reading		69 Pets, pet supplies & srvc.		70 Toys & playground equ.		71 Bicycles	
	Probit	Least Squares	Probit	Least Squares	Probit	Least Squares	Probit	Least Squares
Intercept	3.04	2.54	-10.22	-16.67	-5.16	-0.41	-0.60	1.42
Incomes								
0-8154	0.0011	0.0015	0.0049	0.0096	0.0027	0.0045	0.0001	0.0002
8154-12557	0.0036	0.0039	0.0081	0.0135	0.0014	0.0024	0.0002	0.0009
12557-17929	0.0033	0.0034	0.0071	0.0080	0.0022	0.0027	0.0002	0.0016
17929-26496	0.0059	0.0057	0.0094	0.0127	0.0010	0.0014	-0.0001	-0.0007
26496-infinity	0.0011	0.0011	0.0055	0.0097	0.0023	0.0030	0.0002	0.0012
Region (Northeast=base)								
Midwest	-0.56	0.34	12.22	11.34	1.13	0.03	-0.17	1.05
South	-8.16	-6.76	18.32	23.63	0.10	0.34	-0.27	-3.14
West	-2.87	-1.44	6.65	5.58	-1.11	-2.59	0.69	1.43
Family Size (3-4 =base)								
1	10.22	22.17	-91.95	-68.98	-18.91	-3.97	-1.40	-8.47
2	4.40	7.19	-47.90	-52.21	-1.77	6.97	-0.53	-4.59
5+	1.84	1.47	-7.12	-5.89	4.08	2.26	0.52	0.03
Age of Household Head (35-55 =base)								
35-	-0.34	-0.08	0.58	5.40	1.69	-1.06	0.41	-0.74
55+	6.41	7.61	7.47	26.89	3.09	7.57	-0.02	-1.54
Education (high school =base)								
lower than high school	-6.31	-6.03	-11.81	-16.39	-2.89	-4.00	0.27	1.57
higher than high school	20.71	20.58	5.80	10.33	1.59	2.07	0.31	5.70
Number of wage earners (2 =base)								
1	0.56	0.77	12.35	22.54	1.34	1.67	-0.11	0.56
3+	0.49	0.45	-0.58	-5.34	-2.36	-0.84	-0.40	-1.73
Adult Equivalency Weights (31-40 =1)								
0-5	1.08	1.13	-0.25	-0.24	6.54	5.35	1.72	1.08
6-15	0.96	1.00	0.34	0.27	2.47	1.78	1.06	0.53
16-20	0.59	0.61	0.17	0.16	-0.04	-0.02	0.30	-0.24
21-30	0.64	0.66	0.43	0.43	0.46	0.34	0.19	0.99
41-50	1.35	1.37	0.74	0.70	0.90	1.00	0.08	0.22
51-65	1.38	1.37	0.60	0.62	0.81	0.89	0.38	0.89
66-99	1.24	1.22	0.32	0.39	0.25	0.40	-0.01	-0.01

**Table 2.11 Comparison of Estimated Coefficients Between With and Without Probit Analysis (Continued)**

Equation Independent Variables	72 Cameras & film		73 Guns & sporting equ.		74 Televisions & sound equ.		75 Home computers	
	Probit	Least Squares	Probit	Least Squares	Probit	Least Squares	Probit	Least Squares
Intercept	-0.68	-1.45	-32.77	-61.78	9.02	13.12	-4.50	-8.31
Incomes								
0-8154	0.0006	0.0014	0.0041	0.0089	0.0141	0.0135	0.0033	0.0087
8154-12557	0.0010	0.0014	0.0046	0.0066	0.0111	0.0105	0.0092	0.0134
12557-17929	0.0018	0.0024	0.0030	0.0103	0.0055	0.0048	0.0072	0.0102
17929-26496	0.0015	0.0017	0.0088	0.0175	0.0198	0.0191	0.0089	0.0097
26496-infinity	0.0011	0.0014	0.0100	0.0200	0.0068	0.0067	0.0020	0.0033
Region (Northeast=base)								
Midwest	-1.21	-2.75	17.93	42.85	16.21	16.13	4.16	7.65
South	-1.98	-2.51	5.07	17.80	-7.89	-7.72	5.83	11.18
West	0.07	-0.43	16.03	25.18	-1.42	-1.85	6.47	11.45
Family Size (3-4 =base)								
1	-9.52	-4.64	-94.07	-214.10	113.33	157.11	-40.40	-0.76
2	-1.52	-0.13	-32.76	-65.04	26.24	38.40	-22.54	-18.21
5+	0.58	0.26	15.60	20.11	-25.14	-27.12	1.59	3.26
Age of Household Head (35-55 =base)								
35-	0.15	-0.05	-2.32	-10.72	6.20	4.99	-7.00	-9.30
55+	0.17	0.60	5.51	28.36	18.81	25.18	-9.61	-0.90
Education (high school =base)								
lower than high school	-0.85	-0.46	-4.26	-2.99	0.94	3.17	-14.33	-23.50
higher than high school	1.29	0.68	-16.63	-34.86	10.58	9.28	16.92	10.03
Number of wage earners (2 =base)								
1	0.05	0.86	14.63	23.87	-4.93	-3.57	3.67	5.47
3+	1.18	2.51	7.07	18.72	9.62	10.01	6.01	4.24
Adult Equivalency Weights (31-40 =1)								
0-5	2.33	1.99	2.47	2.27	0.92	0.99	0.61	0.35
6-15	1.55	1.28	1.39	1.26	2.47	2.60	0.90	0.63
16-20	0.91	0.73	3.35	1.73	0.92	0.97	0.92	0.68
21-30	0.53	0.45	0.34	0.38	1.11	1.13	1.40	1.32
41-50	0.90	0.86	0.23	0.11	1.03	1.03	1.06	1.00
51-65	1.19	1.16	2.14	2.07	0.92	0.93	0.93	0.90
66-99	0.40	0.27	0.19	0.25	0.62	0.62	0.56	0.46



**Table 2.11 Comparison of Estimated Coefficients Between With and Without Probit Analysis (Continued)**

Equation Independent Variables	76 Fresh flower & plants		77 Live entertainment		78 Fees for clubs & orgs.		79 Participant amusements	
	Probit	Least Squares	Probit	Least Squares	Probit	Least Squares	Probit	Least Squares
Intercept	1.76	2.61	-2.45	-3.11	0.61	2.68	-1.80	-3.02
Incomes								
0-8154	0.0001	0.0003	0.0026	0.0040	-0.0001	0.0000	0.0008	0.0020
8154-12557	0.0009	0.0021	0.0051	0.0053	0.0005	0.0011	0.0012	0.0024
12557-17929	0.0014	0.0019	0.0033	0.0031	0.0005	0.0007	0.0024	0.0030
17929-26496	0.0021	0.0027	0.0070	0.0072	0.0004	0.0008	0.0006	0.0033
26496-infinity	0.0012	0.0016	0.0054	0.0054	0.0038	0.0046	0.0057	0.0063
Region (Northeast=base)								
Midwest	-1.87	-2.47	2.89	1.90	-0.48	-1.60	2.26	3.31
South	-3.52	-4.13	-7.58	-8.26	-0.99	-1.33	-1.88	-0.64
West	-1.27	-0.67	-2.40	-4.17	-0.61	-0.82	2.23	5.49
Family Size (3-4 =base)								
1	-7.66	-1.84	-10.98	7.85	-8.17	0.46	-19.25	-17.34
2	0.71	5.26	-7.52	-1.31	0.55	7.04	-4.17	0.97
5+	0.73	0.65	2.58	1.78	0.52	-0.02	1.72	1.33
Age of Household Head (35-55 =base)								
35-	-0.77	-0.91	-1.51	-2.22	-1.04	-2.91	-1.30	-4.19
55+	2.04	3.72	-3.92	-1.45	0.70	2.15	-2.92	-5.61
Education (high school =base)								
lower than high school	-0.72	-1.25	-0.94	1.23	-0.05	-0.77	-1.55	-3.90
higher than high school	2.59	3.37	21.41	19.73	4.85	6.62	10.89	14.27
Number of wage earners (2 =base)								
1	-0.47	-0.14	-1.12	0.02	-0.40	-1.42	-0.23	1.67
3+	-0.15	-0.43	1.63	0.65	0.48	0.12	0.92	3.03
Adult Equivalency Weights (31-40 =1)								
0-5	1.16	1.17	0.67	0.66	3.45	5.28	0.17	0.10
6-15	0.72	0.62	1.90	1.95	3.23	3.46	1.76	1.63
16-20	1.92	1.80	1.88	1.91	2.01	2.49	0.73	0.35
21-30	0.63	0.63	0.99	0.99	1.78	2.61	0.80	0.83
41-50	0.88	0.89	0.85	0.87	1.00	1.48	0.86	0.86
51-65	0.85	0.79	1.03	1.11	1.46	1.78	0.86	0.88
66-99	0.81	0.64	0.70	0.68	1.31	1.06	1.92	1.82

**Table 2.11 Comparison of Estimated Coefficients Between With and Without Probit Analysis (Continued)**

Equation Independent Variables	80 Other recreation		81 Higher education		82 Private lower education		83 Other edu. & research	
	Probit	Least Squares	Probit	Least Squares	Probit	Least Squares	Probit	Least Squares
Intercept	1.09	2.64	2.69	13.22	-0.33	1.75	-0.58	0.02
Incomes								
0-8154	0.0003	0.0006	0.0004	0.0049	0.0001	0.0003	0.0001	0.0000
8154-12557	0.0017	0.0020	0.0000	0.0005	0.0001	0.0010	0.0001	0.0000
12557-17929	0.0029	0.0035	0.0020	0.0115	0.0001	-0.0002	0.0002	0.0001
17929-26496	0.0014	0.0013	0.0018	0.0074	0.0005	0.0019	0.0001	0.0000
26496-infinity	0.0031	0.0033	0.0013	0.0055	0.0002	0.0009	0.0002	0.0002
Region (Northeast=base)								
Midwest	1.34	1.03	-5.91	-27.88	0.43	0.00	-0.30	-0.06
South	-1.11	-1.08	-7.74	-37.47	0.46	1.05	-0.09	0.02
West	0.39	0.07	-6.80	-36.37	0.09	-0.61	0.17	0.09
Family Size (3-4 =base)								
1	-15.71	-13.41	-14.31	-62.06	-5.52	-17.35	-2.57	1.37
2	-3.82	-3.02	-7.91	-52.39	-2.82	-6.59	-1.05	0.05
5+	-0.24	-1.42	-0.52	1.68	0.07	-1.13	0.44	-0.06
Age of Household Head (35-55 =base)								
35-	-0.97	-1.85	3.07	11.69	-0.33	-0.43	-0.11	-0.05
55+	-2.44	-3.19	-3.41	-8.55	-0.33	0.69	-0.17	0.00
Education (high school =base)								
lower than high school	-0.88	-1.19	-0.78	1.46	0.14	-0.74	-0.05	-0.02
higher than high school	9.50	11.31	3.24	11.86	2.01	4.20	1.01	0.29
Number of wage earners (2 =base)								
1	-0.70	-0.50	2.42	24.38	0.36	-0.93	0.48	0.03
3+	-0.39	-0.08	4.60	0.01	-0.77	-1.70	0.36	0.17
Adult Equivalency Weights (31-40 =1)								
0-5	4.38	3.78	-3.43	-1.94	8.44	7.62	1.52	14.59
6-15	9.82	8.92	-3.19	-2.14	36.34	23.58	12.42	93.71
16-20	2.64	2.33	31.45	16.94	2.91	3.31	11.28	32.36
21-30	2.52	2.41	10.16	6.41	-0.82	-1.58	2.51	8.12
41-50	1.83	1.76	4.50	2.77	10.03	6.41	3.41	3.03
51-65	1.36	1.36	4.79	4.29	0.22	0.66	0.21	4.09
66-99	3.06	3.00	-0.20	-0.19	-0.27	0.01	0.11	0.39

**Table 2.11 Comparison of Estimated Coefficients Between With and Without Probit Analysis (Continued)**

Equation Independent Variables	84 Cash contributions		85 Miscellaneous			
	Probit	Least Squares	Probit	Least Squares		
Intercept	-24.78	-39.48	-19.40	-50.55		
Incomes						
0-8154	0.0125	0.0177	0.0004	0.0015		
8154-12557	0.0034	0.0050	0.0074	0.0172		
12557-17929	0.0365	0.0405	-0.0001	0.0021		
17929-26496	-0.0396	-0.0416	0.0072	0.0092		
26496-infinity	0.0912	0.0952	0.0041	0.0085		
Region (Northeast=base)						
Midwest	16.79	18.42	22.40	62.94		
South	-11.03	-13.45	25.17	65.92		
West	-22.67	-22.63	9.24	18.85		
Family Size (3-4 =base)						
1	-85.21	-118.10	-30.63	-41.05		
2	-9.17	-3.87	-4.26	-7.15		
5+	37.38	50.66	7.59	11.40		
Age of Household Head (35-55 =base)						
35-	3.96	32.51	-4.32	-5.25		
55+	-16.52	-30.84	0.22	0.57		
Education (high school =base)						
lower than high school	1.97	8.01	-4.72	-7.39		
higher than high school	11.07	8.09	-9.63	-12.45		
Number of wage earners (2 =base)						
1	0.72	4.68	0.57	-1.14		
3+	-15.53	-25.43	9.94	25.91		
Adult Equivalency Weights (31-40 =1)						
0-5	2.19	2.07	0.36	0.24		
6-15	0.53	0.34	-0.34	-0.41		
16-20	8.08	7.85	-0.69	-0.76		
21-30	0.53	0.57	0.63	0.57		
41-50	3.20	3.22	1.36	1.40		
51-65	2.32	2.30	0.41	0.44		
66-99	8.43	8.12	0.14	0.13		

Figure 2.3 Plots of Engel Curves

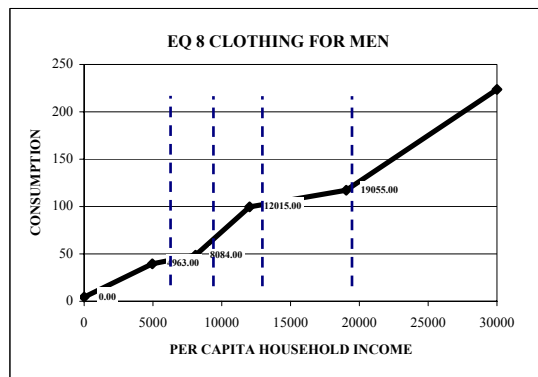
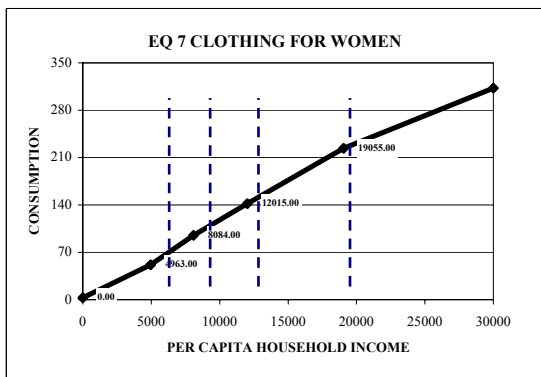
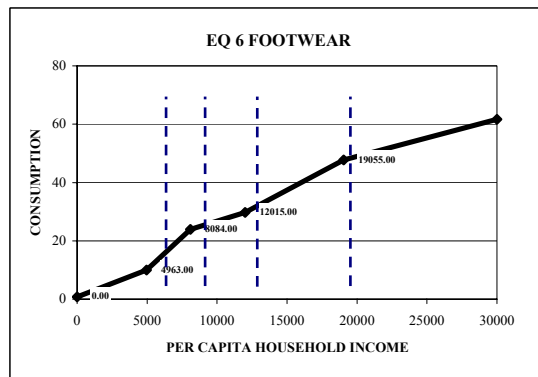
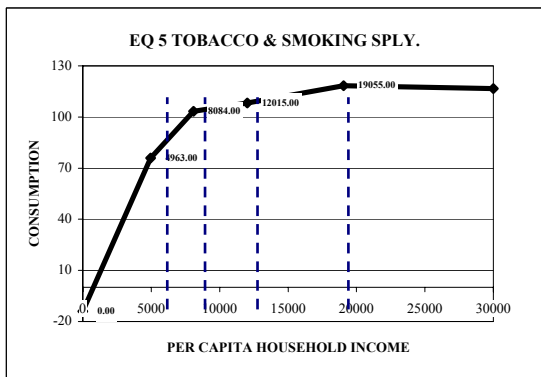
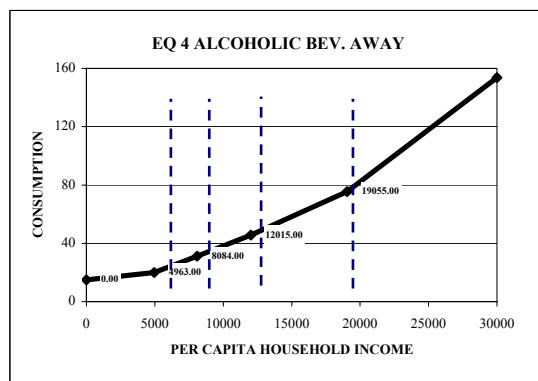
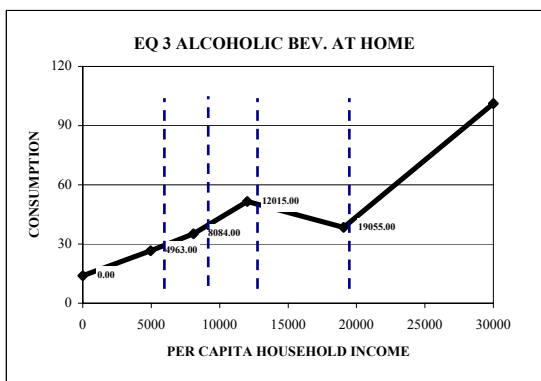
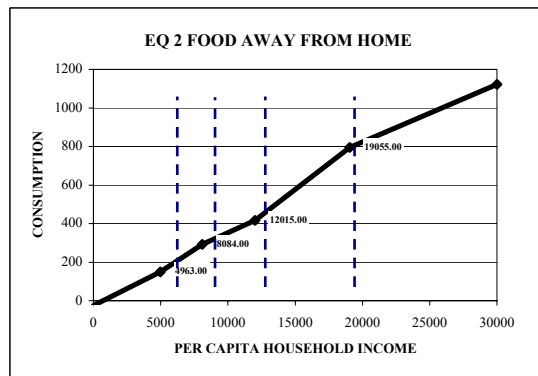
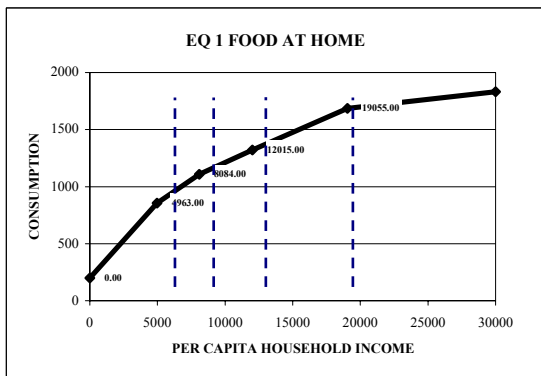


Figure 2.3 Plots of Engel Curves (Continued)

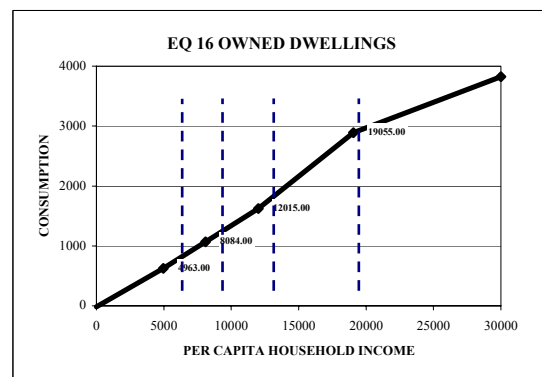
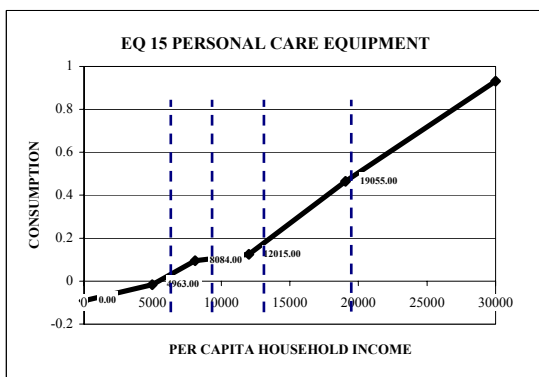
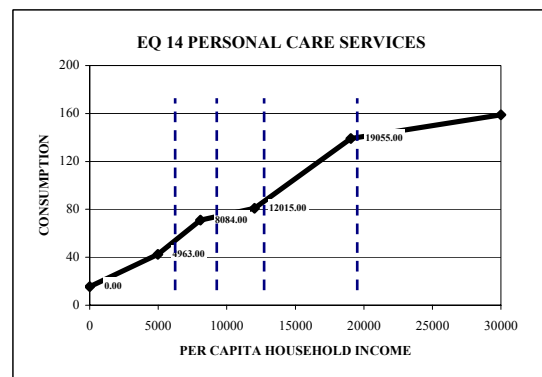
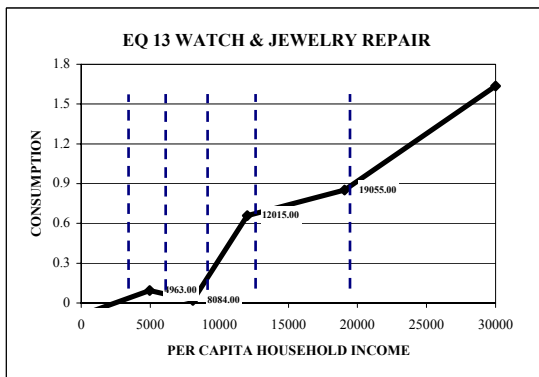
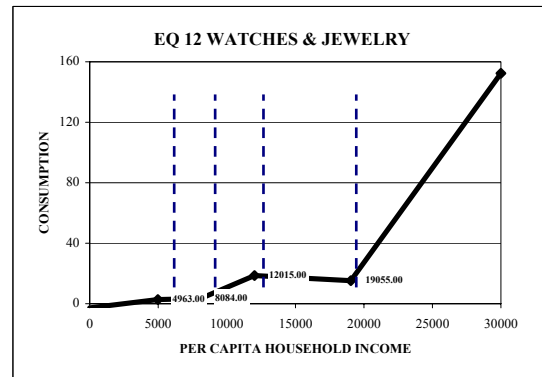
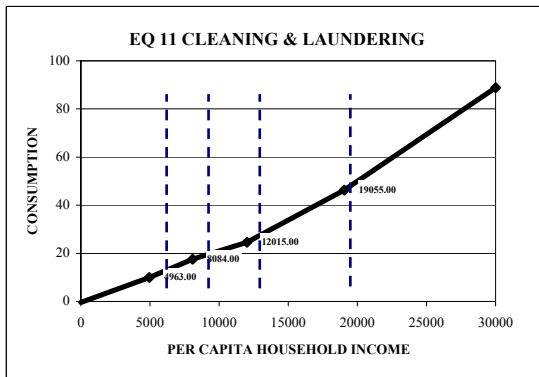
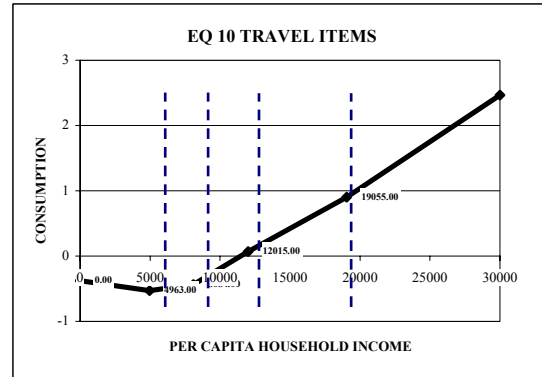
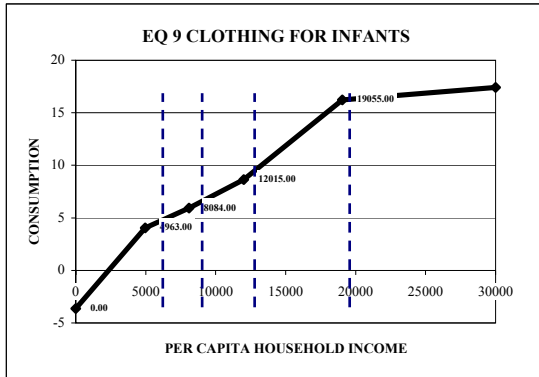


Figure 2.3 Plots of Engel Curves (Continued)

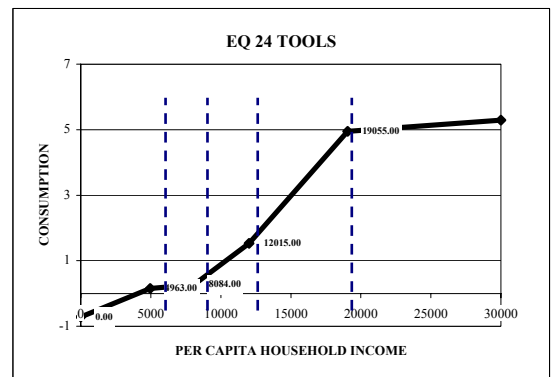
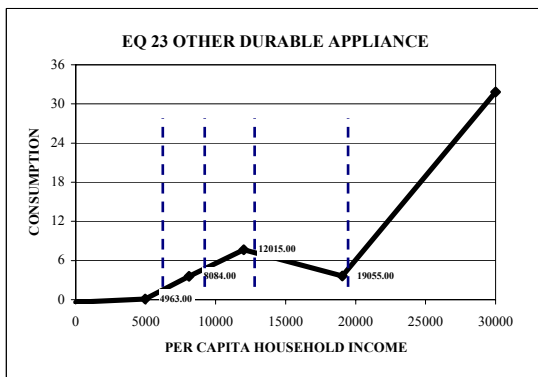
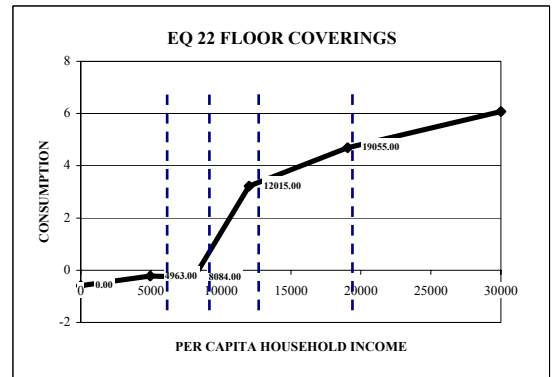
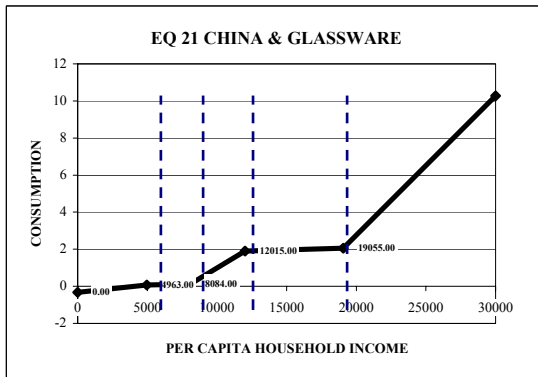
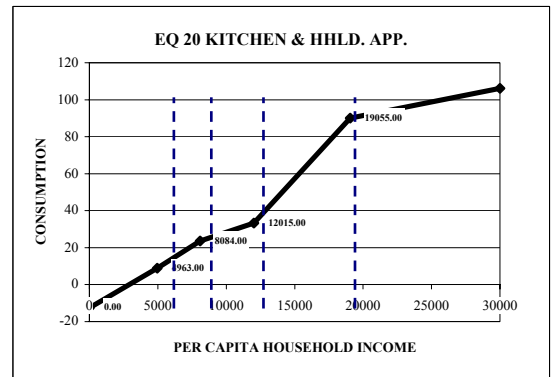
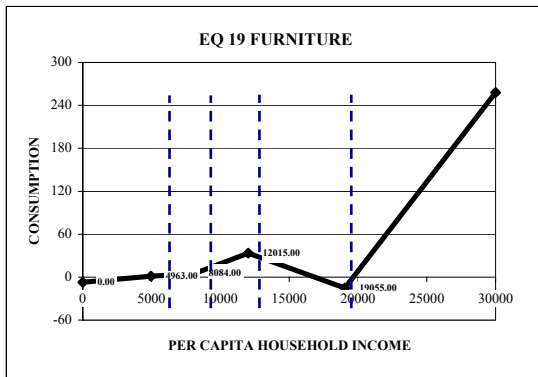
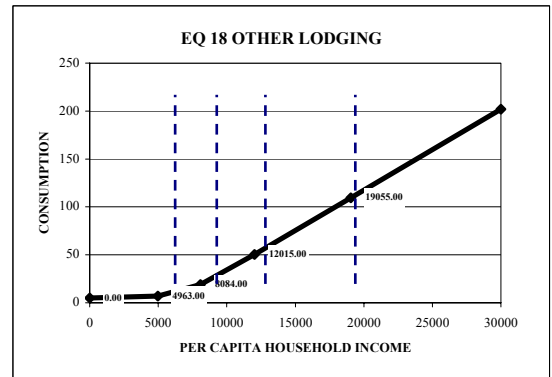
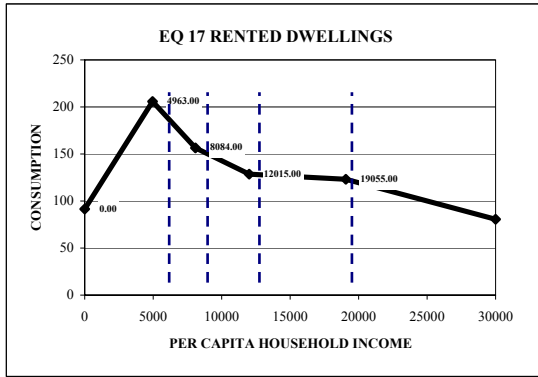


Figure 2.3 Plots of Engel Curves (Continued)

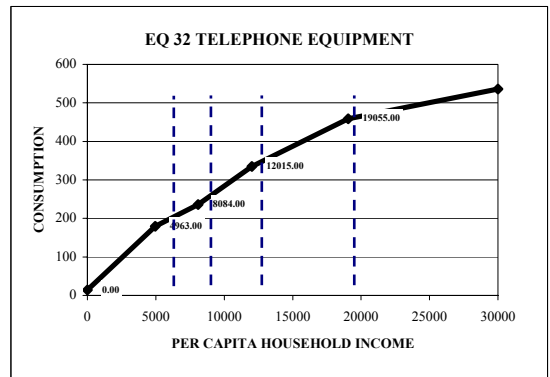
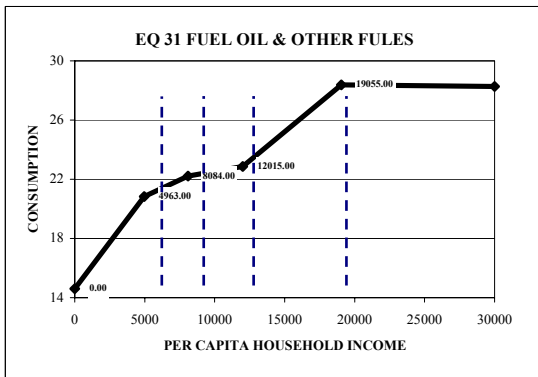
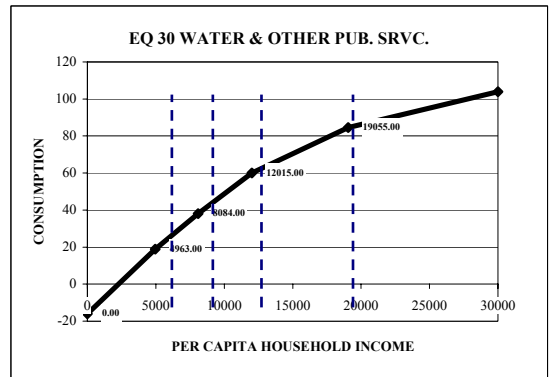
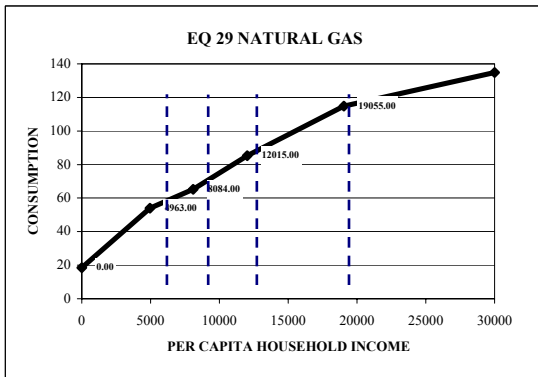
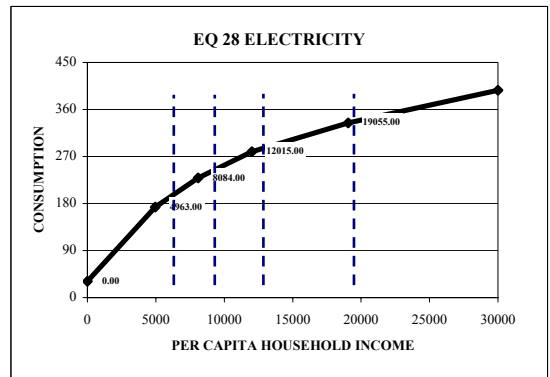
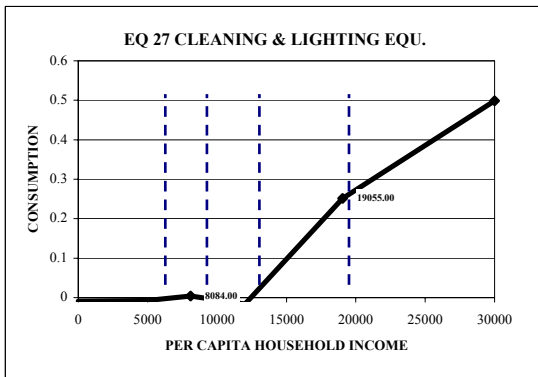
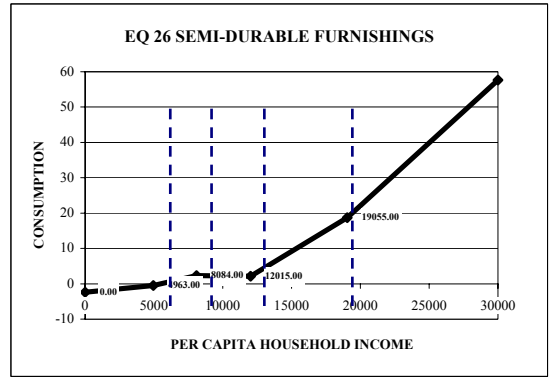
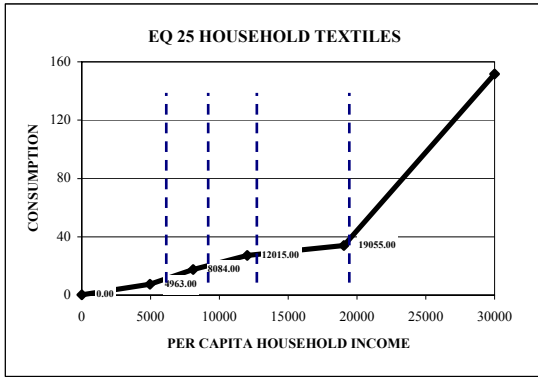


Figure 2.3 Plots of Engel Curves (Continued)

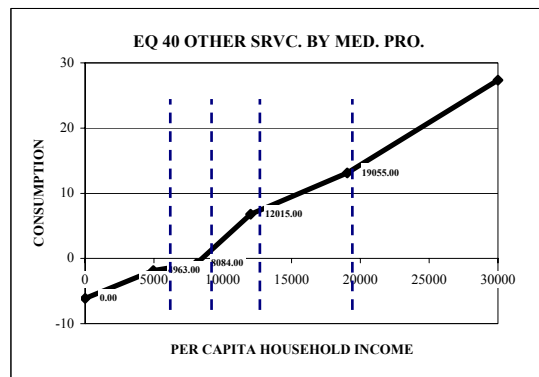
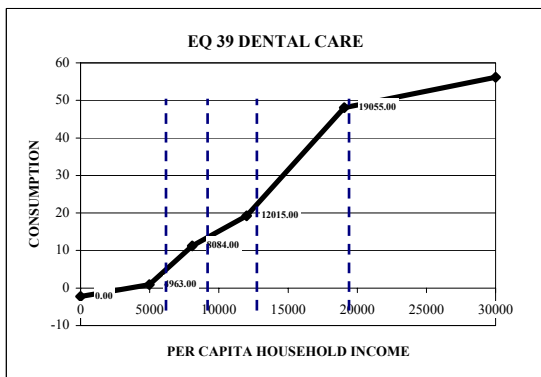
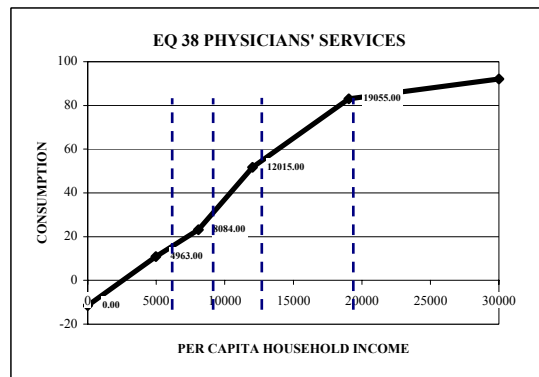
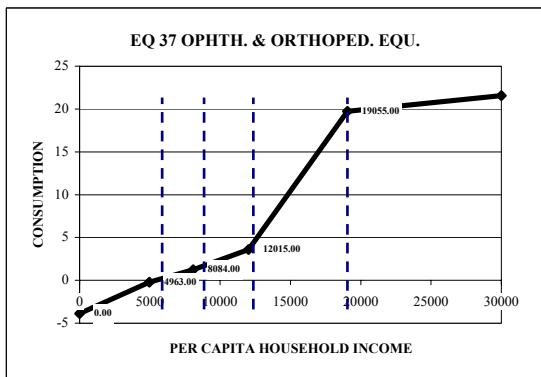
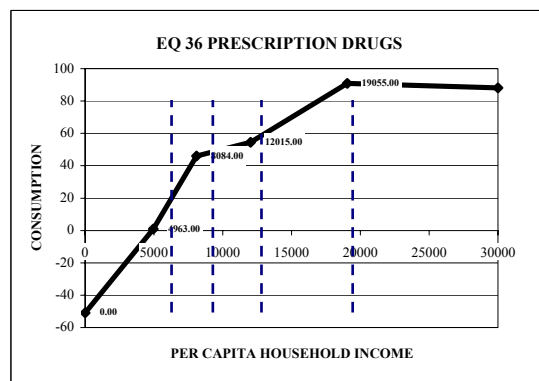
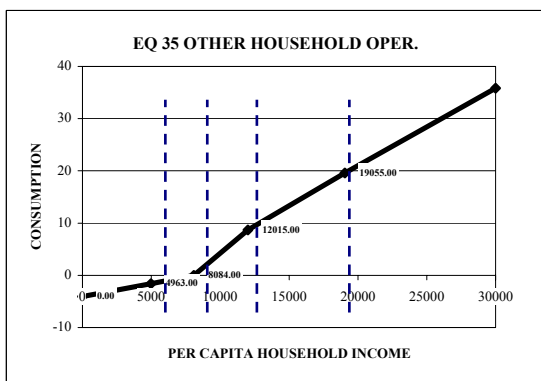
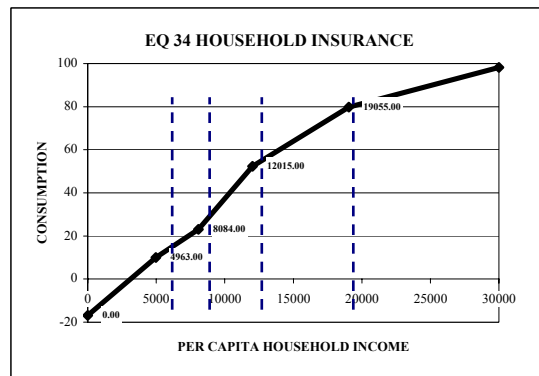
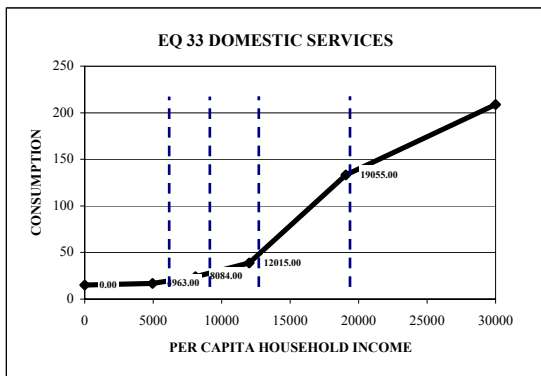




Figure 2.3 Plots of Engel Curves (Continued)

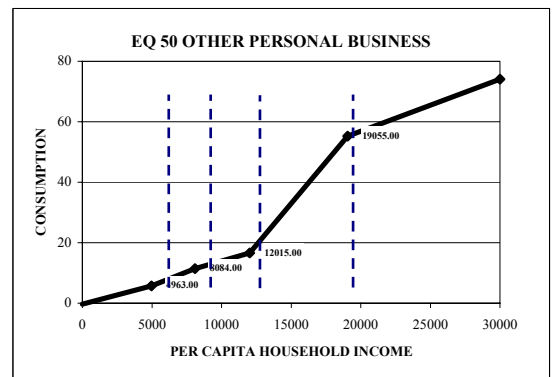
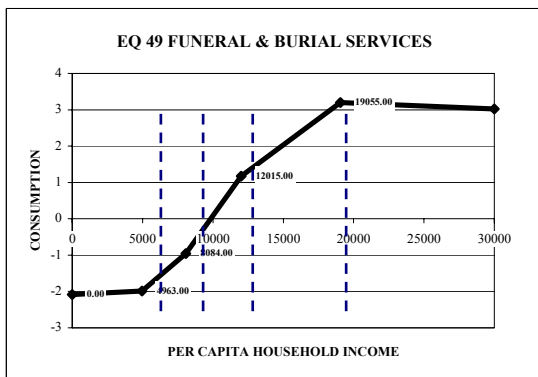
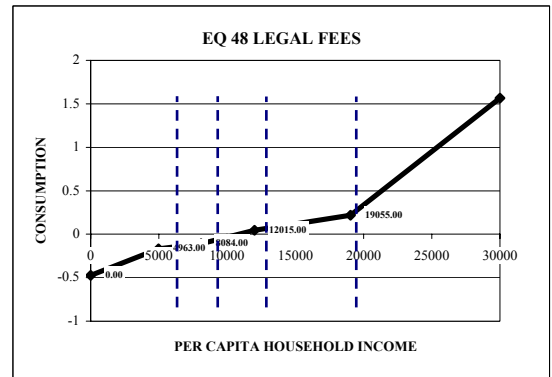
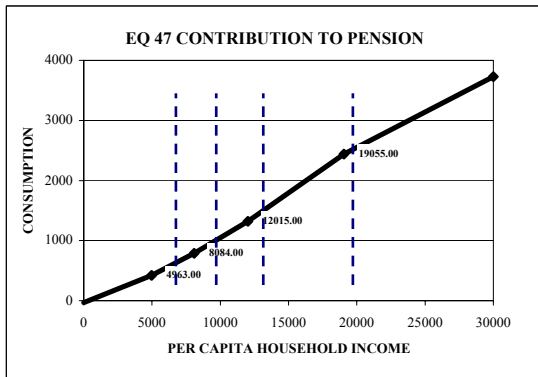
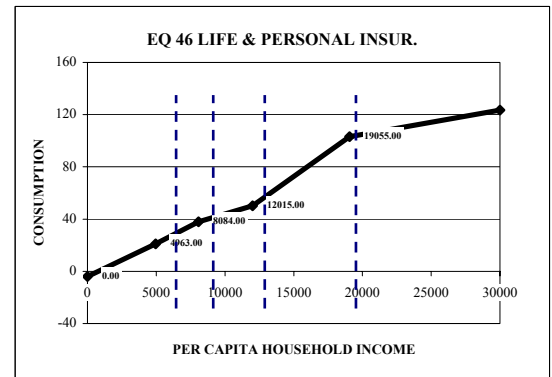
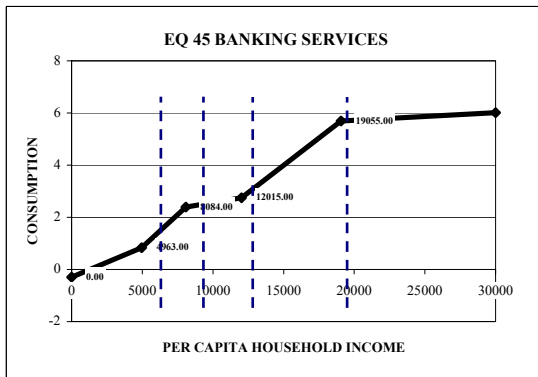
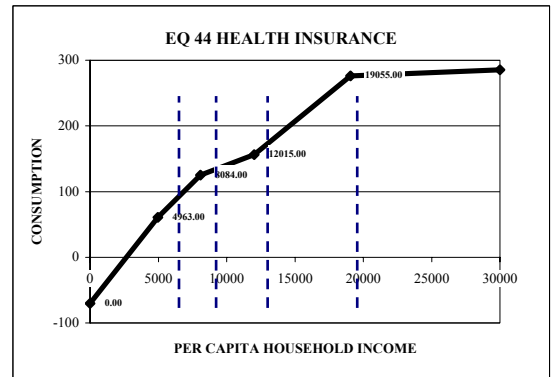
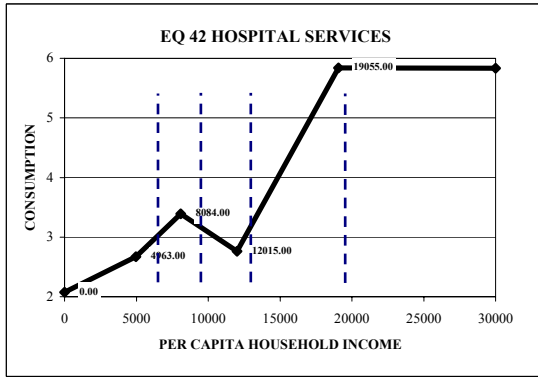


Figure 2.3 Plots of Engel Curves (Continued)

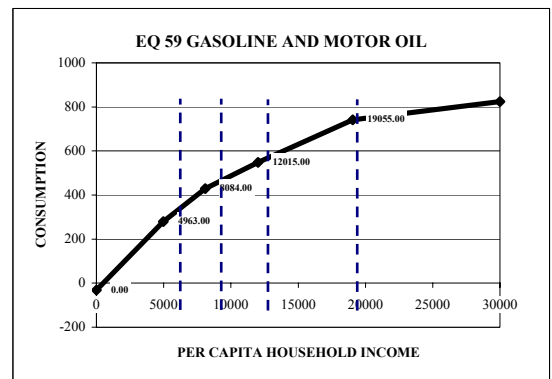
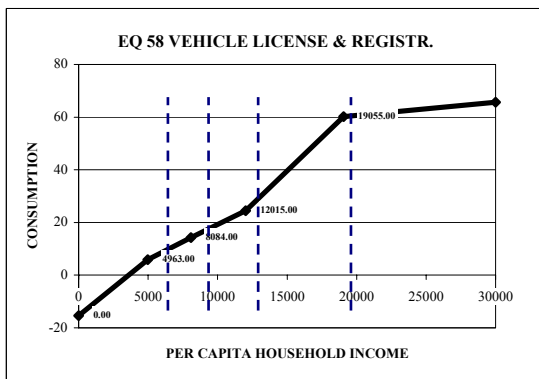
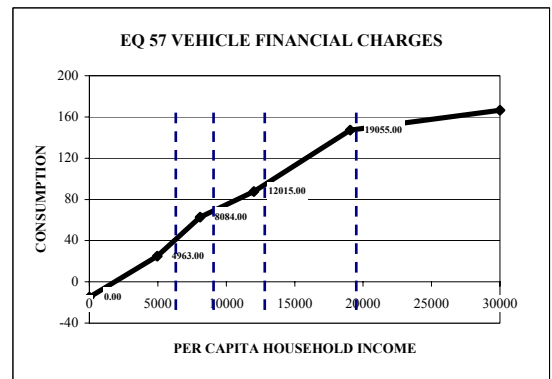
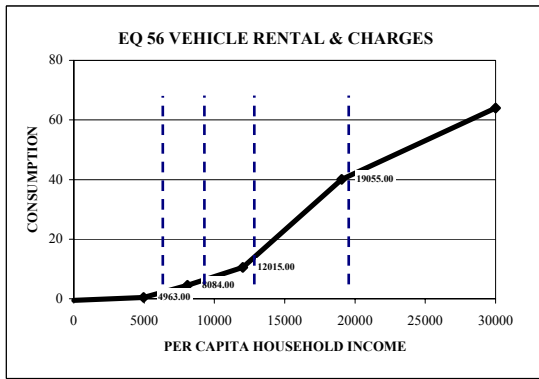
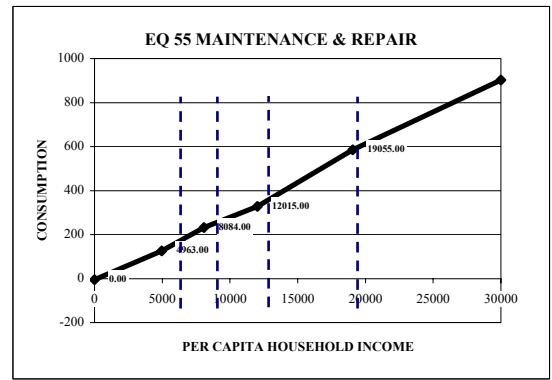
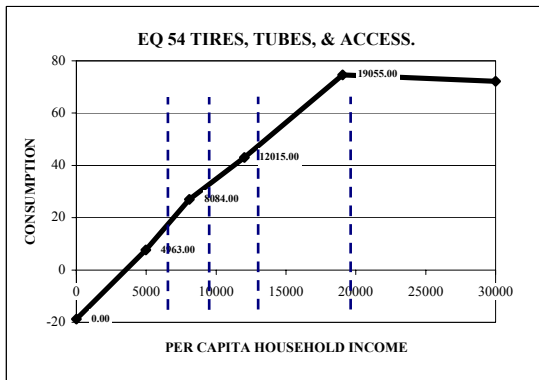
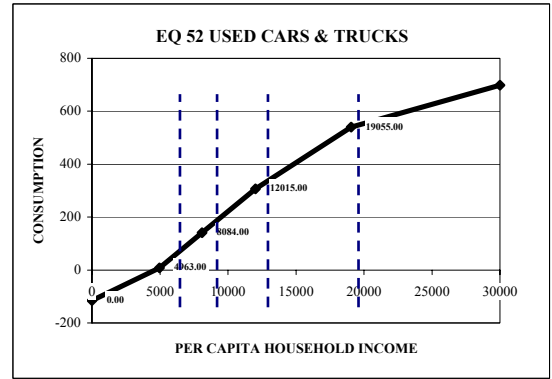
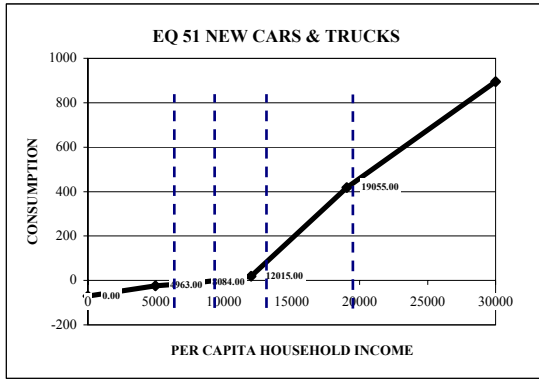


Figure 2.3 Plots of Engel Curves (Continued)

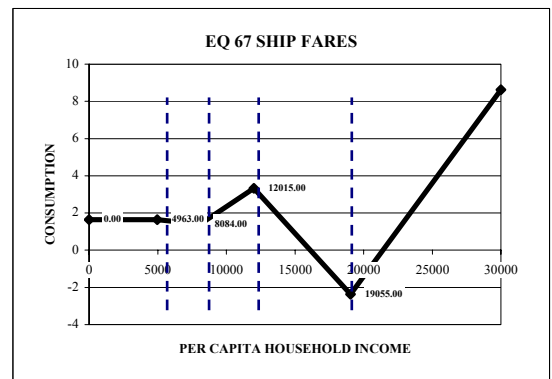
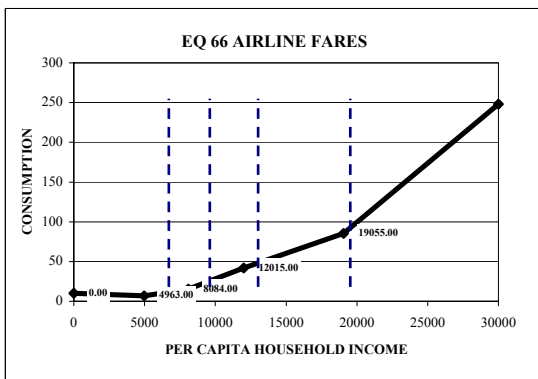
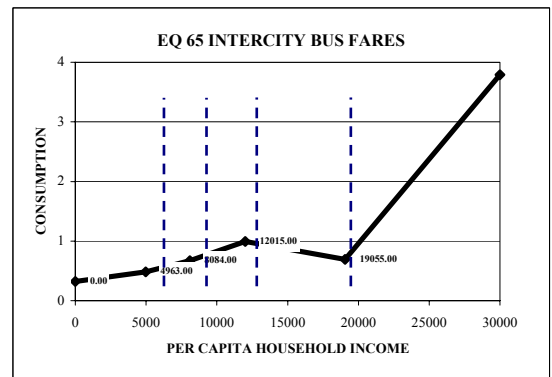
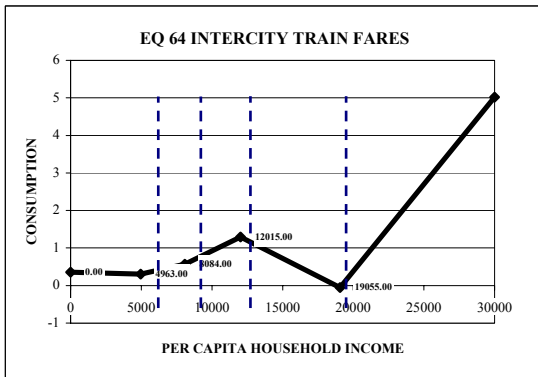
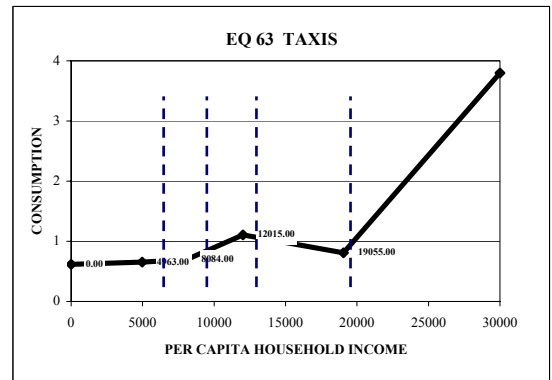
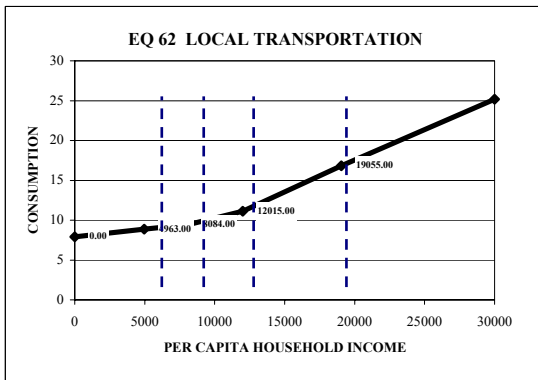
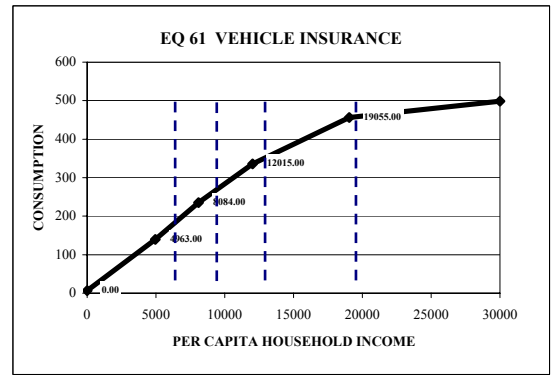
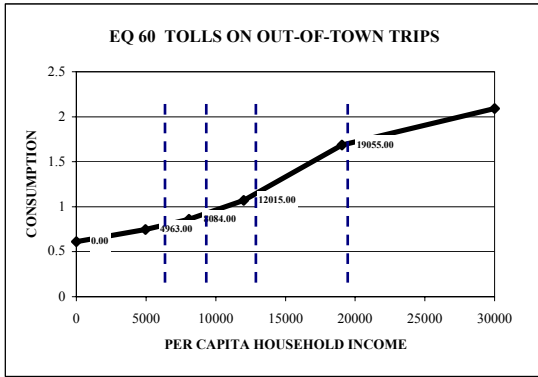


Figure 2.3 Plots of Engel Curves (Continued)

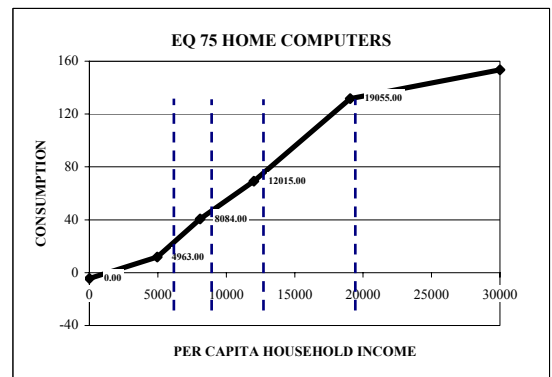
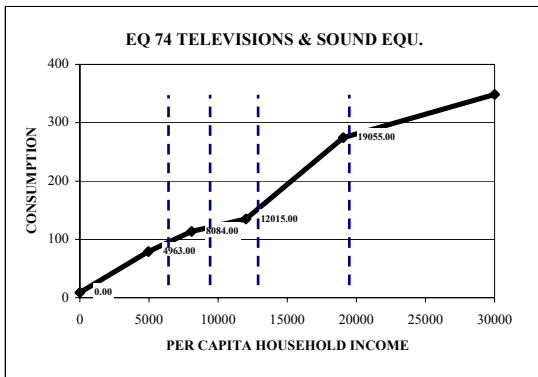
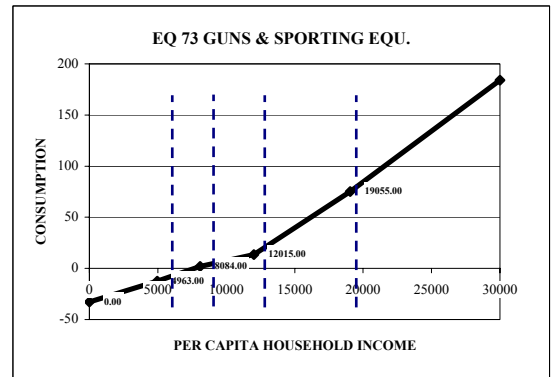
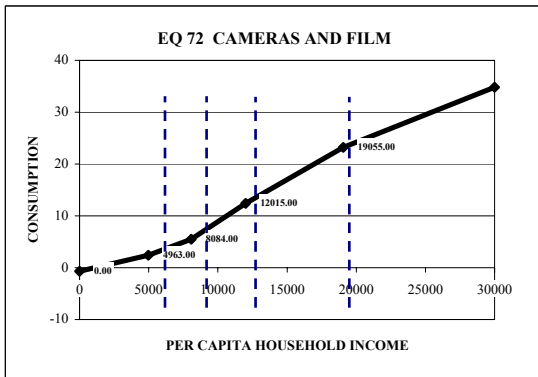
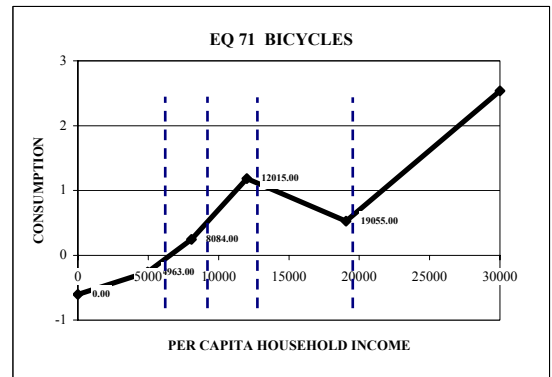
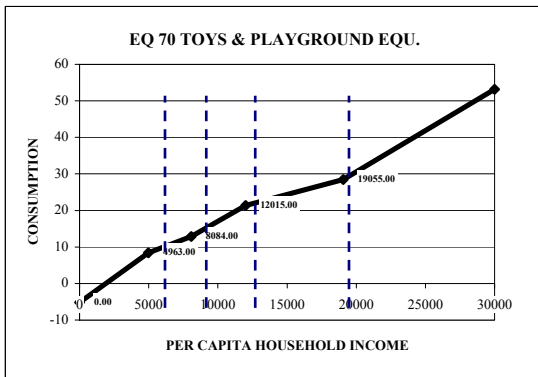
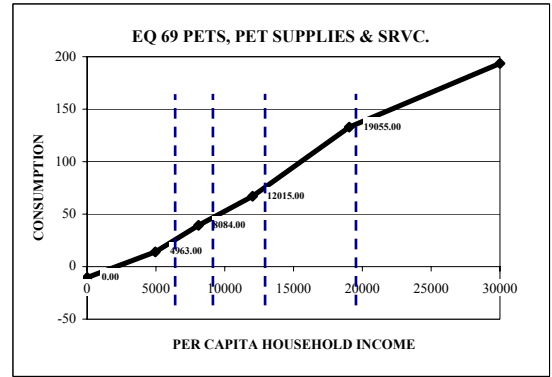
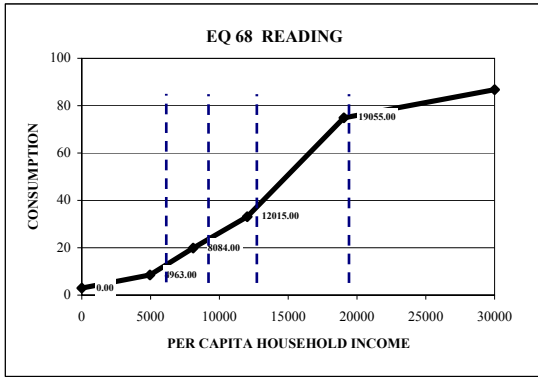


Figure 2.3 Plots of Engel Curves (Continued)

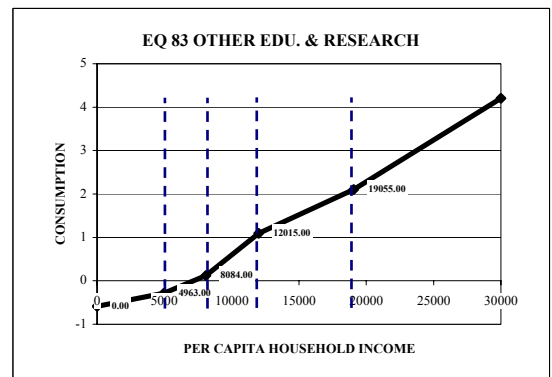
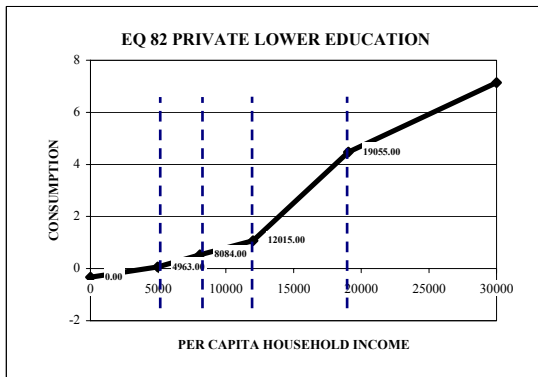
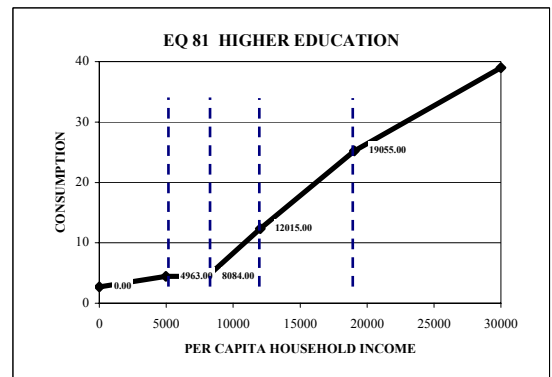
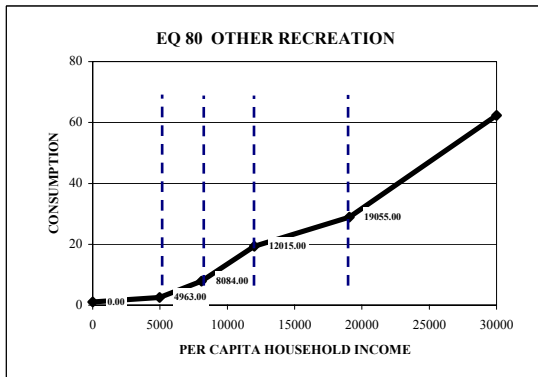
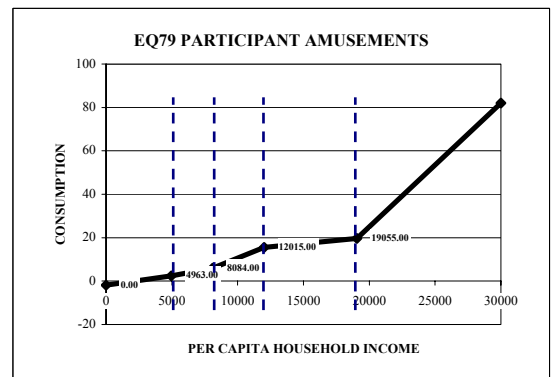
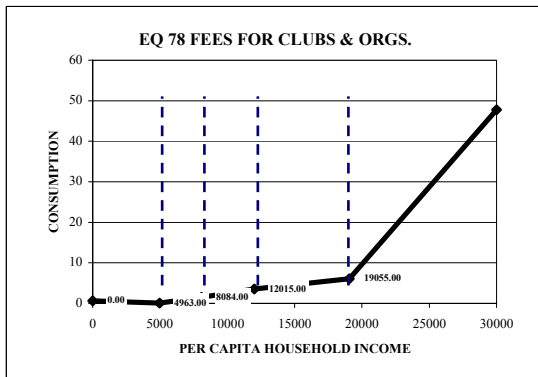
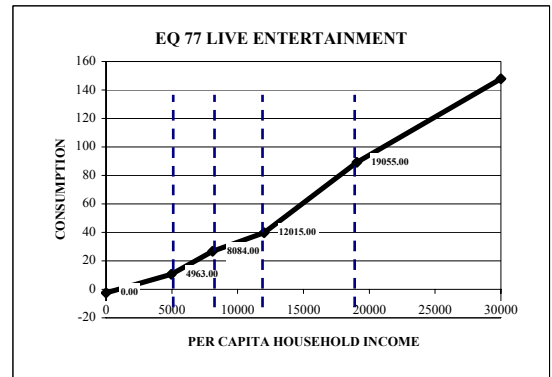
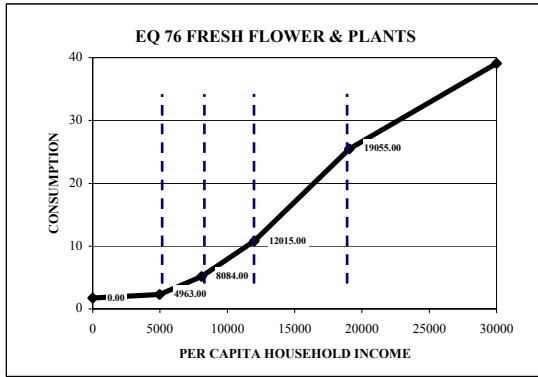
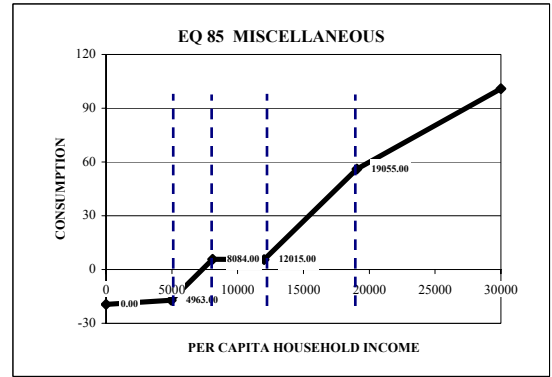
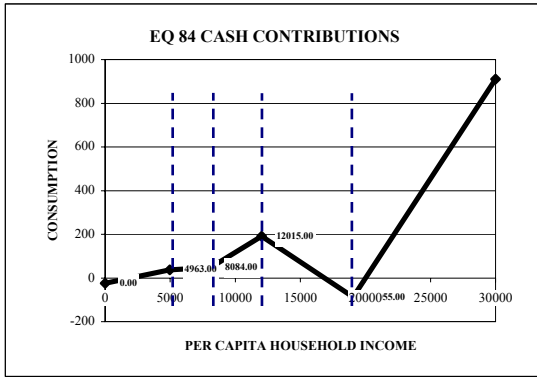


Figure 2.3 Plots of Engel Curves (Continued)



## **APPENDIX 2.1      REGIONS OF RESIDENCE IN CES**

CUs are classified by region according to the address at which they reside during the time of participation in the survey. The regions comprise the following States:

*Northeast* - Connecticut, Maine, Massachusetts, New Hampshire, New Jersey, New York, Pennsylvania, Rhode Island, and Vermont.

