# A Cross-Sectional and Time-Series Analysis of Household Consumption and a Forecast of Personal Consumption Expenditures

Chang-yu I. Chao, Doctor of Philosophy, 1991

Dissertation directed by: Clopper Almon, Jr.
Professor of Economics
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**ABSTRACT**

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A system of demand functions was developed to forecast personal consumption expenditures in 78 sectors for use in a long-term input-out forecasting model of the U.S. economy. The equations incorporate the effects of changes in income, prices, and demographic factors. The influences of income and household characteristics on consumption were estimated in the cross-section. The effects of changing prices and trends were accessed in the time series.

The cross-section consumption function was applied to the data obtained from the Consumer Expenditures Survey. The household demand for a particular good is made up of the product of two components: consumption per household member; and the specific size of the household for that good. The expenditure per household member is determined by household per capita income and demographic attributes of households. The income-expenditure relationship is expressed by a Piecewise Linear Engel Curve (PLEC) for each of the 61 cross-section consumption items. A PLEC is capable of representing luxuries, necessities, as well as inferior goods. It is also able to express different slopes for the Engel curve over different income levels for a particular good.

The product-specific size of household was developed by the scheme of adult equivalency weights. The specific size of a household is a weighted sum of the

number of household members in each age group, with weights being the relevant magnitude, or "adult equivalent", for that age group for the given consumption item.

The cross-section results were transformed into two variables, weighted population and "cross-section-parameter" prediction, for use in the estimation of time series equations. Weighted populations were created by combining the adult equivalency weights with population totals by age. "Predictions" were found by combining the cross-section Engel curves and demographic composition parameters with income distributions and demographic population proportions.

Finally, the system of equations combines the cross-section results and the price effects based on Almon system. The equations were estimated for 78 components of the National Income and Product Account's Personal Consumption Expenditures over the 1966-1987 period. Forecasts of consumption were made through the year 2000.

# A CROSS-SECTIONAL AND TIME-SERIES ANALYSIS OF
# HOUSEHOLD CONSUMPTION AND
# A FORECAST OF PERSONAL CONSUMPTION EXPENDITURES

by

Chang-yu I. Chao

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# CHAPTER 1

# INTRODUCTION

The size and composition of the economy's total output depend heavily upon the size and composition of consumer expenditures. With a share of approximately sixty-five percent, personal consumption expenditure is the largest component of the U.S. Gross National Product. Changes in consumption patterns will therefore strongly influence changes in other economic activities like production, employment, and investment. Consequently, a proper forecast of personal consumption expenditures is necessary to explain or predict the other crucial economic activities.

A comprehensive demand analysis must incorporate an investigation into the effects of changes in income, prices, and demographic factors. This is the goal of the model described in this dissertation. Moreover, the model is to be used to forecast personal consumption expenditures in a long-term input-out forecasting model of the U.S. economy developed by the Interindustry Forecasting Project at the University of Maryland (Inforum).

Our formulation of the comprehensive demand model begins with building a consumption function to be estimated from cross-section data on the purchases of many households. The information acquired from the cross-section is to be used to explain the time-series consumption behavior. More precisely, the cross-section is used to identify the effects of income and household characteristics, while the time series is used to assess the effects of changing prices and trends not accounted for by any of the variables in the cross-section. The cross-section consumption function developed here is applied to the data obtained from the Consumer Expenditures Survey (CES) conducted by the Bureau of Labor Statistics (BLS). The wide variety of households in the BLS sample allows cross-section data to provide a rich diversity of income, expenses, and demographic attributes of households. Each household in the sample provides information concerning its income, purchases of different products, age of household head, education, occupation, region of residence, number of earners, and family size.

The household demand for a particular good is made up of the product of two components: consumption per household member; and the specific size of the household for that good. The expenditure per household member is determined by household per capita income and demographic attributes of households. The specific size of a household is a weighted sum of the number of household members in each age group, with the weights being the relevant magnitude, or "adult equivalent", for that age group for the given consumption item. This is known as the scheme of adult equivalency weights. The reference "adult" is defined in this model to be an adult between thirty-one and forty years of age.

The first step in constructing the component of per capita household consumption is to establish a flexible form of Engel curve. An Engel curve represents an income-expenditure relationship. It plots the consumption expenditure on a commodity against the income of consumers. A flexible Engel functional form should be able to represent luxuries, necessities, as well as inferior goods. Moreover, it should be capable of expressing different slopes for the Engel curve over different income levels for a particular good. In other words, it is possible that a given commodity is a necessity for one income group while being a luxury (or an inferior good) for another.

Table 1.1 contains a complete listing of the 61 consumption items to be investigated.

**TABLE 1.1**

**Cross-Section Consumption Items**

1. Food, off premise
2. Food, on premise
3. Alcoholic beverages, off premise
4. Alcoholic beverages, on premise
5. Tobacco products
6. Shoes and footwear
7. Women's and children's clothing
8. Men's and boy's clothing
9. Luggage
10. Jewelry and watches
11. Laundries, storage, and repair of clothing and shoes
12. Other jewelry and clothing services
13. Personal care
14. Owner-occupied housing
15. Tenant-occupied housing
16. Other housing
17. Additions, alterations, and constructions of residencies
18. Hotels and motels
19. Furniture
20. Kitchen and household appliances
21. China, glassware, and tableware
22. Other durable house furnishings
23. Floor coverings
24. Semidurable house furnishings
25. Electricity
26. Natural gas
27. Fuel oil and coal
28. Wood, other fuel, and bottled or tank gas
29. Water and other sanitary services
30. Telephone and telegraph
31. Domestic service
32. Other household operations
33. Household insurance
34. Prescription drug and sundries
35. Physicians
36. Dental and eyes
37. Other medical services and supplies
38. Hospitals and sanitariums
39. Health insurance
40. Personal business
41. Life insurance
42. New cars
43. Used cars
44. New and used trucks or vans
45. Tires and tubes
46. Auto accessories and parts

**TABLE 1.1**

**Cross-Section Consumption Items (Continued)**

47. Auto repairs
48. Auto insurance
49. Gasoline and oil
50. Tolls, parking fees, and registration
51. Local transportation
52. Intercity transportation
53. Books, magazines, and newspaper
54. Boats, recreational vehicles, and pleasure aircraft
55. Wheel goods, toys, and sport equipment
56. Radio, TV, recorders, and musical instruments
57. Radio, TV, and sound equipment repairs and rental
58. Fees and admissions
59. Other recreational supplies, equipment, and services
60. Education
61. Cash contribution

The Engel relationship in this dissertation accounts for the effect of per capita household income on per capita household expenditure. In order to formulate this flexible form, per capita household income is divided into a number of income brackets, in this case five. The boundaries of the five income brackets are determined such that each of the five brackets contains exactly one fifth of the total households in the sample. Therefore, the Engel curve for a given consumption item is linear in each of the brackets but with different slopes in different brackets. This form is called the Piecewise Linear Engel Curve (PLEC). Figure 1.1 depicts a PLEC with five income brackets. The numerical example in Table 1.2 can help to illustrate this five-income-bracket PLEC.

**FIGURE 1.1**

**A Piecewise Linear Engel Curve**

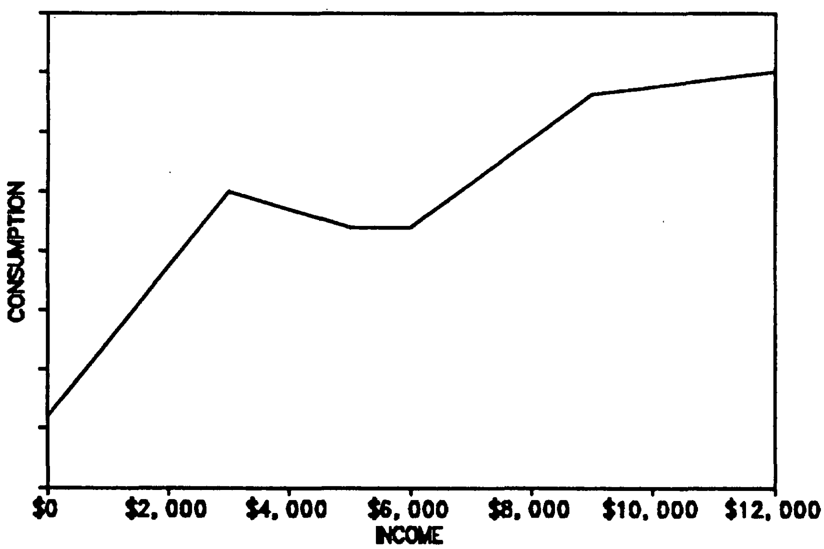


**TABLE 1.2**

**Numerical Example for a PLEC**

| Household | Per Capita Household Income | Amount of Income in Bracket | | | | |
|---|---|---|---|---|---|---|
| | | 1 | 2 | 3 | 4 | 5 |
| A | 1,500 | 1,500 | 0 | 0 | 0 | 0 |
| B | 3,500 | 3,000 | 500 | 0 | 0 | 0 |
| C | 5,500 | 3,000 | 2,000 | 500 | 0 | 0 |
| D | 6,500 | 3,000 | 2,000 | 1,000 | 500 | 0 |
| E | 11,000 | 3,000 | 2,000 | 1,000 | 3,000 | 2,000 |
| Boundaries of Income Bracket | $B_0$: \$0 | $B_1$: \$3,000 | $B_2$: \$5,000 | $B_3$: \$6,000 | $B_4$: \$9,000 | $B_5$: Infinity |

The advantage of a PLEC can be highlighted by its ability to adequately express the characteristics of a typical consumption product. For example, rich households are likely to have a higher marginal propensity to consume (MPC) luxuries than are poor households. The slope of the PLEC for this item, thus, will be steeper in the higher income levels while being moderate in the lower income brackets. On the other hand, the PLEC will illustrate a linear curve with a relatively constant slope if the MPC for a good is roughly the same over the five income brackets.

The second step in modeling is incorporating demographic factors into household consumption. The model classifies the household characteristics into five categories. They are: region of residence, education of household head, working status of spouse, family size, and age of household head. The demographic characteristics of households may affect household spending on various consumption items to a varying extent. The following examples may account for the relevance of these demographic variables in the household consumption:

Region:

The difference in climate results in greater expenditure on heating utilities for households in the northeast over those in the south. On the other hand, the households in the west have a relatively large number of renters whose utilities are included in rent. Thus, these households spend less on electricity, gas, and water but more on shelter than households in other regions.

Education:

The education level of the household head affects the household expenditures especially on children's education and reading materials. A household with a college-educated head may spend more on education related items than a household without a college-educated head.

Working Spouses:

The dramatic increase in the participation of women in the labor force leads to the greatest change in recent household consumption patterns. In the 1950's, less than 20 percent of women were wage earners. This participation more than doubled, however, in the 1970's. Working wives spend less time on housework than do full-time housemakers. Therefore, two-earner households should tend to spend a relatively large amount on time-saving items like domestic and household services.

Family Size:

Family size is important in interpreting economies of scale. An increase in household size inversely affects the household consumption on luxuries. The household consumption on necessities and inferior goods, on the other hand, will go up with an increase in household size.

Age:

The middle aged household head will tend to spend a relatively large amount on transportation and personal business. In contrast, elderly people tend to spend a higher portion of their income on health care.

The procedure of including demographic factors in the PLEC is to allow only the intercept of the PLEC to be different for each demographic group. In other words, the effect of demographic variables shift the entire Engel curve upwards or downwards in a parallel pattern without affecting the specific propensity to consume out of income. This task is accomplished by constructing a zero-one dummy variable for each of the demographic categories.

The next process is to provide the second component of household consumption, the product-specific size of household, by developing adult equivalency weights. The adult equivalency weights give each age group a different weight in the expenditure on each good. Thus, they permit us to give high weights to the group of consumers who are likely to consume a commodity while giving relatively low weights to those less likely to consume the good.

An example of this is shown in Table 1.3 using the consumption of alcohol, furniture, and medical care. The specific weighted household size for the consumption of alcohol, furniture, and medical care are shown in Table 1.3 for four households with different age compositions. Each of the four households in Table 1.3 has four family members. The weighted household size for a given household, however, differs from good to good. Moreover, the range of weighted household size for a particular good is rather large. For example, the four member households range in size from 2.6 to 6.0 for furniture. Figure 1.2 shows the estimated adult equivalency weights for Off premise alcohol consumption, Furniture, and Health insurance. They show plausible patterns broadly similar to the hypothetical ones in Table 1.3. The pattern for furniture is particularly noteworthy.

**TABLE 1.3**

**Weighted Household Sizes for Four Typical Households**

| | Number of Family Members | | | Weighted Household Size | | |
|---|---|---|---|---|---|---|
| Household | Children | Adults | The Aged | Alcohol | Furniture | Medical Care |
| A | 2 | 2 | 0 | 2.2 | 6.0 | 5.0 |
| B | 1 | 3 | 0 | 3.1 | 5.0 | 4.5 |
| C | 1 | 2 | 1 | 2.6 | 4.3 | 5.5 |
| D | 0 | 2 | 2 | 3.0 | 2.6 | 6.0 |

| Adult Equivalency Weights | | | |
|---|---|---|---|
| Alcohol | 0.1 | 1.0 | 0.5 |
| Furniture | 2.0 | 1.0 | 0.3 |
| Medical Care | 1.5 | 1.0 | 2.0 |

**FIGURE 1.2**

**Bar Chart of Adult Equivalency Weights**

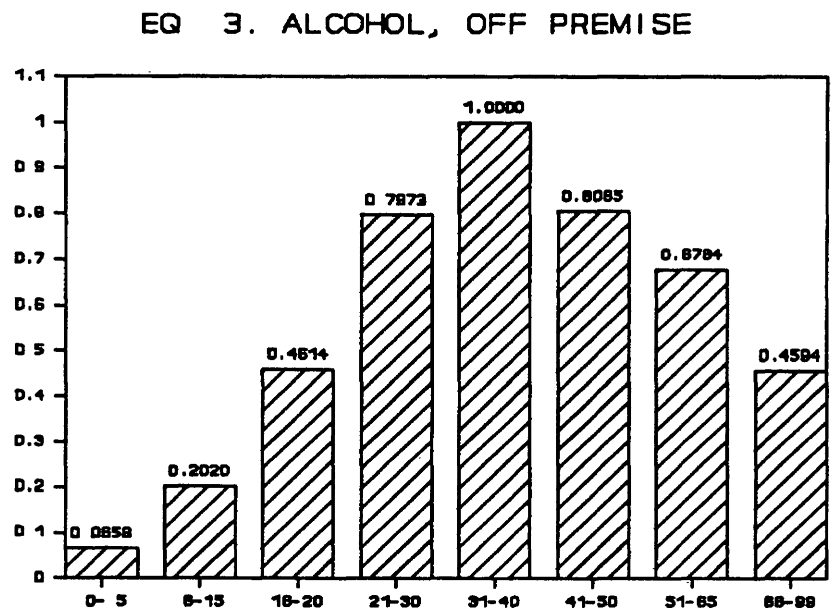


**FIGURE 1.2**

**Bar Chart of Adult Equivalency Weights (Continued)**

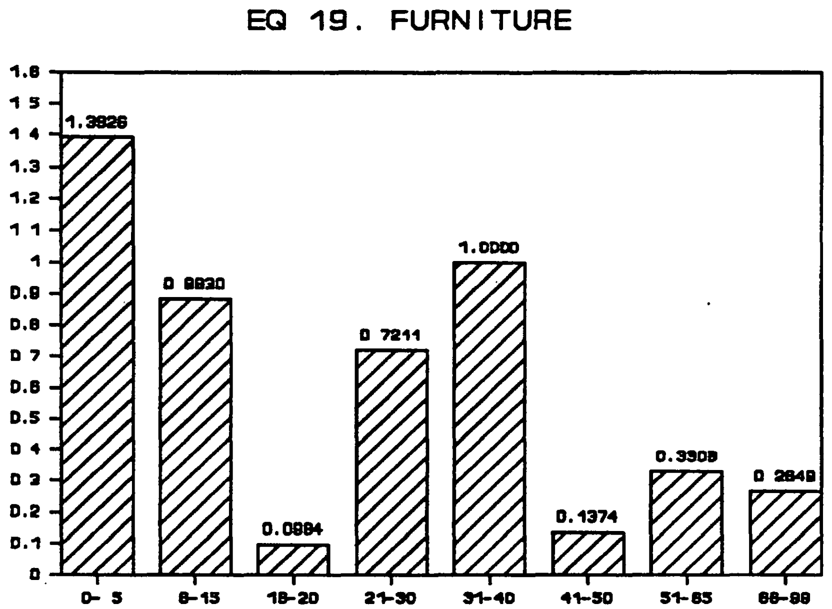
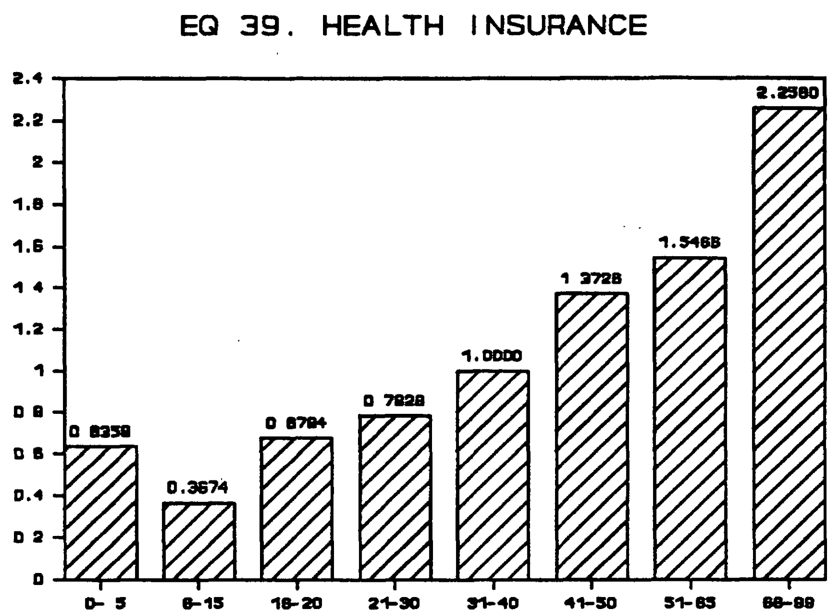


**FIGURE 1.2**

**Bar Chart of Adult Equivalency Weights (Continued)**



The second part of the comprehensive demand model is a system of demand equations in the time series. These equations incorporate the information including size distribution of income, age structure of population, demographic composition, and relative prices. The system estimates 78 components of U.S. personal consumption expenditures in the National Income and Product Accounts. A complete list of 78 sectors is shown in Table 1.4.

In the process of estimating this system, a time-series of weighted populations is first created for each consumption item by 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 commodity specific weighted populations are computed by summing the number of individuals in each age group weighted by the corresponding equivalency weight of a given good over all the age groups. The weighted populations are calculated for each of the 78 categories shown in Table 1.4.

The advantage of using weighted populations as opposed to using simple population totals is the ability to reflect shifts in demand as the age structure of the population changes. For instance, the cross-section results show that young children have a relatively high adult equivalency weight in furniture. The weighted population for furniture, therefore, will grow rapidly as the size of 0-5 age group grows. However, the population growth in this group will not affect the weighted size of population for alcohol because they contribute almost nothing to alcohol consumption.

The estimated cross-section parameters are then used in conjunction with information on size distribution of income and demographic composition to create a "prediction" of per adult equivalent expenditure for each good. The "prediction" which is comprised of two components, income and demographic shifts, will be used as an explanatory variable in the time-series consumption function. In other words, through the use of "predictions", we have assumed that only the factors considered in the cross-section affect consumption in the time series and the parameters estimated in the cross-section accurately reflect those influences.

The magnitude of the demographic shift 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 coefficient. Namely, this aggregation procedure gives the most weight to the most relevant variables for a specific good. For example, the geographic regions are not helpful in the cross-section equation for domestic services, because a shift in the migration of the population does not greatly influence the value of the "predictions" for domestic services. However, a shift in the number of working spouses should greatly affect the consumption of this good.

In order to calculate the income component of the "predictions", it is necessary to know the details of the distribution of income. The PLEC is very sensitive to the distribution of income because it is based on the five segments defined by household income. Recall that the cross-section income variables are the amount of income received by one family member within a specific income bracket. Thus, in the time series, the average values of these five income variables have to be computed for each year. To calculate the magnitude of income variable for a given income bracket, the amount of income received by each person in that bracket is aggregated, and then the sum of income within the bracket is divided by the total number of individuals.

The basic idea of our income distribution model is to convert the model's forecasts of aggregate personal income into a detailed distribution of AGI. The first step of modeling, therefore, is to obtain a forecast of the size distribution of income.

The income distribution in this dissertation is represented by a Lorenz curve. A Lorenz curve plots the percentages of population on the horizontal axis against the percentages of income they receive on the vertical axis. The data utilized for estimating a Lorenz curve is the grouped data on the distribution of adjusted gross income (AGI) from Statistics of Income (SOI), published by the Internal Revenue Service. The shape of each Lorenz curve is described by two parameters: the amount by which each curve bows away from the diagonal line of equally distributed income relative to the base year's (1981) curve; and the amount by which each curve is skewed toward either the upper or lower end of the distribution relative to the base year's curve. The two parameters are estimated for each year and each household size. For the purpose of forecasts, these estimated Lorenz curve parameters are arranged in time-series, and are regressed on cyclical economic variables and a time trend. Consequently, these estimated equations are used in conjunction with the forecasts of the cyclical economic variables to forecast the Lorenz curves. The forecasts of the cyclical economic variables come from the macro model. The resulting Lorenz curves are then applied to the aggregate AGI, which is forecast as a function of personal income and items like transfer payments.

The distribution of AGI and the SOI data are then used to develop the tax model. The objective of the tax model is to remove income taxes from household income and to get a distribution of per capita disposable income to be used in the consumption functions. Our consumption functions require a distribution of personal income which groups the population into ventiles. Each ventile contains five percent of the population. Furthermore, it is necessary to calculate the tax rate schedules separately for different household sizes because income taxes are levied on the basis of household income.

Table 1.5 shows the distribution of population by calculating the number of families of each household size for each income group and the distribution of AGI among the six household sizes and the twenty income groups. Within ventiles, individuals are arranged in ascending order. The income distribution, thus, is defined by indexes which represent the income of the highest person in each ventile relative to the overall average per capita income. Table 1.6 shows the upper limit of per capita AGI in each ventile. Table 1.7 shows the values of the upper limits of per capita AGI relative to the overall mean per capita AGI.

In fact, it is the distribution of disposable personal income, not AGI, which determines consumption in our model. Thus, the distribution of AGI needs to be transformed into the distribution of disposable income. The transformation is accomplished through a bridge which distributes the items not part of AGI among the ventiles. These items include transfer payments, fringe benefits, imputations, and other types of income. The index of ventile limits for personal income is shown in Table 1.8.

In the tax model, there are a total of 120 tax rates for twenty income groups and six household sizes. To apply the income and tax model to the consumption functions, however, we have to combine the distribution of six household sizes into a single distribution. Thus, the tax rates are aggregated into a weighted-average income tax rate of six household sizes for each income group. The tax rates are then applied to the distribution of AGI and personal income to get the distribution of both disposable AGI and disposable personal income. Table 1.9 shows the indexes of ventile limits for disposable personal income which includes a forecast to the year 2000.

The final and the most crucial step in modeling the system of consumption functions is to examine the price effects. In our system of demand equations, the demand for a good depends upon the prices of all other goods. However, the price effects are simplified by assuming that consumption items with similar economic characteristics can be combined into groups. Thus, through the grouping technique, 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. Moreover, a group can be split into several subgroups. The construction of subgroups is to achieve even greater flexibility for the price interaction patterns. A specific subgroup may contain either complementary or substitutable items independently of the other subgroups. Therefore, it is possible for the goods in the first subgroup to be substitutes for the goods in the second subgroup while being complements to those in the third.

The ultimate goal of our consumption model, which is an integral part of the LIFT model, is to help the model's ability to forecast the other economic activities like production and investment. Thus, a proper forecast of personal consumption expenditures is necessary. The projection of consumption has to be made simultaneously with the determination of prices and income in the LIFT model. A final forecast of personal consumption expenditures is achieved through an iterative process. The 78 components of U.S. personal consumption expenditures are projected to the year 2000.

Chapter 2 describes the model and the estimation scheme for the cross-section consumption functions. Chapter 3 forms the transition from the cross-section to the time series. Chapter 4 describes the system of demand equations in the time series. Chapter 5 explains the procedures for forecasts by using the results obtained from the previous three chapters. A review of empirical consumption functions is presented in Appendix A.

**TABLE 1.4**

**Time-Series Sectors**

1. New cars and trucks
2. Net purchases of used cars
3. New and used trucks
4. Tires and tubes
5. Accessories and parts (auto)
6. Furniture, mattresses, and bedsprings
7. Kitchen and other household appliances
8. China, glassware, tableware, and utensils
9. Radio, TV, records, and musical instruments
10. Floor coverings
11. Durable housefurnishings nec
12. Writing equipment
13. Hand tools
14. Jewelry
15. Ophthalmic and orthopedic appliances
16. Books and maps
17. Wheel goods and durable toys
18. Boats, recreational vehicles, and aircraft
19. Food, off premise
20. Food, on premise
21. Alcohol, off premise
22. Alcohol, on premise
23. Shoes and footwear
24. Women's clothing
25. Men's clothing
26. Luggage
27. Gasoline and oil
28. Fuel oil and coal
29. Tobacco
30. Semidurable housefurnishings
31. Drug preparations and sundries
32. Toilet articles and preparations
33. Stationery and writing supplies
34. Nondurable toys and sport supplies
35. Flowers, seeds, and potted plants
36. Lighting supplies
37. Cleaning preparations
38. Household paper products
39. Magazines and newspaper
40. Other nondurables -- identity
41. Owner occupied space rent
42. Tenant occupied space rent
43. Hotels and motels
44. Other housing -- educational housing
45. Electricity
46. Natural gas

**TABLE 1.4**

**Time-Series Sectors**
**(Continued)**

47. Water and other sanitary services
48. Telephone and telegraph
49. Domestic services
50. Household insurance
51. Other household operations -- repair
52. Postage
53. Auto repair
54. Bridge, tolls, etc.
55. Auto insurance
56. Taxicabs
57. Local public transport
58. Intercity railroad
59. Intercity buses
60. Airlines
61. Travel agents and other transportation services
62. Cleaning, laundering and shoe repair
63. Barbershops and beauty shops
64. Physicians
65. Dentists and other professional services
66. Private hospitals and sanitariums
67. Health insurance
68. Brokerage and investment counseling
69. Bank services charges and services without payment
70. Life insurance
71. Legal services
72. Funeral expenses and other personal business
73. Radio and television repair
74. Movies, legitimate theatre, and spectator sports
75. Other recreational services
76. Education
77. Religious and welfare services
78. Foreign travel

## TABLE 1.5

## Population and Income Distribution
## By Ventile and Household Size - 1982

Exemptions Other than Age or Blindness in Thousands

| Household Size Ventile | 1 | 2 | 3 | 4 | 5 | 6 | Total |
|---|---|---|---|---|---|---|---|
| 1 | 1886.4 | 1249.1 | 1674.8 | 2137.4 | 1521.6 | 2314.1 | 10783.5 |
| 2 | 2426.0 | 1110.9 | 1350.3 | 1750.8 | 1549.6 | 2595.9 | 10783.5 |
| 3 | 1365.1 | 1130.2 | 1677.1 | 2465.4 | 1828.5 | 2317.1 | 10783.5 |
| 4 | 2363.5 | 1459.7 | 1821.8 | 2066.3 | 1464.3 | 1608.3 | 10783.8 |
| 5 | 973.7 | 1458.8 | 1665.5 | 2097.9 | 1720.5 | 2867.4 | 10783.8 |
| 6 | 2018.1 | 1632.2 | 1524.7 | 2319.4 | 1358.0 | 1931.4 | 10783.8 |
| 7 | 1037.8 | 1758.4 | 1609.3 | 2427.3 | 3282.6 | 668.6 | 10783.8 |
| 8 | 1728.3 | 1873.1 | 1746.7 | 1753.9 | 687.0 | 2994.9 | 10783.8 |
| 9 | 794.7 | 1234.9 | 1355.3 | 4105.4 | 2914.9 | 378.6 | 10783.8 |
| 10 | 1973.5 | 2513.1 | 2455.9 | 2593.0 | 688.1 | 559.8 | 10783.5 |
| 11 | 1494.6 | 1528.3 | 802.8 | 5172.3 | 959.4 | 826.6 | 10783.8 |
| 12 | 1217.1 | 1798.0 | 3092.9 | 736.3 | 3640.3 | 299.2 | 10783.8 |
| 13 | 2283.3 | 2835.7 | 2361.3 | 2138.5 | 753.2 | 411.8 | 10783.7 |
| 14 | 1016.0 | 1329.4 | 1082.5 | 6129.6 | 1018.5 | 208.0 | 10783.8 |
| 15 | 2844.5 | 2528.2 | 2845.7 | 1537.5 | 762.4 | 265.2 | 10783.5 |
| 16 | 1367.8 | 3963.2 | 2492.3 | 2564.9 | 354.2 | 40.9 | 10783.5 |
| 17 | 2989.8 | 2688.6 | 3087.6 | 1254.8 | 656.6 | 106.0 | 10783.5 |
| 18 | 3162.7 | 3499.1 | 2186.0 | 1598.6 | 170.2 | 166.9 | 10783.5 |
| 19 | 3046.8 | 5844.3 | 913.9 | 453.9 | 255.0 | 269.6 | 10783.5 |
| 20 | 3185.6 | 4208.3 | 1320.3 | 1271.3 | 589.1 | 209.3 | 10783.8 |
| Totals | 39175.2 | 45643.5 | 37066.7 | 46574.5 | 26174.2 | 21039.5 | 215673.6 |

Adjusted Gross Income in millions of Dollars

| Household Size Ventile | 1 | 2 | 3 | 4 | 5 | 6 | Total |
|---|---|---|---|---|---|---|---|
| 1 | 1832.4 | 1300.8 | 1351.4 | 1726.9 | 1081.1 | 1755.8 | 9048.4 |
| 2 | 4155.2 | 1643.5 | 2196.2 | 2845.8 | 2451.8 | 4062.0 | 17354.5 |
| 3 | 2832.6 | 2529.7 | 3709.9 | 5433.7 | 4014.9 | 5077.5 | 23589.3 |
| 4 | 6770.3 | 4102.6 | 5044.4 | 5748.0 | 4102.2 | 4406.4 | 30173.9 |
| 5 | 3266.7 | 4901.9 | 5624.7 | 7076.6 | 5789.0 | 9534.0 | 36192.9 |
| 6 | 7856.3 | 6349.5 | 5919.3 | 9066.1 | 5168.0 | 7797.0 | 42156.2 |
| 7 | 4661.5 | 7801.8 | 7175.2 | 10760.0 | 14903.3 | 2874.5 | 48176.3 |
| 8 | 8534.1 | 9320.3 | 8754.0 | 8677.5 | 3410.5 | 15572.3 | 54268.7 |
| 9 | 4433.7 | 6849.4 | 7447.0 | 23327.8 | 16316.7 | 1992.8 | 60367.4 |
| 10 | 11905.2 | 15427.8 | 15122.1 | 15320.2 | 4159.0 | 3536.9 | 65471.2 |
| 11 | 10306.1 | 10448.4 | 5364.9 | 36281.3 | 6736.0 | 5611.2 | 74747.9 |
| 12 | 9135.1 | 13369.4 | 23850.9 | 5297.4 | 26118.4 | 2087.6 | 79858.8 |
| 13 | 18904.5 | 23620.0 | 18828.6 | 18465.5 | 6323.0 | 3520.8 | 89662.4 |
| 14 | 9273.3 | 12167.6 | 10205.1 | 54535.2 | 9349.3 | 1918.5 | 97449.0 |
| 15 | 29234.8 | 25610.4 | 27747.4 | 15973.0 | 7589.3 | 2531.1 | 108686.0 |
| 16 | 15800.9 | 46263.4 | 29638.8 | 29453.6 | 4235.8 | 446.0 | 125838.5 |
| 17 | 38938.8 | 36153.0 | 38044.3 | 16399.9 | 8229.4 | 1154.7 | 138921.1 |
| 18 | 50420.7 | 53890.9 | 33804.6 | 24577.3 | 2488.8 | 1818.6 | 167000.9 |
| 19 | 62936.3 | 111019.7 | 18407.4 | 7728.7 | 3728.7 | 6393.3 | 210213.5 |
| 20 | 124235.8 | 161632.7 | 45567.6 | 40552.8 | 19007.6 | 5699.5 | 396696.0 |
| Totals | 425434.3 | 554402.8 | 313803.8 | 339247.3 | 155202.8 | 87790.5 | 1875881.5 |

## TABLE 1.6

## Upper Limits of Per Capita AGI

| Ventile | 1966 | 1975 | 1982 |
|---|---|---|---|
| 1 | 455.1 | 739.6 | 1212.1 |
| 2 | 682.4 | 1136.1 | 1886.4 |
| 3 | 830.8 | 1443.1 | 2509.5 |
| 4 | 990.3 | 1780.3 | 3079.0 |
| 5 | 1127.8 | 2088.3 | 3628.8 |
| 6 | 1283.3 | 2392.5 | 4168.0 |
| 7 | 1415.6 | 2694.8 | 4704.2 |
| 8 | 1575.7 | 3040.3 | 5301.8 |
| 9 | 1691.4 | 3322.8 | 5722.4 |
| 10 | 1852.2 | 3553.5 | 6554.5 |
| 11 | 2050.4 | 4070.5 | 7131.2 |
| 12 | 2246.7 | 4278.6 | 7763.3 |
| 13 | 2483.2 | 4828.2 | 8883.9 |
| 14 | 2751.7 | 5196.0 | 9463.1 |
| 15 | 3014.1 | 5907.6 | 11111.6 |
| 16 | 3516.4 | 6769.1 | 11987.0 |
| 17 | 3890.6 | 7816.2 | 14253.7 |
| 18 | 4839.6 | 9672.9 | 17823.6 |
| 19 | 6538.3 | 12807.8 | 23171.9 |
| 20 | $\infty$ | $\infty$ | $\infty$ |

## TABLE 1.7

### Index of Ventile Limits for AGI

| Ventile | 1966 | 1975 | 1982 |
|---|---|---|---|
| 1 | 18.12 | 15.54 | 13.94 |
| 2 | 27.17 | 23.87 | 21.69 |
| 3 | 33.08 | 30.32 | 28.85 |
| 4 | 39.44 | 37.40 | 35.40 |
| 5 | 44.91 | 43.87 | 41.72 |
| 6 | 51.10 | 50.26 | 47.92 |
| 7 | 56.37 | 56.61 | 54.08 |
| 8 | 62.75 | 63.87 | 60.96 |
| 9 | 67.36 | 69.81 | 65.79 |
| 10 | 73.76 | 74.65 | 75.36 |
| 11 | 81.65 | 85.51 | 81.99 |
| 12 | 89.47 | 89.88 | 89.26 |
| 13 | 98.89 | 101.43 | 102.14 |
| 14 | 109.58 | 109.16 | 108.80 |
| 15 | 120.03 | 124.11 | 127.75 |
| 16 | 140.03 | 142.21 | 137.82 |
| 17 | 154.93 | 164.20 | 163.88 |
| 18 | 192.73 | 203.21 | 204.92 |
| 19 | 260.37 | 269.07 | 266.41 |
| 20* | 20.65 | 19.69 | 21.15 |
| Average AGI | 2511.13 | 4760.04 | 8697.75 |

*The overall percentage of the total income held by the richest 5% of population

**TABLE 1.8**

**Index of Ventile Limits for Personal Income**

| Ventile | 1966 | 1975 | 1982 |
|---|---|---|---|
| 1 | 14.49 | 16.58 | 15.94 |
| 2 | 18.37 | 26.40 | 25.79 |
| 3 | 33.90 | 43.96 | 42.69 |
| 4 | 40.48 | 49.04 | 48.21 |
| 5 | 46.45 | 53.92 | 52.89 |
| 6 | 51.75 | 58.22 | 57.03 |
| 7 | 57.90 | 63.04 | 61.69 |
| 8 | 63.20 | 67.86 | 66.49 |
| 9 | 68.93 | 73.02 | 71.13 |
| 10 | 73.80 | 77.99 | 75.81 |
| 11 | 80.45 | 83.35 | 82.87 |
| 12 | 88.04 | 90.17 | 88.40 |
| 13 | 97.09 | 97.48 | 97.72 |
| 14 | 108.00 | 107.01 | 107.32 |
| 15 | 119.57 | 118.87 | 120.70 |
| 16 | 137.94 | 136.36 | 133.86 |
| 17 | 156.11 | 158.98 | 157.23 |
| 18 | 192.42 | 195.66 | 195.89 |
| 19 | 259.03 | 259.97 | 255.70 |
| 20* | 20.99 | 19.35 | 20.53 |
| Average PI | 3055.69 | 6081.14 | 11483.39 |

*The overall percentage of the total income held by the richest 5% of population

**TABLE 1.9**

**Index of Ventile Limits for Disposable Personal Income**

| Ventile | 1966 | 1975 | 1982 | 1990 | 1995 | 2000 |
|---|---|---|---|---|---|---|
| 1 | 16.63 | 18.30 | 17.19 | 16.38 | 16.31 | 16.27 |
| 2 | 20.47 | 29.80 | 29.42 | 27.44 | 26.59 | 26.10 |
| 3 | 37.67 | 49.63 | 48.53 | 46.10 | 45.19 | 43.84 |
| 4 | 44.77 | 55.26 | 54.45 | 52.40 | 51.30 | 50.91 |
| 5 | 50.97 | 60.33 | 59.18 | 57.39 | 56.46 | 56.34 |
| 6 | 56.21 | 64.52 | 63.13 | 62.34 | 61.25 | 61.42 |
| 7 | 62.27 | 68.89 | 67.54 | 67.29 | 66.85 | 66.91 |
| 8 | 67.38 | 73.39 | 71.98 | 72.23 | 71.31 | 71.38 |
| 9 | 72.88 | 78.08 | 76.12 | 76.86 | 76.38 | 76.94 |
| 10 | 77.48 | 82.56 | 80.30 | 81.39 | 81.64 | 81.98 |
| 11 | 83.81 | 87.28 | 86.94 | 88.10 | 88.09 | 88.57 |
| 12 | 91.06 | 93.44 | 91.76 | 92.38 | 93.38 | 93.49 |
| 13 | 99.77 | 100.16 | 100.56 | 100.95 | 101.37 | 101.77 |
| 14 | 110.24 | 109.04 | 109.56 | 109.29 | 110.10 | 110.64 |
| 15 | 121.27 | 119.91 | 121.92 | 123.04 | 124.16 | 124.46 |
| 16 | 138.89 | 136.17 | 133.73 | 134.00 | 135.57 | 136.37 |
| 17 | 155.85 | 156.93 | 155.82 | 155.11 | 156.05 | 157.07 |
| 18 | 190.10 | 190.40 | 190.79 | 188.58 | 188.14 | 187.99 |
| 19 | 251.25 | 247.74 | 244.18 | 240.36 | 242.07 | 240.30 |
| 20* | 18.90 | 17.04 | 18.07 | 17.10 | 17.01 | 16.65 |
| Average Disposable PI | 2674.64 | 5291.24 | 9723.42 | 15213.45 | 20454.58 | 25158.33 |

*The overall percentage of the total income held by the richest 5% of population

## CHAPTER 2

## CROSS-SECTION CONSUMPTION FUNCTIONS

Our cross-section consumption functions are based on surveys of what households buy. These surveys collect the data of each household in the sample not only on major items of expense and income but also on demographic characteristics such as ages of household members, region, education, and number of earners. Since it is assumed that all the households face identical prices in a cross-sectional analysis, the explanations of differences in consumption behavior among households are ascribed to the differences in income and these demographic characteristics.

For items bought by nearly all households, the method is a fairly simple nonlinear least squares. However, for the "big-ticket" or other items which many households do not buy, this study introduces a new technique, which we believe to be better than the tobit technique recommended in many textbooks. Because most of the households in the survey did not purchase the large-ticket items like automobiles and other major durable goods, it is reasonable to ask first how the households determine whether to buy or not to buy and then, separately, to ask how much they will buy once they decide to do so. We will determine, first, the probability that any given household will buy a particular product. For this step, we use probit analysis. Then we determine the expected expenditure in case it does buy. For this second step we use least squares on the households in the sample which, in fact, bought the item. Although the tobit regression model is a typical scheme for the models in which the expense of households are sometime zeroes, our argument will suggest that it is not appropriate.

In this chapter, the structure and the major factors of cross-section consumption functions are first presented in Section I. Section II is about the data and the estimation scheme of the empirical work. Section III is the summary of the estimation results of the least squares method. Section IV contains the results estimated by the big-ticket-item analysis.

## I. The Structure of Cross-Section Consumption Functions

A fundamental notion in this study is a non-linear Engel curve. That is, it is possible for the Engel curve to represent a particular good as a luxury for some income groups while as a necessity for others. A second fundamental notion is that of demographic effects. The impacts of the demographic factors on consumer spending are particularly from region of residence, education, working spouse, family size, and age of household head. For instance, our results will show that the households with working wives spend significantly more than one-earner households on domestic servants and laundry services. A third fundamental notion is that of the adult equivalency weight (AEW). Roughly speaking, the third notion is that age and sex of household members affect their consumption. A man aged thirty counts for more than a girl aged six in the consumption of beer. More precisely, our results will show that adults aged between thirty-one and forty count for more than 15 times as much as do children aged under five years in the consumption of alcohol.

To express our three fundamental notions in a typical consumption function, we can write a general form as follows:

Family consumption of product i =

( $f_i$ ( Income per capita within the family ) + Demographic effects )

* ( Family size for product i ).

Although the details of each fundamental notion will be shortly presented, an overview of the specific form of the consumption function in this dissertation will be first introduced.

The functional form used for a cross-sectional study must be flexible enough to represent the demand for luxuries, necessities, and inferior goods. The form employed is[1]

$$C_i = ( b_{i0} + \sum_j b_{ij} Y_j + \sum_j d_{ij} D_j )( \sum_g w_{ig} n_g ) \tag{2.1}$$

where

$C_i$ is the household consumption of good i;

$Y_j$ is the amount of per capita household income within the j[th] income bracket which will be shortly described in detail;

$D_j$ is the j[th] demographic category represented by a zero-one dummy variable;

$n_g$ is the number of household members in age group g; and

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

In Equation (2.1), household consumption of commodity i is explained by household income per capita, demographic characteristics of the household, and the weighted household size for product i, $\Sigma_g\ w_{ig} n_g$. The weighted household size depends not only on the number of family members but also on their ages. Thus, household consumption of good i is obtained by multiplying expenditure per household member by the specific size of household for i. The weighted size of a household differs by commodities. In addition, the weight for each good varies by age groups.

[1]This form is borrowed directly from Devine (1983), although a different estimation scheme is applied.

## A. Income vs. Consumption Expenditure

One of the most important factors in traditional consumption functions is the income variable. Engel curves represent the relationship between income and outlay of each particular commodity. Before going into a discussion of the functional form, we must clarify the meaning of "income". Theoretically, the level of household expenditure depends on the level of permanent income. In our cross-sectional analysis, total annual expenditure will be used to represent permanent income. In principle, "permanent income" reflects past, present, and expected future income, as well as wealth. In practice, past income, expected future income and a general measure of wealth are not available. Moreover, even if they were, they are so correlated that it seems useless to employ them separately as explanatory variables.

Besides the availability of data, another difficulty arises when using "permanent income" as the determining variable in the consumption functions. In cross-section, higher income is always associated with a higher saving rate. The time-series evidence, however, shows that, although average incomes have increased substantially, the aggregate saving rate tends to remain constant or even to decline slightly over time. Hence, if we use any form of "income" as the explanatory variable, we will underestimate the increase in the time-series aggregate consumption expenditures as income increases. In the cross-section, we will use total expenditure as the "income" variable in the consumption function.

Although a variety of functional forms of Engel curves have been investigated by Brown and Deaton (1972), each of the forms they study is good only for a specific group of commodities with certain characteristics.[2] The Piecewise

[2]For example, the double-logarithmic form is not appropriate if the observed value on the dependent variable is sometimes zero.

Linear Engel Curve (PLEC), employed in what follows, however, is general and flexible enough to represent all the groups.

The basic idea of our consumption function is to represent a family's consumption as a product of two terms, one depends on the per capita income within the family, Y, and the other being the family size for that product. It will be recalled that the basic equation is:

Family consumption of product i =

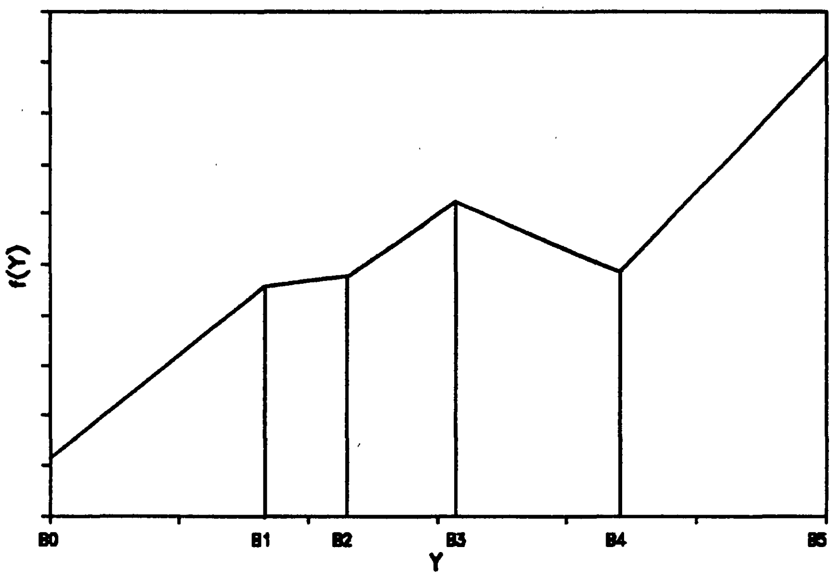
( $f_i$ ( Income per capita within the family ) + Demographic effects )

* ( Family size for product i ).

We now turn to explaining the form of the $f_i$( ). Figure 2.1 shows an example of the form we shall use, a piecewise linear function. We first mark out five income brackets, with points at $B_0$, $B_1$, ... , $B_5$.

**FIGURE 2.1**

**A Piecewise Linear Engel Curve**




Boundaries of the brackets are determined such that each bracket contains exactly one fifth of the total households in the sample. Within a bracket, the Piecewise Linear Engel Curve is a straight line, but slopes may be different in different brackets, though the segments touch at their ends. For luxuries, rich households are likely to have a higher slope or marginal propensity to consume than do poor households. For necessities, all the households have a relatively constant slope over the income brackets.

To see how to write the function so that it can be estimated by regression, let Y be the household income per capita and define $Y_1, \ldots, Y_5$ by

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

Thus, the Piecewise Linear Engel Curve for good i is described as follows:

$$f_i(Y) = b_{i0} + \sum_j b_{ij} Y_j \tag{2.2}$$

To put the same matter in words, if the family's per capita income, Y, is greater than or equal to the boundary $B_k$ but lower than the next boundary $B_{k+1}$, then the family's income in all the income brackets below $B_k$ is equal to the width of that bracket, while the family's income in the $k^{th}$ bracket is of the amount of the excess of Y over $B_k$, and its income in all the higher brackets is zero. A numerical example may be useful here. Suppose the values of the boundaries are as follows: $B_0$ = \$0, $B_1$ = \$2,000, $B_2$ = \$4,000, $B_3$ = \$6,000, $B_4$ = \$8,000, and $B_5$ = infinity. Consider a household with per capita income of \$4,500, which falls between $B_2$ and $B_3$. Its $Y_j$'s are: $Y_1 = B_1 - B_0$ = \$2,000, $Y_2 = B_2 - B_1$ = \$2,000, $Y_3 = Y - B_2$ = \$500, $Y_4$ = \$0, and $Y_5$ = \$0.

The coefficient of $Y_j$, $b_{ij}$, is the slope of Engel curve within bracket j. These slopes differ not only over different goods but also over different income levels. Thus, it is possible to show that a particular commodity is a necessity for some income groups but a luxury for others. If the coefficients of all the income brackets are the same for a particular commodity, the Engel curve is linear.

Recall that the boundaries of income, $B_j$'s, are determined so that each income bracket contains exactly one fifth of the total households in the sample. The resulting boundaries of our data, the 1980-1981 Survey of Consumer Expenditures are as follows:

$B_0 = \$0$

$B_1 = \$3{,}310$

$B_2 = \$4{,}639$

$B_3 = \$6{,}277$

$B_4 = \$8{,}848$

$B_5$ = infinity (In the plots, $B_5$ will be taken as $12,000 for the estimated Engel curves)

Thus, the fundamental equation can now be written as

Family consumption of product i =

$$( b_{i0} + \sum_j b_{ij} Y_j + \text{Demographic effects} ) * ( \text{Family size for product } i ).$$

**B. Household Characteristics**

Given the form we derived in the last section, we now turn to the discussion of demographic variables.

a. <u>The Effect of Demographic Variables</u>

The impacts of the demographic factors on consumption expenditures result especially from region of residence, education, working status of spouse, family size, and age of household head.

Region:

The geographic regions are Northeast, North Central, South, and West. The region of residence has an apparent influence on some expenditure items. The households in the West have a relatively large number of renters whose utilities are included in rent. The expenditures of these households on electricity, gas, and water thus are lower while the expenditures on shelter are higher than those of households in other regions. On the other hand, the Northeast has historically accounted for a larger share of total fuels and utilities expenditures than other regions mostly because of the weather conditions. Precise definitions of the regions are given in Appendix B.

Education:

The education of household head is classified as either college-educated or not college-educated. Besides the high correlation between education and unemployment rates, the households with college educated members spend differently on certain commodities from the families whose heads are not college- educated. Our results will show that the expenditures on reading materials and children's education are the most significant items.

Working Status of Spouse:

In the 1950's, less than 20% of women were wage earners. Since the late 1970's, however, more than 50% of women have been working or looking for work in the labor force. The big changes in the labor-force-participation rate, which increases dramatically for women but declines for men, influence expenditure patterns especially on the consumption of services. The households with working wives spend significantly more than one-earner households on domestic servants and laundry services.

Family Size:

Family size is classified into four groups: one-person; two-person; three or four persons; and five or more persons. The amount of expenditures may not be linearly dependent upon the number of persons in the households. For example, other things being equal, the use of indoor lighting would provide an inverse relationship between family size and per capita expenditure on electricity. Thus, family size is used to account for "economies of scale" in families which may affect per capita expenditure within the family.

Age of Household Head:

The age of householders is divided into three categories: under 35, between 35 and 55, and above 55. As expected, the householders in the over 55 age group spend a higher proportion of total expenditures on health care than do other age groups. The middle age group, however, spends more on transportation and personal business.

Zero-one dummy variables are used to represent the demographic factors. Each household belongs to one and only one of the groups in each category. To avoid collinearity, one of the groups in each category is left out. Suppose there are L demographic categories, then the structure of the dummy variables works as follows:

$$D_j = 1 \qquad \text{if the household is in demographic group } j$$
$$= 0 \qquad \text{otherwise}$$

where $j = 1,\ldots,L$

The left-out demographic group is arbitrarily picked as 3-4 member households in the Northeast region without a working spouse, and with a head aged group 35-55 without college education. The detailed contents of the dummy variables are then

------ Regional category ------

$D_1$: Region = North Central

$D_2$: Region = South

$D_3$: Region = West

------ Education category ------

$D_4$: Education of Household Head = College

------ Working spouse category ------

$D_5$: Working Status of Spouse = Spouse is Employed

------ Family size category ------

$D_6$: Family Size = 1

$D_7$: Family Size = 2

$D_8$: Family Size $\geq 5$

------ Age category ------

$D_9$: Age of Household Head < 35

$D_{10}$: Age of Household Head > 55

In our functional form (2.1), we assume that there are no interactions between the demographic variables, so the total demographic effect is additive:

$$\text{Demographic effects} = \sum_j d_{ij} D_j$$

Since the demographic effects are additive, they influence only in the intercept of the PLEC.

In general, if the interactions between these factors are not excluded and we restrict ourselves to the condition of two-variable interactions, the interaction effect represented by the dummy variables can be described as[3]

| | | |
|---|---|---|
| $D_i{*}D_j$ | = 1 | if there is interaction between $i^{th}$ and $j^{th}$ demographic category |
| | = 0 | otherwise |

It is not difficult to construct these interactions in the cross-section, though the number of parameters to be estimated would rise sharply (In our model, the number of parameters with two-variable interactions are 4*(2+2+4+3) + 2*(4+2+4+3) + 2*(4+2+4+3) + 3*(4+2+2+4) = 132, since we have to be concerned with, for example,

[3]If a full interaction among these variables is allowed, the product of up to five dummies should be used as the explanatory variables. In this case, we may have the demographic interaction effect of a household with four family members and two earners which resides in the Northeast and whose household head is fifty-five years old and college-educated.

not only the effect of a household which resides in the West with college-educated household head but also the effect of a two-earner household which has a five-year-old child). The transition from the cross-section to the time series, however, would be a very complex task. We would need the historical data for all the possible interactions among these factors. In fact, they are not available from our data sources. The assumption that the demographic effect is additive is to make our transition to the time-series analysis possible.

Thus, the basic equation incorporated with the form of demographic effects can now be written as:

Family consumption of product i =

$$( b_{i0} + \sum_j b_{ij} Y_j + \sum_j d_{ij} D_j )*(\text{ Family size for product i }).$$

b. The Effect of Family Composition

How does the age structure of a household affect its consumption? To study this question, we shall divide the population into 8 age groups and record the number of family members in each group, $n_g$, g = 1,...,8. The unweighted family size, n, therefore, is

$$n = \sum_g n_g \qquad (2.3)$$

For each product, we wish to find how much one person in each age group counts relative to a person in the reference group, which we will take to be the 31-40 age group. We will call that weight $w_g$ for group g. Then

$$n_i^* = \sum_g w_{ig} n_g \tag{2.4}$$

becomes the household size weighted for product i. In Equation (2.4), $n_i^*$ is the weighted family size for good i and $w_{ig}$ is the weight of good i for age group g. The unweighted family size is a special case of the weighted sum with all the weights equal to 1.0.

While the total expenditure is divided by the specific size of the household for each particular commodity to get the per capita household consumption on that item, the income of the household needs to be divided by an income scale to provide a more accurate measure of per capita household income. This income scale could be measured by the weighted average of the weights of different age groups for that commodity with weights approximately proportional to the expenditures on the commodities (Prais and Houthakker, 1971). The weight of income of good i for age group g can be expressed as

$$w_{0g} = \sum_i \left(\frac{q_i}{y}\right) w_{ig} \tag{2.5}$$

where the weight $q_i/y$ is the budget share of good i. The household size of income, thus, is

$$n_0 = \sum_g w_{0g} n_g \tag{2.6}$$

The income weights represented by Equation (2.5) are the weighted AEW's for different consumption items in the economy with weights being shares of each corresponding commodity. This assumption thus implies that the overall impact on consumption for each age group will be disclosed via the association of their specific influences on the different goods. Obviously, the bigger the income weight of a certain age group is, the more expensive is the maintenance of that group.

According to Equation (2.6), to incorporate the Engel curves corrected by the household size of income in time series we need to have the data on size distribution of income and age composition at each income level. However, it seems those data are not available in the time-series analysis. To avoid this troublesome situation, we assume that all the age groups have identical income weights, namely, they are equally expensive to maintain. That is, per capita household income is determined by dividing total household income by the number of household members.

The age structure of the household in our analyses is assumed to consist of eight age groups. They are

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

The number of family members in each group, $n_g$, $g = 1,\ldots,8$, is used as the independent variables. Zeroes are for those null categories. It must be perceived that the product of per capita expenditure and weighted family size in Equation (2.1) will cause the under-identification problem. That is, multiplying one term and dividing the other by a same factor at the same time will provide multiple solutions of the equation since it would always end up with the constant product. Thus, to get a unique solution, the weight of age group 5, age 31 - 40, is presumed to be one for each of the categories. It therefore could be viewed as the reference group or the adult equivalent.

Now, we can have a final form of the equation, which contains our three fundamental notions, as follows:

Family consumption of product i =

$$( b_{i0} + \sum_j b_{ij} Y_j + \sum_j d_{ij} D_j )( \sum_g w_{ig} n_g )$$

### C. "Big-Ticket", Seldom-Bought Items

For many large-ticket items like automobiles and other major durable goods, zero expenditures are reported by many if not most of the households in the survey. However, it is not reasonable to just use the zeroes for expenditures of those who did not buy. Instead, we will ask: What are the probabilities of purchase for each household? What is the expected amount of expenditures if it does buy? To answer these questions, we have to formulate a model which contains a distribution of purchase probability and a consumption equation which incorporates the information of the probability distribution.

a. The Model

Our approach, in contrast to the tobit approach often used for this problem, recognizes that the factors determining whether or not a family buys a particular good may be quite different from those that determine the amount spent, given that the family buys. For instance, having a new born baby could be the most important reason for a family to decide to buy a new car. However, once the decision to buy is made, the family's disposable income will dictate the amount spent.

The approach in this study is more flexible than the traditional tobit analysis. A complete description of tobit analysis model can be found in Appendix C. Roughly speaking, tobit analysis formulates a regression model in which the same linear function which determines how much the family spends also determines whether or not it buys by simply setting the purchase equal to zero if the value of the linear function is less than 0. The ordinary least squares approach will cause estimation bias when the dependent variable is limited in this way.

Our criticism of the tobit model is mainly on its specification of the explanatory variables. In tobit, the variables used to explain the probability of purchase must be the same as those that influence the level of consumption. Indeed, they must have the same weight in both decisions. The above example of buying a new car shows that this use of the same weights in both decisions is clearly inappropriate. In contrast, our model allows the possibility of using different factors to answer the two questions: "to buy or not to buy?" and "how much to spend?" Furthermore, even if the same factors are used, their relative importance may be very different for the two questions.

To explain our method, we need to introduce some notation. For each family, let the variable $y_{i1}$ be 1 if the family bought product i and otherwise 0. We will call the row vector of variables used to explain the yes-or-no decision to buy $x_{i1}$, and denote the weights of the variables in this decision by the column vector $\beta_{i1}$. By $x_{i2}$ we denote the variables used to explain the amount spent, $y_{i2}$, by those families which bought. Thus, a general form of the model can be described as

$$y_{i1} = f_{i1}(x_{i1}\beta_{i1}) + u_{i1}$$

for all households. The $f_{i1}$ function can be expressed as follows:

$$y_{i1} = \frac{1}{\sqrt{2\pi}} \int_{-\infty}^{x_{i1}\beta_{i1}} e^{-\frac{t^2}{2}} dt + u_{i1} \tag{2.7}$$

where $u_{i1}$ is a disturbance term, and the integral is the normal cumulative density function. Then, for those who bought,

$$y_{i2} = f(x_{i2}) + u_{i2} \tag{2.8}$$

where f is our usual piecewise linear function, and the $u_{i2}$ are disturbance terms.

We will denote by $y_{i1}$^ the estimate of $y_{i1}$ for each household and interpret it as the probability of purchase by that household. By Equation (2.7), $y_{i1}$^ will be calculated for each household.

The expected value of expenditure for a given household, $y_{i3}$, is then the product of the probability of purchase and the amount spent if the household buys. It is given by the following equation:

$$y_{i3} = f_{i1}(x_{i1}\beta_{i1}) * f(x_{i2}) \tag{2.9}$$

for all households. Equation (2.9) makes the expected purchases of the household a very non-linear function of $x_{i1}$ and $x_{i2}$. At this point, we must look ahead to the next chapter to anticipate a problem. In that chapter, we shall use the variable $C_t^*$ which is what consumption per adult equivalent would be in period t if it were determined solely from income and demographic effects, as ascertained from the cross-section. Thus, for a given product,

$$C^* = \sum_i \left( \sum_j b_j Y_{ij} + \sum_j d_j D_{ij} \right)$$

where the sum on i runs over all households.

This can be rewritten as

$$C^* = \sum_j b_j \sum_i Y_{ij} + \sum_j d_j \sum_i D_{ij} = \sum_j b_j Y_j + \sum_j d_j D_j$$

where $Y_j$ and $D_j$ are population totals for which time series can be constructed.

This use of the population totals to construct $C^*$ was possible because of the linearity of the consumption per adult equivalent in the $Y_{ij}$ and $D_{ij}$. Unfortunately, the product of Equation (2.7) with Equation (2.8) yields a function that is by no means linear in the determining variables. If we simply stopped with the estimation of these two equations, we would be unable to compute the movement of total expenditure of the population from available data on the distribution of income and the demographic variables.

As a way of dealing with this problem, we estimated a function of the normal form (Equation (2.1)) by using as the dependent variable, not the actual expenditures of the household on "big-ticket" items, but the household's expected expenditure, $y_{i3}$. The equation used for estimation can be written as follows:

$$y_{i3} = f(x_{i2}) + u_{i3} \tag{2.10}$$

for all households, where $u_{i3}$ is the disturbance term. In this way, we avoid the problem of zero values.

Although our model recognizes that the factors affecting the probability of purchase may not be the same as those affecting the amount purchased, we will, in fact, use the same determining variables for both purposes. All of the limited number of the explanatory variables in our model seem possibly relevant to both decisions. In terms of our notation, $x_{i1} = x_{i2}$. However, we do not assume that the $\beta_{i1}$ in any way enter the f( $x_{i2}$ ) function in equation (2.8).

We will, in fact, apply the method introduced in this section not only to the "large-ticket" items but also to the consumption goods which are relatively inexpensive but are not bought by many families. For instance, our data shows that about 45% of the households did not buy cigarettes and about 40% of the families reported zero expenditure on alcohol, although these goods are not "big-ticket" items.

b. The Decision to Buy

In this section we turn to the discussion of the purchase probability distribution functions. The objective of Equation (2.7) is to determine the purchase probability of a given product for each family. There are two common approaches to estimating the purchasing decision probability function in advance. One is the probit model, and the other is the logit model. In our analyses, the probit model is selected as the approach in advance without any particular reasons. Besides, we will introduce an approach which not only can be used as an "ex post" test for the results of the probit model but also offers an alternative evaluation of the purchase probability function. It is important that we investigate whether the normal provides a good approximation to the actual probability distribution, because we will take its result seriously as the probability of purchase in our "big-ticket" analysis.

The basic idea of the "ex post" approach is to derive the actual distribution of purchase probability. That is, for good i, we will rank the households by their $x_{i1}\beta_{i1}$ score, group them into ventiles, and use the data reported by each family to calculate the number of households who bought in each $x_{i1}\beta_{i1}$ group and then compute the corresponding percentage of those who bought in that group. This "ex post" probability for households in the ventile can be compared with the average probability computed from the probit for those households. There is no a priori guarantee that these two probabilities will be identical or even similar. Should they prove dissimilar, the "ex port" probabilities could be used in Equation (2.7). In fact, they turned out to be quite similar and the theoretical probabilities were used.

An alternative to the probit method was also tried. The alternative method simply regresses the zero-one variable, $y_{i1}$, on the determining variable, $x_{i1}$, by least squares. It is given by the following equation

$$y_{i1} = x_{i1} b_{i1} + v_{i1} \tag{2.11}$$

for all households, where $v_{i1}$ is the disturbance term.

The usual objection to this method is that it is hard to interpret the predicted values; they cannot be probabilities since they may fall outside the [0,1] interval. This problem of interpretation is readily remedied by the use of the "ex post" method. After estimation, the households are ranked by the value of $x_{i1}b_{i1}$, which is estimated by Equation (2.11). Further, they are grouped into twenty ventiles (each ventile contains exactly one twentieth of the total households). To compute the actual probability of purchase for each ventile, we sum over the values of $y_{i1}$ within the ventile (since $y_{i1}$ equals one if the household bought, and equals zero if the household did not buy, the sum of $y_{i1}$'s is the number of households who bought), and then divide the sum by the number of ventile's households. The computation has to be done for each ventile. By doing this, we get a distribution of actual probability over the twenty ventiles.

The advantage of this alternative approach is its lower computing cost at the first step. However, the cost of function evaluation at the second stage is less expensive for probit once the estimated parameter is obtained. Probit makes use of the established table values of statistical probability for all the equations, while the "ex post" approach has to construct an individual distribution of probability for each of the consumption items. For the convenience of function evaluation, we chose to use the probit analysis in this study. However, we recognized that an "ex post" testing is necessary.

## II. Data and Estimation Scheme

### A. Data

The data used for the cross-sectional analysis is obtained from the Consumer Expenditure Survey: Interview Survey, 1980-1981. The Consumer Expenditure Survey conducted by the Bureau of Labor Statistics consists of two separate components. One is the quarterly interview survey in which each of households in the sample is interviewed once every three months over a 12-month period, and the other is the diary survey in which households are requested to keep a diary of expenses for two consecutive 1-week periods. The interview survey accounts for approximately 95 percent of total household expenditures and includes all the large-ticket items like durable goods.

The 1980-1981 interview survey is the first major survey of consumer expenditure since 1972-1973. The earlier survey has been used to analyze cross-sectional consumption demand by Devine (1983). Since the new survey is designed in a rotating procedure where 20 percent of the sample is dropped and a new group of households added each quarter, only the households who participate in four consecutive quarters over the period from the first quarter of 1980 to the first quarter of 1982 are selected. There are more than 500 items of detailed expenditures in the original tapes of interview survey. They are aggregated into 61 categories shown in Table 2.1 to match the categories of Personal Consumption Expenditure in the National Income and Product Accounts as closely as possible for the time-series analysis.

Besides the data on consumption expenditures, all the other household characteristics are also given in the tape files. This makes the data on demographic and age variables simple to obtain. In order to have as full information as possible for households in the sample, those without reporting of region of residence are excluded. A few households with peculiar or probably erroneously reported amounts of spending on certain consumption categories were also excluded to avoid biasing the estimates to fit outlier observations of questionable accuracy. The total observations available are 4400.

**TABLE 2.1**

**Cross-Section Consumption Categories**

1. Food, off premise
2. Food, on premise
3. Alcoholic beverages, off premise
4. Alcoholic beverages, on premise
5. Tobacco products
6. Shoes and footwear
7. Women's and children's clothing
8. Men's and boy's clothing
9. Luggage
10. Jewelry and watches
11. Laundries, storage, and repair of clothing and shoes
12. Other jewelry and clothing services
13. Personal care
14. Owner-occupied housing
15. Tenant-occupied housing
16. Other housing
17. Additions, alterations, and constructions of residencies
18. Hotels and motels
19. Furniture
20. Kitchen and household appliances
21. China, glassware, and tableware
22. Other durable house furnishings
23. Floor coverings
24. Semidurable house furnishings
25. Electricity
26. Natural gas
27. Fuel oil and coal
28. Wood, other fuel, and bottled or tank gas
29. Water and other sanitary services
30. Telephone and telegraph
31. Domestic service
32. Other household operations
33. Household insurance
34. Prescription drug and sundries
35. Physicians
36. Dental and eyes
37. Other medical services and supplies
38. Hospitals and sanitariums
39. Health insurance
40. Personal business
41. Life insurance
42. New cars
43. Used cars
44. New and used trucks or vans
45. Tires and tubes
46. Auto accessories and parts
47. Auto repairs

**TABLE 2.1**

**Cross-Section Consumption Categories (Continued)**

48. Auto insurance
49. Gasoline and oil
50. Tolls, parking fees, and registration
51. Local transportation
52. Intercity transportation
53. Books, magazines, and newspaper
54. Boats, recreational vehicles. and pleasure aircraft
55. Wheel goods, toys, and sport equipment
56. Radio, TV, recorders, and musical instruments
57. Radio, TV, and sound equipment repairs and rental
58. Fees and admissions
59. Other recreational supplies, equipment, and services
60. Education
61. Cash contribution

## B. Estimation Scheme

The right hand side of Equation (2.1) is the product of per capita expenditure and weighted household size. It is not a linear form, so it cannot be estimated by ordinary least squares directly. Therefore, an iterative method must be used. Roughly speaking, an iterative process attempts to make the parameters converge to the desired solution in however many steps are necessary. An initial guess of the solution will be adjusted through each iteration until it is close enough to the true solution. For estimation, we shall apply the iterative procedure to the Taylor series expansion of Equation (2.1). The linear approximation of Taylor series for Equation (2.1) is as follows:

$$\Delta C_i = N\Delta b_{i0} + \sum_j NY_j \Delta b_{ij} + \sum_j ND_j \Delta d_{ij} + \sum_g Xn_g \Delta w_{ig} \tag{2.12}$$

where X and N denote household expenditure per capita and weighted household size respectively, and $\Delta$ is the amount of changes. It must be perceived that X and N are not constant. The values of X and N change through every iteration.

Equation (2.12) is a linear form, thus it can be estimated by least squares. The least squares method is accomplished by using an iterative process. The first iteration begins with the identical equivalent weights. In other words, the weights of all the age groups are presumed to be one. Subsequently, the current estimated parameters are used as the starting values of the following iteration. The iterative procedure is repeated until all the estimated coefficients converge to the stationary points or the amount of changes in each of the coefficients approaches zero.

To illustrate the detailed iterative procedure, let f be a function of a vector of independent variable x and a vector of parameter B for y so that $y = f(x, B)$. Thus, the Taylor series expansion around $B^{(0)}$, the initial guess, is

$$f(x,B) = f(x,B^{(0)}) + f'(x,B^{(0)})(B - B^{(0)}) \qquad (2.13)$$

where $f'(x,B^{(0)})$ is the first derivatives of $f(x,B)$ with respect to B evaluated at $B^{(0)}$. Thus, we can rewrite the equation as follows

$$y = f(x,B^{(0)}) + f'(x,B^{(0)}) * \Delta B^{(0)} \qquad (2.14)$$

where $\Delta B^{(0)} = B - B^{(0)}$

Equation (2.14) can be estimated by least squares for $\Delta B^{(0)}$. Since the value of the parameter for the next iteration, $B^{(1)}$, equals $B^{(0)} + \Delta B^{(0)}$, f and f' can then be evaluated at $B^{(1)}$ in Equation (2.14) to obtain the least squares estimate for $\Delta B^{(1)}$. Thus, for the $i+1^{th}$ iteration, $B^{(i+1)} = B^{(i)} + \Delta B^{(i)}$. That is, the current estimate of the changes in parameter B, $\Delta B^{(i)}$, is used to provide the value of B in the next iteration, $B^{(i+1)}$, and then to evaluate the function f and f' at $B^{(i+1)}$. The process is repeated until the difference between the estimate in two consecutive iterations, $\Delta B^{(i)}$, becomes less than .01. This procedure has to be done for each of the 61 equations. Each equation has 24 independent variables and 4400 observations. Therefore, the iterative procedure is repeated until each of the 24 parameters in a given equation is converged. By any standard, it is very computer intensive.