*Midwest* - Illinois, Indiana, Iowa, Kansas, Michigan, Minnesota, Missouri, Nebraska, North Dakota, Ohio, South Dakota, and Wisconsin.

*South* - Alabama, Arkansas, Delaware, District of Columbia, Florida, Georgia, Kentucky, Louisiana, Maryland, Mississippi, North Carolina, Oklahoma, South Carolina, Tennessee, Texas, Virginia, and West Virginia.

*West* - Alaska, Arizona, California, Colorado, Hawaii, Idaho, Montana, Nevada, New Mexico, Oregon, Utah, Washington, and Wyoming.

## **CHAPTER THREE      COHORT ANALYSIS OF U.S. HOUSEHOLD CONSUMPTION**

### **SECTION 1   AGE EFFECT, YEAR EFFECT, AND COHORT EFFECT**

The cross-section analysis in Chapter two answers the question of how a household makes decision on the purchase of various goods and services at a certain point of time. A natural question then arises: How will things change if we move along the time dimension? In other words, if there are two families with exactly the same income and demographic characteristics, but one family was living during World War II period, while the other is living in the 1990's, how will the two families' consumption pattern differ? This question leads to the next stage of our study – cohort analysis, an examination of the how the consumption behaviors change just because people are born at different time periods.

A “cohort”, as we shall use the word, refers to the people in our sample born in a particular year or a range of years such as 1935 or 1921-1930. It is close to the idea of a “generation”. Cohort analysis is a method for studying how consumption patterns have changed over cohorts. It is related to panel analysis but with the difference that in the panel analysis the same individuals are observed through time, while in the cohort analysis different samples of “cohort” members are observed.

Regardless of the particular methods adopted by the researcher, the goal of cohort analysis, broadly speaking, is to assess the extent to which variation in some behavior



(for example, expenditures on automobiles) observed on cohorts over time is attributable to *year*, *age*, and *cohort* effects, or possibly to interactions among them and other variables.

Cohort effects are defined to be enduring inter-cohort distinctions that are attributable to the common “imprinting” of cohort members. With regard to dependent variables, cohort effects are often presumed to be the result of cohort members having shared similar socializing experiences. Cohort effects are different from age effects. Age effects refer to long-term movements that are associated with progression through the life cycle. It may be easier to understand the difference between the two with several figures.

Figure 3.1 shows the age effects. The annual household expenditures of two imaginary cohorts are shown. Cohort 1 is a group of people who were born in year 1930 (10 years old in year 1940). Cohort 2 is a group of people who were born in year 1950 (10 years old in 1960). Each curve represents the spending pattern of the cohort from age 10 to age 50. Figure 3.1 demonstrates clear life-cycle pattern for each of the cohort, the movement of the consumption expenditures associated with aging. However there is no cohort effect, as difference in birth year doesn't bring about difference in consumption pattern. If we shift the curve for cohort 1 to the right for 20 years, the two curves coincide with each other.

Figure 3.2 describes two cohorts with strange lifetime consumption profiles. For either cohort, there is no variation in the spending throughout the life span from age 10 to

age 50, although the level of cohort 2's spending is higher than that of cohort 1 across all ages. Aging plays no role, while cohort effects do exist. The generation born in 1950 spends more than the generation born in 1930.

However, for most of the time, both age effects and cohort effects exist. Figure 3.3 provides one example. For the annual household consumption of each of the cohorts, there is a life-cycle pattern. On the other hand, comparing the two cohorts' spending at the same age, cohort 2's level of spending always exceeds that of cohort 1 by 10,000 US dollars.

**Figure 3.1 Age Effects Only, No Cohort Effect**

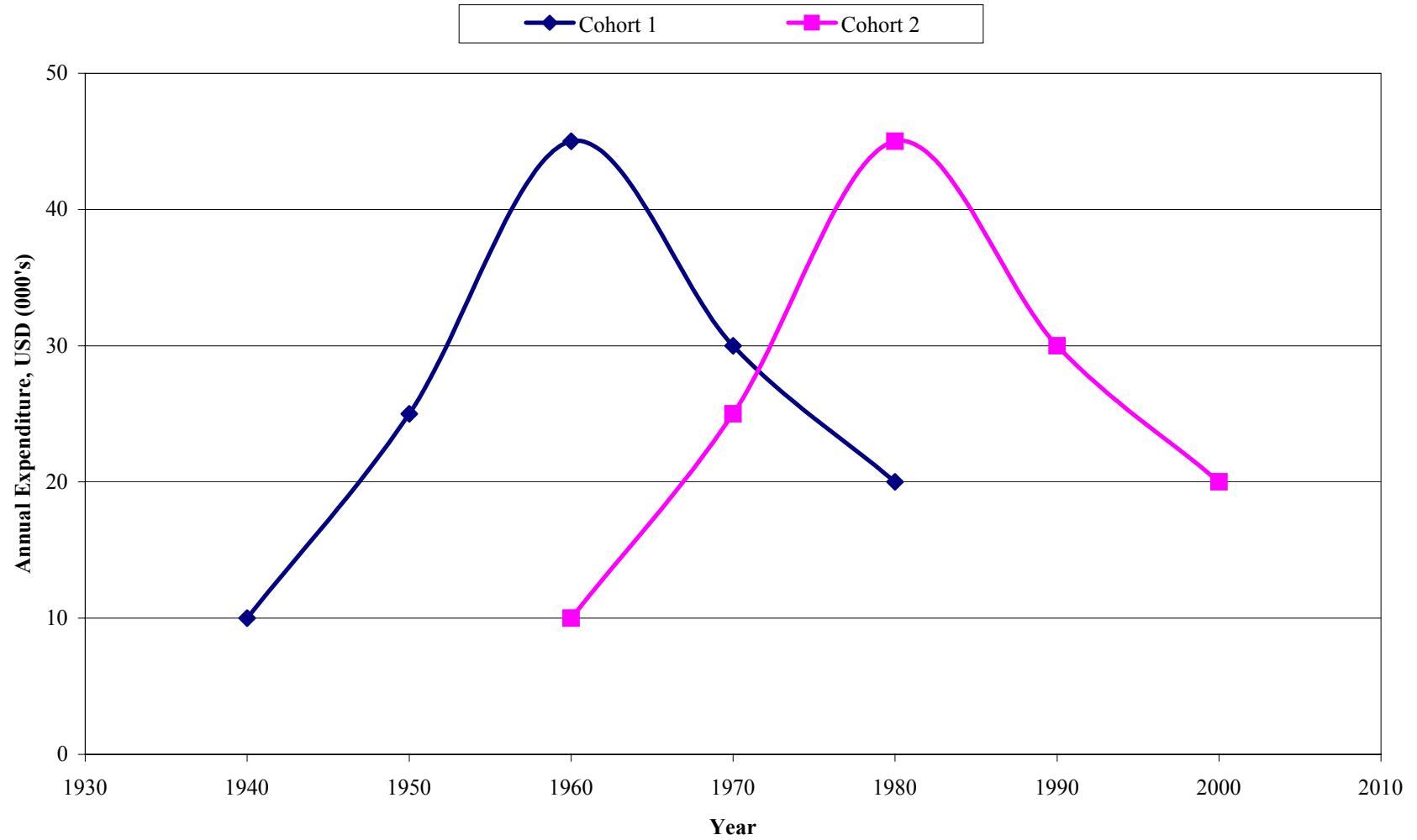


Figure 3.2 Cohort Effects Only, No Age Effect

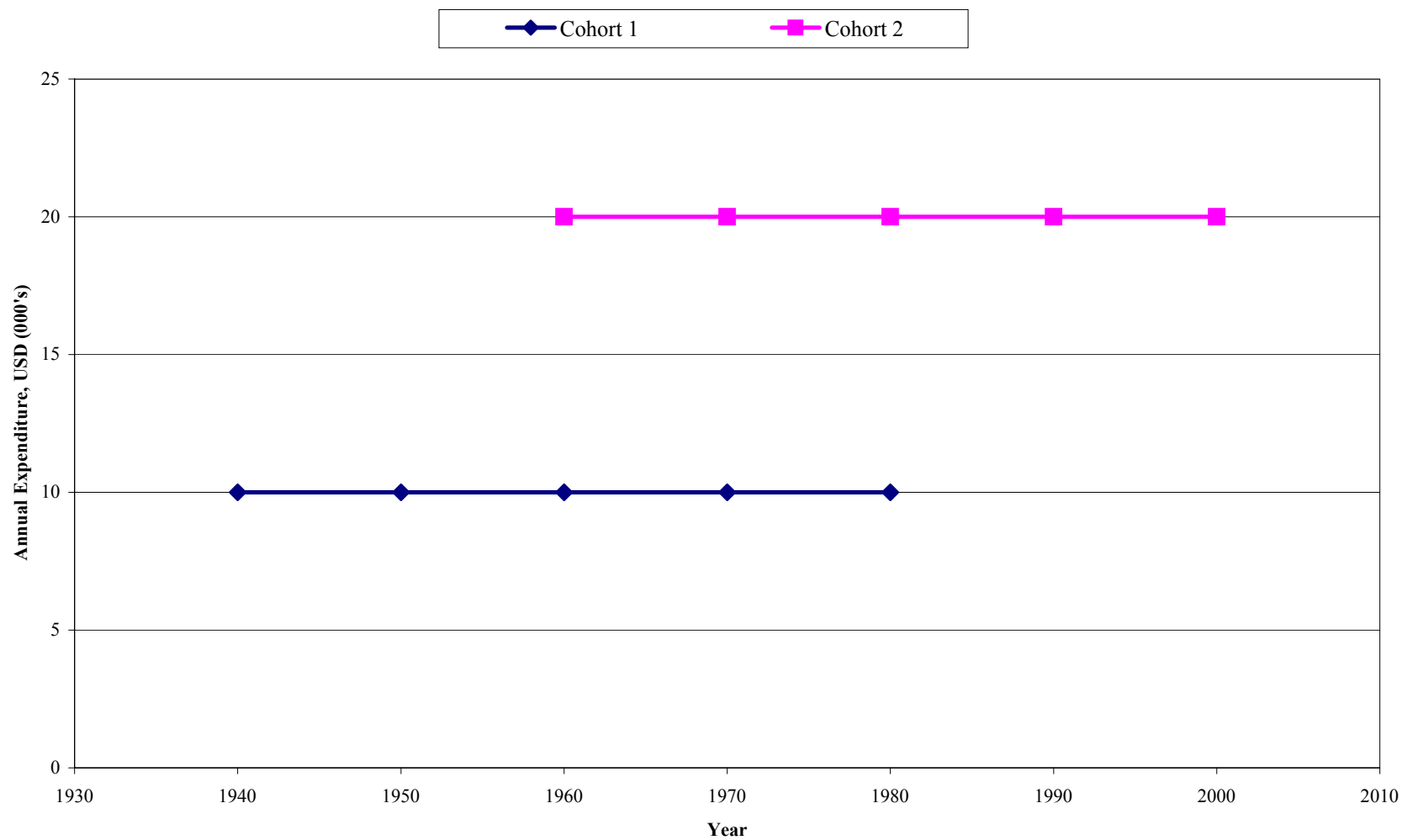
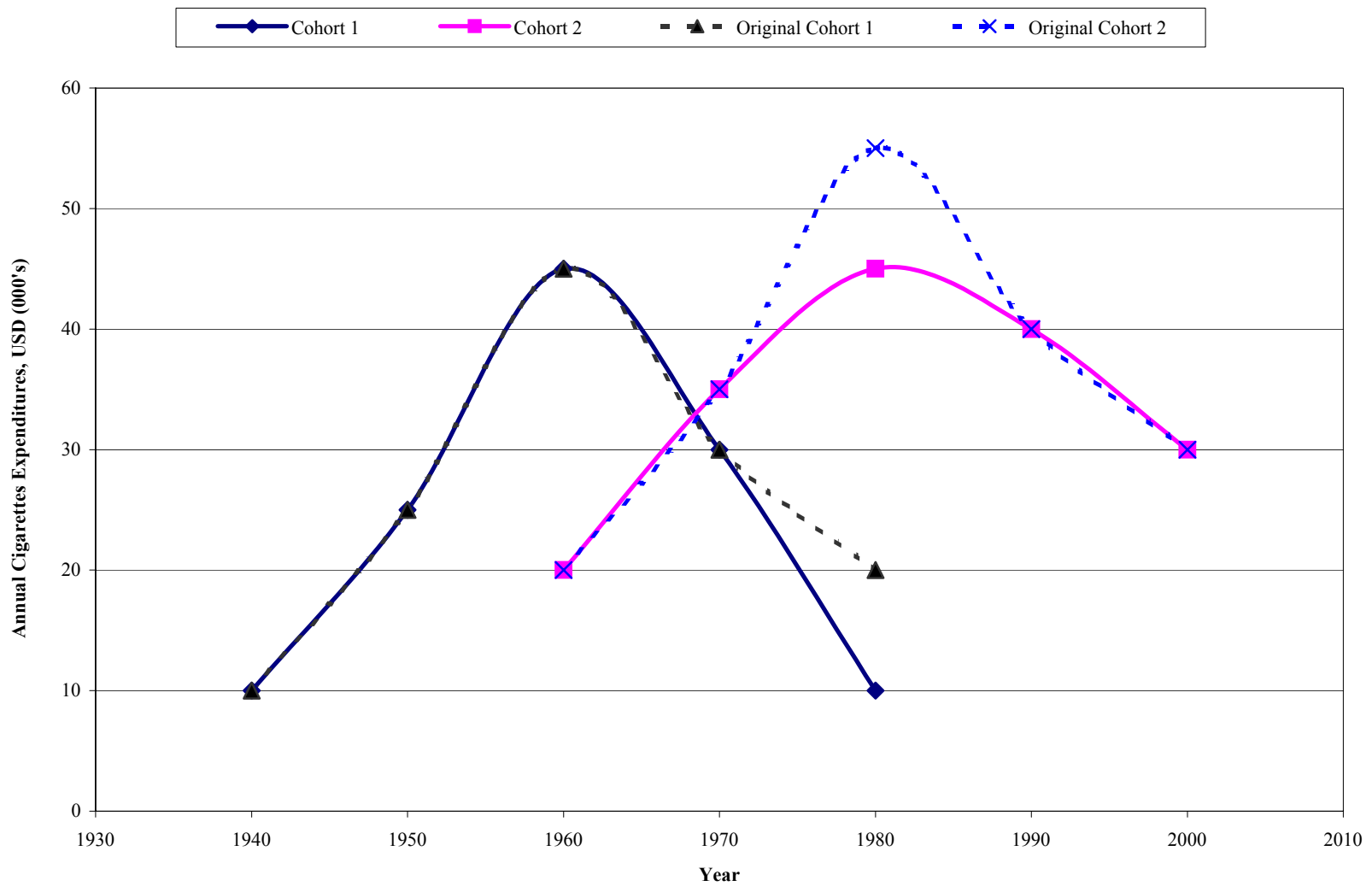


Figure 3.3 Cohort Effects and Age Effects



There is a third effect coexisting with age and cohort effects, *year* effects, also referred to as *period* effects. They are fluctuations in the data due to idiosyncratic events or circumstances occurring at a particular time point. The characteristic of year effects is that it affects all cohorts at the same time. Figure 3.4 shows how cigarette consumption of both cohorts was affected in year 1980 by the passing of an “Anti-Smoking Law”. In this figure, the dotted lines represent the consumption pattern before the law was passed, while the solid lines show the lowered consumption as a result of the year effect.

Figure 3.4 Year Effects



## SECTION 2 CONSTRUCTING COHORT DATA

### 2.1 What is cohort data?

The empirical research on household expenditure has mostly fallen into two categories: cross-section study with microeconomic data or time-series study with macroeconomic data. Perhaps somewhat less obvious is the use of survey data to follow cohorts of individuals over time, where cohorts are defined by date of birth. Provided population is not much affected by immigration and emigration, and provided the cohort is not so old that its members are dying in significant numbers, we can use successive surveys to follow each cohort over time by looking at the members of the cohort who are randomly selected into each survey. For example, we can look at the average consumption of 30-year-olds in the 1976 survey, of 31-year-olds in the 1977 survey, and so on. These averages, because they relate to the same group of people, have many of the properties of panel data. Cohorts are frequently interesting in their own right, and questions about the gainers and losers from economic development are often conveniently addressed by following such groups over time. Because there are many cohorts alive at one time, cohort data are more diverse and richer than are aggregate data, but their semiaggregated structure provides a link between microeconomic household-level data and the macroeconomic data from national accounts. The most important measures of living standards, income and consumption, have strong life-cycle age-related components, but the profiles themselves will move upward over time with economic growth as each generation becomes better-off than its predecessors. Tracking different



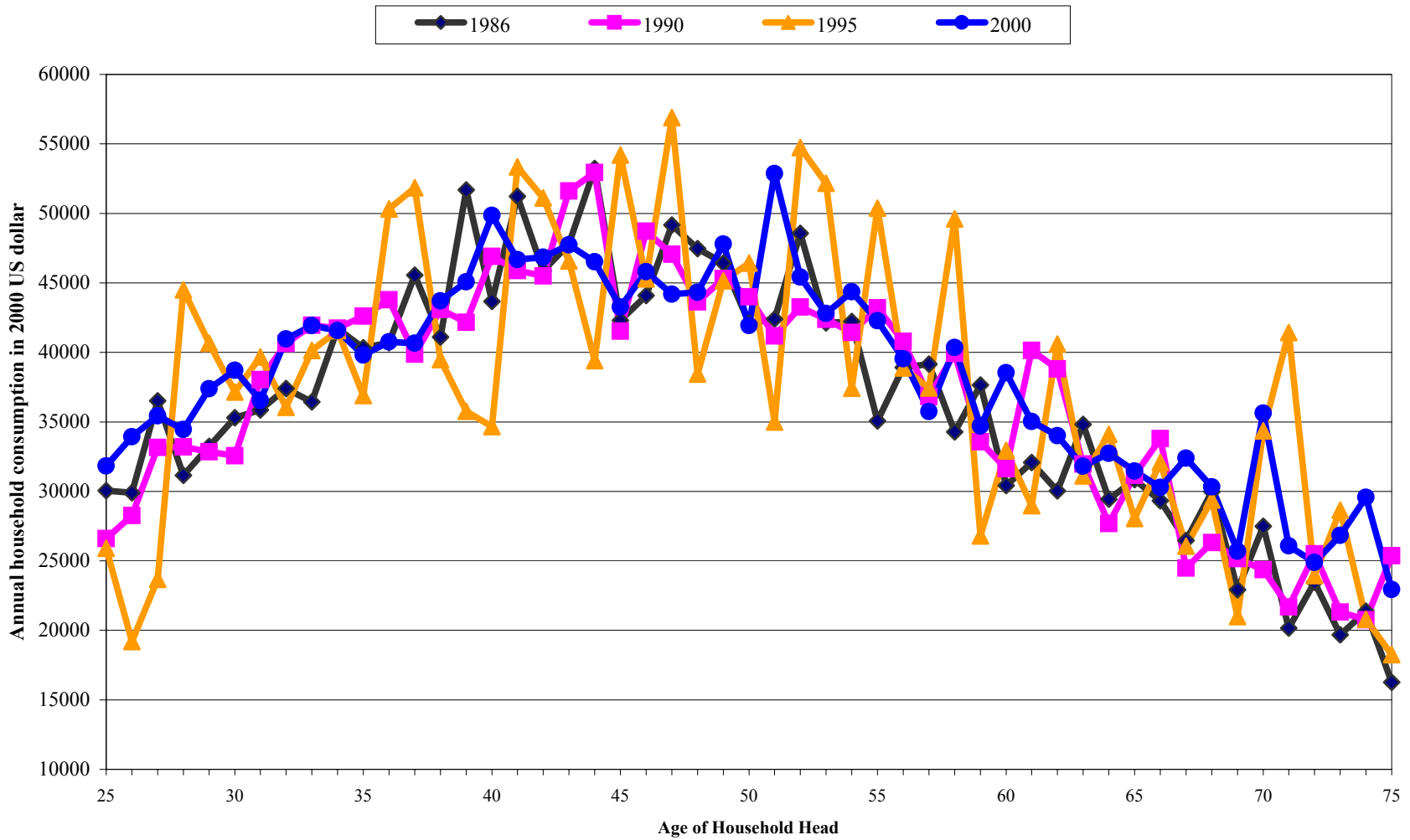
cohorts through successive surveys allows us to disentangle the generational from life-cycle components in income and consumption profiles.

The cross-section analysis of household expenditure has its limits because we are not looking across ages at the same cohort of households, but at the experience at different ages of different groups of households. For describing what happens as all households become richer, the ‘snapshot’ offered by a single cross section can be quite misleading. If there are strong cohort effects, a cross-section age profile may be very different from the age profile of any individual. Shorrocks (1975), for instance, discussing the life cycle accumulation of wealth, constructs an example in which individuals belonging to different cohorts keep accumulating wealth as they age. If younger cohorts are ‘wealthier’, in life cycle terms, than older cohorts (perhaps because of productivity growth), and these effects are strong enough, the use of a single cross section will give the illusion of a ‘hump shaped’ age profile. Same is true for household consumption.

## **2.2 Construct cohort data**

Our cohort analysis is based on the age of the reference person in each household. The reference person generally coincides with the principal earner. To avoid repeated use of awkward phrase “reference person”, we will use simply “head”. Let’s first look at the cross-section age profile of (constant-price) consumption for 1986, 1990, 1995 and 2000. Each curve plots the head’s age against the average consumption of all households with

Figure 3.5 Cross-section Consumption Profiles, selected years

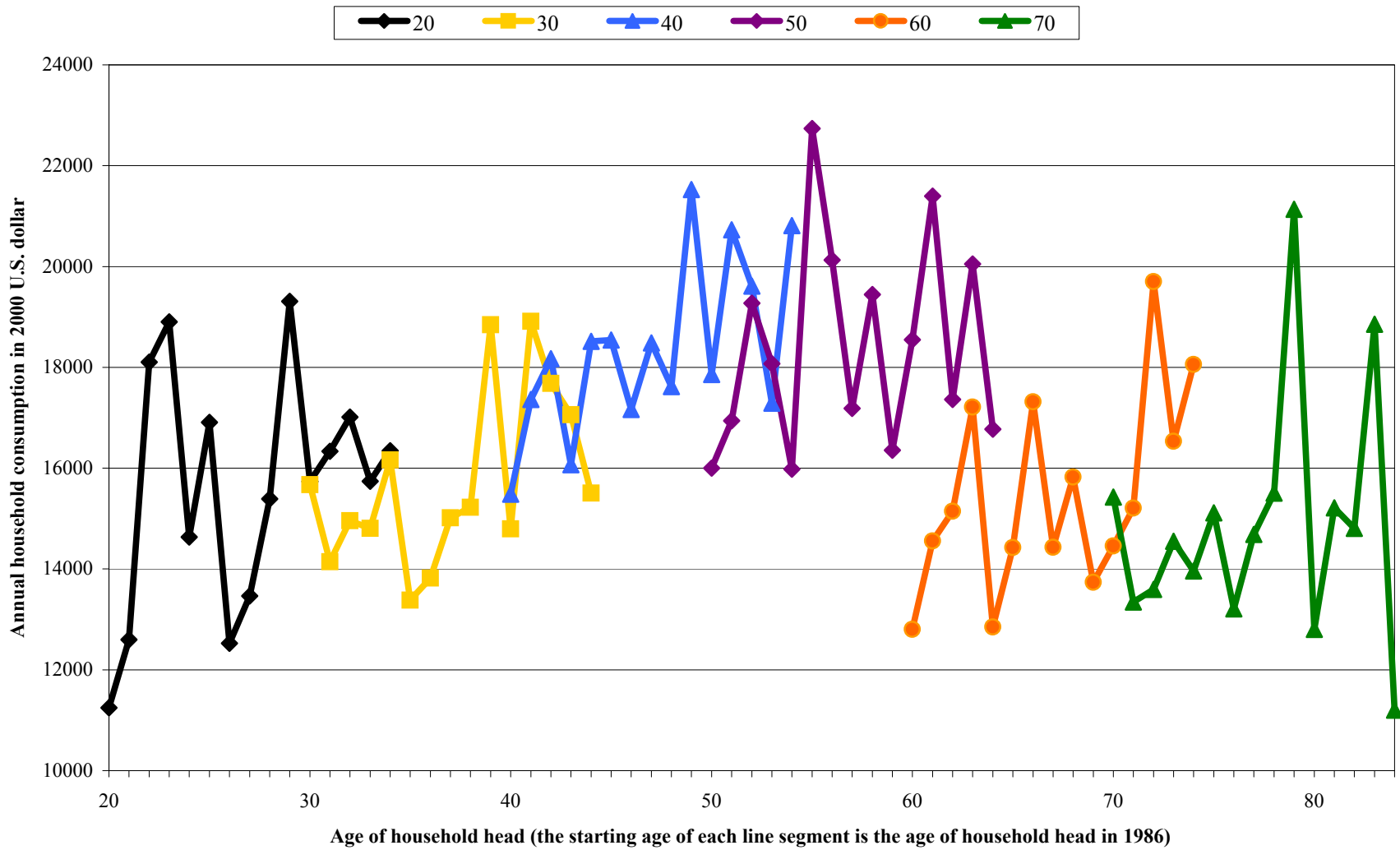


heads of that age. We use Consumer Expenditure Survey of those years to construct the curves.

However the four curves in Figure 3.5 tell us nothing about the experience of any given cohort. To trace the average consumption of each generation the points should be connected not within years but within cohorts.

Cohorts are constructed by date of birth of the household head, or more conveniently, by age in 1986. For each survey, we average the expenditures by age of household head and then track the sample from the same cohort one year older in the next year. For example, we can look at the average consumption of 25-year-olds in the 1986 survey, of 26-year-olds in the 1987 survey and so on. Figure 3.6 shows the cohort consumption for every tenth cohort beginning with those born in 1966. The first line segment in black color connects the average consumption of those who were 20 years old in 1986 to the average consumption of 21 years old in 1987, until last observation of the cohort in 2000, when they were 34 years old. The second line segment in yellow repeats the exercise for those who were ten years older and so on, until the last line segment in green shows those born in 1916 and therefore aged 70 in 1986.

Figure 3.6 U.S. Household Consumption by Cohort



To construct the cohort data from a time series of Consumer Expenditure Survey from 1986 through 2000 requires a number steps:

Step 1, define the year of expenditure as the calendar year when the second interview<sup>12</sup> of the consumer unit took place. Counting the households starting each quarter as a cohort would have given very small sample sizes. By this rule, some of the expenditure counted as year  $t$  expenditure was actually made in year  $t + 1$ . For example, CU A's second interview is in March of 1986, CU B's second interview is in December of 1986, CU A and B's annual expenditures are both counted as expenditure of year 1986.

Step 2, obtain the expenditure, age and other related data for a consumer unit from CES data of two adjacent years. It is necessary to use two adjacent years' data because the CES sample has a rotating pattern. For a consumer unit whose second interview took place at the first quarter of the year, the fifth interview will be conducted in the last quarter of the same year. However if a consumer unit's second interview is in the second quarter of the year, its fifth interview will be in the first quarter of the next year. In order to cover from second to fifth interview of any consumer unit, we need two adjacent years' interview files. Please see Figure 3.7 for an illustration.

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<sup>12</sup> An Interview panel survey in which each CU in the sample is interviewed once every 3 months over five consecutive quarters to obtain a year's worth of data. The initial interview collects demographic and family characteristics data. These pertain to age, sex, race, marital status, education, and CU relationship for each CU member. This information is updated at each subsequent interview. The second through fifth interviews use uniform questionnaires to collect expenditure information from the previous three months.

**Figure 3.7 Rotating pattern of sample of Consumer Expenditure Survey, Interview Survey**

1985	1986				1987				1988				
Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	
	A				J				P				
	B				I				N				
	C				H				M				
	D				G				L				
	E				F				K				Q

- Colored cells illustrate different group of households that enter the sample at different point of time.
- We divide the quarterly interview sample into five sub-samples for each quarter of each year. For example, in the first quarter of year 1986, there are 5 sub-samples, i.e. A, B, C, D and E. Sub-sample A are households that entered the sample and received the first interview in the first quarter of year 1986, Sub-sample B are households that enter the sample at the last quarter of year 1985, and received the second interview in the first quarter of year 1986, so on and so forth. For households in sub-sample E, they received their 5th (and last interview) in the first quarter of year 1986. In the beginning of second quarter of year 1986, Households in group E were replaced by a new sub-sample, group F. So, in the second quarter of 1986, the sample consists of 5 sub-samples: A, B, C, D, F. In the third quarter, sub-sample G came in and replaced sub-sample D.
- Usually the size of each sub-sample is about 20% of the whole sample.

Step 3, define the age of a household head as the age of the head during the second interview of the household. Since the interviews will last for four quarters, usually the head will age by one year after the five interviews. We arbitrarily use the age at the second interview. And we eliminate the consumer units whose head's age has changes for more than one year from the first to the last interviews. Such a change would indicate either a change in household structure or a reporting error.

Step 4, for each year, we construct the annual expenditure in constant 2000 U.S. dollar on 85 categories of goods and services and aggregate household consumption for each household, and compute the average for each age group. And then follow each age group from 1986 through 2000 to construct cohort data for each consumption category. To make sure that each cohort has enough data points, we eliminate household heads whose ages were less than 24 or more than 71. We have 62 cohorts, each of whom has years of expenditure data on 85 categories and aggregate expenditure. Please see Table 3.1 for cohort definition and average cohort size over the 15 years.

**Table 3.1 Cohort Definition and Cell Size**

Cohort	Year of Birth	Age in 1986	Age in 2000	Average Size	Cohort	Year of Birth	Age in 1986	Age in 2000	Average Size
1	1976	10	24	40	32	1945	41	55	952
2	1975	11	25	92	33	1944	42	56	924
3	1974	12	26	159	34	1943	43	57	983
4	1973	13	27	203	35	1942	44	58	817
5	1972	14	28	280	36	1941	45	59	857
6	1971	15	29	347	37	1940	46	60	778
7	1970	16	30	365	38	1939	47	61	701
8	1969	17	31	430	39	1938	48	62	757
9	1968	18	32	478	40	1937	49	63	721
10	1967	19	33	520	41	1936	50	64	743
11	1966	20	34	602	42	1935	51	65	687
12	1965	21	35	761	43	1934	52	66	719
13	1964	22	36	922	44	1933	53	67	672
14	1963	23	37	924	45	1932	54	68	766
15	1962	24	38	1020	46	1931	55	69	647
16	1961	25	39	1073	47	1930	56	70	691
17	1960	26	40	1153	48	1929	57	71	673
18	1959	27	41	1208	49	1928	58	72	631
19	1958	28	42	1183	50	1927	59	73	631
20	1957	29	43	1260	51	1926	60	74	480
21	1956	30	44	1194	52	1925	61	75	508
22	1955	31	45	1218	53	1924	62	76	416
23	1954	32	46	1229	54	1923	63	77	436
24	1953	33	47	1192	55	1922	64	78	383
25	1952	34	48	1163	56	1921	65	79	337
26	1951	35	49	1219	57	1920	66	80	281
27	1950	36	50	1139	58	1919	67	81	225
28	1949	37	51	1192	59	1918	68	82	172
29	1948	38	52	1179	60	1917	69	83	138
30	1947	39	53	1215	61	1916	70	84	86
31	1946	40	54	1007	62	1915	71	85	42



### 2.3 Comparison of cohort and panel data

A useful comparison is between the semiaggregated cohort data and genuine panel data in which individual households are tracked over time. In both cases, we have a time series of observations on a number of units, which are defined as either cohorts or individuals. The cohort data cannot tell us anything about the dynamics of individual families within a cohort; each survey tells us about the distribution of the characteristic in the cohort in each period, but two adjacent surveys tell us nothing about the joint distribution of the characteristic in the two periods. But apart from dynamics, the cohort data can do most of what would be expected of panel data.

Cohort data also have a number of advantages over most panels. Many panels suffer from attrition, especially in early years, and so run risk of becoming increasingly unrepresentative over time. Because the cohort data are constructed from a fresh sample every year, there is no attrition. There will be problems with the cohort data if the sampling design changes over time, or if the probabilities of selection into the sample depend on age as, for example, if people in the military are excluded. The way in which the cohort data are used will often be less susceptible to random and unbiased measurement error than is the case with panels. The quantity that is being tracked over time is typically an average (or some other statistic such as the median or other percentile) and the average will nearly always reduce the effects of measurement error and enhance the signal-to-noise ratio. In this sense, cohort methods can be regarded as

instrument variable methods, where the instruments are grouping variables, whose application averages away the measurement error.

Another advantage of cohort methods is that they allow the combination of data from different surveys on different households. The means of cohort consumption from an expenditure survey can be combined with the means of cohort income from a labor force survey, and the hybrid data set used to study saving. It is not necessary that all variables are collected from the same households in one and the same survey.

Against the use of cohort data, it should be noted that there are sometimes problems with the assumption that the cohort population is constant, an assumption that is needed if the successive surveys are to generate random samples from the same underlying population. Most serious difficulties come when we work with households, and to define the cohorts of households by the age of household head. If a household, once formed, were indissoluble, there would be no difficulty, but divorce and remarriage reorganize households, as does the process whereby older people go to live with their children, so that previously “old” households become “young” households in subsequent years.

### SECTION 3 THEORETICAL FOUNDATION

In order to estimate the decomposition of three types of effects, researchers usually regress the cohort averages of consumption against dummy variables for all three sets of effects. The basic model can be written as

$$x = \beta + A\alpha + C\gamma + Y\psi + u \quad (3.3.1)$$

where  $x$  is the stacked vector of observations of the dependent variable,  $A$  is a matrix of age dummies,  $C$  a matrix of cohort dummies,  $Y$  a matrix of year dummies, and  $u$  a vector of disturbance term. Vector  $x$  and all matrices of dummy variables have  $m$  rows, which is the number of cohort-year pairs for consumption. The number of columns for matrix  $A$  is the number of ages, the number of columns for matrix  $C$  is the number of cohorts, and the number of columns for matrix  $Y$  is the number of years.  $\beta, \alpha, \gamma, \psi$  are vectors of intercept, coefficients for age effects, cohort effects, and year effects respectively. The size of  $\beta$  is the  $m$ , the number of cohort-year pairs; the size of  $\alpha, \gamma, \psi$  are number of ages, cohorts and years respectively.

Let us use an example to illustrate the above model. Suppose we have two cohorts. Cohort one is households with heads born in 1930, and cohort two is those with heads born in 1960. And we assume that the sample is the consumption on automobiles of the two cohorts in year 1990, 1995 and 2000. Now the vector

$$x = (x_{1,1990}, x_{1,1995}, x_{1,2000}, x_{2,1990}, x_{2,1995}, x_{2,2000}) \text{ where } x_{c,t} (c = 1, 2; t = 1990, 1995, 2000)$$

denotes cohort  $c$ 's automobile consumption in year  $t$ ; vector

$\alpha = (\alpha_{30}, \alpha_{35}, \alpha_{40}, \alpha_{60}, \alpha_{65}, \alpha_{70})$  where  $\alpha_a (a = 30, 35, 40, 60, 65, 70)$  denotes the age effect coefficient for age  $a$ ; vector  $\gamma = (\gamma_1, \gamma_2)$  where  $\gamma_c (c = 1, 2)$  denotes the cohort effect coefficient for cohort  $c$ ; vector  $\psi = (\psi_{1990}, \psi_{1995}, \psi_{2000})$  where  $\psi_t (t = 1990, 1995, 2000)$  denotes the year effect coefficient for year  $t$ . Here we suppress the index for product so as to simplify the notation. Therefore the general model written in matrix format for this example is as follows:

$$\begin{pmatrix} x_{1,1990} \\ x_{1,1995} \\ x_{1,2000} \\ x_{2,1990} \\ x_{2,1995} \\ x_{2,2000} \end{pmatrix} = \beta + \begin{pmatrix} 0 & 0 & 0 & 1 & 0 & 0 \\ 0 & 0 & 0 & 0 & 1 & 0 \\ 0 & 0 & 0 & 0 & 0 & 1 \\ 1 & 0 & 0 & 0 & 0 & 0 \\ 0 & 1 & 0 & 0 & 0 & 0 \\ 0 & 0 & 1 & 0 & 0 & 0 \end{pmatrix} \begin{pmatrix} \alpha_{30} \\ \alpha_{35} \\ \alpha_{40} \\ \alpha_{60} \\ \alpha_{65} \\ \alpha_{70} \end{pmatrix} + \begin{pmatrix} 1 & 0 \\ 1 & 0 \\ 1 & 0 \\ 0 & 1 \\ 0 & 1 \\ 0 & 1 \end{pmatrix} + \begin{pmatrix} \gamma_1 \\ \gamma_2 \end{pmatrix} + \begin{pmatrix} 1 & 0 & 0 \\ 0 & 1 & 0 \\ 0 & 0 & 1 \\ 1 & 0 & 0 \\ 0 & 1 & 0 \\ 0 & 0 & 1 \end{pmatrix} \begin{pmatrix} \psi_{1990} \\ \psi_{1995} \\ \psi_{2000} \end{pmatrix} \quad (3.3.2)$$

Before we start to tackle the issues involved in estimation, we should discuss the theoretical basis for the above specification.

With no income uncertainty, the life cycle model predicts that consumption is a function of lifetime resources (earnings plus inherited assets), with the fraction of resources consumed being a function of age, as dictated by preferences and the life-cycle variation in household size and composition. We write

$$x(a) = g(a)W \quad (3.3.3)$$

where  $W$  is the sum of assets and the discounted present value of current and expected labor income, and  $g(a)$  is some function of age  $a$ . Taking logs, we have

$$\ln x(a) = \ln g(a) + \ln W \quad (3.3.4)$$

This equation holds for a typical consumer, that represents the average of the cohort. Equation (3.3.4) can then be estimated using the cohort data, by regressing the logarithm of cohort averages of consumption against cohort dummies and age dummies.

We take into account the existence of uncertainty, i.e. the presence of macroeconomic effects that impinge on all cohorts to a greater or less degree. An obvious extension to equation (3.3.4) is to allow for fixed year effects, so that the consumption equation becomes

$$\ln x_{at} = \ln g(a) + \ln W_b + \theta_t \quad (3.3.5)$$

where  $\theta_t$  is a year fixed effect, and the subscripts  $a$ ,  $b$ , and  $t$  denote age, cohort, and time respectively. Note that given age and time, cohort is determined; indeed we have been measuring  $b$  as age in 1986, which is  $a - t + 1986$ .

Equation (3.3.4) is an implication of the life-cycle model of consumption when there is no uncertainty, so that cohort wealth levels are never revised. Once uncertainty is admitted, wealth levels will be revised in responses to macroeconomic shocks, so that the

life-cycle model with uncertainty provides at least some basis for (3.3.5). However, the link between (3.3.5) and the model under uncertainty is not as clean as was the link with (3.3.4) under certainty, since the effects of a common macroeconomic shock on wealth levels ought to vary with age. Nevertheless, the year effects are certainly present in the data, and it seems useful to estimate (3.3.5) as an approximation to the more general model, if only to ensure that the failure to accommodate the year effects does not contaminate the estimates of the age and cohort effects, with which the year dummies are strongly correlated.

## SECTION 4 EMPIRICAL ESTIMATION

### 4.1 The Model

In this section, we discuss a concrete model<sup>13</sup> that we can use to analyze the decomposition of age, cohort, and year effects using cohort data. To reiterate the differences among the types of effects: age effects give a typical age profile of consumption, cohort effects explain the difference in the positions of age profiles for different cohorts, and year effects consider the aggregate shocks that synchronously but temporarily move all cohorts off their profiles. This decomposition assumes away the interaction effects between age, cohort and years, so that, for example, the shape of the age profile is unaffected by changes in their positions, or any macroeconomic disturbance.

Based on our discussion in Section 3, a standard model to analyze the decomposition of those effects can be written as

$$x_{ct} = \beta + \alpha_a + \gamma_c + \psi_t + u_{ct} \quad (3.4.1)$$

where the subscripts  $c$  and  $t$  refer to cohort and year, and  $a$  refers to age, defined as the age of cohort  $c$  in year  $t$ . Here we define cohort  $c$  as the age in year  $t = 0$  (in our analysis the starting year is 1986.) By this,  $c$  is just a number like  $a$  and  $t$ . Given the way in which

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<sup>13</sup> We borrow the model from Deaton (1997). And more discussions of the general model can be seen at Mason and Fienberg (1986).

we have defined cohorts, with bigger value of  $c$  corresponding to older cohorts, we would expect  $\gamma_c$  to be declining with  $c$ .

Suppose that  $A$  is a matrix of age dummies,  $C$  a matrix of cohort dummies,  $Y$  a matrix of year dummies, and  $u$  a vector of disturbance term. The cohort data are arranged as cohort-year pairs, with each observation corresponding to the average of logarithms of annual consumption of all households in a single cohort in a specific year. If there are  $m$  such cohort-year pairs, the three matrices will each have  $m$  rows; the number of columns will be the number of ages (or age groups), the number of cohorts, and the number of years, respectively. The model (3.4.1) can then be written in the form

$$x_i = \beta_i + A_{T,48}\alpha_i + C_{T,62}\gamma_i + Y_{T,15}\psi_i + u_i \quad (3.4.2)$$

where  $x_i$  is a stacked vector of cohort-year observations—each row corresponds to a single observation on a cohort—the cohort means of the logarithm of consumption. In our analysis, matrix  $A_{T,48}$  has 48 columns (from age 24 to age 71), matrix  $C_{T,62}$  62 columns (for those aged 10 in 1986 to those aged 71 in 1986), and matrix  $Y_{T,15}$  15 columns (from 1986 to 2000).  $\beta_i, \alpha_i, \gamma_i, \psi_i$  are vectors of intercept, coefficients for age effects, cohort effects, and year effects respectively. The size of  $\beta_i$  is  $T$ , the number of cohort-year pairs; the size of  $\alpha_i, \gamma_i, \psi_i$  are 48, 62 and 15 respectively.



To avoid the dummy variable trap, we must drop one column from each of the three matrices, since for the full matrices, the sum of the columns is a column of ones, which is already included as the constant term.

## 4.2 The Identification Problem

However, we are facing another problem with this model. If we know the year of consumption, and the cohort a household belongs to, then we can deduct the age of household head. Because of a linear dependence of age, cohort and year, we are still not able to estimate the model. By definition of cohort  $c$ , we have the following identity

$$a - c = t \tag{3.4.3}$$

which implies that the matrices of the dummies satisfy<sup>14</sup>

$$As_a = Cs_c + Ys_y \tag{3.4.4}$$

where  $s$  vectors are arithmetic sequences  $\{0, 1, 2, 3, \dots\}$  of length given by the number of columns of the matrix that premultiplies them. As a result of (3.4.4), parameters in (3.4.2) are not identified, even after one category has been dropped from each set of dummies. In particular, if we replace the parameter vector  $\alpha$ ,  $\gamma$  and  $\psi$  by

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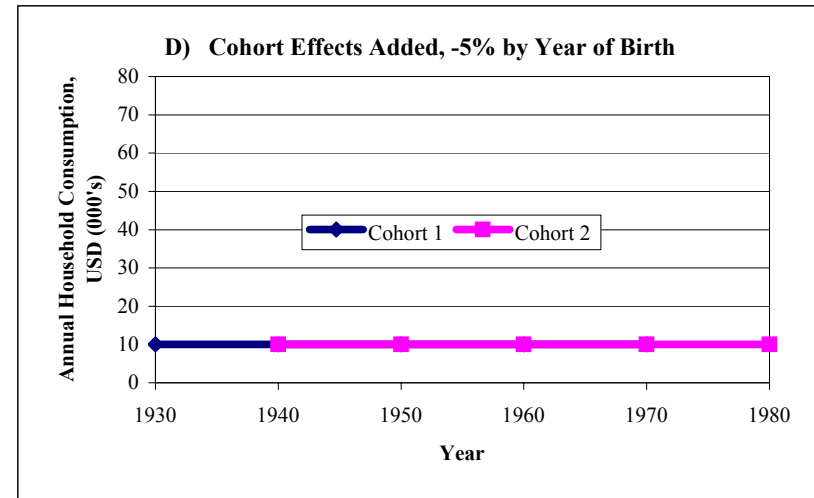
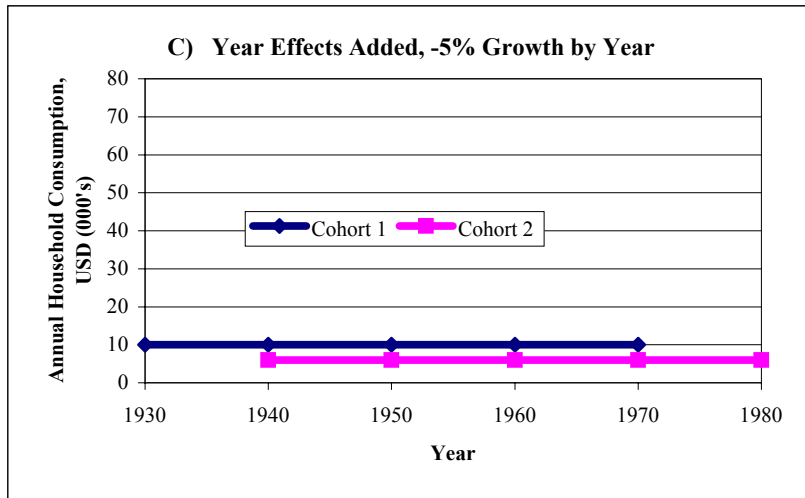
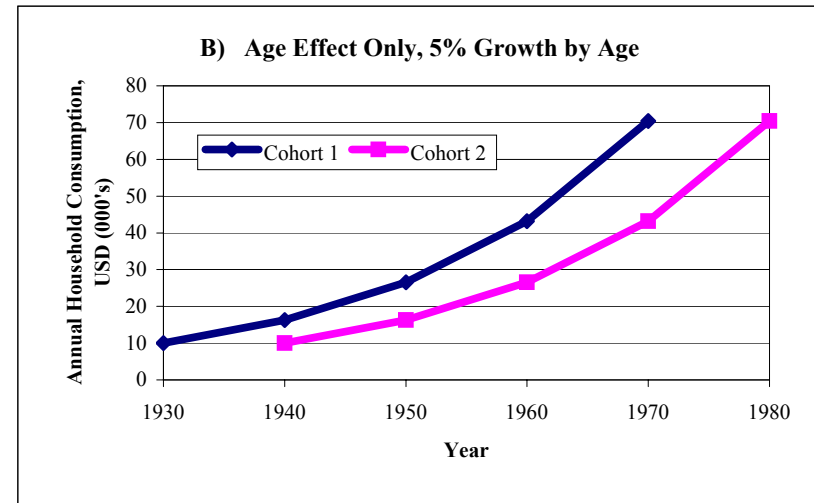
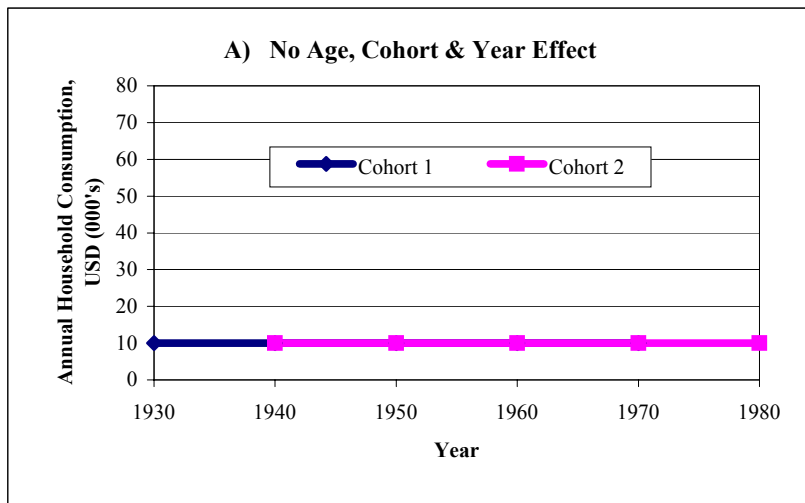
<sup>14</sup> See a proof in Appendix 3.1.

$$\tilde{\alpha} = \alpha + \kappa s_a, \tilde{\gamma} = \gamma - \kappa s_c, \tilde{\psi} = \psi - \kappa s_y \quad (3.4.5)$$

for any scalar constant  $\kappa$ , and by (3.4.4) there will be no change in the predicted value of  $y$  in (3.4.2).

This can be understood by looking at a special case illustrated in Figure 3.8. There are two cohorts: cohort 1 (aged 30 in 1930) and cohort 2 (30 in 1940). Panel A) describes the spending pattern of both cohorts from 30 to 60. Panel A) shows that there is no age, cohort, or year effect. The consumption has been constant at 10,000 US dollars at any age for each of the cohort. Now, let us consider another situation. There is an age effect with consumption growing at 5% for each year of age, as shown in panel B). Added to the age effect is a negative 5% year effect that gives a macroeconomic shock whereby everyone gets 5% less than in the previous year, as shown in panel C). In panel C), the consumption levels of cohort 1 and 2 are pulled back by year effect to straight lines, with the level of cohort 2 lower than that of cohort 1. Now, if we add a negative cohort effect that gives cohort 2, the younger cohort, 5% more by year of birth, the consumption level of cohort 2 returns to that of cohort 1 as shown in panel D). The cohort effect is -5% because we indicate an older cohort with a bigger number (age at year 0). This example shows that a single straight line with slope 0 can be interpreted as either no effect at all or 5% growth age effect offset by -5% growth year effect and added by a -5% cohort effect.

**Figure 3.8 Identification Problem, An Illustrative Example**



### 4.3 Solution

Therefore, it is necessary to impose another restriction to obtain the year effects. Our treatment is based on Deaton and Paxson (1994) and the argument grows out our previous discussion with (3.4.5).

In our analysis, we want to use the *year* variable to describe the effect of special events taking place in certain year, instead of the time trend. In other words, the *year* variable should be orthogonal to time trend. Let's consider the consumption growing at a 5 percent rate for each year as for each cohort. This growth can be represented by a time-trend of 5% a year in the year effects, without either cohort or age effects or by age effects that rise linearly with age added to cohort effects that fall linearly with age. Note that the two effects are equal (5 percent) but of opposite sign because cohort are labeled by age at a fixed date, so that older (larger  $c$ ) are poorer, not richer. Therefore, it seems reasonable to attribute growth to age and cohort effects not year, and to use the year effects to capture cyclical fluctuations that average to zero over the long run.

In light of the discussion above, we could estimate (3.4.2) with the first age group, and the first cohort omitted, so that the reference group is that for a household headed by a 10 year-old in 1986. The fifteen year dummies are constrained to be orthogonal to a time trend, and to add to zero. The 'base year' is thus a timeless average of all years, and *any "time trend" is attributed to cohorts and ages, not to year*. Using the same notation as above, we have

$$s'_y \psi = 0 \quad (3.4.6)$$

and a set of  $T - 2$  year dummies defined as following, from  $t = 3, \dots, T$

$$d_t^* = d_t - [(t-1)d_2 - (t-2)d_1] \quad (3.4.7)$$

where  $d_t$  is the usual year dummy, equal to 1 if the year is  $t$  and 0 otherwise. This procedure enforces the restriction (3.4.6) as well as the restriction that the year dummies add to zero. The coefficient of the  $d_t^*$  give the third through final year coefficients; the first and second can be recovered from the fact that all year effects add to zero and satisfy (3.4.6).

## SECTION 5 RESULTS FOR AGGREGATE EXPENDITURES

We adopt the method in Deaton and Paxson (1994) to estimate the age, cohort and year effects for total expenditures using cohort data. The natural logarithm of total household expenditure (in 2000 prices) is regressed on three sets of age, cohort and year dummies, with transformation shown in Section 4.

We present the results in four panels in Figure 3.9 (The results for aggregate household consumption are shown in the first group of graphs). The lower right panel shows the household consumption of six from the 62 cohorts in the sample. They are cohorts of age of household head at 20, 30, 40, 50, 60, and 70 in year 1986. Different cohorts are marked with different colors. The other three panels show the age effects, cohort effects and year effects, respectively.

Before we start to describe the three effects of aggregate household consumption, we need to remind ourselves that the “age” in our analysis is the age of head of household, while the consumption is measured by the natural logarithm of the per capita expenditure of the whole household in 2000 constant U.S. dollars.

The upper left panel shows the age effect of the aggregate household consumption. The coefficients of age effects range between -0.023 (age of 38) and 0.340 (age of 61) throughout the life span from 24 to 71. The analysis on the constructed cohort data shows that the per capita aggregate household consumption with a 38-year-old household head is about 98% of the level when the age of household is 24 years; while

the per capita aggregate household consumption with a 61-year-old household head is about 140% of the level of a 24-year-old household.

We can roughly partition the whole range into three phases. The first phase is from 24 to 38, with the age effects falling between 0.133 (age of 28) and -0.023 (age of 38). The average age effect is about 0.05, with the average consumption level about 105% of the level of the starting age. There is a peak at the age of 28, and a dip at 38. Comparing with the levels of later phases, the age effects are relatively low at this phase. The second phase is from 39 to 55, where the age effects rising from -0.023 to the peak of 0.339. However, the changes of age effects are not monotonic. There are small dips at the age of 43 (0.085) and 54 (0.301). The level of per capita aggregate household consumption climbs from 98% to 140% of the 24-year-old level, a substantial increase. The third phase is from 56 to 71, with the age effects gradually falling between 0.340 and 0.228. There are ups and downs every two-three years. At the age of 61, the age effect achieves the highest level of 0.340. Then the age effects slowly decrease to a level around 0.25. The magnitude of correspondent change in per capita aggregate household consumption is between 140% and 126% of the 24-year-old level.

The panel of cohort effects on the upper right plots the coefficients of cohort dummies against the cohort, which is defined as the age of household head in year 1986. Number 10 on the horizontal axis refers to the group of households whose head were born in 1976 (age of 10 in 1986), and number 70 refers to the group of households whose head were born in 1916 (age of 70 in 1986). Overall, the panel of cohort effects tells us

that generally younger generations are spending more than the elder generations, a sign of societal progress. However, the change is not monotonic from cohort to cohort.

We may roughly divide the 62 cohorts into 2 categories: the younger generations (cohort 10 – 43), and the elder generations (cohort 44 – 71). For the younger generations, the cohort effect coefficients are between 0.166 (cohort 11) and -0.0003 (cohort 14), implying the cohort effects on the per capita aggregate household consumption is between 118% and 99.9% of the level of cohort 10, the reference cohort with the cohort effect coefficient 0. The chart shows that the younger generations' cohort effect coefficients are centering round the line of 0.1. Intuitively, the younger generations grew up in post-war period, a period of relative peace and economic growth. There are no significant inter-cohort differences on the pattern of spending. For the elder generations (cohort 45 – 71), the cohort effects shows a clear fashion that cohorts born earlier spend less while those born later spend more. The intuitive reason is that most of the cohorts lived through the Great Depression, World War I, and World War II. The spending level of the cohorts reflects the growth of economy and national income. As the chart shows, the cohort effect coefficients have dropped from 0.095 (cohort 44) down to -0.425 (cohort 71), suggesting the cohort effects on the per capita aggregate household consumption decreases from 110% to 65.3% of the reference cohort. However, the changes are not monotonic, either. There are several peaks (cohort 49, 56, and 69) on the road of declining.



The year effects are minor compared with age and cohort effects. The contribution of macroeconomic disturbance to the household expenditure reaches highest in 1999 (0.034) and lowest in 1996 (-0.038). The volatility of the year effects on per capita aggregate household consumption is less than 7.5% of the 1986 level.

## SECTION 6 RESULTS FOR 81 EXPENDITURE CATEGORIES

Ideally we could have obtained the coefficients for age, year and cohort effects for each of the 85 consumption categories, if we have avoided the dummy variables traps and fixed the identification problem. However, considering the fact that we need to estimate 121 coefficients including those for 47 age categories, 13 year categories and 61 cohort categories<sup>15</sup>, we cannot obtain reasonable estimates for the coefficients if there aren't enough data points spanning over all possible cohort-year pairs. Because of the existence of many zero expenditures for many categories, taking the natural logarithm dramatically decreases the number of data points. For four categories<sup>16</sup>, we are not able to obtain the estimates for the coefficients although the number of data points exceeds the number of total coefficients to be estimated. To understand this, let's go back to a simpler version of the model illustrated in Section 3.

Suppose we have two cohorts. Cohort one is households with heads born in 1930, and cohort two is those with heads born in 1960. And we assume that the sample is the consumption on automobiles of the two cohorts in year 1990, 1995 and 2000. Now the vector  $x = (x_{1,1990}, x_{1,1995}, x_{1,2000}, x_{2,1990}, x_{2,1995}, x_{2,2000})$  where  $x_{c,t}$  ( $c = 1, 2; t = 1990, 1995, 2000$ ) denotes cohort  $i$ 's automobile consumption in year  $j$ ; vector  $\alpha = (\alpha_{30}, \alpha_{35}, \alpha_{40}, \alpha_{60}, \alpha_{65}, \alpha_{70})$  where  $\alpha_a$  ( $a = 30, 35, 40, 60, 65, 70$ ) denotes the age effect coefficients for age  $a$ ; vector  $\gamma = (\gamma_1, \gamma_2)$  where  $\gamma_c$  ( $c = 1, 2$ ) denotes the cohort effect

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<sup>15</sup> The first age category, first cohort category and first two year category are dropped to avoid the dummy variable traps and identification problem.

<sup>16</sup> They are "43, Care in convalescent or nursing home (net outlay)", "53, Other Vehicles", "71, Bicycles", and "75, Home Computer".

coefficients for cohort  $c$ ; vector  $\psi = (\psi_{1990}, \psi_{1995}, \psi_{2000})$  where  $\psi_t (t = 1990, 1995, 2000)$  denotes the year effect coefficients for year  $t$ . Therefore the general model written in matrix format for this example is as follows:

$$\begin{pmatrix} x_{1,1990} \\ x_{1,1995} \\ x_{1,2000} \\ x_{2,1990} \\ x_{2,1995} \\ x_{2,2000} \end{pmatrix} = \beta + \begin{pmatrix} 0 & 0 & 0 & 1 & 0 & 0 \\ 0 & 0 & 0 & 0 & 1 & 0 \\ 0 & 0 & 0 & 0 & 0 & 1 \\ 1 & 0 & 0 & 0 & 0 & 0 \\ 0 & 1 & 0 & 0 & 0 & 0 \\ 0 & 0 & 1 & 0 & 0 & 0 \end{pmatrix} \begin{pmatrix} \alpha_{30} \\ \alpha_{35} \\ \alpha_{40} \\ \alpha_{60} \\ \alpha_{65} \\ \alpha_{70} \end{pmatrix} + \begin{pmatrix} 1 & 0 \\ 1 & 0 \\ 1 & 0 \\ 0 & 1 \\ 0 & 1 \\ 0 & 1 \end{pmatrix} + \begin{pmatrix} \gamma_1 \\ \gamma_2 \end{pmatrix} + \begin{pmatrix} 1 & 0 & 0 \\ 0 & 1 & 0 \\ 0 & 0 & 1 \\ 1 & 0 & 0 \\ 0 & 1 & 0 \\ 0 & 0 & 1 \end{pmatrix} \begin{pmatrix} \psi_{1990} \\ \psi_{1995} \\ \psi_{2000} \end{pmatrix} \quad (3.6.1)$$

However, if all of the data points are only expenditures of cohort 1 in 1990, then the above model becomes

$$x_{1,1990} = \beta + \alpha_{30} + \gamma_1 + \psi_{1990} \quad (3.6.2)$$

There is no way for us to get estimates of age, year and cohort coefficients except those of age 30, year 1990, and cohort 1.

Unfortunately, four consumption categories in our model fall into the above situation and we are not able to obtain the age, year and cohort coefficients for them. From the rest 81 consumption categories, we select a few categories for our analysis: Food at home (1); Food away from home (2); Tobacco and smoking supplies (5); Owned dwellings (16); Rented dwellings (17); Electricity (28); Natural gas (29); Telephone equipment and services (32); Prescription drugs, medicines, purchases and rental of

medical supplies (36); Retirement, pension, social security (47); New cars and trucks (51); Used cars and trucks (52); Reading (68); Television, radios, and sound equipment (74); Higher education (81); Private and lower education (82); Other education and research (83).

The cohort effect panels of Food at home (1) and Food away from home (2) show that generally speaking, younger generations are spending less both on Food at home and away from home. Considering the income has grown over the generations, the panels imply that the share of food consumption has fallen in the younger generations.

Tobacco and smoking (5): from the graphs, we might conclude that people tend to smoke less when they get old, as can be shown from the panel of age effects. However, the reality is smokers don't get old! From the panel of cohort effects, young generations smoke less than old generations.

The age effects curves of Owned dwellings (16) and Rented Dwellings (17) fit quite well with everyday observations. Young people usually rent rather than purchase a house. When they reach work age, people usually buy house instead of renting. The age effects panels have shown this substitution effects between owned and rented dwellings.

Putting together the cohort panels of Electricity (28) and Natural gas (29), we can find younger generations are spending more on electricity and less natural gas than elder generations.

Telephone equipment and services (32): the cohort chart on telephone equipment and services partially reflects the growth of service sector of U.S. economy. With ever strengthened communication and information services, people spend more on telephone equipment and services.

Prescription drugs, medicines, purchases and rental of medical supplies (36): when people get old, they will spend more on their health, as can be shown from the panel of age effects. The care for health is also reflected in generational change. However, the spending on drugs and medicines is affected by age effects to a larger extent. Putting together the cohort panels of Physicians' services (38), Dental care (39), Other services by medical professionals (40), Other medical care services and medical care in retirement community (41), Hospital room and meals (42), Health insurance premiums (44), we find the younger generations are spending less on these categories than elder generations. There are two factors contributing to this phenomenon: 1) People's health condition has improved by generations, thus less is needed to spend on the health care items; 2) with only 15 years of the life span, the data for the younger cohorts are mostly the health expenditures of people when they are relatively young, while the data for the elder cohorts are mostly the health expenditures of people when they are relatively old. Since younger people usually spend less on the health care items, the bias in data contributes to similar cohort effects for those consumption categories.

The age effect curve of Contribution to retirement, pension, social security (47) exemplifies a life-cycle pattern of the payment of pension. When people are at working age, they spend on retirement plan to save for the retired period. When they retire, they spend their savings.

Cohort panels of New cars and trucks (51) and Used cars and trucks (52) show that younger generations are spending more on cars and trucks, a reflection of growth of car industry and people's income.

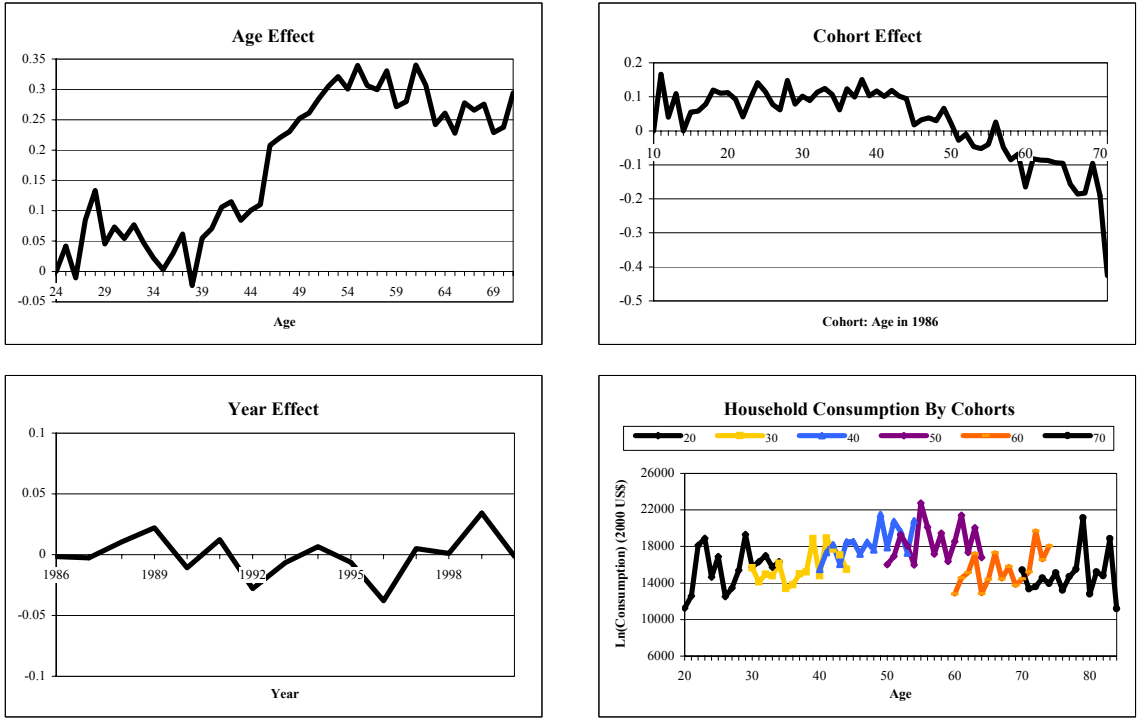
The category of Reading (68) includes books, maps, magazines, and newspapers. The age effects panel shows that people read more when they are young. The expenditure on reading reaches a peak at age of 29, and the spending on readings declines afterwards. However, the cohort effects panel tells us that on average young generations spend less on readings than old generations. The possible explanation for this phenomenon is that with the widespread use of TV and the Internet, people can read materials online instead of spending money on books, magazines and newspapers.