To estimate the "big-ticket" items represented by Equation (2.10), we need the household's expected expenditure. Thus, we have to first estimate the probability of purchasing for each household and the amount spent by those families which bought. Equation (2.7) determines the household's probability of purchasing and Equation (2.8) provides the amount of expenditure for those households which bought. To estimate (2.7), we need to obtain the parameters which maximize the objective function. The objective function of this probit model is a nonlinear form.

Thus, an iterative process has to be used. We utilize the Newton-Raphson[4] method to estimate the equations. In the estimation process, the cumulative density function of standard normal distribution is repeatedly evaluated at different points in each iteration until the convergence of the function parameters is achieved.

The estimation scheme for Equation (2.8) is the same as that for Equation (2.1). We first approximate the equation by the Taylor series expansion, and then use the iterative procedure to yield the stationary estimates. The only difference in estimating these two equations is the dependent variables. The dependent variable in Equation (2.8) is the amount spent by those families which bought. We now can create the dependent variable, the household's expected expenditure, for Equation (2.10) by multiplying the probability of purchase by the amount of expense if one will buy. The estimation procedure for (2.10) is also the same as that for (2.1).

## III. Estimation Results of Least Squares Method

Our regression results show that all the equations converge except Equation (17) of Additions, alterations, and constructions of residencies. The details of the estimation results are shown in Table 2.2. The figures in the parentheses are the t statistics. For adult equivalency weights, the t values are calculated with respect to the deviations from 1.0, the reference adult equivalent.

### A. Observations on Engel Curves

The plots of the estimated Engel curve are presented in Figure 2.2. The curves are drawn for the reference household, which is composed of three or four

[4]See Appendix C for the estimation scheme of the Newton-Raphson iterative procedure.

members and resides in the North East region, with a non-college educated householder aged between 35 and 55 and with a non-working spouse. In Figure 2.2, the consumption expenditure per adult equivalent on the vertical axis is plotted against per capita household income (which is per capita total household expenditures by our definition) on the horizontal axis. In general, there are no great surprises though it also is clear from the pictures that most of the consumption items have rather distinctive Engel curves. We summarize the results by the groups of equations with similar characteristics.

a. Food, Alcohol, and Tobacco

Off-premise consumption of both Food (1) and Alcoholic beverages (3) show a definite necessity pattern of consumption. It takes a smaller share of the budget as income gets higher. On the other hand, On-premise consumption of Food (2) and Alcohol (4) are luxuries particularly for the high income groups. (The Engel curves are steeper in the upper levels of income). Besides the negative slope of the third income bracket, the consumption of Tobacco products (5) show the pattern of a necessity.

b. Apparel, Luggage, and Jewelry and Watches

The equations on Apparel, Shoes and footwear (6), Women's and children's clothing (7), and Men's and boy's clothing (8), show a relatively constant slope of Engel curves throughout all the income brackets. Luggage (9) and Jewelry and watches (10) are luxuries except for the third and the fourth bracket respectively. The services on these items, Other jewelry and clothing services (12), and Laundries, storage, and repair of clothing and shoes (11) are more like luxuries for low while necessities for high income families. Personal Care (13), as excepted, has a necessity pattern.

c. Shelter

Our results show that high income households have relatively large shares of budget on Owner-occupied housing (14), while low income families spend more on Tenant-occupied housing (15). Moreover, the U-shaped Engel curve for Equation (15) indicates that Tenant-occupied housing is an inferior good for the low income groups. The slope is negative within the low income bracket because low income families will move to the owner-occupied housing as their income increases. However, the curve turns upward at upper levels of income because high income families are likely to live in the expensive apartments. The Engel curves for Other housing (16) show the slopes first climbing and then descending. The expenditure on Hotels and motels (18) is rather a luxury.

d. House Furnishings and Equipment

In general, all the equations of house furnishings and equipment (19) - (24) reveal a luxury nature except for Kitchen and household appliances (20). A distinct pattern of the Engel curves is shown for Semidurable house furnishings (24). The second and the fourth income bracket of (24) have a relatively high MPC. This phenomenon can be explained by the increase in the quantity of spending for the second bracket while the progress of the quality of consumption for the fourth.

e. Utilities

Almost all the utility expenditures, Equation (25) - (30), have a unique pattern of income-expenditure relationship. They are all necessities undoubtedly. The only exception is Wood, other fuel, and bottled or tank gas (28). The possible reason is, strictly speaking, they should not be classified into utilities. Telephone and telegraph (30) has a sharpest slope in the first income bracket followed by the fifth. The intuitive interpretation is that the basic fees account for the highest MPC in the lowest bracket. On the other hand, the expenses on the long distance phone calls are attributed to the amount of phone bill for the richest families.

f. <u>Household Operations</u>

Domestic services (31) and Other household operations (32) are more likely to be a luxury. The result shows that the MPC of the highest income group for these two equations is about ten times of that of the lowest bracket. On the other hand, Household insurance (33) is definitely a necessity.

g. <u>Health Care</u>

Basically, we expect a necessity pattern of Engel curves for health care, Equation (34) - (39), since the expenditures of them are heavily dependent upon the health conditions no matter one is rich or poor. Indeed, the estimation result shows that except Hospitals and sanitariums (38), all the other equations disclose a necessity type of Engel curves.

h. <u>Personal Business and Life Insurance</u>

Personal business (40) and Life insurance (41) have relatively constant slopes of Engel curves throughout the income brackets.

i. <u>Transportation</u>

Except for New cars (42) and New and used trucks or vans (44), all the other expenditures on automobiles have a similar Engel curve. That is, they do not take up a larger share of budget for better-off households. New cars (42) is undoubtedly a luxury. Local transportation (51) has very small values on MPC's. Intercity transportation (52), however, has luxury good characteristics.

j. Reading and Entertainment

Books, magazines, and newspaper (53) does not show any particular trend of MPC's. It is highest in the second and the fourth income bracket and about the same in others. The relatively expensive entertainment categories like Boats, RV, and pleasure aircraft (54) and Fees and admissions (58) have larger shares of income for higher income brackets than that of lower ones. Thus, they are luxuries. Other entertainment items have relatively constant slopes of Engel curves.

k. Education and Cash Contribution

It is surprising that Education (60) is almost unrelated to income. The slopes of five income brackets altogether are statistically insignificant. The tendency to Cash contribution (61) is obviously higher for rich families than that of the poor.

**B. Impact of Demographic Variables**

The effects of demographic variables on each individual consumption item are presented in Table 2.3. They are indicated by (+) or (-) if the demographic factors have a significant positive or negative impact on the magnitude of a given consumption category at .10 level of significance.

a. Region

40 out of 60 equations are significant at .10 level for at least one region category. It is shown that the Northeast has a highest share in Owner-occupied housing (14) while the West in Tenant-occupied housing (15). On the other hand, households in the Northeast and in the West, respectively, have a highest share in Fuel oil and coal (27) and a lowest share in Electricity (25). Another finding is that the South region has highest share in Electricity (25). It may be attributed to the electric heating systems which are mostly built in the South.

b. Education of Household Head

40 out of 60 equations have a significant impact for education. The college-educated householders typically tend to consume less on Alcohol, (3) and (4), and Tobacco (5) while spend more on Readings (53), and Fees and admissions (58) than otherwise.

c. Working Status of Spouse

For 16 out of 60 equations, working status of spouse contributes to various consumption patterns. The families with two earners spend more on Domestic services (31) than do those with a non-working spouse. It indicates that the restriction of time-budget leads to a diminishing share of housework with women's increasing participation in the labor force.

d. Family Size

There is highest proportion of the equations with significant influence of family size. 42 out of 60 equations are significant at .10 level. Family size is negatively correlated with the amount of per capita expenditure on Electricity (25) and Natural gas (26) because these services can be shared by family members. This is known as the economies of scales in consumption.

e. Age of Household Head

At least one of the two age variables for household head is significant in 22 out of 60 equations. It is expected that householders in the over-55 age group spend a higher proportion of their income on housing and health care than do the other two groups. The results, however, show that the consumption of these two items does not significantly differ among the three life cycle stages. This is probably because of the trend of increasing life expectancy. A threshold of sixty-five years old for the third life cycle stage may reflect the anticipated patterns.

## C. Observations on Adult Equivalency Weights

The bar chart representation of the adult equivalency weights is quite helpful here. They are graphed equation by equation in Figure 2.3. It is clear from the pictures that age matters for most of the consumption items. Furthermore, it is hard to find a particular pattern of the distribution of adult equivalency weights between any two or among more than two of the 60 equations. A general summary made by age groups is as follows:

a. Age group 1: 0- 5

Children under five years old have the highest weights on Domestic services, which obviously is the expense of baby-sitting and other home care for children, Furniture, and Floor coverings. In addition, they contribute almost nothing to the consumption of alcohol. Another interesting finding for this group is that their weight for Trucks or vans is equal to almost three times of the adult equivalent.

b. <u>Age group 2: 6-15</u>

This age group has the highest weights on Shoes and footwear, Clothing, and Luggage. It is obvious that the children in this age group are growing faster than any other groups. Thus, the amount of the expenditures on apparel are typically high.

c. <u>Age group 3: 16-20</u>

As expected, this age group has relatively high equivalency weights on Auto insurance and Education. But there is no intuitive explanation for one outcome. That is, this group is of eight times of the adult equivalent on the Hospitals and sanitariums. However, the preliminary examination of the data did not show any peculiar amount of the expenses on hospitals among the households.

d. <u>Age group 4: 21-30</u>

The weights of the On-premise consumption both of food and of alcohol are highest in this group. This group also has the highest weight on automobiles, both New cars and Used cars.

e. <u>Age group 6: 41-50</u>

Generally speaking, this group possesses almost the same weights for most of the consumption items as those of the reference group, age 30 - 41. That is, the estimated weights for this group are not significantly deviated from 1.0, the adult equivalent. The big differences in consumption between these two age groups are the diminishing consumption of alcohol and the fewer expenditures on furniture for individuals aged 41-50.

f. Age group 7: 51-65

The adult equivalency weights for this group are very close to those of age group 8, 66 - 99, for many equations. But the expenditures on medical services and supplies are much lower. This is consistent with our findings on the effect of age of household head.

g. Age group 8: 66-99

It is shown that persons in the over 66 age group have the highest weights in housing, personal care, medical expenses, and readings. But they account for the consumption of alcohol and tobacco only less than half of the adult equivalent.

## IV. Estimation Results of the "Big-Ticket" Items

The model for the "big-ticket" items is designed particularly for the consumption items which are expensive or relatively inexpensive but are not bought by many families. It is expected that for the items which are bought by many households, the estimated coefficients from this approach and the least squares method will not have big difference. We ran this regression for all the equations and the results confirm our prior anticipation. Table 2.4 shows the coefficients estimated by these two different methods. The first column is the big-ticket-item analysis, denoted as "probit". The second column is the least squares method using all observations. We also include the results of the least squares method using nonzero observations in the third column of Table 2.4. The number of the nonzero observations for each equation is shown at the bottom of the table.

The t-statistics of the parameters and $R^2$ for most equations estimated by the "probit" method are extremely high. This is because that we used the expected values of consumption expenditures as the dependent variable. This dependent variable was created by using the estimation results of the amount spent by households which bought, which are shown in the third column in Table 2.4, and the probability of purchase for all households. Thus, the equations, in this case, are fitted quite well by the explanatory variables. Since almost all the t-statistics are far above the values of the 1% significant level, we shall not list these figures in the tables.

The more expensive items like New cars (42), New and used trucks or vans (44), and Boats, RV, and pleasure aircraft (54) have quite different results from the two different approaches. For income effect, in this case the marginal propensity to consume or the coefficients of the income variables, the "probit" method has less income impact than the least squares method does. That is, 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. For demographic effect, each estimated coefficient has the same sign from these two approaches despite the differences in magnitude.

For most other equations estimated by the "probit" method, the effects of income and demographic factors on consumption are quite similar with that of the least squares method. Thus, we shall not repeat the summary of the estimation results for each equation and the charts for Engel curve and adult equivalency weights.

**TABLE 2.2**

**Estimated Coefficients by Least Squares**

Variable List

| | | |
|---|---|---|
| VAR 1 | - | constant |
| VAR 2 | - | income between \$0 and \$3,310 |
| VAR 3 | - | income between \$3,310 and \$4,639 |
| VAR 4 | - | income between \$4,639 and \$6,277 |
| VAR 5 | - | income between \$6,277 and \$8,848 |
| VAR 6 | - | income over \$8,848 |
| VAR 7 | - | household resides in the North Central |
| VAR 8 | - | household resides in the South |
| VAR 9 | - | household resides in the West |
| VAR 10 | - | household head is college educated |
| VAR 11 | - | spouse is employed |
| VAR 12 | - | household has one member |
| VAR 13 | - | household has two members |
| VAR 14 | - | household has five and more members |
| VAR 15 | - | age of household head is less than 35 |
| VAR 16 | - | age of household head is greater than 55 |

EQUATION 1 FOOD, OFF PREMISE RSQ = 0.616 MEAN = 2942.17

| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| VAR 1 | VAR 2 | VAR 3 | VAR 4 | VAR 5 | VAR 6 | VAR 7 | VAR 8 | VAR 9 | VAR10 |
| 363.274 | 0.226 | 0.091 | 0.067 | 0.077 | 0.040 | -109.396 | -81.667 | -28.916 | -81.869 |
| (10.45) | (18.14) | (5.63) | (4.31) | (7.15) | (10.73) | (7.39) | (5.49) | (1.77) | (6.79) |
| VAR11 | VAR12 | VAR13 | VAR14 | VAR15 | VAR16 | | | | |
| -87.499 | 25.316 | -13.969 | -16.419 | 51.849 | 34.400 | | | | |
| (6.41) | (0.63) | (0.65) | (1.21) | (2.89) | (1.72) | | | | |
| 0- 5 | 6-15 | 16-20 | 21-30 | 31-40 | 41-50 | 51-65 | 66-99 | | |
| 0.711 | 0.934 | 0.916 | 0.862 | 1.000 | 1.155 | 1.081 | 0.961 | | |
| (5.75) | (1.43) | (2.01) | (5.01) | (0.00) | (4.49) | (2.38) | (1.09) | | |

EQUATION 2 FOOD, ON PREMISE RSQ = 0.445 MEAN = 811.91

| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| VAR 1 | VAR 2 | VAR 3 | VAR 4 | VAR 5 | VAR 6 | VAR 7 | VAR 8 | VAR 9 | VAR10 |
| -44.399 | 0.061 | 0.063 | 0.092 | 0.047 | 0.094 | 9.668 | -18.937 | -0.812 | 49.330 |
| (1.63) | (6.35) | (4.72) | (7.19) | (5.40) | (19.13) | (0.82) | (1.60) | (0.06) | (4.98) |
| VAR11 | VAR12 | VAR13 | VAR14 | VAR15 | VAR16 | | | | |
| -13.808 | 15.085 | 10.878 | 16.955 | 2.972 | -3.052 | | | | |
| (1.26) | (0.46) | (0.65) | (1.59) | (0.23) | (0.22) | | | | |
| 0- 5 | 6-15 | 16-20 | 21-30 | 31-40 | 41-50 | 51-65 | 66-99 | | |
| 0.270 | 0.575 | 1.426 | 1.015 | 1.000 | 1.007 | 0.660 | 0.807 | | |
| (7.02) | (5.66) | (4.65) | (0.28) | (0.00) | (0.13) | (8.91) | (3.64) | | |

EQUATION 3 ALCOHOL, OFF PREMISE RSQ = 0.144 MEAN = 152.85

| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| VAR 1 | VAR 2 | VAR 3 | VAR 4 | VAR 5 | VAR 6 | VAR 7 | VAR 8 | VAR 9 | VAR10 |
| -2.380 | 0.022 | 0.010 | 0.013 | 0.013 | 0.012 | -12.621 | -7.381 | 2.348 | -8.618 |
| (0.18) | (4.78) | (1.76) | (2.41) | (3.74) | (9.34) | (2.45) | (1.43) | (0.41) | (2.08) |
| VAR11 | VAR12 | VAR13 | VAR14 | VAR15 | VAR16 | | | | |
| -7.767 | 35.987 | 31.001 | 2.603 | 7.849 | -14.480 | | | | |
| (1.62) | (2.87) | (4.64) | (0.53) | (1.33) | (2.37) | | | | |
| 0- 5 | 6-15 | 16-20 | 21-30 | 31-40 | 41-50 | 51-65 | 66-99 | | |
| 0.066 | 0.202 | 0.461 | 0.797 | 1.000 | 0.807 | 0.678 | 0.459 | | |
| (8.22) | (9.83) | (6.31) | (3.53) | (0.00) | (3.12) | (6.02) | (9.89) | | |

EQUATION 4 ALCOHOL, ON PREMISE RSQ = 0.190 MEAN = 105.53

| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| VAR 1 | VAR 2 | VAR 3 | VAR 4 | VAR 5 | VAR 6 | VAR 7 | VAR 8 | VAR 9 | VAR10 |
| -3.834 | 0.011 | 0.013 | 0.010 | 0.007 | 0.023 | -5.035 | -20.085 | -0.208 | -7.991 |
| (0.35) | (2.98) | (2.49) | (2.08) | (2.07) | (12.84) | (1.08) | (4.08) | (0.04) | (2.14) |
| VAR11 | VAR12 | VAR13 | VAR14 | VAR15 | VAR16 | | | | |
| -2.184 | 177.534 | 16.900 | 4.462 | 0.188 | -4.276 | | | | |
| (0.51) | (8.42) | (2.63) | (1.07) | (0.04) | (0.71) | | | | |
| 0- 5 | 6-15 | 16-20 | 21-30 | 31-40 | 41-50 | 51-65 | 66-99 | | |
| -0.189 | 0.464 | 0.785 | 1.136 | 1.000 | 0.566 | 0.318 | 0.244 | | |
| (6.51) | (4.37) | (1.97) | (1.78) | (0.00) | (8.10) | (17.74) | (16.84) | | |

EQUATION 5 TOBACCO PRODUCTS RSQ = 0.121 MEAN = 176.16

| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| VAR 1 | VAR 2 | VAR 3 | VAR 4 | VAR 5 | VAR 6 | VAR 7 | VAR 8 | VAR 9 | VAR10 |
| 39.520 | 0.021 | 0.009 | -0.007 | 0.004 | 0.002 | -7.705 | -13.277 | -19.143 | -35.771 |
| (3.86) | (5.95) | (1.93) | (1.57) | (1.24) | (1.70) | (1.90) | (3.18) | (4.09) | (8.70) |
| VAR11 | VAR12 | VAR13 | VAR14 | VAR15 | VAR16 | | | | |
| -2.741 | 39.183 | 23.560 | -6.795 | 2.098 | -7.439 | | | | |
| (0.75) | (3.60) | (4.21) | (1.84) | (0.43) | (1.44) | | | | |
| 0- 5 | 6-15 | 16-20 | 21-30 | 31-40 | 41-50 | 51-65 | 66-99 | | |
| 0.421 | 0.395 | 0.699 | 0.783 | 1.000 | 1.010 | 0.926 | 0.416 | | |
| (4.91) | (6.75) | (3.00) | (3.16) | (0.00) | (0.12) | (0.90) | (10.19) | | |

EQUATION 6 SHOES & FOOTWEAR RSQ = 0.354 MEAN = 110.25

| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| VAR 1 | VAR 2 | VAR 3 | VAR 4 | VAR 5 | VAR 6 | VAR 7 | VAR 8 | VAR 9 | VAR10 |
| 1.219 | 0.009 | 0.004 | 0.009 | 0.007 | 0.005 | -0.983 | -0.975 | -3.015 | 4.510 |
| (0.43) | (8.04) | (2.97) | (5.99) | (6.19) | (10.57) | (0.72) | (0.71) | (1.97) | (4.02) |
| VAR11 | VAR12 | VAR13 | VAR14 | VAR15 | VAR16 | | | | |
| -0.072 | 13.188 | 6.620 | 0.947 | -1.714 | -3.126 | | | | |
| (0.06) | (2.58) | (2.68) | (0.79) | (1.28) | (1.66) | | | | |
| 0- 5 | 6-15 | 16-20 | 21-30 | 31-40 | 41-50 | 51-65 | 66-99 | | |
| 0.670 | 1.496 | 0.948 | 0.861 | 1.000 | 0.840 | 0.729 | 0.496 | | |
| (2.76) | (3.87) | (0.58) | (2.53) | (0.00) | (2.84) | (5.52) | (9.99) | | |

EQUATION 7 WOMEN'S & CHILDREN'S CLOTHING RSQ = 0.373 MEAN = 402.40

| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| VAR 1 | VAR 2 | VAR 3 | VAR 4 | VAR 5 | VAR 6 | VAR 7 | VAR 8 | VAR 9 | VAR10 |
| -9.571 | 0.025 | 0.028 | 0.021 | 0.027 | 0.037 | 4.379 | -2.934 | -11.085 | 10.296 |
| (0.90) | (6.30) | (4.86) | (3.73) | (6.39) | (13.54) | (0.88) | (0.59) | (1.98) | (2.52) |
| VAR11 | VAR12 | VAR13 | VAR14 | VAR15 | VAR16 | | | | |
| -6.039 | -18.992 | 3.916 | 9.064 | 0.643 | -14.879 | | | | |
| (1.36) | (1.09) | (0.47) | (2.04) | (0.12) | (2.46) | | | | |
| 0- 5 | 6-15 | 16-20 | 21-30 | 31-40 | 41-50 | 51-65 | 66-99 | | |
| 1.012 | 1.377 | 2.038 | 0.841 | 1.000 | 1.031 | 1.003 | 0.827 | | |
| (0.07) | (2.46) | (6.21) | (2.21) | (0.00) | (0.39) | (0.04) | (2.15) | | |

EQUATION 8 MEN'S & BOY'S CLOTHING RSQ = 0.359 MEAN = 228.61

| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| VAR 1 | VAR 2 | VAR 3 | VAR 4 | VAR 5 | VAR 6 | VAR 7 | VAR 8 | VAR 9 | VAR10 |
| 2.526 | 0.015 | 0.022 | 0.014 | 0.022 | 0.019 | -2.618 | -6.254 | -13.673 | 18.793 |
| (0.32) | (5.46) | (5.36) | (3.53) | (7.32) | (12.48) | (0.73) | (1.71) | (3.31) | (5.91) |
| VAR11 | VAR12 | VAR13 | VAR14 | VAR15 | VAR16 | | | | |
| -5.352 | -43.612 | -11.561 | 7.023 | -3.249 | -6.935 | | | | |
| (1.67) | (3.45) | (1.91) | (2.13) | (0.89) | (1.51) | | | | |
| 0- 5 | 6-15 | 16-20 | 21-30 | 31-40 | 41-50 | 51-65 | 66-99 | | |
| 0.432 | 1.309 | 1.043 | 0.959 | 1.000 | 0.965 | 0.818 | 0.551 | | |
| (4.32) | (2.24) | (0.40) | (0.58) | (0.00) | (0.50) | (2.95) | (6.82) | | |

EQUATION 9 LUGGAGE RSQ = 0.097 MEAN = 6.89

| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| VAR 1 | VAR 2 | VAR 3 | VAR 4 | VAR 5 | VAR 6 | VAR 7 | VAR 8 | VAR 9 | VAR10 |
| -0.948 | 0.000 | 0.001 | -0.000 | 0.004 | 0.001 | 0.112 | 0.151 | 0.755 | 0.248 |
| (1.11) | (1.11) | (1.49) | (0.85) | (5.50) | (3.85) | (0.28) | (0.37) | (1.62) | (0.77) |
| VAR11 | VAR12 | VAR13 | VAR14 | VAR15 | VAR16 | | | | |
| 0.082 | -1.436 | -0.247 | 0.500 | -0.216 | -0.361 | | | | |
| (0.24) | (0.78) | (0.32) | (1.42) | (0.52) | (0.70) | | | | |
| 0- 5 | 6-15 | 16-20 | 21-30 | 31-40 | 41-50 | 51-65 | 66-99 | | |
| -0.967 | 1.856 | 1.762 | 0.645 | 1.000 | 0.023 | 0.601 | 0.219 | | |
| (4.98) | (1.91) | (1.98) | (2.24) | (0.00) | (0.11) | (2.98) | (5.37) | | |

EQUATION 10 JEWELRY & WATCHES RSQ = 0.116 MEAN = 77.50

| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| VAR 1 | VAR 2 | VAR 3 | VAR 4 | VAR 5 | VAR 6 | VAR 7 | VAR 8 | VAR 9 | VAR10 |
| -11.669 | 0.006 | 0.009 | 0.014 | -0.004 | 0.016 | -2.988 | 2.303 | 2.836 | 2.704 |
| (1.40) | (2.09) | (2.09) | (3.24) | (1.54) | (7.13) | (0.82) | (0.63) | (0.70) | (0.91) |
| VAR11 | VAR12 | VAR13 | VAR14 | VAR15 | VAR16 | | | | |
| 2.264 | -21.762 | -0.242 | 2.629 | 8.022 | -4.351 | | | | |
| (0.71) | (1.88) | (0.05) | (0.81) | (1.95) | (1.14) | | | | |
| 0- 5 | 6-15 | 16-20 | 21-30 | 31-40 | 41-50 | 51-65 | 66-99 | | |
| 0.357 | 0.847 | 1.828 | 0.812 | 1.000 | 0.322 | 1.192 | 0.433 | | |
| (2.02) | (0.62) | (2.73) | (1.35) | (0.00) | (7.22) | (1.14) | (4.19) | | |

EQUATION 11 LAUNDRIES, STORAGE, & REPAIR RSQ = 0.186 MEAN = 69.04

| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| VAR 1 | VAR 2 | VAR 3 | VAR 4 | VAR 5 | VAR 6 | VAR 7 | VAR 8 | VAR 9 | VAR10 |
| 20.659 | -0.001 | 0.005 | 0.001 | 0.007 | 0.008 | -5.359 | -3.385 | -5.704 | 6.122 |
| (5.38) | (1.24) | (3.07) | (0.47) | (5.96) | (12.54) | (3.33) | (2.10) | (3.17) | (4.57) |
| VAR11 | VAR12 | VAR13 | VAR14 | VAR15 | VAR16 | | | | |
| -1.046 | 38.442 | 10.911 | -4.071 | 4.866 | -0.823 | | | | |
| (0.74) | (7.45) | (4.44) | (3.02) | (2.86) | (0.42) | | | | |
| 0- 5 | 6-15 | 16-20 | 21-30 | 31-40 | 41-50 | 51-65 | 66-99 | | |
| 0.333 | 0.818 | 1.120 | 0.847 | 1.000 | 0.716 | 0.705 | 0.555 | | |
| (4.43) | (1.47) | (1.03) | (2.55) | (0.00) | (4.70) | (5.53) | (8.02) | | |

EQUATION 12 OTHER JEW & CLO SERVICES RSQ = 0.056 MEAN = 7.47

| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| VAR 1 | VAR 2 | VAR 3 | VAR 4 | VAR 5 | VAR 6 | VAR 7 | VAR 8 | VAR 9 | VAR10 |
| -0.295 | 0.000 | 0.001 | 0.000 | 0.001 | 0.000 | -0.108 | 0.164 | 0.089 | 0.090 |
| (0.34) | (1.25) | (1.76) | (0.21) | (2.83) | (3.35) | (0.31) | (0.47) | (0.23) | (0.31) |
| VAR11 | VAR12 | VAR13 | VAR14 | VAR15 | VAR16 | | | | |
| 0.820 | -1.137 | -0.292 | -0.736 | 0.332 | -0.422 | | | | |
| (2.24) | (1.29) | (0.66) | (2.15) | (0.65) | (1.14) | | | | |
| 0- 5 | 6-15 | 16-20 | 21-30 | 31-40 | 41-50 | 51-65 | 66-99 | | |
| -0.090 | 0.396 | 1.882 | 1.178 | 1.000 | 1.565 | 1.547 | 1.139 | | |
| (2.44) | (1.75) | (1.54) | (0.56) | (0.00) | (1.45) | (1.39) | (0.36) | | |

EQUATION 13 PERSONAL CARE RSQ = 0.331 MEAN = 165.72

| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| VAR 1 | VAR 2 | VAR 3 | VAR 4 | VAR 5 | VAR 6 | VAR 7 | VAR 8 | VAR 9 | VAR10 |
| -6.350 | 0.011 | 0.011 | 0.010 | 0.006 | 0.006 | 1.167 | 0.697 | 1.141 | 2.825 |
| (1.55) | (6.86) | (5.16) | (5.35) | (5.05) | (10.93) | (0.69) | (0.40) | (0.59) | (1.98) |
| VAR11 | VAR12 | VAR13 | VAR14 | VAR15 | VAR16 | | | | |
| 2.450 | -3.401 | -2.723 | 0.511 | -2.330 | 3.078 | | | | |
| (1.59) | (0.89) | (1.22) | (0.31) | (1.09) | (1.51) | | | | |
| 0- 5 | 6-15 | 16-20 | 21-30 | 31-40 | 41-50 | 51-65 | 66-99 | | |
| 0.525 | 1.021 | 0.966 | 0.904 | 1.000 | 1.318 | 1.554 | 1.709 | | |
| (3.42) | (0.17) | (0.30) | (1.26) | (0.00) | (3.36) | (5.04) | (5.35) | | |

EQUATION 14 OWNER-OCCUPIED HOUSING RSQ = 0.131 MEAN = 289.76

| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| VAR 1 | VAR 2 | VAR 3 | VAR 4 | VAR 5 | VAR 6 | VAR 7 | VAR 8 | VAR 9 | VAR10 |
| 14.133 | 0.010 | 0.024 | 0.026 | 0.014 | 0.028 | -13.769 | -15.744 | -37.579 | 21.462 |
| (0.70) | (1.37) | (2.34) | (2.61) | (2.18) | (5.99) | (1.57) | (1.76) | (3.33) | (2.73) |
| VAR11 | VAR12 | VAR13 | VAR14 | VAR15 | VAR16 | | | | |
| -8.345 | -22.590 | 2.871 | 2.361 | -4.232 | 2.661 | | | | |
| (1.09) | (1.27) | (0.26) | (0.29) | (0.46) | (0.27) | | | | |
| 0- 5 | 6-15 | 16-20 | 21-30 | 31-40 | 41-50 | 51-65 | 66-99 | | |
| 1.939 | 0.964 | 0.487 | 0.392 | 1.000 | 0.898 | 1.640 | 2.203 | | |
| (1.75) | (0.12) | (2.31) | (4.71) | (0.00) | (0.61) | (2.46) | (3.30) | | |

EQUATION 15 TENANT-OCCUPIED HOUSING RSQ = 0.098 MEAN = 714.22

| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| VAR 1 | VAR 2 | VAR 3 | VAR 4 | VAR 5 | VAR 6 | VAR 7 | VAR 8 | VAR 9 | VAR10 |
| 174.457 | -0.009 | 0.019 | -0.003 | 0.000 | 0.005 | -52.292 | -6.639 | 40.204 | -27.949 |
| (4.87) | (0.97) | (1.30) | (0.22) | (0.03) | (1.28) | (3.63) | (0.50) | (2.60) | (2.54) |
| VAR11 | VAR12 | VAR13 | VAR14 | VAR15 | VAR16 | | | | |
| -42.035 | 1059.977 | 224.257 | -55.553 | 77.521 | -37.833 | | | | |
| (3.16) | (10.92) | (7.93) | (4.56) | (4.67) | (2.10) | | | | |
| 0- 5 | 6-15 | 16-20 | 21-30 | 31-40 | 41-50 | 51-65 | 66-99 | | |
| 1.243 | 1.524 | 1.728 | 1.429 | 1.000 | 1.063 | 0.669 | 0.704 | | |
| (0.68) | (1.61) | (2.97) | (3.19) | (0.00) | (0.47) | (3.98) | (3.74) | | |

EQUATION 16 OTHER HOUSING RSQ = 0.133 MEAN = 24.933

| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| VAR 1 | VAR 2 | VAR 3 | VAR 4 | VAR 5 | VAR 6 | VAR 7 | VAR 8 | VAR 9 | VAR10 |
| 1.015 | 0.000 | 0.001 | 0.001 | 0.002 | 0.000 | 0.741 | -0.585 | -0.795 | 2.232 |
| (0.65) | (0.40) | (0.71) | (0.98) | (1.06) | (0.91) | (0.86) | (0.79) | (0.85) | (1.04) |
| VAR11 | VAR12 | VAR13 | VAR14 | VAR15 | VAR16 | | | | |
| -2.045 | -7.166 | -3.293 | 0.162 | -0.675 | 0.265 | | | | |
| (1.02) | (1.04) | (1.03) | (0.34) | (0.52) | (0.43) | | | | |
| 0- 5 | 6-15 | 16-20 | 21-30 | 31-40 | 41-50 | 51-65 | 66-99 | | |
| -0.604 | -0.891 | 9.490 | -0.659 | 1.000 | 12.679 | 5.237 | 0.073 | | |
| (1.16) | (2.19) | (0.93) | (1.55) | (0.00) | (0.99) | (0.86) | (1.17) | | |

EQUATION 18 HOTELS & MOTELS RSQ = 0.268 MEAN = 119.56

| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| VAR 1 | VAR 2 | VAR 3 | VAR 4 | VAR 5 | VAR 6 | VAR 7 | VAR 8 | VAR 9 | VAR10 |
| -0.638 | 0.003 | 0.011 | 0.011 | 0.019 | 0.013 | -4.717 | -8.403 | -6.730 | 15.393 |
| (0.10) | (1.26) | (3.39) | (3.48) | (7.15) | (9.70) | (1.62) | (2.79) | (2.03) | (5.57) |
| VAR11 | VAR12 | VAR13 | VAR14 | VAR15 | VAR16 | | | | |
| 4.610 | -24.671 | 6.829 | 2.009 | -3.508 | 0.277 | | | | |
| (1.89) | (3.12) | (1.62) | (0.78) | (1.19) | (0.08) | | | | |
| 0- 5 | 6-15 | 16-20 | 21-30 | 31-40 | 41-50 | 51-65 | 66-99 | | |
| 0.372 | 1.522 | 0.589 | 0.653 | 1.000 | 1.115 | 0.998 | 1.308 | | |
| (2.89) | (2.49) | (3.17) | (4.17) | (0.00) | (1.06) | (0.02) | (2.27) | | |

EQUATION 19 FURNITURE RSQ = 0.154 MEAN = 202.31

| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| VAR 1 | VAR 2 | VAR 3 | VAR 4 | VAR 5 | VAR 6 | VAR 7 | VAR 8 | VAR 9 | VAR10 |
| -5.615 | 0.018 | 0.035 | 0.034 | 0.028 | 0.065 | 16.130 | -4.904 | 11.538 | -15.867 |
| (0.27) | (2.53) | (3.27) | (3.07) | (3.19) | (11.97) | (1.63) | (0.49) | (1.06) | (2.07) |
| VAR11 | VAR12 | VAR13 | VAR14 | VAR15 | VAR16 | | | | |
| -1.435 | -136.045 | -7.257 | -7.516 | -4.727 | 1.102 | | | | |
| (0.19) | (3.47) | (0.39) | (0.95) | (0.60) | (0.07) | | | | |
| 0- 5 | 6-15 | 16-20 | 21-30 | 31-40 | 41-50 | 51-65 | 66-99 | | |
| 1.393 | 0.883 | 0.098 | 0.721 | 1.000 | 0.137 | 0.331 | 0.265 | | |
| (1.64) | (0.89) | (10.77) | (4.20) | (0.00) | (20.76) | (17.08) | (13.12) | | |

EQUATION 20 APPLIANCES RSQ = 0.082 MEAN = 140.58

| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| VAR 1 | VAR 2 | VAR 3 | VAR 4 | VAR 5 | VAR 6 | VAR 7 | VAR 8 | VAR 9 | VAR10 |
| -17.966 | 0.012 | 0.011 | 0.007 | 0.013 | 0.004 | 10.132 | 17.142 | 8.629 | -3.985 |
| (1.93) | (3.59) | (2.51) | (1.59) | (4.06) | (4.01) | (2.48) | (3.83) | (1.94) | (1.26) |
| VAR11 | VAR12 | VAR13 | VAR14 | VAR15 | VAR16 | | | | |
| 2.589 | -10.302 | -1.775 | -1.411 | 9.943 | -3.507 | | | | |
| (0.77) | (1.05) | (0.34) | (0.40) | (2.12) | (0.77) | | | | |
| 0- 5 | 6-15 | 16-20 | 21-30 | 31-40 | 41-50 | 51-65 | 66-99 | | |
| 0.780 | 0.862 | 0.678 | 1.084 | 1.000 | 1.001 | 1.204 | 1.027 | | |
| (0.82) | (0.63) | (1.72) | (0.56) | (0.00) | (0.01) | (1.21) | (0.15) | | |

EQUATION 21 CHINA, GLASSWARE, & TABLEWARE RSQ = 0.058 MEAN = 31.24

| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| VAR 1 | VAR 2 | VAR 3 | VAR 4 | VAR 5 | VAR 6 | VAR 7 | VAR 8 | VAR 9 | VAR10 |
| -10.059 | 0.004 | 0.007 | 0.007 | 0.013 | 0.002 | 7.247 | 3.840 | 28.327 | 6.476 |
| (0.72) | (0.73) | (1.25) | (1.53) | (4.30) | (2.76) | (1.62) | (0.87) | (5.07) | (1.80) |
| VAR11 | VAR12 | VAR13 | VAR14 | VAR15 | VAR16 | | | | |
| -5.540 | -40.785 | -20.880 | 2.992 | 5.697 | 7.311 | | | | |
| (1.31) | (4.29) | (4.27) | (0.61) | (1.23) | (1.45) | | | | |
| 0- 5 | 6-15 | 16-20 | 21-30 | 31-40 | 41-50 | 51-65 | 66-99 | | |
| -0.432 | -0.249 | -0.087 | 1.069 | 1.000 | 0.722 | 0.507 | 0.290 | | |
| (9.16) | (12.65) | (8.36) | (0.49) | (0.00) | (2.31) | (5.20) | (6.44) | | |

EQUATION 22 OTHER DURABLE HOUSE FURNISHING RSQ = 0.137 MEAN = 115.90

| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| VAR 1 | VAR 2 | VAR 3 | VAR 4 | VAR 5 | VAR 6 | VAR 7 | VAR 8 | VAR 9 | VAR10 |
| -22.442 | 0.010 | 0.014 | 0.025 | -0.001 | 0.030 | 16.686 | 9.769 | 11.407 | 1.464 |
| (1.58) | (2.12) | (2.04) | (3.63) | (0.24) | (10.45) | (2.62) | (1.55) | (1.67) | (0.31) |
| VAR11 | VAR12 | VAR13 | VAR14 | VAR15 | VAR16 | | | | |
| 9.926 | -15.329 | 1.689 | -0.272 | -6.937 | 2.023 | | | | |
| (2.08) | (0.81) | (0.18) | (0.05) | (1.32) | (0.24) | | | | |
| 0- 5 | 6-15 | 16-20 | 21-30 | 31-40 | 41-50 | 51-65 | 66-99 | | |
| 1.422 | 0.375 | -0.022 | 0.662 | 1.000 | 0.864 | 0.580 | 0.328 | | |
| (1.37) | (4.54) | (9.49) | (4.18) | (0.00) | (1.59) | (6.52) | (8.97) | | |

EQUATION 23 FLOOR COVERINGS RSQ = 0.038 MEAN = 30.53

| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| VAR 1 | VAR 2 | VAR 3 | VAR 4 | VAR 5 | VAR 6 | VAR 7 | VAR 8 | VAR 9 | VAR10 |
| -2.002 | 0.001 | 0.002 | 0.002 | 0.004 | 0.006 | 0.913 | 0.173 | -2.247 | 0.519 |
| (0.67) | (1.29) | (1.27) | (1.07) | (2.07) | (4.17) | (0.61) | (0.11) | (1.29) | (0.45) |
| VAR11 | VAR12 | VAR13 | VAR14 | VAR15 | VAR16 | | | | |
| 1.379 | 1.940 | -0.928 | -0.238 | -1.267 | 3.409 | | | | |
| (1.22) | (0.27) | (0.28) | (0.20) | (1.06) | (1.26) | | | | |
| 0- 5 | 6-15 | 16-20 | 21-30 | 31-40 | 41-50 | 51-65 | 66-99 | | |
| 4.987 | 1.797 | -0.150 | 0.404 | 1.000 | 0.752 | 0.577 | 0.986 | | |
| (2.64) | (1.31) | (3.83) | (3.21) | (0.00) | (1.17) | (2.57) | (0.05) | | |

EQUATION 24 SEMIDURABLE HOUSE FURNISHINGS RSQ = 0.164 MEAN = 90.22

| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| VAR 1 | VAR 2 | VAR 3 | VAR 4 | VAR 5 | VAR 6 | VAR 7 | VAR 8 | VAR 9 | VAR10 |
| 1.481 | 0.005 | 0.013 | 0.005 | 0.012 | 0.007 | 1.720 | -3.634 | 11.336 | 7.847 |
| (0.26) | (2.43) | (4.22) | (1.84) | (5.48) | (7.57) | (0.68) | (1.42) | (3.79) | (3.67) |
| VAR11 | VAR12 | VAR13 | VAR14 | VAR15 | VAR16 | | | | |
| -3.866 | -16.215 | -2.810 | -1.192 | -2.511 | -0.516 | | | | |
| (1.79) | (2.17) | (0.75) | (0.54) | (1.05) | (0.17) | | | | |
| 0- 5 | 6-15 | 16-20 | 21-30 | 31-40 | 41-50 | 51-65 | 66-99 | | |
| 1.554 | 0.654 | 0.626 | 0.785 | 1.000 | 0.676 | 0.991 | 0.717 | | |
| (2.07) | (2.44) | (2.91) | (2.38) | (0.00) | (3.86) | (0.10) | (2.84) | | |

EQUATION 25 ELECTRICITY RSQ = 0.341 MEAN = 464.69

| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| VAR 1 | VAR 2 | VAR 3 | VAR 4 | VAR 5 | VAR 6 | VAR 7 | VAR 8 | VAR 9 | VAR10 |
| 13.366 | 0.044 | 0.019 | 0.006 | 0.015 | 0.011 | -1.235 | 57.652 | -30.600 | 2.542 |
| (1.27) | (11.08) | (3.79) | (1.34) | (4.80) | (10.63) | (0.28) | (11.51) | (6.04) | (0.71) |
| VAR11 | VAR12 | VAR13 | VAR14 | VAR15 | VAR16 | | | | |
| -4.476 | 7.870 | 3.987 | -17.460 | 17.495 | -15.938 | | | | |
| (1.11) | (0.75) | (0.68) | (4.25) | (3.08) | (2.93) | | | | |
| 0- 5 | 6-15 | 16-20 | 21-30 | 31-40 | 41-50 | 51-65 | 66-99 | | |
| 0.602 | 0.638 | 0.681 | 0.784 | 1.000 | 1.120 | 1.166 | 1.098 | | |
| (5.35) | (6.04) | (5.38) | (5.50) | (0.00) | (2.31) | (3.01) | (1.59) | | |

EQUATION 26 NATURAL GAS RSQ = 0.175 MEAN = 263.24

| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| VAR 1 | VAR 2 | VAR 3 | VAR 4 | VAR 5 | VAR 6 | VAR 7 | VAR 8 | VAR 9 | VAR10 |
| 61.693 | 0.010 | 0.001 | 0.015 | 0.002 | 0.004 | 31.932 | -38.009 | -34.618 | 6.837 |
| (6.04) | (3.17) | (0.12) | (3.59) | (0.53) | (4.40) | (6.90) | (7.86) | (6.88) | (2.17) |
| VAR11 | VAR12 | VAR13 | VAR14 | VAR15 | VAR16 | | | | |
| -4.122 | 16.540 | 7.177 | -16.471 | -1.111 | 3.030 | | | | |
| (1.19) | (1.73) | (1.36) | (4.73) | (0.25) | (0.60) | | | | |
| 0- 5 | 6-15 | 16-20 | 21-30 | 31-40 | 41-50 | 51-65 | 66-99 | | |
| 0.930 | 0.835 | 0.794 | 0.807 | 1.000 | 1.197 | 1.144 | 1.218 | | |
| (0.45) | (1.29) | (1.79) | (2.48) | (0.00) | (1.91) | (1.42) | (1.83) | | |

EQUATION 27 FUEL OIL & COAL RSQ = 0.186 MEAN = 123.62

| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| VAR 1 | VAR 2 | VAR 3 | VAR 4 | VAR 5 | VAR 6 | VAR 7 | VAR 8 | VAR 9 | VAR10 |
| 66.249 | 0.013 | -0.001 | 0.006 | 0.010 | -0.000 | -103.873 | -101.539 | -119.009 | 7.087 |
| (4.27) | (2.72) | (0.17) | (1.23) | (2.89) | (0.37) | (6.41) | (6.38) | (6.41) | (1.72) |
| VAR11 | VAR12 | VAR13 | VAR14 | VAR15 | VAR16 | | | | |
| 4.914 | 10.152 | -0.912 | 9.805 | -2.032 | 7.062 | | | | |
| (1.07) | (1.24) | (0.18) | (1.83) | (0.32) | (1.34) | | | | |
| 0- 5 | 6-15 | 16-20 | 21-30 | 31-40 | 41-50 | 51-65 | 66-99 | | |
| -0.147 | 0.252 | 1.222 | 0.914 | 1.000 | 0.962 | 1.363 | 2.207 | | |
| (5.84) | (4.78) | (0.88) | (0.51) | (0.00) | (0.21) | (1.59) | (3.31) | | |

EQUATION 28 WOOD, OTHER FUEL, & TANK GAS RSQ = 0.013 MEAN = 23.28

| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| VAR 1 | VAR 2 | VAR 3 | VAR 4 | VAR 5 | VAR 6 | VAR 7 | VAR 8 | VAR 9 | VAR10 |
| 7.620 | -0.001 | 0.000 | 0.000 | -0.000 | 0.001 | 0.625 | 1.107 | -2.543 | -0.727 |
| (1.71) | (0.98) | (0.12) | (0.35) | (0.31) | (2.11) | (0.55) | (0.93) | (1.57) | (0.76) |
| VAR11 | VAR12 | VAR13 | VAR14 | VAR15 | VAR16 | | | | |
| 1.404 | 8.693 | 2.436 | -1.665 | -1.151 | -0.773 | | | | |
| (1.27) | (2.06) | (1.51) | (1.43) | (0.77) | (0.63) | | | | |
| 0- 5 | 6-15 | 16-20 | 21-30 | 31-40 | 41-50 | 51-65 | 66-99 | | |
| 1.626 | 0.602 | 1.595 | 0.689 | 1.000 | 1.332 | 2.371 | 1.774 | | |
| (0.51) | (0.62) | (0.65) | (0.75) | (0.00) | (0.54) | (1.36) | (0.95) | | |

EQUATION 29 WATER & OTHER SANITARY SERVICE RSQ = 0.173 MEAN = 123.09

| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| VAR 1 | VAR 2 | VAR 3 | VAR 4 | VAR 5 | VAR 6 | VAR 7 | VAR 8 | VAR 9 | VAR10 |
| 1.565 | 0.009 | 0.002 | 0.003 | 0.004 | 0.001 | 7.789 | 19.395 | 13.826 | 2.645 |
| (0.38) | (5.88) | (1.24) | (1.36) | (3.05) | (3.07) | (4.17) | (8.61) | (6.26) | (1.81) |
| VAR11 | VAR12 | VAR13 | VAR14 | VAR15 | VAR16 | | | | |
| 3.061 | 0.983 | -0.213 | -3.728 | -1.536 | 0.218 | | | | |
| (1.96) | (0.23) | (0.09) | (2.24) | (0.71) | (0.09) | | | | |
| 0- 5 | 6-15 | 16-20 | 21-30 | 31-40 | 41-50 | 51-65 | 66-99 | | |
| 0.788 | 0.810 | 0.653 | 0.836 | 1.000 | 1.110 | 1.143 | 1.208 | | |
| (1.52) | (1.68) | (4.59) | (2.25) | (0.00) | (1.25) | (1.52) | (1.81) | | |

EQUATION 30 TELEPHONE & TELEGRAPH RSQ = 0.226 MEAN = 338.94

| VAR 1 | VAR 2 | VAR 3 | VAR 4 | VAR 5 | VAR 6 | VAR 7 | VAR 8 | VAR 9 | VAR10 |
|---|---|---|---|---|---|---|---|---|---|
| 63.274 | 0.019 | 0.007 | 0.010 | 0.012 | 0.013 | -7.149 | 0.588 | -11.583 | 11.976 |
| (6.66) | (6.07) | (1.68) | (2.63) | (4.44) | (12.96) | (1.88) | (0.15) | (2.72) | (3.82) |
| VAR11 | VAR12 | VAR13 | VAR14 | VAR15 | VAR16 | | | | |
| -12.691 | 88.605 | 25.047 | -17.905 | 5.196 | -14.725 | | | | |
| (3.50) | (8.51) | (4.70) | (5.23) | (1.12) | (3.05) | | | | |
| 0- 5 | 6-15 | 16-20 | 21-30 | 31-40 | 41-50 | 51-65 | 66-99 | | |
| 0.475 | 0.488 | 0.968 | 1.004 | 1.000 | 1.005 | 0.871 | 0.781 | | |
| (6.23) | (8.21) | (0.44) | (0.07) | (0.00) | (0.11) | (2.91) | (4.64) | | |

EQUATION 31 DOMESTIC SERVICES RSQ = 0.217 MEAN = 159.17

| VAR 1 | VAR 2 | VAR 3 | VAR 4 | VAR 5 | VAR 6 | VAR 7 | VAR 8 | VAR 9 | VAR10 |
|---|---|---|---|---|---|---|---|---|---|
| -2.589 | 0.002 | 0.005 | 0.006 | 0.000 | 0.013 | -0.710 | 20988 | -1.160 | 1.407 |
| (0.90) | (1.32) | (1.73) | (1.76) | (0.14) | (1.98) | (0.55) | (1.50) | (0.77) | (1.16) |
| VAR11 | VAR12 | VAR13 | VAR14 | VAR15 | VAR16 | | | | |
| 4.654 | -17.045 | -9.304 | -3.307 | 1.503 | 0.491 | | | | |
| (1.83) | (1.81) | (1.76) | (1.71) | (1.12) | (0.24) | | | | |
| 0- 5 | 6-15 | 16-20 | 21-30 | 31-40 | 41-50 | 51-65 | 66-99 | | |
| 32.252 | 4.749 | 2.929 | 0.418 | 1.000 | 1.706 | 0.922 | 10.973 | | |
| (1.86) | (1.38) | (1.17) | (1.30) | (0.00) | (0.78) | (0.15) | (1.79) | | |

EQUATION 32 OTHER HOUSEHOLD OPERATIONS RSQ = 0.109 MEAN = 158.44

| VAR 1 | VAR 2 | VAR 3 | VAR 4 | VAR 5 | VAR 6 | VAR 7 | VAR 8 | VAR 9 | VAR10 |
|---|---|---|---|---|---|---|---|---|---|
| -8.172 | 0.004 | 0.019 | 0.007 | 0.016 | 0.048 | 16.078 | 9.113 | 19.338 | 18.701 |
| (0.35) | (0.50) | (1.64) | (0.60) | (1.97) | (7.41) | (1.51) | (0.86) | (1.61) | (2.12) |
| VAR11 | VAR12 | VAR13 | VAR14 | VAR15 | VAR16 | | | | |
| -9.758 | 8.432 | -14.068 | 3.401 | -4.027 | -0.833 | | | | |
| (1.14) | (0.32) | (0.96) | (0.37) | (0.43) | (0.07) | | | | |
| 0- 5 | 6-15 | 16-20 | 21-30 | 31-40 | 41-50 | 51-65 | 66-99 | | |
| 1.680 | 0.880 | 0.079 | 0.284 | 1.000 | 0.427 | 1.178 | 1.031 | | |
| (1.26) | (0.46) | (5.12) | (7.17) | (0.00) | (6.18) | (1.11) | (0.19) | | |

EQUATION 33 HOUSEHOLD INSURANCE RSQ = 0.142 MEAN = 107.06

| VAR 1 | VAR 2 | VAR 3 | VAR 4 | VAR 5 | VAR 6 | VAR 7 | VAR 8 | VAR 9 | VAR10 |
|---|---|---|---|---|---|---|---|---|---|
| -8.766 | 0.010 | 0.006 | 0.006 | 0.009 | 0.003 | 5.881 | 0.680 | -4.436 | 9.154 |
| (1.38) | (4.48) | (2.17) | (2.39) | (4.69) | (5.77) | (2.31) | (0.27) | (1.58) | (4.22) |
| VAR11 | VAR12 | VAR13 | VAR14 | VAR15 | VAR16 | | | | |
| 3.274 | -0.785 | -0.290 | -0.246 | 3.999 | 5.749 | | | | |
| (1.49) | (0.16) | (0.10) | (0.10) | (1.30) | (1.82) | | | | |
| 0- 5 | 6-15 | 16-20 | 21-30 | 31-40 | 41-50 | 51-65 | 66-99 | | |
| 0.665 | 0.489 | 0.042 | 0.629 | 1.000 | 1.041 | 1.073 | 1.339 | | |
| (2.14) | (4.67) | (10.41) | (5.50) | (0.00) | (0.44) | (0.78) | (2.61) | | |

EQUATION 34 PRESCRIPTION DRUG & SUNDRIES RSQ = 0.165 MEAN = 98.80

| VAR 1 | VAR 2 | VAR 3 | VAR 4 | VAR 5 | VAR 6 | VAR 7 | VAR 8 | VAR 9 | VAR10 |
|---|---|---|---|---|---|---|---|---|---|
| -5.630 | 0.006 | 0.006 | 0.002 | 0.002 | 0.001 | 6.020 | 10.137 | -0.487 | -3.414 |
| (1.40) | (3.41) | (2.92) | (1.51) | (2.24) | (3.64) | (3.38) | (4.40) | (0.31) | (2.52) |
| VAR11 | VAR12 | VAR13 | VAR14 | VAR15 | VAR16 | | | | |
| -0.936 | -5.869 | -1.582 | -0.271 | 0.067 | 3.750 | | | | |
| (0.64) | (2.39) | (1.00) | (0.16) | (0.03) | (1.89) | | | | |
| 0- 5 | 6-15 | 16-20 | 21-30 | 31-40 | 41-50 | 51-65 | 66-99 | | |
| 0.769 | 0.510 | 0.869 | 0.759 | 1.000 | 1.828 | 2.153 | 4.422 | | |
| (0.64) | (2.00) | (0.46) | (1.28) | (0.00) | (2.42) | (2.84) | (4.07) | | |

EQUATION 35 PHYSICIANS RSQ = 0.114 MEAN = 153.30

| VAR 1 | VAR 2 | VAR 3 | VAR 4 | VAR 5 | VAR 6 | VAR 7 | VAR 8 | VAR 9 | VAR10 |
|---|---|---|---|---|---|---|---|---|---|
| -4.319 | 0.013 | 0.014 | 0.008 | 0.002 | 0.014 | -3.666 | 2.024 | -3.734 | 3.165 |
| (0.47) | (3.81) | (3.07) | (1.94) | (0.61) | (7.80) | (0.91) | (0.50) | (0.83) | (0.96) |
| VAR11 | VAR12 | VAR13 | VAR14 | VAR15 | VAR16 | | | | |
| -10.338 | -23.526 | 9.024 | -1.008 | 1.235 | 9.860 | | | | |
| (2.59) | (2.28) | (1.52) | (0.28) | (0.28) | (1.85) | | | | |
| 0- 5 | 6-15 | 16-20 | 21-30 | 31-40 | 41-50 | 51-65 | 66-99 | | |
| 1.526 | 0.408 | 1.528 | 0.712 | 1.000 | 0.896 | 0.706 | 1.441 | | |
| (1.55) | (3.68) | (2.31) | (2.64) | (0.00) | (0.87) | (3.06) | (2.38) | | |

EQUATION 36 DENTAL & EYES RSQ = 0.168 MEAN = 186.84

| VAR 1 | VAR 2 | VAR 3 | VAR 4 | VAR 5 | VAR 6 | VAR 7 | VAR 8 | VAR 9 | VAR10 |
|---|---|---|---|---|---|---|---|---|---|
| -10.680 | 0.012 | 0.011 | 0.008 | 0.008 | 0.008 | -2.670 | 0.511 | -1.342 | 18.060 |
| (1.38) | (3.88) | (2.75) | (2.14) | (3.09) | (5.92) | (0.82) | (0.16) | (0.37) | (4.80) |
| VAR11 | VAR12 | VAR13 | VAR14 | VAR15 | VAR16 | | | | |
| -3.135 | -11.370 | 1.003 | 3.440 | -4.719 | -6.644 | | | | |
| (1.04) | (1.51) | (0.23) | (1.06) | (1.14) | (1.81) | | | | |
| 0- 5 | 6-15 | 16-20 | 21-30 | 31-40 | 41-50 | 51-65 | 66-99 | | |
| 0.450 | 1.575 | 1.350 | 0.708 | 1.000 | 1.470 | 1.859 | 2.109 | | |
| (1.97) | (1.71) | (1.26) | (2.06) | (0.00) | (2.16) | (3.17) | (3.35) | | |

EQUATION 37 OTHER MEDICAL SERVICES & SUPP RSQ = 0.046 MEAN = 53.98

| VAR 1 | VAR 2 | VAR 3 | VAR 4 | VAR 5 | VAR 6 | VAR 7 | VAR 8 | VAR 9 | VAR10 |
|---|---|---|---|---|---|---|---|---|---|
| 4.071 | 0.001 | 0.002 | 0.002 | 0.001 | 0.002 | -2.140 | -0.421 | -0.567 | 0.260 |
| (1.09) | (0.61) | (1.24) | (1.31) | (0.68) | (1.78) | (1.30) | (0.36) | (0.41) | (0.25) |
| VAR11 | VAR12 | VAR13 | VAR14 | VAR15 | VAR16 | | | | |
| -1.128 | -2.850 | -0.588 | -1.612 | -0.756 | -2.072 | | | | |
| (0.83) | (1.14) | (0.41) | (1.08) | (0.46) | (1.11) | | | | |
| 0- 5 | 6-15 | 16-20 | 21-30 | 31-40 | 41-50 | 51-65 | 66-99 | | |
| 3.003 | 2.009 | -0.016 | 1.444 | 1.000 | 2.601 | 2.468 | 7.755 | | |
| (0.86) | (0.65) | (1.38) | (0.50) | (0.00) | (1.11) | (1.06) | (1.57) | | |

EQUATION 38 HOSPITALS & SANITARIUMS RSQ = 0.084 MEAN = 53.65

| VAR 1 | VAR 2 | VAR 3 | VAR 4 | VAR 5 | VAR 6 | VAR 7 | VAR 8 | VAR 9 | VAR10 |
|---|---|---|---|---|---|---|---|---|---|
| -1.299 | 0.001 | 0.002 | 0.002 | -0.005 | 0.010 | 0.121 | 1.939 | 0.700 | -1.725 |
| (0.46) | (1.13) | (1.06) | (1.17) | (2.19) | (2.61) | (0.09) | (1.25) | (0.45) | (1.34) |
| VAR11 | VAR12 | VAR13 | VAR14 | VAR15 | VAR16 | | | | |
| -0.304 | 5.865 | 6.602 | -0.848 | -0.183 | 1.326 | | | | |
| (0.25) | (0.89) | (1.81) | (0.72) | (0.12) | (0.74) | | | | |
| 0- 5 | 6-15 | 16-20 | 21-30 | 31-40 | 41-50 | 51-65 | 66-99 | | |
| 0.575 | 4.584 | 8.836 | 0.536 | 1.000 | 1.451 | 0.499 | 1.816 | | |
| (0.22) | (1.78) | (2.29) | (1.32) | (0.00) | (0.76) | (1.93) | (1.08) | | |

EQUATION 39 HEALTH INSURANCE RSQ = 0.097 MEAN = 238.72

| VAR 1 | VAR 2 | VAR 3 | VAR 4 | VAR 5 | VAR 6 | VAR 7 | VAR 8 | VAR 9 | VAR10 |
|---|---|---|---|---|---|---|---|---|---|
| -14.387 | 0.015 | 0.021 | 0.006 | 0.003 | 0.003 | 14.364 | 24.174 | 8.306 | -1.363 |
| (1.08) | (3.12) | (3.28) | (1.23) | (0.74) | (2.60) | (2.69) | (4.08) | (1.46) | (0.33) |
| VAR11 | VAR12 | VAR13 | VAR14 | VAR15 | VAR16 | | | | |
| -4.589 | 6.238 | 11.822 | -5.315 | 9.481 | 18.932 | | | | |
| (0.94) | (0.68) | (1.94) | (1.03) | (1.21) | (2.72) | | | | |
| 0- 5 | 6-15 | 16-20 | 21-30 | 31-40 | 41-50 | 51-65 | 66-99 | | |
| .0636 | 0.367 | 0.678 | 0.783 | 1.000 | 1.373 | 1.547 | 2.258 | | |
| (1.38) | (3.56) | (1.59) | (1.61) | (0.00) | (1.79) | (2.42) | (3.72) | | |

EQUATION 40 PERSONAL BUSINESS RSQ = 0.061 MEAN = 170.33

| VAR 1 | VAR 2 | VAR 3 | VAR 4 | VAR 5 | VAR 6 | VAR 7 | VAR 8 | VAR 9 | VAR10 |
|---|---|---|---|---|---|---|---|---|---|
| -26.158 | 0.016 | 0.019 | 0.017 | 0.019 | 0.014 | 13.118 | 16.706 | 9.966 | -6.035 |
| (1.05) | (1.86) | (1.74) | (1.75) | (2.92) | (5.24) | (1.38) | (1.73) | (0.95) | (0.79) |
| VAR11 | VAR12 | VAR13 | VAR14 | VAR15 | VAR16 | | | | |
| 1.418 | -41.119 | -13.651 | 10.370 | 15.098 | 9.103 | | | | |
| (0.17) | (2.08) | (1.24) | (1.04) | (1.28) | (0.86) | | | | |
| 0- 5 | 6-15 | 16-20 | 21-30 | 31-40 | 41-50 | 51-65 | 66-99 | | |
| 0.489 | 0.209 | 0.173 | 0.707 | 1.000 | 0.987 | 1.110 | 1.081 | | |
| (1.78) | (4.55) | (4.75) | (2.21) | (0.00) | (0.08) | (0.63) | (0.40) | | |

EQUATION 41 LIFE INSURANCE RSQ = 0.202 MEAN = 292.32

| VAR 1 | VAR 2 | VAR 3 | VAR 4 | VAR 5 | VAR 6 | VAR 7 | VAR 8 | VAR 9 | VAR10 |
|---|---|---|---|---|---|---|---|---|---|
| -41.350 | 0.036 | 0.022 | 0.012 | 0.037 | 0.021 | 10.020 | 30.560 | -4.121 | 29.909 |
| (1.90) | (4.64) | (2.15) | (1.30) | (5.59) | (8.48) | (1.13) | (3.30) | (0.42) | (4.00) |
| VAR11 | VAR12 | VAR13 | VAR14 | VAR15 | VAR16 | | | | |
| 17.811 | -105.488 | -30.631 | 0.306 | 1.848 | 13.490 | | | | |
| (2.35) | (4.25) | (2.54) | (0.04) | (0.19) | (1.29) | | | | |
| 0- 5 | 6-15 | 16-20 | 21-30 | 31-40 | 41-50 | 51-65 | 66-99 | | |
| 0.809 | 0.345 | 0.563 | 0.497 | 1.000 | 0.938 | 1.068 | 0.403 | | |
| (1.16) | (6.77) | (4.24) | (7.97) | (0.00) | (0.76) | (0.74) | (7.97) | | |

EQUATION 42 NEW CARS RSQ = 0.191 MEAN = 615.38

| VAR 1 | VAR 2 | VAR 3 | VAR 4 | VAR 5 | VAR 6 | VAR 7 | VAR 8 | VAR 9 | VAR10 |
|---|---|---|---|---|---|---|---|---|---|
| -65.052 | 0.024 | 0.101 | 0.147 | 0.198 | 0.123 | 30.125 | -6.655 | -46.341 | -49.274 |
| (0.89) | (1.00) | (2.71) | (3.89) | (6.24) | (7.75) | (0.94) | (0.21) | (1.30) | (1.89) |
| VAR11 | VAR12 | VAR13 | VAR14 | VAR15 | VAR16 | | | | |
| -37.240 | -584.117 | -241.631 | 77.395 | 38.608 | 3.302 | | | | |
| (1.35) | (5.30) | (4.61) | (2.54) | (1.31) | (0.09) | | | | |
| 0- 5 | 6-15 | 16-20 | 21-30 | 31-40 | 41-50 | 51-65 | 66-99 | | |
| 1.133 | 0.612 | 1.009 | 1.220 | 1.000 | 0.712 | 0.865 | 0.825 | | |
| (0.40) | (2.12) | (0.05) | (1.39) | (0.00) | (2.70) | (1.19) | (1.32) | | |

EQUATION 43 USED CARS RSQ = 0.083 MEAN = 452.36

| VAR 1 | VAR 2 | VAR 3 | VAR 4 | VAR 5 | VAR 6 | VAR 7 | VAR 8 | VAR 9 | VAR10 |
|---|---|---|---|---|---|---|---|---|---|
| -247.573 | 0.087 | 0.059 | 0.082 | 0.031 | 0.029 | 117.125 | 62.854 | 86.631 | -74.068 |
| (3.42) | (3.62) | (2.06) | (2.99) | (1.71) | (3.99) | (3.80) | (2.38) | (2.89) | (3.31) |
| VAR11 | VAR12 | VAR13 | VAR14 | VAR15 | VAR16 | | | | |
| 16.617 | -69.277 | -75.181 | 120.522 | -7.077 | 34.030 | | | | |
| (0.74) | (1.07) | (2.19) | (3.60) | (0.28) | (1.06) | | | | |
| 0- 5 | 6-15 | 16-20 | 21-30 | 31-40 | 41-50 | 51-65 | 66-99 | | |
| 0.227 | 0.293 | 1.079 | 1.443 | 1.000 | 0.750 | 0.573 | 0.367 | | |
| (2.93) | (4.05) | (0.32) | (1.90) | (0.00) | (1.70) | (3.42) | (4.45) | | |

EQUATION 44 NEW & USED TRUCKS OR VANS RSQ = 0.054 MEAN = 178.84

| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| VAR 1 | VAR 2 | VAR 3 | VAR 4 | VAR 5 | VAR 6 | VAR 7 | VAR 8 | VAR 9 | VAR10 |
| -94.544 | 0.022 | 0.038 | 0.075 | 0.038 | 0.011 | 30.262 | 37.589 | 71.574 | -68.679 |
| (2.25) | (1.71) | (1.92) | (3.12) | (2.44) | (1.93) | (1.70) | (2.00) | (2.98) | (3.42) |
| VAR11 | VAR12 | VAR13 | VAR14 | VAR15 | VAR16 | | | | |
| 13.391 | -66.846 | -86.711 | 44.008 | 18.006 | 5.769 | | | | |
| (1.08) | (1.02) | (2.45) | (2.42) | (1.24) | (0.22) | | | | |
| 0- 5 | 6-15 | 16-20 | 21-30 | 31-40 | 41-50 | 51-65 | 66-99 | | |
| 2.818 | 0.410 | 0.022 | 0.733 | 1.000 | 0.978 | 0.492 | 0.340 | | |
| (2.19) | (2.10) | (4.10) | (1.27) | (0.00) | (0.09) | (3.03) | (3.17) | | |

EQUATION 45 TIRES & TUBES RSQ = 0.145 MEAN = 117.80

| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| VAR 1 | VAR 2 | VAR 3 | VAR 4 | VAR 5 | VAR 6 | VAR 7 | VAR 8 | VAR 9 | VAR10 |
| -35.301 | 0.019 | 0.012 | 0.008 | 0.008 | 0.003 | 2.304 | 14.356 | 21.246 | -4.430 |
| (4.13) | (6.04) | (3.16) | (2.25) | (3.26) | (3.48) | (0.70) | (4.06) | (5.22) | (1.66) |
| VAR11 | VAR12 | VAR13 | VAR14 | VAR15 | VAR16 | | | | |
| 3.700 | -4.223 | 2.989 | 9.496 | 2.928 | 0.935 | | | | |
| (1.24) | (0.48) | (0.66) | (2.80) | (0.77) | (0.22) | | | | |
| 0- 5 | 6-15 | 16-20 | 21-30 | 31-40 | 41-50 | 51-65 | 66-99 | | |
| 0.235 | 0.466 | 0.905 | 1.055 | 1.000 | 0.930 | 0.714 | 0.531 | | |
| (5.21) | (4.63) | (0.71) | (0.55) | (0.00) | (0.73) | (3.53) | (5.34) | | |

EQUATION 46 AUTO ACCESSORIES & PARTS RSQ = 0.191 MEAN = 88.51

| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| VAR 1 | VAR 2 | VAR 3 | VAR 4 | VAR 5 | VAR 6 | VAR 7 | VAR 8 | VAR 9 | VAR10 |
| -5.911 | 0.006 | 0.012 | 0.005 | 0.008 | 0.003 | 3.111 | 1.373 | 6.457 | 4.288 |
| (1.30) | (3.93) | (5.39) | (2.65) | (5.82) | (5.66) | (1.65) | (0.73) | (3.04) | (2.76) |
| VAR11 | VAR12 | VAR13 | VAR14 | VAR15 | VAR16 | | | | |
| 2.306 | -0.812 | 5.122 | 0.857 | 1.077 | -1.027 | | | | |
| (1.37) | (0.18) | (2.07) | (0.49) | (0.49) | (0.46) | | | | |
| 0- 5 | 6-15 | 16-20 | 21-30 | 31-40 | 41-50 | 51-65 | 66-99 | | |
| 0.476 | 0.407 | 0.836 | 0.867 | 1.000 | 1.026 | 0.874 | 0.947 | | |
| (3.80) | (6.28) | (1.54) | (1.88) | (0.00) | (0.32) | (1.79) | (0.59) | | |