The age profile of spending on Television, radios, and sound equipment (74) shows that when people get older, they spend more on those consumption items. Cohort effects panel shows that younger generations spend more on these recreation equipments than elder generations.

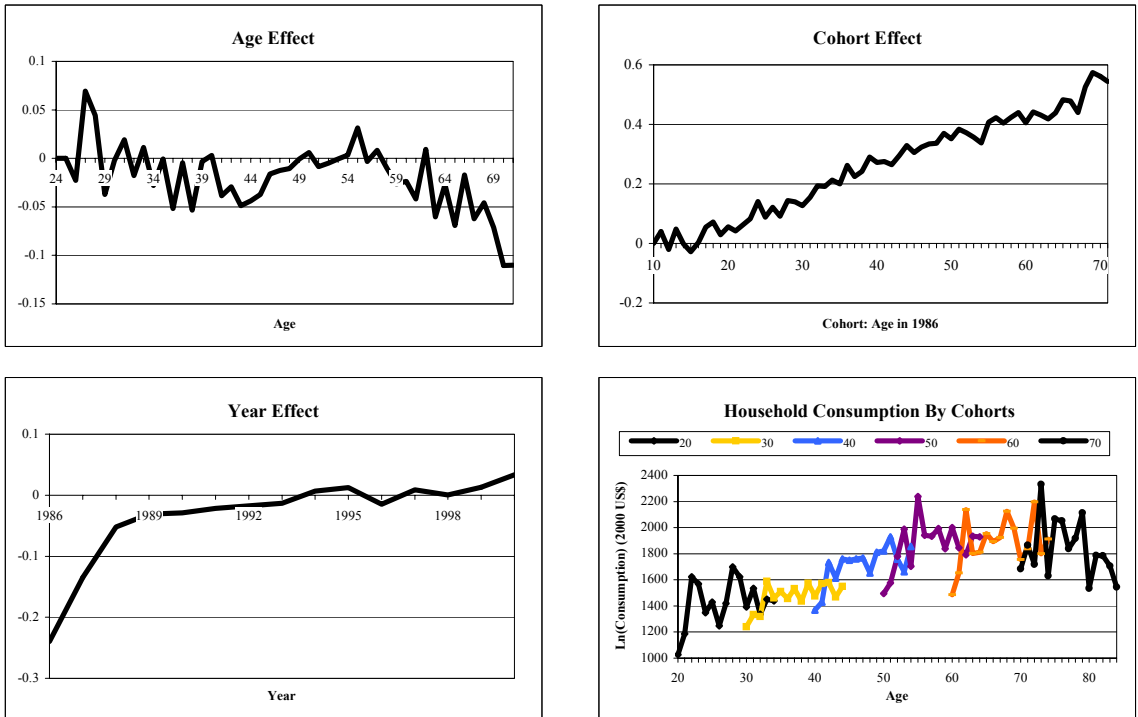
The age effect panels of Higher education (81); Private and lower education (82); Other education and research (83) show a peak of spending at the age from mid-40's to early 50's. It's counter-intuitive since the age of people receiving higher and other education are in 20's and 30's. But remember that the age here is the age of head of household, most likely a parent of the education recipients.

**Figure 3.9 Household Consumption by Cohorts and Decomposition, 1986 - 2000**

**Aggregate Household Consumption**



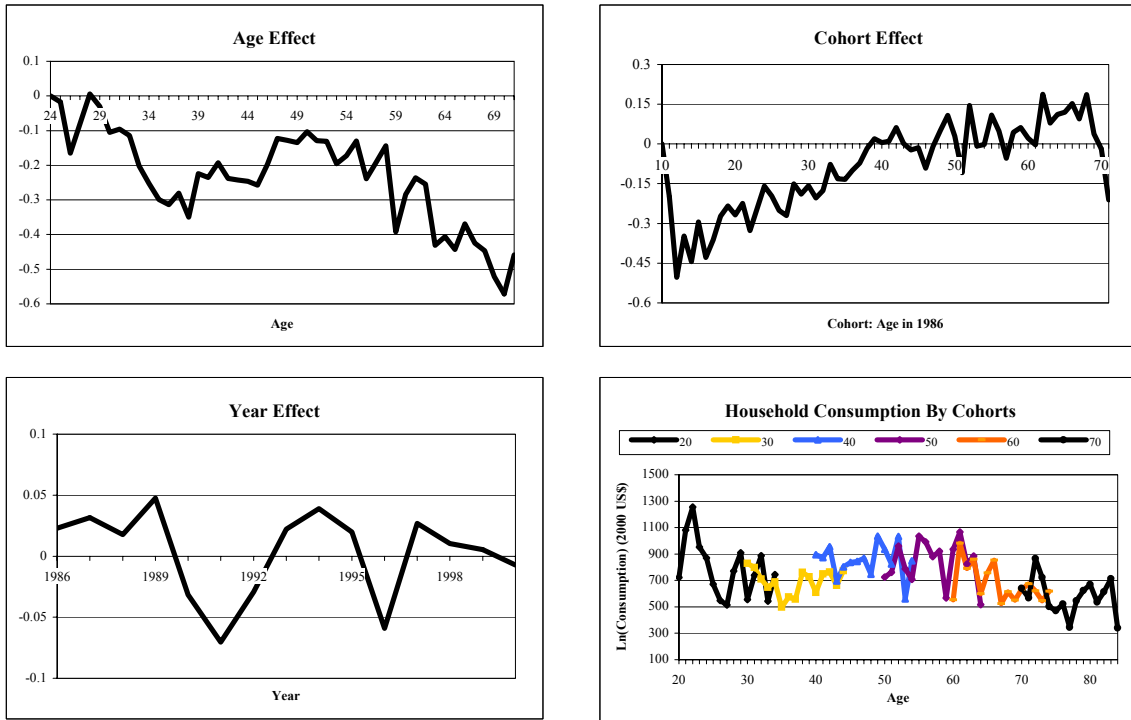
**1, Food at home**



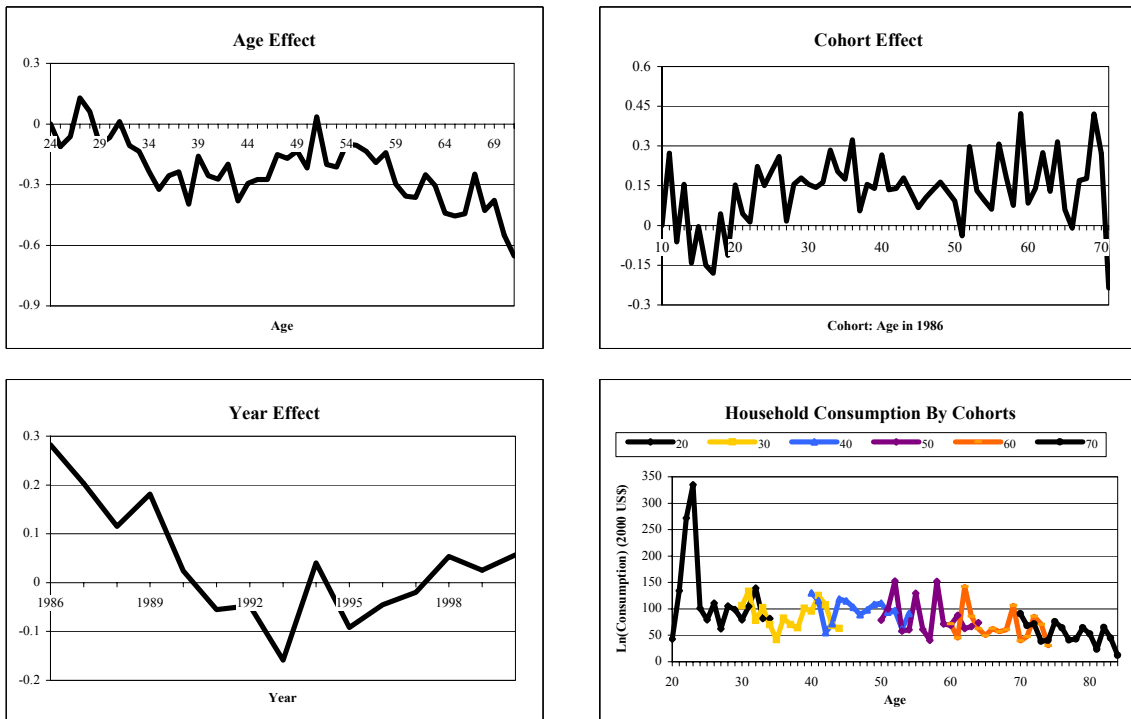


**Figure 3.9 Household Consumption by Cohorts and Decomposition, 1986 - 2000**  
**(Continued)**

**2, Food away from home**

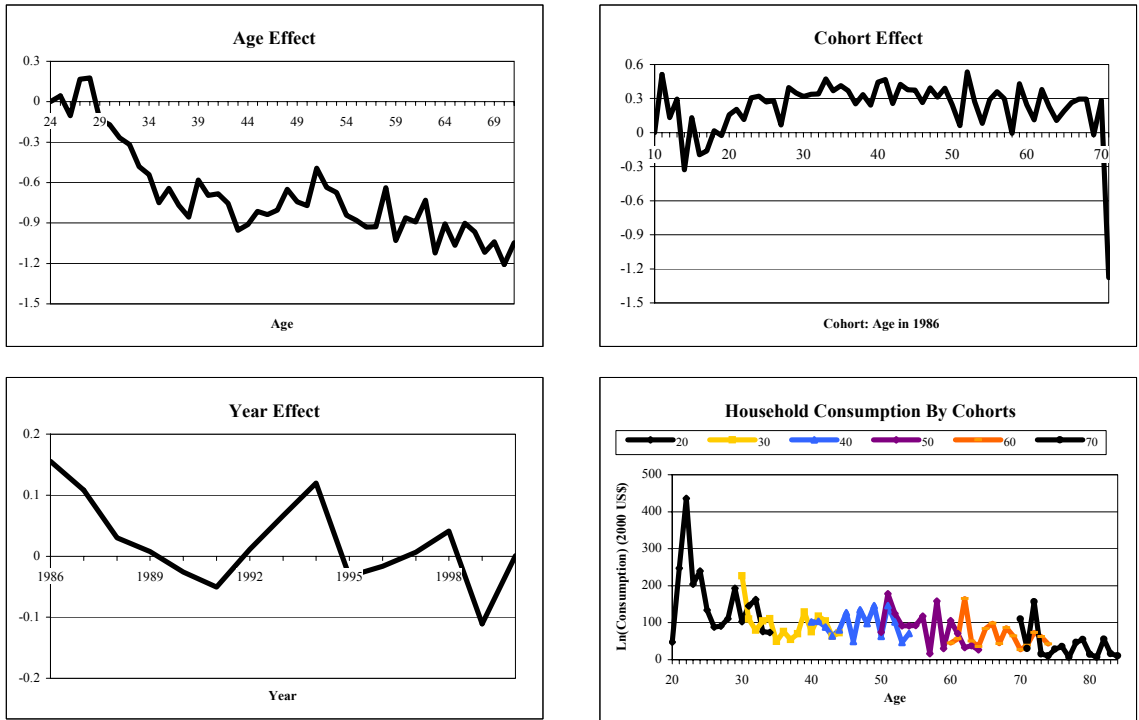


**3, Alcoholic beverages at home**

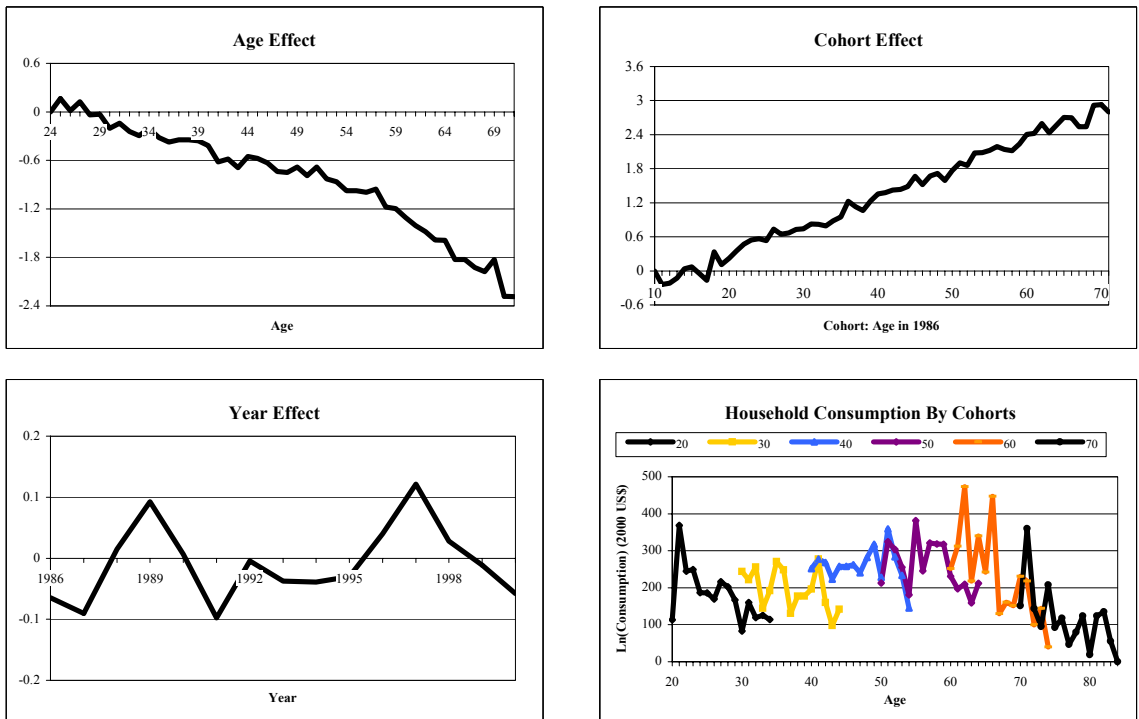


**Figure 3.9 Household Consumption by Cohorts and Decomposition, 1986 - 2000**  
**(Continued)**

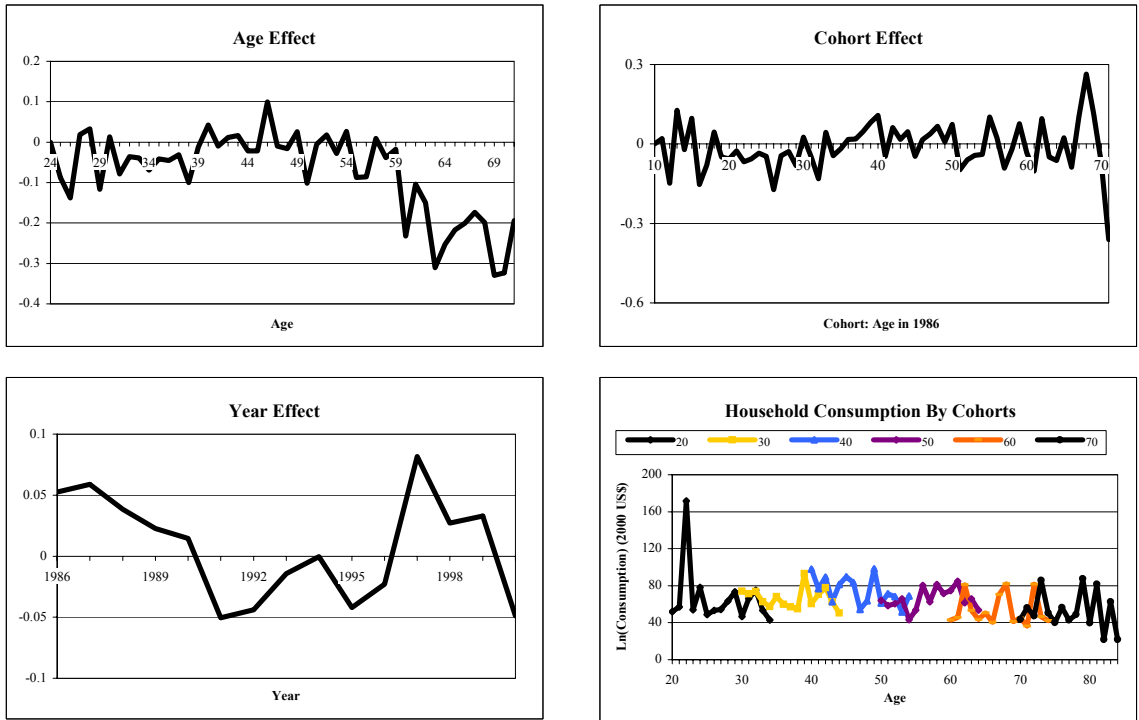
**4, Alcoholic beverages away from home**



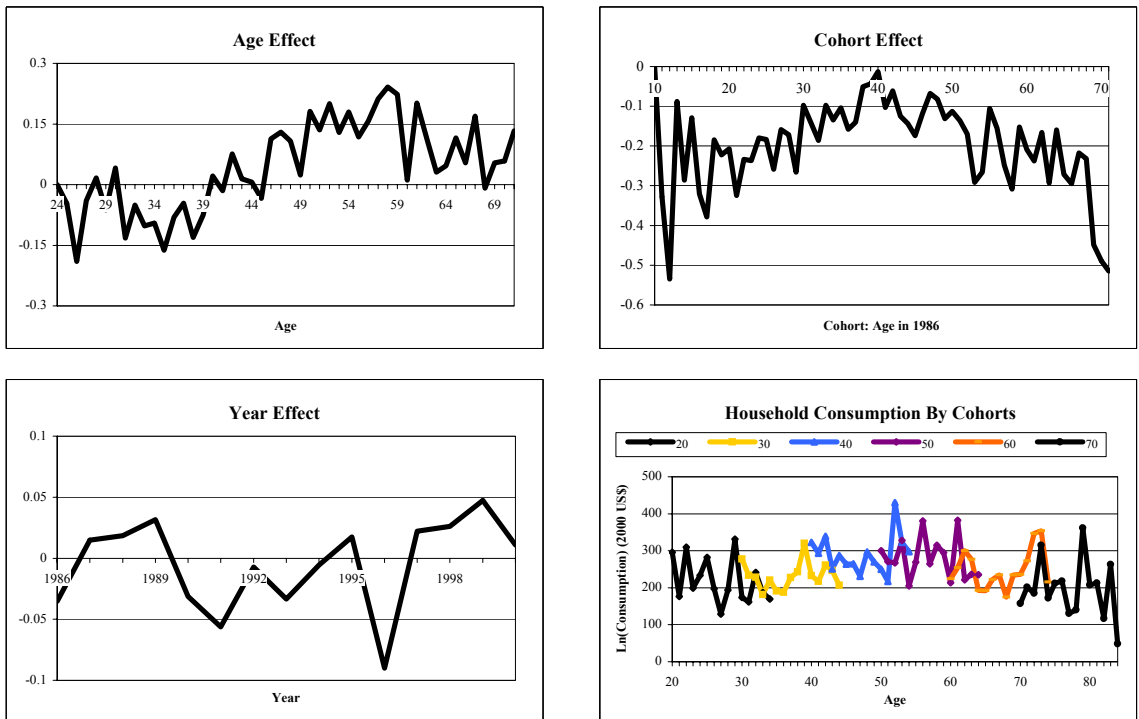
**5, Tobacco and smoking supplies**



**Figure 3.9 Household Consumption by Cohorts and Decomposition, 1986 - 2000  
(Continued)  
6, Footwear**

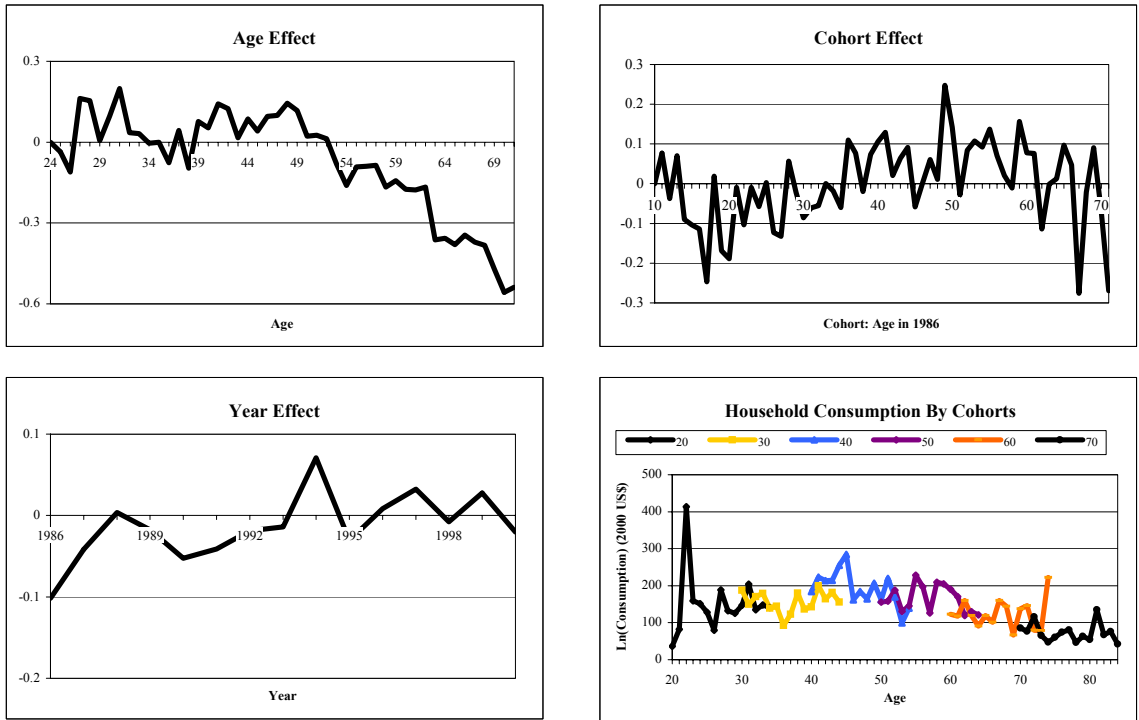


**7, Clothing for women and girls, 2 and over**

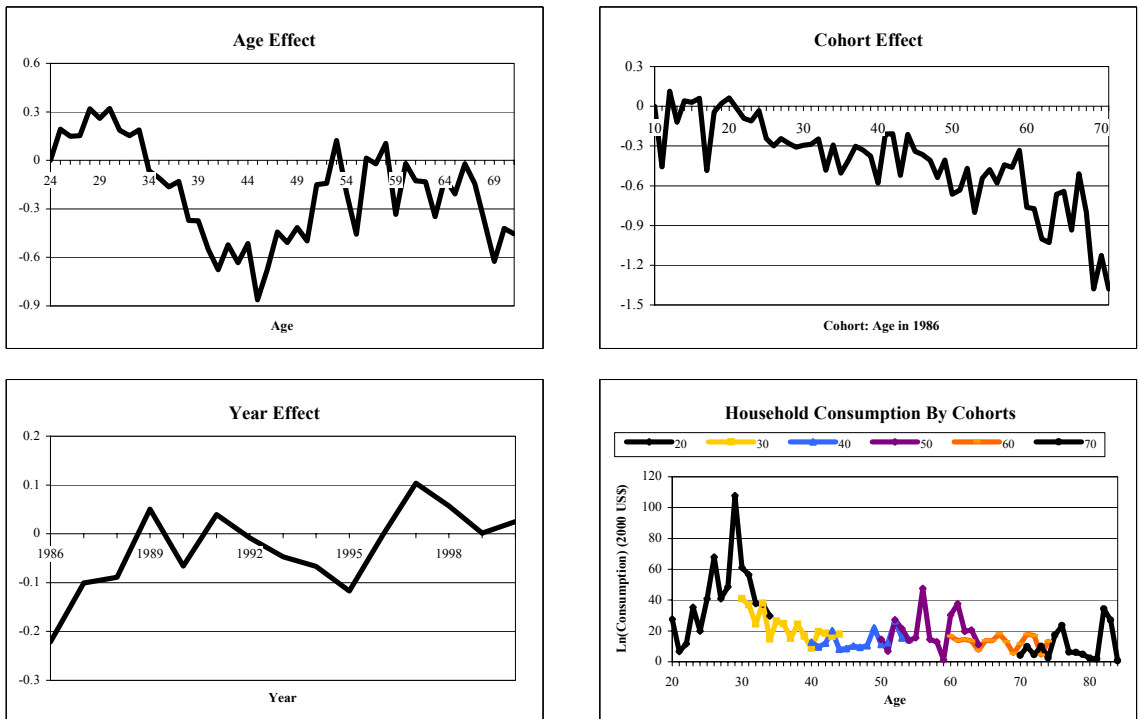


**Figure 3.9 Household Consumption by Cohorts and Decomposition, 1986 - 2000  
(Continued)**

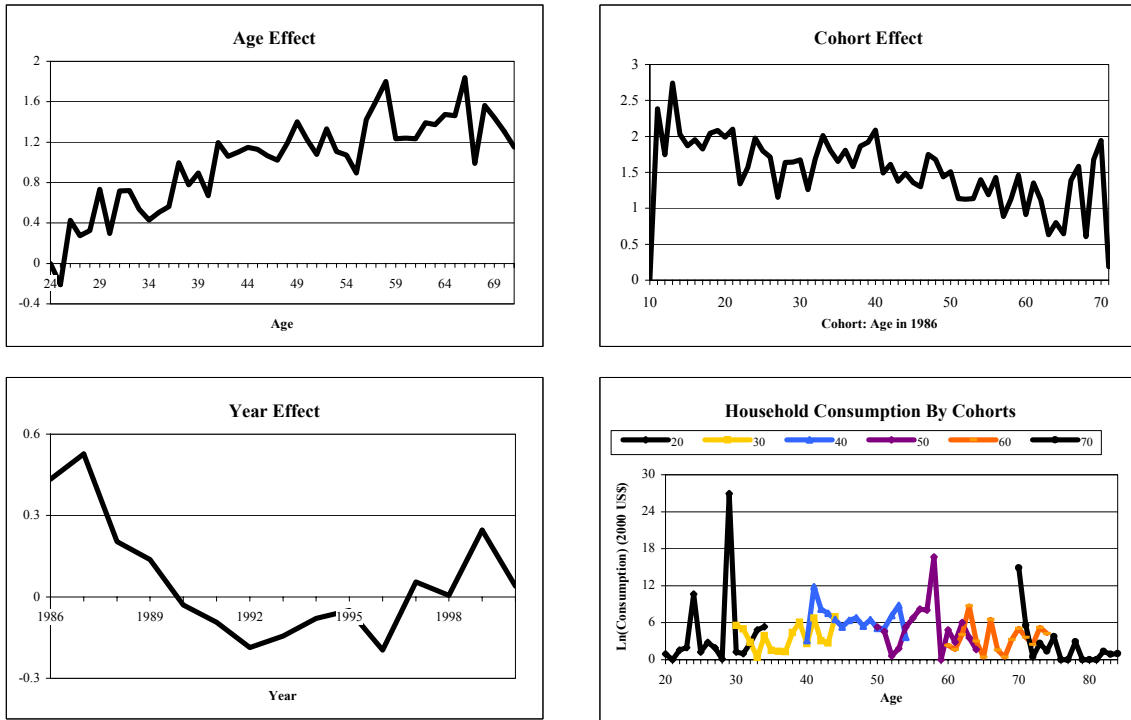
**8, Clothing for men and boys, 2 and over**



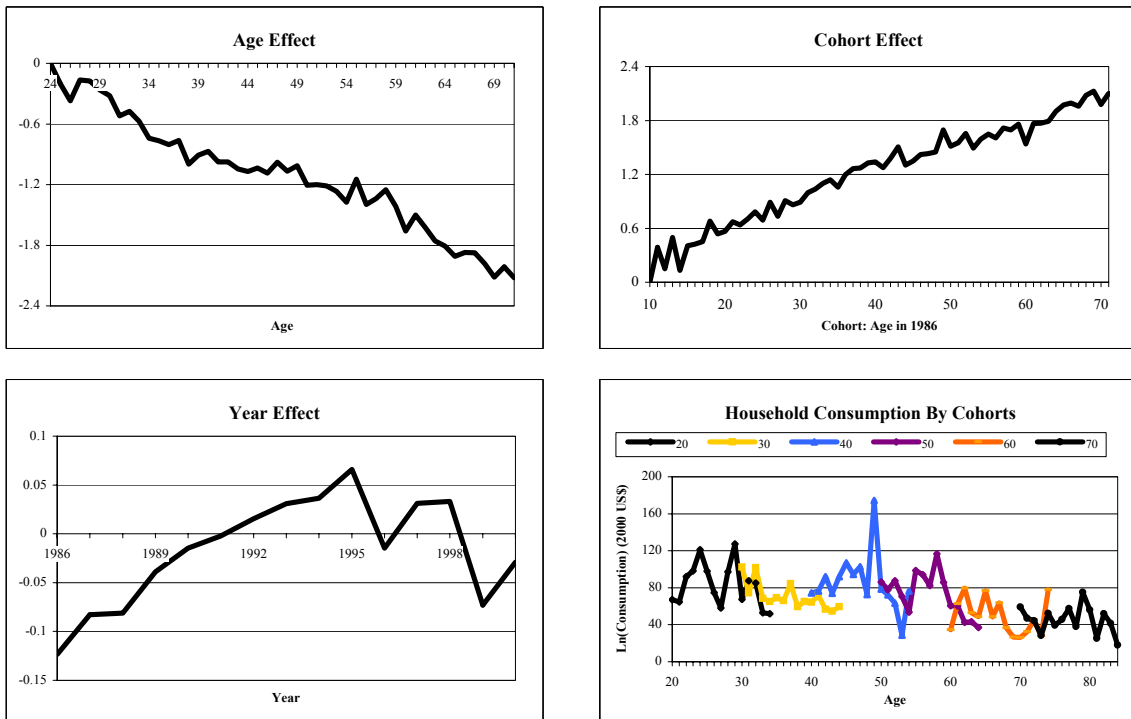
**9, Clothing for infants**



**Figure 3.9 Household Consumption by Cohorts and Decomposition, 1986 - 2000**  
**(Continued)**  
**10, Travel items**

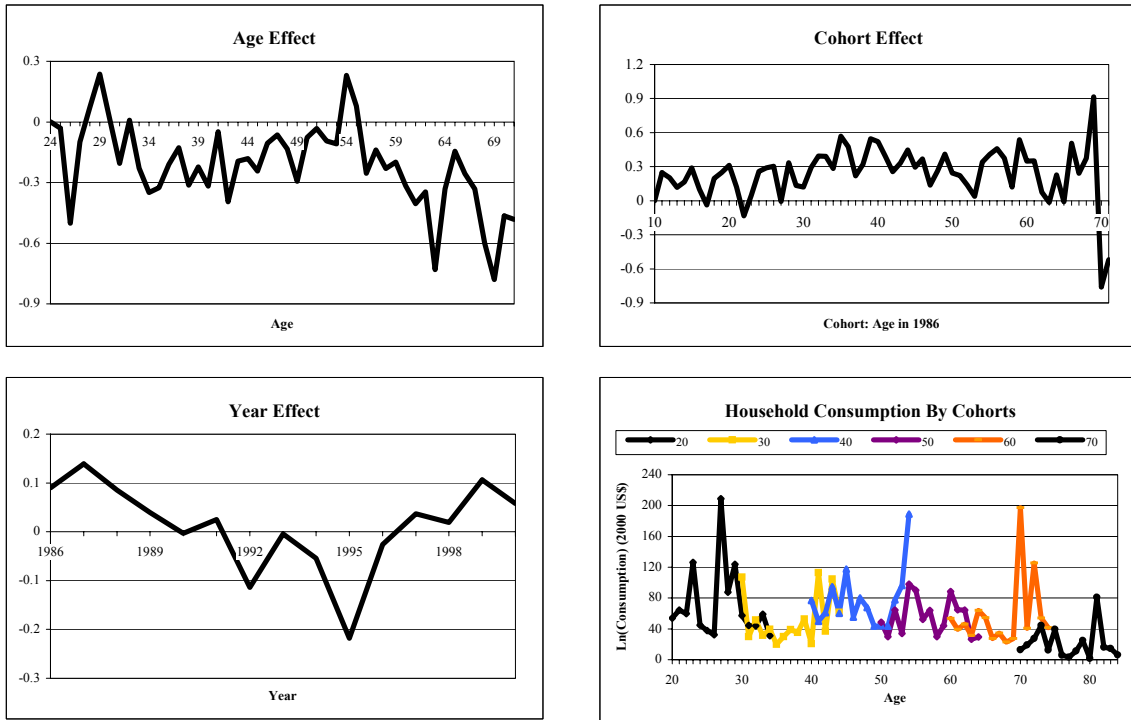


**11, Cleaning, laundering, repair of clothing and shoes**

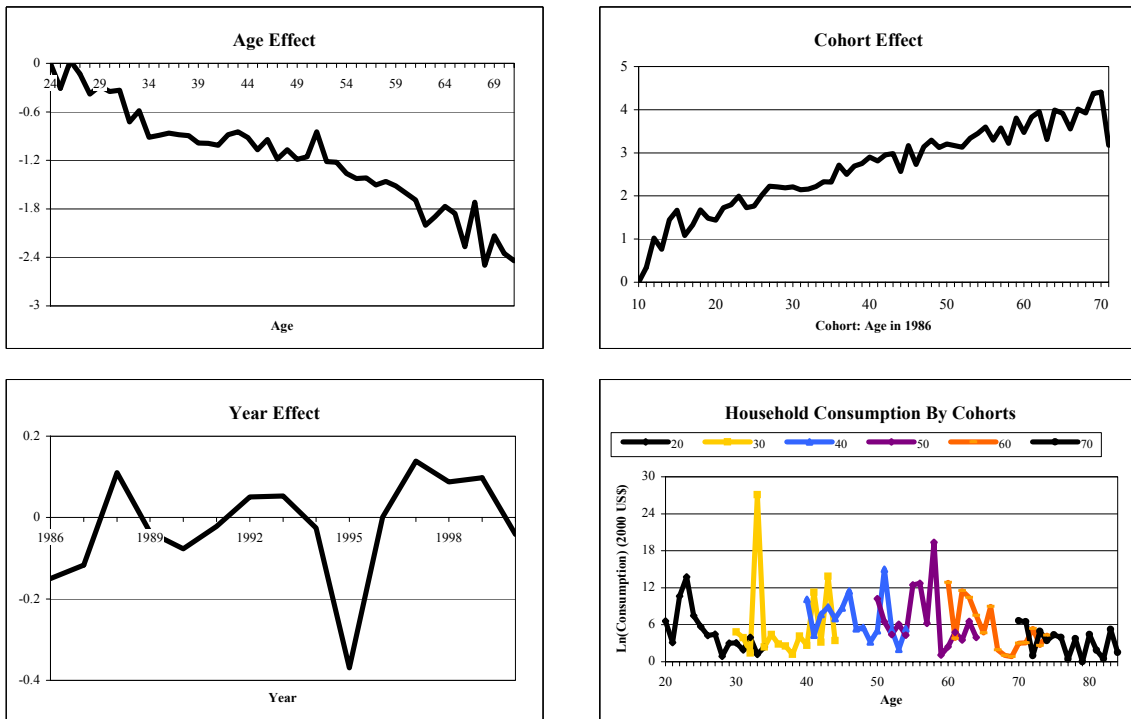


**Figure 3.9 Household Consumption by Cohorts and Decomposition, 1986 - 2000**  
**(Continued)**

**12, Watches and jewelry**

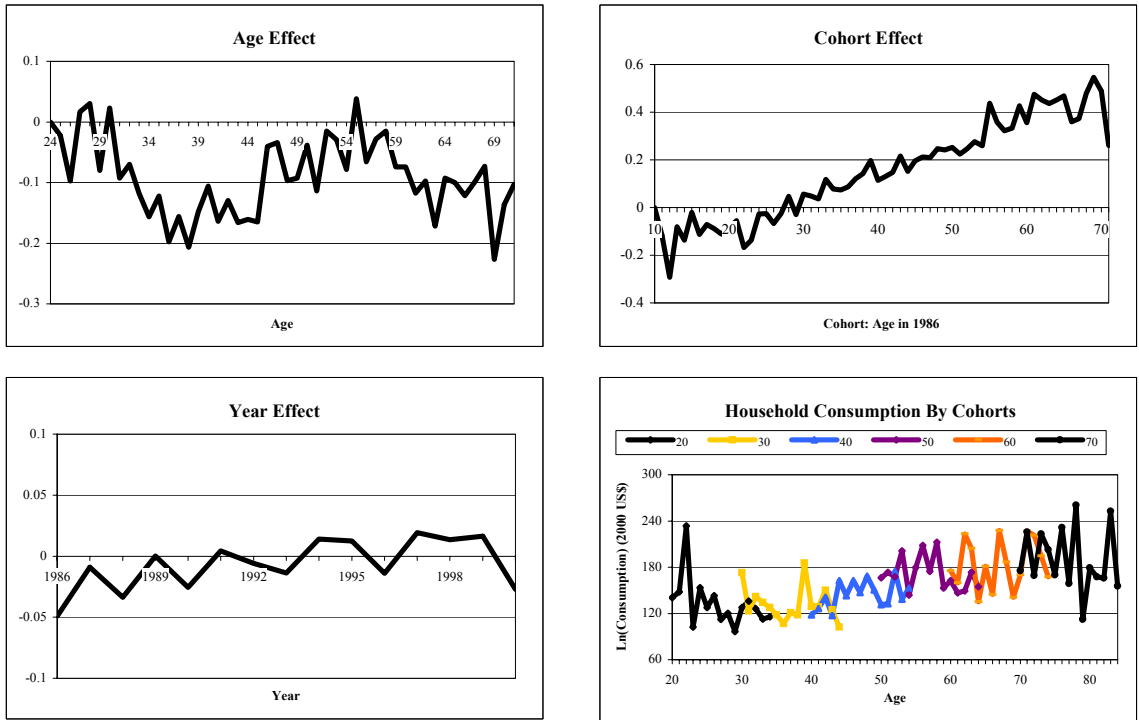


**13, Watches and jewelry repair, other clothing services**

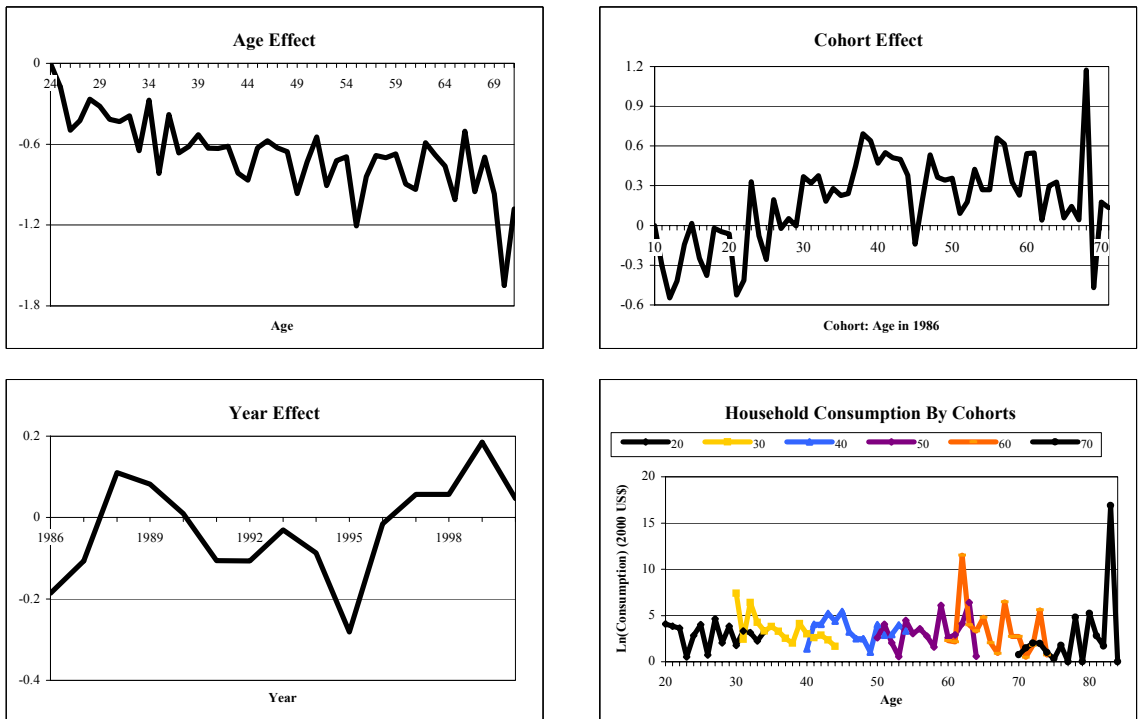


**Figure 3.9 Household Consumption by Cohorts and Decomposition, 1986 - 2000  
(Continued)**

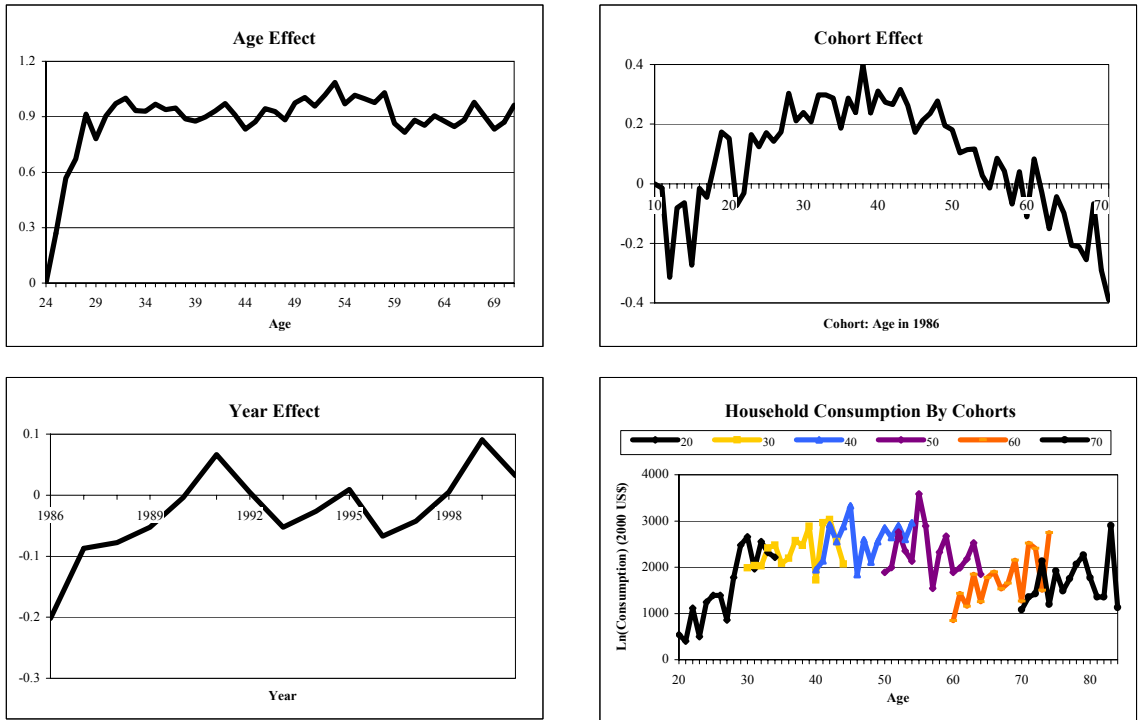
**14, Personal care services for males and females**



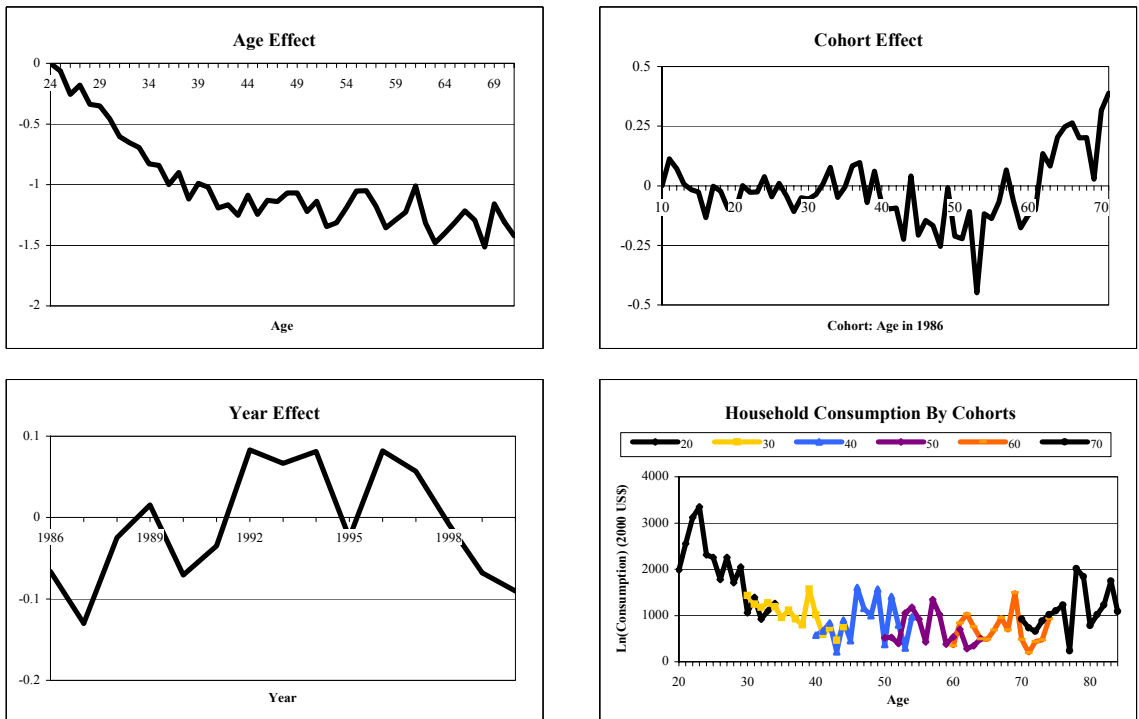
**15, Personal care equipment**



**Figure 3.9 Household Consumption by Cohorts and Decomposition, 1986 - 2000**  
**(Continued)**  
**16, Owned dwellings**

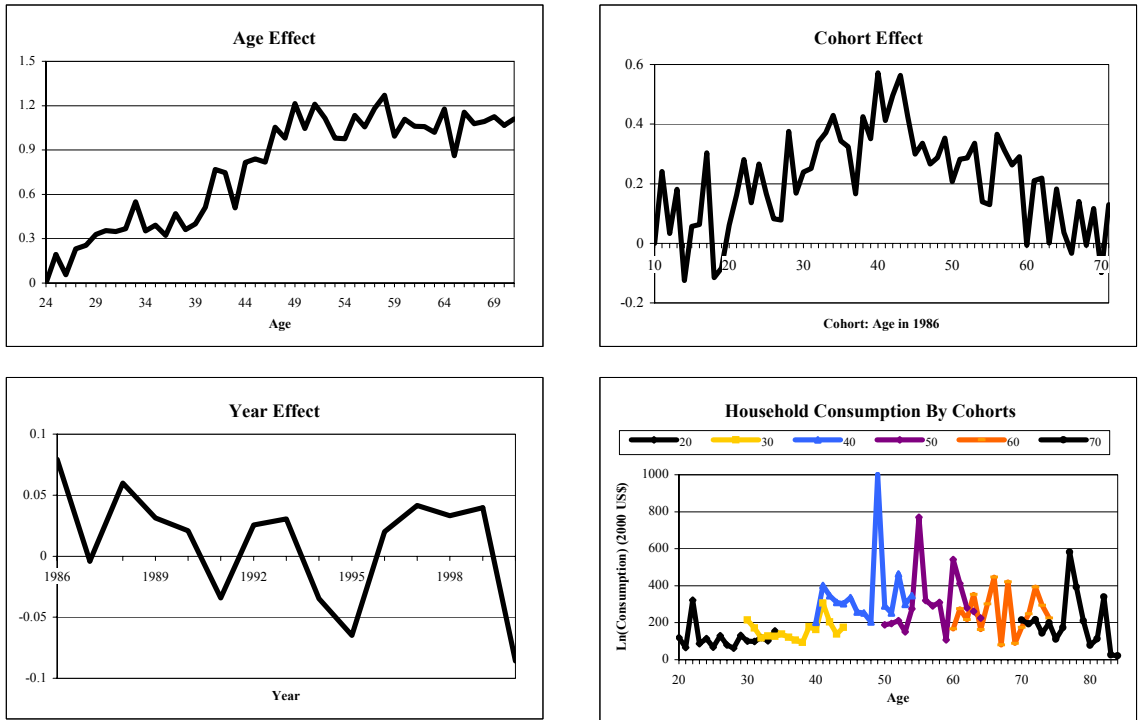


**17, Rented dwellings**

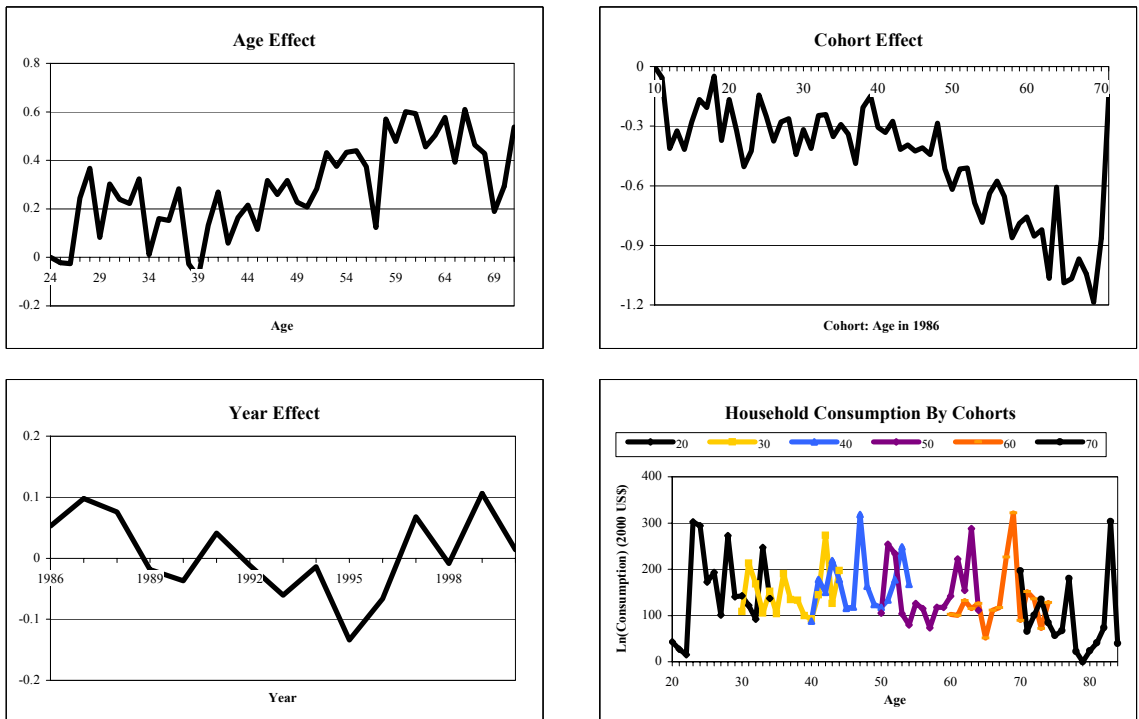




**Figure 3.9 Household Consumption by Cohorts and Decomposition, 1986 - 2000**  
**(Continued)**  
**18, Other lodging**

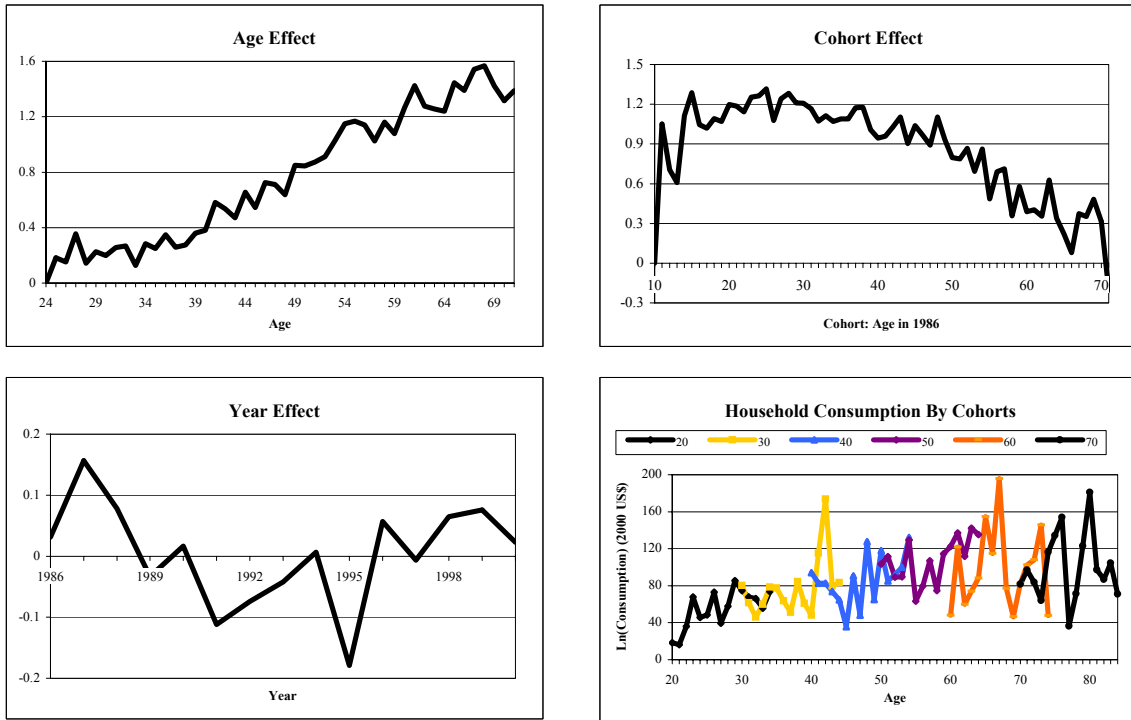


**19, Furniture**

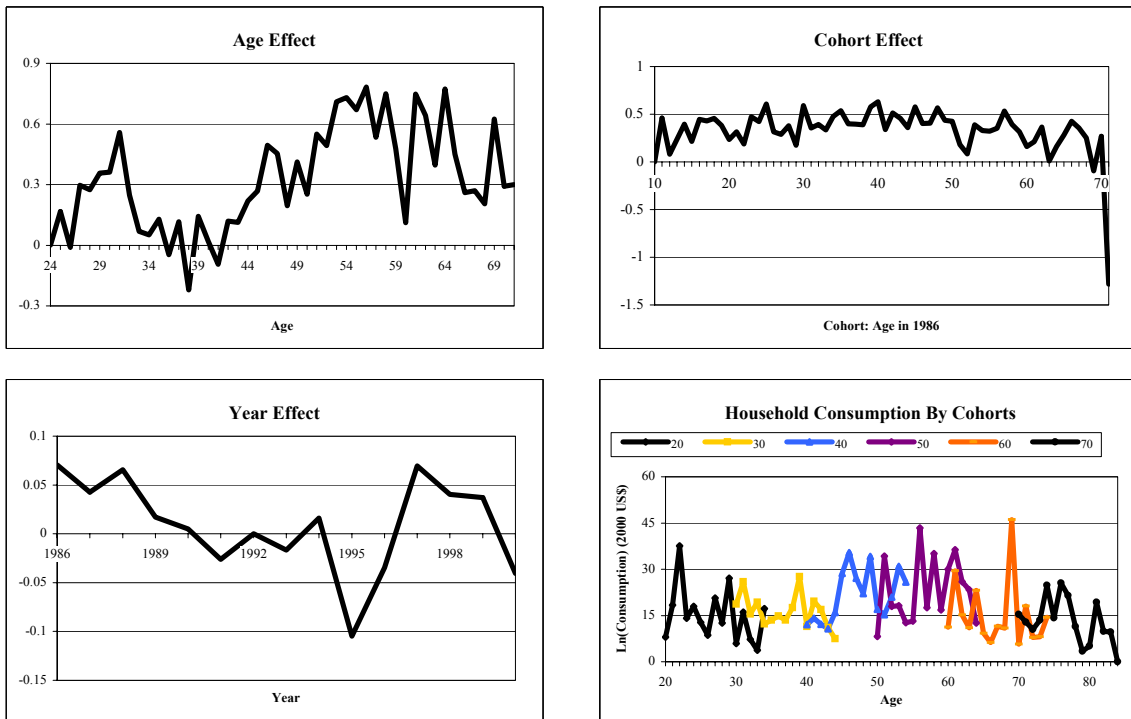


**Figure 3.9 Household Consumption by Cohorts and Decomposition, 1986 - 2000**  
**(Continued)**

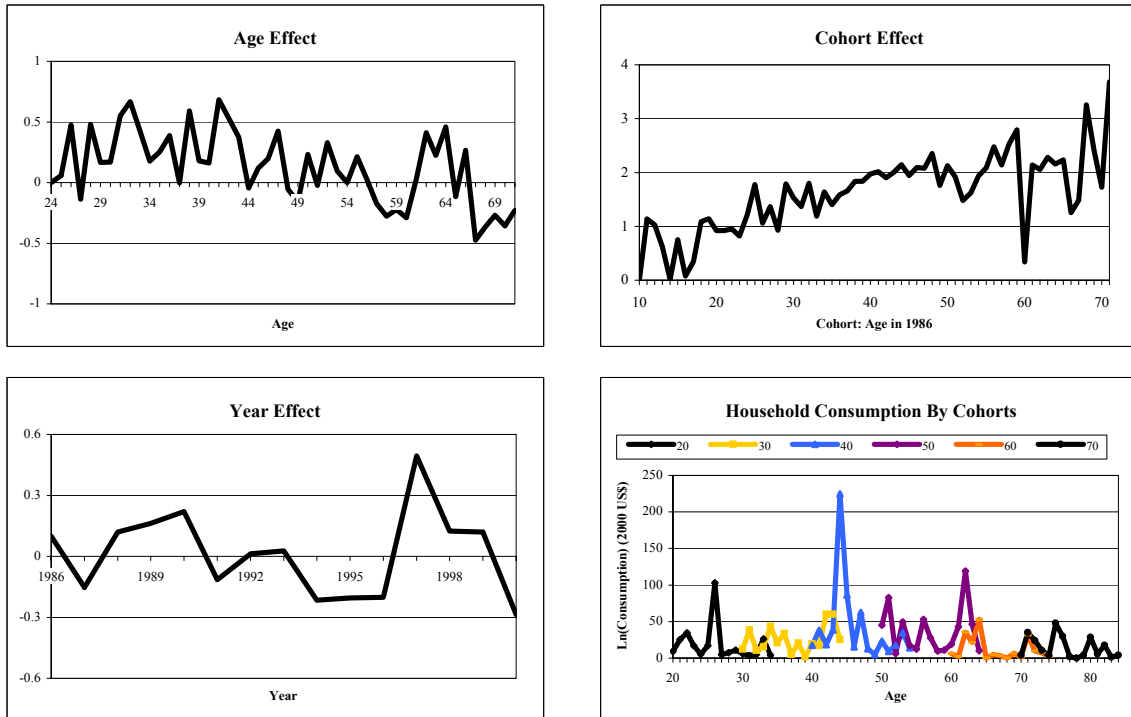
**20, Kitchen and household appliances**



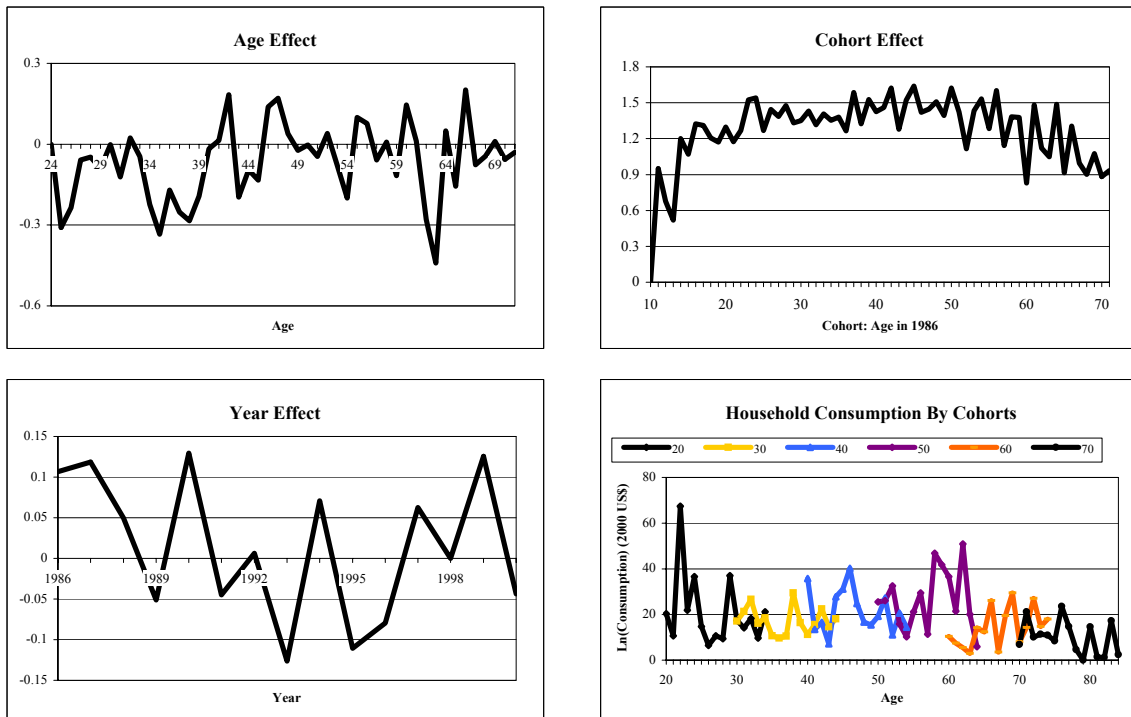
**21, China, glassware and utensils**



**Figure 3.9 Household Consumption by Cohorts and Decomposition, 1986 - 2000**  
**(Continued)**  
**22, Floor coverings**