EQUATION 47 AUTO REPAIRS RSQ = 0.119 MEAN = 127.93

| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| VAR 1 | VAR 2 | VAR 3 | VAR 4 | VAR 5 | VAR 6 | VAR 7 | VAR 8 | VAR 9 | VAR10 |
| 0.892 | 0.007 | 0.009 | 0.007 | 0.005 | 0.007 | -5.431 | -5.551 | -1.364 | 4.726 |
| (0.15) | (3.01) | (2.78) | (2.41) | (2.50) | (6.48) | (1.93) | (1.94) | (0.44) | (2.03) |
| VAR11 | VAR12 | VAR13 | VAR14 | VAR15 | VAR16 | | | | |
| 7.197 | 9.780 | 4.896 | -5.194 | -2.855 | -0.535 | | | | |
| (2.88) | (1.22) | (1.20) | (2.16) | (0.97) | (0.16) | | | | |
| 0- 5 | 6-15 | 16-20 | 21-30 | 31-40 | 41-50 | 51-65 | 66-99 | | |
| 0.776 | 1.124 | 1.775 | 1.204 | 1.000 | 0.881 | 1.164 | 0.948 | | |
| (0.73) | (0.49) | (2.77) | (1.24) | (0.00) | (0.89) | (1.05) | (0.33) | | |

EQUATION 48 AUTO INSURANCE RSQ = 0.232 MEAN = 275.93

| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| VAR 1 | VAR 2 | VAR 3 | VAR 4 | VAR 5 | VAR 6 | VAR 7 | VAR 8 | VAR 9 | VAR10 |
| -25.492 | 0.033 | 0.031 | 0.017 | 0.009 | 0.008 | -10.092 | -9.399 | -1.932 | -5.199 |
| (2.06) | (6.98) | (5.37) | (3.34) | (2.53) | (6.85) | (2.06) | (1.90) | (0.36) | (1.30) |
| VAR11 | VAR12 | VAR13 | VAR14 | VAR15 | VAR16 | | | | |
| 11.189 | -23.688 | -11.569 | -2.623 | 12.762 | -4.024 | | | | |
| (2.48) | (2.00) | (1.83) | (0.57) | (1.93) | (0.70) | | | | |
| 0- 5 | 6-15 | 16-20 | 21-30 | 31-40 | 41-50 | 51-65 | 66-99 | | |
| 0.405 | 0.269 | 1.052 | 0.920 | 1.000 | 1.156 | 1.069 | 0.872 | | |
| (5.04) | (9.15) | (0.47) | (1.12) | (0.00) | (1.86) | (0.83) | (1.42) | | |

EQUATION 49 GASOLINE & OIL RSQ = 0.458 MEAN = 1174.50

| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| VAR 1 | VAR 2 | VAR 3 | VAR 4 | VAR 5 | VAR 6 | VAR 7 | VAR 8 | VAR 9 | VAR10 |
| -116.984 | 0.168 | 0.085 | 0.071 | 0.051 | 0.023 | 62.695 | 79.535 | 29.925 | -92.598 |
| (3.57) | (13.76) | (5.69) | (5.24) | (5.58) | (7.74) | (4.69) | (5.89) | (2.04) | (8.39) |
| VAR11 | VAR12 | VAR13 | VAR14 | VAR15 | VAR16 | | | | |
| 49.260 | -54.308 | -19.030 | 16.273 | 38.662 | -58.503 | | | | |
| (4.14) | (1.68) | (1.11) | (1.26) | (2.33) | (3.59) | | | | |
| 0- 5 | 6-15 | 16-20 | 21-30 | 31-40 | 41-50 | 51-65 | 66-99 | | |
| 0.302 | 0.325 | 0.636 | 0.900 | 1.000 | 0.977 | 0.879 | 0.618 | | |
| (12.84) | (17.01) | (8.16) | (2.91) | (0.00) | (0.63) | (3.29) | (9.87) | | |

EQUATION 50 TOLLS, PARKING FEES, ETC RSQ = 0.127 MEAN = 95.91

| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| VAR 1 | VAR 2 | VAR 3 | VAR 4 | VAR 5 | VAR 6 | VAR 7 | VAR 8 | VAR 9 | VAR10 |
| -8.272 | 0.008 | 0.012 | 0.007 | 0.012 | 0.007 | -4.848 | -6.326 | 5.203 | 8.234 |
| (0.98) | (2.84) | (3.07) | (2.02) | (4.43) | (7.11) | (1.39) | (1.78) | (1.33) | (2.80) |
| VAR11 | VAR12 | VAR13 | VAR14 | VAR15 | VAR16 | | | | |
| 0.787 | -3.392 | -3.258 | 4.142 | 6.944 | 0.237 | | | | |
| (0.25) | (0.39) | (0.70) | (1.24) | (1.74) | (0.06) | | | | |
| 0- 5 | 6-15 | 16-20 | 21-30 | 31-40 | 41-50 | 51-65 | 66-99 | | |
| 0.237 | 0.499 | 0.679 | 0.897 | 1.000 | 0.926 | 0.791 | 0.716 | | |
| (4.30) | (3.63) | (2.33) | (1.07) | (0.00) | (0.72) | (2.33) | (2.65) | | |

EQUATION 51 LOCAL TRANSPORTATION RSQ = 0.013 MEAN = 10.51

| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| VAR 1 | VAR 2 | VAR 3 | VAR 4 | VAR 5 | VAR 6 | VAR 7 | VAR 8 | VAR 9 | VAR10 |
| 9.756 | -0.002 | 0.001 | -0.001 | 0.001 | 0.001 | -1.154 | -0.551 | -1.985 | -0.168 |
| (2.72) | (1.70) | (1.09) | (0.83) | (1.02) | (3.68) | (1.12) | (0.54) | (1.66) | (0.21) |
| VAR11 | VAR12 | VAR13 | VAR14 | VAR15 | VAR16 | | | | |
| -0.189 | 7.543 | -0.277 | -1.408 | -1.191 | 1.702 | | | | |
| (0.23) | (2.53) | (0.18) | (1.62) | (1.26) | (1.10) | | | | |
| 0- 5 | 6-15 | 16-20 | 21-30 | 31-40 | 41-50 | 51-65 | 66-99 | | |
| 1.011 | 0.700 | -0.088 | 0.368 | 1.000 | 0.746 | 0.540 | 0.821 | | |
| (0.02) | (0.80) | (4.18) | (3.93) | (0.00) | (1.27) | (3.02) | (0.82) | | |

EQUATION 52 INTERCITY TRANSPORTATION RSQ = 0.199 MEAN = 218.39

| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| VAR 1 | VAR 2 | VAR 3 | VAR 4 | VAR 5 | VAR 6 | VAR 7 | VAR 8 | VAR 9 | VAR10 |
| 6.767 | 0.002 | 0.008 | 0.010 | 0.014 | 0.028 | -11.254 | -13.150 | 7.549 | 9.335 |
| (0.83) | (0.71) | (1.89) | (2.30) | (3.87) | (7.68) | (2.68) | (3.03) | (1.65) | (2.71) |
| VAR11 | VAR12 | VAR13 | VAR14 | VAR15 | VAR16 | | | | |
| 2.715 | 19.926 | 31.698 | 2.101 | -1.403 | 9.312 | | | | |
| (0.81) | (1.38) | (4.08) | (0.62) | (0.36) | (1.80) | | | | |
| 0- 5 | 6-15 | 16-20 | 21-30 | 31-40 | 41-50 | 51-65 | 66-99 | | |
| 0.852 | 2.622 | 2.426 | 0.899 | 1.000 | 1.281 | 0.989 | 1.310 | | |
| (0.34) | (3.70) | (3.95) | (0.71) | (0.00) | (1.59) | (0.08) | (1.63) | | |

EQUATION 53 BOOKS, MAGAZINES, & NEWSPAPER RSQ = 0.231 MEAN = 119.25

| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| VAR 1 | VAR 2 | VAR 3 | VAR 4 | VAR 5 | VAR 6 | VAR 7 | VAR 8 | VAR 9 | VAR10 |
| 9.680 | 0.007 | 0.010 | 0.005 | 0.009 | 0.005 | -3.495 | -12.919 | -6.402 | 15.438 |
| (2.02) | (4.00) | (4.56) | (2.32) | (6.22) | (9.46) | (1.75) | (6.07) | (2.83) | (8.34) |
| VAR11 | VAR12 | VAR13 | VAR14 | VAR15 | VAR16 | | | | |
| 1.080 | 17.477 | 11.904 | -5.520 | -1.067 | -3.898 | | | | |
| (0.62) | (3.74) | (4.49) | (3.02) | (0.48) | (1.63) | | | | |
| 0- 5 | 6-15 | 16-20 | 21-30 | 31-40 | 41-50 | 51-65 | 66-99 | | |
| 0.432 | 0.646 | 0.437 | 0.857 | 1.000 | 0.914 | 0.968 | 1.030 | | |
| (5.02) | (3.97) | (7.39) | (2.57) | (0.00) | (1.43) | (0.54) | (0.41) | | |

EQUATION 54 BOATS, RV, & AIRCRAFT RSQ = 0.051 MEAN = 88.76

| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| VAR 1 | VAR 2 | VAR 3 | VAR 4 | VAR 5 | VAR 6 | VAR 7 | VAR 8 | VAR 9 | VAR10 |
| -58.376 | 0.011 | 0.013 | 0.054 | -0.007 | 0.036 | 66.729 | 25.801 | 39.132 | -14.129 |
| (1.27) | (0.73) | (0.68) | (2.56) | (0.60) | (4.21) | (2.77) | (1.44) | (1.92) | (1.08) |
| VAR11 | VAR12 | VAR13 | VAR14 | VAR15 | VAR16 | | | | |
| 1.168 | -144.842 | -97.201 | 28.856 | -3.685 | 2.961 | | | | |
| (0.09) | (2.85) | (3.24) | (1.60) | (0.27) | (0.13) | | | | |
| 0- 5 | 6-15 | 16-20 | 21-30 | 31-40 | 41-50 | 51-65 | 66-99 | | |
| 1.648 | -0.672 | -0.425 | 1.399 | 1.000 | 1.485 | 0.471 | -0.012 | | |
| (0.84) | (7.68) | (5.41) | (1.09) | (0.00) | (1.37) | (3.30) | (5.52) | | |

EQUATION 55 WHEEL GOODS, TOYS, & SPORT EQU RSQ = 0.207 MEAN = 131.49

| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| VAR 1 | VAR 2 | VAR 3 | VAR 4 | VAR 5 | VAR 6 | VAR 7 | VAR 8 | VAR 9 | VAR10 |
| -7.827 | 0.012 | 0.010 | 0.019 | -0.004 | 0.017 | 4.044 | -2.723 | 3.037 | 6.121 |
| (1.36) | (5.31) | (3.17) | (5.15) | (1.70) | (8.79) | (1.42) | (0.95) | (0.96) | (2.67) |
| VAR11 | VAR12 | VAR13 | VAR14 | VAR15 | VAR16 | | | | |
| -6.568 | -18.383 | -5.139 | 0.521 | 0.950 | -3.054 | | | | |
| (2.72) | (1.42) | (0.88) | (0.22) | (0.39) | (0.68) | | | | |
| 0- 5 | 6-15 | 16-20 | 21-30 | 31-40 | 41-50 | 51-65 | 66-99 | | |
| 2.126 | 1.782 | 0.608 | 1.292 | 1.000 | 0.275 | 0.471 | 0.228 | | |
| (3.24) | (3.08) | (2.91) | (2.18) | (0.00) | (10.35) | (7.57) | (9.16) | | |

EQUATION 56 RADIO, TV, MUSICAL INSTRUMENTS RSQ = 0.086 MEAN = 154.08

| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| VAR 1 | VAR 2 | VAR 3 | VAR 4 | VAR 5 | VAR 6 | VAR 7 | VAR 8 | VAR 9 | VAR10 |
| -16.804 | 0.021 | 0.003 | 0.018 | -0.011 | 0.027 | -0.018 | -5.077 | 1.350 | 14.370 |
| (0.86) | (2.84) | (0.36) | (0.09) | (1.91) | (6.83) | (0.00) | (0.62) | (0.15) | (2.10) |
| VAR11 | VAR12 | VAR13 | VAR14 | VAR15 | VAR16 | | | | |
| -6.089 | -3.183 | -0.802 | 8.199 | 6.105 | -24.824 | | | | |
| (0.86) | (0.16) | (0.08) | (1.03) | (0.68) | (2.92) | | | | |
| 0- 5 | 6-15 | 16-20 | 21-30 | 31-40 | 41-50 | 51-65 | 66-99 | | |
| 0.437 | 0.707 | 0.601 | 0.748 | 1.000 | 0.341 | 1.520 | 0.322 | | |
| (1.90) | (1.25) | (2.00) | (1.87) | (0.00) | (6.62) | (2.36) | (4.80) | | |

EQUATION 57 RADIO & TV REPAIRS RSQ = 0.028 MEAN = 17.12

| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| VAR 1 | VAR 2 | VAR 3 | VAR 4 | VAR 5 | VAR 6 | VAR 7 | VAR 8 | VAR 9 | VAR10 |
| -4.628 | 0.003 | -0.000 | 0.002 | 0.000 | 0.000 | 0.493 | 1.084 | -0.274 | 0.323 |
| (2.38) | (3.12) | (0.18) | (2.54) | (0.04) | (1.08) | (0.74) | (1.54) | (0.37) | (0.59) |
| VAR11 | VAR12 | VAR13 | VAR14 | VAR15 | VAR16 | | | | |
| -0.229 | 1.719 | 0.729 | 1.684 | 1.251 | -0.001 | | | | |
| (0.37) | (1.16) | (0.85) | (2.03) | (1.32) | (0.00) | | | | |
| 0- 5 | 6-15 | 16-20 | 21-30 | 31-40 | 41-50 | 51-65 | 66-99 | | |
| 0.524 | 0.871 | 1.114 | 0.627 | 1.000 | 1.245 | 1.441 | 1.762 | | |
| (1.20) | (0.33) | (0.29) | (1.88) | (0.00) | (0.75) | (1.21) | (1.60) | | |

EQUATION 58 FEES & ADMISSIONS RSQ = 0.375 MEAN = 229.94

| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| VAR 1 | VAR 2 | VAR 3 | VAR 4 | VAR 5 | VAR 6 | VAR 7 | VAR 8 | VAR 9 | VAR10 |
| -10.282 | 0.015 | 0.024 | 0.017 | 0.030 | 0.029 | -1.392 | -18.172 | 0.751 | 32.505 |
| (1.16) | (4.68) | (5.08) | (3.59) | (7.78) | (13.43) | (0.33) | (4.13) | (0.16) | (8.06) |
| VAR11 | VAR12 | VAR13 | VAR14 | VAR15 | VAR16 | | | | |
| -4.002 | -48.916 | -17.128 | 6.005 | -4.626 | -0.184 | | | | |
| (1.14) | (3.24) | (2.28) | (1.63) | (1.17) | (0.03) | | | | |
| 0- 5 | 6-15 | 16-20 | 21-30 | 31-40 | 41-50 | 51-65 | 66-99 | | |
| 0.536 | 1.669 | 0.782 | 0.740 | 1.000 | 0.869 | 0.698 | 0.776 | | |
| (3.15) | (4.22) | (2.24) | (4.17) | (0.00) | (2.00) | (5.56) | (3.08) | | |

EQUATION 59 OTHER REC SUPPLIES, EQUIPMENT RSQ = 0.213 MEAN = 204.80

| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| VAR 1 | VAR 2 | VAR 3 | VAR 4 | VAR 5 | VAR 6 | VAR 7 | VAR 8 | VAR 9 | VAR10 |
| -32.564 | 0.022 | 0.027 | 0.013 | 0.028 | 0.016 | -2.546 | 0.825 | 22.176 | 11.871 |
| (2.63) | (5.16) | (4.46) | (2.32) | (6.45) | (8.83) | (0.47) | (0.15) | (3.55) | (2.69) |
| VAR11 | VAR12 | VAR13 | VAR14 | VAR15 | VAR16 | | | | |
| -1.393 | -16.651 | 16.621 | 8.317 | 15.866 | -3.829 | | | | |
| (0.30) | (0.99) | (1.95) | (1.69) | (2.80) | (0.56) | | | | |
| 0- 5 | 6-15 | 16-20 | 21-30 | 31-40 | 41-50 | 51-65 | 66-99 | | |
| 0.277 | 0.816 | 0.746 | 0.791 | 1.000 | 0.658 | 0.641 | 0.441 | | |
| (5.87) | (1.64) | (2.65) | (3.47) | (0.00) | (5.65) | (6.67) | (9.30) | | |

EQUATION 60 EDUCATION RSQ = 0.226 MEAN = 213.07

| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| VAR 1 | VAR 2 | VAR 3 | VAR 4 | VAR 5 | VAR 6 | VAR 7 | VAR 8 | VAR 9 | VAR10 |
| -1.428 | 0.001 | 0.003 | 0.002 | 0.005 | 0.001 | -1.441 | -1.202 | -2.563 | 3.791 |
| (0.51) | (0.58) | (0.61) | (0.60) | (0.61) | (0.61) | (0.59) | (0.58) | (0.60) | (0.61) |
| VAR11 | VAR12 | VAR13 | VAR14 | VAR15 | VAR16 | | | | |
| -0.638 | -12.552 | -7.431 | 1.942 | 0.128 | -0.182 | | | | |
| (0.51) | (0.61) | (0.61) | (0.59) | (0.15) | (0.21) | | | | |
| 0- 5 | 6-15 | 16-20 | 21-30 | 31-40 | 41-50 | 51-65 | 66-99 | | |
| 1.122 | 20.581 | 25.027 | 6.691 | 1.000 | 19.483 | 10.608 | -0.345 | | |
| (0.22) | (0.57) | (0.58) | (0.52) | (0.00) | (0.59) | (0.56) | (0.83) | | |

EQUATION 61 CASH CONTRIBUTION RSQ = 0.230 MEAN = 441.13

| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| VAR 1 | VAR 2 | VAR 3 | VAR 4 | VAR 5 | VAR 6 | VAR 7 | VAR 8 | VAR 9 | VAR10 |
| -24.323 | 0.017 | 0.018 | 0.018 | 0.025 | 0.024 | 28.629 | 21.782 | 14.823 | 48.048 |
| (1.30) | (2.54) | (2.06) | (2.31) | (4.11) | (6.11) | (3.39) | (2.76) | (1.78) | (4.92) |
| VAR11 | VAR12 | VAR13 | VAR14 | VAR15 | VAR16 | | | | |
| -11.106 | -29.487 | -29.001 | -1.781 | -20.466 | 7.481 | | | | |
| (1.60) | (2.17) | (3.07) | (0.24) | (2.09) | (0.93) | | | | |
| 0- 5 | 6-15 | 16-20 | 21-30 | 31-40 | 41-50 | 51-65 | 66-99 | | |
| 1.344 | 0.995 | 0.572 | 0.955 | 1.000 | 1.782 | 2.378 | 3.470 | | |

## TABLE 2.3

## Effect of Demographic Variables

| | REGION | | | EDUCATION | WORKING SPOUSE | FAMILY SIZE | | | AGE | |
|---|---|---|---|---|---|---|---|---|---|---|
| | N.C. | S. | W. | COLLEGE | YES | 1 | 2 | 5+ | 35- | 55+ |
| 1. FOOD, OFF PRE | (-) | (-) | (-) | (-) | (-) | | | | (+) | (+) |
| 2. FOOD, ON PREM | | | | (+) | | | | | | |
| 3. ALCOHOL, OFF | (-) | | | (-) | | (+) | (+) | | | (-) |
| 4. ALCOHOL, ON P | | (-) | | (-) | | (+) | (+) | | | |
| 5. TOBACCO PRODU | (-) | (-) | (-) | (-) | | (+) | (+) | (-) | | |
| 6. SHOES & FOOTW | | | (-) | (+) | | (+) | (+) | | | (-) |
| 7. WOMEN'S & CHI | | | (-) | (+) | | | | (+) | | (-) |
| 8. MEN'S & BOY'S | | (-) | (-) | (+) | (-) | (-) | (-) | (+) | | |
| 9. LUGGAGE | | | | | | | | | | |
| 10. JEWELRY & WAT | | | | | | (-) | | | (+) | |
| 11. LAUNDRIES, ST | (-) | (-) | (-) | (+) | | (+) | (+) | (-) | (+) | |
| 12. OTHER JEWELRY | | | | | (+) | | | (-) | | |
| 13. PERSONAL CARE | | | | (+) | | | | | | |
| 14. OWNER-OCCUPIE | | (-) | (-) | (+) | | | | | | |
| 15. TENANT-OCCUPI | (-) | | | (-) | (-) | (+) | (+) | (-) | (+) | (-) |
| 16. OTHER HOUSING | | | | | | | | | | |
| 17. ADDITIONS, AL | | | | | | | | | | |
| 18. HOTELS & MOTE | | (-) | (-) | (+) | (+) | (-) | | | | |
| 19. FURNITURE | | | | (-) | | (-) | | | | |
| 20. KITCHEN & HOU | (+) | (+) | (+) | | | | | | (+) | |
| 21. CHINA, GLASSW | | | (+) | (+) | | (-) | (-) | | | |
| 22. OTHER DURABLE | (+) | | (+) | | (+) | | | | | |
| 23. FLOOR COVERIN | | | | | | | | | | |
| 24. SEMIDURABLE H | | | (+) | (+) | (-) | (-) | | | | |

## TABLE 2.3

### Effect of Demographic Variables (Continued)

| | REGION | | | EDUCATION | WORKING SPOUSE | FAMILY SIZE | | | AGE | |
|---|---|---|---|---|---|---|---|---|---|---|
| | N.C. | S. | W. | COLLEGE | YES | 1 | 2 | 5+ | 35- | 55+ |
| 25. ELECTRICITY | | (+) | (-) | | | | | (-) | (+) | (-) |
| 26. NATURAL GAS | (+) | (-) | (-) | (+) | | (+) | | (-) | | |
| 27. FUEL OIL & CO | (-) | (-) | (-) | (+) | | | | (+) | | |
| 28. WOOD, OTHER F | | | | | | (+) | | | | |
| 29. WATER & OTHER | (+) | (+) | (+) | (+) | (+) | | | (-) | | |
| 30. TELEPHONE & T | (-) | | (-) | (+) | (-) | (+) | (+) | (-) | | (-) |
| 31. DOMESTIC SERV | | | | | (+) | (-) | (-) | (-) | | |
| 32. OTHER HOUSEHO | | | | (+) | | | | | | |
| 33. HOUSEHOLD INS | (+) | | | (+) | | | | | | (+) |
| 34. PRESCRIPTION | (+) | (+) | | (-) | | (-) | | | | (+) |
| 35. PHYSICIANS | | | | | (-) | (-) | | | | (+) |
| 36. DENTAL & EYES | | | | (+) | | | | | | (-) |
| 37. OTHER MEDICAL | | | | | | | | | | |
| 38. HOSPITALS & S | | | | | | | (+) | | | |
| 39. HEALTH INSURA | (+) | (+) | | | | | (+) | | | (+) |
| 40. PERSONAL BUSI | | (+) | | | | (-) | | | | |
| 41. LIFE INSURANC | | (+) | | (+) | (+) | (-) | (-) | | | |
| 42. NEW CARS | | | | (-) | | (-) | (-) | (+) | | |
| 43. USED CARS | (+) | (+) | (+) | (-) | | | (-) | (+) | | |
| 44. TRUCKS | (+) | (+) | (+) | (-) | | | (-) | (+) | | |
| 45. TIRES & TUBES | | (+) | (+) | (-) | | | | (+) | | |
| 46. AUTO ACCESSOR | (+) | | (+) | (+) | | | (+) | | | |
| 47. AUTO REPAIRS | (-) | (-) | | (+) | (+) | | | (-) | | |
| 48. AUTO INSURANC | (-) | (-) | | | (+) | (-) | (-) | | (+) | |

**TABLE 2.3**

**Effect of Demographic Variables (Continued)**

| | REGION | | | EDUCATION | WORKING SPOUSE | FAMILY SIZE | | | AGE | |
|---|---|---|---|---|---|---|---|---|---|---|
| | N.C. | S. | W. | COLLEGE | YES | 1 | 2 | 5+ | 35- | 55+ |
| 49. GASOLINE & OI | (+) | (+) | (+) | (-) | (+) | (-) | | | (+) | (-) |
| 50. TOLLS, PARKIN | | (-) | | (+) | | | | | (+) | |
| 51. LOCAL TRANSPO | | | (-) | | | (+) | | | | |
| 52. INTERCITY TRA | (-) | (-) | (+) | (+) | | | (+) | | | (+) |
| 53. BOOKS, MAGAZI | (-) | (-) | (-) | (+) | | (+) | (+) | | (-) | |
| 54. BOATS, RV, & | (+) | | (+) | | | (-) | (-) | | | |
| 55. WHEEL GOODS, | | | | (+) | (-) | | | | | |
| 56. RADIO, TV, RE | | | | (+) | | | | | | (-) |
| 57. REPAIRS, RADI | | | | | | | | (+) | | |
| 58. FEES & ADMISS | | (-) | | (+) | | (-) | (-) | | | |
| 59. OTHER RECREAT | | | (+) | (+) | | | (+) | (+) | (+) | |
| 60. EDUCATION | | | | | | | | | | |
| 61. CASH CONTRIBU | (+) | (+) | (+) | (+) | | (-) | (-) | | (-) | |

**FIGURE 2.2**

**Plot of Engel Curves**

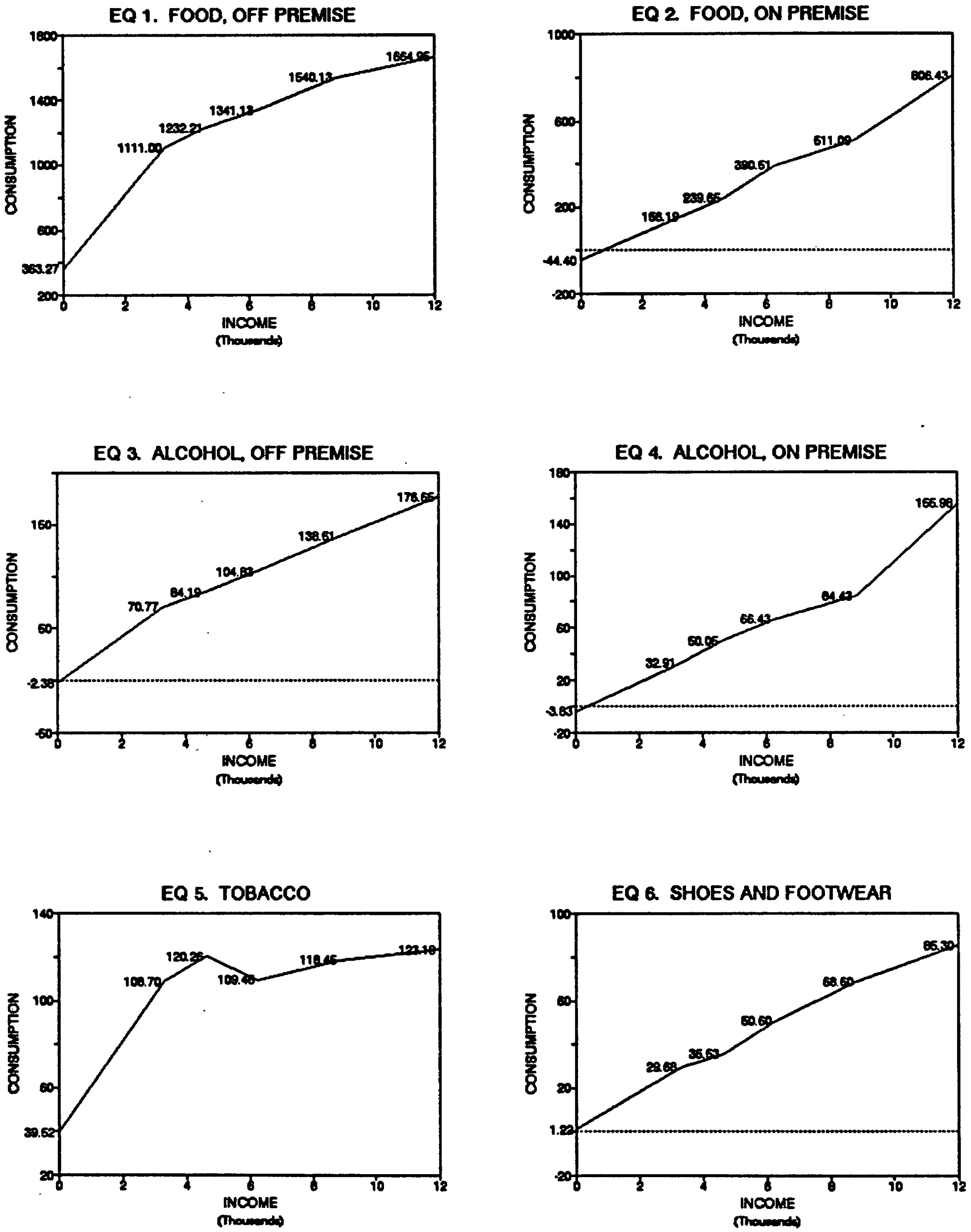
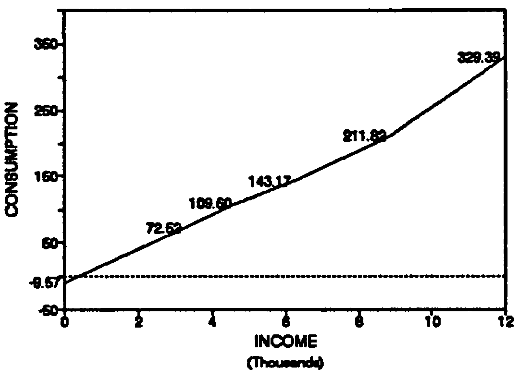