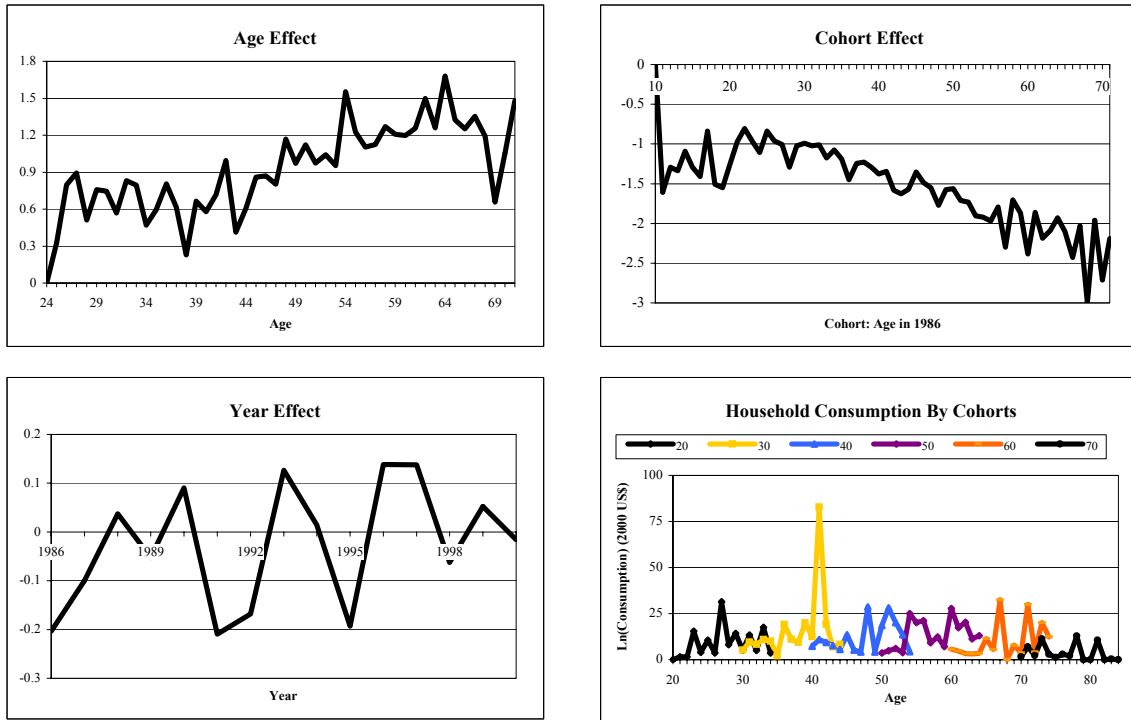


**23, Other durable house furnishings and writing equipment**

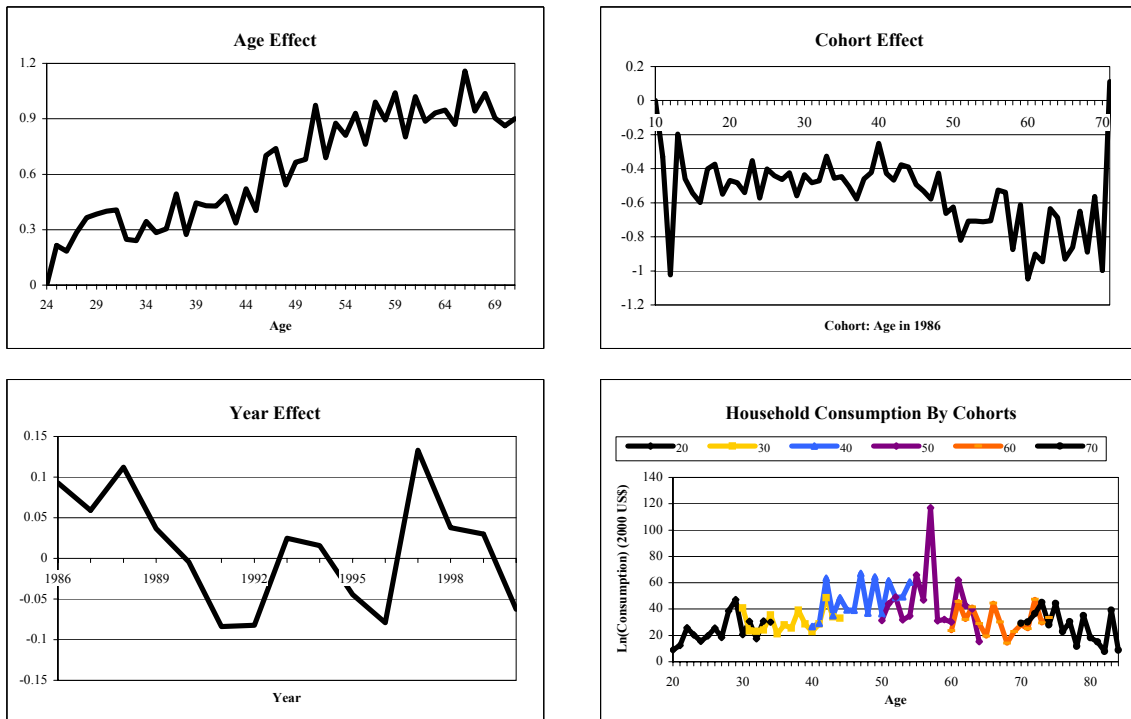


**Figure 3.9 Household Consumption by Cohorts and Decomposition, 1986 - 2000**  
**(Continued)**

**24, Power and non-power tools**

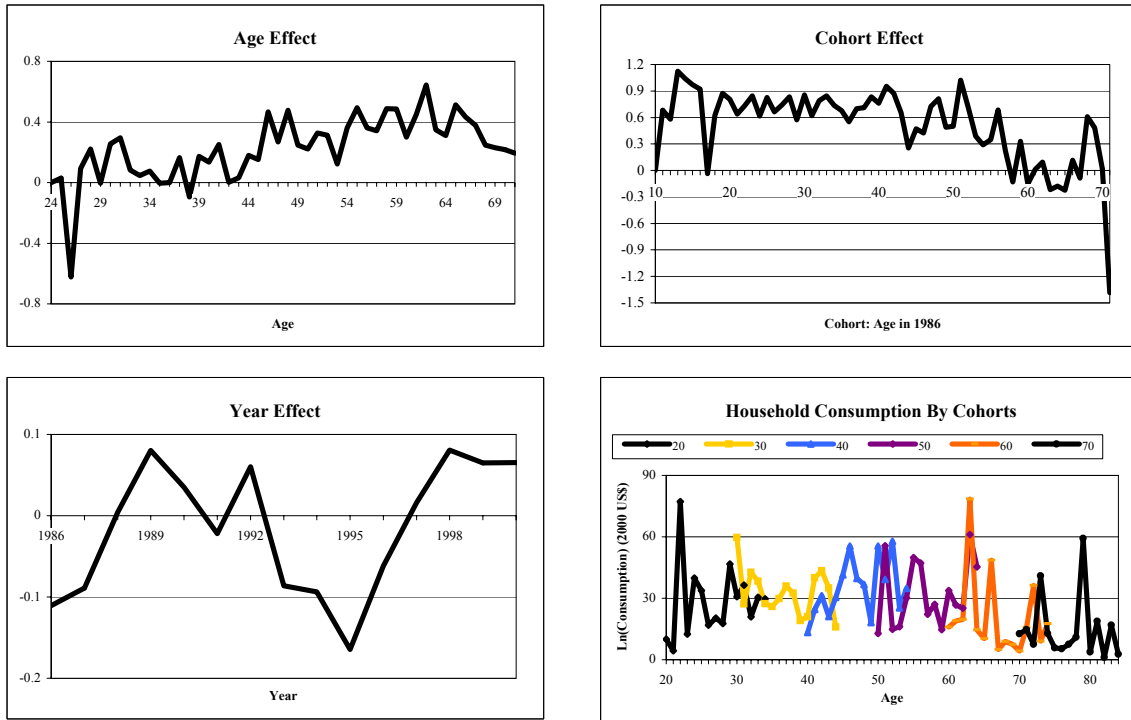


**25, Household textiles**

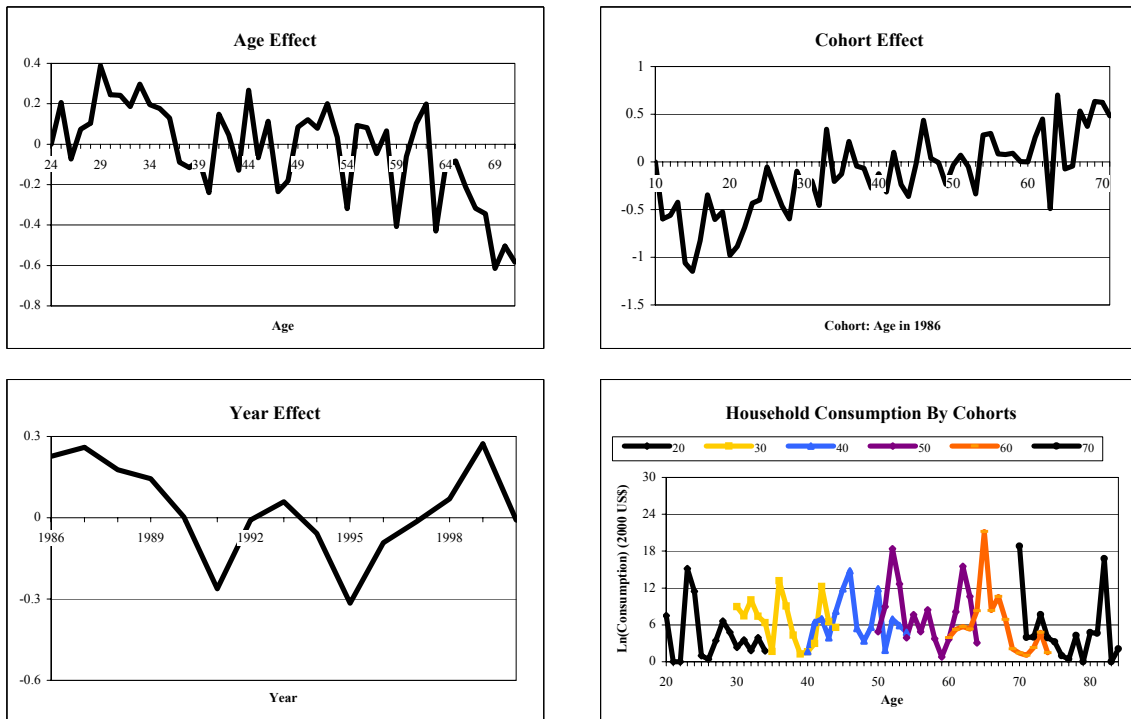


**Figure 3.9 Household Consumption by Cohorts and Decomposition, 1986 - 2000**  
**(Continued)**

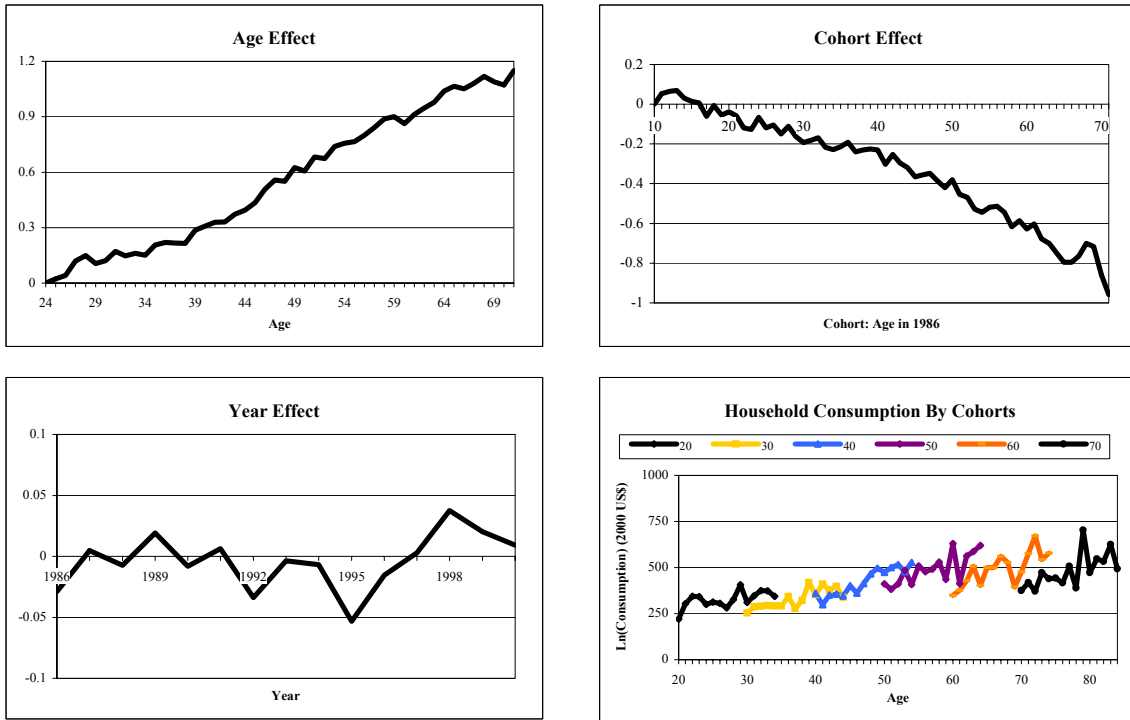
**26, Semi-durable house furnishings**



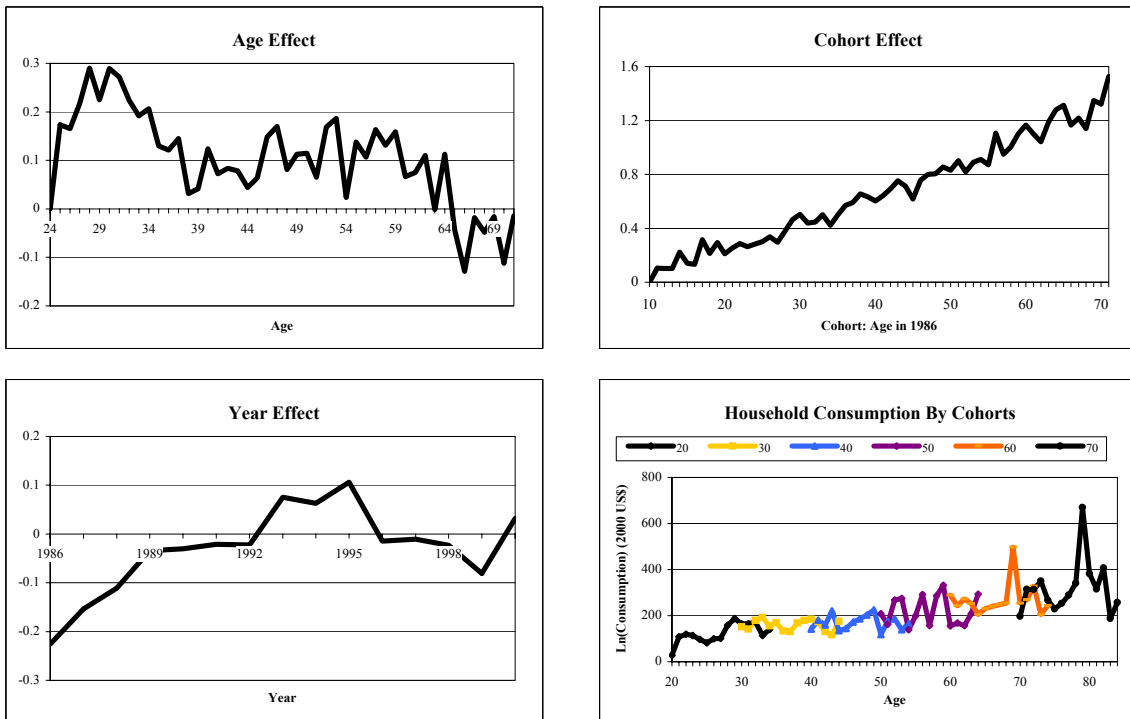
**27, Cleaning and lighting supplies**



**Figure 3.9 Household Consumption by Cohorts and Decomposition, 1986 - 2000**  
**(Continued)**  
**28, Electricity**

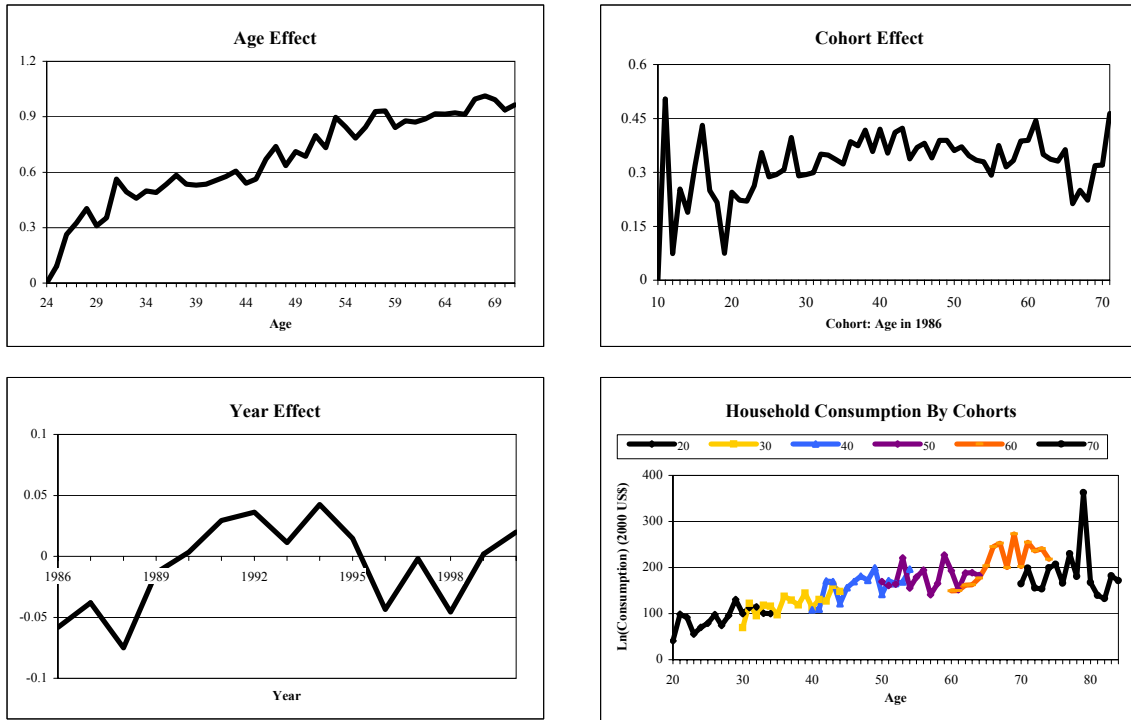


**29, Natural gas**

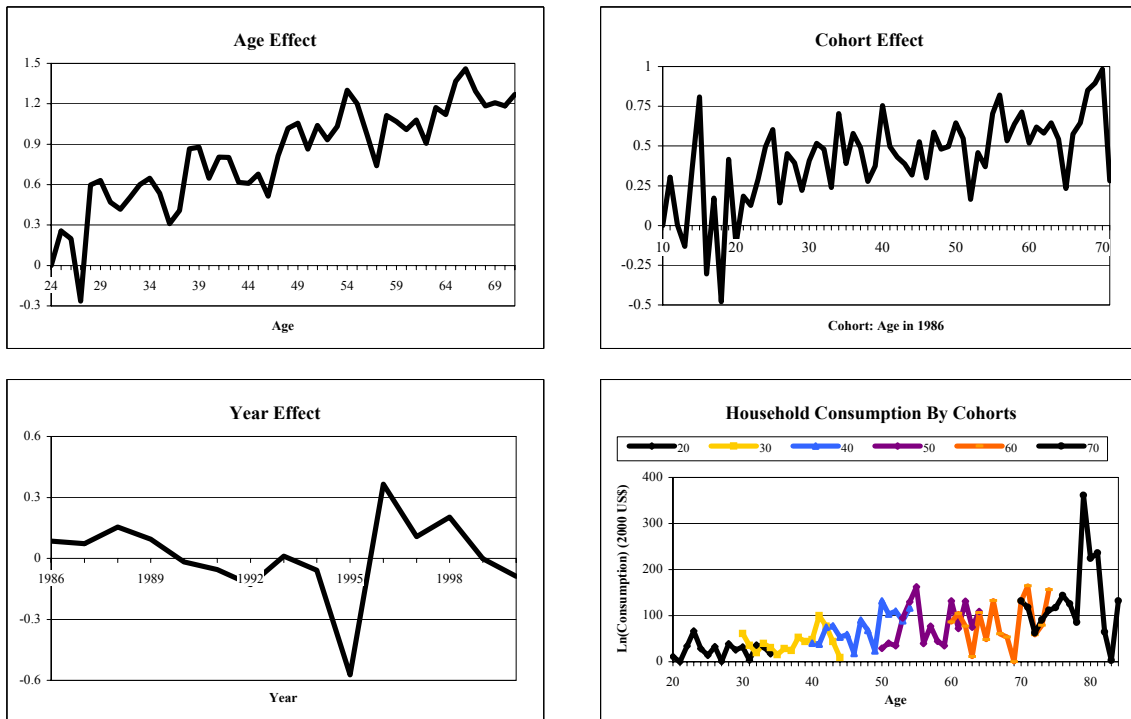


**Figure 3.9 Household Consumption by Cohorts and Decomposition, 1986 - 2000**  
**(Continued)**

**30, Water and other public services**

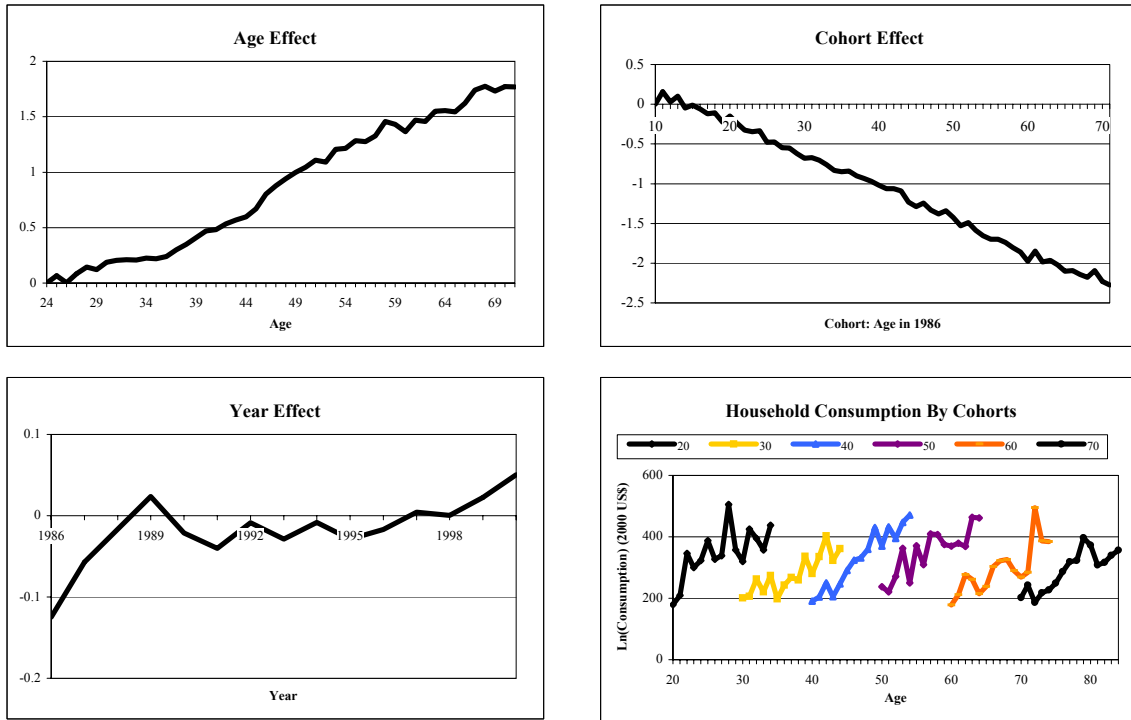


**31, Fuel oil and other fuels**

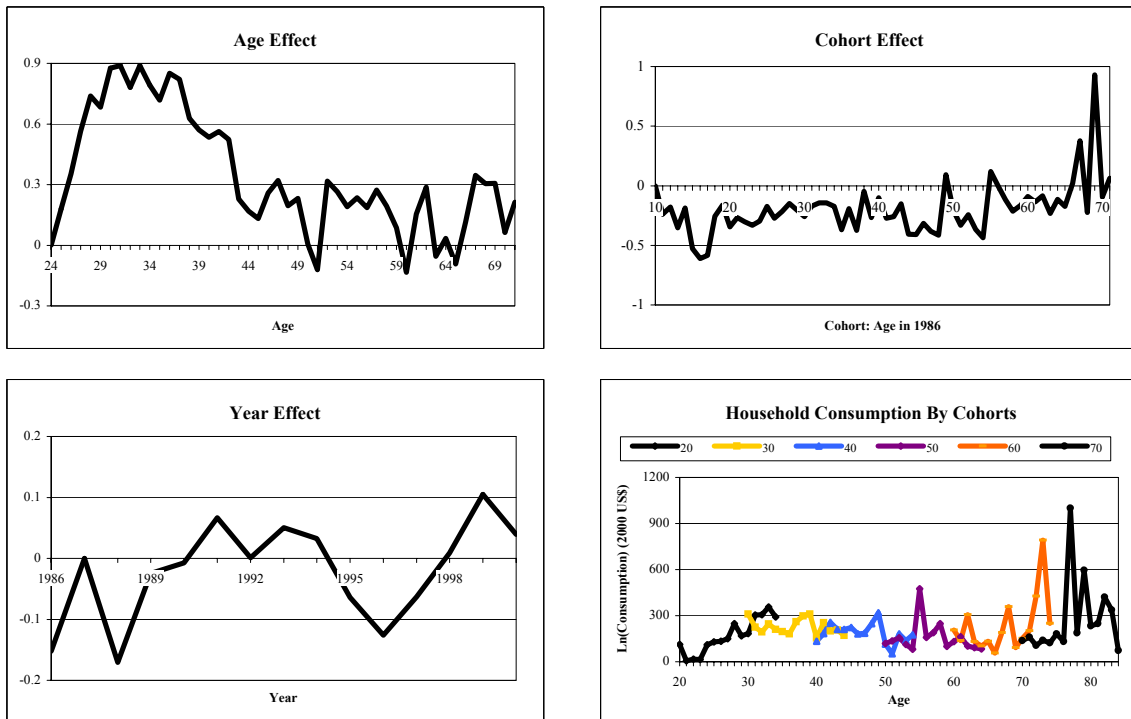


**Figure 3.9 Household Consumption by Cohorts and Decomposition, 1986 - 2000**  
**(Continued)**

**32, Telephone equipment and services**



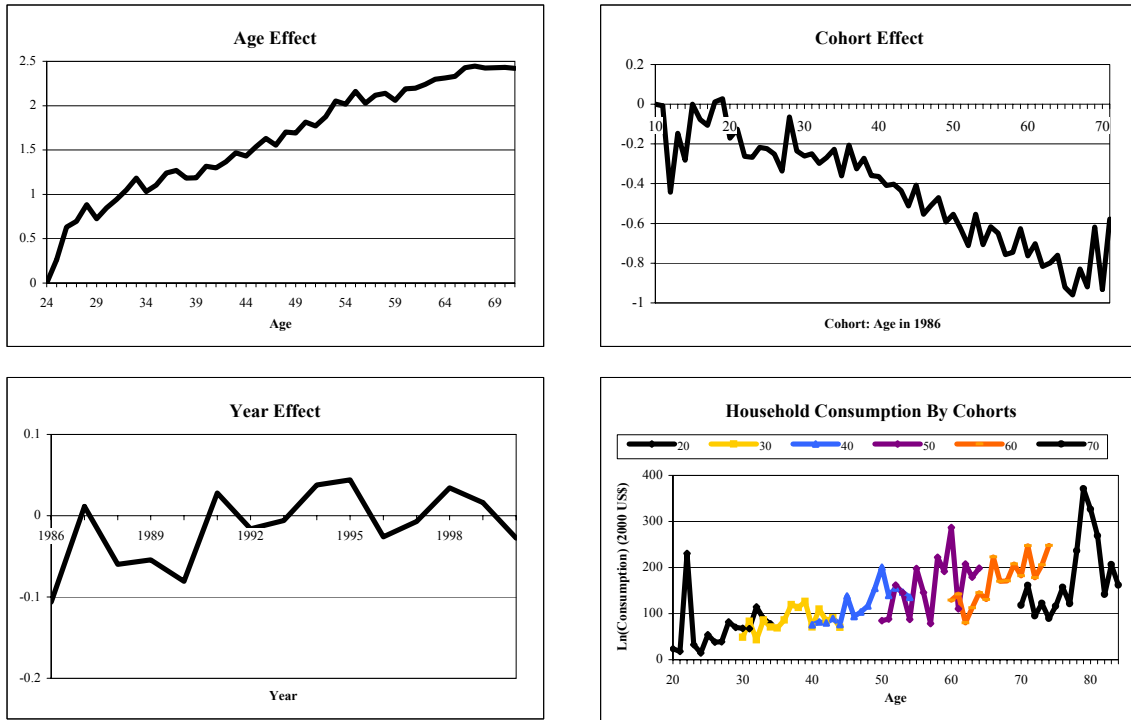
**33, Domestic services**



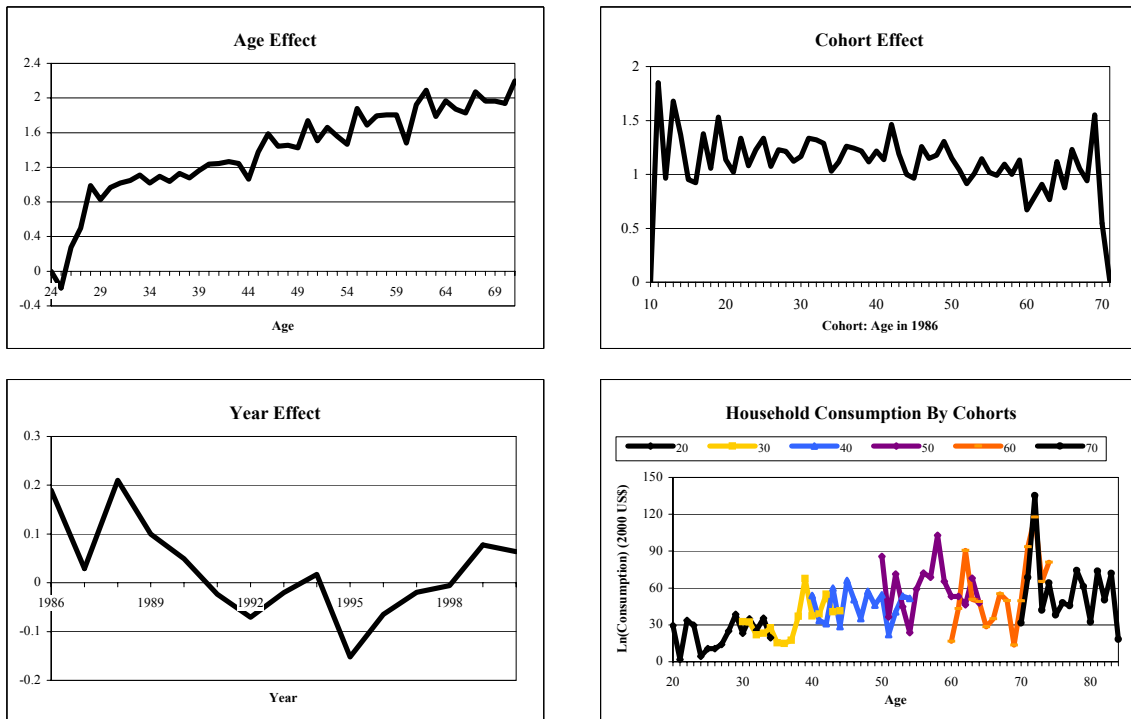


**Figure 3.9 Household Consumption by Cohorts and Decomposition, 1986 - 2000**  
**(Continued)**

**34, Household insurance premiums**

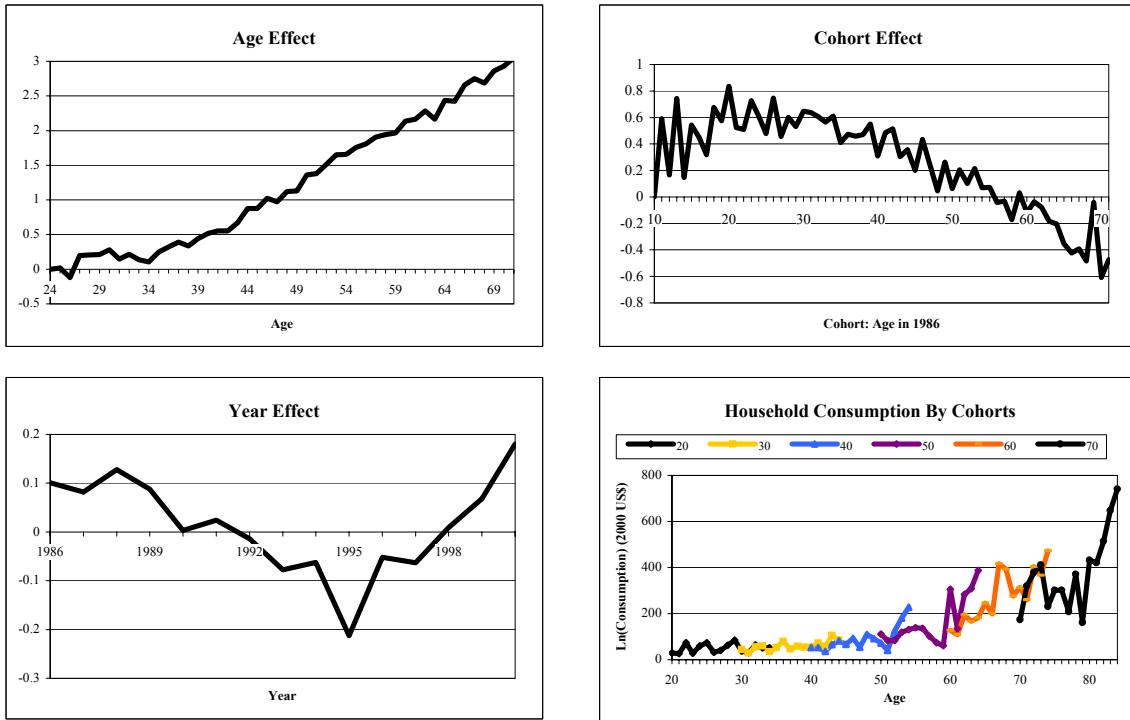


**35, Other household operations**

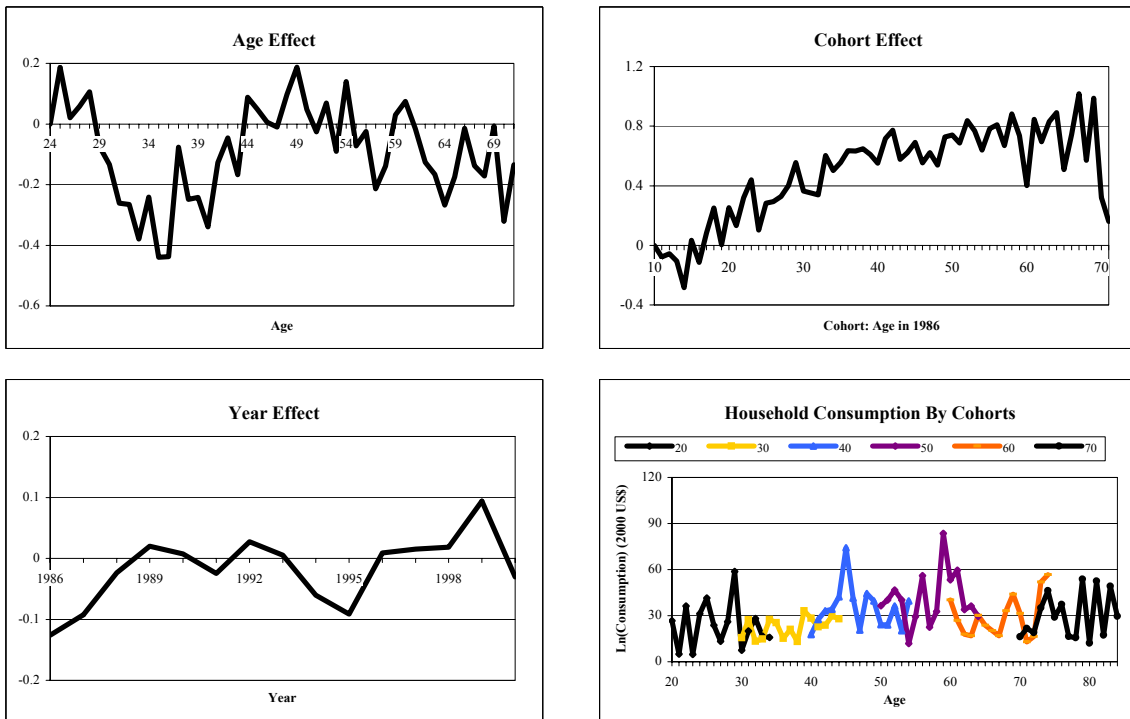


**Figure 3.9 Household Consumption by Cohorts and Decomposition, 1986 - 2000**  
**(Continued)**

**36, Prescription drugs, medicines, purchase and rental of medical supplies**

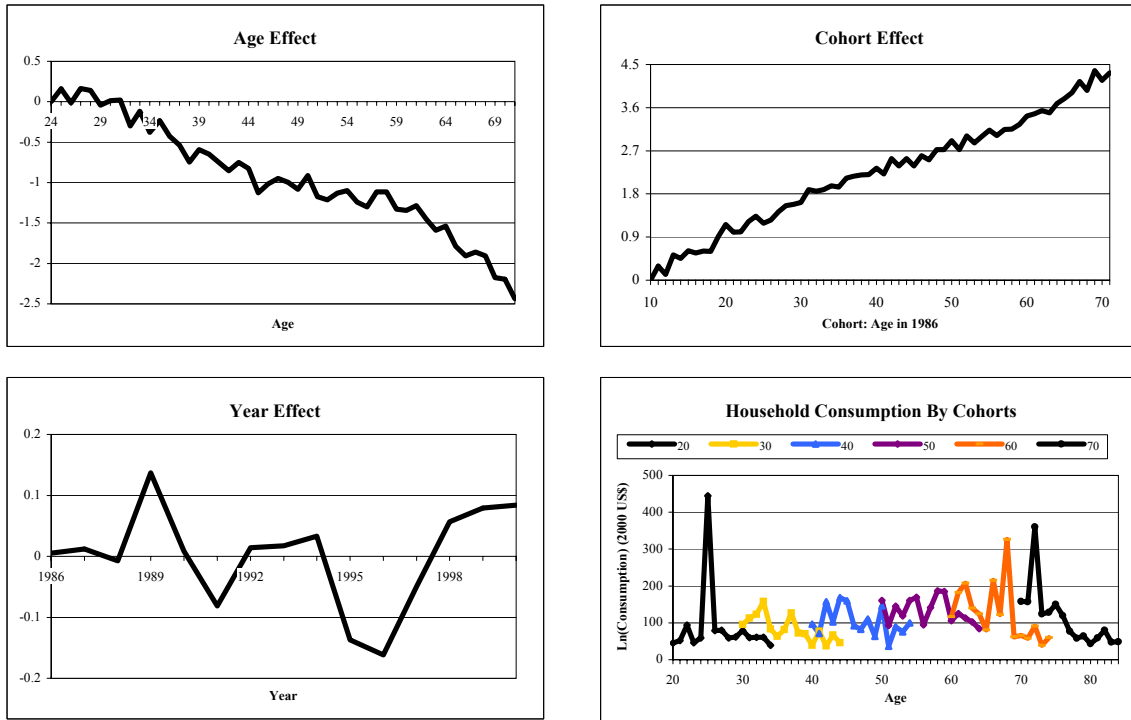


**37, Ophthalmic & orthopedic equipment**

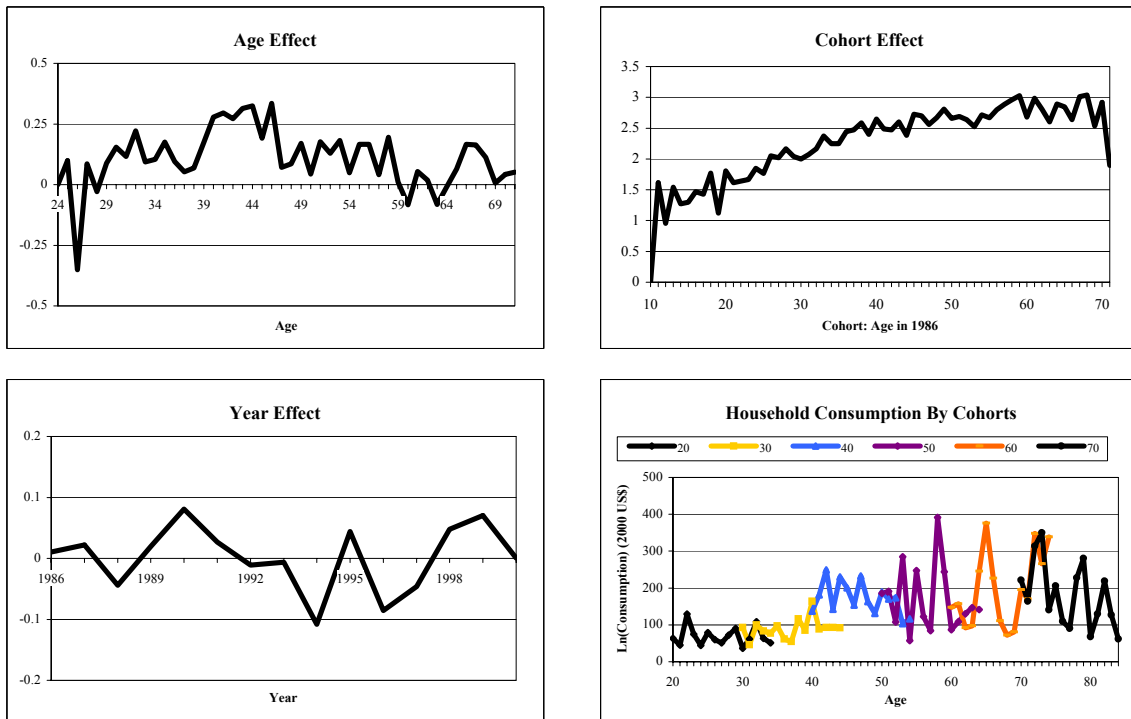


**Figure 3.9 Household Consumption by Cohorts and Decomposition, 1986 - 2000**  
**(Continued)**

**38, Physicians' services**

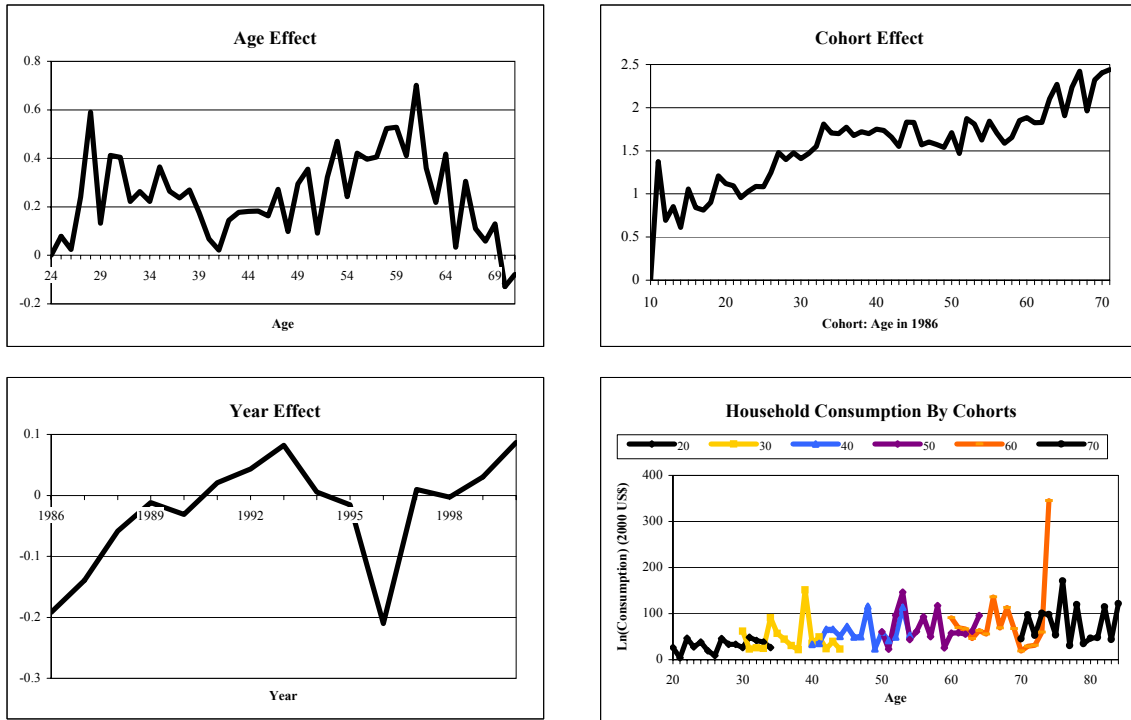


**39, Dental care**

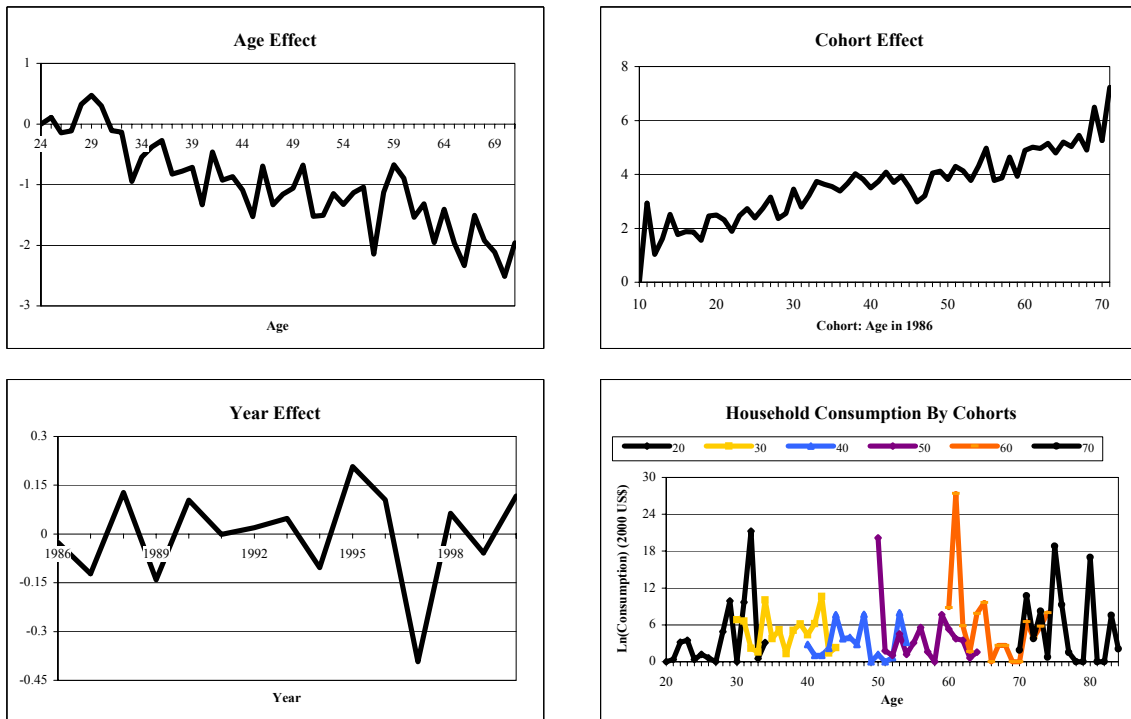


**Figure 3.9 Household Consumption by Cohorts and Decomposition, 1986 - 2000**  
**(Continued)**

**40, Other services by medical professionals**

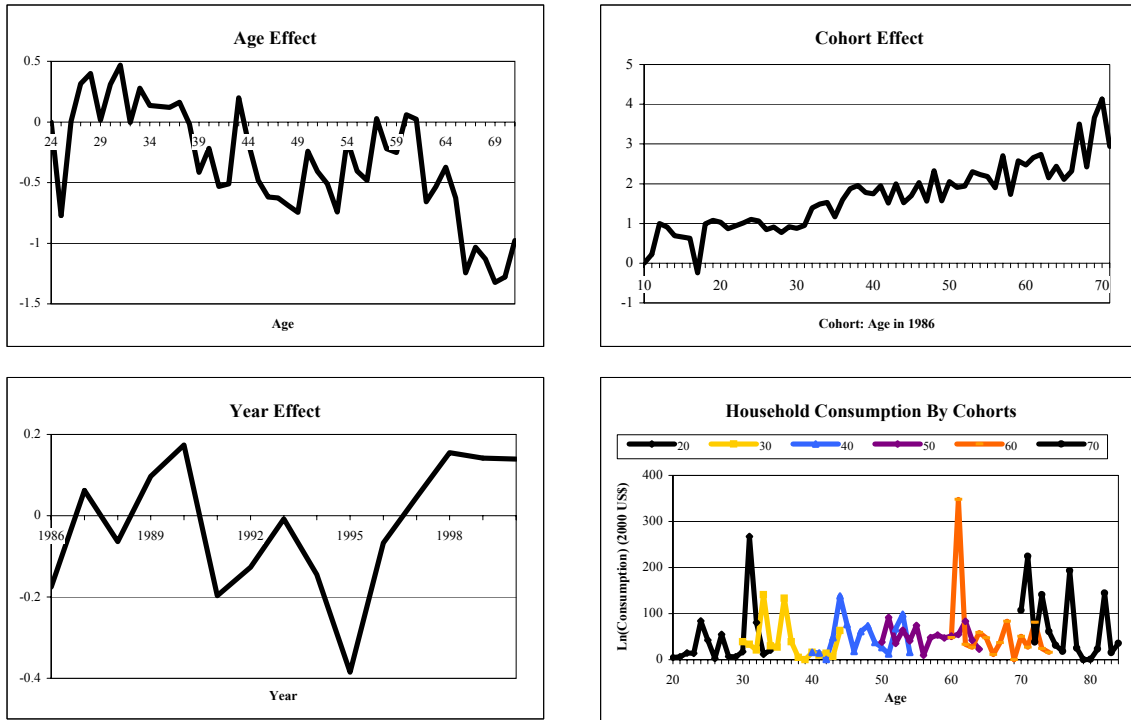


**41, Other medical care services and medical care in retirement communities**

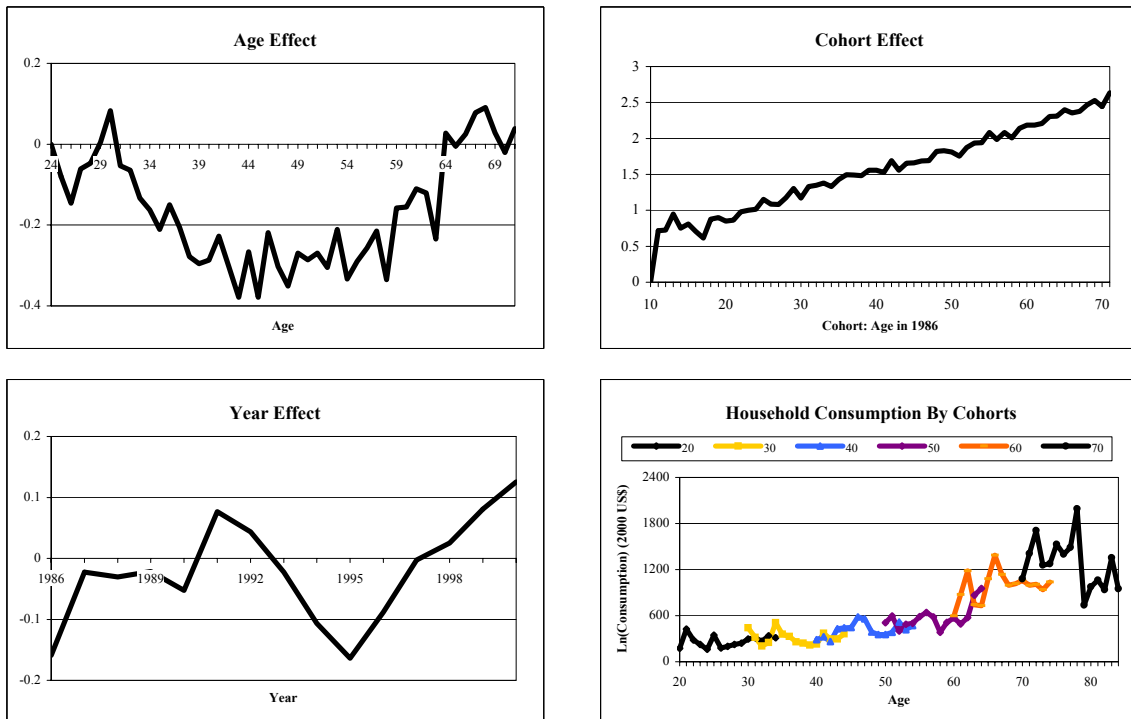


**Figure 3.9 Household Consumption by Cohorts and Decomposition, 1986 - 2000**  
**(Continued)**

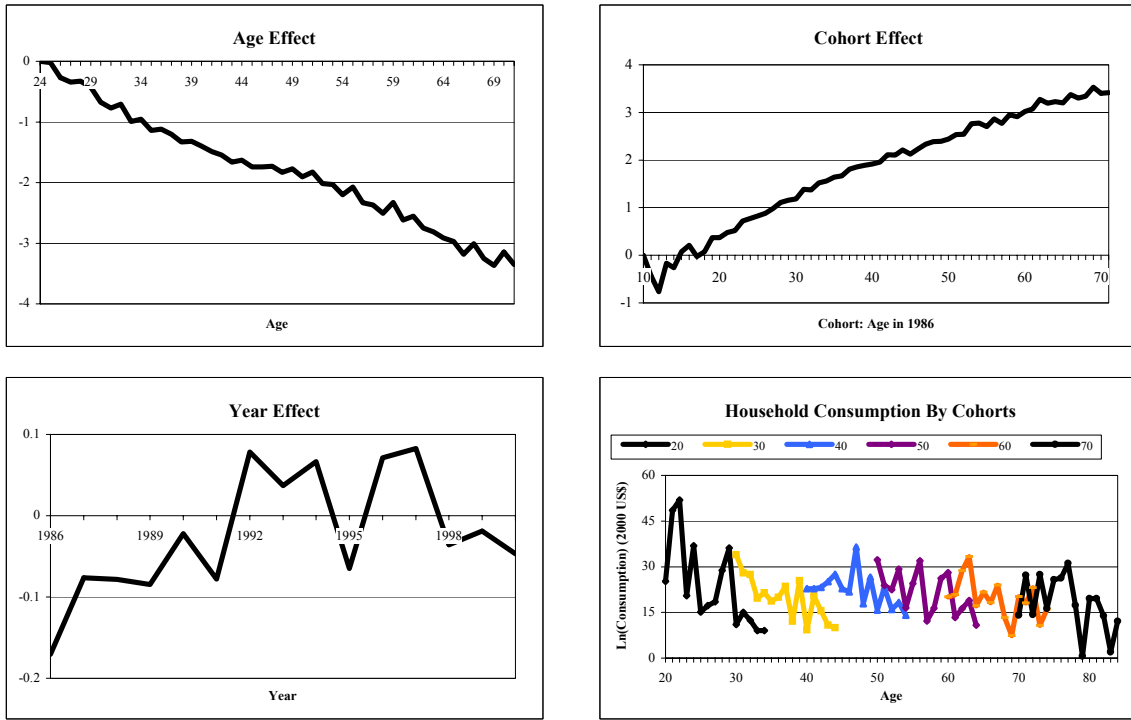
**42, Hospital room, meals, and services**



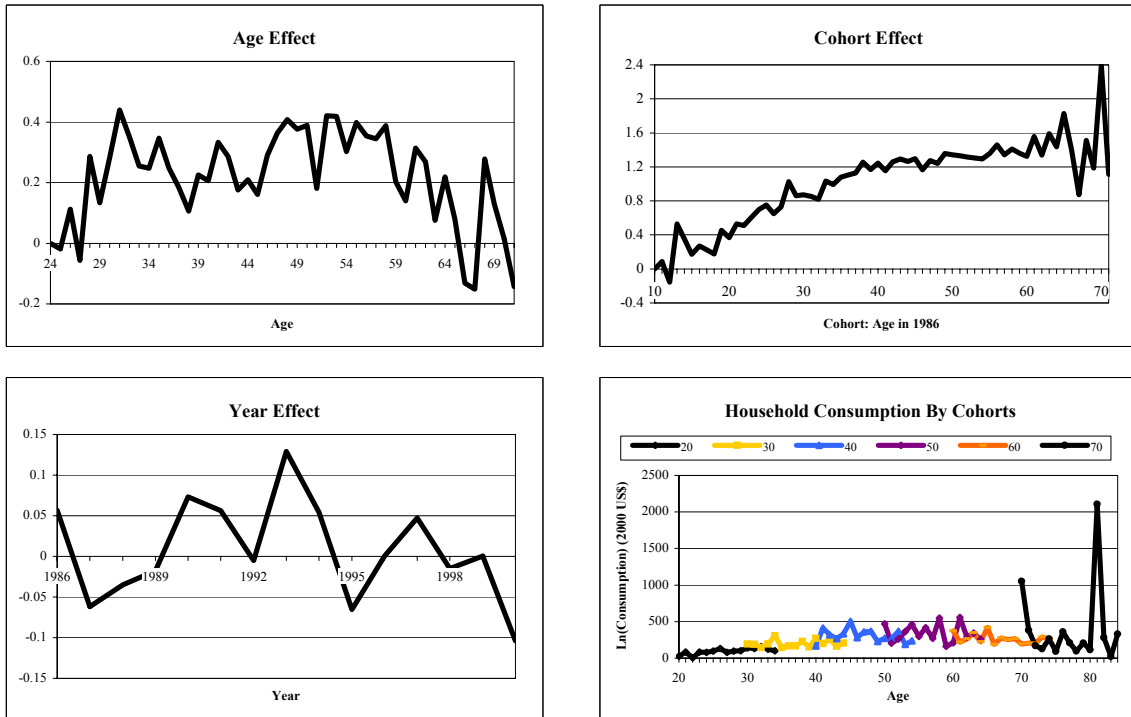
**44, Health insurance premiums**



**Figure 3.9 Household Consumption by Cohorts and Decomposition, 1986 - 2000**  
**(Continued)**  
**45, Banking services**

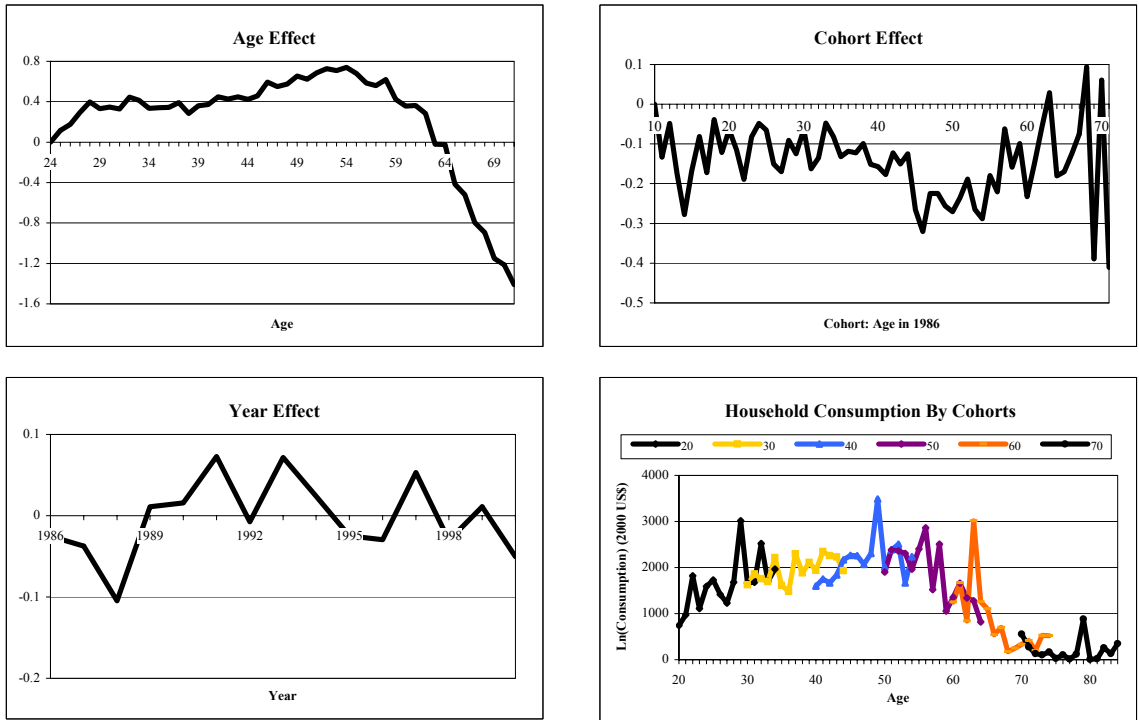


**46, Life and other personal insurance**

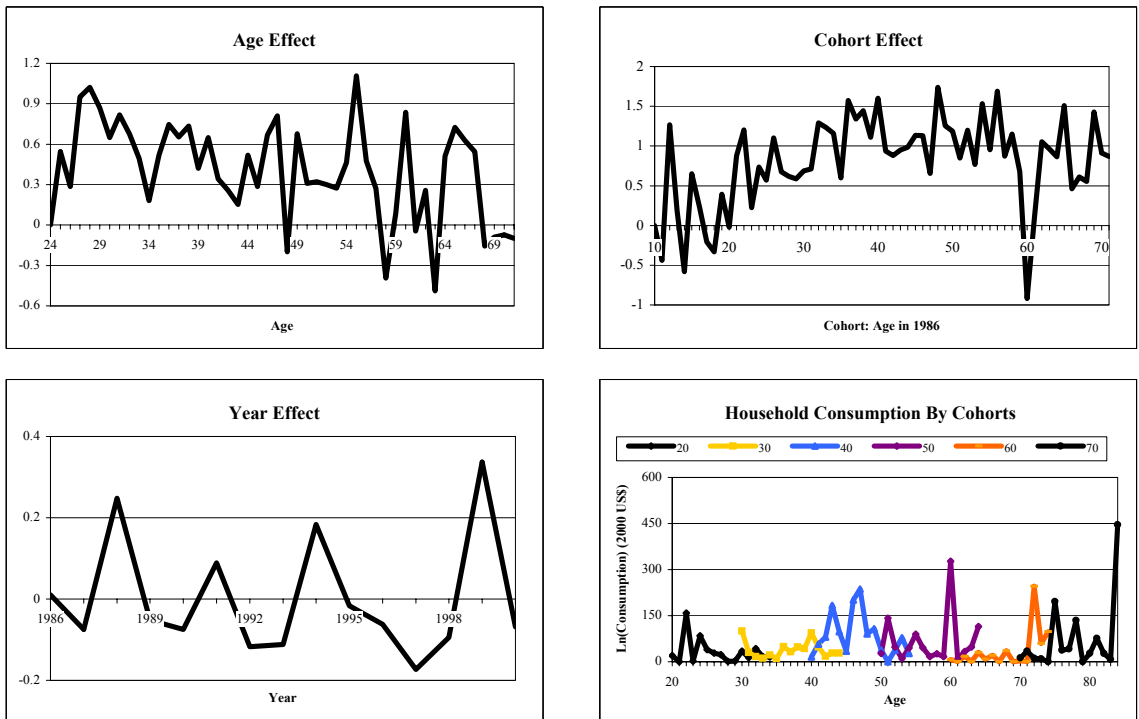


**Figure 3.9 Household Consumption by Cohorts and Decomposition, 1986 - 2000**  
**(Continued)**

**47, Contribution to retirement, pension, social security**

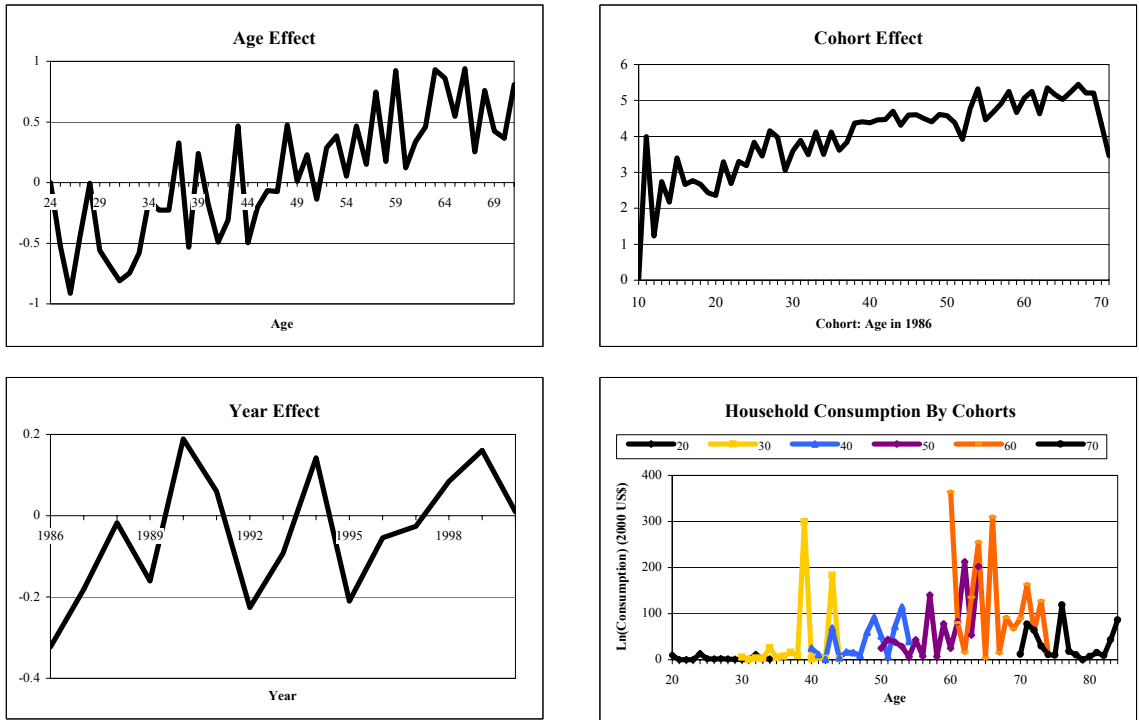


**48, Legal fees**

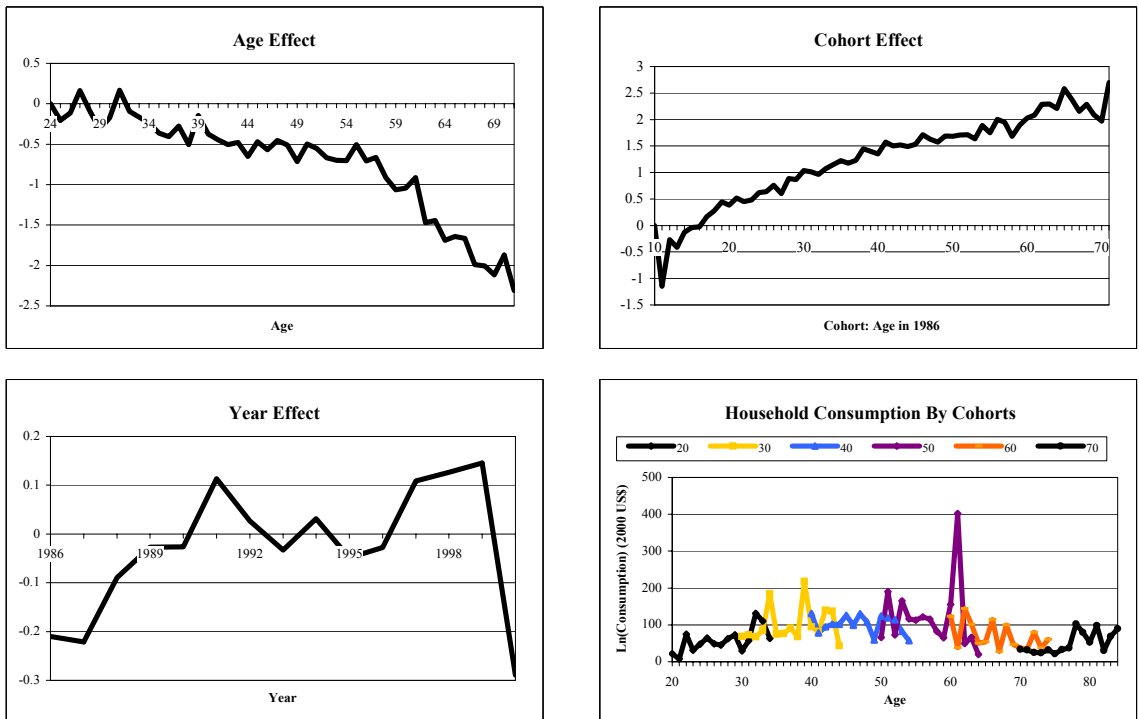


**Figure 3.9 Household Consumption by Cohorts and Decomposition, 1986 - 2000**  
**(Continued)**

**49, Funeral and burial services**



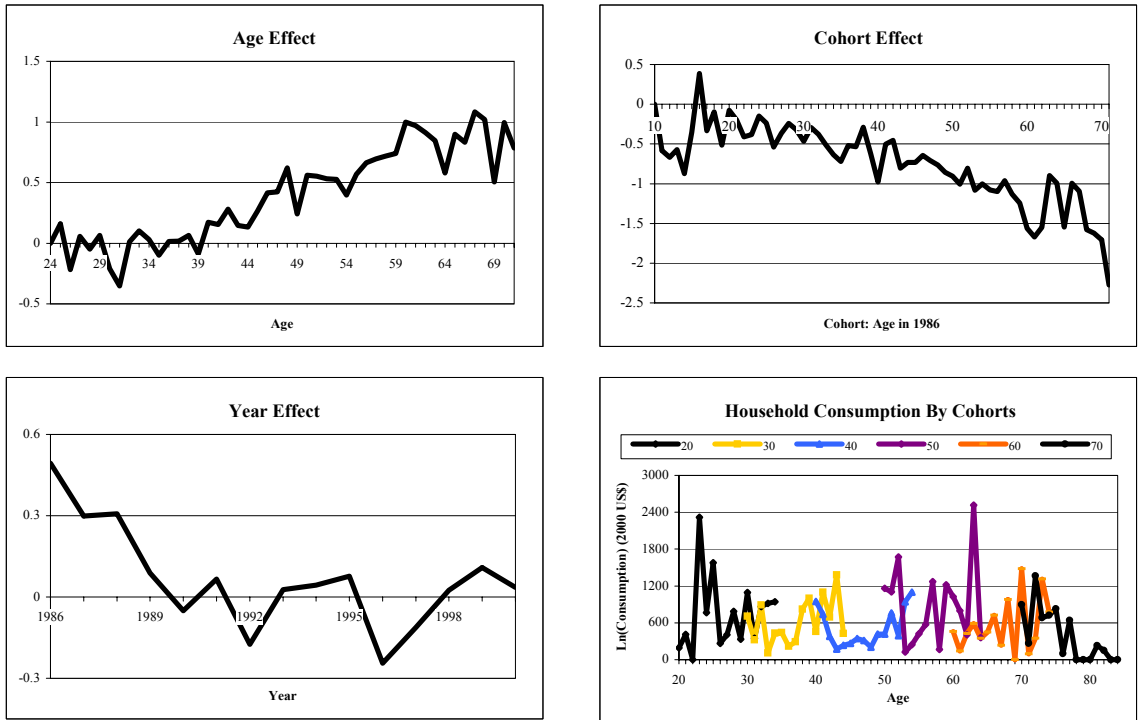
**50, Other personal business**



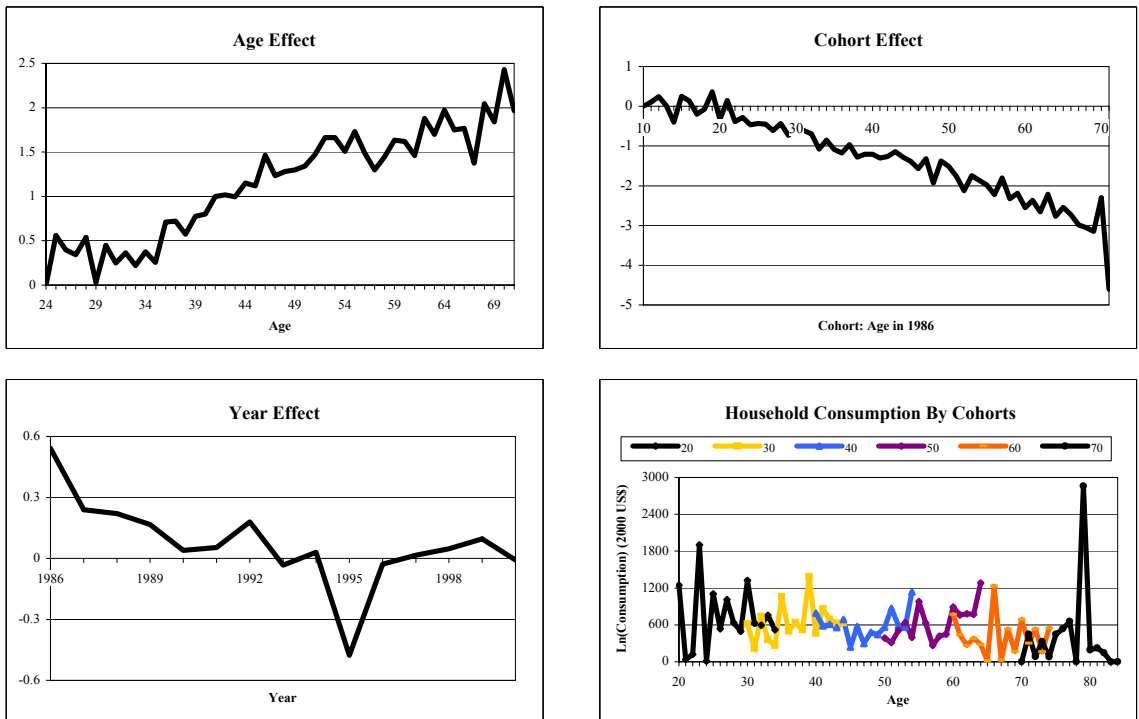


**Figure 3.9 Household Consumption by Cohorts and Decomposition, 1986 - 2000**  
**(Continued)**

**51, New cars and trucks**

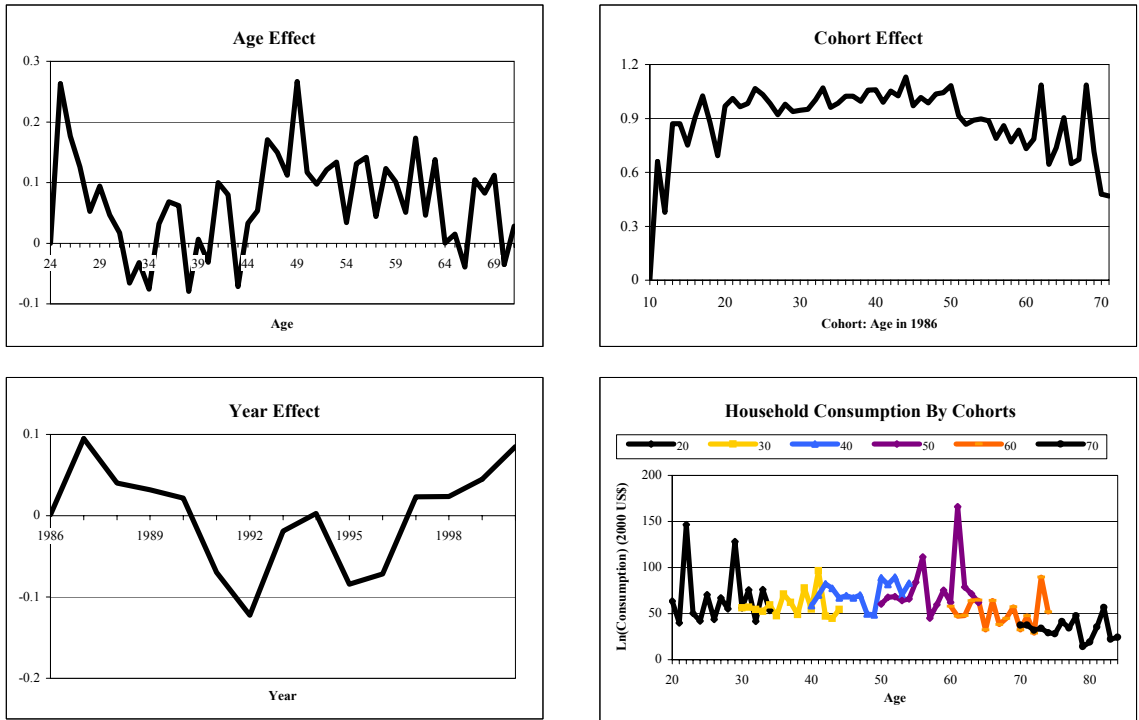


**52, Used cars and trucks**

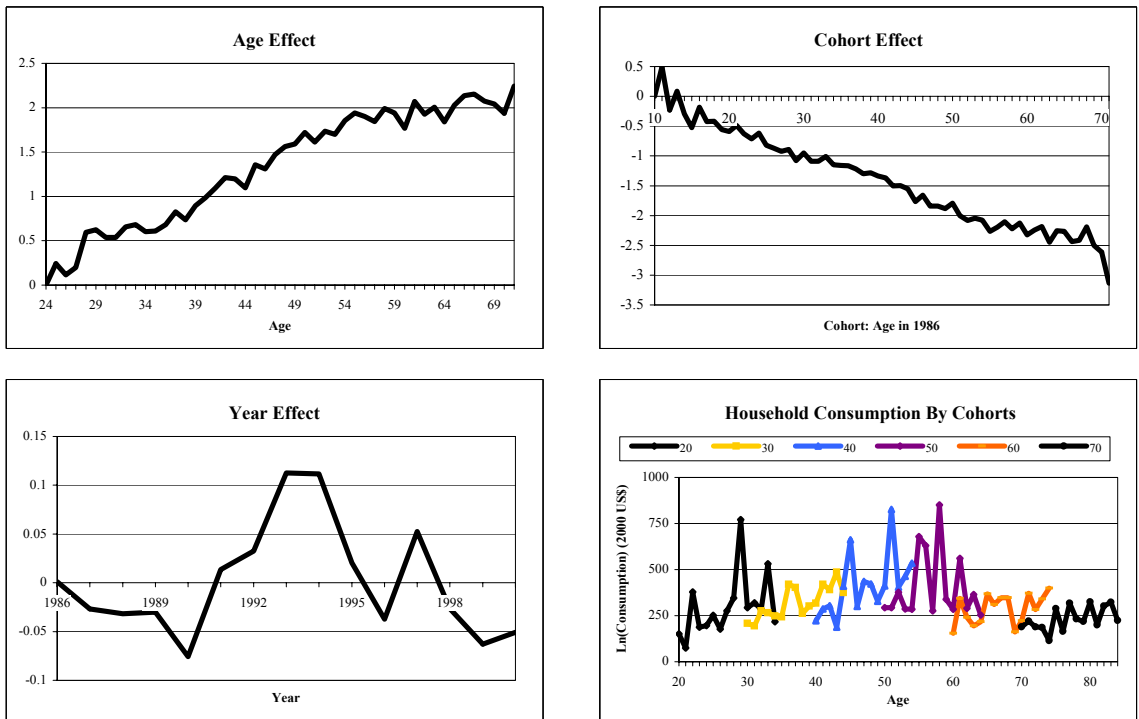


**Figure 3.9 Household Consumption by Cohorts and Decomposition, 1986 - 2000**  
**(Continued)**

**54, Tires and tubes, accessories, and parts**

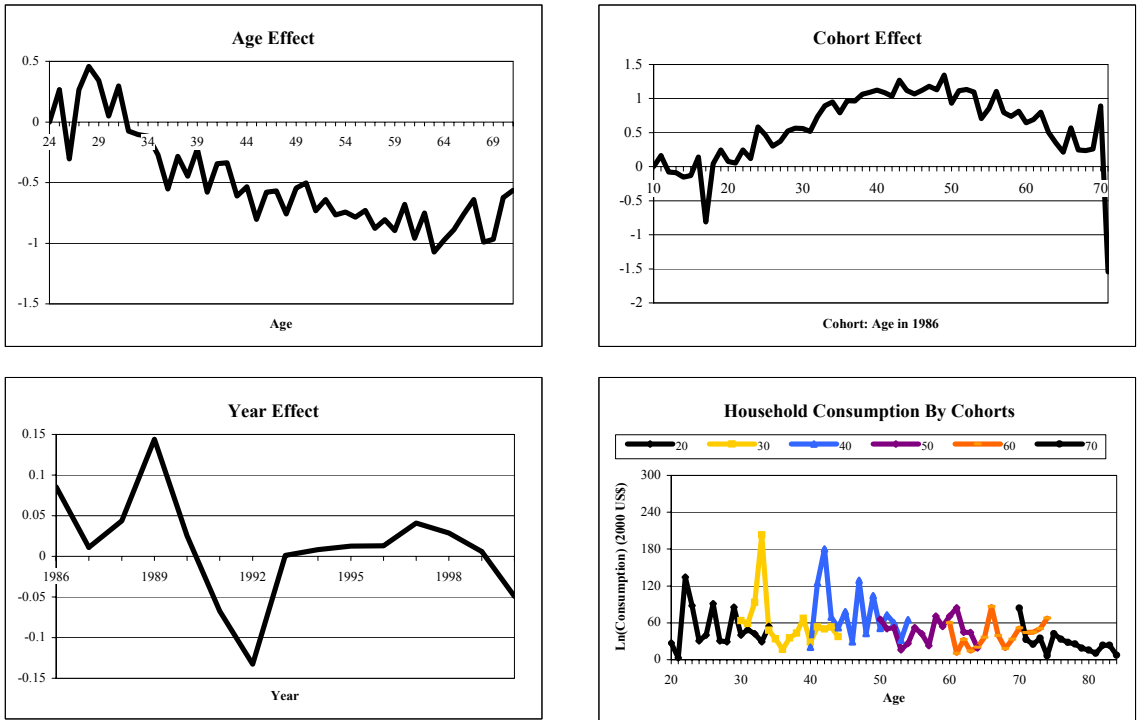


**55, Maintenance and repairs of vehicles**

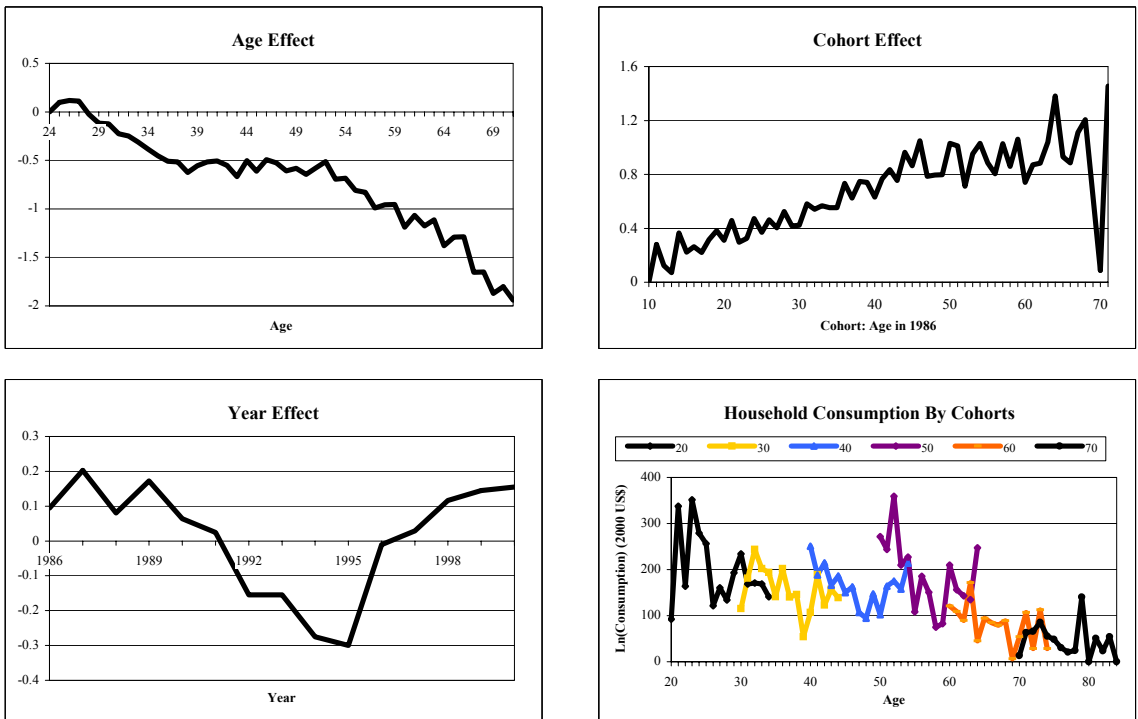


**Figure 3.9 Household Consumption by Cohorts and Decomposition, 1986 - 2000**  
**(Continued)**

**56, Vehicle rental and other charges**

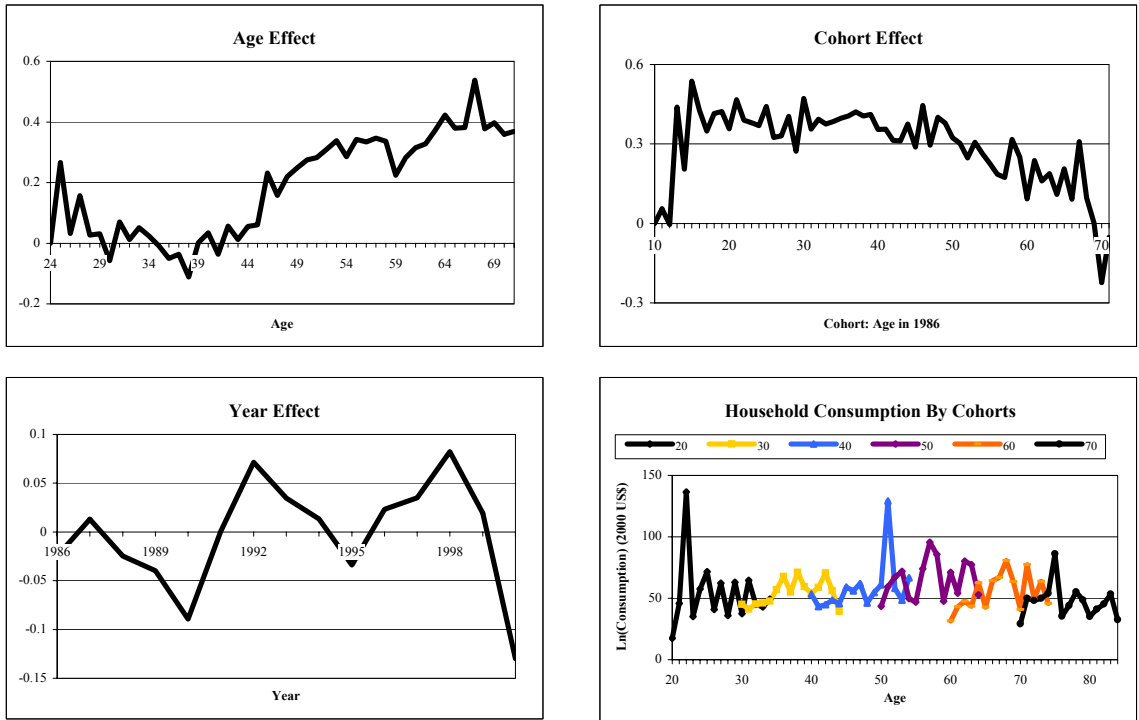


**57, Vehicle financial charge**

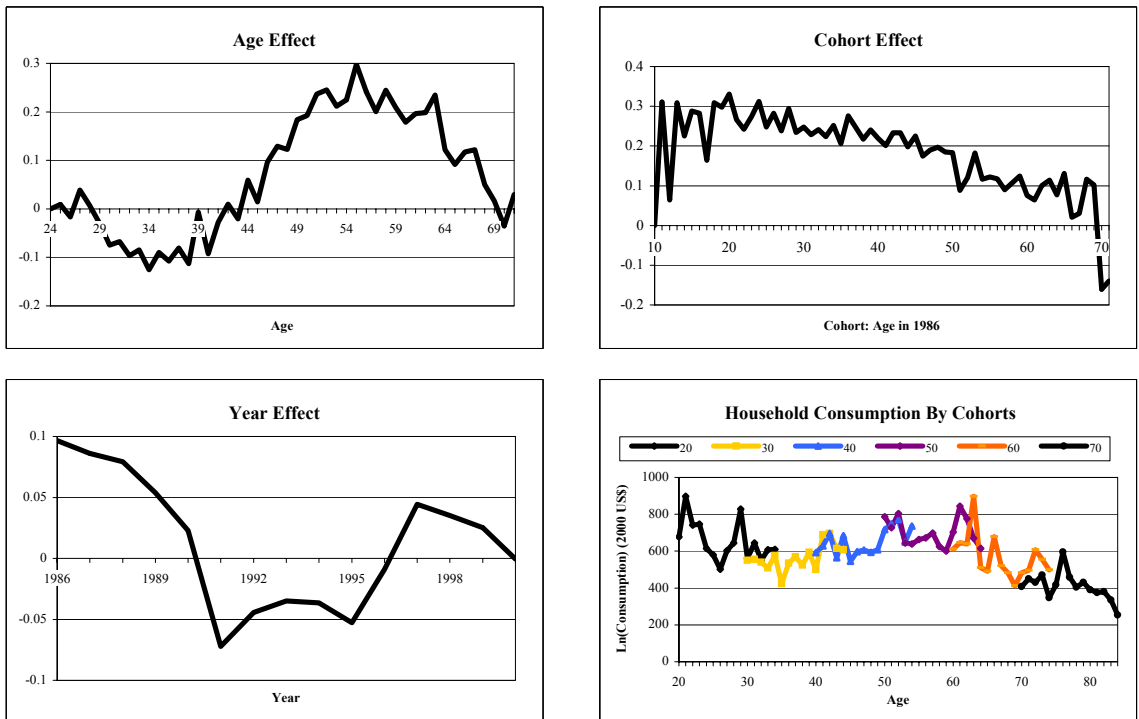


**Figure 3.9 Household Consumption by Cohorts and Decomposition, 1986 - 2000**  
**(Continued)**

**58, Vehicle license and registration**

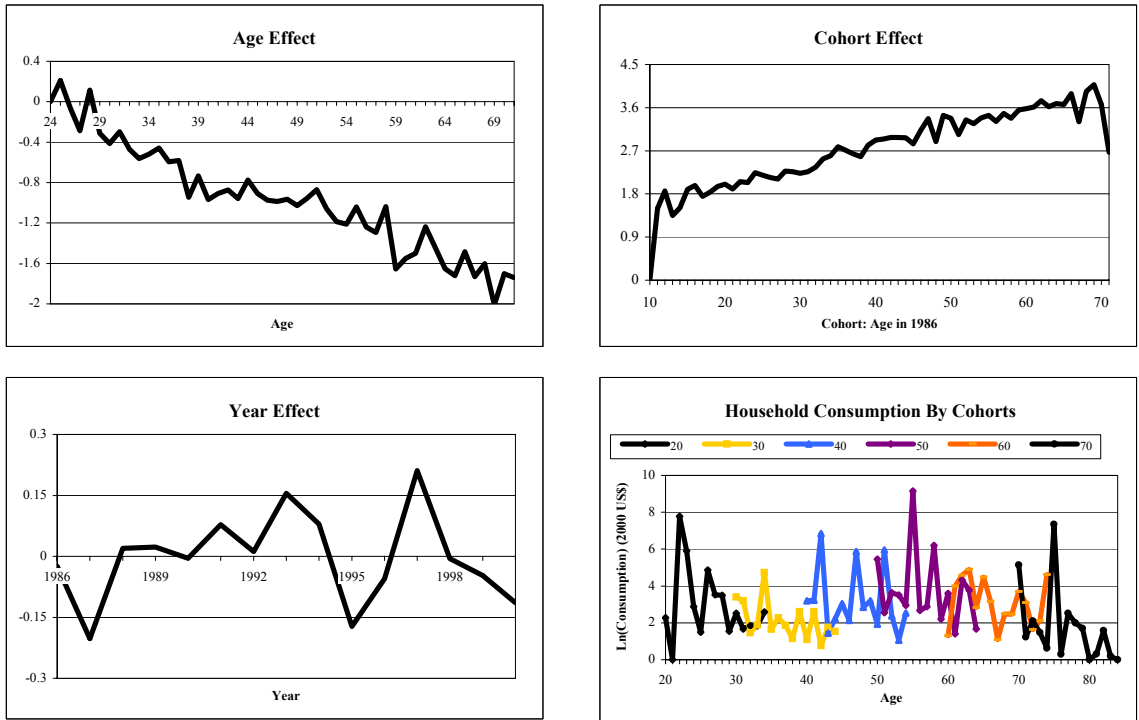


**59, Gasoline and motor oil**

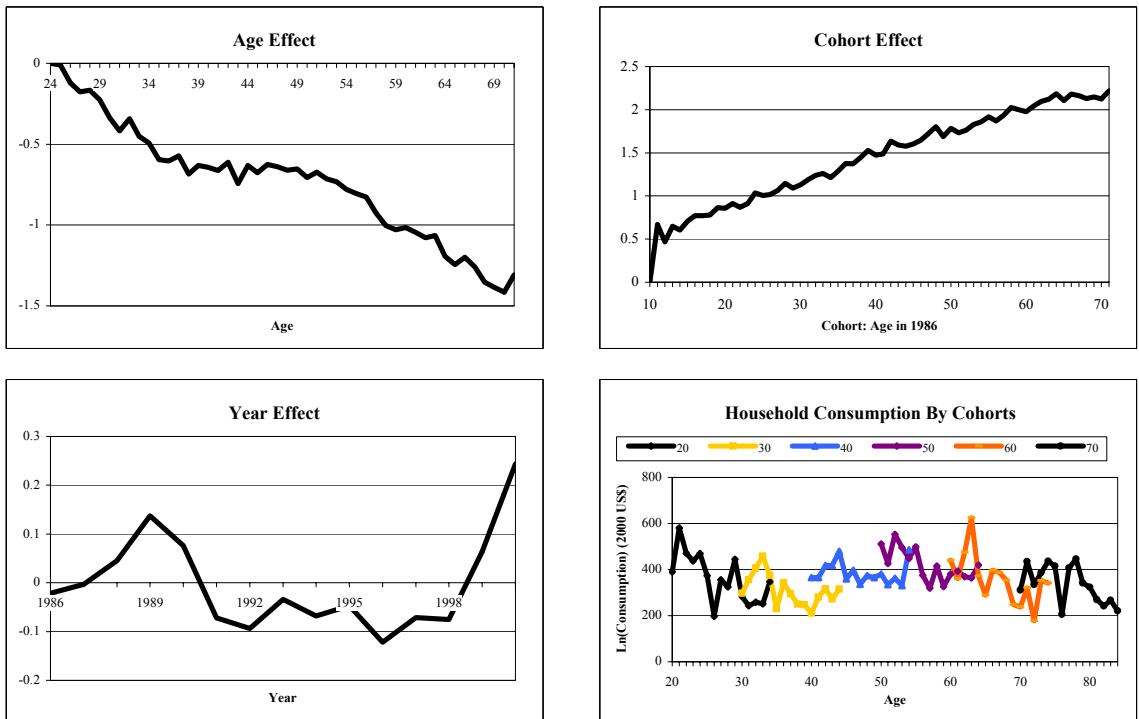


**Figure 3.9 Household Consumption by Cohorts and Decomposition, 1986 - 2000**  
**(Continued)**

**60, Tolls on out-of-town trips**

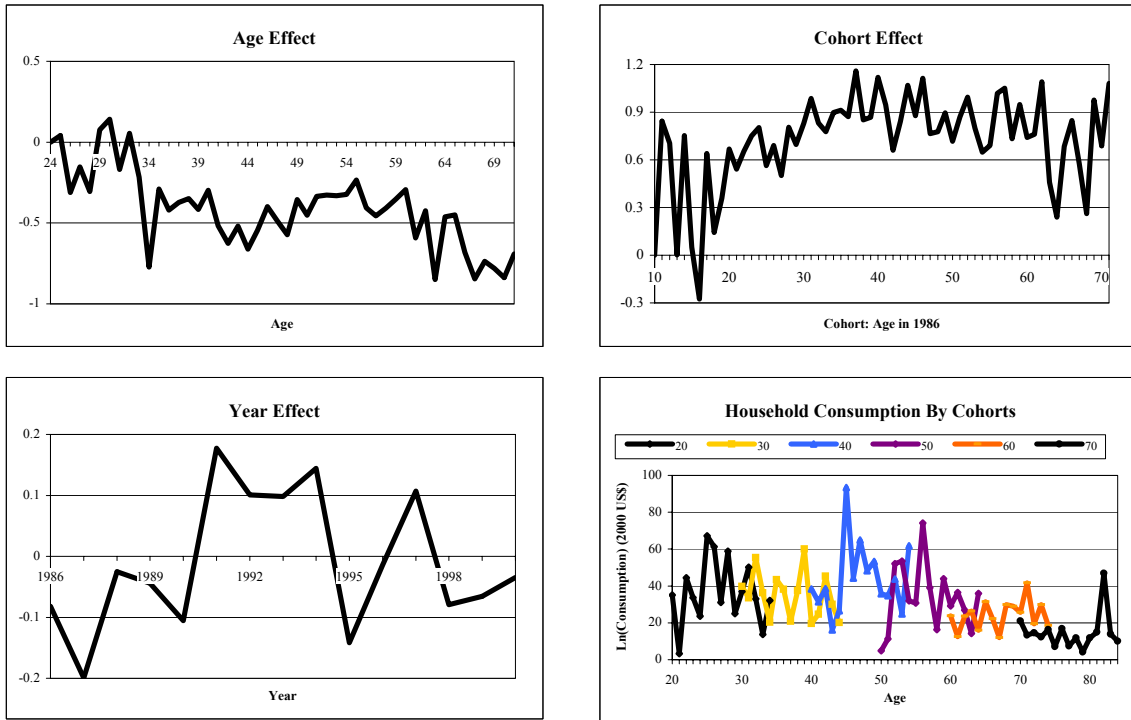


**61, Vehicle insurance**

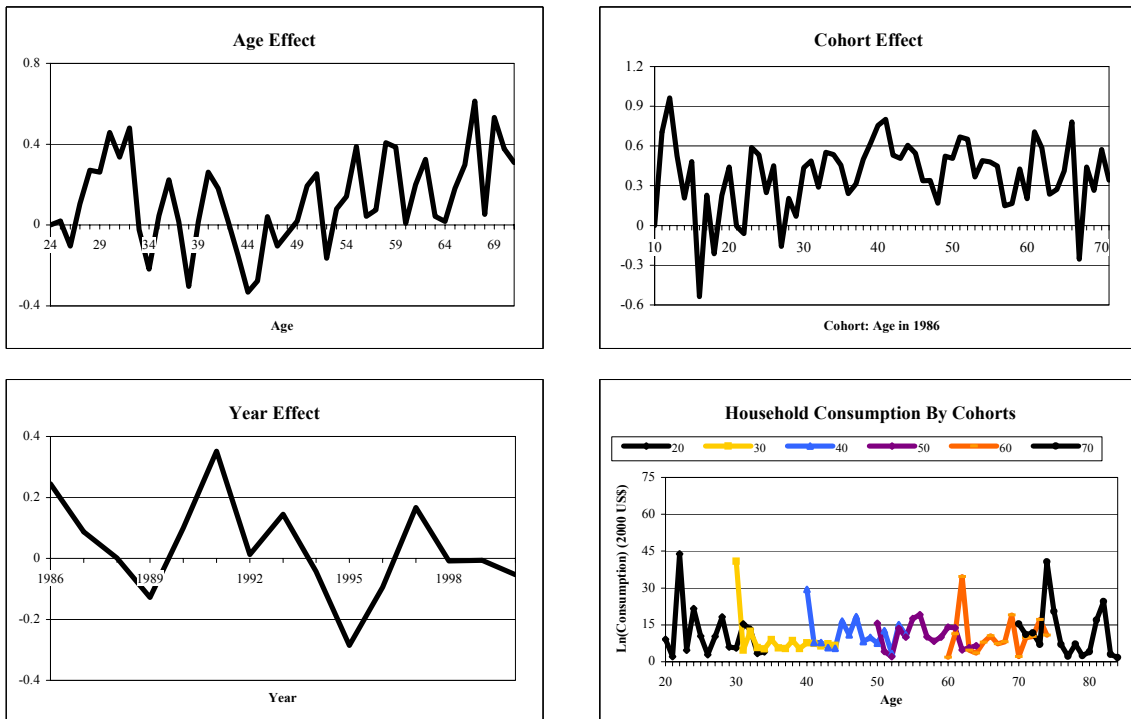


**Figure 3.9 Household Consumption by Cohorts and Decomposition, 1986 - 2000**  
**(Continued)**

**62, Local transportation (excl. taxis)**

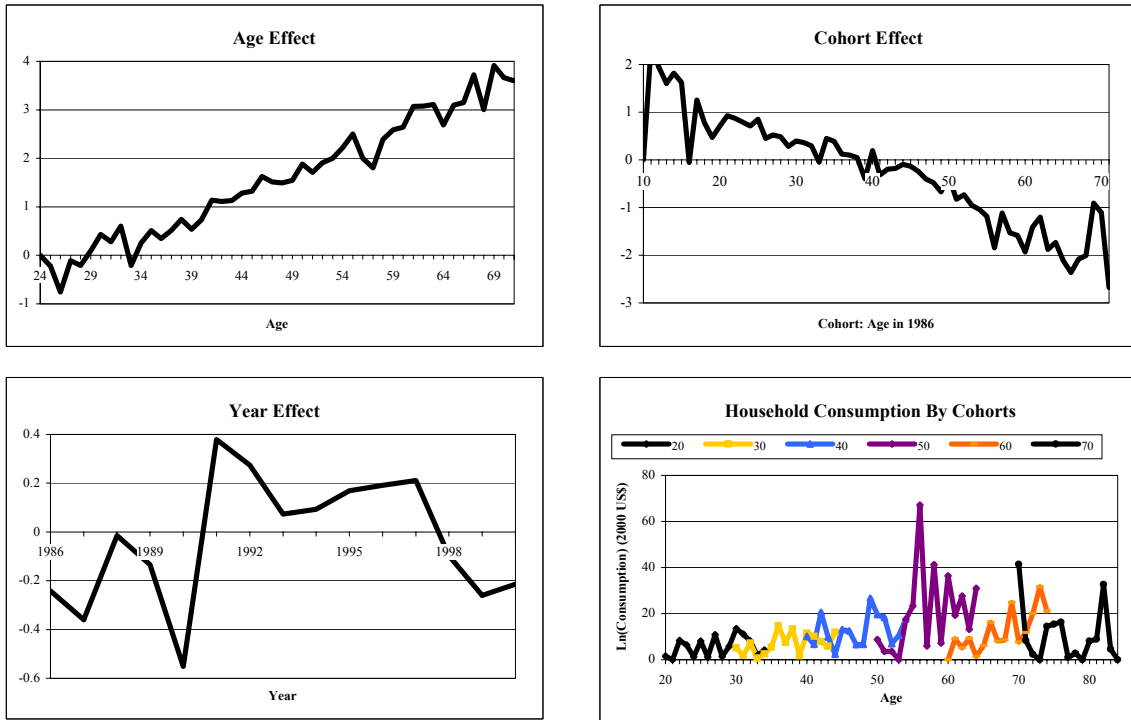


**63, Taxis**

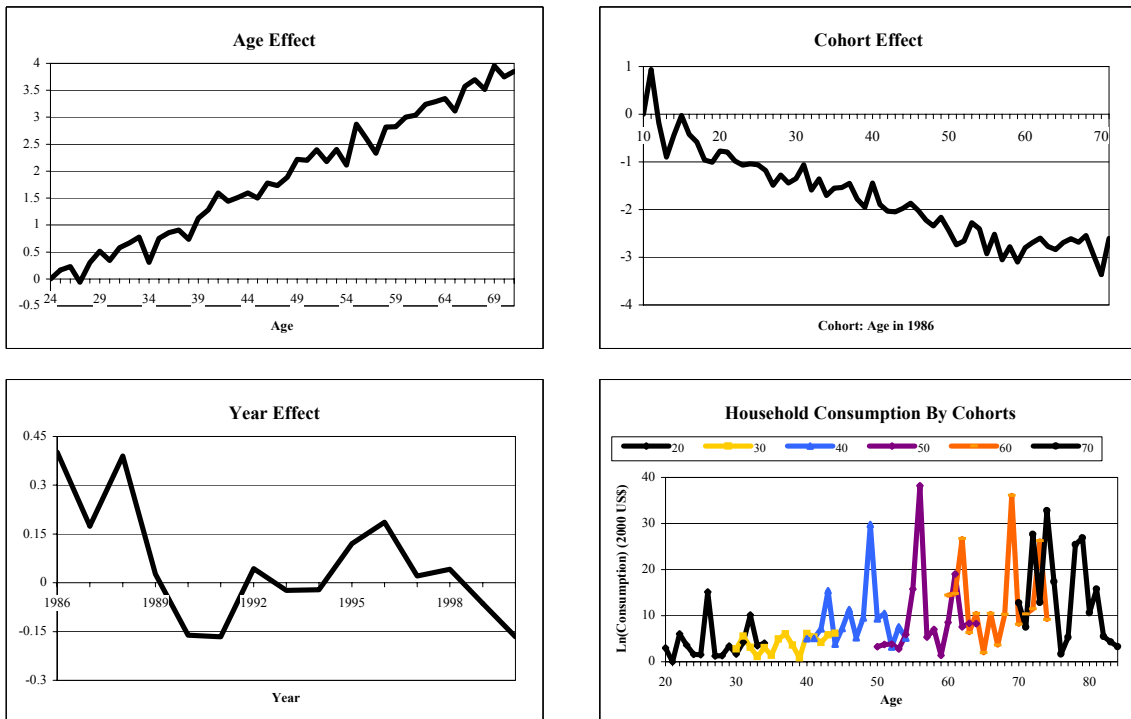


**Figure 3.9 Household Consumption by Cohorts and Decomposition, 1986 - 2000**  
**(Continued)**

**64, Intercity train fares on out-of-town trips**

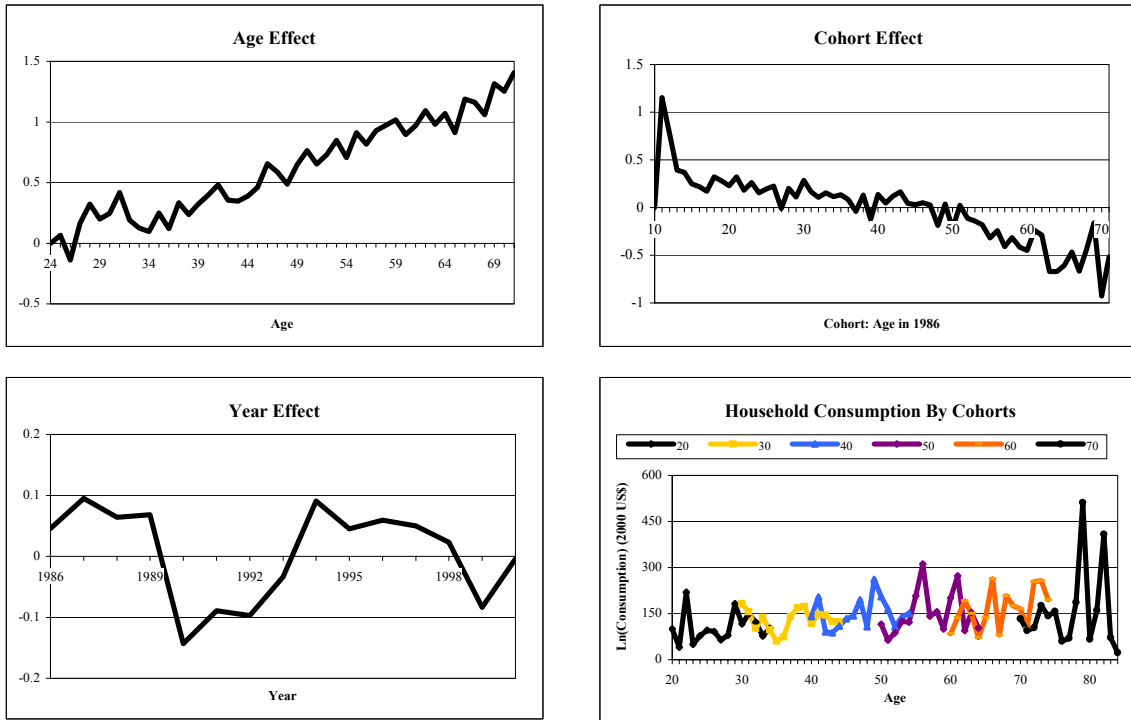


**65, Intercity bus fares on out-of-town trips**

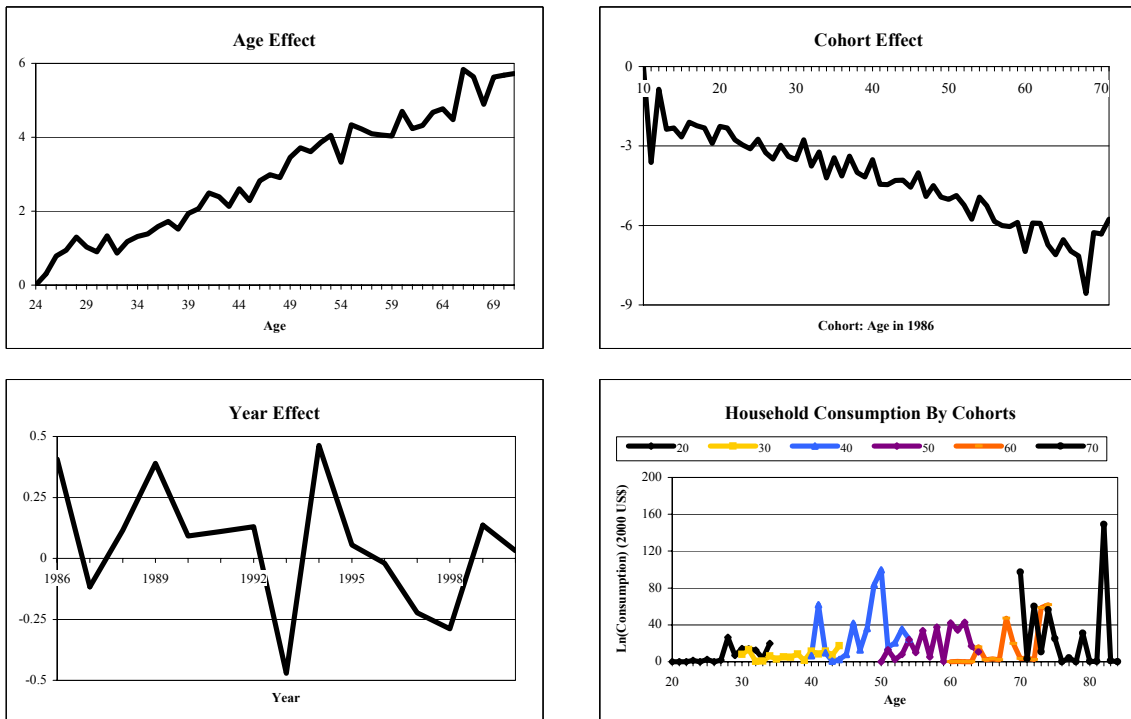


**Figure 3.9 Household Consumption by Cohorts and Decomposition, 1986 - 2000**  
**(Continued)**

**66, Airline fares on out-of-town trips**

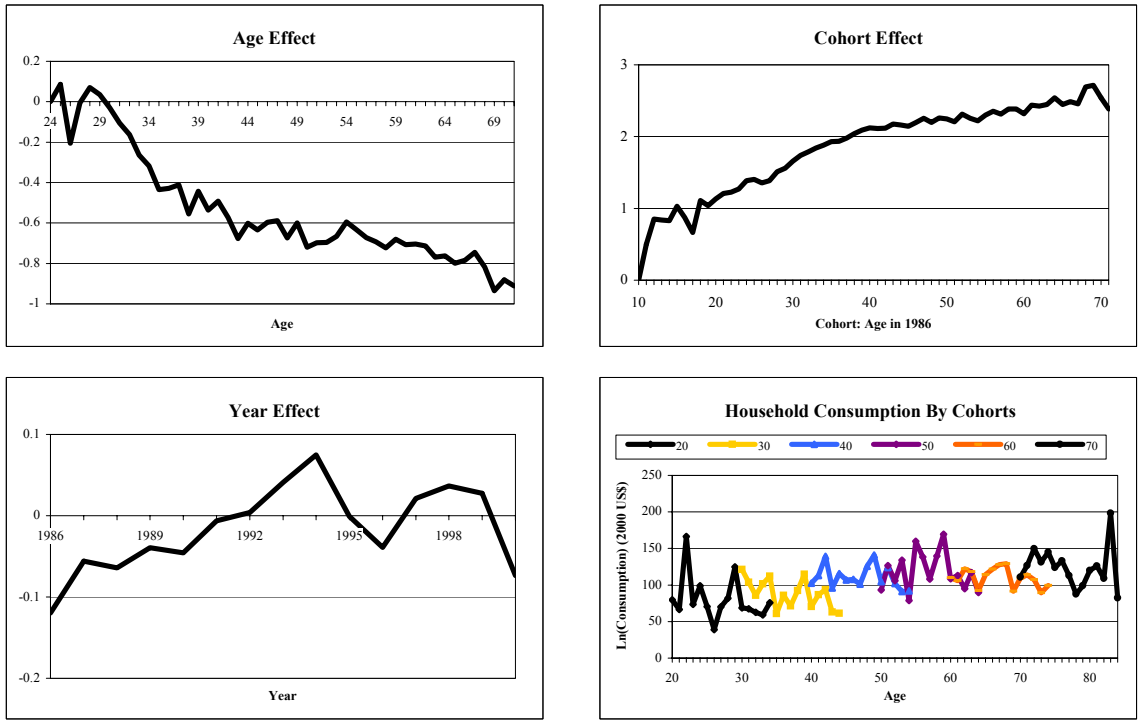


**67, Ship fares on out-of-town trips**

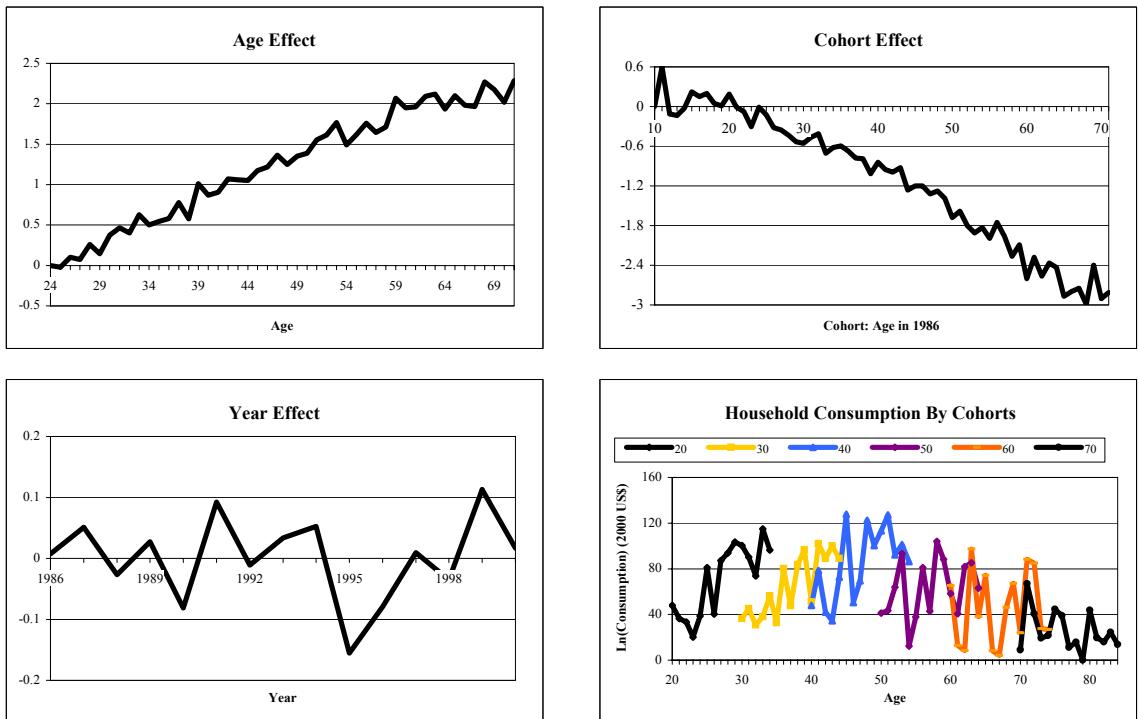




**Figure 3.9 Household Consumption by Cohorts and Decomposition, 1986 - 2000**  
**(Continued)**  
**68, Readings**

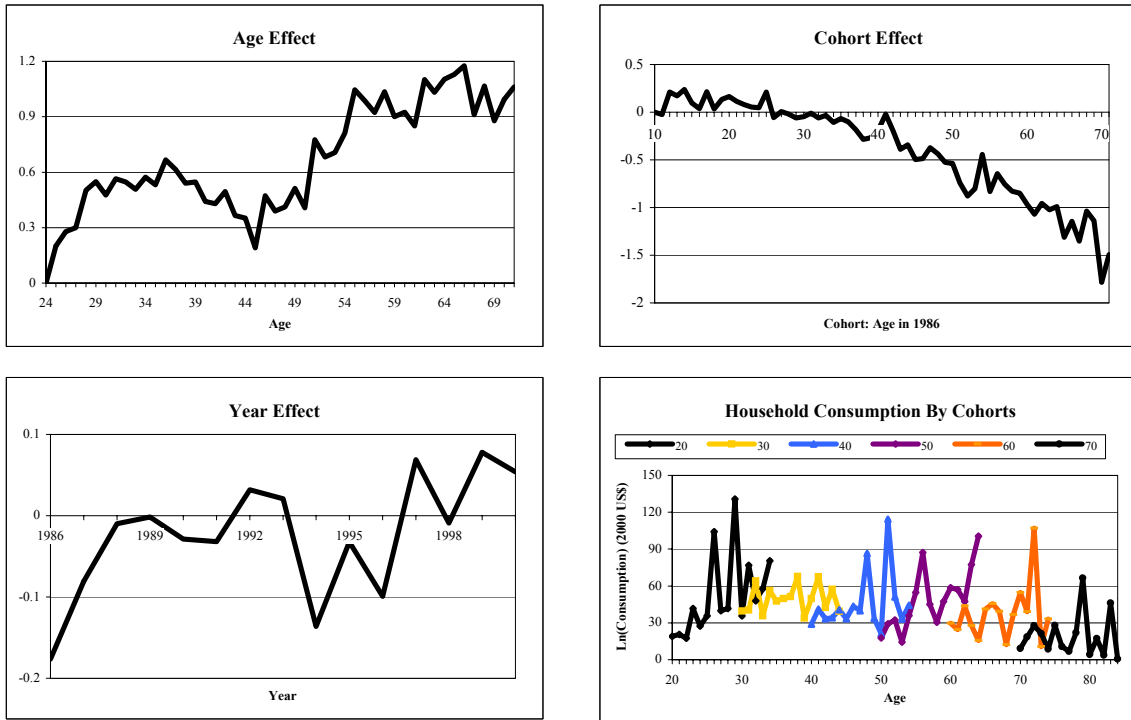


**69, Pets, pets supplies, and pet services**

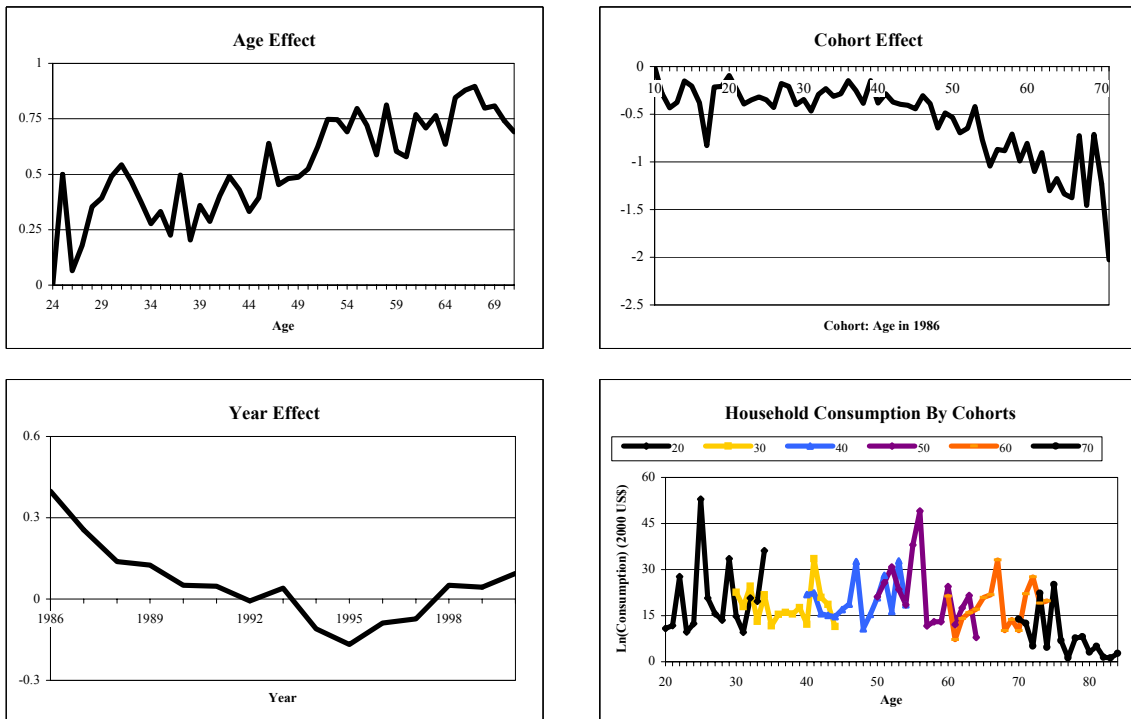


**Figure 3.9 Household Consumption by Cohorts and Decomposition, 1986 - 2000**  
**(Continued)**

**70, Toys and playground equipment**

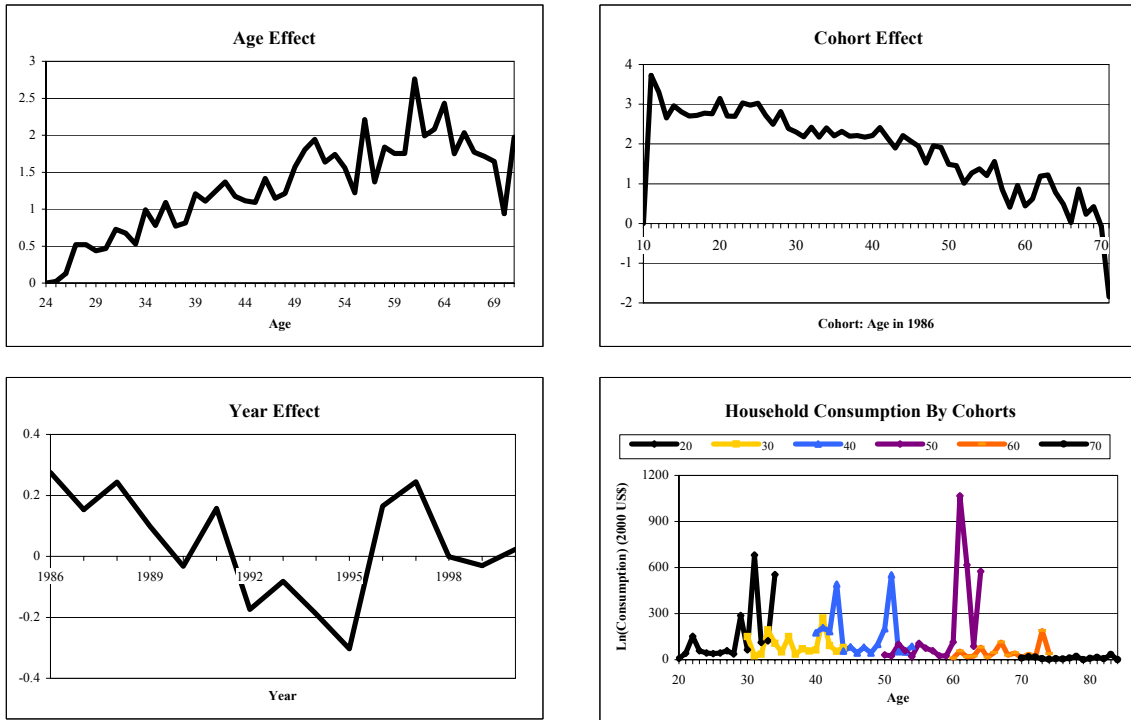


**72, Cameras and films**

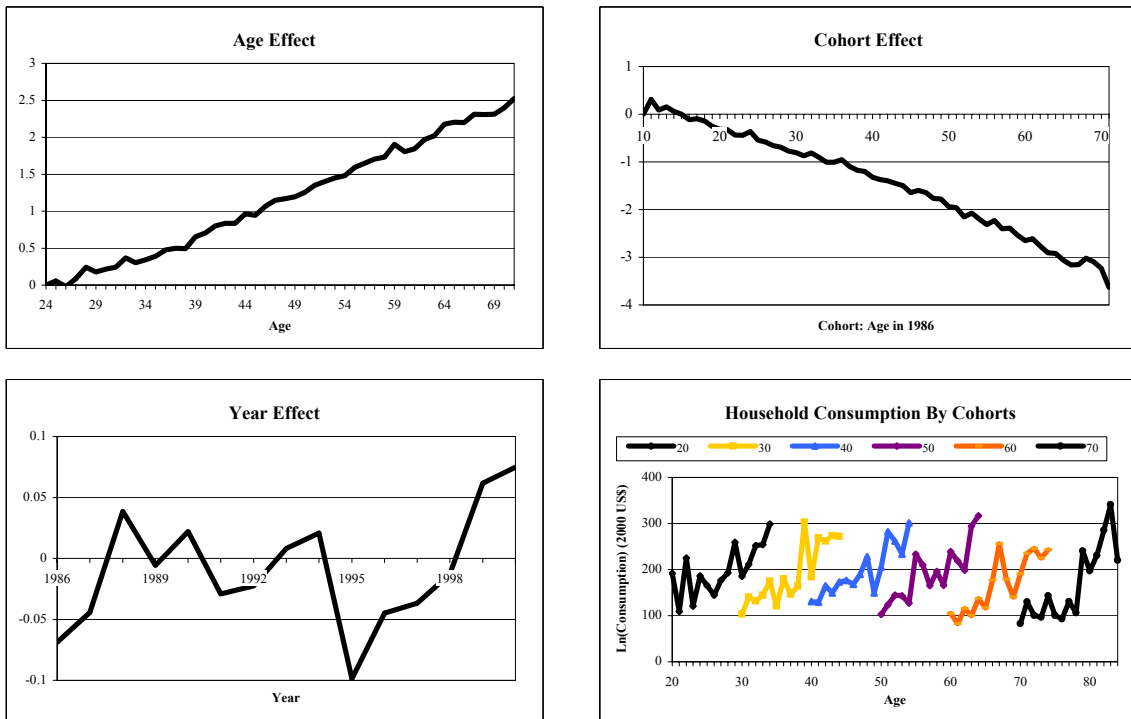


**Figure 3.9 Household Consumption by Cohorts and Decomposition, 1986 - 2000**  
**(Continued)**

**73, Guns, ammunition, sporting equipment, boats and aircrafts**

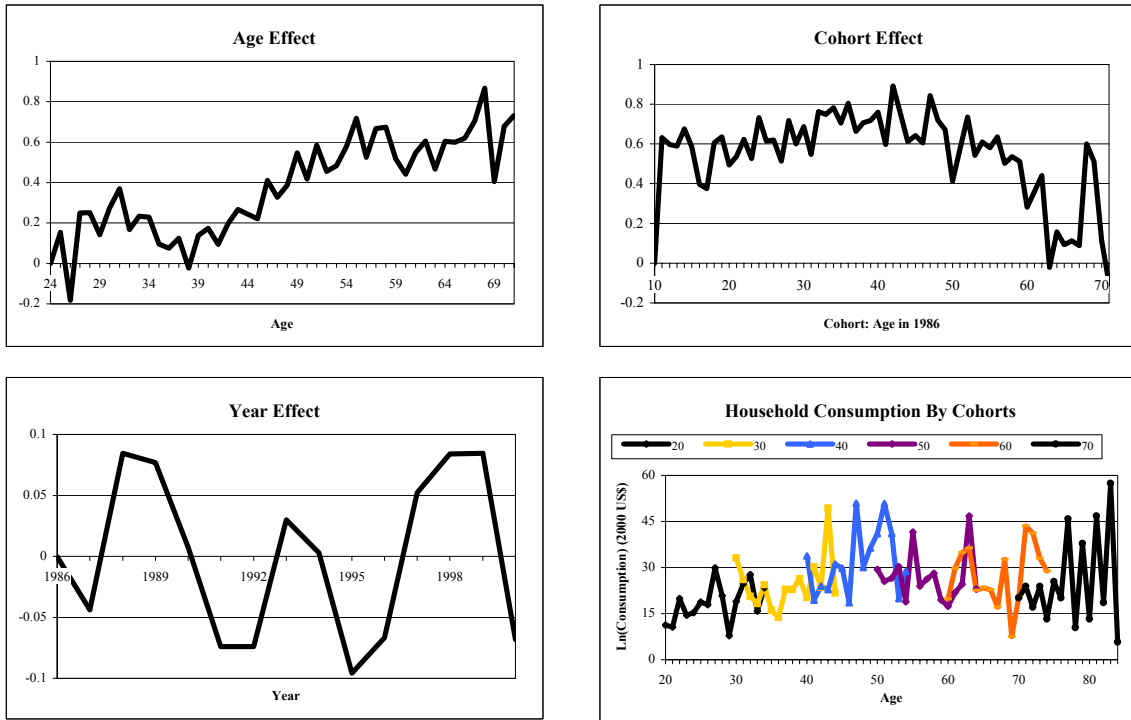


**74, Televisions, radios, and sound equipment**

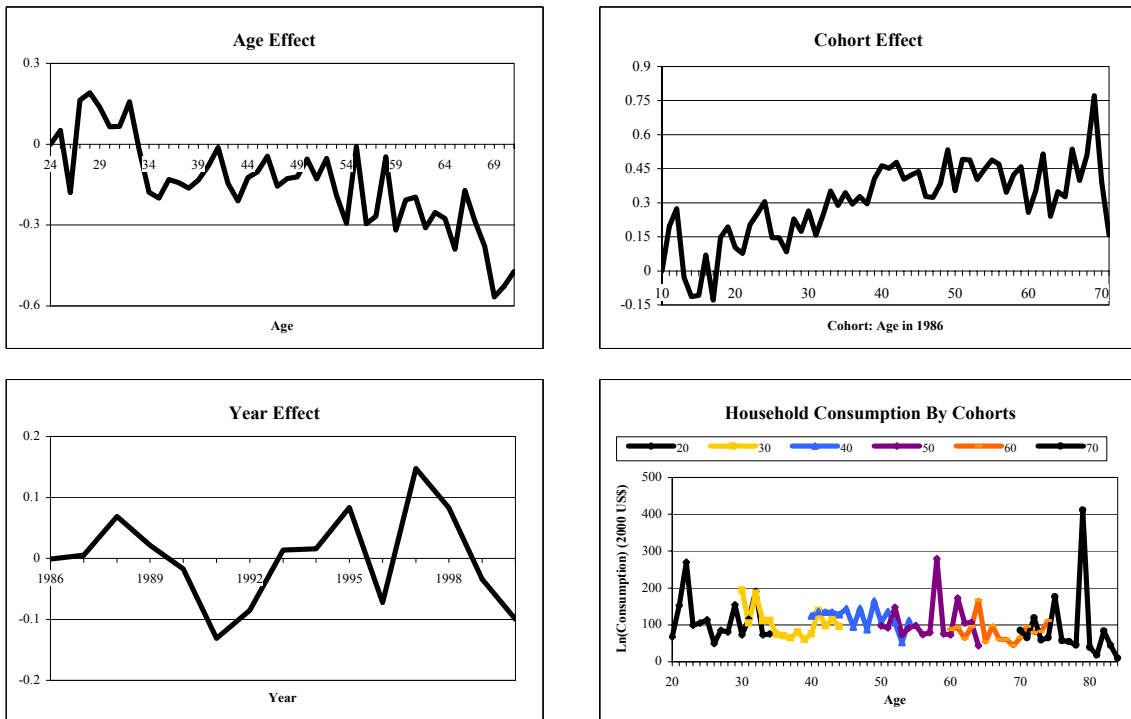


**Figure 3.9 Household Consumption by Cohorts and Decomposition, 1986 - 2000**  
**(Continued)**

**76, Fresh flower or potted plants**

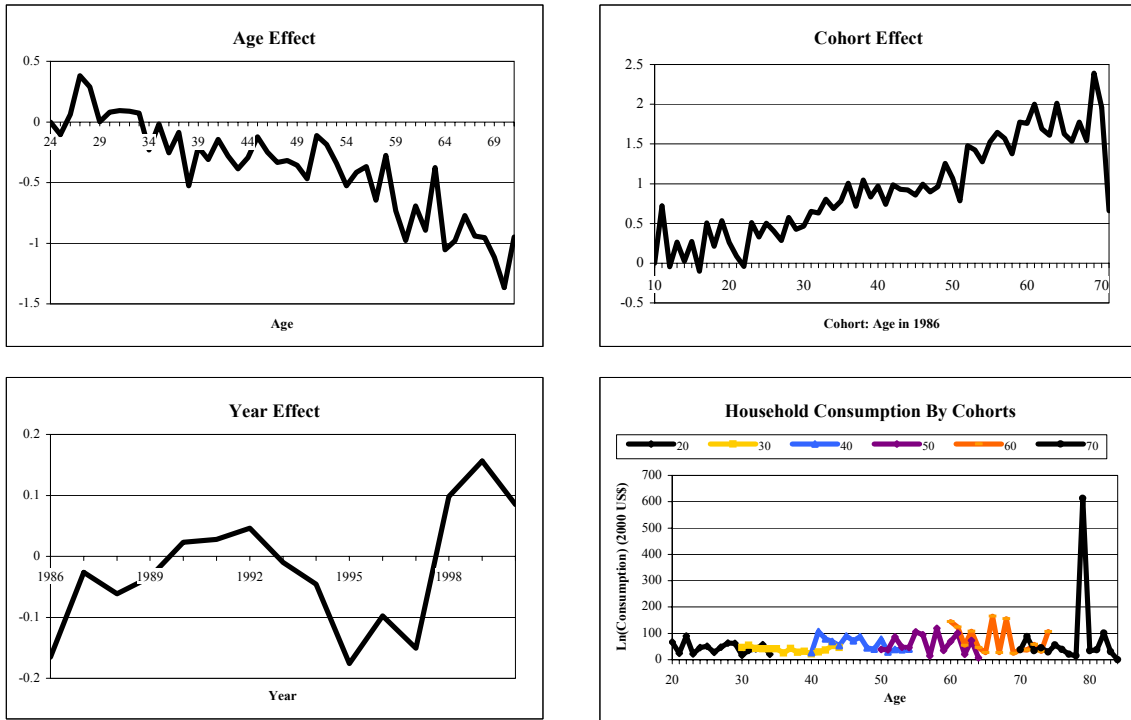


**77, Live entertainment, sports, and movie admissions**

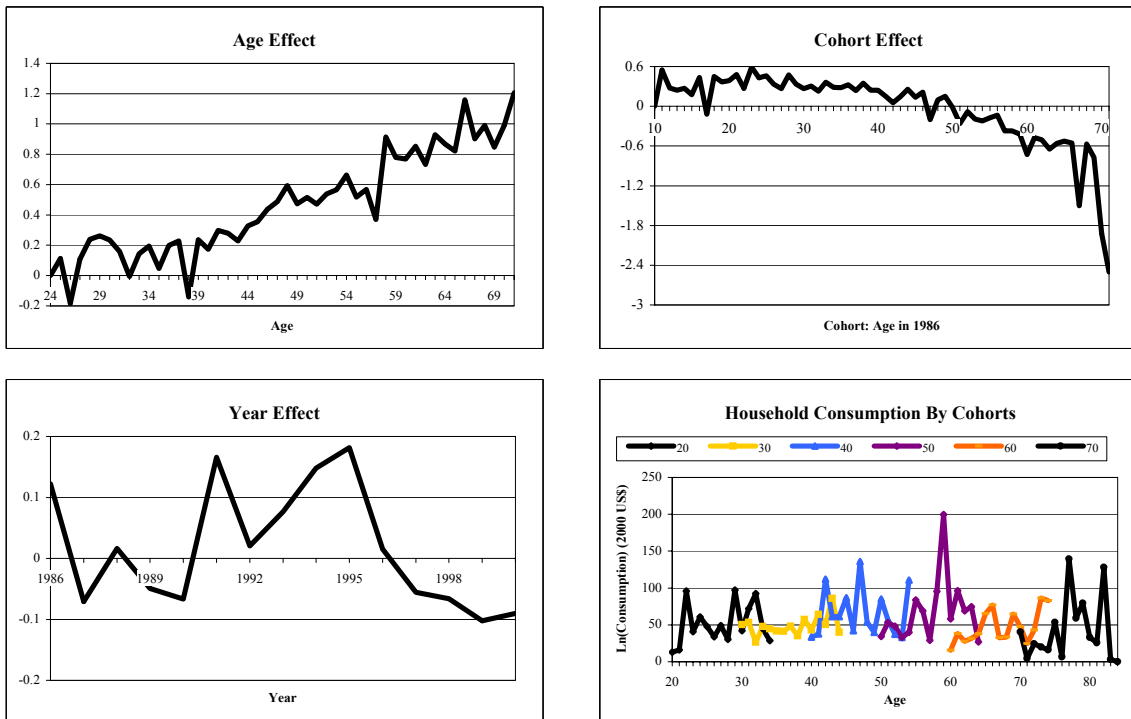


**Figure 3.9 Household Consumption by Cohorts and Decomposition, 1986 - 2000**  
**(Continued)**

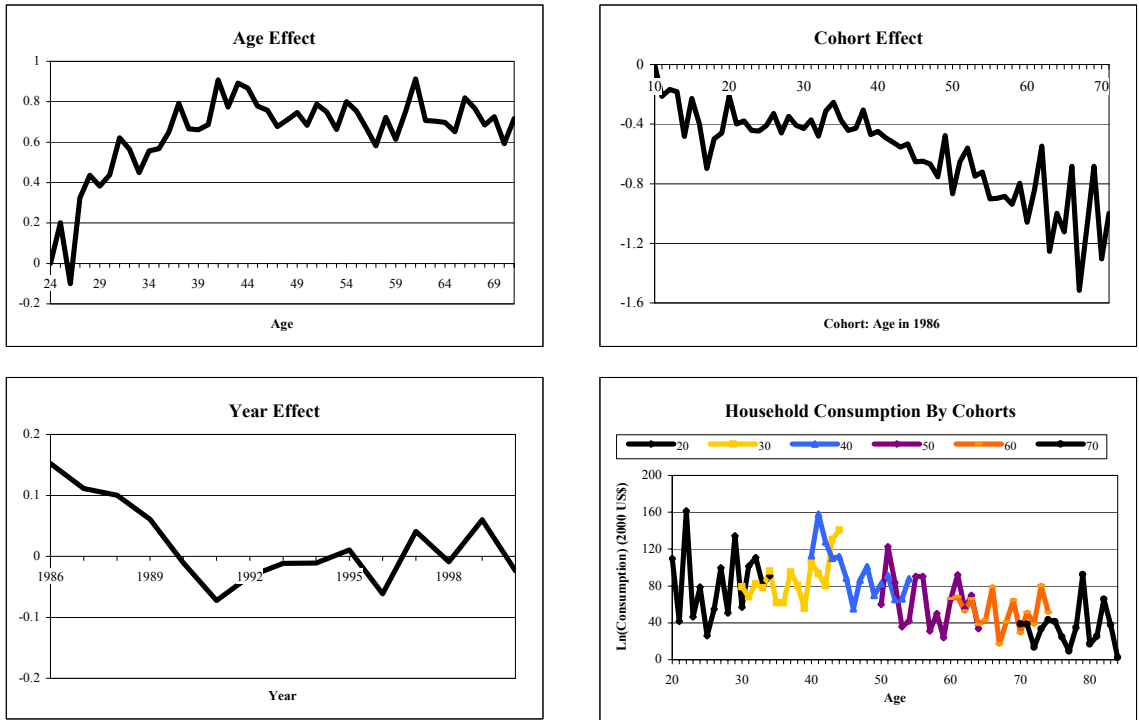
**78, Fees for clubs or fraternal organizations**