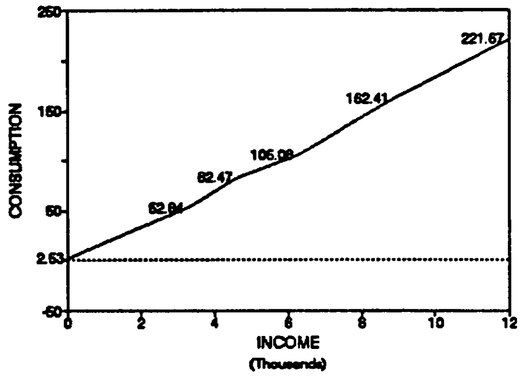
**FIGURE 2.2**

**Plot of Engel Curves**
**(Continued)**

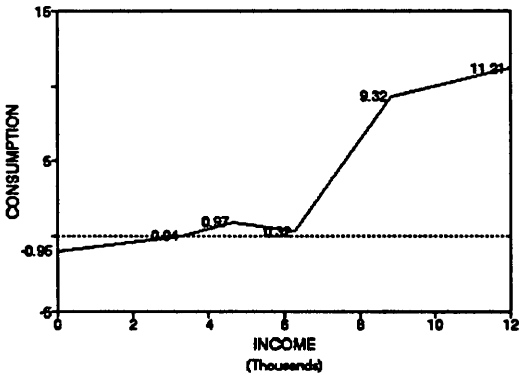
EQ 7. WOMEN'S AND CHILDREN'S CLOTHING



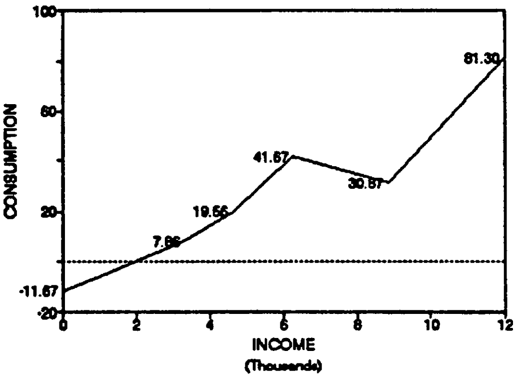

EQ 8. MEN'S AND BOY'S CLOTHING



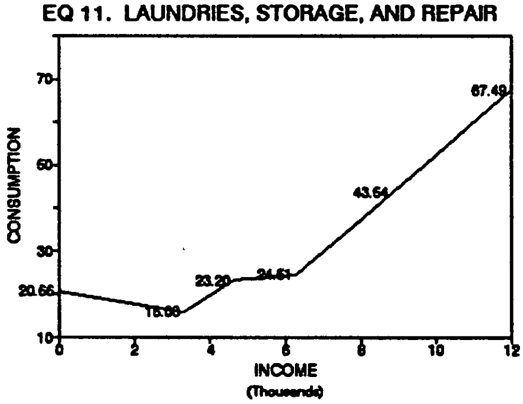

EQ 9. LUGGAGE




EQ 10. JEWELRY AND WATCHES




EQ 11. LAUNDRIES, STORAGE, AND REPAIR




EQ 12. OTHER JEWELRY AND CLOTHING

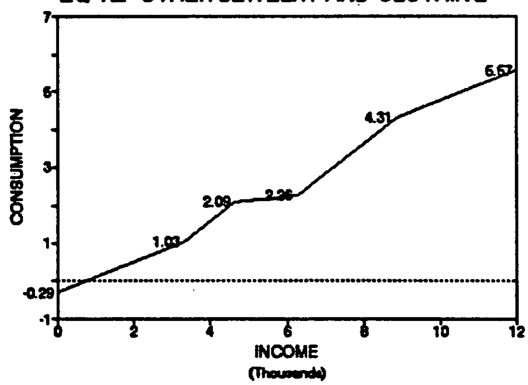


**FIGURE 2.2**

**Plot of Engel Curves (Continued)**

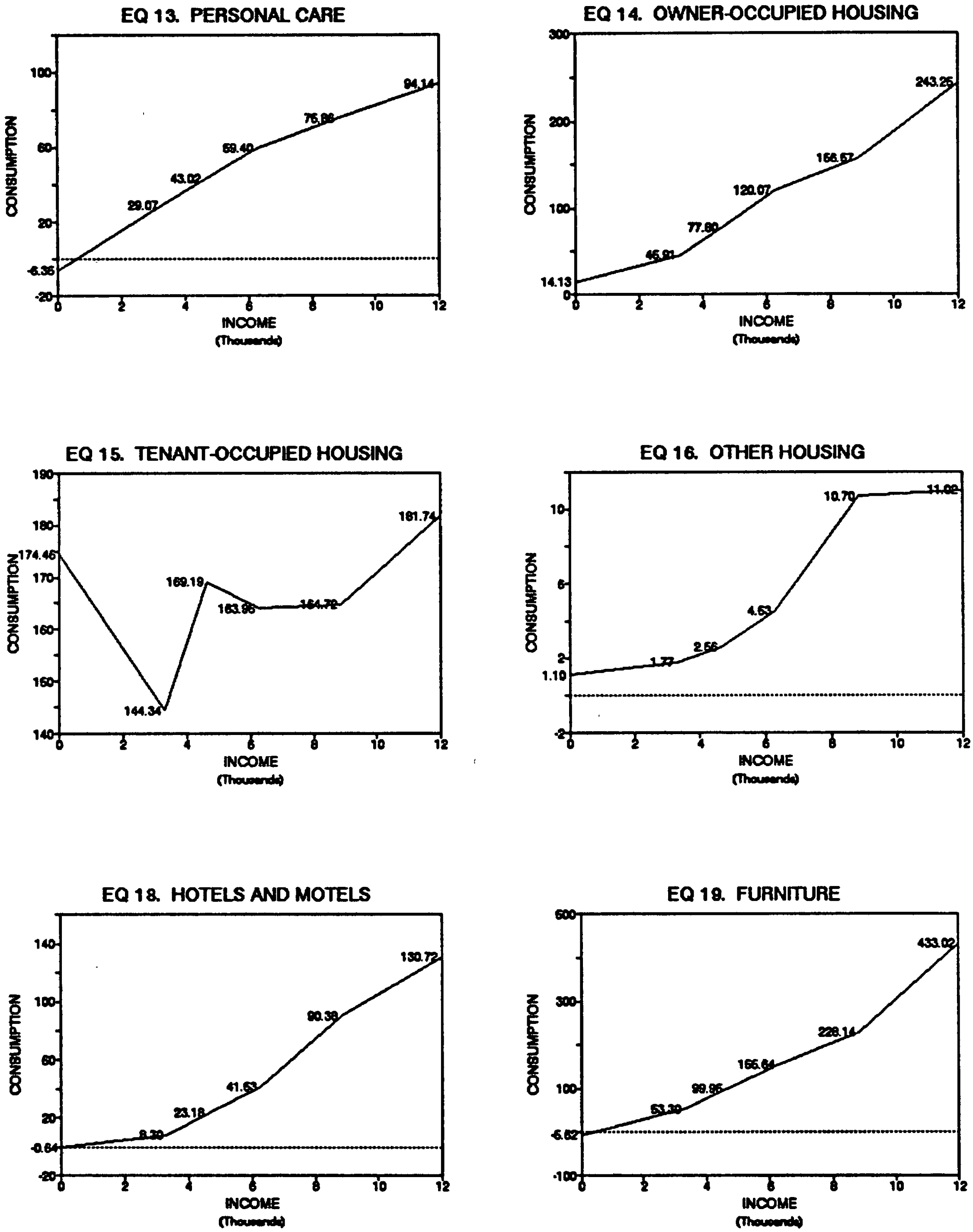


**FIGURE 2.2**

**Plot of Engel Curves**
**(Continued)**

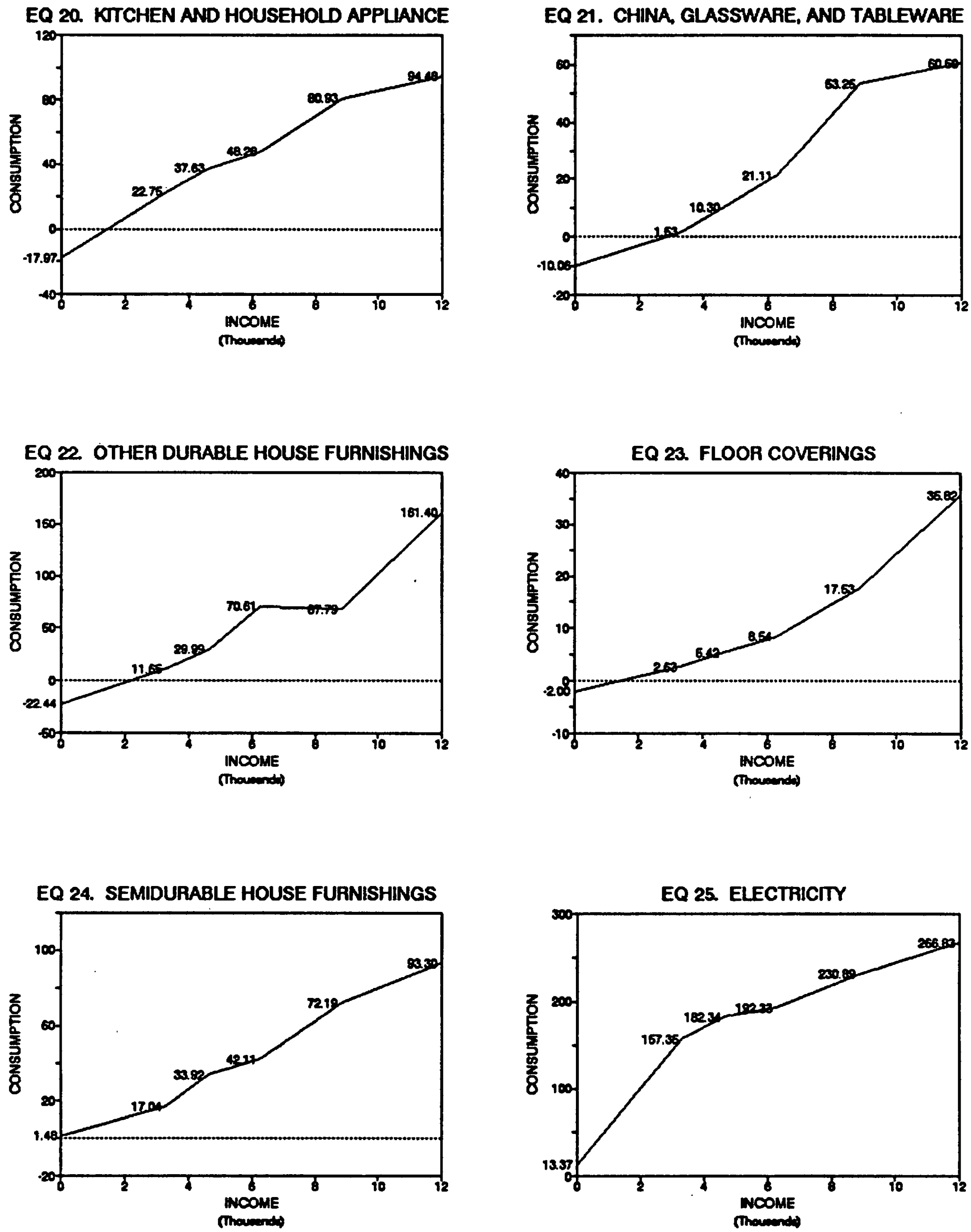
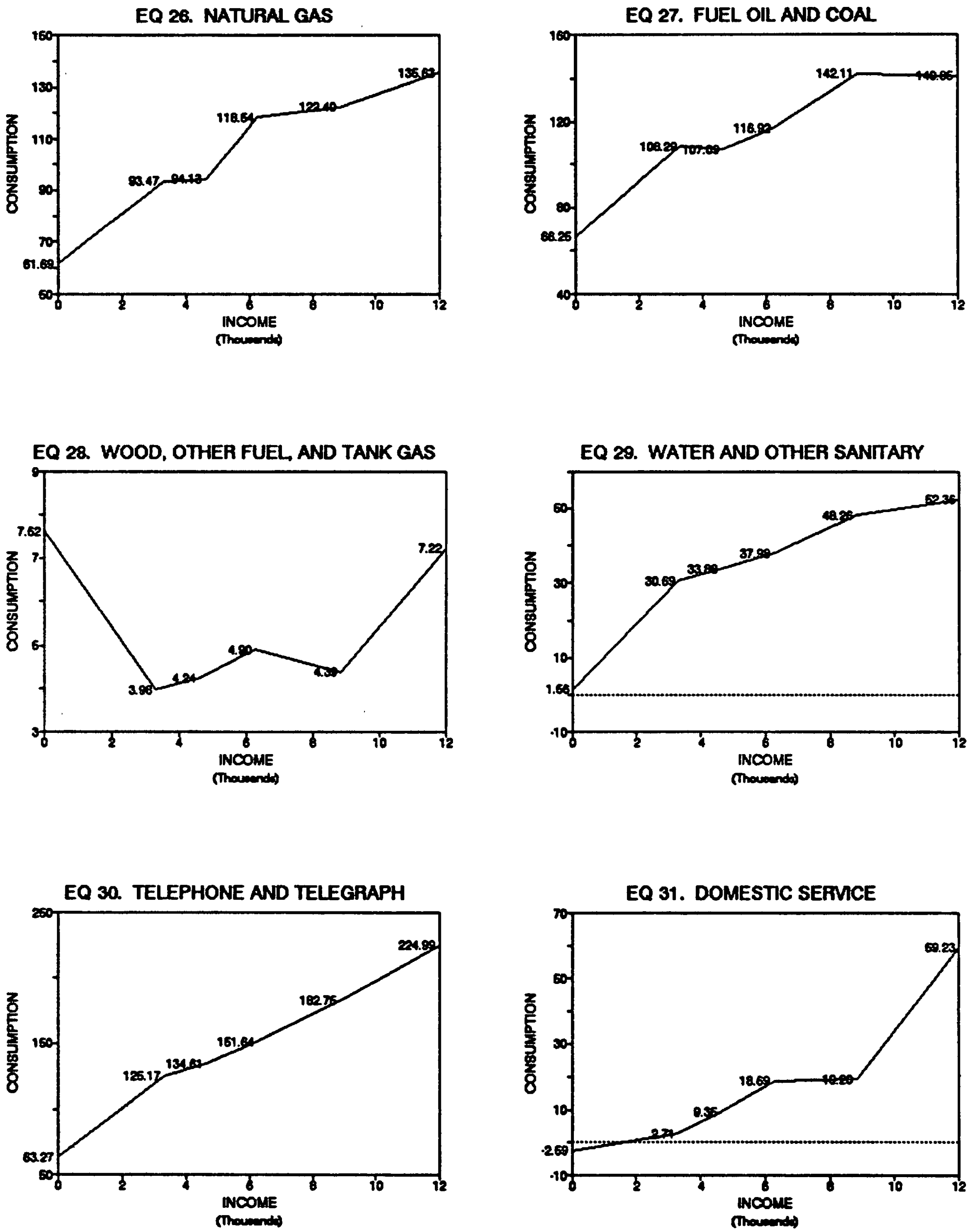


**FIGURE 2.2**

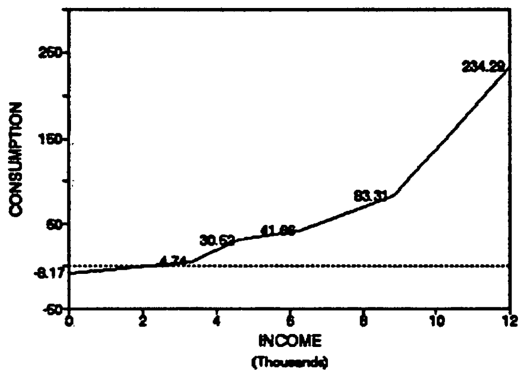
**Plot of Engel Curves (Continued)**



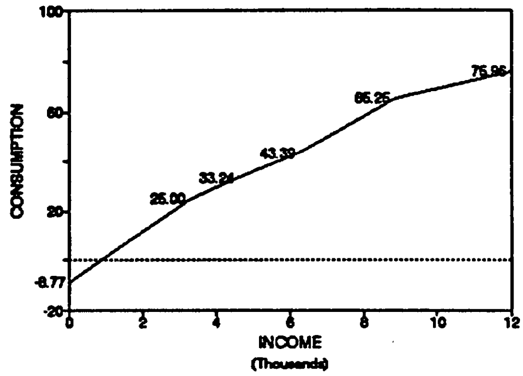
## FIGURE 2.2

## Plot of Engel Curves (Continued)

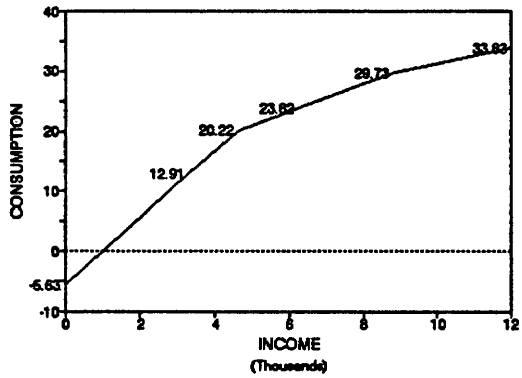
EQ 32. OTHER HOUSEHOLD OPERATIONS



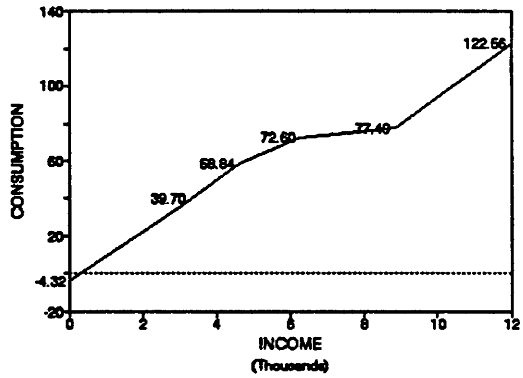

EQ 33. HOUSEHOLD INSURANCE



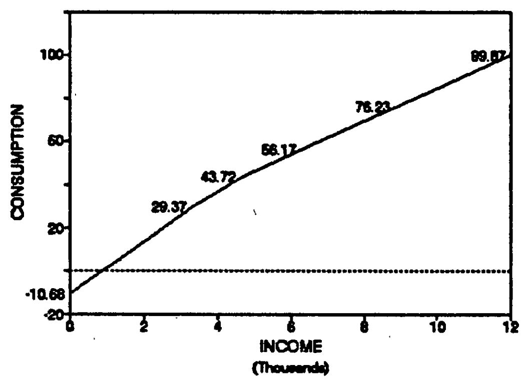

EQ 34. PRESCRIPTION DRUG AND SUNDRIES




EQ 35. PHYSICIANS




EQ 36. DENTAL AND EYES




EQ 37. OTHER MEDICAL SERVICES

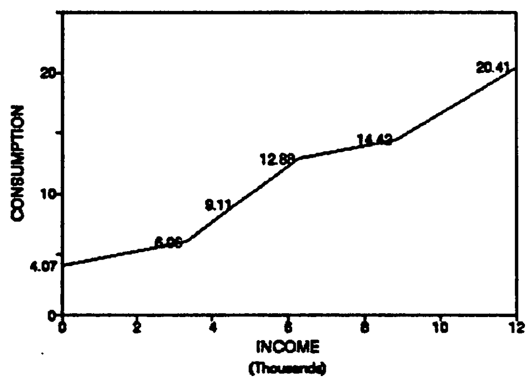


**FIGURE 2.2**

**Plot of Engel Curves
(Continued)**

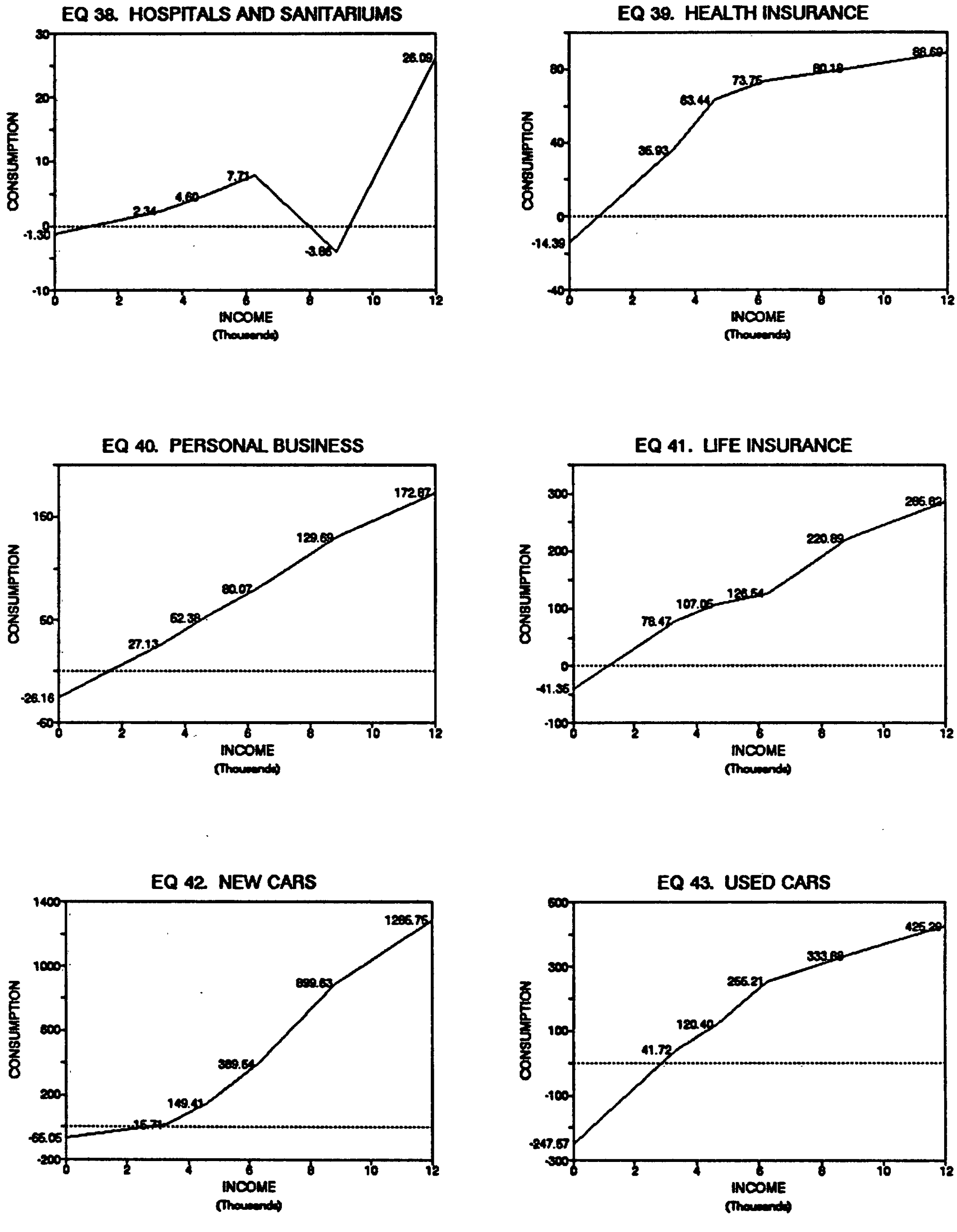
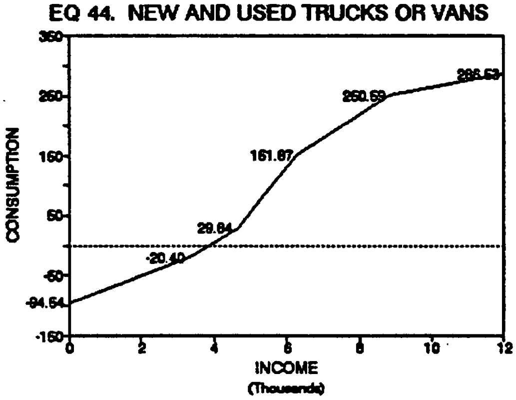


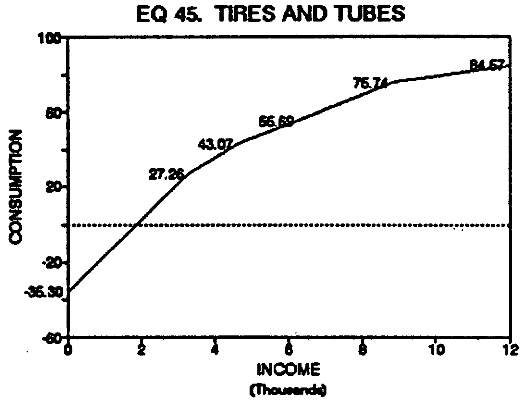
**FIGURE 2.2**

**Plot of Engel Curves (Continued)**

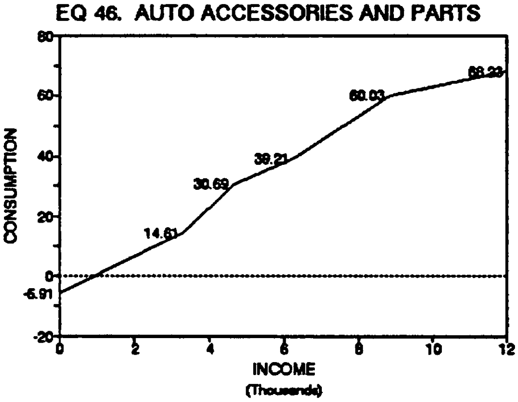
EQ 44. NEW AND USED TRUCKS OR VANS



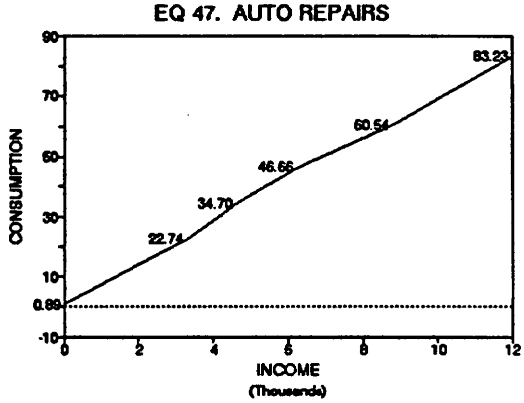

EQ 45. TIRES AND TUBES



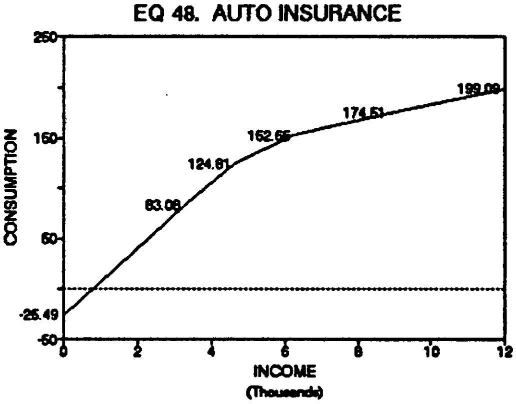

EQ 46. AUTO ACCESSORIES AND PARTS




EQ 47. AUTO REPAIRS




EQ 48. AUTO INSURANCE




EQ 49. GASOLINE AND OIL

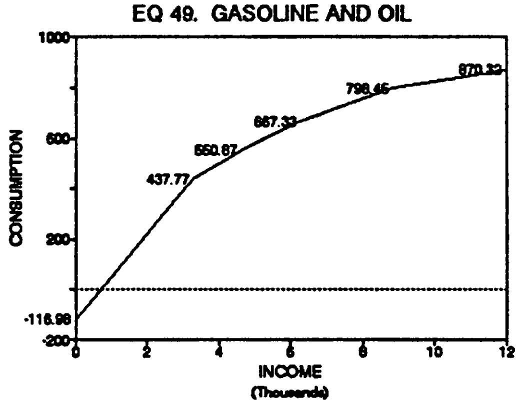
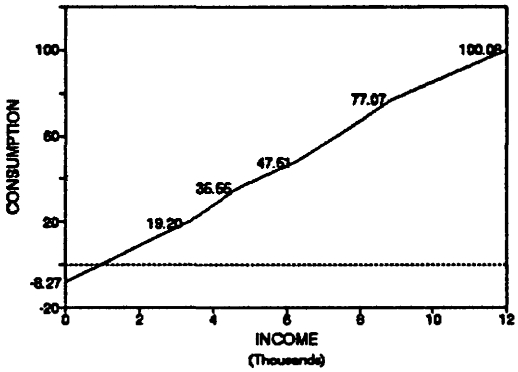


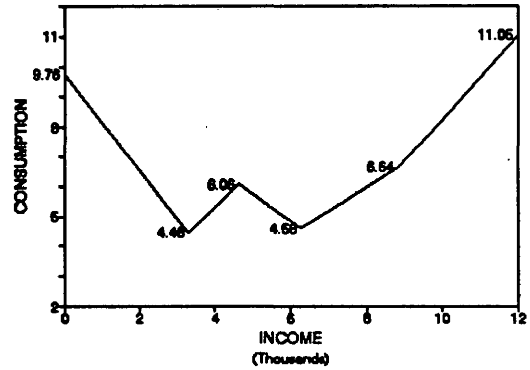
**FIGURE 2.2**

**Plot of Engel Curves
(Continued)**

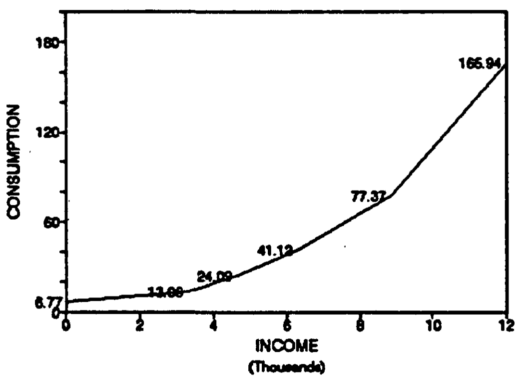
EQ 50. TOLLS, PARKING FEES, ETC



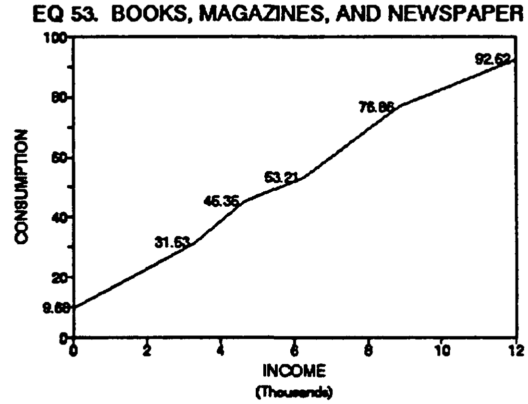

EQ 51. LOCAL TRANSPORTATION



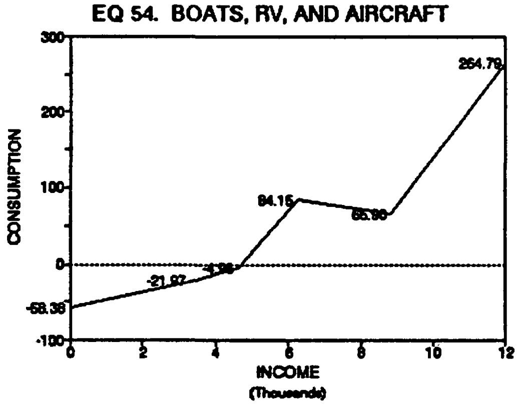

EQ 52. INTERCITY TRANSPORTATION




EQ 53. BOOKS, MAGAZINES, AND NEWSPAPER




EQ 54. BOATS, RV, AND AIRCRAFT




EQ 55. WHEEL GOODS, TOYS, AND SPORT

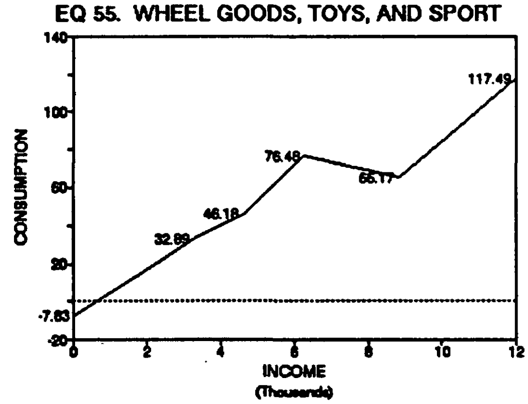
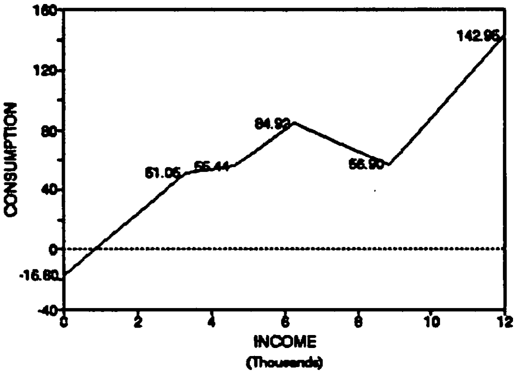


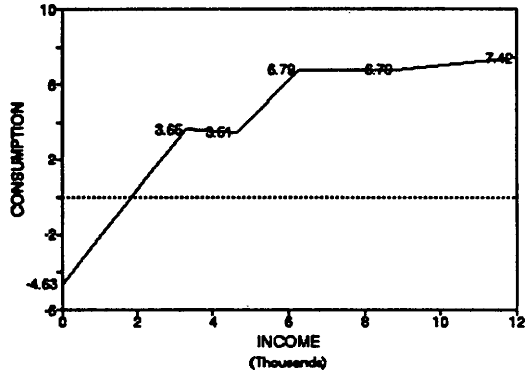
**FIGURE 2.2**

**Plot of Engel Curves (Continued)**

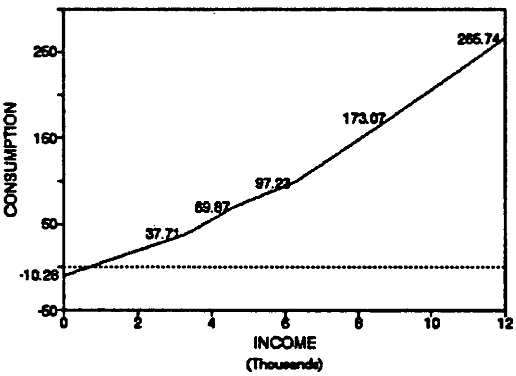
EQ 56. RADIO, TV, RECORDERS



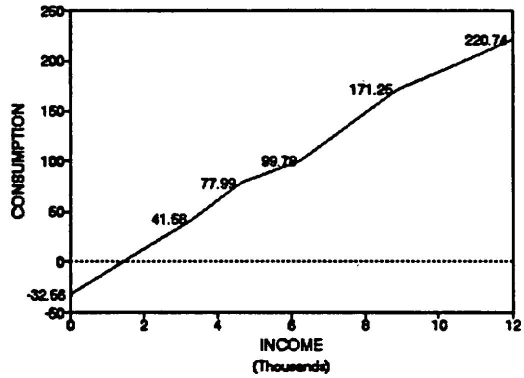

EQ 57. RADIO AND TV REPAIRS AND RENTAL



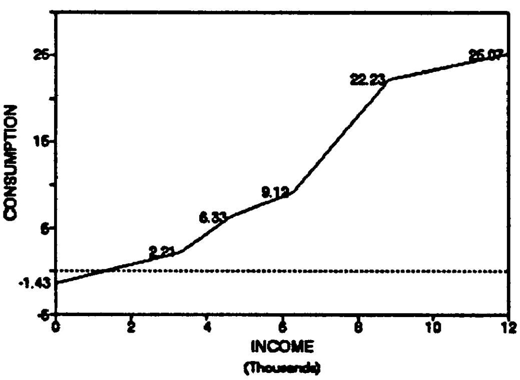

EQ 58. FEES AND ADMISSIONS




EQ 59. OTHER RECREATIONAL SUPPLIES




EQ 60. EDUCATION




EQ 61. CASH CONTRIBUTION

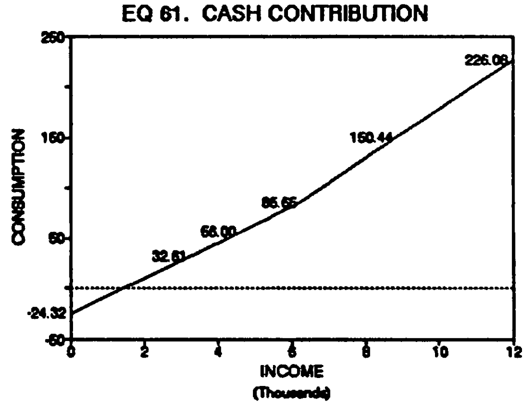


**FIGURE 2.3**

**Bar Chart of Adult Equivalency Weights**

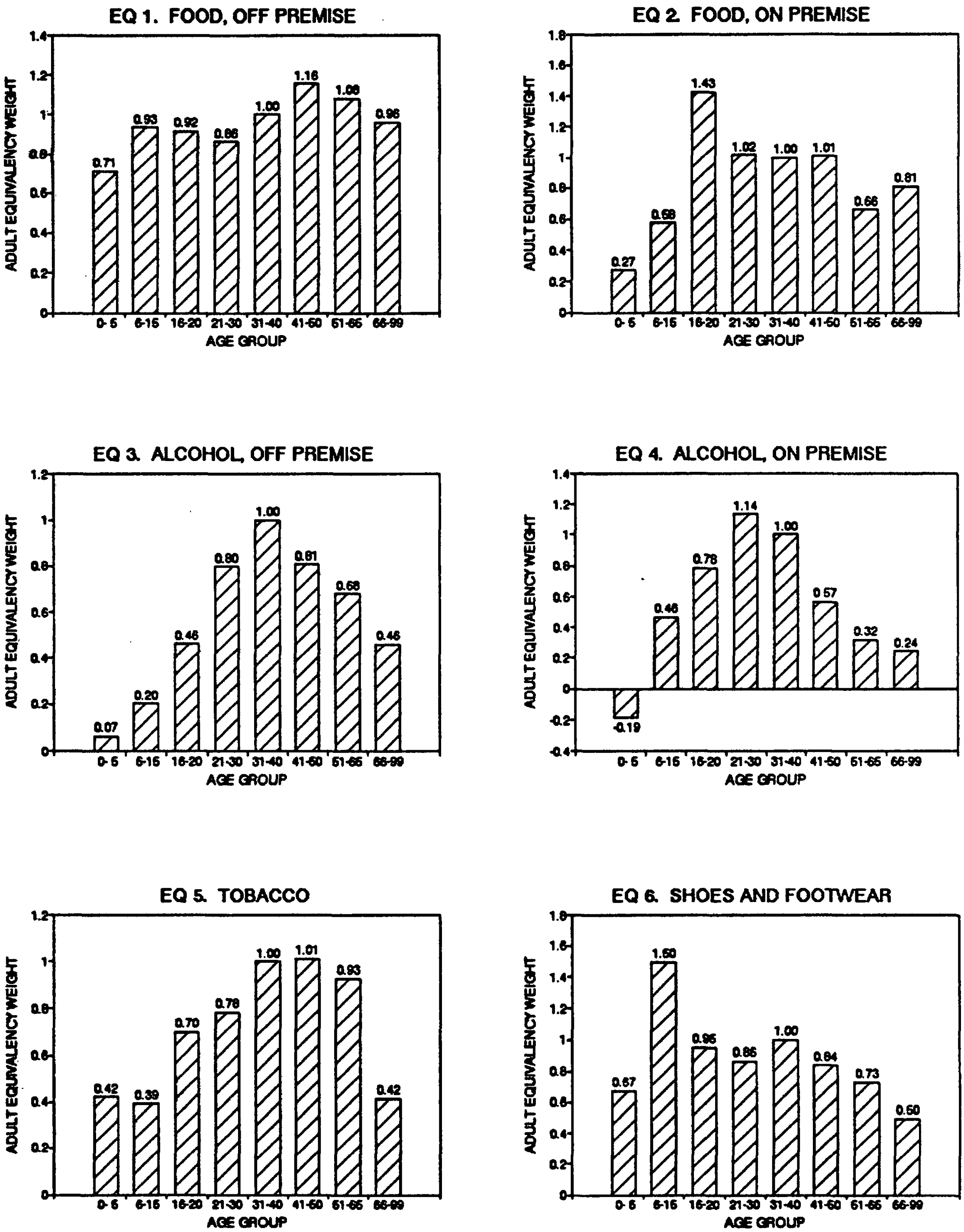
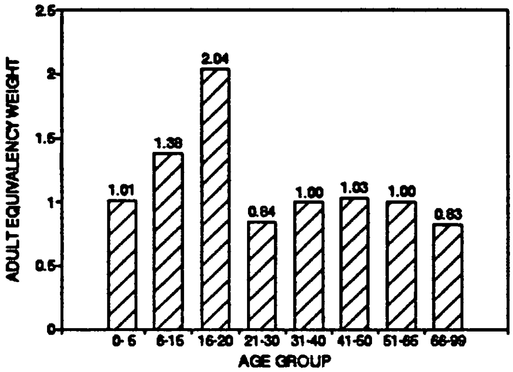