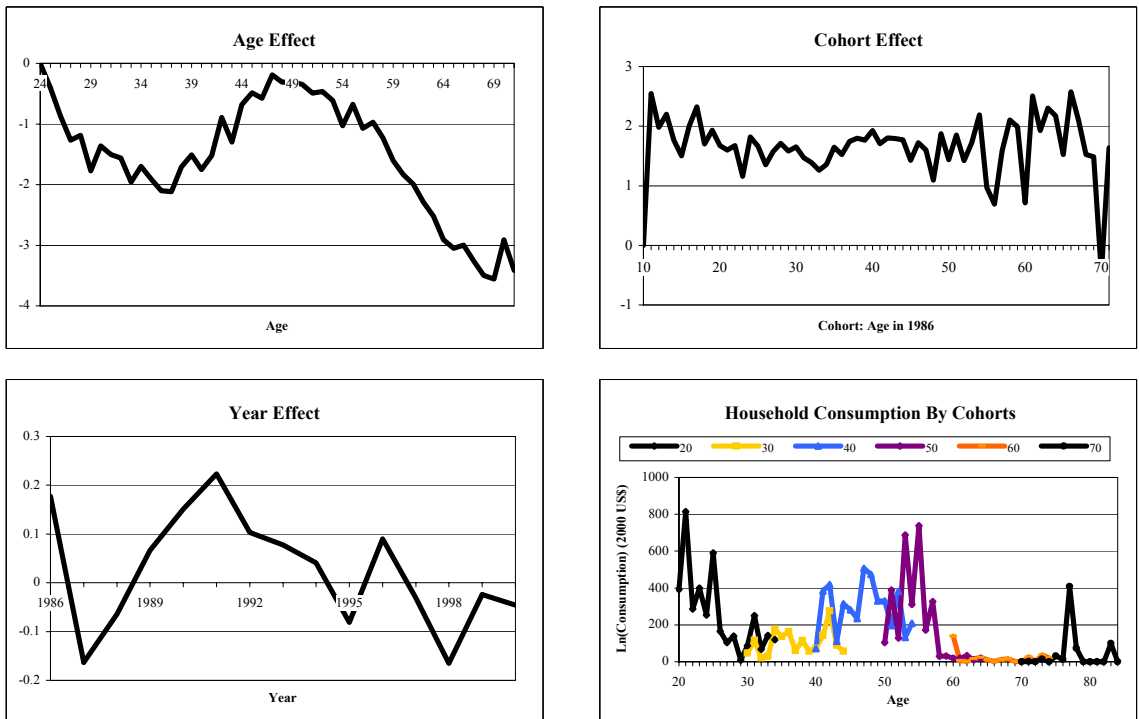
**79, Participant amusements and pari-mutual net receipts**



**Figure 3.9 Household Consumption by Cohorts and Decomposition, 1986 - 2000**  
**(Continued)**  
**80, Other recreation**

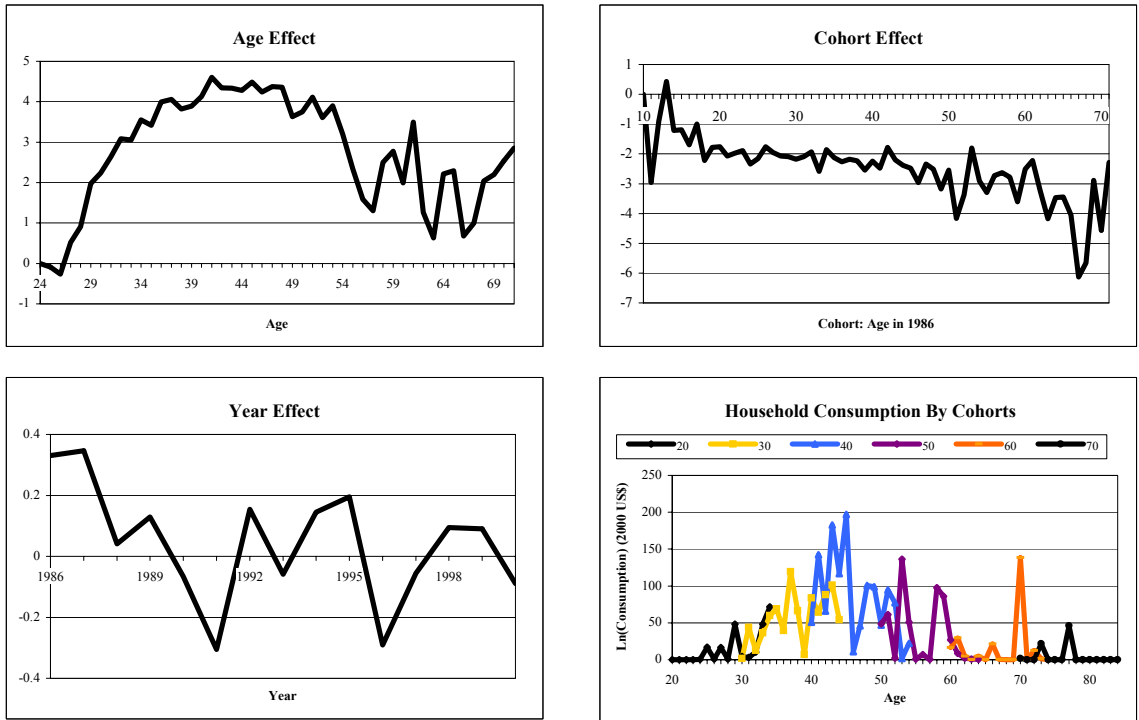


**81, Higher education**

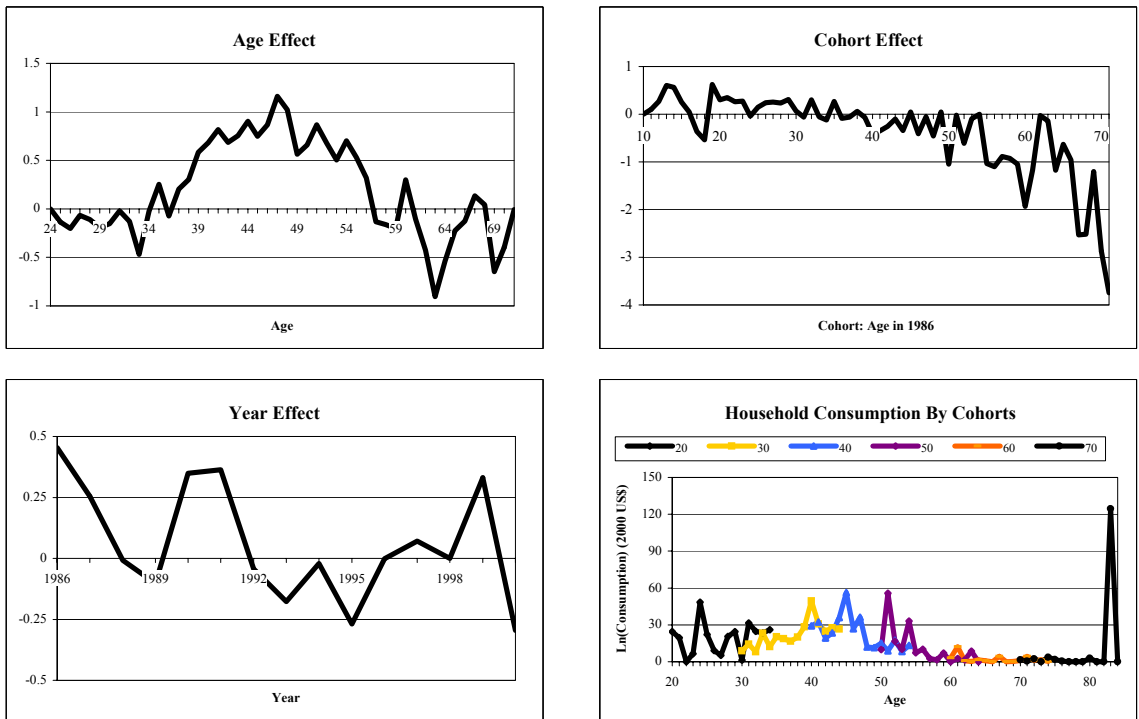


**Figure 3.9 Household Consumption by Cohorts and Decomposition, 1986 - 2000**  
**(Continued)**

**82, Private lower education**

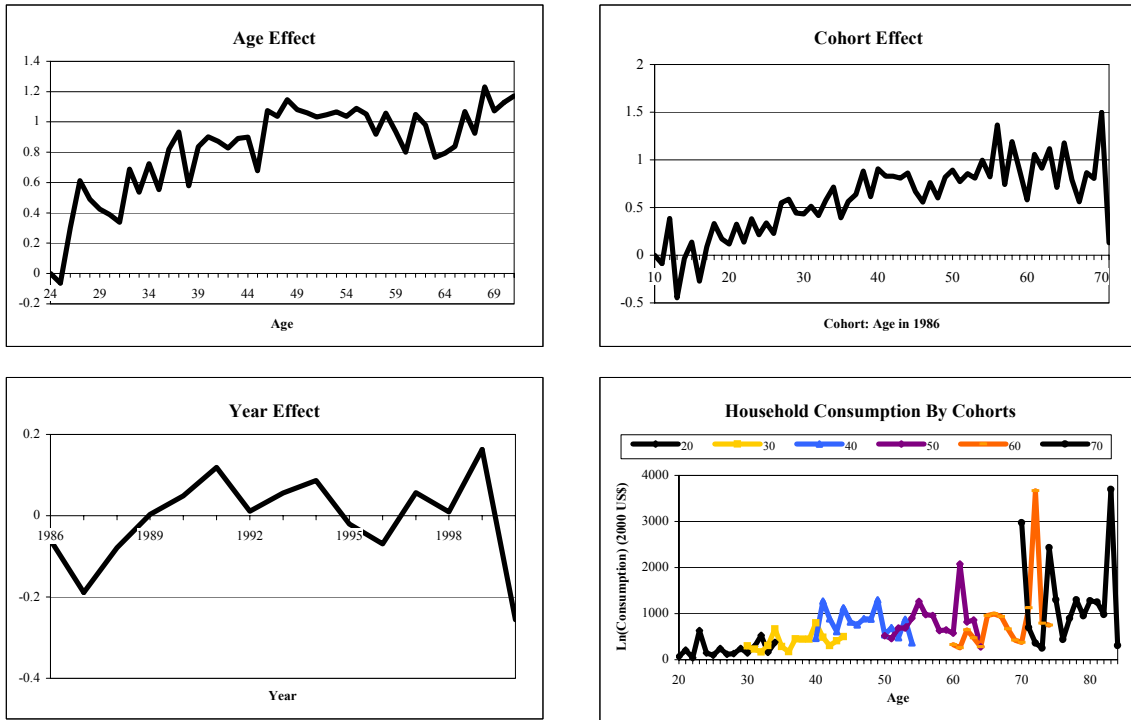


**83, Other education and research**

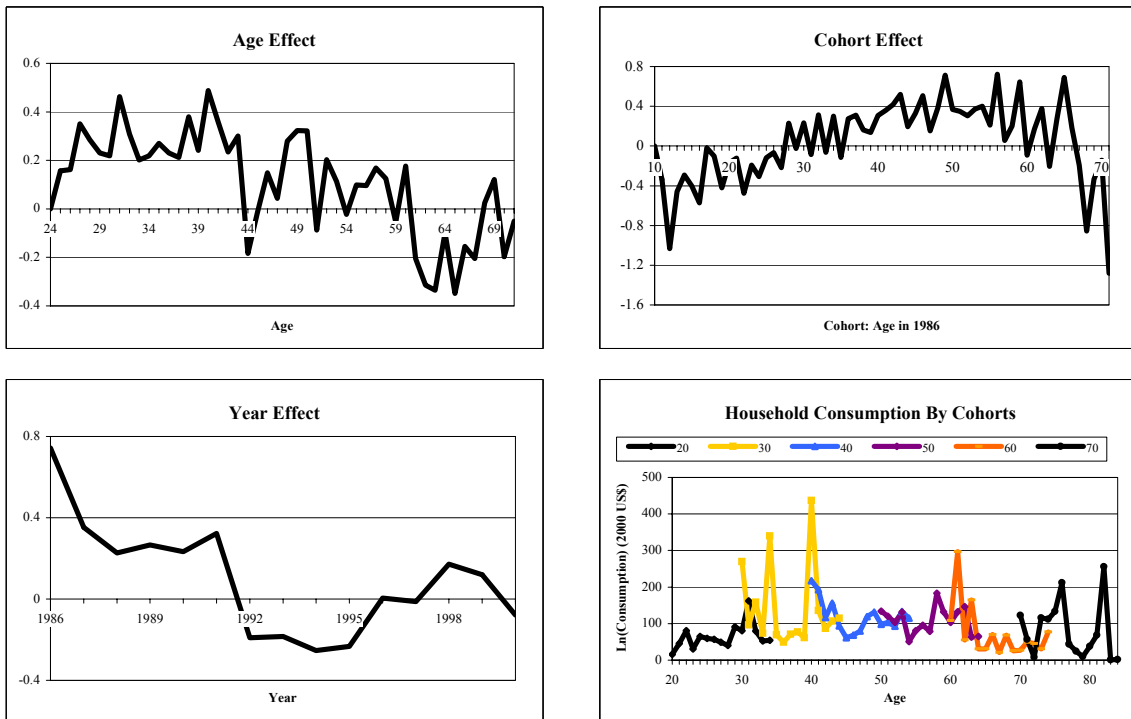


**Figure 3.9 Household Consumption by Cohorts and Decomposition, 1986 - 2000**  
**(Continued)**

**84, Cash contributions**



**85, Miscellaneous**





### APPENDIX 3.1 PROOF OF (3.4.4)

Let's suppose there are  $n_A$  ages ( $age_1, \dots, age_{n_A}$ ),  $n_Y$  years ( $year_1, \dots, year_{n_Y}$ ), and  $n_C$  cohorts ( $cohort_1, \dots, cohort_{n_C}$ ) in the dataset. We define matrix  $A$  as the matrix for age dummies, matrix  $Y$  as the matrix for year dummies, and matrix  $C$  as the matrix for cohort dummies. Thus we have

$$A = \begin{pmatrix} a_{11} & \cdots & a_{1n_A} \\ \vdots & \ddots & \vdots \\ a_{m1} & \cdots & a_{mn_A} \end{pmatrix}$$

$$Y = \begin{pmatrix} y_{11} & \cdots & y_{1n_Y} \\ \vdots & \ddots & \vdots \\ y_{m1} & \cdots & y_{mn_Y} \end{pmatrix}$$

and

$$C = \begin{pmatrix} c_{11} & \cdots & c_{1n_C} \\ \vdots & \ddots & \vdots \\ c_{m1} & \cdots & c_{mn_C} \end{pmatrix}$$

where  $a_{i,j} = 1$  if the household head is of  $age_j$  ( $j = 1, \dots, n_A$ ), and  $a_{i,j} = 0$  otherwise;  $y_{i,j} = 1$  if the purchase took place in  $year_j$  ( $j = 1, \dots, n_Y$ ), and  $y_{i,j} = 0$  otherwise;  $c_{i,j} = 1$  if the household belongs to  $cohort_j$  ( $j = 1, \dots, n_C$ ), and  $c_{i,j} = 0$  otherwise. There are totally  $m$  observations.

Define

$$t_a = \begin{pmatrix} age_1 \\ age_2 \\ \dots \\ age_{n_A} \end{pmatrix}$$

$$t_y = \begin{pmatrix} year_1 \\ year_2 \\ \dots \\ year_{n_Y} \end{pmatrix}$$

and

$$t_c = \begin{pmatrix} cohort_1 \\ cohort_2 \\ \dots \\ cohort_{n_C} \end{pmatrix}$$

so  $t_a = s_a + I_{n_a} * age_1$ ,  $t_y = s_y + I_{n_y} * year_1$ , and  $t_c = s_c + I * cohort_1$ , where  $I$  vectors are arithmetic sequences  $(1, 1, \dots, 1)$ .

Note that

$$At_a = \begin{pmatrix} age_1 \\ age_2 \\ \dots \\ age_m \end{pmatrix}$$

$$Ct_c = \begin{pmatrix} cohort_1 \\ cohort_2 \\ \dots \\ cohort_m \end{pmatrix}$$

and

$$Yt_y = \begin{pmatrix} year_1 \\ year_2 \\ \dots \\ year_m \end{pmatrix}$$

Here  $(age_1, age_2, \dots, age_m)$ ,  $(cohort_1, cohort_2, \dots, cohort_m)$  and  $(year_1, year_2, \dots, year_m)$  are value of age, cohort and year of each observation. By the definition of cohort, we have

$$At_a = Ct_c + Yt_y$$

Substituting  $t_a, t_c$  and  $t_y$  with  $s_a, s_c$  and  $s_y$ , we get

$$A(s_a + I_{n_A} * age_1) = C(s_c + I_{n_C} * cohort_1) + Y(s_y + I_{n_Y} * year_1)$$

Since  $AI_{n_A} = I_m$ ,  $CI_{n_C} = I_m$  and  $YI_{n_Y} = I_m$ , and  $age_1 = cohort_1 + year_1$ , (3.4.4) is proved.

## **CHAPTER FOUR      TIME SERIES CONSUMPTION FUNCTIONS**

### **SECTION 1   A PERHAPS ADEQUATE DEMAND SYSTEM**

In previous chapters, we conducted cross-section and cohort analyses of consumption. This chapter is devoted to integrating the two ways of looking at household consumption decision into a composite model which also includes the effects of prices. The current version of my model is based on PADS (A Perhaps Adequate Demand System) proposed by Almon (1996).

#### **1.1    Literature Review**

Many researchers have sought a good functional form for a household demand system. Earlier scholars such as Engel (1895), Working (1943), and Leser (1963) mainly concentrated on the relationship between commodity expenditure and income (the Engel curve). However, a complete description of the consumer behavior requires both the Engel curves and relative price effects.

Contributions to this sort of function include Christensen et al. (1975), Muellbauer (1976), Deaton and Muellbauer (1980), Jorgenson et al. (1980), Cooper and McLaren (1992, 1996), Almon (1979, 1996), and Banks et al. (1997).

Christensen et al. (1975) studied the direct utility function and indirect utility function with special functional forms: the negative of the logarithm of the direct utility is

quadratic in the logarithms of the quantities consumed, and the logarithm of the indirect utility is quadratic in logarithms of the ratios of the prices to the total expenditure. Both utility functions have been examined for their conformity with various properties such as *additivity*, *homotheticity*, and *duality*.

In Muellbauer (1976), necessary and sufficient conditions are given on micro and macro behavior for a representative consumer to exist. Under some restrictions, particular forms of utility functions are derived, including the PIGLOG<sup>17</sup> family.

Deaton and Muellbauer (1980) suggested another form, AIDS (Almost Ideal Demand System). Starting from a particular type of PIGLOG function, the AIDS demand function in budget share form was derived through utility maximization. As pointed out by the authors, AIDS gives a first-order approximation to any demand system; it satisfies the axioms of choice; it aggregates perfectly without invoking parallel Engel curves; it has a functional form which is consistent with known household data; it is simple to estimate and it can be used to test various restrictions.

Despite these features, in an AIDS system, an increase in income eventually leads to negative consumption of one or more goods, unless the consumption of all goods increase in the same proportion. To get around this problem, Cooper and McLaren (1996) proposed a parametric specification of an indirect utility function in terms of expenditures and two unit cost functions. It established an “effectively globally regular” system of

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<sup>17</sup> A name for a family of budget share equations that possess the property of “price independent generalized linearity” and depend on the logarithm of total expenditure.

demand equations. This system includes a number of popular demand systems, such as the Linear Expenditure System, as a special case. However, it does not have the “adding-up” property.

Banks et al (1997) suggested a model of consumer demand with the Engel curves requiring quadratic terms in the logarithm of expenditure. This is different from previous Translog or the Almost Ideal Demand Systems, which have the expenditure share Engel curves linear in the logarithm of total expenditure.

The popularity of AIDS and its variants in empirical studies of private consumption behavior is gained through its elegant theoretical derivations from utility maximization. However, such ancestry is no assurance of the adequacy of a form for empirical use. In fact, shortcomings of these forms have been well documented. Deaton (1974), for example, pointed out that because the Linear Expenditure System (LES) form is derived from an additive utility function, the specification of the income elasticities and one price elasticity are sufficient to determine all price elasticities. For a fairly detailed disaggregation of commodities, even for eight or ten commodities in practice, the assumption of additivity is likely to yield Pigou's Law of approximate proportionality of expenditure and price elasticities. That is, the ratio of a product's own price elasticity to its income elasticity is the same for all products. Unless we have grounds for believing that elasticities should be proportional — there is a good deal of evidence against such a proposition — LES is believed too restrictive to be useful in general models.

Gauyacq (1985) compared several proposed forms of demand systems. Using French data for 1959-1979, he estimated “the linear expenditure system of Stone; the model with real prices and income of Fourgeaud and Nataf; the additive quadratic model of Houthakker and Taylor; the logarithmically additive model of Houthakker, ... the Rotterdam model of Theil and Barten, the Translog model based on a logarithmic transformation of the utility function; the AIDS model of Deaton and Muellbauer; ... [and] the model proposed by Clopper Almon.” The conclusion was “From the study which we have done, it appears that definitely only the model of C. Almon offers a system which satisfies approximately theoretical expectations and is of real interest for the econometric study of detailed demand functions.”

What is used in this dissertation is a demand system suggested by Almon (1996) that generalizes slightly that estimated by Gauyacq. The form is named as PADS, A Perhaps Adequate Demand System.

## **1.2 PADS: A Perhaps Adequate Demand System**

PADS is a system of market demand functions that calculates consumer expenditures in detail by product. Unlike many other demand systems, PADS is not derived from utility maximization. The functional form of PADS is specified so as to satisfy the requirements that should be met with by any market demand system. The basic requirement for a market demand system includes at least the following:

1. It should allow complementarity and substitution effects among different goods.



2. It should be homogeneous of degree zero in price and income.
3. It should add up, i.e. the sum of the expenditures on all products should be equal to the total expenditure.
4. As income rises, the marginal propensities to consumption should be different for different goods and should depend upon relative prices.
5. It should allow effects of variables other than prices and income, such as time, and demographic factors.
6. Practically it should not be too complicated to estimate.

The general form of the PADS demand system is:

$$x_i(t) = [a_i(t) + b_i(y/P)] \prod_{k=1}^n p_k^{c_{ik}} \quad (4.1.1)$$

where

$x_i(t)$  is the consumption *per capita* of product  $i$  in period  $t$ ;

$a_i(t)$  is a function of time;

$b_i$  is a positive constant;

$y$  is nominal income *per capita*;

$p_k$  is the price index of product  $k$ ;

$P$  is an overall price index defined by

$$P = \prod_{k=1}^n p_k^{s_k} \quad (4.1.2)$$

where  $s_k$  is the budget share of product  $k$  in the period in which the price indices are all 1;

$c_{ik}$  are constants satisfying the constraint

$$\sum_{k=1}^n c_{ik} = 0 \quad (4.1.3)$$

The functional form does not guarantee the expenditures on products will add up to income. The way to solve this problem is to add a “spreader”, that is, a term which spreads the difference between  $y$  and the sum of expenditures on the  $x_i$  given by (4.1.1) in proportions which add to 1. Since the amount to spread is usually small, we neglect the “spreader” for now to simplify our description.

Another practical difficulty is that there are many  $c$ ’s to be estimated. Assuming we have 20 years of annual data, and there are 80 categories of expenditures, we have only 1,600 data points to determine 6,320 parameters (6,400  $c$ ’s less 80 determined by equation(4.1.3)). Some reasonable restrictions have to be adopted to make the estimation possible.

A market demand equation is different from an individual demand equation in that Slutsky symmetry normally does not apply to market demand equation. We may, however, assume an approximate symmetry in the base year. From (4.1.1), the symmetry condition gives<sup>18</sup>

$$c_{ij}x_i / p_j = c_{ji}x_j / p_i \quad (4.1.4)$$

multiplying both sides by  $p_i p_j / y$ , we have

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<sup>18</sup> Please see the derivation of equation (4.1.4) in Appendix 4.1

$$\frac{c_{ij}x_i p_i p_j}{y p_j} = c_{ij} / s_j = c_{ji} / s_i \quad (4.1.5)$$

where  $s_i$  is the budget share of good  $i$ . If we define

$$\lambda_{ij} = c_{ij} / s_j \quad (4.1.6)$$

then we can decrease the number of parameters by half by imposing

$$\lambda_{ij} = \lambda_{ji} \quad (4.1.7)$$

as implied by (4.1.5) and (4.1.6).

To cut down further the number of parameters, the concepts of “group” and “subgroup” of commodities are introduced. A group in PADS contains at least two products that are closely related while a subgroup includes at least two products from the same group that are even more closely related. A product is not required to join a group, nor can it be in more than one group or in more than one subgroup. The closeness of two related products is usually measured by the sensitivity of the demand for one product to the price of the other product.

With the group and subgroup concepts, we can further simplify the estimation in the following ways:

If product  $i$  and product  $j$  are not in the same group or subgroup, then

$$\lambda_{ij} = \lambda_i + \lambda_j \quad (4.1.8)$$

and if they are in the same group,  $G$ , but not same subgroup, then

$$\lambda_{ij} = \lambda_i + \lambda_j + \mu_G \quad (4.1.9)$$

and if they are in the same subgroup,  $g$ , of the group  $G$ , then

$$\lambda_{ij} = \lambda_i + \lambda_j + \mu_G + \nu_g \quad (4.1.10)$$

With the above definition, the final functional form for estimation is as follows:

$$x_i(t) = \left[ a_i(t) + b_i \frac{y}{P} \right] \left( \frac{p_i}{P} \right)^{-\lambda_i} \prod_{k=1}^n \left( \frac{p_i}{P_k} \right)^{-\lambda_k s_k} \left( \frac{p_i}{P_G} \right)^{-\mu_G} \left( \frac{p_i}{P_g} \right)^{-\nu_g} \quad (4.1.11)$$

where

$x_i(t)$  is household consumption of product  $i$ , which is in group  $G$  and (possibly)

subgroup  $g$ ;

$p_k$  is the price index for product  $k$ ;

$a_i(t)$ ,  $b_i$ ,  $\lambda_i$ ,  $\mu_G$ , and  $\nu_g$  are parameters to be estimated;

$P$ ,  $P_G$ ,  $P_g$  are overall price, group price, and subgroup price indexes, respectively, defined

by

$$P = \prod_{k=1}^n p_k^{s_k}, P_G = \left( \prod_{k \in G} p_k^{s_k} \right)^{1/\sum_{k \in G} s_k} \text{ and } P_g = \left( \prod_{k \in g} p_k^{s_k} \right)^{1/\sum_{k \in g} s_k} \quad (4.1.12)$$

where  $s_k$  is the budget share of product  $k$  in the period in which the price indexes are all 1.

In the end, we have one price substitution parameter for each good (the  $\lambda_i$ ), plus one for each group (the  $\mu_G$ ) and one for each subgroup (the  $\nu_g$ ).

## SECTION 2 CROSS-SECTIONAL TIME SERIES CONSUMPTION FUNCTIONS

### 2.1 The Demand System

This chapter integrates the cross-sectional and cohort analysis with PADS into one framework. A composite household demand system is proposed in the following:

$$\frac{x_{it}^h}{W_u^h} = \left[ b_{i0} + \sum_j \frac{b_{ij} Y_{jt}^h}{P_t} + \sum_j d_{ij} D_{jt}^h + \sum_j c_{ij} C_{jt}^h \right] \left( \frac{P_{it}}{P_t} \right)^{-\lambda_i} \prod_{k=1}^n \left( \frac{P_{kt}}{P_{kt}} \right)^{-\lambda_k s_k} \left( \frac{P_{it}}{P_{Gt}} \right)^{-\mu_G} \left( \frac{P_{it}}{P_{gt}} \right)^{-v_g} \quad (4.2.1)$$

$x_{it}^h$  is the household  $h$ 's consumption on product  $i$  in year  $t$ ;

$W_u^h$  is defined by:

$$W_u^h = \sum_g \hat{w}_{ig} n_{gt}^h \quad (4.2.2)$$

where  $\hat{w}_{ig}$  is the estimated Adult Equivalency Weights<sup>19</sup> for product  $i$  and age group  $g$ ,

$n_{gt}^h$  is the number of people in age group  $g$  in household  $h$  at year  $t$ ;

$\sum_j \frac{b_{ij} Y_{jt}^h}{P_t}$  is the Piecewise-Linear Engel Curve part of the consumption function,  $Y_{jt}^h$ 's are

household  $h$ 's income in bracket  $j$ , and  $b_{ij}$ 's are parameters to be estimated;

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<sup>19</sup> In Chapter 2, we have estimated the Adult Equivalency Weights for different age group by product.

$\sum_j d_{ij} D_{jt}^h$  is the demographic dummies variable part of the consumption function,  $D_{jt}^h$ 's

are dummy variables for various demographic factors<sup>20</sup>,  $d_{ij}$ 's are parameters to be estimated;

$\sum_j c_{ij} C_{jt}^h$  is the cohort effects part of the consumption function,  $C_{jt}^h$ 's are dummy variables

for various cohorts<sup>21</sup>,  $c_{ij}$ 's are parameters to be estimated;

$p_{kt}$  is the price index for product  $k$ ;

$P_t, P_{Gt}, P_{gt}$  are overall price, group price, and subgroup price indexes, respectively,

defined by

$$P_t = \prod_{k=1}^n p_{kt}^{s_k}, P_{Gt} = \left( \prod_{k \in G} p_{kt}^{s_k} \right)^{1/\sum_{k \in G} s_k} \text{ and } P_{gt} = \left( \prod_{k \in g} p_{kt}^{s_k} \right)^{1/\sum_{k \in g} s_k} \quad (4.2.3)$$

where  $s_k$  is the budget share of product  $k$  in the period in which the price indexes are all ones;

$\lambda, \mu_G, v_g$ 's are parameters to be estimated.

## 2.2 Discussion

The functional form of (4.2.1) is not much different from the original PADS equation, except that we added piecewise linear terms for income effects, dummy variables for demographic part, and cohort effect part in the first bracket. However,

<sup>20</sup> They are the same as those listed in Chapter 2.

<sup>21</sup> Please see Chapter 3 for cohort definition.

because we add in those household specific characteristics, the original macro time series PADS model turns into a micro cross-sectional time series model. We have 15 years of Consumer Expenditure Survey data, each containing about 4,000 households' consumption of 85 products. Now the model becomes a gigantic system of regression equations.

We benefited from this framework by obtaining the income effects, demographic effects, and cohort effects from a dynamic environment with the price of each product changing over time. And our analysis of the price elasticities will be enriched by taking other "micro" factors into consideration. In PADS, the Slutsky symmetry of the market demand functions is assumed so as to reduce the number of parameters, although we are aware that the Slutsky symmetry of individual demand function does not guarantee the Slutsky symmetry at the market level.

If we could estimate this system, we would have income effects, demographic effects, cohort effects, year effects and price effects all estimated simultaneously on a rich data set: a times series of cross-section data. However, this is a nonlinear demand system of 85 equations with 15 years of 4,000 household survey data for each year. Part of the equation involves the products of 85 price terms with the parameter in the exponential of each term. Because there are many cross price effects, the estimation needs to be done with 85 equations simultaneously. The tremendous task of calculation made it impossible to find any statistical package to estimate the parameters within a reasonable time, so we will use a simplification.



## SECTION 3 ESTIMATION SCHEME

### 3.1 A Two-Step Scheme

We use a two-step approach to approximate the solution. The first step is to create a time-series variable which will summarize all the income, demographic, and cohort information as it bears on the consumption of each product. This variable should, however, be free of price effects. To create this variable, which we will call  $C_{it}^*$ , we first estimate on the time series of cross section data the following equation:

$$\frac{x_{it}^h}{W_{it}^h P_t} = b_{i0} + \sum_j \frac{b_{ij} Y_{jt}^h}{P_t} + \sum_j d_{ij} D_{jt}^h + \sum_j c_{ij} C_{jt}^h + a_i \frac{P_{it}}{P_t} \quad (4.3.1)$$

Note that equation (4.3.1) is no difference from equation (4.2.1) except that the price term is simplified into an own-relative price of the product, not the complete PADS price term. Once it is estimated, we set  $p_{it} / P_t = 1$  and calculate  $C_{it}^*$ , what consumption would have been (according to the equation) had all income and demographic variables had their actual, historical value while the relative price remained constant at 1.0. Thus  $C_{it}^*$  can carry into the PADS form all the income and demographic information and leave PADS to handle price effects. In the second step, the following equation is estimated:

$$\frac{q_{it}}{W P_{it}} = \left[ a_i + b_i t + c_i C_{it}^* \right] \left( \frac{P_{it}}{P_t} \right)^{-\lambda_i} \prod_{k=1}^n \left( \frac{P_{it}}{P_{kt}} \right)^{-\lambda_k s_k} \left( \frac{P_{it}}{P_{Gt}} \right)^{-\mu} \left( \frac{P_{it}}{P_{gt}} \right)^{-\nu} \quad (4.3.2)$$

where  $q_{it}$  is macro variable of Personal Consumption Expenditure for product  $i$  at time  $t$ .  $WP_{it}$  is the weighted population created from the commodity-specific Adult Equivalent Weights we obtained through cross-sectional estimation in Chapter 2. The  $C_{it}^*$  in this equation serves as a “prediction” of per adult equivalent expenditure of each good, created by incorporating the information of income, demographic composition and cohort effects.

In this way, the system of demand equations will be estimated for the 92 detailed components of the Personal Consumption Expenditure in the National Income and Product Accounts.

### 3.2 Linear Regression with Own-Relative Price

Estimation of equation **Error! Reference source not found.** is a practical way to obtain an estimate of  $C_{it}^*$ . The equation is linear with all time series of cross-section data plus the time series of the own-relative own price. The  $W_{it}$  in the left hand side is the estimated Adult Equivalency Weights from our previous cross-sectional analysis with the 2000 Consumer Expenditure Survey<sup>22</sup>. We simplify the definition of the cohorts so that they are of 10-year age ranges. More specifically, the functional form for the estimation is as follows:

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<sup>22</sup> To simplify the work, I use 2000 weights for all the years.

$$\frac{x_{it}^h}{W_{it}^h P_t} = b_{i0} + \sum_j \frac{b_{ij} Y_{jt}^h}{P_t} + \sum_j d_{ij} D_{jt}^h + \sum_j c_{ij} C_{jt}^h + a_i \frac{P_{it}}{P_t} \quad (4.3.3)$$

The definitions of the variables are as follows:

$y_{1t}^h$  - income between \$0 and \$4,451.1<sup>23</sup>;

$y_{2t}^h$  - income between \$4,451.1 and \$8,520.0;

$y_{3t}^h$  - income between \$8,520.0 and \$13,479.6;

$y_{4t}^h$  - income between \$13,479.6 and \$21,717.4;

$y_{5t}^h$  - income over \$21,717.4;

$D_{1t}^h$  - household resides in the Midwest;

$D_{2t}^h$  - household resides in the South;

$D_{3t}^h$  - household resides in the West;

$D_{4t}^h$  - household has one member;

$D_{5t}^h$  - household has two members;

$D_{6t}^h$  - household has five or more members;

$D_{7t}^h$  - age of household head is less than 35;

$D_{8t}^h$  - age of household head is greater than 55;

$D_{9t}^h$  - household head is educated below high school level;

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<sup>23</sup> The income is defined as the per capita household income in 2000 dollars.

$D_{10t}^h$  - household head is educated above high school level;

$D_{11t}^h$  - household has one wage earner;

$D_{12t}^h$  - household has two or more wage earners;

$C_{1t}^h$  - age of the household head in 1986 is less than 20;

$C_{2t}^h$  - age of the household head in 1986 is between 20 and 30<sup>24</sup>;

$C_{4t}^h$  - age of the household head in 1986 is between 40 and 50;

$C_{5t}^h$  - age of the household head in 1986 is between 50 and 60;

$C_{6t}^h$  - age of the household head in 1986 is between 60 and 70;

$C_{7t}^h$  - age of the household head in 1986 is over 70;

$a_i$  - coefficient for price term.

To avoid the dummy variable trap, one variable from each group of dummy variables is omitted. The reference household in this specification is a 3-4 member household in the Northeast region with two wage earners, and with a head aged between 35 and 55 and born from 1946 to 1956, with high school or associate degrees.

The results of the regression are shown in Table 4.1, Table 4.2 and Table 4.3.

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<sup>24</sup> “Between 20 and 30” means greater than 20 and less than or equal to 30. And other cohort parameters are defined in a similar way.

**Table 4.1 Linear Regression With Own-Relative Price, Income and Price Effects**

	Sector	Intercept	Income Brackets (2000 dollars)					PrElas (1986)	PrElas (2000)
			0 ~ 4,451	4,451 ~ 8,520	8,520 ~ 13,479	13,479 ~ 21,717	21,717 ~		
1	Food at home	2063.22	-0.005	0.031	0.019	0.022	0.005	-0.50	-0.60
2	Food away from home	1933.35	-0.004	0.025	0.024	0.029	0.022	-2.05	-3.37
3	Alcoholic bev. at home	135.82	0.000	0.005	0.002	0.004	0.002	-0.51	-0.96
4	Alcoholic bev. away	515.70	-0.002	0.004	0.002	0.005	0.004	-4.32	-8.58
5	Tobacco & smoking sply	572.54	0.011	0.004	0.002	-0.003	0.000	-0.40	-2.18
6	Footwear	8.26	0.001	0.002	0.001	0.002	0.001	0.44	0.46
7	Clothing for women	95.11	-0.002	0.006	0.003	0.009	0.006	0.20	0.17
8	Clothing for men	60.09	-0.003	0.004	0.002	0.006	0.005	0.05	0.04
9	Clothing for infants	30.71	0.000	0.000	0.000	0.001	0.000	-2.02	-1.10
10	Travel items	9.31	0.000	0.000	0.000	0.000	0.000	-1.10	-1.18
11	Cleaning & laundering	1033.82	0.001	-0.001	0.000	0.003	0.003	-13.46	-29.15
12	Watches & jewelry	73.85	0.000	0.003	0.002	0.008	0.004	-0.41	-0.42
13	Watch & jewelry repair	73.24	0.000	0.000	0.000	0.000	0.000	-12.25	-24.63
14	Personal care services	337.29	-0.001	0.004	0.002	0.005	0.002	-2.32	-3.62
15	Personal care equipment	4.83	0.000	0.000	0.000	0.000	0.000	-1.23	-1.35
16	Owned dwellings	3520.55	-0.083	0.108	0.076	0.171	0.090	-0.88	-1.16
17	Rented dwellings	3581.44	0.023	-0.023	-0.039	-0.028	-0.004	-2.82	-4.09
18	Other lodging	275.03	-0.004	0.004	0.005	0.007	0.008	-1.21	-2.77
19	Furniture	104.58	-0.002	0.004	0.001	0.009	0.008	-0.54	-0.42
20	Kitchen & hhld. app.	42.92	0.001	0.002	0.002	0.002	0.002	-0.35	-0.24
21	China & glassware	-2.39	0.000	0.000	0.000	0.001	0.001	0.20	0.23
22	Floor coverings	-104.90	-0.001	0.002	0.001	0.002	0.002	3.51	7.38
23	Other durable appliance	2.66	0.001	0.000	0.000	0.003	0.001	0.26	0.33
24	Tools	12.23	0.000	0.001	0.000	0.001	0.000	-0.76	-0.53
25	Household textiles	49.37	0.000	0.001	0.000	0.004	0.001	-0.95	-0.78
26	Semi-durable furnishings	20.34	-0.002	0.001	0.000	0.004	0.002	-0.37	-0.25
27	Cleaning & lighting equ.	-15.87	0.000	0.000	0.000	0.001	0.000	2.79	5.18
28	Electricity	299.17	-0.003	0.009	0.003	0.006	0.002	-0.11	-0.10
29	Natural gas	183.85	0.000	0.000	0.002	0.004	0.001	-0.22	-0.38
30	Water & other pub. svcs.	116.03	-0.002	0.005	0.003	0.003	0.001	-0.40	-0.75
31	Fuel oil & other fuels	140.33	0.001	0.003	0.000	0.001	0.000	-0.49	-1.63

**Table 4.1 Linear Regression With Own-Relative Price, Income and Price Effects (Continued)**

Sector	Intercept	Income Brackets (2000 dollars)					PrElas (1986)	PrElas (2000)
		0 ~ 4,451	4,451 ~ 8,520	8,520 ~ 13,479	13,479 ~ 21,717	21,717 ~		
32 Telephone equipment	530.74	0.004	0.004	0.002	0.006	0.004	-2.37	-0.96
33 Domestic services	196.64	-0.003	0.004	0.007	0.006	0.008	-0.92	-1.29
34 Household insurance	211.30	-0.001	0.005	0.003	0.004	0.002	-2.10	-2.22
35 Other household oper.	-1.00	0.000	0.001	0.001	0.003	0.001	0.18	0.28
36 Prescription drugs	25.77	0.005	0.004	0.002	0.000	0.000	0.11	0.13
37 Ophth. & orthoped. equ.	106.90	0.001	0.002	0.001	0.001	0.000	-3.43	-4.91
38 Physicians' services	491.21	0.000	0.011	0.002	0.002	0.001	-1.95	-7.81
39 Dental care	155.84	0.000	0.005	0.002	0.003	0.001	-1.03	-3.62
40 Other svcs. by med. pro.	207.80	0.001	0.002	0.000	0.002	0.001	-4.36	-9.17
41 Other medical care services	60.25	0.001	0.000	0.000	0.000	0.000	-8.12	-26.12
42 Hospital services	373.50	-0.001	0.003	0.003	0.002	0.001	-1.49	-4.35
43 Convalescent/nursing homes	-1.82	0.001	-0.001	0.000	0.000	0.000	1.80	4.22
44 Health insurance	350.96	0.002	0.025	0.006	0.002	0.001	-0.24	-0.95
45 Banking services	50.50	0.000	0.001	0.000	0.000	0.000	-1.29	-6.89
46 Life & personal insur.	267.79	-0.001	0.006	0.004	0.007	0.004	-1.29	-4.01
47 Contribution to pension	1326.44	0.096	0.166	0.147	0.174	0.107	-0.56	-0.78
48 Legal fees	242.14	0.009	0.001	0.007	0.005	0.007	-0.73	-2.09
49 Funeral & burial services	46.18	0.006	0.000	0.003	0.000	0.000	-0.53	-1.71
50 Other personal business	502.15	-0.001	0.011	0.005	0.004	0.003	-3.26	-12.94
51 New cars & trucks	-658.22	-0.004	0.020	0.050	0.065	0.021	1.07	1.30
52 Used cars & trucks	-107.47	0.007	0.035	-0.006	0.016	0.002	0.86	1.02
53 Other Vehicles	-133.26	-0.008	0.018	-0.004	0.000	0.005	8.54	5.57
54 Tires, tubes, & access.	14.37	0.002	0.005	0.003	0.003	0.001	0.34	0.32
55 Maintenance & repair	-2092.12	0.006	0.013	0.012	0.017	0.008	8.85	7.54
56 Vehicle rental & charges	266.26	-0.001	0.001	0.003	0.004	0.002	-3.20	-7.61
57 Vehicle financial charges	393.21	-0.001	0.016	0.008	0.012	0.001	-1.31	-2.29
58 Vehicle license & registr.	124.51	0.000	0.004	0.001	0.002	0.001	-1.99	-2.83
59 Gasoline & motor oil	771.46	0.010	0.029	0.016	0.016	0.002	-0.56	-0.92
60 Tolls	9.05	0.000	0.000	0.000	0.000	0.000	-1.66	-5.35
61 Vehicle insurance	433.86	0.002	0.021	0.014	0.013	0.002	-0.29	-0.64
62 Local transportation	104.43	0.003	-0.003	-0.001	0.001	0.001	-0.91	-1.68

**Table 4.1 Linear Regression With Own-Relative Price, Income and Price Effects (Continued)**

Sector	Intercept	Income Brackets (2000 dollars)					PrElas (1986)	PrElas (2000)	
		0 ~ 4,451	4,451 ~ 8,520	8,520 ~ 13,479	13,479 ~ 21,717	21,717 ~			
63	Taxis	34.91	0.001	0.000	0.000	0.000	0.001	-1.41	-5.48
64	Intercity train fares	5.33	0.000	0.000	0.000	0.001	0.000	-0.45	-0.40
65	Intercity bus fares	3.05	0.000	0.000	0.000	0.000	0.000	-0.23	-0.22
66	Airline fares	130.05	-0.002	0.003	0.004	0.010	0.007	-0.60	-0.68
67	Ship fares	-24.63	0.000	0.000	0.000	0.001	0.001	3.79	2.53
68	Reading	503.71	0.000	0.003	0.002	0.005	0.002	-4.94	-11.62
69	Pets, pet supplies & srvc.	368.70	0.001	0.005	0.005	0.004	0.002	-5.44	-3.01
70	Toys & playground equ.	34.25	0.001	0.002	0.002	0.001	0.000	-0.46	-0.26
71	Bicycles	57.87	0.000	0.001	0.000	0.001	0.000	-7.02	-11.25
72	Cameras & film	-3.61	0.000	0.000	0.000	0.002	0.000	0.66	0.77
73	Guns & sporting equ.	315.26	-0.005	0.006	0.027	0.010	0.017	-1.11	-0.70
74	Televisions & sound equ.	266.52	0.000	0.006	0.007	0.005	0.004	-2.00	-0.51
75	Home computers	280.70	0.000	0.002	0.004	0.004	0.002	-13.04	-2.47
76	Fresh flower & plants	14.75	0.000	0.001	0.001	0.002	0.001	-0.05	-0.06
77	Live entertainment	103.37	-0.002	0.004	0.001	0.005	0.004	-0.88	-1.66
78	Fees for clubs & orgs.	69.75	-0.001	0.000	0.001	0.001	0.002	-2.33	-3.92
79	Participant amusements	130.48	-0.002	0.003	0.003	0.004	0.003	-2.18	-3.12
80	Other recreation	52.38	-0.001	0.001	0.002	0.002	0.003	-0.88	-1.29
81	Higher education	15.13	0.000	-0.003	0.002	0.003	0.000	0.32	0.72
82	Private lower education	32.19	0.001	0.000	0.001	0.001	0.001	-0.96	-1.62
83	Other edu. & research	37.59	0.001	0.001	-0.001	0.002	0.001	-1.74	-3.95
84	Cash contributions	3519.45	-0.025	0.067	0.018	0.050	0.054	-3.81	-7.39
85	Miscellaneous	-791.66	0.003	0.009	0.003	-0.001	0.007	4.07	21.31

**Table 4.2 Linear Regression With Own-Relative Price, Demographic Effects**

Sectors	Region			Family Size			Age		Education		Wage Earners		
	rd1	rd2	rd3	fd1	fd2	fd3	ad1	ad2	ed1	ed2	wd1	wd2	
1	Food at home	-192.64	-196.95	-43.10	495.32	199.69	-190.24	23.37	-59.84	-26.38	83.48	40.64	-65.55
2	Food away from home	-41.68	-46.29	-44.73	563.32	148.15	-66.81	41.44	-160.88	-107.59	156.82	-58.08	28.71
3	Alcoholic bev. at home	-11.70	-14.47	5.91	97.51	22.32	-13.09	12.91	-25.83	-2.63	3.71	-16.48	-13.57
4	Alcoholic bev. away	-1.98	-26.25	-0.99	184.58	29.63	-7.58	11.45	-19.26	-15.53	2.83	-9.29	-3.05
5	Tobacco & smoking sply	6.11	-48.15	-108.68	163.94	102.80	-48.55	11.11	-52.82	70.64	-198.43	-21.24	-16.36
6	Footwear	-2.40	-0.42	-1.03	32.23	7.72	-4.02	-2.13	-2.78	-5.63	9.15	-0.76	-0.63
7	Clothing for women	-16.99	-30.33	-34.48	80.77	44.41	-25.75	-10.18	-15.56	-32.84	55.96	-6.34	13.95
8	Clothing for men	-13.88	-15.53	-18.59	113.46	30.60	-9.72	2.97	-4.52	-9.46	34.42	-7.01	2.97
9	Clothing for infants	-2.61	-3.39	-1.72	-9.73	1.74	-1.87	2.89	-0.84	-1.55	0.79	-0.07	-3.86
10	Travel items	0.25	0.63	0.92	-1.73	0.64	0.03	-1.37	-1.31	-1.00	4.00	0.27	-0.42
11	Cleaning & laundering	-13.47	0.88	-5.87	100.75	17.40	-7.34	3.01	0.04	-5.32	23.10	1.60	1.73
12	Watches & jewelry	-9.83	-1.90	2.04	-27.89	21.48	-19.38	9.52	-63.89	-14.68	8.26	-6.54	14.58
13	Watch & jewelry repair	-0.08	0.24	-0.12	0.92	1.93	-0.51	0.71	-1.43	-1.07	1.50	-0.76	0.85
14	Personal care services	-13.53	-3.13	-10.71	66.56	26.71	-15.30	-2.17	-6.85	-15.49	22.30	-4.76	1.33
15	Personal care equipment	-0.72	-0.63	-0.22	2.49	0.12	-0.37	-0.25	-0.57	-0.76	-1.30	0.05	-0.10
16	Owned dwellings	-258.48	-347.98	147.07	-333.65	164.68	-212.28	-91.32	-140.34	-443.00	838.26	-232.76	-199.67
17	Rented dwellings	-422.18	-356.44	154.91	2791.36	710.65	-307.12	193.29	-60.32	145.74	3.65	202.51	-4.59
18	Other lodging	-22.48	-19.59	-14.07	28.36	-4.62	-9.35	-13.56	-15.52	-30.05	88.58	-9.07	-8.46
19	Furniture	-3.59	-9.98	1.73	17.72	74.22	-18.00	1.89	28.94	-14.73	42.84	-7.03	-0.77
20	Kitchen & hhld. app.	6.37	-0.89	-5.40	23.18	20.16	-5.28	-7.79	3.17	-7.07	-3.89	-4.75	2.36
21	China & glassware	-0.69	0.93	3.15	10.72	5.88	-1.72	2.82	0.46	-2.53	6.57	0.23	3.52
22	Floor coverings	3.34	0.39	-0.40	-22.62	3.24	-4.28	-6.61	6.26	-2.72	16.90	10.96	9.56
23	Other durable appliance	3.16	2.46	10.29	-14.84	1.85	-2.47	-1.71	-1.25	-5.85	5.33	-1.24	5.57
24	Tools	4.80	-2.06	4.72	5.71	3.57	-1.83	2.99	-0.68	-0.15	-2.48	-3.02	1.69
25	Household textiles	-5.05	-6.78	-3.31	-4.61	22.40	-7.42	-1.91	-13.82	-6.61	5.53	-0.45	1.57
26	Semi-durable furnishings	8.76	5.63	13.67	-10.11	15.67	-7.11	1.50	0.16	-8.49	15.19	-2.57	2.41
27	Cleaning & lighting equ.	-0.71	-2.98	-1.42	-0.44	3.20	-1.00	1.17	-0.15	-0.13	3.03	0.18	1.34
28	Electricity	-5.26	106.34	-56.01	152.70	54.14	-53.19	-13.92	-6.74	-40.06	-3.90	4.31	-13.10
29	Natural gas	38.47	-89.10	-57.33	45.92	23.34	-18.48	12.90	-8.08	-12.00	15.30	8.09	-11.67
30	Water & other pub. srvc.	27.94	42.07	45.18	17.36	5.20	-14.79	-4.84	8.90	-19.39	14.99	-2.73	-7.50
31	Fuel oil & other fules	-88.15	-100.16	-106.42	3.47	4.69	-3.71	1.87	-5.10	-0.97	-0.53	-7.67	-0.92
32	Telephone equipment	-7.49	13.17	-3.26	265.38	90.95	-49.66	1.46	-14.02	-19.54	36.93	12.85	5.16
33	Domestic services	-4.13	20.42	13.71	-125.37	-37.15	-29.29	4.11	-26.13	-28.30	78.40	-24.92	-40.69
34	Household insurance	7.64	14.90	1.25	-8.03	-0.49	-12.20	-12.21	-0.01	-19.22	14.91	-8.47	-9.52
35	Other household oper.	3.17	6.69	14.38	3.25	4.05	-5.40	0.22	-4.60	-7.17	16.38	4.34	3.17
36	Prescription drugs	12.57	24.14	-6.34	-20.17	-0.65	1.18	-7.67	8.28	-7.02	7.61	8.35	-14.65
37	Ophth. & orthoped. equ.	4.50	2.10	1.40	2.78	1.36	-2.07	0.28	-3.77	-5.72	8.85	-0.93	-0.05
38	Physicians' services	-15.58	4.69	-13.93	-44.69	-23.34	-10.03	15.38	-0.97	-26.09	26.71	7.53	-34.68
39	Dental care	-13.55	-6.75	-10.00	30.06	10.65	-6.02	-11.70	-6.30	-19.63	15.27	3.20	-12.20
40	Other srvc. by med. pro.	-8.47	-1.66	9.07	74.89	4.78	-3.09	-2.07	10.09	-8.85	15.06	2.02	-6.59
41	Other medical care services	3.92	2.19	3.21	1.03	-1.80	-0.50	-0.74	1.26	-0.83	1.23	-0.09	-2.25
42	Hospital services	26.22	49.49	33.14	-100.51	-52.88	7.77	-11.72	29.96	-18.87	-7.55	-9.31	-1.16
43	Convalescent/nursing homes	0.64	1.47	2.74	2.82	-1.30	-2.18	0.18	7.12	-1.67	-0.06	1.41	0.41



**Table 4.2 Linear Regression With Own-Relative Price, Demographic Effects (Continued)**

Sectors		Region			Family Size			Age		Education		Wage Earners	
		rd1	rd2	rd3	fd1	fd2	fd3	ad1	ad2	ed1	ed2	wd1	wd2
44	Health insurance	16.75	90.66	17.61	81.93	32.36	-60.92	-2.66	36.35	-59.43	61.89	-44.29	-34.39
45	Banking services	3.06	6.90	8.31	22.69	4.71	-2.81	0.75	-0.24	-4.80	0.26	-1.63	-2.10
46	Life & personal insur.	12.48	23.48	-10.12	33.76	24.62	-11.69	-16.25	6.79	-22.53	32.79	-16.70	0.87
47	Contribution to pension	45.91	36.73	236.79	-209.68	-216.61	69.65	-117.39	-311.84	-114.37	386.98	-180.35	6.26
48	Legal fees	20.58	1.81	32.83	-162.57	-70.52	32.54	-4.90	-32.03	-52.90	7.88	12.35	-28.10
49	Funeral & burial services	-6.40	-6.79	-2.94	-1.97	-7.31	-8.55	-10.42	-18.34	19.26	8.34	1.92	26.85
50	Other personal business	9.78	-0.90	38.78	17.99	-19.47	0.27	-0.15	-4.81	-19.54	1.60	-11.99	-3.86
51	New cars & trucks	15.16	164.51	-23.98	-125.35	152.79	-151.71	22.08	13.11	-147.63	14.16	-12.40	231.31
52	Used cars & trucks	147.82	103.57	62.25	346.56	123.69	-63.69	-99.16	-47.95	10.75	-94.64	-110.70	1.68
53	Other Vehicles	-0.46	8.28	12.67	-28.23	-14.85	-11.59	-13.51	-21.01	6.06	-44.06	-25.85	-23.40
54	Tires, tubes, & access.	2.05	13.10	27.07	32.35	-0.54	-4.04	-3.46	-1.09	-12.93	-13.30	-9.77	-3.82
55	Maintenance & repair	5.87	-20.67	38.94	76.08	20.44	-32.44	-45.48	36.90	-65.51	105.43	-17.66	0.70
56	Vehicle rental & charges	-1.84	-5.36	-3.88	32.63	11.25	-2.52	16.16	-10.16	-10.14	27.39	-1.75	-2.10
57	Vehicle financial charges	44.26	66.97	24.42	27.86	19.99	-18.25	24.36	-40.34	-30.49	-41.02	-41.77	27.96
58	Vehicle license & registr.	22.26	3.83	49.98	12.80	7.33	-9.90	5.01	0.69	-9.29	3.19	-7.28	-1.03
59	Gasoline & motor oil	76.09	93.78	79.59	265.04	79.68	-72.70	21.64	-73.24	-73.59	-39.71	-80.09	16.83
60	Tolls	-2.67	-2.30	-3.64	2.23	0.68	-0.18	-0.06	0.19	-0.38	1.11	-0.11	0.42
61	Vehicle insurance	-50.47	-26.11	-8.06	138.89	32.26	-34.43	14.55	-63.32	-69.68	16.97	-30.53	-9.60
62	Local transportation	-59.64	-60.84	-59.06	41.97	14.61	-8.13	-0.55	-3.97	7.93	12.42	5.52	8.56
63	Taxis	-9.94	-9.40	-8.92	16.23	2.23	-1.99	-1.68	-0.01	0.12	5.28	0.38	0.24
64	Intercity train fares	-3.10	-2.98	-0.28	-0.70	-2.09	-1.09	-1.80	1.70	-1.50	3.92	0.61	0.00
65	Intercity bus fares	-1.49	-1.05	-0.62	2.65	1.18	-0.34	-0.79	-0.14	-0.16	1.56	0.31	0.93
66	Airline fares	-18.64	-23.77	40.53	-15.73	-4.08	-0.87	-17.74	-22.13	-25.31	99.11	7.19	-7.30
67	Ship fares	-1.44	-1.49	2.24	-7.98	3.85	0.83	-4.02	-3.76	-2.92	3.80	1.71	2.39
68	Reading	-1.56	-15.22	-3.79	77.31	20.33	-9.95	7.43	0.91	-17.41	38.45	-4.25	-5.51
69	Pets, pet supplies & srvc.	0.08	9.96	9.44	-11.88	17.87	-6.92	2.32	-3.12	-30.97	17.61	-1.81	-6.91
70	Toys & playground equ.	2.67	-1.74	-4.53	-1.10	1.79	-2.08	-0.44	10.53	-5.72	2.72	-1.17	-6.26
71	Bicycles	0.98	0.77	6.52	5.30	2.22	0.85	-2.63	-2.66	-0.51	3.59	-1.22	-2.72
72	Cameras & film	-0.70	-2.24	1.45	6.11	4.71	-2.88	2.12	-4.43	-4.53	6.76	-3.26	0.61
73	Guns & sporting equ.	24.58	6.12	117.86	-244.24	-84.66	-60.02	35.01	-97.82	-86.28	-126.35	-48.27	-35.46
74	Televisions & sound equ.	-5.75	-10.64	0.70	142.25	52.17	-31.61	5.15	17.40	-22.28	-1.93	-15.74	-4.36
75	Home computers	2.13	0.01	13.73	9.71	1.10	-3.56	-10.64	-0.39	-17.67	36.00	-4.79	-6.29
76	Fresh flower & plants	-2.99	-5.39	-3.45	7.31	7.91	-2.26	2.40	-2.70	-4.41	6.28	-2.33	-3.20
77	Live entertainment	-0.66	-8.68	2.73	91.55	32.15	-7.23	9.27	-17.79	-13.20	33.93	-6.57	4.59
78	Fees for clubs & orgs.	3.93	5.24	4.66	39.55	9.14	-0.49	3.02	-8.48	-3.05	25.14	-0.17	-4.72
79	Participant amusements	5.73	-3.64	9.55	5.55	2.58	-4.19	4.06	-4.57	-13.56	9.63	-3.65	1.90
80	Other recreation	-6.82	-9.89	1.74	54.86	24.33	-3.49	1.17	-2.79	-5.78	26.25	-4.24	2.53
81	Higher education	-22.20	-28.25	-11.45	70	29	-20.14	19.12	-38.94	-27.1	101.03	11.10	35.78
82	Private lower education	1.68	2.15	-3.10	-20.88	-20.12	-0.22	-9.75	-2.50	-8.31	10.70	2.12	-4.76
83	Other edu. & research	-2.86	4.44	7.93	-0.64	8.83	-3.79	-0.91	-0.75	-5.55	6.39	1.11	6.75
84	Cash contributions	284.20	328.74	201.12	523.68	122.17	-28.69	-247.24	-141.57	-154.96	156.35	-11.93	-255.38
85	Miscellaneous	-3.51	18.65	17.25	91.02	-27.80	14.40	-38.89	5.55	-29.01	36.85	12.32	-27.45

**Table 4.3 Linear Regression With Own-Relative Price, Cohort Effects**

	Sector	Age of head in 1986<=20	20~30 (30~40 = 0)	40~50	50~60	60~70	>70
1	Food at home	-110.64	-51.64	73.19	115.26	48.17	-107.08
2	Food away from home	-40.30	-56.49	69.89	144.71	91.03	55.92
3	Alcoholic bev. at home	-16.31	-8.60	-2.17	8.96	0.71	-15.11
4	Alcoholic bev. away	-14.38	-8.43	9.44	24.41	8.17	15.96
5	Tobacco & smoking sply	-15.91	-17.12	44.91	115.31	99.19	7.89
6	Footwear	1.50	-0.33	-0.82	2.30	-0.92	3.74
7	Clothing for women	-2.00	-9.35	2.78	20.89	15.93	-10.82
8	Clothing for men	-2.99	1.37	8.56	12.77	4.28	-9.82
9	Clothing for infants	1.68	-0.11	3.07	2.28	0.71	-2.23
10	Travel items	-1.83	-1.33	-0.37	0.42	-0.24	-1.57
11	Cleaning & laundering	-1.48	-4.19	-7.38	-8.08	-11.97	-19.93
12	Watches & jewelry	-24.79	-30.23	36.69	72.89	47.33	46.65
13	Watch & jewelry repair	-0.94	-0.39	1.16	1.01	0.67	0.59
14	Personal care services	-2.46	-5.12	4.81	17.48	18.26	0.67
15	Personal care equipment	-0.62	-0.20	-0.05	0.35	0.45	0.46
16	Owned dwellings	-247.50	27.01	110.65	-10.14	-310.69	-484.17
17	Rented dwellings	232.99	53.09	-60.57	-200.56	-337.48	-312.04
18	Other lodging	-8.50	1.17	-11.71	-9.24	-11.34	-24.77
19	Furniture	-6.61	-6.27	38.73	15.84	-10.27	-35.83
20	Kitchen & hhd. app.	-8.41	-0.02	1.35	5.66	6.92	6.45
21	China & glassware	-2.23	-0.63	4.32	4.49	3.14	-0.19
22	Floor coverings	-2.30	-2.47	13.85	14.68	-4.69	-14.36
23	Other durable appliance	-8.15	-2.87	8.98	6.01	-1.11	7.91
24	Tools	-2.07	0.39	-1.80	-2.17	-1.72	3.42
25	Household textiles	-17.72	-13.39	23.14	24.50	11.78	11.31
26	Semi-durable furnishings	-1.80	-3.46	9.84	-4.12	1.89	-6.28
27	Cleaning & lighting equ.	-1.58	-0.39	-0.30	-1.18	-1.36	-1.51
28	Electricity	3.53	2.80	-0.70	-8.04	-30.62	-7.69
29	Natural gas	-37.96	-14.48	21.18	42.65	43.07	36.59
30	Water & other pub. srvc.	-10.50	2.43	-5.95	-7.56	-7.34	-11.51
31	Fuel oil & other fules	-14.22	-5.41	-8.05	-3.19	1.97	21.35
32	Telephone equipment	12.77	1.06	25.77	20.62	11.42	15.09
33	Domestic services	-6.12	-7.27	16.60	29.42	5.83	5.16
34	Household insurance	-0.92	3.89	2.63	4.47	3.13	-3.93
35	Other household oper.	-5.95	-4.11	3.61	13.48	10.21	-1.02
36	Prescription drugs	-7.66	-3.85	2.82	11.02	-8.72	15.20
37	Ophth. & orthoped. equ.	-1.89	-1.87	4.14	4.32	5.34	3.26
38	Physicians' services	-20.61	-8.95	-16.82	3.73	-0.07	-0.15
39	Dental care	2.86	-4.20	-9.48	0.56	-15.10	-17.99
40	Other srvc. by med. pro.	5.04	-0.10	-14.53	-16.95	-18.19	-13.39
41	Other medical care services	0.40	0.77	-3.73	-6.52	-7.01	-7.25
42	Hospital services	-6.13	-18.96	-7.33	6.23	-42.36	-24.89
43	Convalescent/nursing homes	-3.84	-3.14	3.31	-4.81	-8.69	-8.15

**Table 4.3 Linear Regression With Own-Relative Price, Cohort Effects (Continued)**

	Sector	Age of head in 1986<=20	20~30 (30~40 = 0)	40~50	50~60	60~70	>70
44	Health insurance	-29.53	-9.58	-28.79	4.57	27.49	-15.56
45	Banking services	-3.46	-1.86	-3.28	-4.08	-7.10	-8.96
46	Life & personal insur.	-15.29	4.62	-13.96	-14.65	-31.71	-34.89
47	Contribution to pension	113.44	90.77	-15.36	85.05	-60.83	-59.91
48	Legal fees	-64.94	-27.13	11.72	57.87	-4.86	-52.65
49	Funeral & burial services	-13.06	-12.73	100.54	57.95	-8.07	-18.65
50	Other personal business	29.93	10.56	-11.67	-28.39	-49.39	-42.64
51	New cars & trucks	86.83	-21.65	133.25	201.05	95.57	48.47
52	Used cars & trucks	96.88	10.86	40.31	-72.44	-55.45	-135.71
53	Other Vehicles	27.89	-19.83	-37.36	21.85	-23.95	-13.31
54	Tires, tubes, & access.	8.11	3.85	-2.11	-5.39	-1.94	-9.84
55	Maintenance & repair	29.81	20.36	20.72	-20.06	19.11	-27.63
56	Vehicle rental & charges	-32.18	-17.08	-5.96	-0.95	-0.20	-10.29
57	Vehicle financial charges	-33.13	-27.50	9.48	52.31	23.77	26.76
58	Vehicle license & registr.	5.08	1.39	2.20	-2.86	-9.22	-10.94
59	Gasoline & motor oil	-47.71	-33.55	40.60	69.57	79.85	25.43
60	Tolls	-0.14	-0.19	-0.23	-0.21	-0.46	-1.18
61	Vehicle insurance	-57.06	-35.42	35.82	50.95	72.26	39.87
62	Local transportation	-3.04	-4.00	-3.73	6.74	-3.27	7.68
63	Taxis	1.82	-0.78	-1.42	-0.34	-1.54	3.95
64	Intercity train fares	2.52	1.68	-1.48	-2.17	0.79	-2.98
65	Intercity bus fares	1.88	-0.22	-0.50	0.54	0.86	-1.47
66	Airline fares	-2.57	7.66	15.42	35.21	34.82	6.00
67	Ship fares	2.53	0.94	-1.83	-1.36	0.40	1.65
68	Reading	-22.66	-14.04	-6.19	-1.02	7.44	-1.33
69	Pets, pet supplies & srvc.	15.59	-4.51	-3.43	-11.19	-12.74	-23.36
70	Toys & playground equ.	8.79	2.81	-1.65	-3.39	-13.89	-17.60
71	Bicycles	-1.88	-0.47	-3.26	-3.56	-1.77	-4.58
72	Cameras & film	-1.57	-1.84	1.40	3.35	3.69	0.29
73	Guns & sporting equ.	42.99	22.43	57.15	52.83	79.62	55.13
74	Televisions & sound equ.	7.47	-4.43	7.09	1.39	-5.60	-8.22
75	Home computers	-2.37	8.40	-4.81	-7.35	0.78	-8.74
76	Fresh flower & plants	-4.47	-2.61	2.19	4.49	2.19	-0.02
77	Live entertainment	-2.95	-1.57	12.62	26.07	26.72	13.13
78	Fees for clubs & orgs.	-8.33	-6.30	-0.28	4.06	7.22	3.62
79	Participant amusements	6.80	3.50	2.47	-3.20	0.30	-7.94
80	Other recreation	-1.93	-2.87	-0.01	1.96	5.07	0.71
81	Higher education	-30.93	-17.75	49.81	30.89	41.54	16.55
82	Private lower education	3.83	2.38	8.57	5.08	13.14	14.43
83	Other edu. & research	1.82	-1.60	5.14	-2.25	-0.77	12.22
84	Cash contributions	104.23	-29.08	81.75	69.52	-156.59	-268.71
85	Miscellaneous	30.78	11.90	-17.65	17.23	-18.59	-18.85

### 3.3 $C_{it}^*$ and Weighted Population

With the result of estimation of equation (4.3.3), we are able to compute a  $C_{it}^*$  variable, which is defined as follows:

$$C_{it}^* = b_{i0} + \sum_{j=1}^5 \frac{b_{ij} Y_{jt}}{P_t} + \sum_{j=1}^{12} d_{ij} D_{jt} + \sum_{j=1}^6 c_{ij} C_{jt} + a_i \quad (4.3.4)$$

Please note that there is no price effect in this equation. Because we use  $C_{it}^*$  to capture the cross-sectional effects, and then translate the cross-sectional effects into the time series model, all the price effects will be dealt with in the time series analysis. So we set the term  $\frac{P_{it}}{P_t}$  in (4.3.2) to equal to 1.0.