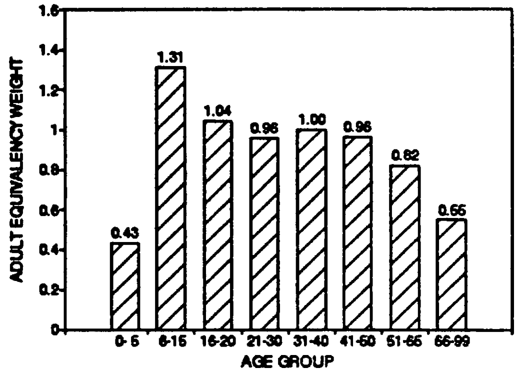
**FIGURE 2.3**

**Bar Chart of Adult Equivalency Weights**
**(Continued)**

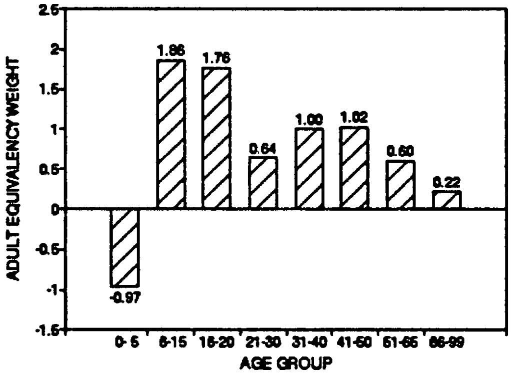
EQ 7. WOMEN'S AND CHILDREN'S CLOTHING



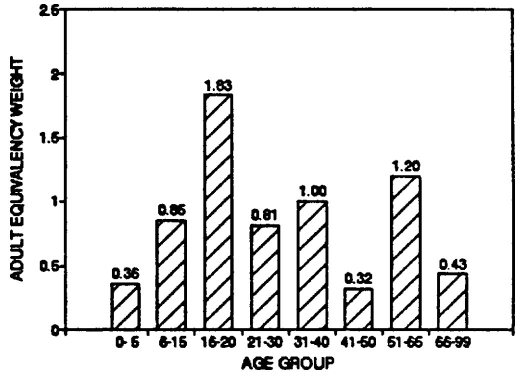

EQ 8. MEN'S AND BOY'S CLOTHING



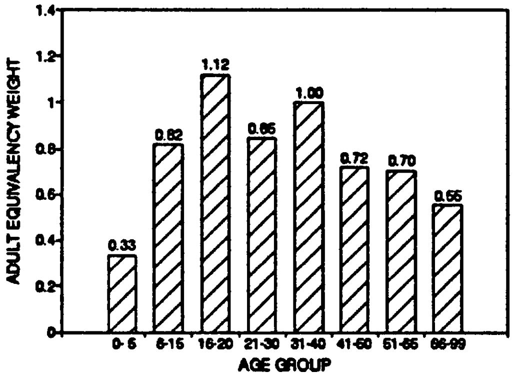

EQ 9. LUGGAGE




EQ 10. JEWELRY AND WATCHES




EQ 11. LAUNDRIES, STORAGE, AND REPAIR




EQ 12. OTHER JEWELRY AND CLOTHING

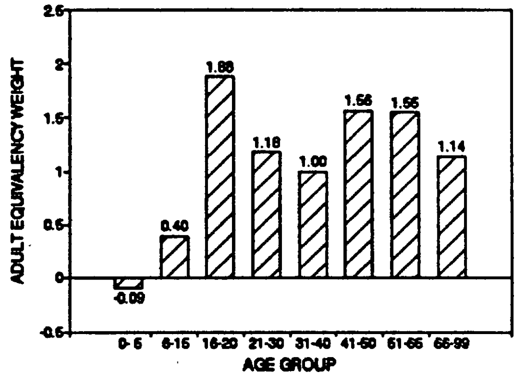


**FIGURE 2.3**

**Bar Chart of Adult Equivalency Weights (Continued)**

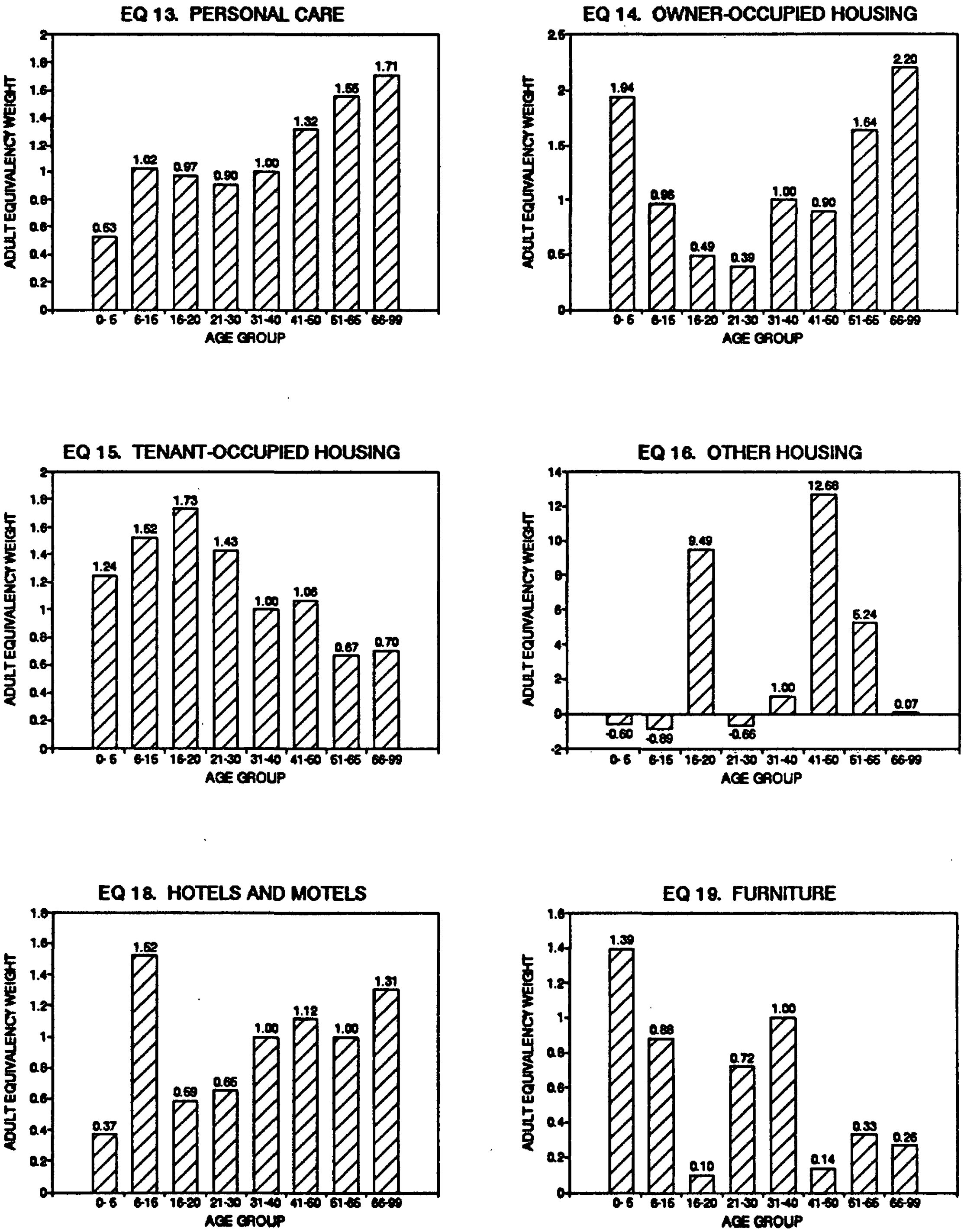
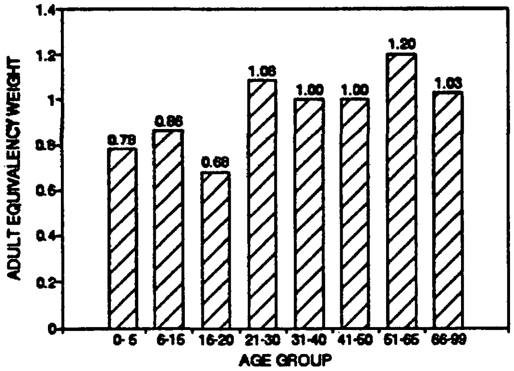


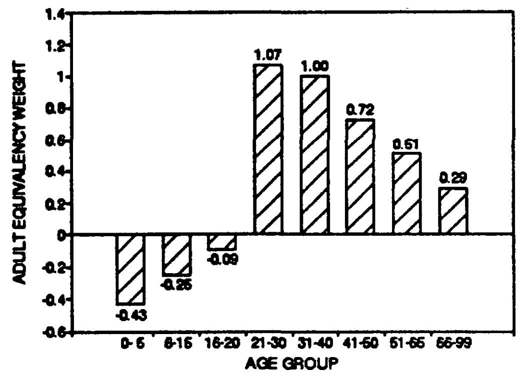
**FIGURE 2.3**

**Bar Chart of Adult Equivalency Weights**
**(Continued)**

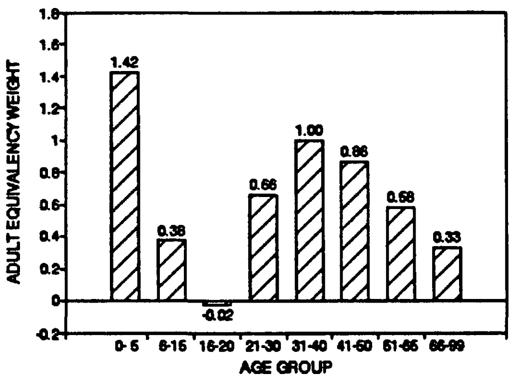
EQ 20. KITCHEN AND HOUSEHOLD APPLIANCE



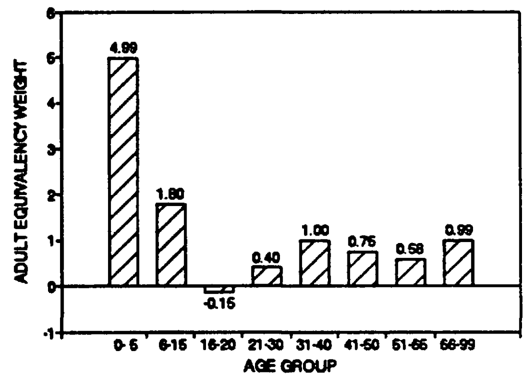

EQ 21. CHINA, GLASSWARE, AND TABLEWARE



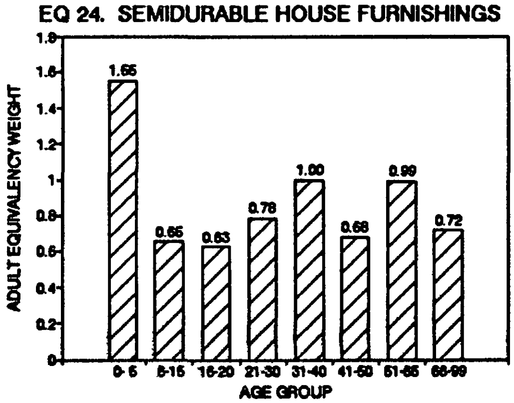

EQ 22. OTHER DURABLE HOUSE FURNISHINGS




EQ 23. FLOOR COVERINGS




EQ 24. SEMIDURABLE HOUSE FURNISHINGS




EQ 25. ELECTRICITY

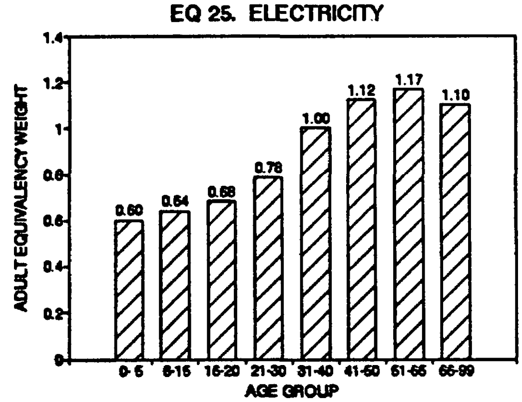
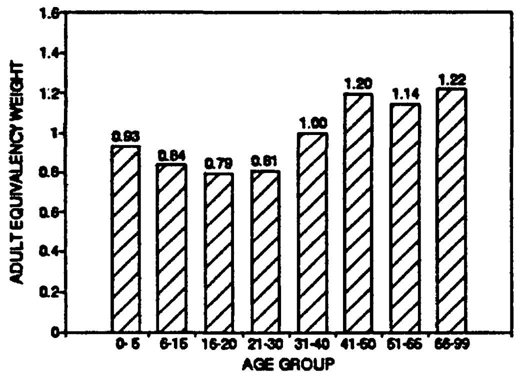


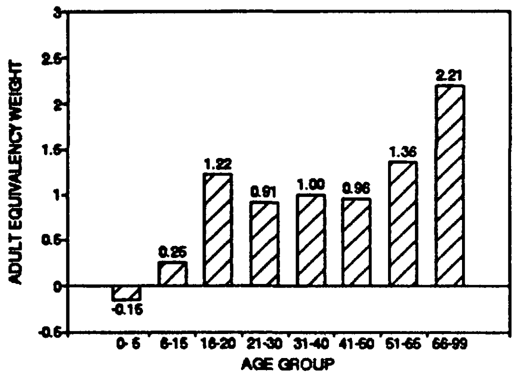
**FIGURE 2.3**

**Bar Chart of Adult Equivalency Weights (Continued)**

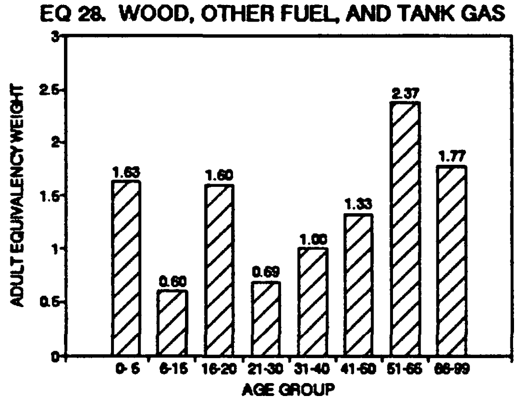
EQ 26. NATURAL GAS



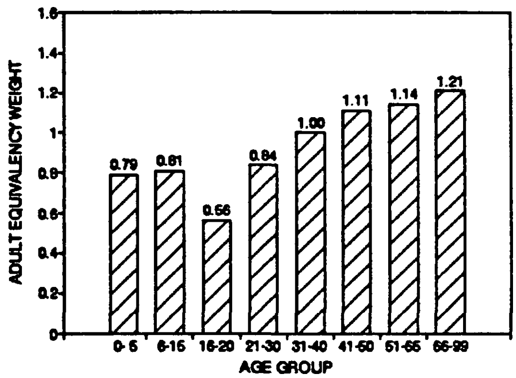

EQ 27. FUEL OIL AND COAL



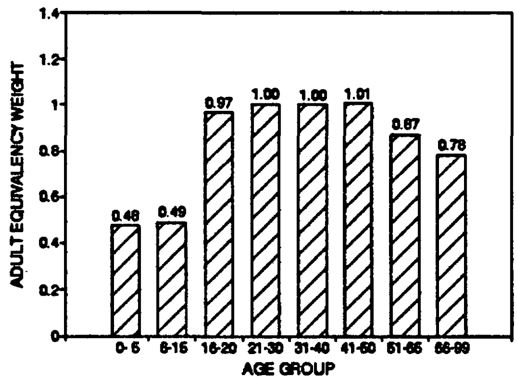

EQ 28. WOOD, OTHER FUEL, AND TANK GAS




EQ 29. WATER AND OTHER SANITARY




EQ 30. TELEPHONE AND TELEGRAPH




EQ 31. DOMESTIC SERVICE

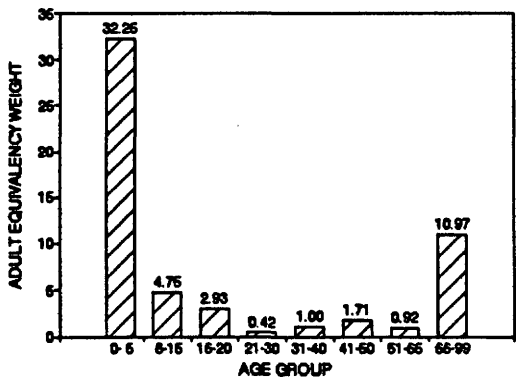
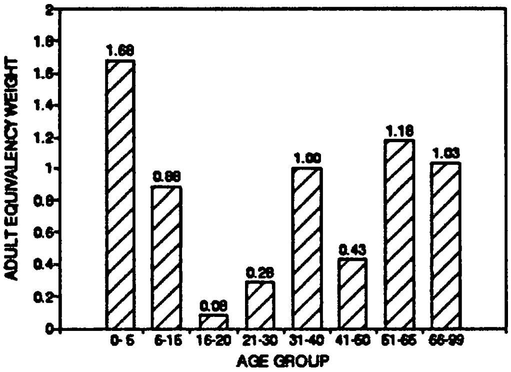


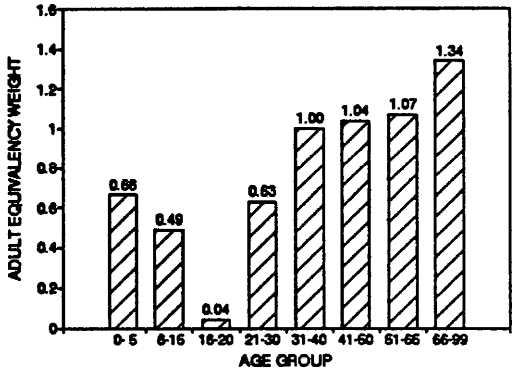
**FIGURE 2.3**

**Bar Chart of Adult Equivalency Weights (Continued)**

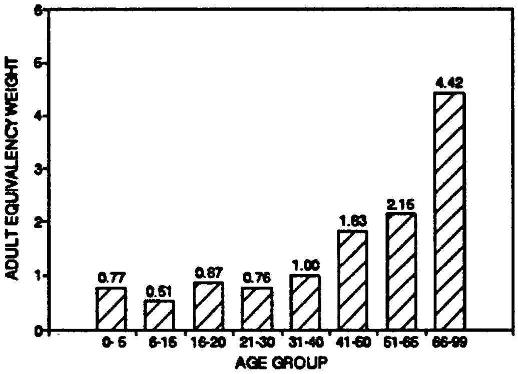
EQ 32. OTHER HOUSEHOLD OPERATIONS



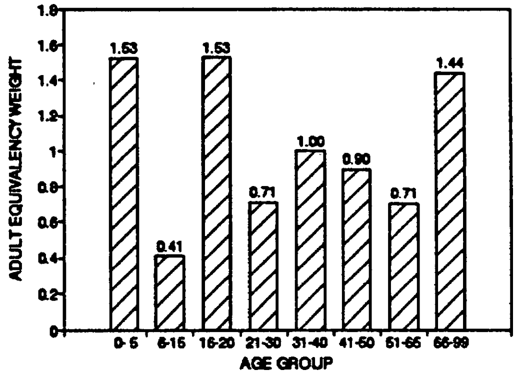

EQ 33. HOUSEHOLD INSURANCE



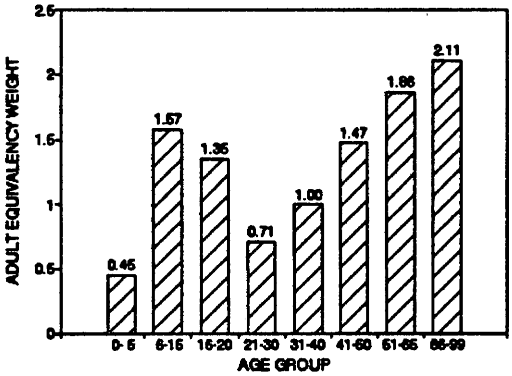

EQ 34. PRESCRIPTION DRUG AND SUNDRIES




EQ 35. PHYSICIANS




EQ 36. DENTAL AND EYES




EQ 37. OTHER MEDICAL SERVICES

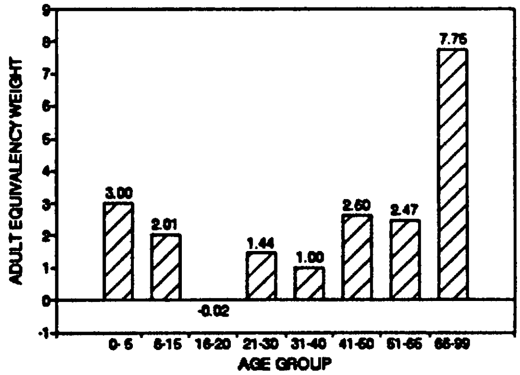


**FIGURE 2.3**

**Bar Chart of Adult Equivalency Weights (Continued)**

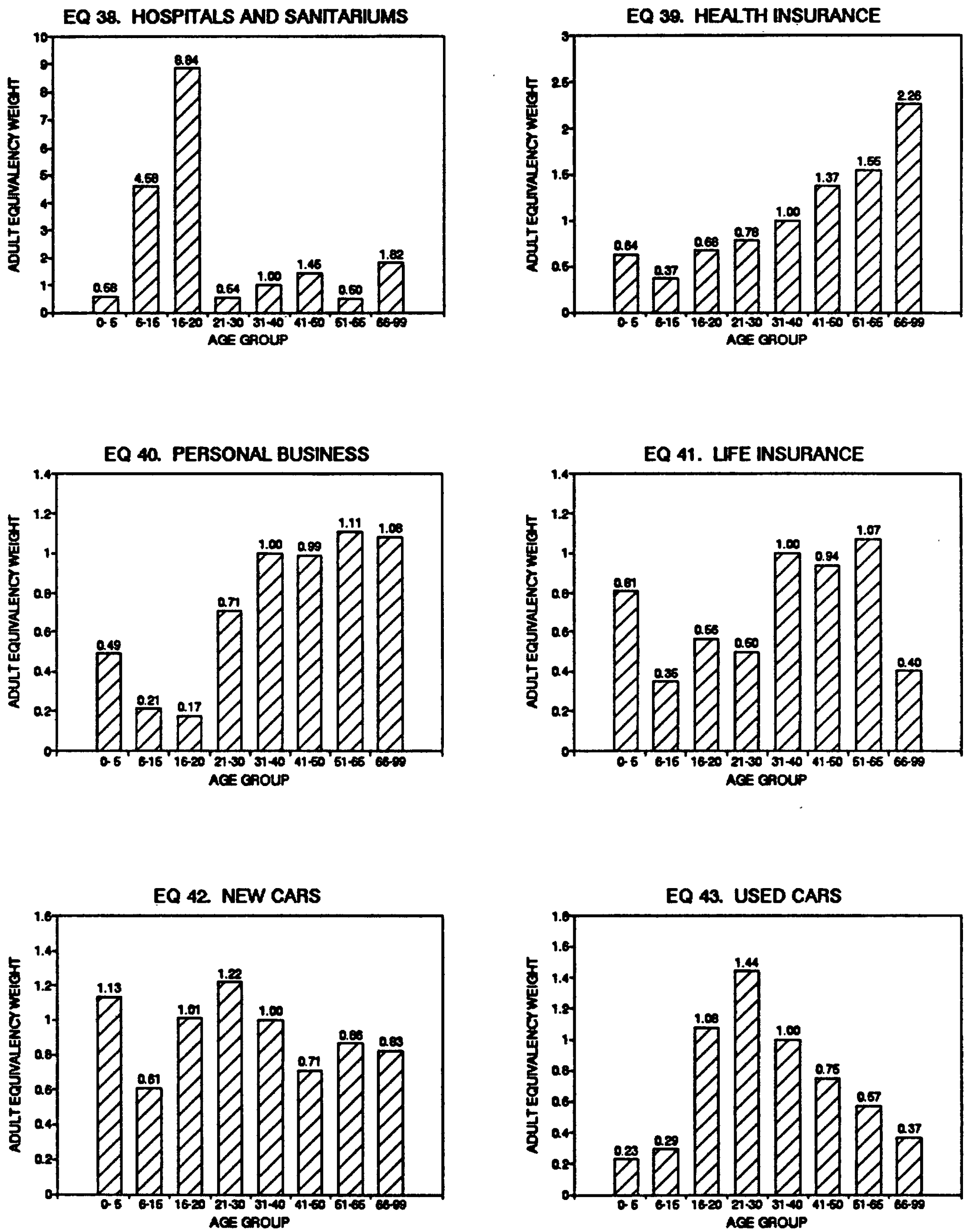
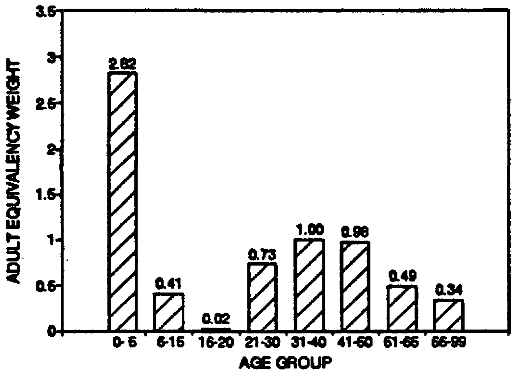


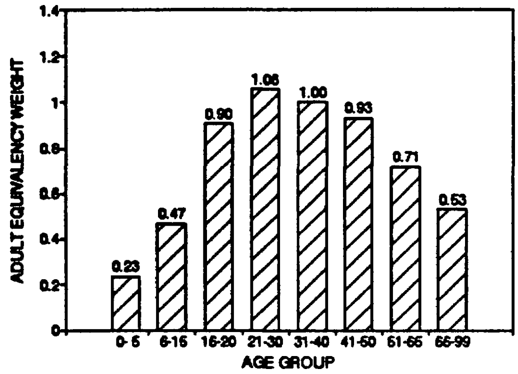
**FIGURE 2.3**

**Bar Chart of Adult Equivalency Weights (Continued)**

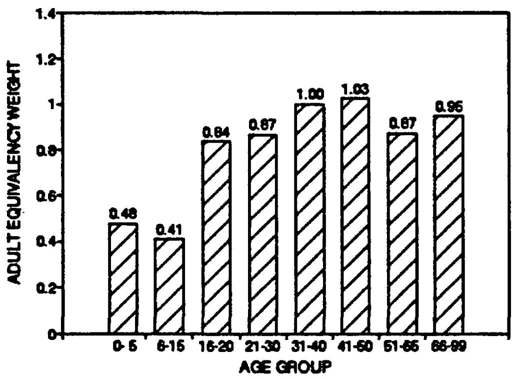
EQ 44. NEW AND USED TRUCKS OR VANS



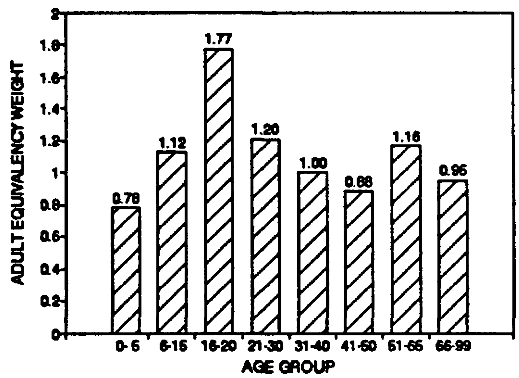

EQ 45. TIRES AND TUBES



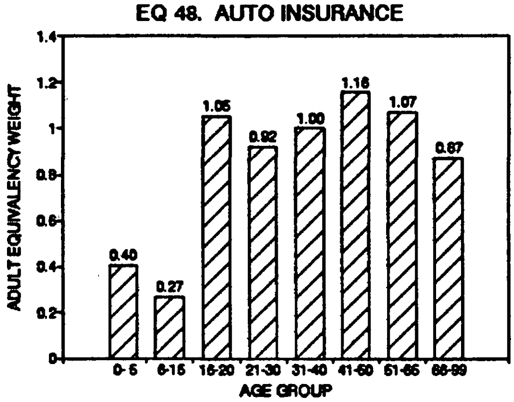

EQ 46. AUTO ACCESSORIES AND PARTS




EQ 47. AUTO REPAIRS




EQ 48. AUTO INSURANCE




EQ 49. GASOLINE AND OIL

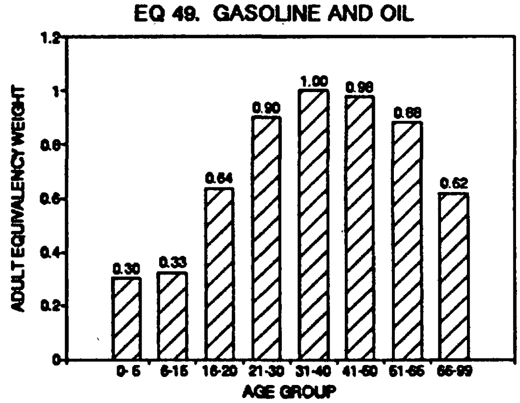
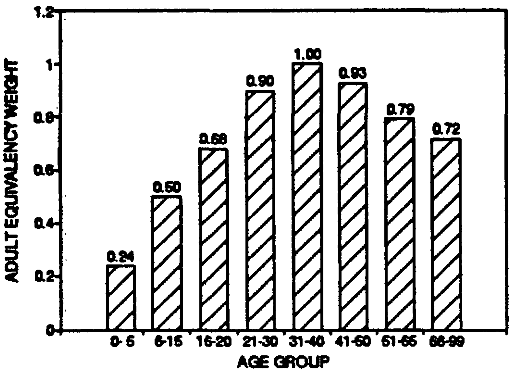


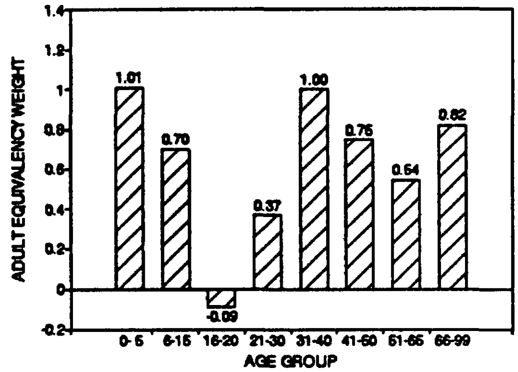
**FIGURE 2.3**

**Bar Chart of Adult Equivalency Weights (Continued)**

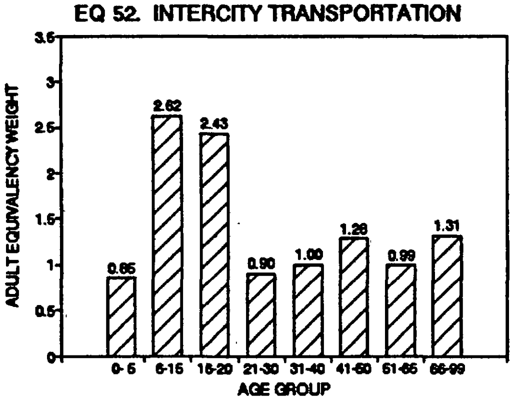
EQ 50. TOLLS, PARKING FEES, ETC



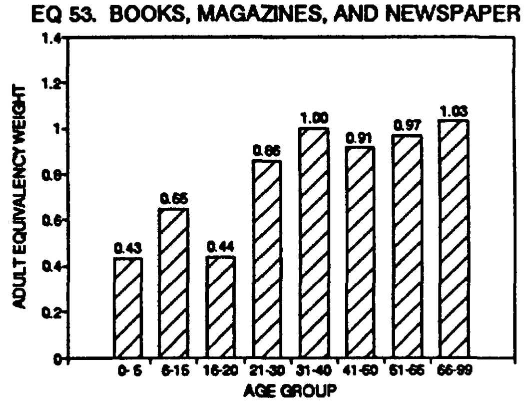

EQ 51. LOCAL TRANSPORTATION



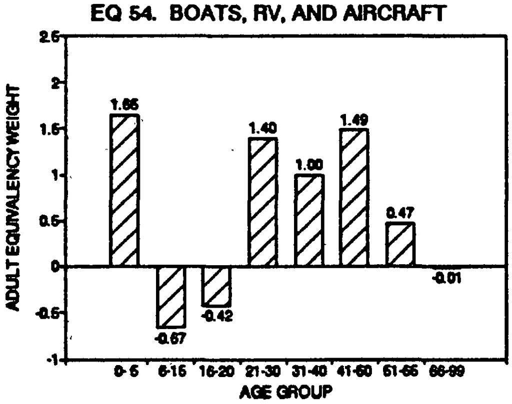

EQ 52. INTERCITY TRANSPORTATION




EQ 53. BOOKS, MAGAZINES, AND NEWSPAPER




EQ 54. BOATS, RV, AND AIRCRAFT




EQ 55. WHEEL GOODS, TOYS, AND SPORT

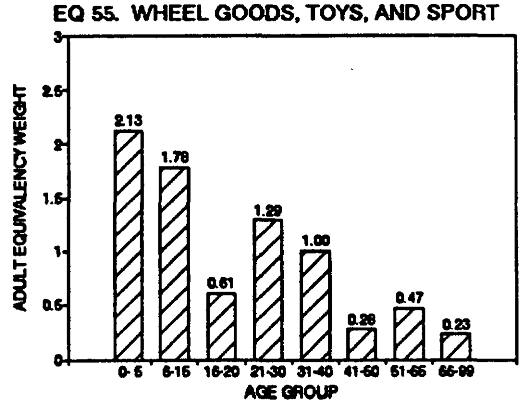
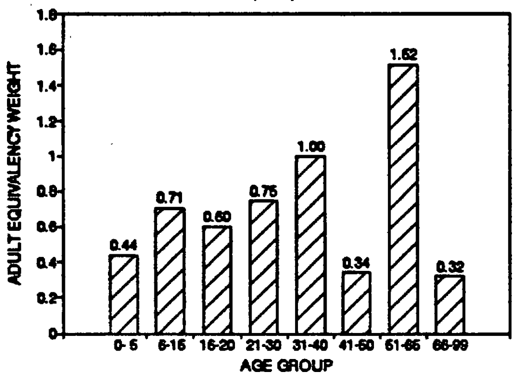