There is only one  $C_{it}^*$  for each good in each year. The  $Y_{jt}$ 's are calculated by summing the amount of income over all individuals in each income bracket and then dividing the total amount in that bracket by the population<sup>25</sup>. For the demographic effects, to incorporate the results from the estimation on micro data, we replace  $D_{jt}$ 's with the proportion of the population that falls into each category. The cohort effects variables  $C_{jt}$ 's are treated in a similar way.

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<sup>25</sup> In our calculation, we use the 15 year Consumer Expenditure Survey as the data set to calculate the  $Y_{jt}$ 's.

In cross-section, we estimated the adult equivalency weights for each of the 85 consumption categories. In the second step estimation, those equivalency weights will be used to construct the relevant population sizes for different items of personal consumption expenditures. The Population Estimates<sup>26</sup> published by the Census Bureau contains series of monthly or quarterly estimates of population by each age year. With these population data, we could calculate the number of people in each age group defined in our cross-section analysis. Thus the weighted size of population for good  $i$  in year  $t$ ,  $WP_{it}$ , is calculated by the following formula:

$$WP_{it} = \sum_{g=1}^8 w_{ig} N_{gt} \quad (4.3.5)$$

where  $w_{ig}$  is the Adult Equivalency Weights for good  $i$  in age group  $g$  estimated from cross-section analysis, and  $N_{gt}$  is the population in age group  $g$  in year  $t$ .

Both the  $C_{it}^*$  variable and weighted populations are calculated for each of the 85 cross-section consumption categories. However, in our time series equations we will use the 92 IDLIFT categories. Therefore, we derive the  $C_{it}^*$  variable and weighted populations for PADS by matching the two classification systems. For categories that have no correspondence in the cross-section, the simple population total and average of estimates of  $C_{it}^*$  of all cross-section categories will be used. The details of the correspondence between the cross-section and the time series categories are represented in Table 4.4.

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<sup>26</sup> Please refer to the website of Census Bureau <http://eire.census.gov/popest/estimates.php>

**Table 4.4 Matching of 85 CES Expenditure Categories and 92 LIFT Categories**

92 LIFT Categories		85 CES Categories	
1	Meat		
2	Dairy products		
3	Poultry and eggs		
4	Fresh fruit and vegetables		
5	Processed fruit and vegetables		
6	Cereal and bakery products	1	Food at home
7	Fats and oils		
8	Sugar and sweets		
9	Nonalcoholic beverages		
10	Other prepared food		
11	Fish and seafood		
12	Pet food	69	Pets, pet supplies, and pet services
13	Alcohol for off-premise consumption	3	Alcoholic beverages at home
		4	Alcoholic beverages away from home
14	Purchased meals, food furnished for employee and on farms	2	Food away from home
15	Tobacco	5	Tobacco and smoking supplies
16	Footwear	6	Footwear
17	Clothing, Women's & girls	7	Clothing for women and girls, 2 and over
18	Clothing, Men's & boys' and military	8	Clothing for men and boys, 2 and over
19	Luggage	10	Travel items
20	Cleaning, laundering, & repair of clothing and shoes	11	Cleaning, laundering, repair of clothing and shoes
21	Jewelry & watches	12	Watches and jewelry
22	Watch repair; misc personal services	13	Watches and jewelry repair, other clothing services
23	Toilet articles & preps		(not in Interview Survey)
24	Barbershops, beauty, & health clubs	14	Personal care services for males and females
25	Owner occupied nonfarm space	16	Owned dwellings, expenses on mortgage, taxes, repairs, etc.
26	Tenant occupied nonfarm space	17	Rented dwellings
27	Other housing	18	Other lodging
28	Furniture	19	Furniture
29	Kitchen & household appliances	20	Kitchen and household appliances
30	China & glassware, tableware & utilities	21	China, glassware and utensils
31	Floor coverings	22	Floor coverings
32	Other durable house furnishings; Writing equipment	23	Other durable house furnishings and writing equipment
33	Hand tools	24	Power and non-power tools
34	Semi-durable house furnishings	25	Household textiles
		26	Semi-durable house furnishings
35	Cleaning, lighting, paper supplies	27	Cleaning and lighting supplies
36	Stationery, writing supplies		(not in Interview Survey)
37	Electricity	28	Electricity
38	Natural gas	29	Natural gas
39	Water & sanitary services	30	Water and other public services
40	Fuel oil & coal	31	Fuel oil and other fuels
41	Telephone & telegraph	32	Telephone equipment and services
42	Domestic services	33	Domestic services
43	Household Insurance premiums	34	Household insurance premiums
44	Other household operation	35	Other household operations
45	Drug preparations and sundries	36	Prescription drugs, medicines, purchase and rental of medical supplies
46	Ophthalmic & orthopedic equipment	37	Ophthalmic & orthopedic equipment
47	Physicians	38	Physicians' services
48	Dentists	39	Dental care

**Table 4.4 Matching of 85 CES Expenditure Categories and 92 LIFT Categories  
(Continued)**

92 LIFT Categories		85 CES Categories	
49	Other professional medical	40	Other services by medical professionals
50	Hospitals	41	Other medical care services and medical care in retirement community
51	Nursing homes	42	Hospital room, meals, and services
52	Health insurance premiums	43	Care in convalescent or nursing home
53	Brokerage & invest counsel	44	Health insurance premiums (not in Interview Survey)
54	Bank service charges	45	Banking services (not in Interview Survey)
55	Imputed service charges	46	Life and other personal Insurance
56	Expense of handling life insurance	48	Legal fees
57	Legal services	49	Funeral and burial services
58	Funeral & burial expenses	50	Other personal business
59	Other personal business	51	New cars and trucks
60	New autos	52	Used cars and trucks
61	Net purchases of used autos	53	Other vehicles
62	Other motor vehicles	54	Tires and tubes, accessories, and parts
63	Tires & tubes, accessories and parts	55	Maintenance and repairs of vehicles
64	Automobile repair, rental, leasing	56	Vehicle rental, and other charges
65	Gasoline & oil	59	Gasoline and motor oil
66	Tolls	60	Tolls on out-of-town trips
67	Net auto insurance premiums	61	Vehicle insurance
68	Mass transit	62	Local transportation (excl. taxis)
69	Taxicab	63	Taxis
70	Intercity rail	64	Intercity train fares on out-of-town trips
71	Intercity bus	65	Intercity bus fares on out-of-town trips
72	Airline	66	Airline fares on out-of-town trips
73	Other transportation services	67	Ship fares on out-of-town trips
74	Books & maps, Magazines and newspapers	68	Readings
75	Toys, dolls, & games	70	Toys and playground equipment
76	Bicycles, motorcycles	71	Bicycles
77	Cameras, film, and processing	72	Cameras and films
78	Guns, ammunition, sporting eq, boats, aircraft	73	Guns, ammunition, sporting eq, boats, aircraft
79	Electronic entertainment and Musical instruments	74	Televisions, radios, and sound Equipment
80	Home computers	75	Home computers
81	Flowers seeds & potted plants	76	Fresh flower or potted plants
82	Live entertainment, sports, movie admissions	77	Live entertainment, sports, movie admissions
83	Clubs & fraternal organization	78	Fees for clubs or fraternal organizations
84	Participant amusements and pari-mutuel net receipts	79	Participant amusements and pari-mutual net receipts
85	Other recreation	80	Other recreation
86	Higher education	81	Higher education
87	Private lower education	82	Private lower education
88	Other education & research	83	Other education and research
89	religious & welfare	84	Cash contributions
90	Foreign travel, and purchases abroad		(not in Interview Survey)
91	Less: exp in U.S. by foreigners		
92	Less: HH insurance benefits		
	(No correspondents in PCE-NIPA)	85	Miscellaneous
		9	Clothing for infants
		15	Personal care equipment
		47	Contribution to retirement, social security
		57	Vehicle financial charge
		58	Vehicle license and registration

### 3.4 PADS – Time Series Estimation

In the current context, we can write down the PADS equations introduced in section 1 as the following:

$$\frac{q_{it}}{WP_{it}} = [a_i + b_i t + c_i C_{it}^*] \left(\frac{P_{it}}{P_t}\right)^{-\lambda_i} \prod_{k=1}^n \left(\frac{P_{it}}{P_{kt}}\right)^{-\lambda_k s_k} \left(\frac{P_{it}}{P_{Gt}}\right)^{-\mu_G} \left(\frac{P_{it}}{P_{gt}}\right)^{-v_g} \quad (4.3.6)$$

where

$q_{it}$  is the total personal consumption expenditure of commodity  $i$  in year  $t$ ;

$WP_{it}$  is the weighted population size relevant to commodity  $i$  in year  $t$ ;

$C_{it}^*$  is the cross-section prediction of consumption on good  $i$  in year  $t$ ;

$t$  is the time trend;

$p_{kt}$  is the price index for product  $k$  in year  $t$ ;

$a_i, b_i, \lambda_i, \mu_G,$  and  $v_g$  are parameters to be estimated;

$P_t, P_{Gt}, P_{gt}$  are overall price, group price, and subgroup price indexes, respectively,

defined by

$$P_t = \prod_{k=1}^n p_{kt}^{s_k}, P_{Gt} = \left(\prod_{k \in G} p_{kt}^{s_k}\right)^{1/\sum_{k \in G} s_k} \text{ and } P_{gt} = \left(\prod_{k \in g} p_{kt}^{s_k}\right)^{1/\sum_{k \in g} s_k}$$

where  $s_k$  is the budget share of product  $k$  in the period in which the price indexes are all ones.

The data for the dependent variable used to estimate equation (4.3.6) come from the Personal Consumption Expenditure (PCE) component of the National Income and



Product Account from 1986 to 2000. The items of consumption expenditures were originally reported both in current and in constant 1987 dollars. Consumption expenditures for each item in constant 2000 dollars are computed based on the price deflators calculated from the series in current dollars and in constant 1987 dollars.

As discussed in section 1, we divide the 92 consumption categories into groups and subgroups. The idea of constructing groups and subgroups is to cut down the number of parameters and allow price interactions between groups and subgroups. Please see Table 4.5 for the groups and subgroups in our PADS estimation.

**Table 4.5 Groups and Subgroups in PADS Estimation**

Sector	Group	SbGrp	Sector	Group	SbGrp
1, Meat	1	1	46, Ophthalmic & orthopedic eq.	6	12
2, Dairy products	1	1	47, Physicians	6	11
3, Poultry and eggs	1	1	48, Dentists	6	11
4, Fresh fruit and vegetables	1	1	49, Other med professional service	6	11
5, Processed fruit and vegetables	1	1	50, Hospitals	6	11
6, Cereal and bakery products	1	1	51, Nursing homes	6	12
7, Fats and oils	1	1	52, Health insurance premiums	6	12
8, Sugar and sweets	1	1	53, Brokerage & invest counsel	7	13
9, Nonalcoholic beverages	1	1	54, Bank service charges	7	13
10, Other prepared food	1	1	55, Imputed service charges	7	14
11, Fish and seafood	1	1	56, Expense of handling life insur.	7	14
12, Pet food	9	19	57, Legal services	7	14
13, Alcohol for off-premise	1	2	58, Funeral & burial expenses	7	14
14, Purchased meals	1	2	59, Other personal business	7	14
15, Tobacco	0	0	60, New autos	8	15
16, Footware	2	4	61, Net purchases of used autos	8	15
17, Clothing, Women's & girls'	2	3	62, Other motor vehicl	8	15
18, Clothing, Men's & boys'	2	3	63, Tires & tubes, accessaoires	8	16
19, Luggages	2	4	64, Automobile repair, rental	8	16
20, Cleaning, laundering, & repairs	2	5	65, Gasoline & oil	8	0
21, Jewelry & watches	2	4	66, Tolls	8	17
22, Watch repair; personal services	2	5	67, Net auto insurance	8	16
23, Toilet articles & preps	2	5	68, Mass transit	8	17
24, Barbershops & health clubs	2	5	69, Taxicab	8	17
25, Owner occupied space	5	9	70, Intercity rail	9	18
26, Tenant occupied space	5	9	71, Intercity bus	9	18
27, Other housing	5	9	72, Airline	9	18
28, Furniture	3	6	73, Other transportation services	9	18
29, Kitchen & household app.	3	6	74, Books & maps, Magazines	10	22
30, China & glasswares	3	7	75, Toys, dolls, & games	9	19
31, Floor coverings	3	7	76, Bicycles, motorcycles	9	19
32, Other durable house furnishings	3	7	77, Cameras, film, and processing	9	19
33, Hand tools	3	7	78, Guns, ammuniton, & sport equ.	9	19
34, Semi-durable house furnishings	3	7	79, Electronical entertainment	9	19
35, Cleaning, lighting, & paper	4	0	80, Home computers	0	0
36, Stationery, writing supplies	10	22	81, Flowers seeds & potted plants	9	19
37, Electricity	5	10	82, Live entertainment	9	20
38, Natural gas	5	10	83, Clubs & fraternal orgs	9	20
39, Water & sanitary services	4	8	84, Participant amusement	9	20
40, Fuel oil & coal	5	10	85, Other recreation	9	0
41, Telephone & telegraph	4	0	86, Higher education	10	21
42, Domestic services	4	8	87, Private lower education	10	21
43, Household Insurance	4	8	88, Other education & research	10	21
44, Other household operations	4	8	89, religious & welfare	10	21
45, Drug preparations	6	12	90, Foreign travel and purchase	9	0

## SECTION 4 ESTIMATION RESULTS

The result of the estimation is summarized in Table 4.6, Table 4.7 and Figure 4.1. The second column of Table 4.6 is the number of the group to which a product was assigned. Group 1 is Food and Alcohol, 2 is Clothing, Accessories, and Personal Care, 3 is Household Durables, 4 is Household Operation, 5 is Housing and Household Utilities, 6 is Medical Equipment and Services, 7 is Personal Business Services, 8 is Transportation, 9 is Recreation and Travel. 2 consumption categories (Tobacco and Home Computers) are not assigned to any group. The third column is the subgroup. The column labeled “lambda” shows the values of lambda for each sector, while “share” gives the share in the base year. The “IncEl” column reports the income elasticity. The “DIncEl” column shows the coefficient on the change in income divided by income coefficient. Thus a value of .5 means that the coefficient on the change in income was half the value of the income coefficient. The “time%” column presents the annual change due to the time trend expressed as a percentage of the base year, The “Err%” column reports the standard error of estimates as a percentage of the 2000 value, and the “rho” column shows the autocorrelation coefficient of the residuals.

The estimation process was done with a computer program called SYMCON. The input for the program includes time series data of personal consumption expenditure, C-star variable, weighted population, price, grouping information and a time trend. Output of the program include estimated income parameters and price parameters, income elasticity, own and cross price elasticity, fitted value of personal consumption expenditure, and other diagnostic statistics.

**Table 4.6 Results of PADS Estimation, By Product**

Sector	Group	Subgrp	lambda	share	IncEI	DIncEI	time%	PrEI	Err%	rho
1, Meat	1	1	-0.10	0.010	3.43	-0.31	-1.62	-0.01	2.64	0.42
2, Dairy products	1	1	0.78	0.007	1.03	-0.64	-1.01	-0.87	1.94	0.70
3, Poultry and eggs	1	1	1.27	0.005	0.89	0.03	2.29	-1.35	5.61	0.83
4, Fresh fruit and vegetables	1	1	0.58	0.006	1.91	-0.91	-0.44	-0.68	2.73	0.76
5, Processed fruit and vegetables	1	1	0.39	0.003	3.75	-0.54	-1.59	-0.48	4.17	0.74
6, Cereal and bakery products	1	1	-0.09	0.011	1.25	-0.72	0.13	-0.02	0.99	0.49
7, Fats and oils	1	1	0.03	0.001	0.52	-0.66	-0.77	-0.13	4.70	0.76
8, Sugar and sweets	1	1	0.49	0.005	1.10	-1.24	0.81	-0.58	1.39	0.66
9, Nonalcoholic beverages	1	1	-0.10	0.010	0.86	-0.98	1.45	-0.01	1.16	-0.10
10, Other prepared food	1	1	0.65	0.011	1.28	-0.83	0.70	-0.75	1.76	0.70
11, Fish and seafood	1	1	0.00	0.001	4.12	-0.60	-2.31	-0.09	4.67	0.76
12, Pet food	9	19	0.41	0.002	0.56	-0.53	1.25	-0.89	2.38	0.61
13, Alcohol for off-premise	1	2	0.34	0.010	2.99	-0.64	-0.35	-0.24	3.03	0.52
14, Purchased meals	1	2	0.32	0.057	0.48	-0.26	1.19	-0.45	0.83	0.19
15, Tobacco	0	0	-0.06	0.011	-0.76	0.10	-4.10	-0.07	5.02	0.49
16, Footware	2	4	-0.10	0.007	1.79	-0.61	1.88	-0.01	2.63	0.80
17, Clothing, Women's & girls'	2	3	-0.20	0.025	1.34	-0.48	2.47	-0.38	2.29	0.68
18, Clothing, Men's & boys'	2	3	0.24	0.014	1.05	-0.43	2.34	-1.16	2.27	0.75
19, Luggages	2	4	-0.12	0.001	3.27	-0.50	1.60	0.00	5.91	0.63
20, Cleaning, laundering, & repairs	2	5	0.06	0.002	0.56	-0.69	-0.36	-0.10	4.10	0.59
21, Jewelry & watches	2	4	-0.08	0.008	2.43	-0.43	2.14	-0.03	4.45	0.61
22, Watch repair; personal services	2	5	0.06	0.004	2.12	-0.48	2.28	-0.11	3.62	-0.05
23, Toilet articles & preps	2	5	-0.04	0.008	0.92	-0.65	1.66	-0.02	2.31	0.70
24, Barbershops & health clubs	2	5	1.09	0.005	0.49	0.09	1.17	-1.13	3.14	0.63
25, Owner occupied space	5	9	0.06	0.104	0.37	-0.43	1.03	-0.23	0.59	0.66
26, Tenant occupied space	5	9	0.42	0.031	0.00	-3.23	-0.28	-0.84	0.84	-0.14
27, Other housing	5	9	-0.09	0.007	0.15	0.09	0.24	-0.45	1.73	0.60
28, Furniture	3	6	-0.39	0.009	1.85	-0.46	1.41	-0.14	3.45	0.71
29, Kitchen & household app.	3	6	-0.28	0.005	2.15	-0.41	2.21	-0.19	2.24	0.69
30, China & glasswares	3	7	-1.39	0.005	1.35	-0.36	2.79	-0.05	6.82	0.83
31, Floor coverings	3	7	1.24	0.003	3.89	-0.50	-1.62	-2.81	8.79	0.77
32, Other durable house furnishings	3	7	-0.13	0.006	2.51	-0.47	2.36	-1.25	3.19	0.52
33, Hand tools	9	19	-0.83	0.001	2.19	-0.42	3.05	-0.81	5.01	0.86
34, Semi-durable house furnishings	3	7	-0.59	0.006	1.13	-0.38	3.08	-0.80	1.94	0.38
35, Cleaning, lighting, & paper	4	0	0.25	0.009	0.62	-0.45	0.96	-0.50	1.34	0.71
36, Stationery, writing supplies	10	22	-1.76	0.003	0.75	-0.41	1.51	-1.07	2.56	0.49

**Table 4.6 Results of PADS Estimation, By Product (Continued)**

Sector	Group	Subgrp	lambda	share	IncEl	DIncEl	time%	PrEl	Err%	rho
37, Electricity	5	10	0.42	0.015	1.38	-0.19	0.67	-0.06	1.19	-0.08
38, Natural gas	5	10	0.53	0.006	0.30	0.27	-0.45	-0.17	4.14	0.22
39, Water & sanitary services	4	8	-0.28	0.007	1.41	-0.58	0.38	0.00	1.53	0.68
40, Fuel oil & coal	5	10	1.01	0.003	1.46	-0.30	-0.87	-0.66	5.81	0.36
41, Telephone & telegr	4	0	-0.01	0.019	2.03	-0.57	3.69	-0.20	2.99	0.75
42, Domestic services	4	8	2.75	0.002	0.10	1.47	0.82	-3.04	6.04	0.57
43, Household Insurance	4	8	-0.26	0.002	1.12	-0.46	0.63	-0.04	2.23	0.73
44, Other household operations	4	8	-0.08	0.006	1.64	-0.61	1.01	-0.20	2.72	0.59
45, Drug preparations	6	12	0.14	0.023	3.92	-0.54	3.59	-0.19	3.40	0.68
46, Ophthalmic & orthopedic eq.	6	12	0.03	0.003	1.67	-0.81	2.48	-0.10	4.56	0.42
47, Physicians	6	11	-0.41	0.036	0.01	-1.17	0.79	-1.15	1.59	0.46
48, Dentists	6	11	-1.01	0.009	0.58	-0.21	0.00	-0.98	4.84	0.84
49, Other med professional service	6	11	0.45	0.021	0.25	-0.04	3.60	-2.20	3.86	0.83
50, Hospitals	6	11	-0.80	0.058	0.21	-2.63	0.69	-0.46	2.96	0.88
51, Nursing homes	6	12	2.37	0.012	0.29	-1.38	4.60	-2.38	3.12	0.62
52, Health insurance premiums	6	12	-0.09	0.010	1.23	-0.07	-2.15	0.02	4.95	0.71
53, Brokerage & invest counsel	7	13	1.03	0.013	4.96	-0.53	4.34	-1.14	6.15	0.66
54, Bank service charges	7	14	-0.01	0.010	1.90	-0.12	2.16	-0.11	4.05	0.78
55, Imputed service charges	7	14	-0.22	0.038	1.18	-0.68	1.37	-0.02	1.62	0.26
56, Expense of handling life insur.	7	14	-0.10	0.015	0.06	1.91	0.13	-0.17	6.27	0.61
57, Legal services	7	14	-0.17	0.010	0.48	0.33	-1.19	-0.12	3.35	0.55
58, Funeral & burial expenses	7	14	-0.21	0.002	0.74	1.31	-0.53	-0.09	3.74	0.64
59, Other personal business	7	14	0.09	0.005	0.45	-0.22	1.86	-0.38	1.73	0.63
60, New autos	8	15	0.00	0.016	4.98	-0.39	-4.56	-0.06	7.11	0.39
61, Net purchases of used autos	8	15	-0.38	0.009	1.77	-0.19	1.37	0.31	2.18	0.45
62, Other motor vehicl	8	15	0.78	0.019	2.65	-0.40	1.31	-0.81	3.58	0.26
63, Tires & tubes, accessories	8	16	-0.10	0.007	2.02	-0.50	2.55	0.00	2.07	0.62
64, Automobile repair, rental	8	16	-0.06	0.026	1.83	-0.51	2.24	-0.02	3.96	0.66
65, Gasoline & oil	8	0	0.12	0.024	1.78	-0.39	0.20	-0.16	2.33	0.69
66, Tolls	8	17	2.16	0.001	0.93	-0.02	1.92	-2.37	6.73	0.64
67, Net auto insurance	8	16	-0.10	0.005	0.12	0.28	-0.37	0.00	2.57	0.83
68, Mass transit	8	17	0.02	0.001	0.57	0.03	0.41	-0.17	2.45	0.54
69, Taxicab	8	17	-0.11	0.001	1.03	-0.72	-0.51	-0.12	5.49	0.25
70, Intercity rail	9	18	0.68	0.000	1.86	-0.43	-3.69	-0.94	9.63	0.76
71, Intercity bus	9	18	1.79	0.000	1.71	0.80	-2.26	-2.05	18.14	0.58
72, Airline	9	18	-0.04	0.005	2.30	-0.56	0.78	-0.19	4.52	0.67

**Table 4.6 Results of PADS Estimation, By Product (Continued)**

<b>Sector</b>	<b>Group</b>	<b>Subgrp</b>	<b>lambda</b>	<b>share</b>	<b>IncEl</b>	<b>DIncEl</b>	<b>time%</b>	<b>PrEl</b>	<b>Err%</b>	<b>rho</b>
73, Other transportation services	9	18	-0.08	0.001	-0.44	-0.13	2.33	-0.17	5.10	0.30
74, Books & maps, Magazines	10	22	-0.14	0.010	1.91	-0.61	1.43	-0.86	1.81	0.32
75, Toys, dolls, & games	9	19	-0.41	0.007	2.39	-0.52	4.66	-0.04	2.67	0.57
76, Bicycles, motorcycles	9	19	-0.48	0.002	2.39	-0.38	2.04	-0.02	6.63	0.80
77, Cameras, film, and processing	9	19	-0.16	0.003	2.95	-0.34	0.35	-0.32	5.16	0.78
78, Guns, ammunition, & sport equ.	9	19	-0.18	0.008	1.88	-0.54	1.93	-0.26	4.45	0.77
79, Electrical entertainment	9	19	-0.27	0.011	3.71	-0.52	3.23	-0.15	3.94	0.62
80, Home computers	0	0	-0.10	0.005	1.31	-0.53	5.92	-0.03	3.58	0.60
81, Flowers seeds & potted plants	9	19	-0.13	0.003	0.96	-0.39	2.27	-0.35	2.70	0.66
82, Live entertainment	9	20	0.44	0.004	0.11	1.17	1.50	-0.69	2.89	0.81
83, Clubs & fraternal orgs	9	20	7.07	0.002	0.34	-0.49	3.02	-7.29	7.74	0.83
84, Participant amusement	9	20	0.15	0.011	1.03	-0.42	3.91	-0.38	2.13	0.63
85, Other recreation	9	20	0.61	0.019	0.23	0.33	2.72	-0.80	2.38	0.71
86, Higher education	10	21	-0.05	0.012	0.56	-0.36	0.52	0.00	1.92	0.77
87, Private lower education	10	21	0.15	0.005	0.02	-2.08	0.10	-0.19	1.43	0.37
88, Other education & research	10	21	-0.02	0.007	1.22	-0.22	3.00	-0.02	3.86	0.75
89, religious & welfare	10	21	1.59	0.028	0.08	-1.10	2.14	-1.57	2.71	0.56
90, Foreign travel and purchase	9	0	0.70	0.012	3.01	-0.50	1.09	-0.91	3.55	0.41

The original run of the program did not produce the “desired” results. There were more than 20 consumption categories with positive own price elasticity, and the income elasticity of 17 consumption categories were negative. With soft constraints on income parameters and price parameters, the program produced fairly satisfactory estimate.

Table 4.6 shows that except for Net Purchase of used automobiles (61), all of the own price elasticity are either negative or negligible. For income parameters, all but Tobacco (15) and Other transportation services (73) have positive income elasticity. While it is difficult to understand the positive own price effect, the negativity income effect can be explained. Consumption of Tobacco (15) is usually determined by factors other than price and income. Other transportation services (73) is mainly ship fares on out-of-town trips. It is hard to believe that most of the families will choose to spend more on traveling by ship with rising household income. The “Err%” column shows the fitness of the model. Except for Intercity Bus (71), 89 out of the 90 consumption categories have standard error of estimates less than 10 percentage of the 2000 value.

Table 4.7 shows the estimated coefficients for each group and subgroup, with own and cross price elasticity. The estimates for group and subgroup price parameters ( $\mu$ 's and  $\nu$ 's) are also shown for each group and subgroup. The reason for putting consumption categories into groups and subgroups was to cut down the number of parameters in the price terms in the PADS. At the same time, the grouping and subgrouping allows us to look at substitution and complementarity between goods. Two goods (A and B) are substitutes when the household will decrease the expenditure on

good A when spend more on good B. Two goods are complementary to each other if increase in the consumption of good A means a respondent increase in consumption of good B. We can also use the cross price elasticity to tell whether two good are substitutes or complements. In general, positive cross price elasticity imply substitutability and negative cross price elasticity suggests complemenarity. Own and cross price elasticities are shown in a matrix for goods in each group. In each of matrix, the number in row  $i$  and column  $j$  is the elasticity of product  $i$  with respect to the price of product  $j$ .

Group 1:      Food and Alcohol

There are two subgroups in the first group. The first subgroup is Food and Alcohol at Home, including Meat (1), Dairy products (2), Poultry and eggs (3), Fresh fruit and vegetables (4), Processed fruit (5), Cereal and bakery products (6), Fats and oils (7), Sugar and sweets (8), Nonalcoholic beverages (9), Other prepared food (10) and Fish and seafood (11); the second subgroup is Food and Alcohol away from Home, including Alcohol for off-premise consumption (13) and Purchased meals, food furnished for employee and on farms (14). The signs of cross price elasticities of 11 food products in the first subgroup change in the same direction in response to the price of any member of the subgroup. Purchases of other products in the subgroup are not affected by the prices of fruits (4, 5), Fats and oils (7), Sugar and sweets (8), and Fish and seafood (11). Price elasticities are negative for the prices of Meat (1), Cereal and bakery products (6), and Nonalcoholic beverages (9) and positive for Dairy



**Table 4.7 Results of PADS Estimation, By Group and Subgroup**

**Group 1: FOOD AND ALCOHOL**

Equation	SUBGRP	LAMBDA	SHARE	IncElas	OwnElas	Mu	Nu
1, Meat	1	-0.10	0.010	3.43	-0.01	0.21	-0.24
2, Dairy products	1	0.78	0.007	1.03	-0.87		
3, Poultry and eggs	1	1.27	0.005	0.89	-1.35		
4, Fresh fruit and vegetables	1	0.58	0.006	1.91	-0.68		
5, Processed fruit and vegetables	1	0.39	0.003	3.75	-0.48		
6, Cereal and bakery products	1	-0.09	0.011	1.25	-0.02		
7, Fats and oils	1	0.03	0.001	0.52	-0.13		
8, Sugar and sweets	1	0.49	0.005	1.10	-0.58		
9, Nonalcoholic beverages	1	-0.10	0.010	0.86	-0.01		
10, Other prepared food	1	0.65	0.011	1.28	-0.75		
11, Fish and seafood	1	0.00	0.001	4.12	-0.09		
13, Alcohol for off-premise	2	0.34	0.010	2.99	-0.24		-0.48
14, Purchased meals	2	0.32	0.057	0.48	-0.45		

**PRICE ELASTICITIES**

	<u>1</u>	<u>2</u>	<u>3</u>	<u>4</u>	<u>5</u>	<u>6</u>	<u>7</u>
<u>1</u>	-0.01	0.00	0.01	0.00	0.00	-0.03	0.00
<u>2</u>	-0.01	-0.87	0.01	0.00	0.00	-0.02	0.00
<u>3</u>	-0.01	0.01	-1.35	0.01	0.00	-0.01	0.00
<u>4</u>	-0.02	0.01	0.01	-0.68	0.00	-0.02	0.00
<u>5</u>	-0.02	0.01	0.01	0.00	-0.48	-0.02	0.00
<u>6</u>	-0.02	0.00	0.01	0.00	0.00	-0.02	0.00
<u>7</u>	-0.02	0.00	0.01	0.00	0.00	-0.02	-0.13
<u>8</u>	-0.02	0.01	0.01	0.00	0.00	-0.02	0.00
<u>9</u>	-0.02	0.00	0.01	0.00	0.00	-0.02	0.00
<u>10</u>	-0.01	0.01	0.01	0.00	0.00	-0.02	0.00
<u>11</u>	-0.02	0.00	0.01	0.00	0.00	-0.02	0.00
<u>13</u>	0.02	0.02	0.02	0.02	0.01	0.02	0.00
<u>14</u>	0.02	0.02	0.02	0.02	0.01	0.02	0.00

	<u>8</u>	<u>9</u>	<u>10</u>	<u>11</u>	<u>13</u>	<u>14</u>	
<u>1</u>	0.00	-0.02	0.00	0.00	0.02	0.12	
<u>2</u>	0.00	-0.01	0.01	0.00	0.03	0.17	
<u>3</u>	0.00	-0.01	0.01	0.00	0.04	0.19	
<u>4</u>	0.00	-0.02	0.01	0.00	0.03	0.15	
<u>5</u>	0.00	-0.02	0.01	0.00	0.03	0.14	
<u>6</u>	0.00	-0.02	0.00	0.00	0.02	0.12	
<u>7</u>	0.00	-0.02	0.00	0.00	0.02	0.12	
<u>8</u>	-0.58	-0.02	0.01	0.00	0.03	0.15	
<u>9</u>	0.00	-0.01	0.00	0.00	0.02	0.12	
<u>10</u>	0.00	-0.02	-0.75	0.00	0.03	0.16	
<u>11</u>	0.00	-0.02	0.00	-0.09	0.02	0.12	
<u>13</u>	0.01	0.02	0.03	0.00	-0.24	-0.24	
<u>14</u>	0.01	0.02	0.03	0.00	-0.04	-0.45	

**SUBGROUP**

- 1 Food and Alcohol, at Home
- 2 Food and Alcohol, away from Home

products (2) and Poultry and eggs (3), Other prepared food (10). The cross price elasticities of the 2 food products in the second subgroup show that they are complements to each other, and substitutes to the food products in the first subgroup. The cross price elasticities of food products in the first subgroup are positive for the prices of the food products (especially to Purchased meals) in the second subgroup.

#### Group 2: Clothing, Accessories, and Personal Care

There are three subgroups in this group. The first subgroup is Clothing, including Women's Clothing (17) and Men's Clothing (18); the second subgroup is Accessories, including Footwear (16), Luggage (19), and Jewelry and watches (21); the third subgroup is Personal care items, including Cleaning, laundering, & repair of clothing and shoes (20), Watch repair; misc personal services (22), Toilet articles & preps (23) and Barbershops, beauty, & health clubs (24).

Men's Clothing (18) has higher own price elasticity than Women's Clothing (17). This may be due to the fact that women have stronger and more inelastic demand for clothing. Luggage (19), Jewelry and Watches (21), Watch repair; misc personal services (22) has higher income elasticity because they are luxury good compared with Cleaning, laundering, & repair of clothing and shoes (20), Toilet articles & preps (23), and Barbershops, beauty & health club (24). The income elasticities of Women's Clothing (17), Men's Clothing (18), and Footwear (16) lie in between. This may be explained by the facts that some of clothing and footwear are necessities and some are luxuries.

**Table 4.7 Results of PADS Estimation, By Group and Subgroup (Continued)**

**Group 2: CLOTHING, ACCESSORIES, AND PERSONAL CARE**

Equation	SUBGR	AMBDA	SHARE	IncElas	OwnElas	Mu	Nu
17, Clothing, Women's & girls'	3	-0.20	0.025	1.34	-0.38	-0.02	1.28
18, Clothing, Men's & boys'	3	0.24	0.014	1.05	-1.16		
16, Footwear	4	-0.10	0.007	1.79	-0.01		0.01
19, Luggage	4	-0.12	0.001	3.27	0.00		
21, Jewelry & watches	4	-0.08	0.008	2.43	-0.03		
20, Cleaning, laundering, & repairs	5	0.06	0.002	0.56	-0.10		-0.07
22, Watch repair; personal services	5	0.06	0.004	2.12	-0.11		
23, Toilet articles & preps	5	-0.04	0.008	0.92	-0.02		
24, Barbershops & health clubs	5	1.09	0.005	0.49	-1.13		

**PRICE ELASTICITIES**

	<u>17</u>	<u>18</u>	<u>16</u>	<u>19</u>	<u>21</u>	<u>20</u>	<u>22</u>
<u>17</u>	-0.38	0.46	0.00	0.00	0.00	0.00	0.00
<u>18</u>	0.81	-1.16	0.00	0.00	0.00	0.00	0.00
<u>16</u>	-0.02	0.00	-0.01	0.00	0.00	0.00	0.00
<u>19</u>	-0.02	0.00	0.00	0.00	0.00	0.00	0.00
<u>21</u>	-0.02	0.00	0.00	0.00	-0.03	0.00	0.00
<u>20</u>	-0.01	0.00	0.00	0.00	0.00	-0.10	-0.02
<u>22</u>	-0.01	0.00	0.00	0.00	0.00	-0.01	-0.11
<u>23</u>	-0.02	0.00	0.00	0.00	0.00	-0.01	-0.02
<u>24</u>	0.01	0.02	0.00	0.00	0.01	-0.01	-0.01

	<u>23</u>	<u>24</u>
<u>17</u>	0.00	0.01
<u>18</u>	0.00	0.01
<u>16</u>	0.00	0.01
<u>19</u>	0.00	0.01
<u>21</u>	0.00	0.01
<u>20</u>	-0.03	0.00
<u>22</u>	-0.03	0.00
<u>23</u>	-0.02	0.00
<u>24</u>	-0.02	-1.13

**SUBGROUP**

- 3 Clothing
- 4 Accessories
- 5 Personal Care Items

The within-subgroup or inter-subgroup cross price elasticities are not prominent except for Clothing. Men's Clothing (18) are a good substitute for Women's Clothing (17), and Women's Clothing (17) are not as good a substitute for Men's Clothing (18). When looking at the own and cross price elasticities within the subgroup of Clothing, we find Men's clothing is more price elastic than Women's. This interesting observation can be explained by the phenomenon that Women's clothing has more styles and Men's has relatively few. Therefore, when the price of clothing of a particular style rises, Women and Men will naturally turn to other styles. However, Men usually has fewer substitutes than Women. In another word, it is easier for Women than for Men to continue purchasing clothing when the price is on the rise.

### Group 3: Household Durables

There are two subgroups in this group. The first subgroup is Major household durables, including Furniture (28) and Kitchen & household appliances (29); the second subgroup is Minor household durables, including China & glassware, tableware & utilities (30), Floor coverings (31), Other durable house furnishings; Writing equipment (32), Hand tools (33), Semi-durable house furnishings (34). Products in these two subgroups can be necessities, but can be luxuries as well. Households with lower income level usually consume "lower end" part of the market, while household with higher income level quite often occupy the "higher end" part of the market. The income elasticities of the all the items are greater than 1, and the Floor coverings (31) and Other

**Table 4.7 Results of PADS Estimation, By Group and Subgroup (Continued)**

**Group 3: HOUSEHOLD DURABLES**

Equation	SUBGR	LAMBDA	SHARE	IncElas	OwnElas	Mu	Nu
28, Furniture	6	-0.39	0.009	1.85	-0.14	0.84	-0.57
29, Kitchen & household app.	6	-0.28	0.005	2.15	-0.19		
30, China & glasswares	7	-1.39	0.005	1.35	-0.05		0.78
31, Floor coverings	7	1.24	0.003	3.89	-2.81		
32, Other durable house furnishings	7	-0.13	0.006	2.51	-1.25		
33, Hand tools	7	-0.83	0.001	2.19	-0.81		
34, Semi-durable house furnishings	7	-0.59	0.006	1.13	-0.80		

**PRICE ELASTICITIES**

	<u>28</u>	<u>29</u>	<u>30</u>	<u>31</u>	<u>32</u>	<u>33</u>	<u>34</u>
<u>28</u>	-0.14	-0.08	0.10	0.07	0.13	0.03	0.13
<u>29</u>	-0.15	-0.19	0.10	0.07	0.13	0.03	0.13
<u>30</u>	0.21	0.12	-0.05	0.17	0.34	0.09	0.33
<u>31</u>	0.23	0.13	0.29	-2.81	0.35	0.09	0.35
<u>32</u>	0.22	0.12	0.29	0.17	-1.25	0.09	0.34
<u>33</u>	0.21	0.12	0.28	0.17	0.34	-0.81	0.34
<u>34</u>	0.21	0.12	0.28	0.17	0.34	0.09	-0.80

**SUBGROUP**

6 Major Household Durables  
7 Minor Household Durables

durable house furnishings (32) are also price elastic. The estimated parameters depend to a great extent on how many of the surveyed households occupy which segment of the market.

The table of cross elasticities shows that the purchases of Furniture (28) and Kitchen & household appliance (29) move together in response to prices of either their own or items in the second subgroup.

#### Group 4: Household Operation

There is one subgroup in this group. It's Services and Insurance, including Water and Sanitary services (39), Domestic services (42), Household Insurance (43) and Other household operations (44). Cleaning, lighting, paper supplies (35) and Telephone & telegraph services (41) are not put into any subgroup.

Except for Domestic services (42), all the items in this group are price inelastic. Telephone & telegraph services (41), Water and Sanitary services (39), Household Insurance (43) and Other household operations (44) have income elasticities that are greater than 1.

There are insignificant cross price effects among the four items within the subgroup of Services and Insurance.

#### Group 5: Housing and Household Utilities

**Table 4.7 Results of PADS Estimation, By Group and Subgroup (Continued)**

**Group 4: HOUSEHOLD OPERATION**

Equation	SUBGRP	LAMBDA	SHARE	IncElas	OwnElas	Mu	Nu
35, Cleaning, lighting, & paper	0	0.25	0.009	0.62	-0.50	0.16	0.03
41, Telephone & telegraph	0	-0.01	0.019	2.03	-0.20		
39, Water & sanitary services	8	-0.28	0.007	1.41	0.00		
42, Domestic services	8	2.75	0.002	0.10	-3.04		
43, Household Insurance	8	-0.26	0.002	1.12	-0.04		
44, Other household operations	8	-0.08	0.006	1.64	-0.20		

**PRICE ELASTICITIES**

	<u>35</u>	<u>41</u>	<u>39</u>	<u>42</u>	<u>43</u>	<u>44</u>	
<u>35</u>	-0.50	0.07	0.02	0.02	0.01	0.02	
<u>41</u>	0.03	-0.20	0.02	0.02	0.01	0.02	
<u>39</u>	0.03	0.06	0.00	0.03	0.01	0.03	
<u>42</u>	0.06	0.12	0.05	-3.04	0.01	0.05	
<u>43</u>	0.03	0.06	0.03	0.03	-0.04	0.03	
<u>44</u>	0.03	0.06	0.03	0.03	0.01	-0.20	

**SUBGROUP**

8

Services and Insurance

**Table 4.7 Results of PADS Estimation, By Group and Subgroup (Continued)**

**Group 5: HOUSING AND HOUSEHOLD UTILITIES**

Equation	SUBGRP	LAMBDA	SHARE	IncElas	OwnElas	Mu	Nu
25, Owner occupied space	9	0.06	0.104	0.37	-0.23	-0.55	0.99
26, Tenant occupied space	9	0.42	0.031	0.00	-0.84		
27, Other housing	9	-0.09	0.007	0.15	-0.45		
37, Electricity	10	0.42	0.015	1.38	-0.06		0.08
38, Natural gas	10	0.53	0.006	0.30	-0.17		
40, Fuel oil & coal	10	1.01	0.003	1.46	-0.66		

**PRICE ELASTICITIES**

	<u>25</u>	<u>26</u>	<u>27</u>	<u>37</u>	<u>38</u>	<u>40</u>	
<u>25</u>	-0.23	0.15	0.02	-0.04	-0.01	0.00	
<u>26</u>	0.44	-0.84	0.03	-0.03	-0.01	0.00	
<u>27</u>	0.39	0.15	-0.45	-0.04	-0.01	0.00	
<u>37</u>	-0.29	-0.06	-0.02	-0.06	0.01	0.01	
<u>38</u>	-0.28	-0.06	-0.02	0.03	-0.17	0.01	
<u>40</u>	-0.23	-0.05	-0.02	0.03	0.02	-0.66	

**SUBGROUP**                    9        Housing  
                                      10        Housing Utilities



There are two subgroups in this group. The first is Housing, including Owner occupied space (25), Tenant occupied space (26), and Other Housing (27); the second subgroup is Housing utilities, including Electricity (37), Natural gas (38), and Fuel oil & coal (40). For items in each subgroup, the own price elasticities are negative and less than 1, with the Electricity (37) least price elastic. The income elasticities are all positive with Electricity (37) and Fuel oil & coal (40) greater than 1.

Within the subgroup of Housing, there are significant substitution effects between the three housing items. When the price of Owner occupied space (25) increases, the purchase of Tenant occupied space rises, and vice versa. However, the purchase of Owner occupied space (25) and Tenant occupied space (26) is not quite responsive to the price change in Other housing (27). Within the subgroup of Housing utilities, there are insignificant substitution effects.

The cross price elasticities also tells that housing utilities, as a group, responds negatively and significantly to the price change of Owner occupied space (25) , but insignificantly to Tenant occupied space (26) and Other housing (27). The reason can be the facts that price of many Tenant occupied space (26) and Other housing (27) covers the utilities, while the price of Owner occupied space (25) does not. There is prominent complementarity between Owner occupied space (25) and the subgroup of Housing Utilities.

Group 6: Medical Equipment and Services

**Table 4.7 Results of PADS Estimation, By Group and Subgroup (Continued)**

**Group 6: MEDICAL EQUIPMENT AND SERVICES**

Equation	SUBGRP	LAMBDA	SHARE	IncElas	OwnElas	Mu	Nu
47, Physicians	11	-0.41	0.036	0.01	-1.15	-0.11	2.11
48, Dentists	11	-1.01	0.009	0.58	-0.98		
49, Other med professional service	11	0.45	0.021	0.25	-2.20		
50, Hospitals	11	-0.80	0.058	0.21	-0.46		
45, Drug preparations	12	0.14	0.023	3.92	-0.19		0.07
46, Ophthalmic & orthopedic eq.	12	0.03	0.003	1.67	-0.10		
51, Nursing homes	12	2.37	0.012	0.29	-2.38		
52, Health insurance premiums	12	-0.09	0.010	1.23	0.02		

**PRICE ELASTICITIES**

	<u>47</u>	<u>48</u>	<u>49</u>	<u>50</u>	<u>45</u>	<u>46</u>	<u>51</u>
<u>47</u>	-1.15	0.12	0.36	0.78	-0.02	0.00	0.04
<u>48</u>	0.51	-0.98	0.35	0.75	-0.03	-0.01	0.04
<u>49</u>	0.56	0.13	-2.20	0.83	0.00	0.00	0.05
<u>50</u>	0.52	0.12	0.36	-0.46	-0.03	0.00	0.04
<u>45</u>	-0.05	-0.02	0.01	-0.12	-0.19	0.00	0.09
<u>46</u>	-0.05	-0.02	0.01	-0.13	0.03	-0.10	0.09
<u>51</u>	0.03	0.00	0.05	0.01	0.08	0.01	-2.38
<u>52</u>	-0.06	-0.03	0.00	-0.14	0.02	0.00	0.09

	<u>52</u>
<u>47</u>	-0.01
<u>48</u>	-0.02
<u>49</u>	0.00
<u>50</u>	-0.02
<u>45</u>	0.01
<u>46</u>	0.00
<u>51</u>	0.03
<u>52</u>	0.02

**SUBGROUP**                      11      Physicians and Hospitals  
   12      Drugs and Equipments

There are two subgroups in this group. The first subgroup is Physicians and hospitals, including Physicians (47), Dentists (48), Other professional medical services (49) and Hospitals (50); the second subgroup is Drugs and equipments, including drug preparations and sundries (45), Ophthalmic & orthopedic equipment (46), Nursing homes (51) and Health insurance premiums (52).

Except for Health insurance premium (52), all consumption items in the group have negative own price elasticities, with those of Physicians (47), Other professional medical services (49) and Nursing homes (51) greater than 1. All of the consumption items in this group have positive income elasticities, with those of Drug preparations (45), Ophthalmic & orthopedic equipment (46), and Health insurance premium (52) greater than 1.

The cross price elasticities of subgroup of Physicians and hospitals show significant substitution effects between the four items within this subgroup. It is not easy to understand why people should go to see a dentist when physician's service become more expensive, as fixing the eye problems probably does help other parts of the body. The significant substitution effects could partly be explained by the ways people put their money into medical insurance. There is a "medical flexible spending account", into which people can put a portion of their payroll on a pre-tax base. As medical expenses occur, they submit their claim to the plan administrators and get that money back from the account. The limit for this system is that if people don't use up all of the money

within the year, there is no refund. This type of insurance system could explain why when seeing a physician becomes more expensive, people will spend more on dentist, other medical professional services, or hospitals. The cross price elasticities of subgroup of Drugs and equipments show insignificant substitution effects between the items within this subgroup. There is also a complementarity effects between some of the consumption items in the two subgroups. Purchases of Physicians (47), Dentists (48) and Hospitals (50) have negative price elasticities in response to the price change of Drug preparations (45) and Health insurance premium (52). Purchases of Drugs preparations (45), Ophthalmic & orthopedic equipment (46) and Health insurance premium (52) are negatively affected by the prices of Physicians (47), Dentists (48) and Hospitals (50).

#### Group 7: Personal Business Services

There are two subgroups in this group. The first is banking services, including Brokerage & invest counsel (53), and Bank service charges (54); the second subgroup is Other personal services, including Imputed service charges (55), Expense of handling life insurance (56), Legal services (57), Funeral & burial expenses (58) and Other personal business (59).

The own price elasticities of all consumption items in this group are negative, with that of Brokerage & invest counsel (53) greater than 1. The income elasticities of all consumption items in this group are positive, with those of Brokerage & invest counsel (53), Bank service charges (54), and Imputed service charges (55) greater than 1. The price and income elasticity of

**Table 4.7 Results of PADS Estimation, By Group and Subgroup (Continued)**

**Group 7: PERSONAL BUSINESS SERVICES**

Equation	SUBGRP	LAMBDA	SHARE	IncElas	OwnElas	Mu	Nu
53, Brokerage & invest counsel	13	1.03	0.013	4.96	-1.14	0.08	-0.13
54, Bank service charges	13	-0.01	0.010	1.90	-0.11		
55, Imputed service charges	14	-0.22	0.038	1.18	-0.02		0.10
56, Expense of handling life insur.	14	-0.10	0.015	0.06	-0.17		
57, Legal services	14	-0.17	0.010	0.48	-0.12		
58, Funeral & burial expenses	14	-0.21	0.002	0.74	-0.09		
59, Other personal business	14	0.09	0.005	0.45	-0.38		

**PRICE ELASTICITIES**

	<u>53</u>	<u>54</u>	<u>55</u>	<u>56</u>	<u>57</u>	<u>58</u>	<u>59</u>
<u>53</u>	-1.14	-0.04	0.06	0.03	0.02	0.00	0.01
<u>54</u>	-0.02	-0.11	0.02	0.01	0.01	0.00	0.01
<u>55</u>	0.04	0.01	-0.02	0.03	0.02	0.00	0.01
<u>56</u>	0.04	0.01	0.06	-0.17	0.02	0.00	0.01
<u>57</u>	0.04	0.01	0.06	0.03	-0.12	0.00	0.01
<u>58</u>	0.04	0.01	0.06	0.03	0.02	-0.09	0.01
<u>59</u>	0.04	0.01	0.07	0.03	0.02	0.00	-0.38

**SUBGROUP**

13 Banking Services  
 14 Other Personal Services

Brokerage & invest counsel (53) shows that it is a luxury good. For Bank service charges (54), it has both necessity and luxury part. Funeral & burial expenses (58) is price inelastic.

The cross price effects between all the consumption item within either subgroup is positive and insignificant.

#### Group 8:       Transportation

There are three subgroups in this group. The first subgroup is Durable purchase, including New autos (60), Net purchases of used autos (61) and Other motor vehicles (62); the second subgroup is Maintenance expenses except gasoline, including Tires & tubes, accessories and parts (63), Automobile repair, rental, leasing (64), Net auto insurance premiums (67); the third subgroup is Public transportation, including Tolls (66), Mass transit (68), and Taxicab (69).

Except for Net purchases of used autos (61), the own price elasticities of all of the consumption items are either negative or zero, with that of Tolls (66) greater than 1. The income elasticities of all of the consumption items are positive, with those of Gasoline & oil (65), New autos (60), Net purchases of used autos (61), Other motor vehicles (62), Tires & tubes, accessories and parts (63), and Automobile repair, rental, leasing (64), and Taxicab (69) greater than 1.

**Table 4.7 Results of PADS Estimation, By Group and Subgroup (Continued)**

**Group 8: TRANSPORTATION**

Equation	SUBGRP	LAMBDA	SHARE	IncElas	OwnElas	Mu	Nu
65, Gasoline & oil	0	0.12	0.024	1.78	-0.16	-0.09	
60, New autos	15	0.00	0.016	4.98	-0.06		0.02
61, Net purchases of used autos	15	-0.38	0.009	1.77	0.31		
62, Other motor vehicl	15	0.78	0.019	2.65	-0.81		
63, Tires & tubes, accessaoies	16	-0.10	0.007	2.02	0.00		0.08
64, Automobile repair, rental	16	-0.06	0.026	1.83	-0.02		
67, Net auto insurance	16	-0.10	0.005	0.12	0.00		
66, Tolls	17	2.16	0.001	0.93	-2.37		0.25
68, Mass transit	17	0.02	0.001	0.57	-0.17		
69, Taxicab	17	-0.11	0.001	1.03	-0.12		

**PRICE ELASTICITIES**

	<u>65</u>	<u>60</u>	<u>61</u>	<u>62</u>	<u>63</u>	<u>64</u>	<u>67</u>
<u>65</u>	-0.16	-0.01	-0.01	0.02	-0.01	-0.02	0.00
<u>60</u>	-0.01	-0.06	-0.01	0.04	-0.01	-0.02	0.00
<u>61</u>	-0.02	-0.01	0.31	0.03	-0.01	-0.03	-0.01
<u>62</u>	0.00	0.01	-0.01	-0.81	0.00	0.00	0.00
<u>63</u>	-0.02	-0.01	-0.01	0.01	0.00	0.03	0.00
<u>64</u>	-0.02	-0.01	-0.01	0.01	0.01	-0.02	0.00
<u>67</u>	-0.02	-0.01	-0.01	0.01	0.01	0.03	0.00
<u>66</u>	0.04	0.02	0.00	0.05	0.01	0.03	0.00
<u>68</u>	-0.01	-0.01	-0.01	0.01	-0.01	-0.02	0.00
<u>69</u>	-0.02	-0.01	-0.01	0.01	-0.01	-0.03	-0.01

	<u>66</u>	<u>68</u>	<u>69</u>
<u>65</u>	0.00	0.00	0.00
<u>60</u>	0.00	0.00	0.00
<u>61</u>	0.00	0.00	0.00
<u>62</u>	0.00	0.00	0.00
<u>63</u>	0.00	0.00	0.00
<u>64</u>	0.00	0.00	0.00
<u>67</u>	0.00	0.00	0.00
<u>66</u>	-2.37	0.13	0.05
<u>68</u>	0.07	-0.17	0.05
<u>69</u>	0.07	0.13	-0.12

**SUBGROUP**

- 15 Durable Purchases
- 16 Maintenance expenses except gasoline
- 17 Public Transportation

The income elasticity of New autos (60) is close to 5, the highest among all of the 90 sectors. There are two elements contributing to the very high elasticity. The first element is that car is indispensable to every U.S. family, and the second that a new car is affordable to most families.

The within-subgroup or inter-subgroup cross price effects are insignificant except for the subgroup of Public transportation. Spending on Tolls (66), Mass transit (68) and Taxicab (69) are substitutes to each other.

Group 9: Recreation and Travel

There are three subgroups in this group. The first subgroup is Travel expenses, including Foreign travel, and purchases abroad (90), Intercity rail (70), Intercity bus (71) and Airline (72); the second is recreational non-durables and durables, including Other transportation services (73), Pet food (12), Toys, dolls, & games (75), Bicycles, motorcycles (76), Cameras, film, and processing (77), Guns, ammunition, sporting equipment, boats, aircraft (78), Electronic entertainment and Musical instruments (79), and Flowers seeds & potted plants (81); the third subgroup is Admissions, including Live entertainment, sports, movie admissions (82), Clubs & fraternal organization (83), and Participant amusements and pari-mutuel net receipts (84).



**Table 4.7 Results of PADS Estimation, By Group and Subgroup (Continued)**

**Group 9: RECREATION AND TRAVEL**

Equation	SUBGR	AMBDA	SHARE	IncElas	OwnElas	Mu	Nu
85, Other recreation	0	0.61	0.019	0.23	-0.80	0.12	
90, Foreign travel and purchase	18	0.70	0.012	3.01	-0.91		0.02
70, Intercity rail	18	0.68	0.000	1.86	-0.94		
71, Intercity bus	18	1.79	0.000	1.71	-2.05		
72, Airline	18	-0.04	0.005	2.30	-0.19		
73, Other transportation services	19	-0.08	0.001	-0.44	-0.17		0.27
12, Pet food	19	0.41	0.002	0.56	-0.89		
75, Toys, dolls, & games	19	-0.41	0.007	2.39	-0.04		
76, Bicycles, motorcycles	19	-0.48	0.002	2.39	-0.02		
77, Cameras, film, and processing	19	-0.16	0.003	2.95	-0.32		
78, Guns, ammunition, & sport equ.	19	-0.18	0.008	1.88	-0.26		
79, Electronical entertainment	19	-0.27	0.011	3.71	-0.15		
81, Flowers seeds & potted plants	19	-0.13	0.003	0.96	-0.35		
82, Live entertainment	20	0.44	0.004	0.11	-0.69		0.02
83, Clubs & fraternal orgs	20	7.07	0.002	0.34	-7.29		
84, Participant amusement	20	0.15	0.011	1.03	-0.38		

**PRICE ELASTICITIES**

	<u>85</u>	<u>90</u>	<u>70</u>	<u>71</u>	<u>72</u>	<u>73</u>	<u>12</u>
<u>85</u>	-0.80	0.04	0.00	0.00	0.01	0.00	0.01
<u>90</u>	0.06	-0.91	0.00	0.00	0.01	0.00	0.01
<u>70</u>	0.06	0.04	-0.94	0.00	0.02	0.00	0.01
<u>71</u>	0.08	0.05	0.00	-2.05	0.03	0.00	0.01
<u>72</u>	0.05	0.03	0.00	0.00	-0.19	0.00	0.01
<u>73</u>	0.05	0.03	0.00	0.00	0.02	-0.17	0.00
<u>12</u>	0.06	0.04	0.00	0.00	0.01	0.00	-0.89
<u>75</u>	0.04	0.03	0.00	0.00	0.00	0.00	0.02
<u>76</u>	0.04	0.03	0.00	0.00	0.00	0.00	0.02
<u>77</u>	0.04	0.03	0.00	0.00	0.01	0.00	0.02
<u>78</u>	0.04	0.03	0.00	0.00	0.01	0.00	0.02
<u>79</u>	0.04	0.03	0.00	0.00	0.01	0.00	0.02
<u>81</u>	0.05	0.03	0.00	0.00	0.01	0.00	0.02
<u>82</u>	0.06	0.04	0.00	0.00	0.01	0.00	0.01
<u>83</u>	0.18	0.12	0.00	0.00	0.04	0.01	0.02
<u>84</u>	0.05	0.03	0.00	0.00	0.01	0.00	0.01

**PRICE ELASTICITIES**

	<u>75</u>	<u>76</u>	<u>77</u>	<u>78</u>	<u>79</u>	<u>81</u>	<u>82</u>
<u>85</u>	0.01	0.00	0.00	0.01	0.02	0.00	0.01
<u>90</u>	0.01	0.00	0.00	0.01	0.02	0.00	0.01
<u>70</u>	0.01	0.00	0.00	0.01	0.02	0.00	0.01
<u>71</u>	0.02	0.00	0.01	0.02	0.03	0.01	0.02
<u>72</u>	0.00	0.00	0.00	0.01	0.01	0.00	0.01
<u>73</u>	0.00	0.00	0.00	0.01	0.01	0.00	0.01
<u>12</u>	0.05	0.01	0.02	0.07	0.10	0.02	0.01
<u>75</u>	-0.04	0.01	0.02	0.06	0.09	0.02	0.01
<u>76</u>	0.05	-0.02	0.02	0.06	0.09	0.02	0.01
<u>77</u>	0.05	0.01	-0.32	0.06	0.09	0.02	0.01
<u>78</u>	0.05	0.01	0.02	-0.26	0.09	0.02	0.01
<u>79</u>	0.05	0.01	0.02	0.06	-0.15	0.02	0.01
<u>81</u>	0.05	0.01	0.02	0.06	0.09	-0.35	0.01
<u>82</u>	0.01	0.00	0.00	0.01	0.01	0.00	-0.69
<u>83</u>	0.05	0.01	0.02	0.06	0.09	0.02	0.04
<u>84</u>	0.00	0.00	0.00	0.01	0.01	0.00	0.02
<hr/>							
	<u>83</u>	<u>84</u>					
<u>85</u>	0.04	0.02					
<u>90</u>	0.04	0.03					
<u>70</u>	0.04	0.02					
<u>71</u>	0.04	0.04					
<u>72</u>	0.04	0.02					
<u>73</u>	0.04	0.02					
<u>12</u>	0.04	0.02					
<u>75</u>	0.04	0.01					
<u>76</u>	0.04	0.01					
<u>77</u>	0.04	0.02					
<u>78</u>	0.04	0.02					
<u>79</u>	0.04	0.01					
<u>81</u>	0.04	0.02					
<u>82</u>	0.06	0.04					
<u>83</u>	-7.29	0.11					
<u>84</u>	0.06	-0.38					

**SUBGROUP**

- 18 Travel expenses
- 19 Recreational nondurables and durables
- 20 Admissions

The own price elasticities of all of the consumption items are negative, with those of Intercity bus (71) and Clubs & fraternal organization (83) greater than 1. Except for Other transportation services (73), the income elasticities of all of the consumption items are positive, with those of Foreign travel, and purchases abroad (90), Intercity rail (70), Intercity bus (71), Airline (72), Toys, dolls, & games (75), Bicycles, motorcycles (76), Cameras, film, and processing (77), Guns, ammunition, sporting equipment, boats, aircraft (78), Electronic entertainment and Musical instruments (79), and Participant amusements and pari-mutuel net receipts (84) greater than 1. Many of consumption items in this group exhibit characteristics of luxury goods.

The cross price effects between or within the subgroups are insignificant. There are insignificant substitution effects between the items within the subgroup of Travel expenses, and insignificant substitution effects between the consumption items within the subgroup of Admissions.

#### Group 10: Reading and Education

There are two subgroups in this group. The first is Education and religious expenses, including Higher education (86), Private lower education (87), Other education & research (88) and Religious & welfare (89); the second subgroup is Reading, including Stationery, writing supplies (36) and Books & maps, Magazines and newspapers (74).

**Table 4.7 Results of PADS Estimation, By Group and Subgroup (Continued)**

**Group 10: READING AND EDUCATION**

Equation	SUBGRP	LAMBDA	SHARE	IncElas	OwnElas	Mu	Nu
86, Higher education	21	-0.05	0.012	0.56	0.00	-0.11	0.03
87, Private lower education	21	0.15	0.005	0.02	-0.19		
88, Other education & research	21	-0.02	0.007	1.22	-0.02		
89, religious & welfare	21	1.59	0.028	0.08	-1.57		
36, Stationery, writing supplies	22	-1.76	0.003	0.75	-1.07		3.77
74, Books & maps, Magazines	22	-0.14	0.010	1.91	-0.86		

**PRICE ELASTICITIES**

	<u>86</u>	<u>87</u>	<u>88</u>	<u>89</u>	<u>36</u>	<u>74</u>	
<u>86</u>	0.00	0.00	-0.01	0.10	-0.02	-0.02	
<u>87</u>	-0.02	-0.19	-0.01	0.10	-0.02	-0.02	
<u>88</u>	-0.02	0.00	-0.02	0.10	-0.02	-0.02	
<u>89</u>	0.00	0.00	0.00	-1.57	-0.01	0.00	
<u>36</u>	-0.04	-0.02	-0.02	-0.01	-1.07	2.76	
<u>74</u>	-0.02	-0.01	-0.01	0.04	0.95	-0.86	

**SUBGROUP**

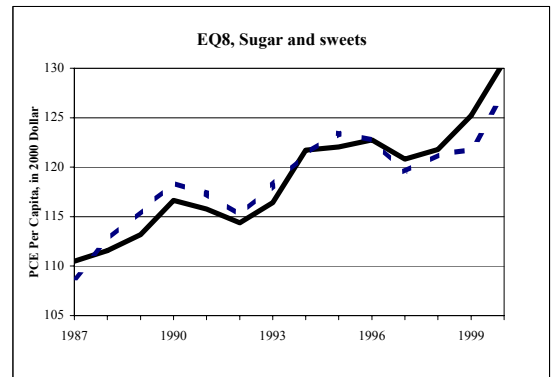
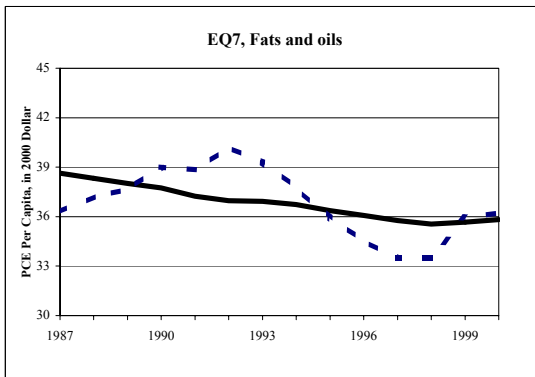
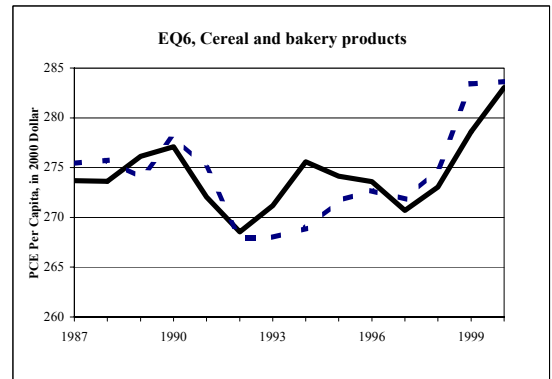
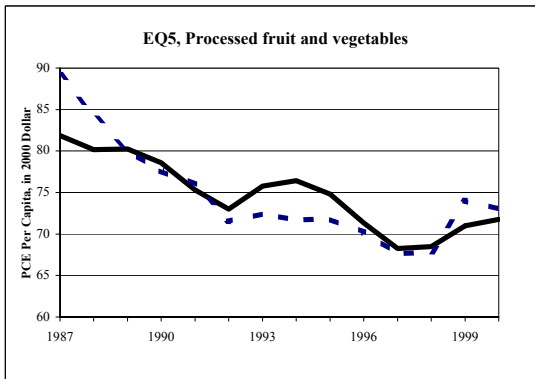
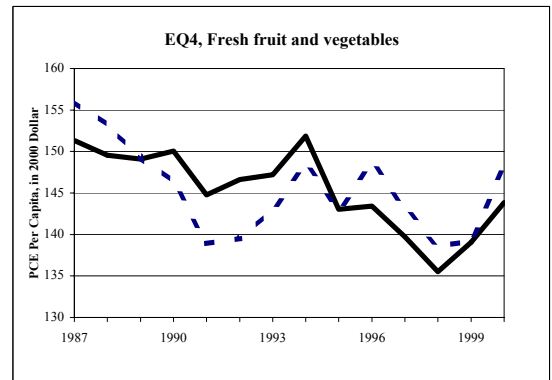
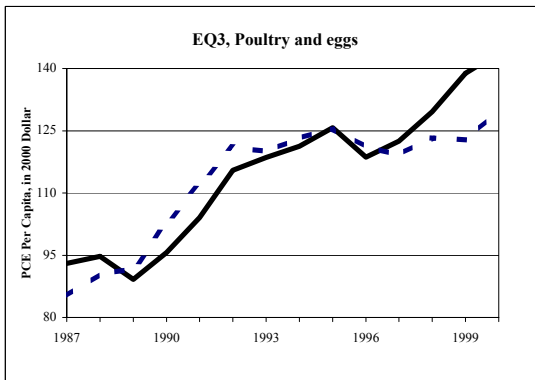
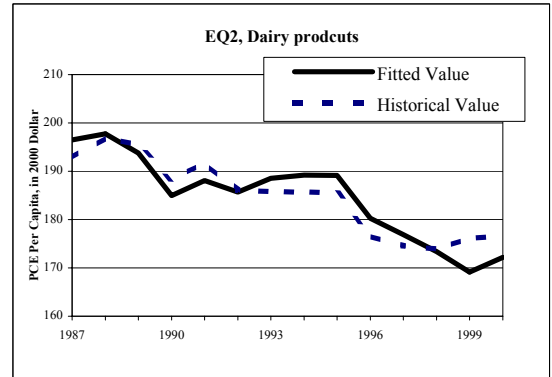
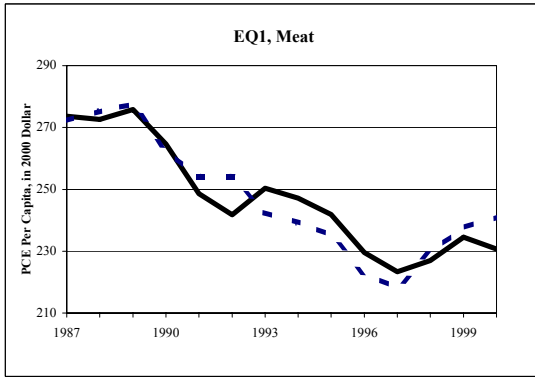
21 Education and religious  
 22 Reading

The own price elasticities of all of the consumption items are either negative or zero, with those of Religious & welfare (89) and Stationery, writing supplies (36) greater than 1. The income elasticities of all of the consumption items are positive, with those of Other education & research (88) and Books & maps, Magazines and newspapers (74) greater than 1.

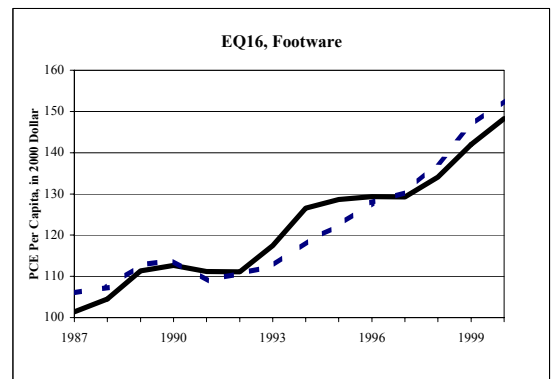
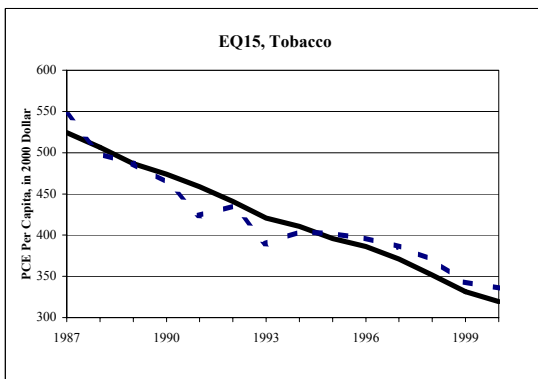
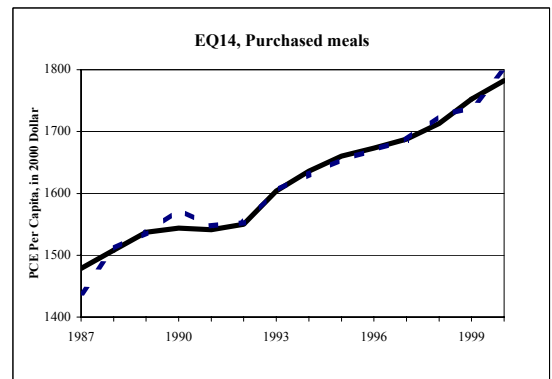
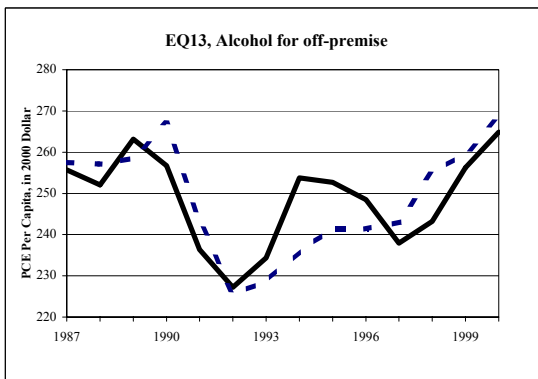
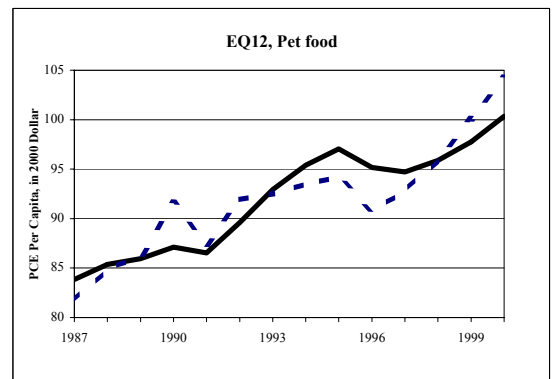
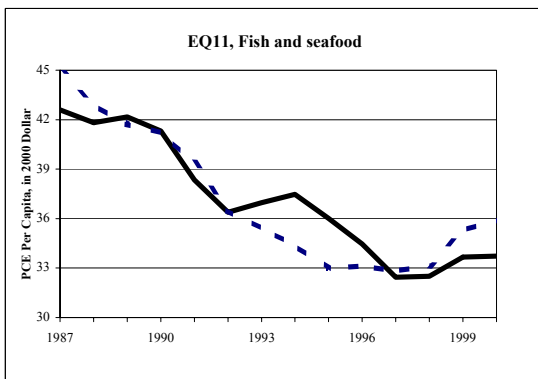
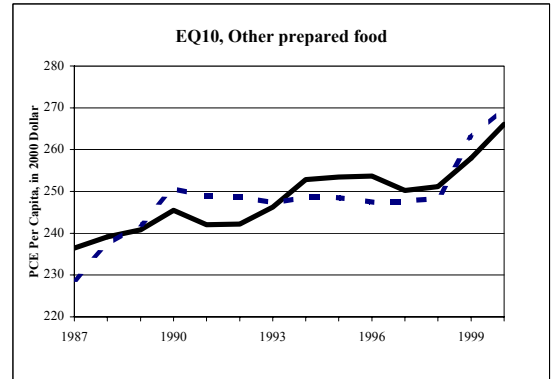
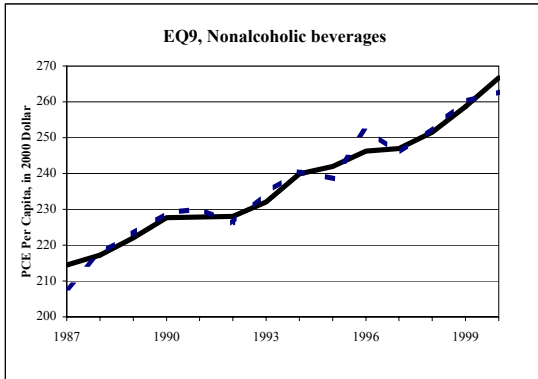
There are insignificant complementary effects between Higher education (86), Private lower education (87) and Other education & research (88). Higher price of Higher education (86) decreases the expenses on Private lower education (87) and Other education & research. Price of Private and lower education (87) has no effect on the expenses on Higher education (86) and Other education & research (88). Higher price of Other education & research (88) decreases the expenses on Higher education (86) and Private and lower education (87). There is significant substitution effect between Religious & welfare (89) and education (86, 87, 88). The prices of education have no effect on the Religious & welfare (89), but when Religious & welfare is more expensive, households respond with receiving more education (86, 87, 88).

For the subgroup of Reading, there is an interesting substitution effects. Although we tend to accept the complementarity effect, that people who read more usually write more, the significant positive cross price elasticities are telling the opposite story.

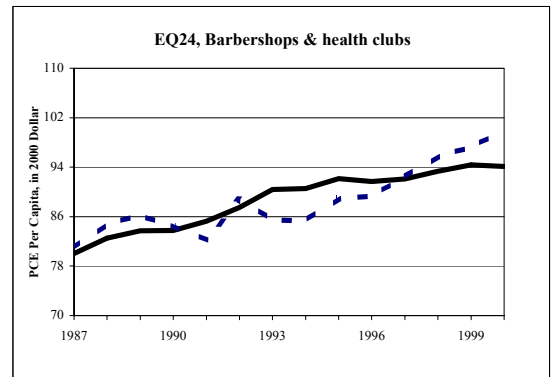
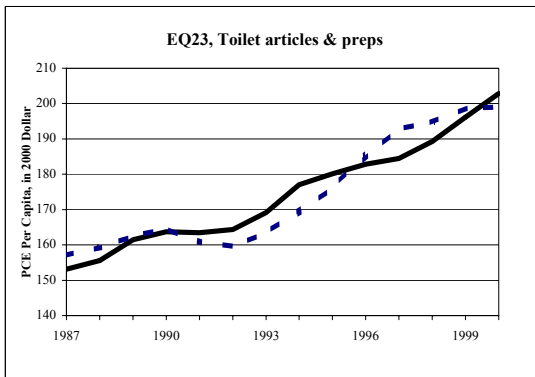
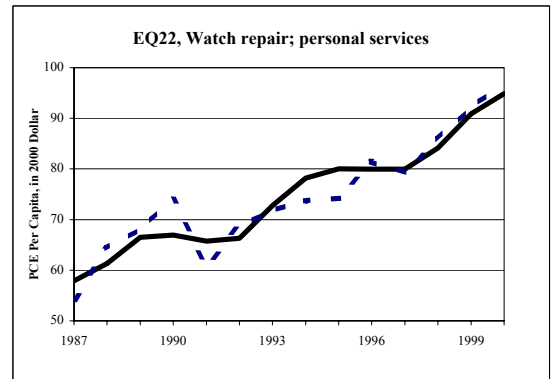
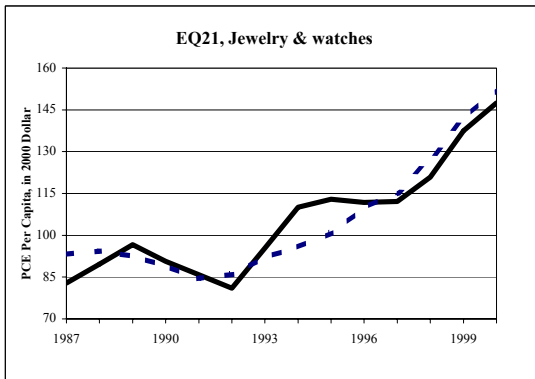
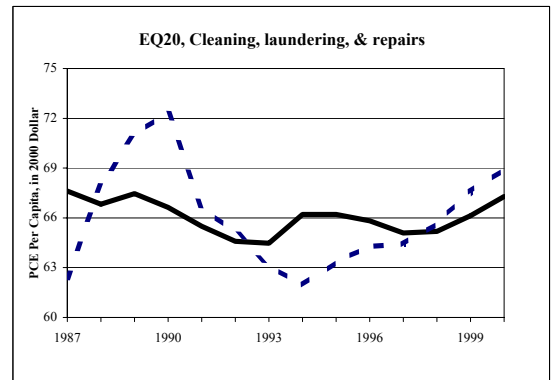
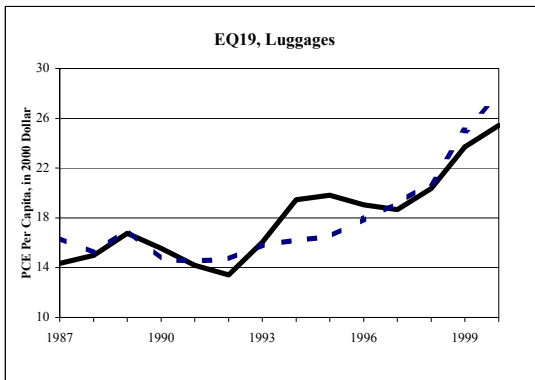
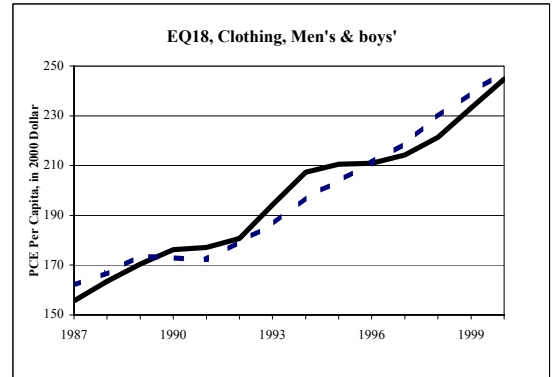
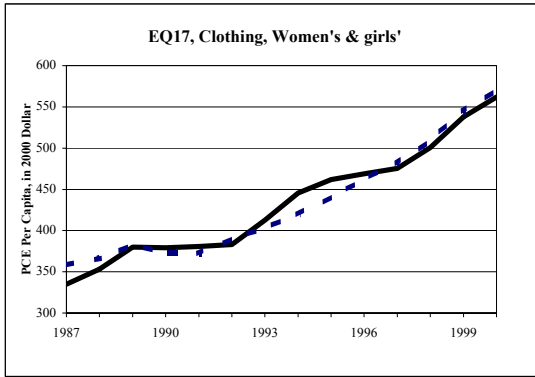
**Figure 4.1 Results of PADS Estimation, Personal Consumption**



**Figure 4.1 Results of PADS Estimation, Personal Consumption (Continued)**

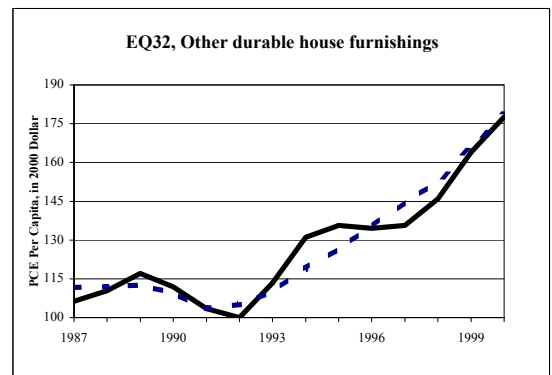
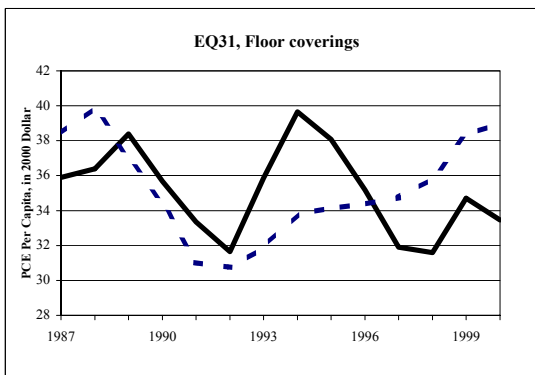
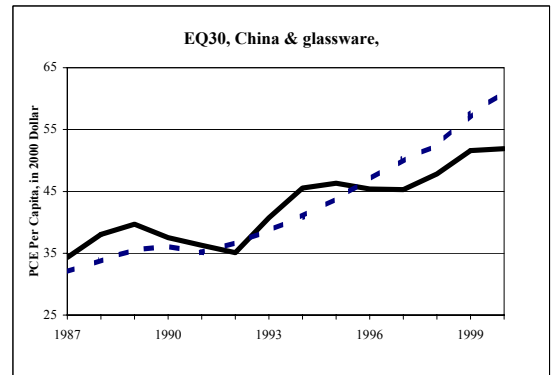
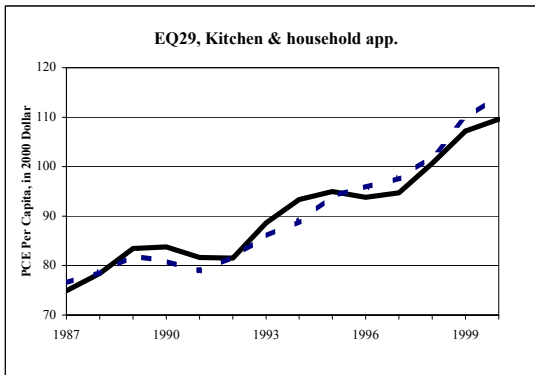
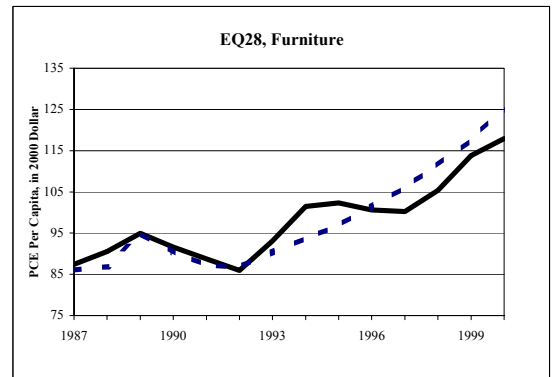
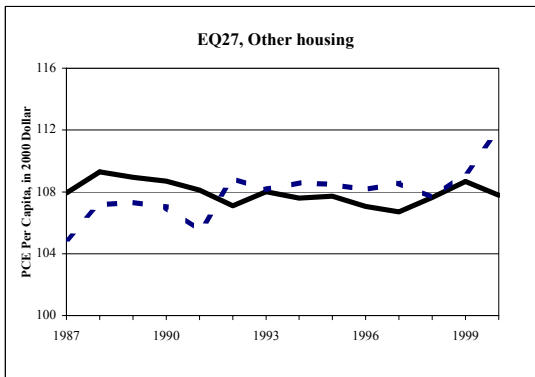
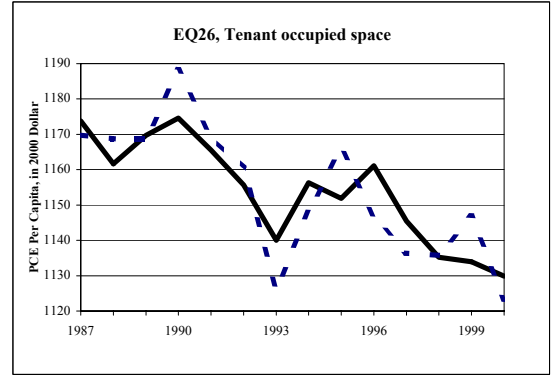
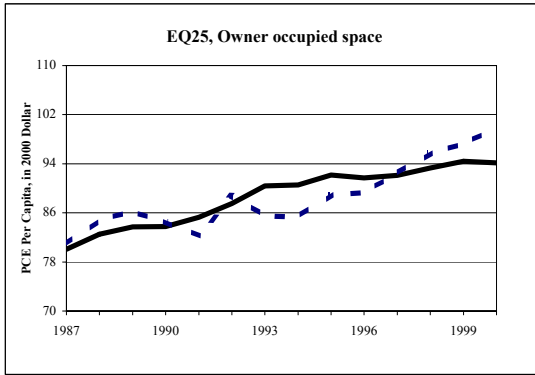


**Figure 4.1 Results of PADS Estimation, Personal Consumption (Continued)**

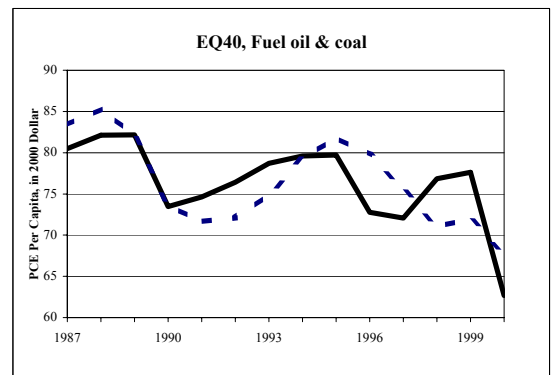
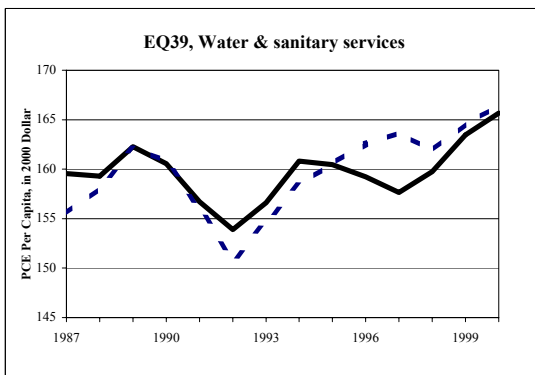
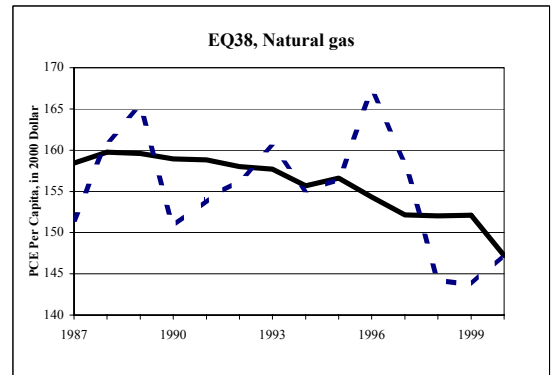
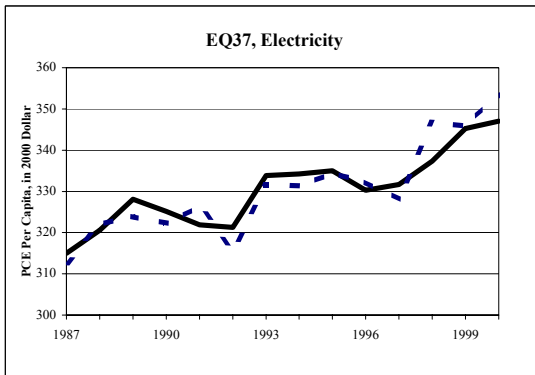
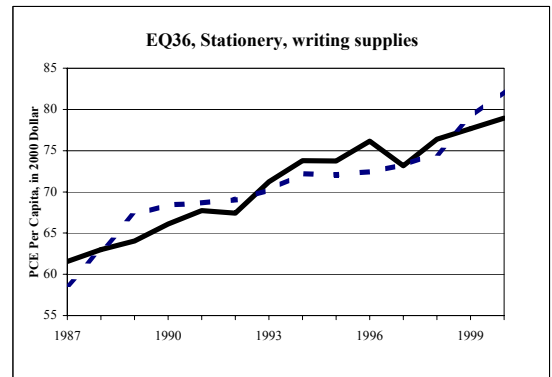
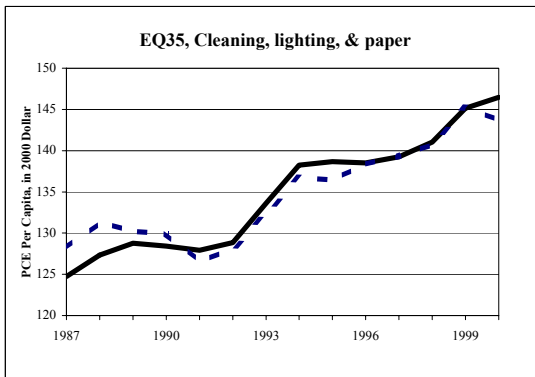
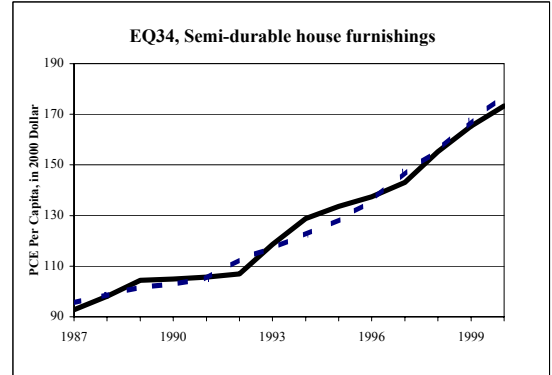
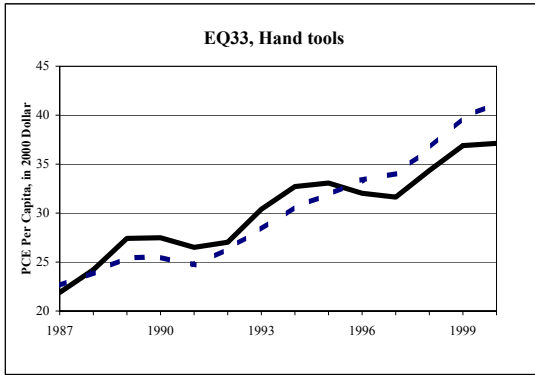




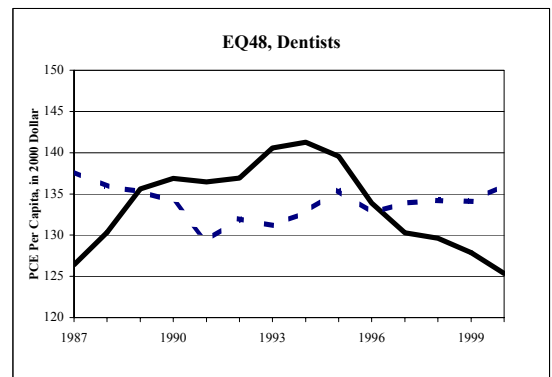
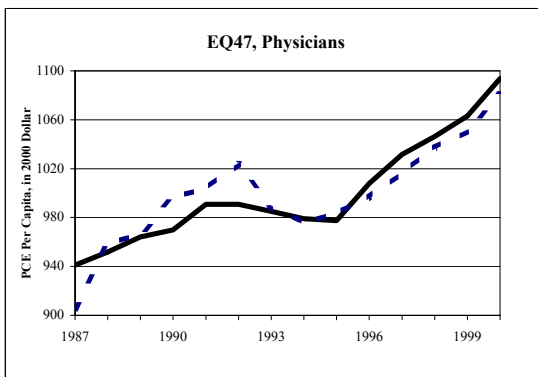
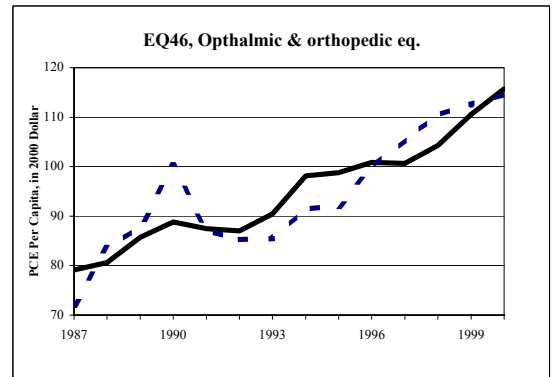
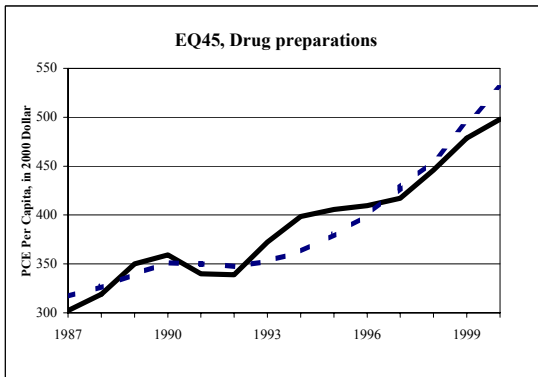
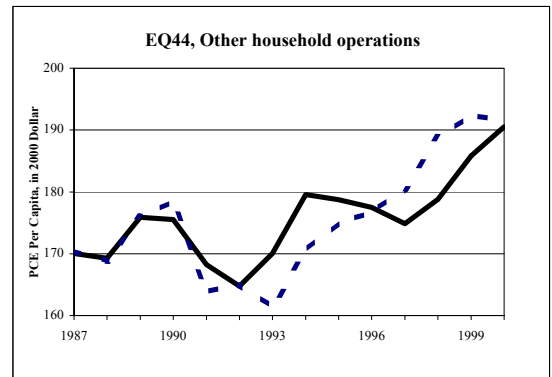
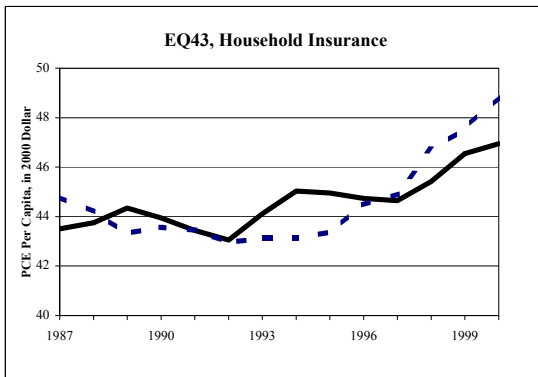
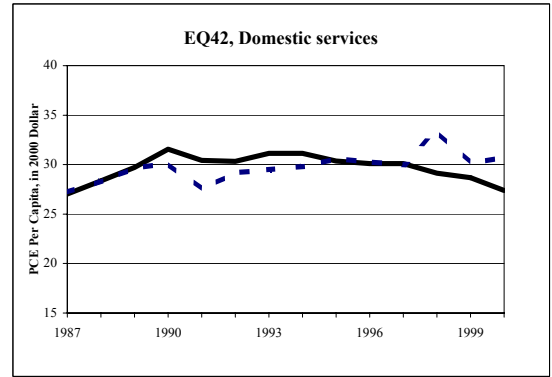
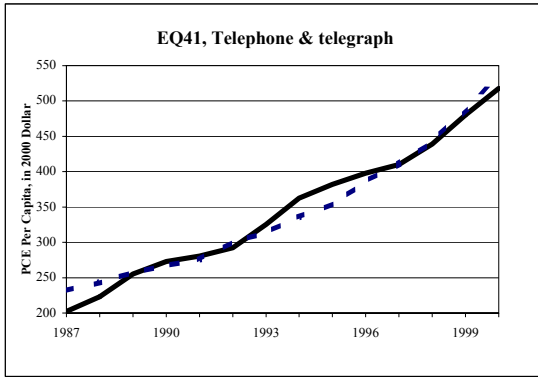
**Figure 4.1 Results of PADS Estimation, Personal Consumption (Continued)**



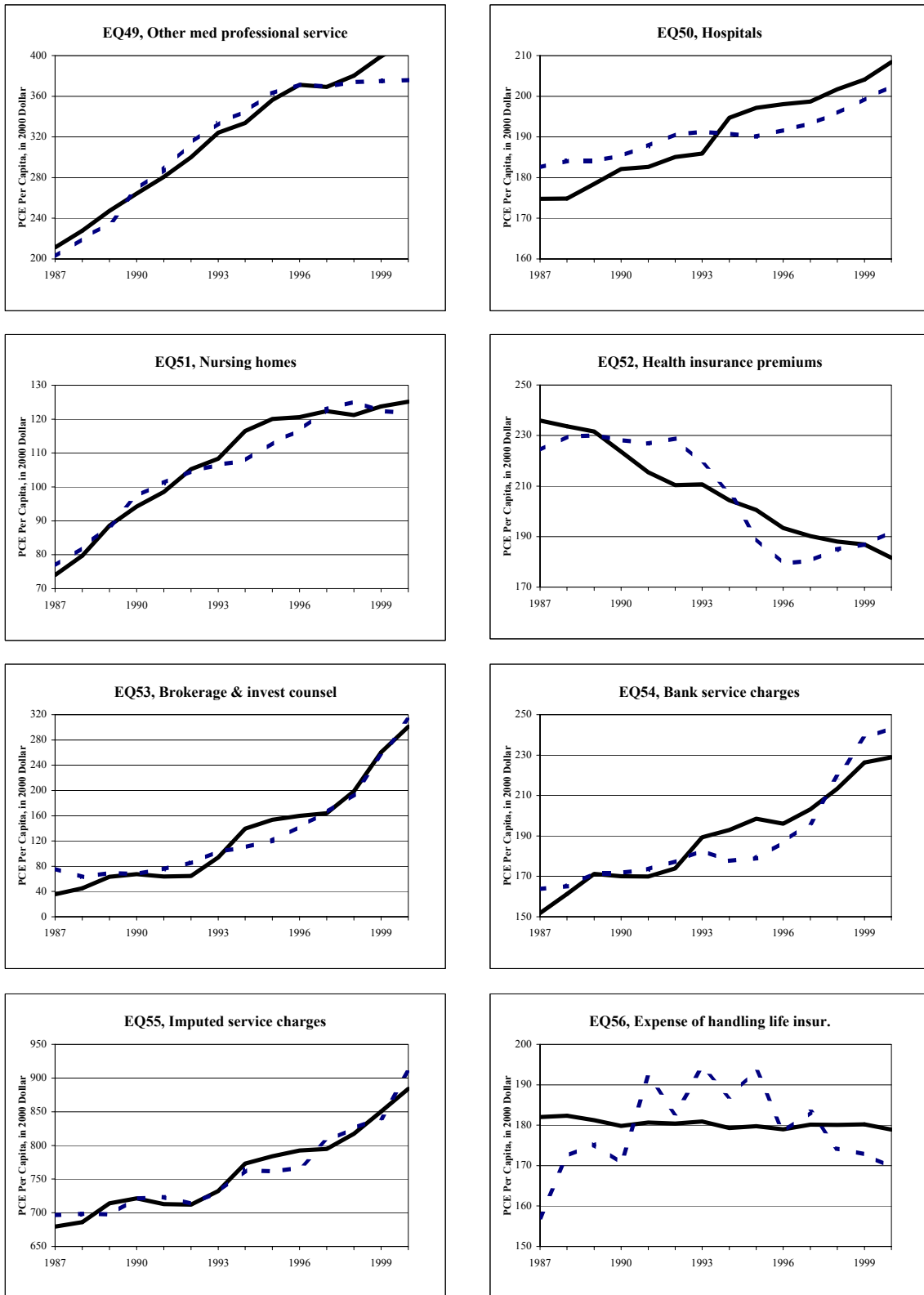
**Figure 4.1 Results of PADS Estimation, Personal Consumption (Continued)**



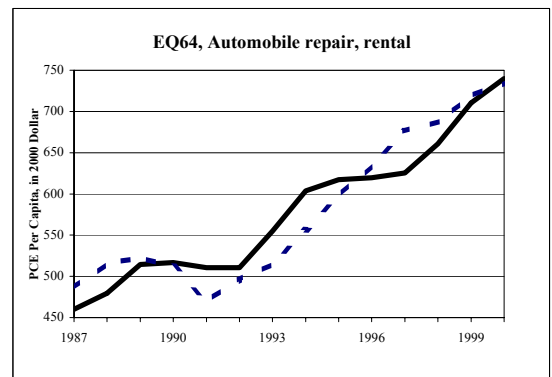
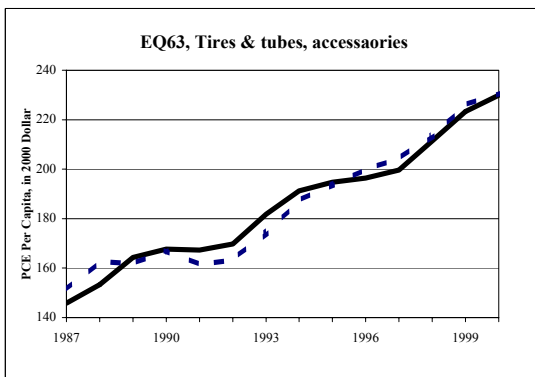
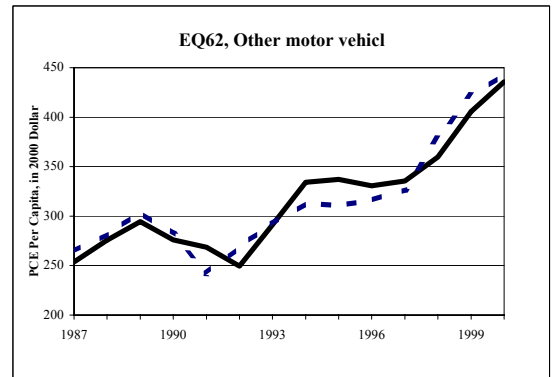
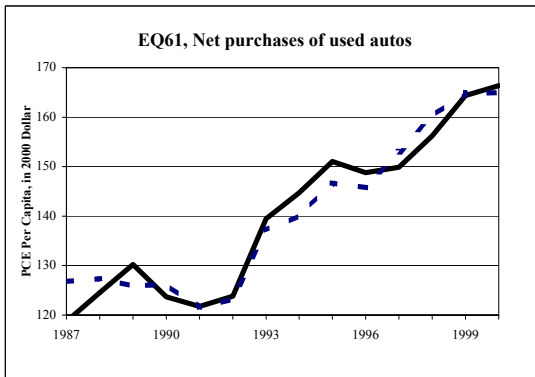
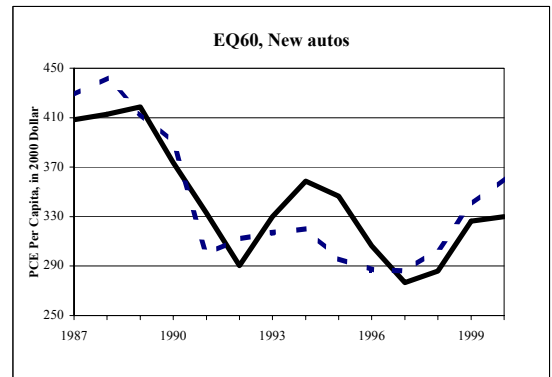
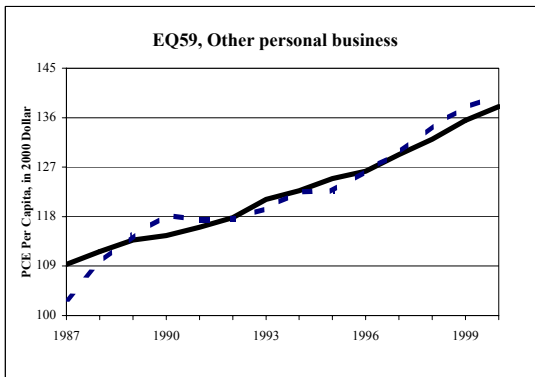
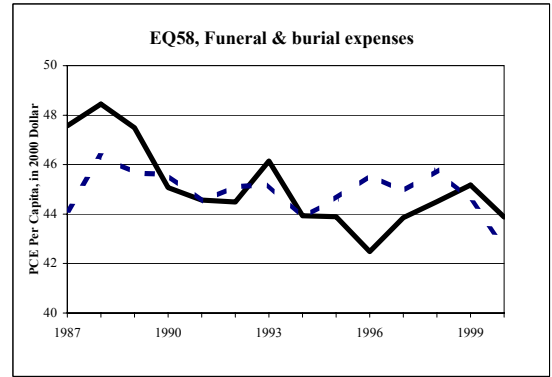
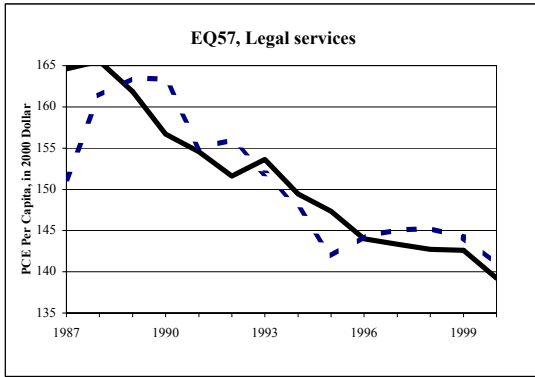
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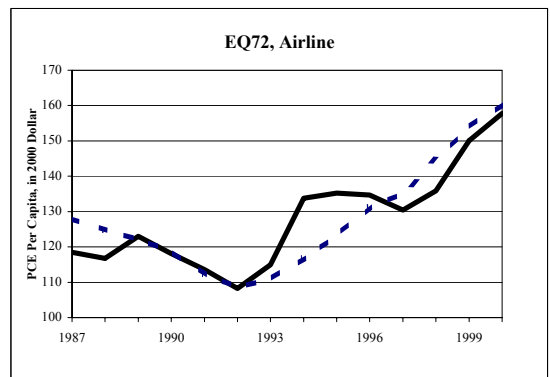
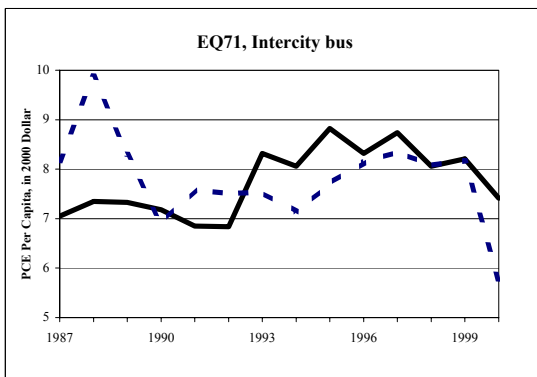
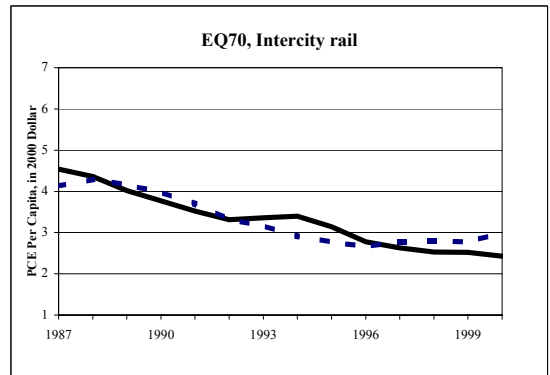
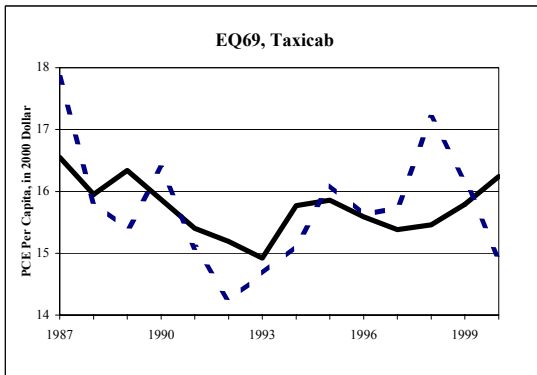
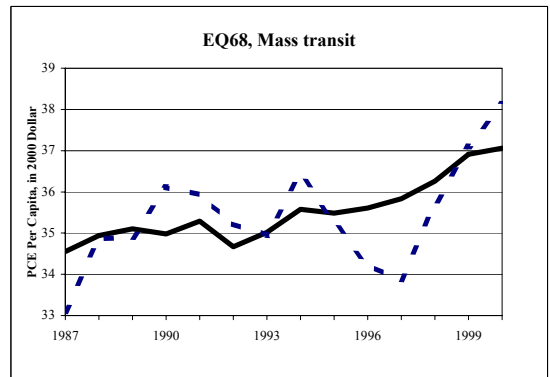
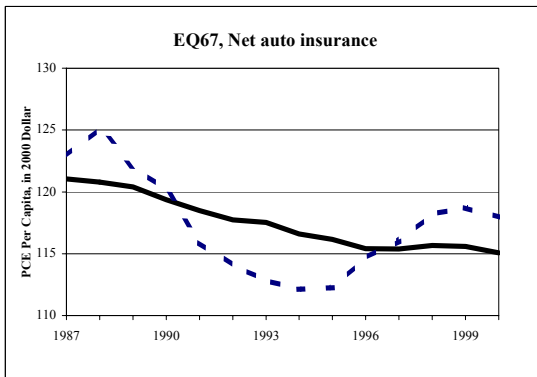
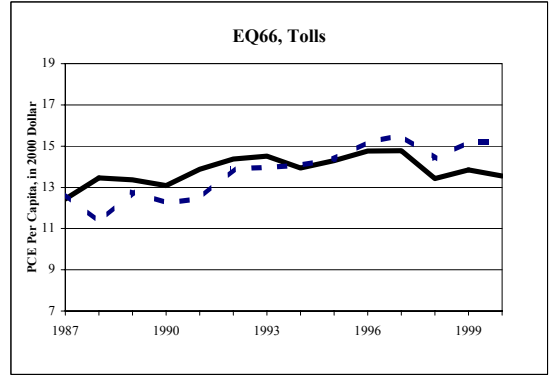
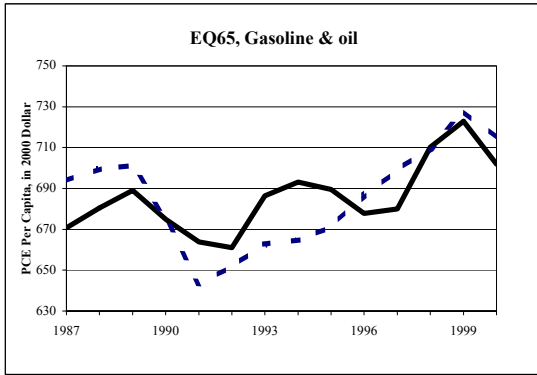
**Figure 4.1 Results of PADS Estimation, Personal Consumption (Continued)**



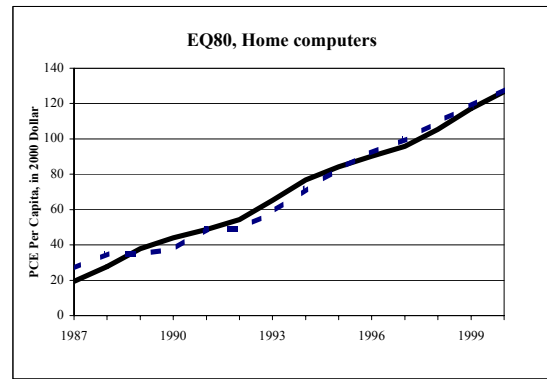
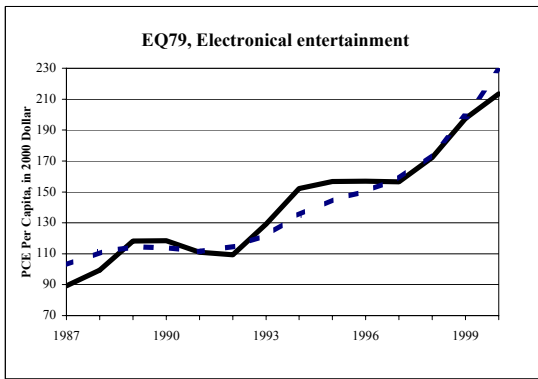
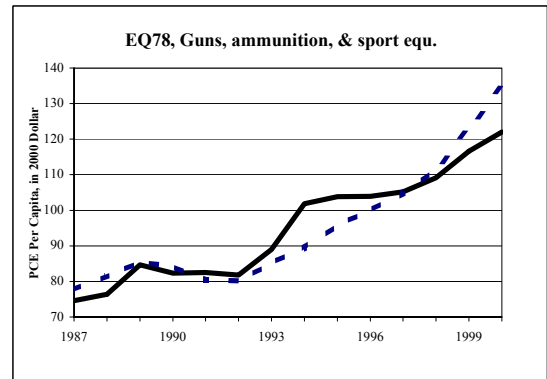
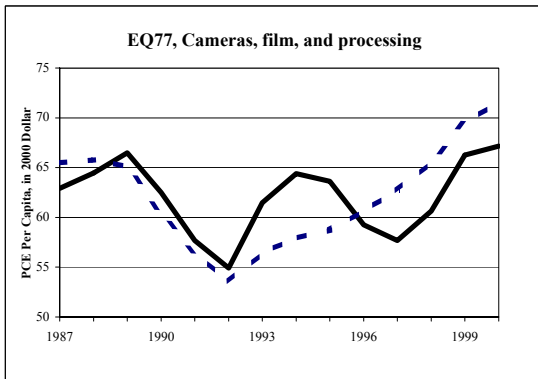
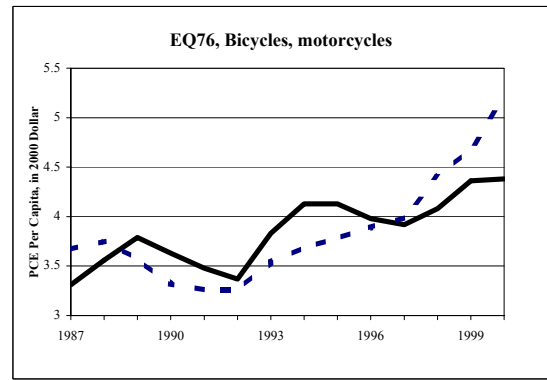
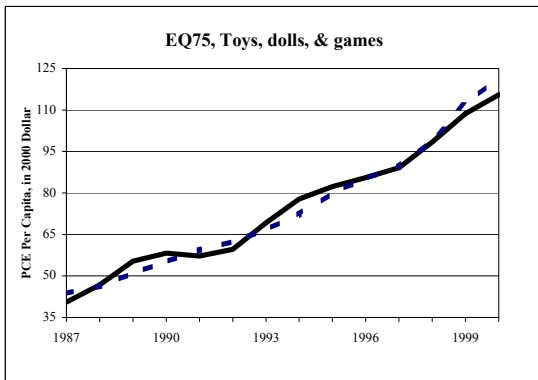
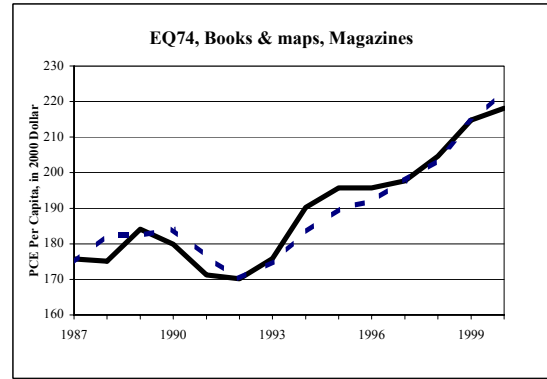
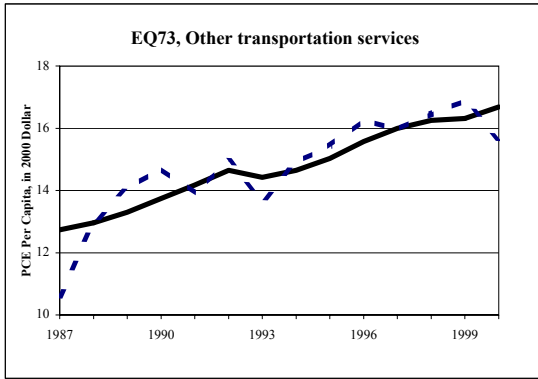
**Figure 4.1 Results of PADS Estimation, Personal Consumption (Continued)**



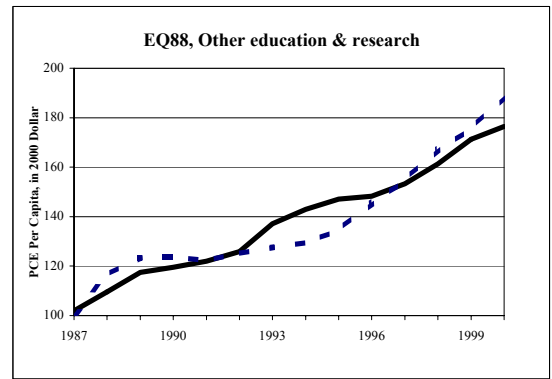
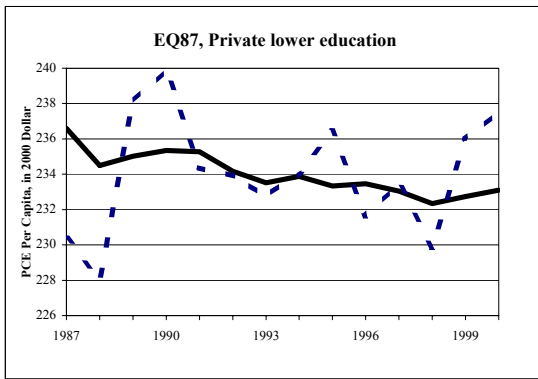
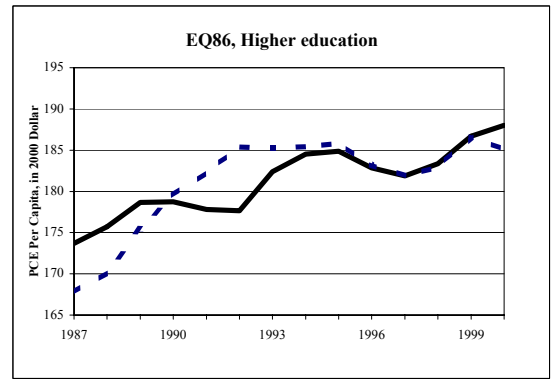
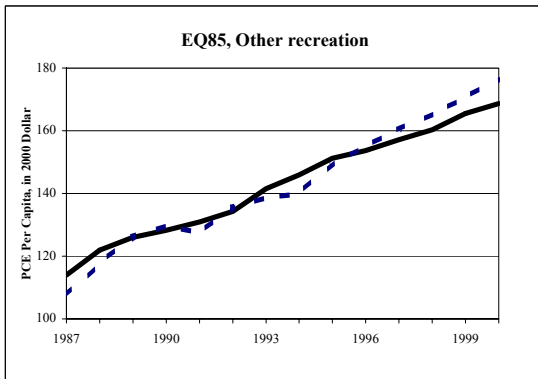
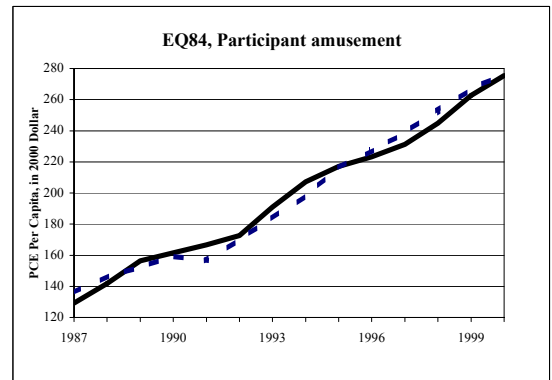
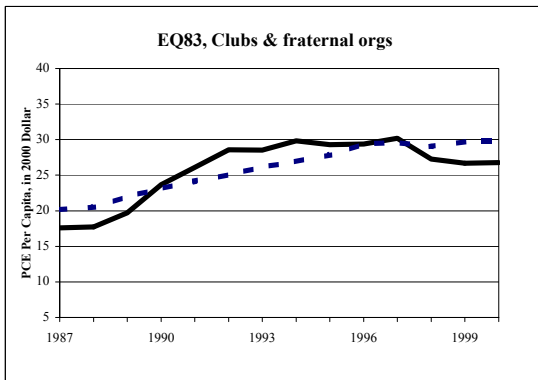
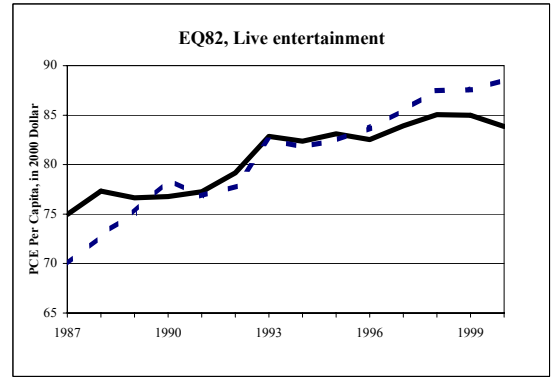
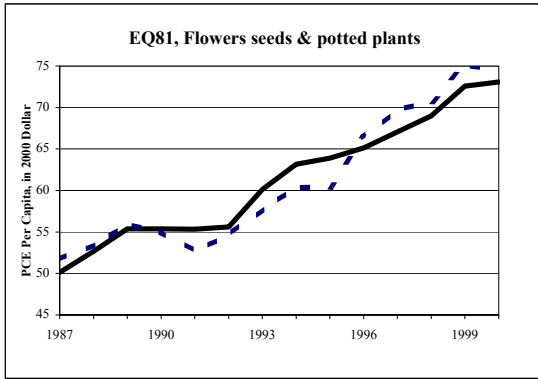
**Figure 4.1 Results of PADS Estimation, Personal Consumption (Continued)**



**Figure 4.1 Results of PADS Estimation, Personal Consumption (Continued)**

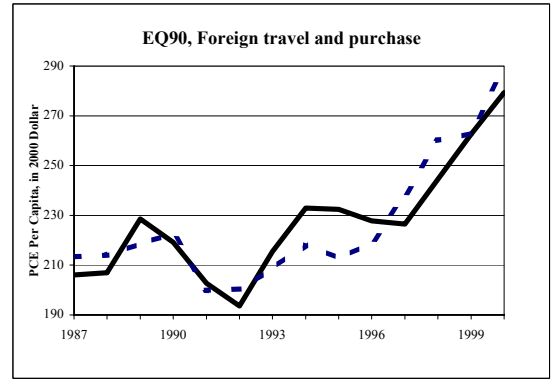
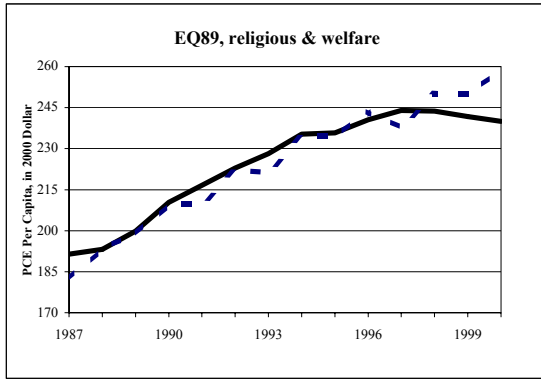


**Figure 4.1 Results of PADS Estimation, Personal Consumption (Continued)**





**Figure 4.1 Results of PADS Estimation, Personal Consumption (Continued)**



## APPENDIX 4.1      PROOF OF (4.1.4)

To simplify notation, the general form of the PADS demand system can be written as

$$x_i(t) = A_i(t) * B_i(t) \quad (4.A.1)$$

where

$$A_i = [a_i(t) + b_i(y/P)] \quad (4.A.2)$$

and

$$B_i = \prod_{k=1}^n p_k^{c_{ik}} \quad (4.A.3)$$

The Slutsky symmetry condition in the base year requires that

$$\frac{\partial x_i(t)}{\partial p_j} + x_j \frac{\partial x_i(t)}{\partial y} = \frac{\partial x_j(t)}{\partial p_i} + x_i \frac{\partial x_j(t)}{\partial y} \quad (4.A.4)$$

By (4.A.1), we have

$$\frac{\partial x_i(t)}{\partial p_j} = A_i(t) \frac{\partial B_i(t)}{\partial p_j} + B_i(t) \frac{\partial A_i(t)}{\partial p_j} \quad (4.A.5)$$

where

$$\frac{\partial B_i(t)}{\partial p_j} = B_i(t) \frac{c_{ij}}{p_j} \quad \text{and} \quad \frac{\partial A_i(t)}{\partial p_j} = -\frac{b_i s_j y}{p_j P} = -b_i x_j / P \quad (4.A.6)$$

and

$$\frac{\partial x_i(t)}{\partial y} = b_i B_i(t) / P \quad (4.A.7)$$

By (4.A.5) – (4.A.7), the left side of (4.A.4) equals to

$$A_i(t)B_i(t)\frac{c_{ij}}{p_j} - b_i x_j B_i(t)/P + x_j b_i B_i(t)/P = A_i(t)B_i(t)\frac{c_{ij}}{p_j} = c_{ij}x_i / p_j \quad (4.A.8)$$

By the same procedure, the right side of (4.A.4) equals to  $c_{ji}x_j / p_i$ , therefore

(4.1.4) is proved.

# CHAPTER FIVE            CONCLUSIONS AND DIRECTIONS FOR FUTURE RESEARCHES

## SECTION 1 CONCLUSIONS

This study is part of ongoing research of household consumption. It differs from the efforts of others in two aspects. Firstly, it builds a linkage so that the consumption behavior at household level can be summarized into one variable which becomes one of the key determinants to personal consumption expenditure at national level. Secondly, it constructs a set of cohort data and lay out a framework so that the changes of consumption patterns over generations could be examined.

The whole study is conducted in three stages.

In the first stage, a sample of about 5,000 households from 2000 U.S. Consumer Expenditure Survey (CES) is used to study how income, demographic variables, and age structure affect the household's consumption decision. The household consumption expenditures are divided into 85 categories. A nonlinear regression model is adopted to estimate the coefficients for each of the category. To tackle the problem of large number of zero entries in the sample, we use a *probit* model to first estimate the expected consumption, and then apply the nonlinear regression. The estimation of the 85 equation converged except for three categories. The estimation results show significant effects of

demographic factors. For each of the category, we are able to draw an Engle curve and Adult Equivalency Weights by age group with estimated coefficients.

In the second stage, we use the sample of 15 years of CES data (from 1986 to 2000) to construct 62 cohorts of households based on the birth year of the head of the household, and then examine the impact of age, cohort, and year on the household's spending pattern. We run regression of cohort consumption of each of the 85 categories on a set of matrices of age, cohort, and year dummies. In order to avoid the specification problem due to the identity among age, cohort and year, we put a constraint on the year variable so that it is orthogonal to a time trend. The estimation gives age, cohort, and year coefficients for all except for four consumption categories. With those coefficients, we are able to see the three effects in separation. Age coefficients show a life-cycle pattern of spending from 24 to 71; the cohort coefficients show the magnitude of changes in consumption level of each cohort from people born in 1915 to those born in 1976; and year effects show how the macro shocks affect the consumption of all generations for each year between 1986 and 2000.

In the third and final stage, we tackle the price effects within the framework of a system of time series equations, incorporating results from the previous two stages. A "prediction" of per adult equivalent expenditure of each good is created by incorporating the information of income, demographic composition and cohort effects. A linear system of equations on 15-year time series of CES surveys is used to obtain this "prediction", for which we assume that income, demographic variable, cohort, and a simple price term are

the only factors that affect consumption. And this “predicted” is fed into a system of macro consumption time series equations to examine the price effects. The macro equations use a 92-category consumption classification, which is further divided into 10 groups with subgroups within each group. Main results include the income elasticities and price elasticities, which show different commodities’ responsiveness to income and prices of other commodities.

## **SECTION 2 KEY FINDINGS**

The key findings of the thesis come from the cohort analysis.

The cohort analysis is conducted on total household consumption. By dividing the 62 cohorts under study into two broad generations, we find there are no significant inter-cohort differences on the spending patterns among young cohorts (cohort 10 – 44, or those born between 1976 and 1942). The level of spending ranges between 99.9% and 118.0% of the level of reference cohort (cohort 10, or those born in 1976). For elder cohorts (cohort 45 – 71, or those born between 1941 and 1915), the coefficients shows a clear fashion that those born earlier spend less while those born later spend more. The level of spending grows from 65.3% of the reference cohort for cohort 71, or those born in 1915, to 110% for cohort 45, or those born in 1941. Intuitively, the younger generations grew up in post-war period, a period of relative peace and economic growth, while most of the elder generations lived through the Great Depression, World War I, and World War II, a period of dramatic societal change.

The analysis is also conducted on each of 85 consumption products aggregated from consumption items surveyed by Consumer Expenditure Surveys. Cohort coefficients of many products show clear trend that suggest changes of people's living style and spending pattern across different generations.

For food products, the cohort effects show that younger generations are spending less on food either at home or away from home than elder generations in general. Comparing with the age effects showing that a person in the early period of his/her life cycle spend more on food either at home or away from home, we may include that this is because of the growth of real income over the generations so that the younger generation could spend less on food consumption.

The data suggests that a person smoke less when he/she gets old. However, because smokers' life expectancy is generally shorter than nonsmoker, the reality is smokers don't get old! Nevertheless, the cohort effects of tobacco and smoking supplies exhibit a clear pattern that younger generations are smoking less than elder generations. This observation is indicative of improved health over generations, which is in accordance with the cohort effects of most of medical equipment and services products. The cohort coefficients for ophthalmic and orthopedic equipment, physicians' services, dental care, other services by medical professionals, other medical care services and medical care in retirement communities, hospital room and services, and health insurance

premium give a general trend that younger generations are spending less than elder generations.

The cohort effects of travel related products reveal that younger generations spend more on travel items, new and used cars, gasoline and motor oil, intercity train fares, intercity bus fare, airline fares, and ship fares on out-of-town trips. The shift of people's living style is also reflected in the expenditure of recreational products. The cohort coefficients declines as a trend across cohorts on pets, toys and playground equipment, cameras and films, ammunition and sporting equipment, televisions, radio and sound equipment, participant amusements, and other recreation, implying that younger generations spend more on recreational items.

One of the societal changes is that more women go to work than before. Our analysis shows a climbing slope of cohort coefficients on cleaning and laundering, watch and jewelry repair, other clothing services, and personal care services, suggesting less is spent on these items for the younger generations.

Another aspect of the societal changes are lowered transaction cost, reflected in the cohort pattern of personal businesses including fees on banking services, life and other personal insurance, funeral and burial services, vehicle finance charges and insurance, where people nowadays are spending less on those items. This might be attributed to the technology progress so that many transactions can be done through computer or Internet at a lower cost.



Other consumption products showing a clear cohort pattern include electricity and telephone equipment and services, where younger generations spend more. Spending on newspapers, books and magazines gives an opposite trend, because television and Internet have now reshaped traditional ways of absorbing information.

### **SECTION 3 DIRECTIONS FOR FUTURE RESEARCHES**

As one of the purposes of this study is to improve the consumption equations of *INFORUM*'s LIFT (Long-term Interindustry Forecasting Tool) model, a natural next step is to re-run the historical simulation and forecasting to test the newly estimated equations in stage. However, the study itself may lead to other valuable future empirical researches.

One direction is to develop a model to predict consumption based on structure and aging of the population. *INFORUM* has developed a Demographic Projections Model (DPM) to provide population forecasts to 2080 based on assumptions about fertility rates, survival rates, immigration, and population levels in the economy. Once age structure is projected, cohort equations estimated in Chapter three can be adopted to give forecast of cohort-level consumption by each consumption category. With projected age structure, the cohort-level consumption can be summed up to give an estimate of national consumption level. This model, once fully developed, could answer following policy questions such as:

How will changes in immigration policy affect the household consumption?

What would be the impact on overall spending if there were a baby boom, and what would be the dynamics in the future?

What would be the impact of increased life expectancy on the economy?

Another direction is to work out a channel so that changes of policy variables such as those demographic factors can be directly reflected in the changes of consumption at macro level. In the current framework, the linkage between cross-section equations and time series equation is through a “prediction” variable computed. Thus any change in demographic factors has a direct effect at household consumption but indirect effect at national consumption. If there is a function instead of a variable that serves as a linkage, the effect on the macro variable will be direct. In this way, there will be a fully integrated system with equations at both micro and macro level so that we can answer more interesting policy questions such as:

How will changes in the national education affect the overall economy?

What is the impact of high divorce rate (change of family size and structure) on the consumption?

Other interesting topics relate with the use of a time series of household surveys, thus many static issues can be brought into studies of its dynamics. They include poverty, inequality, and income distribution. For example, if we add a policy variable such as tax rate, we will be able to study how a change of taxation policy will affect the income distribution, household consumption, and their dynamics in foreseeable future.

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