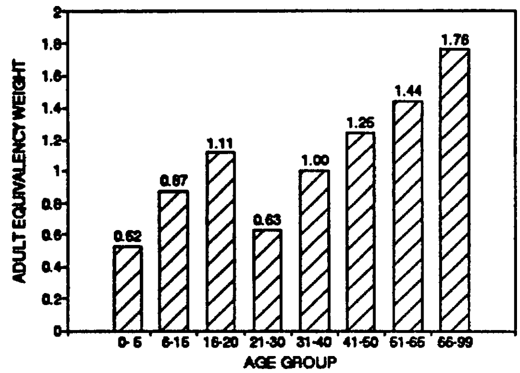
**FIGURE 2.3**

**Bar Chart of Adult Equivalency Weights (Continued)**

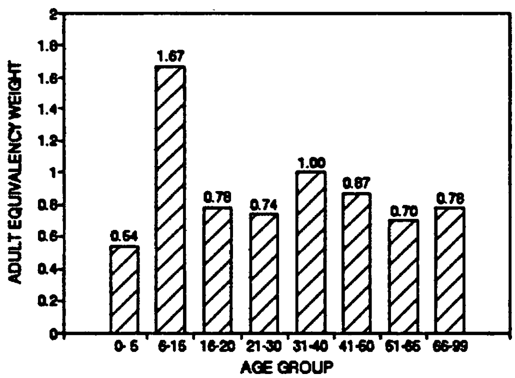
EQ 56. RADIO, TV, RECORDERS



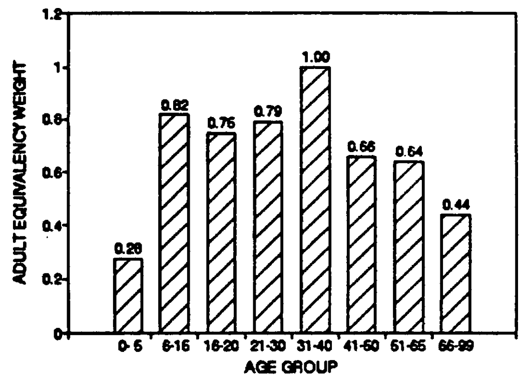

EQ 57. RADIO AND TV REPAIRS AND RENTAL



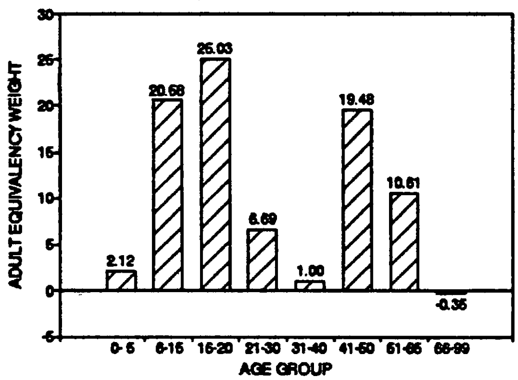

EQ 58. FEES AND ADMISSIONS



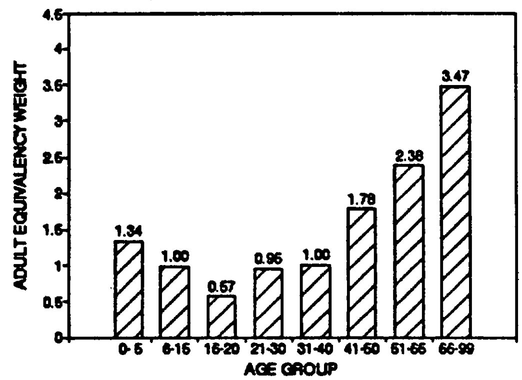

EQ 59. OTHER RECEATIONAL SUPPLIES




EQ 60. EDUCATION




EQ 61. CASH CONTRIBUTION



## TABLE 2.4

## Estimated Coefficients by the Big-Ticket-Item Analysis

| Equation | 1. Food, Off Premise | | | 2. Food, On Premise | | |
|---|---|---|---|---|---|---|
| Independent Variable | Probit | Least Squares1 | Least Squares2 | Probit | Least Squares1 | Least Squares2 |
| Intercept | 362.5991 | 363.2742 | 362.4836 | -39.0799 | -44.3994 | -22.2764 |
| Income ($): | | | | | | |
| 0-3310 | 0.2259 | 0.2259 | 0.2259 | 0.0598 | 0.0606 | 0.0567 |
| 3310-4639 | 0.0908 | 0.0912 | 0.0908 | 0.0638 | 0.0628 | 0.0620 |
| 4639-6277 | 0.0666 | 0.0665 | 0.0666 | 0.0912 | 0.0921 | 0.0889 |
| 6277-8848 | 0.0772 | 0.0774 | 0.0772 | 0.0464 | 0.0469 | 0.0444 |
| 8848-infinity | 0.0396 | 0.0396 | 0.0396 | 0.0936 | 0.0937 | 0.0935 |
| Region: | | | | | | |
| Northeast (=base) | | | | | | |
| North Central | -109.1070 | -109.3958 | -109.0695 | 5.9148 | 9.6683 | 3.0855 |
| South | -81.5175 | -81.6665 | -81.5128 | -21.9736 | -18.9367 | -23.0189 |
| West | -28.7697 | -28.9160 | -28.7467 | -2.6749 | -0.8121 | -3.7772 |
| Education: | | | | | | |
| College | -81.9003 | -81.8692 | -81.9057 | 48.0764 | 49.3303 | 45.6968 |
| Noncollege (=base) | | | | | | |
| Working Spouse: | | | | | | |
| Yes | -87.2695 | -87.4989 | -87.2742 | -15.1658 | -13.8078 | -16.6788 |
| No (=base) | | | | | | |
| Family Size: | | | | | | |
| 1 | 29.9174 | 25.3163 | 31.2745 | 6.5719 | 15.0854 | 49.4125 |
| 2 | -13.8265 | -13.9693 | -13.5620 | 12.9203 | 10.8783 | 21.7246 |
| 3-4 (=base) | | | | | | |
| 5+ | -16.6047 | -16.4186 | -16.7210 | 17.6617 | 16.9549 | 14.8597 |
| Age of Householder: | | | | | | |
| 35- | 51.7642 | 51.8488 | 51.8835 | 4.5470 | 2.9719 | 3.6579 |
| 35-55 (=base) | | | | | | |
| 55+ | 34.4531 | 34.4001 | 34.4919 | -2.9543 | -3.0520 | 3.1372 |
| Adult Equivalency Weights: | | | | | | |
| 0 - 5 | 0.7119 | 0.7110 | 0.7123 | 0.2674 | 0.2703 | 0.2830 |
| 6 - 15 | 0.9346 | 0.9337 | 0.9351 | 0.5772 | 0.5752 | 0.5898 |
| 16 - 20 | 0.9167 | 0.9156 | 0.9180 | 1.4274 | 1.4261 | 1.4413 |
| 21 - 30 | 0.8615 | 0.8615 | 0.8615 | 1.0143 | 1.0150 | 1.0078 |
| 31 - 40 | 1.0000 | 1.0000 | 1.0000 | 1.0000 | 1.0000 | 1.0000 |
| 41 - 50 | 1.5549 | 1.1554 | 1.1555 | 1.0036 | 1.0068 | 1.0137 |
| 51 - 65 | 1.0814 | 1.0813 | 1.0815 | 0.6796 | 0.6602 | 0.6844 |
| 66 - 99 | 0.9626 | 0.9613 | 0.9626 | 0.8048 | 0.8074 | 0.8235 |
| Nonzero Observations: | | | 4395 | | | 4090 |

1The least squares method using total observations
2The least squares method using nonzero observations

## TABLE 2.4

## Estimated Coefficients by the Big-Ticket-Item Analysis (Continued)

| Equation | 3. Alcohol, Off Premise | | | 4. Alcohol, On Premise | | |
|---|---|---|---|---|---|---|
| Independent Variable | Probit | Least Squares1 | Least Squares2 | Probit | Least Squares1 | Least Squares2 |
| Intercept | -4.7863 | -2.3801 | 17.0747 | -2.3225 | -3.8337 | 17.3705 |
| Income ($): | | | | | | |
| 0-3310 | 0.0240 | 0.0221 | 0.0220 | 0.0092 | 0.0111 | 0.0115 |
| 3310-4639 | 0.0107 | 0.0101 | 0.0059 | 0.0128 | 0.0129 | 0.0130 |
| 4639-6277 | 0.0134 | 0.0126 | 0.0092 | 0.0103 | 0.0100 | 0.0045 |
| 6277-8848 | 0.0129 | 0.0131 | 0.0138 | 0.0084 | 0.0070 | 0.0067 |
| 8848-infinity | 0.0117 | 0.0121 | 0.0090 | 0.0206 | 0.0227 | 0.0201 |
| Region: | | | | | | |
| Northeast (=base) | | | | | | |
| North Central | -10.0600 | -12.6207 | -4.5034 | -3.5143 | -5.0346 | -2.6904 |
| South | -4.4050 | -7.3813 | 12.2160 | -19.8066 | -20.0851 | -15.9300 |
| West | 4.8960 | 2.3476 | 8.1049 | 0.8449 | -0.2077 | 0.9029 |
| Education: | | | | | | |
| College | -11.2442 | -8.6180 | -18.2008 | -7.1709 | -7.9906 | -15.9953 |
| Noncollege (=base) | | | | | | |
| Working Spouse: | | | | | | |
| Yes | -10.7212 | -7.7667 | -9.4008 | -0.8412 | -2.1835 | -7.3083 |
| No (=base) | | | | | | |
| Family Size: | | | | | | |
| 1 | 35.2607 | 35.9874 | 91.4919 | 57.4962 | 117.5344 | 164.7671 |
| 2 | 25.4197 | 31.0009 | 42.3961 | 15.2210 | 16.8998 | 34.2201 |
| 3-4 (=base) | | | | | | |
| 5+ | 4.9193 | 2.6030 | -7.6783 | 5.9034 | 4.4623 | 1.2731 |
| Age of Householder: | | | | | | |
| 35- | 7.9808 | 7.8485 | -0.7010 | 1.6741 | 0.1884 | -7.3126 |
| 35-55 (=base) | | | | | | |
| 55+ | -17.5155 | -14.4800 | -14.3243 | -9.8245 | -4.2758 | 0.1233 |
| Adult Equivalency Weights: | | | | | | |
| 0 - 5 | -0.0309 | 0.0658 | 0.2336 | -0.0798 | -0.1888 | 0.0572 |
| 6 - 15 | 0.1252 | 0.2020 | 0.3728 | 0.4335 | 0.4636 | 0.5966 |
| 16 - 20 | 0.4361 | 0.4614 | 0.5853 | 0.7371 | 0.7846 | 0.8025 |
| 21 - 30 | 0.8276 | 0.7973 | 0.8667 | 1.1845 | 1.1362 | 1.1732 |
| 31 - 40 | 1.0000 | 1.0000 | 1.0000 | 1.0000 | 1.0000 | 1.0000 |
| 41 - 50 | 0.7978 | 0.8065 | 0.9509 | 0.6072 | 0.5657 | 0.6398 |
| 51 - 65 | 0.6986 | 0.6784 | 0.8619 | 0.4113 | 0.3182 | 0.4323 |
| 66 - 99 | 0.3835 | 0.4594 | 0.6807 | 0.4019 | 0.2443 | 0.4338 |
| Nonzero Observations: | | | 2796 | | | 2503 |

1The least squares method using total observations
2The least squares method using nonzero observations

## TABLE 2.4

## Estimated Coefficients by the Big-Ticket-Item Analysis (Continued)

| Equation | 5. Tobacco Products | | | 6. Shoes and Footwear | | |
|---|---|---|---|---|---|---|
| Independent Variable | Probit | Least Squares1 | Least Squares2 | Probit | Least Squares1 | Least Squares2 |
| Intercept | 35.2269 | 39.5203 | 51.9615 | 1.2499 | 1.2187 | 4.0922 |
| Income ($): | | | | | | |
| 0-3310 | 0.0203 | 0.0209 | 0.0253 | 0.0087 | 0.0086 | 0.0082 |
| 3310-4639 | 0.0083 | 0.0087 | 0.0143 | 0.0045 | 0.0044 | 0.0037 |
| 4639-6277 | -0.0049 | -0.0066 | -0.0066 | 0.0093 | 0.0092 | 0.0092 |
| 6277-8848 | 0.0025 | 0.0035 | 0.0063 | 0.0072 | 0.0070 | 0.0066 |
| 8848-infinity | 0.0016 | 0.0015 | 0.0023 | 0.0054 | 0.0053 | 0.0052 |
| Region: | | | | | | |
| Northeast (=base) | | | | | | |
| North Central | -5.5541 | -7.7051 | -0.9668 | -0.6822 | -0.9828 | -0.4242 |
| South | -12.1203 | -13.2765 | -10.4108 | -0.9440 | -0.9745 | -0.6399 |
| West | -16.6094 | -19.1425 | -13.6409 | -2.8516 | -3.0147 | -2.5716 |
| Education: | | | | | | |
| College | -35.9370 | -35.7711 | -24.2438 | 4.3785 | 4.5104 | 4.2231 |
| Noncollege (=base) | | | | | | |
| Working Spouse: | | | | | | |
| Yes | -2.2572 | -2.7407 | -6.8932 | -0.2042 | -0.0715 | -0.5573 |
| No (=base) | | | | | | |
| Family Size: | | | | | | |
| 1 | 51.3128 | 39.1829 | 124.9846 | 9.6762 | 13.1877 | 29.7563 |
| 2 | 24.7978 | 23.5595 | 48.2090 | 6.5389 | 6.6202 | 11.1622 |
| 3-4 (=base) | | | | | | |
| 5+ | -6.4220 | -6.7953 | -17.3167 | 1.1161 | 0.9471 | 0.4143 |
| Age of Householder: | | | | | | |
| 35- | -1.1366 | 2.0976 | -4.0523 | -1.8450 | -1.7144 | -2.0932 |
| 35-55 (=base) | | | | | | |
| 55+ | -4.3878 | -7.4386 | -14.9095 | -3.2199 | -3.1257 | -2.3384 |
| Adult Equivalency Weights: | | | | | | |
| 0 - 5 | 0.5000 | 0.4206 | 0.5358 | 0.6613 | 0.6699 | 0.6904 |
| 6 - 15 | 0.4635 | 0.3945 | 0.5805 | 1.4616 | 1.4956 | 1.4819 |
| 16 - 20 | 0.7453 | 0.6991 | 0.6487 | 0.9533 | 0.9481 | 0.9824 |
| 21 - 30 | 0.8512 | 0.7833 | 0.8920 | 0.8610 | 0.8607 | 0.8787 |
| 31 - 40 | 1.0000 | 1.0000 | 1.0000 | 1.0000 | 1.0000 | 1.0000 |
| 41 - 50 | 1.0525 | 1.0101 | 0.9600 | 0.8236 | 0.8402 | 0.8662 |
| 51 - 65 | 0.9151 | 0.9261 | 1.0176 | 0.7291 | 0.7288 | 0.7667 |
| 66 - 99 | 0.4434 | 0.4155 | 0.6891 | 0.4944 | 0.4955 | 0.5901 |
| Nonzero Observations: | | | 2440 | | | 3765 |

1The least squares method using total observations
2The least squares method using nonzero observations

# TABLE 2.4

## Estimated Coefficients by the Big-Ticket-Item Analysis (Continued)

| Equation | 7. Women's and Children's Cloth | | | 8. Men's and Boy's Clothing | | |
|---|---|---|---|---|---|---|
| Independent Variable | Probit | Least Squares1 | Least Squares2 | Probit | Least Squares1 | Least Squares2 |
| Intercept | -6.5127 | -9.5712 | -1.8939 | 2.0641 | 2.5255 | 11.2391 |
| Income($): | | | | | | |
| 0-3310 | 0.0246 | 0.0248 | 0.0257 | 0.0146 | 0.0152 | 0.0136 |
| 3310-4639 | 0.0288 | 0.0279 | 0.0290 | 0.0226 | 0.0223 | 0.0223 |
| 4639-6277 | 0.0217 | 0.0205 | 0.0231 | 0.0134 | 0.0138 | 0.0113 |
| 6277-8848 | 0.0263 | 0.0267 | 0.0255 | 0.0215 | 0.0223 | 0.0212 |
| 8848-infinity | 0.0388 | 0.0373 | 0.0433 | 0.0183 | 0.0188 | 0.0187 |
| Region: | | | | | | |
| Northeast (=base) | | | | | | |
| North Central | 3.4722 | 4.3793 | 2.0261 | -2.5917 | -2.6180 | -3.5682 |
| South | -4.1284 | -2.9340 | -5.4591 | -6.4073 | -6.2538 | -5.4168 |
| West | -11.9908 | -11.0850 | -12.8776 | -13.6115 | -13.6733 | -14.0331 |
| Education: | | | | | | |
| College | 11.2283 | 10.2960 | 11.6908 | 18.7304 | 18.7932 | 18.8058 |
| Noncollege (=base) | | | | | | |
| Working Spouse: | | | | | | |
| Yes | -7.0419 | -6.0390 | -8.9181 | -4.5509 | -5.3516 | -5.9611 |
| No (=base) | | | | | | |
| Family Size: | | | | | | |
| 1 | -25.6348 | -18.9917 | 62.6819 | -61.4425 | -43.6121 | 8.8629 |
| 2 | 3.3918 | 3.9155 | 12.2042 | -12.0399 | -11.5605 | -3.2979 |
| 3-4 (=base) | | | | | | |
| 5+ | 8.8476 | 9.0636 | 9.4989 | 6.7606 | 7.0227 | 3.7750 |
| Age of Householder: | | | | | | |
| 35- | 0.3715 | 0.6429 | -0.0546 | -2.2253 | -3.2493 | -4.8358 |
| 35-55 (=base) | | | | | | |
| 55+ | -14.6541 | -14.8786 | -15.0365 | -9.7995 | -6.9347 | -8.2388 |
| Adult Equivalency Weights: | | | | | | |
| 0 - 5 | 0.9808 | 1.0124 | 0.8896 | 0.4739 | 0.4318 | 0.4922 |
| 6 - 15 | 1.3362 | 1.3768 | 1.2201 | 1.3407 | 1.3087 | 1.3636 |
| 16 - 20 | 1.9988 | 2.0375 | 1.8540 | 1.0445 | 1.0428 | 1.0518 |
| 21 - 30 | 0.8471 | 0.8414 | 0.8411 | 0.9694 | 0.9588 | 0.9850 |
| 31 - 40 | 1.0000 | 1.0000 | 1.0000 | 1.0000 | 1.0000 | 1.0000 |
| 41 - 50 | 1.0120 | 1.0305 | 1.0190 | 1.0072 | 0.9648 | 1.0058 |
| 51 - 65 | 0.9709 | 1.0033 | 0.9265 | 0.8791 | 0.8178 | 0.8907 |
| 66 - 99 | 0.8032 | 0.8267 | 0.7641 | 0.6540 | 0.5510 | 0.7041 |
| Nonzero Observations: | | | 3886 | | | 3524 |

1The least squares method using total observations
2The least squares method using nonzero observations

## TABLE 2.4

## Estimated Coefficients by the Big-Ticket-Item Analysis (Continued)

| Equation | 9. Luggage | | | 10. Jewelry and Watches | | |
|---|---|---|---|---|---|---|
| Independent Variable | Probit | Least Squares1 | Least Squares2 | Probit | Least Squares1 | Least Squares2 |
| Intercept | -1.4690 | -0.9484 | -1.1458 | -8.9028 | -11.6686 | -3.7595 |
| Income($): | | | | | | |
| 0-3310 | 0.0004 | 0.0003 | 0.0017 | 0.0039 | 0.0059 | 0.0057 |
| 3310-4639 | 0.0006 | 0.0007 | 0.0049 | 0.0061 | 0.0088 | 0.0077 |
| 4639-6277 | 0.0000 | -0.0004 | -0.0017 | 0.0110 | 0.0135 | 0.0132 |
| 6277-8848 | 0.0024 | 0.0035 | 0.0061 | -0.0045 | -0.0042 | -0.0067 |
| 8848-infinity | 0.0005 | 0.0006 | 0.0008 | 0.0151 | 0.0160 | 0.0188 |
| Region: | | | | | | |
| Northeast (=base) | | | | | | |
| North Central | 0.2892 | 0.1123 | 2.6379 | -1.0761 | -2.9877 | -3.8683 |
| South | 0.2054 | 0.1511 | 1.3213 | 1.3179 | 2.3034 | 3.0488 |
| West | 0.6251 | 0.7549 | 5.2946 | 1.4457 | 2.8360 | 3.1278 |
| Education: | | | | | | |
| College | 0.5848 | 0.2485 | 1.3909 | 1.9059 | 2.7035 | 0.9350 |
| Noncollege (=base) | | | | | | |
| Working Spouse: | | | | | | |
| Yes | 0.3069 | 0.0818 | 0.3139 | 1.3469 | 2.2640 | -0.4220 |
| No (=base) | | | | | | |
| Family Size: | | | | | | |
| 1 | -1.8072 | -1.4355 | 15.0093 | -21.0843 | -21.7617 | 15.8247 |
| 2 | -0.7434 | -0.2468 | 1.5335 | 0.1694 | -0.2421 | 15.4862 |
| 3-4 (=base) | | | | | | |
| 5+ | 0.5688 | 0.5004 | -0.3778 | 2.4703 | 2.6285 | -1.8640 |
| Age of Householder: | | | | | | |
| 35- | 0.1905 | -0.2157 | 11.6148 | 6.9225 | 8.0217 | 9.2179 |
| 35-55 (=base) | | | | | | |
| 55+ | -0.4842 | -0.3614 | -2.4129 | -1.4731 | -4.3509 | 1.7070 |
| Adult Equivalency Weights: | | | | | | |
| 0 - 5 | -0.2020 | -0.9671 | -0.3881 | 0.7177 | 0.3571 | 0.5762 |
| 6 - 15 | 1.5922 | 1.8563 | 0.7950 | 1.3405 | 0.8469 | 1.1859 |
| 16 - 20 | 2.0163 | 1.7624 | 1.1891 | 3.1946 | 1.8276 | 2.7807 |
| 21 - 30 | 1.1436 | 0.6448 | 1.0279 | 1.0175 | 0.8122 | 0.9871 |
| 31 - 40 | 1.0000 | 1.0000 | 1.0000 | 1.0000 | 1.0000 | 1.0000 |
| 41 - 50 | 1.3532 | 1.0230 | 1.3927 | 0.4772 | 0.3217 | 0.4796 |
| 51 - 65 | 0.8705 | 0.6005 | 1.1404 | 1.3164 | 1.1972 | 1.3154 |
| 66 - 99 | 0.6115 | 0.2192 | 1.1236 | 0.5411 | 0.4328 | 0.5599 |
| Nonzero Observations: | | | 476 | | | 2169 |

1The least squares method using total observations
2The least squares method using nonzero observations

# TABLE 2.4

## Estimated Coefficients by the Big-Ticket-Item Analysis (Continued)

| Equation | 11. Laundries, Storage, and Repa | | | 12. Other Jewelry and Clothing | | |
|---|---|---|---|---|---|---|
| Independent Variable | Probit | Least Squares1 | Least Squares2 | Probit | Least Squares1 | Least Squares2 |
| Intercept | 20.1363 | 20.6590 | 27.3380 | -0.3807 | -0.2949 | 2.0142 |
| Income($): | | | | | | |
| 0-3310 | -0.0013 | -0.0014 | -0.0020 | 0.0003 | 0.0004 | 0.0018 |
| 3310-4639 | 0.0053 | 0.0054 | 0.0045 | 0.0007 | 0.0008 | 0.0013 |
| 4639-6277 | 0.0008 | 0.0008 | 0.0003 | 0.0002 | 0.0001 | -0.0003 |
| 6277-8848 | 0.0076 | 0.0074 | 0.0071 | 0.0009 | 0.0008 | 0.0008 |
| 8848-infinity | 0.0077 | 0.0076 | 0.0073 | 0.0003 | 0.0004 | 0.0006 |
| Region: | | | | | | |
| Northeast (=base) | | | | | | |
| North Central | -4.9288 | -5.3587 | -4.6625 | -0.1615 | -0.1083 | -1.6970 |
| South | -3.0671 | -3.3846 | -1.0850 | -0.0271 | 0.1635 | -0.7598 |
| West | -5.2584 | -5.7043 | -4.2483 | 0.1720 | 0.0886 | -0.3288 |
| Education: | | | | | | |
| College | 5.8277 | 6.1224 | 4.1736 | 0.1384 | 0.0898 | -0.4668 |
| Noncollege (=base) | | | | | | |
| Working Spouse: | | | | | | |
| Yes | -1.5100 | -1.0459 | -2.8024 | 1.0616 | 0.8204 | 2.8584 |
| No (=base) | | | | | | |
| Family Size: | | | | | | |
| 1 | 36.6345 | 38.4424 | 53.5882 | -1.5479 | -1.1366 | 10.3557 |
| 2 | 10.5579 | 10.9107 | 15.1791 | -0.3620 | -0.2916 | 3.4900 |
| 3-4 (=base) | | | | | | |
| 5+ | -3.8786 | -4.0713 | -5.9887 | -0.6607 | -0.7355 | -3.1958 |
| Age of Householder: | | | | | | |
| 35- | 4.9027 | 4.8659 | 5.2349 | -0.0269 | 0.3317 | 1.1681 |
| 35-55 (=base) | | | | | | |
| 55+ | -0.4349 | -0.8229 | -0.0505 | -0.7144 | -0.4218 | -4.6862 |
| Adult Equivalency Weights: | | | | | | |
| 0 - 5 | 0.3427 | 0.3330 | 0.4096 | 0.0276 | -0.0895 | -0.0237 |
| 6 - 15 | 0.8291 | 0.8179 | 0.8745 | 0.6946 | 0.3959 | 0.4879 |
| 16 - 20 | 1.1650 | 1.1197 | 1.1776 | 1.2989 | 1.8820 | 0.8968 |
| 21 - 30 | 0.8626 | 0.8466 | 0.8918 | 1.3108 | 1.1780 | 1.3821 |
| 31 - 40 | 1.0000 | 1.0000 | 1.0000 | 1.0000 | 1.0000 | 1.0000 |
| 41 - 50 | 0.7142 | 0.7162 | 0.7566 | 1.4916 | 1.5646 | 1.6682 |
| 51 - 65 | 0.6990 | 0.7048 | 0.7290 | 1.9188 | 1.5473 | 2.2339 |
| 66 - 99 | 0.5402 | 0.5545 | 0.5958 | 0.9056 | 1.1394 | 1.2589 |
| Nonzero Observations: | | | 3462 | | | 847 |

1The least squares method using total observations
2The least squares method using nonzero observations

## TABLE 2.4

### Estimated Coefficients by the Big-Ticket-Item Analysis (Continued)

| Equation | 13. Personal Care | | | 14. Owner-Occupied Housing | | |
|---|---|---|---|---|---|---|
| Independent Variable | Probit | Least Squares1 | Least Squares2 | Probit | Least Squares1 | Least Squares2 |
| Intercept | -7.0681 | -6.3498 | -1.2813 | 12.2911 | 14.1327 | 70.9860 |
| Income($): | | | | | | |
| 0-3310 | 0.0109 | 0.0107 | 0.0099 | 0.0100 | 0.0096 | 0.0081 |
| 3310-4639 | 0.0107 | 0.0105 | 0.0108 | 0.0229 | 0.0240 | 0.0313 |
| 4639-6277 | 0.0101 | 0.0100 | 0.0098 | 0.0235 | 0.0258 | 0.0266 |
| 6277-8848 | 0.0064 | 0.0064 | 0.0060 | 0.0109 | 0.0142 | 0.0139 |
| 8848-infinity | 0.0059 | 0.0058 | 0.0059 | 0.0282 | 0.0275 | 0.0362 |
| Region: | | | | | | |
| Northeast (=base) | | | | | | |
| North Central | 1.4562 | 1.1669 | 2.2401 | -11.8008 | -13.7685 | -33.9420 |
| South | 0.7191 | 0.6970 | 0.9502 | -16.9299 | -15.7441 | -25.7732 |
| West | 1.3141 | 1.1412 | 1.5790 | -36.4985 | -37.5787 | -53.1998 |
| Education: | | | | | | |
| College | 2.7555 | 2.8249 | 2.2944 | 24.9111 | 21.4617 | 27.1387 |
| Noncollege (=base) | | | | | | |
| Working Spouse: | | | | | | |
| Yes | 2.3917 | 2.4504 | 1.9221 | -7.9398 | -8.3445 | -13.8397 |
| No (=base) | | | | | | |
| Family Size: | | | | | | |
| 1 | -4.0686 | -3.4009 | 6.9544 | -57.8726 | -22.5900 | 80.9420 |
| 2 | -2.4952 | -2.7231 | -0.5478 | -6.1083 | 2.8707 | 22.5134 |
| 3-4 (=base) | | | | | | |
| 5+ | 0.6400 | 0.5114 | -0.6560 | 1.3932 | 2.3609 | -11.9991 |
| Age of Householder: | | | | | | |
| 35- | -2.0389 | -2.3295 | -1.4317 | -10.9395 | -4.2319 | -4.6674 |
| 35-55 (=base) | | | | | | |
| 55+ | 3.3410 | 3.0781 | 3.5751 | 8.3996 | 2.6605 | -13.8919 |
| Adult Equivalency Weights: | | | | | | |
| 0 - 5 | 0.5335 | 0.5245 | 0.5602 | 1.8067 | 1.9393 | 1.5226 |
| 6 - 15 | 1.0232 | 1.0214 | 1.0243 | 0.9438 | 0.9643 | 0.7173 |
| 16 - 20 | 0.9910 | 0.9664 | 1.0139 | 0.5557 | 0.4868 | 0.3831 |
| 21 - 30 | 0.9100 | 0.9044 | 0.9025 | 0.7192 | 0.3919 | 0.7009 |
| 31 - 40 | 1.0000 | 1.0000 | 1.0000 | 1.0000 | 1.0000 | 1.0000 |
| 41 - 50 | 1.3068 | 1.3177 | 1.2820 | 0.9510 | 0.8980 | 0.8648 |
| 51 - 65 | 1.5377 | 1.5542 | 1.5046 | 1.6906 | 1.6402 | 1.5772 |
| 66 - 99 | 1.6805 | 1.7087 | 1.6257 | 2.0340 | 2.2026 | 1.9409 |
| Nonzero Observations: | | | 3991 | | | 2406 |

1The least squares method using total observations
2The least squares method using nonzero observations

## TABLE 2.4

## Estimated Coefficients by the Big-Ticket-Item Analysis (Continued)

| Equation | 15. Tenant-Occupied Housing | | | 16. Other Housing | | |
|---|---|---|---|---|---|---|
| Independent Variable | Probit | Least Squares1 | Least Squares2 | Probit | Least Squares1 | Least Squares2 |
| Intercept | 276.4075 | 174.4567 | 293.1152 | 0.7857 | 1.1046 | 71.1690 |
| Income ($): | | | | | | |
| 0-3310 | -0.0190 | -0.0091 | 0.1174 | 0.0001 | 0.0002 | 0.0064 |
| 3310-4639 | 0.0299 | 0.0187 | 0.1550 | 0.0004 | 0.0006 | -0.0026 |
| 4639-6277 | -0.0101 | -0.0032 | 0.0465 | 0.0006 | 0.0012 | 0.0125 |
| 6277-8848 | 0.0024 | 0.0003 | 0.1567 | 0.0013 | 0.0024 | 0.0114 |
| 8848-infinity | 0.0131 | 0.0054 | 0.0455 | 0.0004 | 0.0001 | 0.0016 |
| Region: | | | | | | |
| Northeast (=base) | | | | | | |
| North Central | -101.0710 | -52.2923 | -66.1449 | 0.1358 | 0.7412 | -8.9763 |
| South | 6.7446 | -6.6385 | -36.5126 | -0.9852 | -0.5853 | -28.8634 |
| West | 32.0441 | 40.2035 | 106.8989 | -1.1538 | -0.7947 | -23.6418 |
| Education: | | | | | | |
| College | -36.0882 | -27.9485 | 50.7649 | 0.8397 | 2.2316 | -14.0158 |
| Noncollege (=base) | | | | | | |
| Working Spouse: | | | | | | |
| Yes | -64.4085 | -42.0352 | -124.9333 | -0.9755 | -2.0445 | -31.7021 |
| No (=base) | | | | | | |
| Family Size: | | | | | | |
| 1 | 1274.7476 | 1059.9768 | 908.1262 | -3.0872 | -7.1662 | -18.1381 |
| 2 | 267.7925 | 224.2568 | 371.2786 | -2.2027 | -3.2928 | -28.4077 |
| 3-4 (=base) | | | | | | |
| 5+ | -79.3262 | -55.5528 | -122.8616 | 0.2635 | 0.1618 | -7.7101 |
| Age of Householder: | | | | | | |
| 35- | 177.5639 | 77.5205 | 95.3447 | 2.9202 | -0.6754 | 305.4976 |
| 35-55 (=base) | | | | | | |
| 55+ | -103.8625 | -37.8332 | -129.5441 | 0.2344 | 0.2646 | -0.9825 |
| Adult Equivalency Weights: | | | | | | |
| 0 - 5 | 0.9005 | 1.2431 | 0.9646 | -0.8455 | -0.6042 | -0.6861 |
| 6 - 15 | 0.7870 | 1.5239 | 0.8657 | -0.3702 | -0.8913 | -0.5512 |
| 16 - 20 | 0.4725 | 1.7283 | 0.6514 | 19.5960 | 9.4901 | 2.3586 |
| 21 - 30 | 0.8719 | 1.4293 | 0.8819 | 0.2968 | -0.6587 | 0.2270 |
| 31 - 40 | 1.0000 | 1.0000 | 1.0000 | 1.0000 | 1.0000 | 1.0000 |
| 41 - 50 | 0.8987 | 1.0627 | 1.0142 | 14.9653 | 12.6793 | 4.7497 |
| 51 - 65 | 0.7192 | 0.6685 | 0.8910 | 7.2682 | 5.2374 | 3.1280 |
| 66 - 99 | 0.8083 | 0.7038 | 1.0684 | 2.3205 | 0.0730 | 1.5033 |
| Nonzero Observations: | | | 1401 | | | 200 |

1The least squares method using total observations
2The least squares method using nonzero observations

## TABLE 2.4

## Estimated Coefficients by the Big-Ticket-Item Analysis (Continued)

| Equation | 18. Hotels and Motels | | | 19. Furniture | | |
|---|---|---|---|---|---|---|
| Independent Variable | Probit | Least Squares1 | Least Squares2 | Probit | Least Squares1 | Least Squares2 |
| Intercept | -2.6478 | -0.6383 | 26.7040 | -10.0210 | -5.6153 | 49.4820 |
| Income ($): | | | | | | |
| 0-3310 | 0.0023 | 0.0027 | 0.0001 | 0.0174 | 0.0178 | 0.0245 |
| 3310-4639 | 0.0126 | 0.0112 | 0.0181 | 0.0360 | 0.0351 | 0.0517 |
| 4639-6277 | 0.0109 | 0.0112 | 0.0089 | 0.0340 | 0.0340 | 0.0339 |
| 6277-8848 | 0.0171 | 0.0190 | 0.0184 | 0.0298 | 0.0282 | 0.0303 |
| 8848-infinity | 0.0123 | 0.0128 | 0.0137 | 0.0617 | 0.0650 | 0.0828 |
| Region: | | | | | | |
| Northeast (=base) | | | | | | |
| North Central | -4.8549 | -4.7170 | -15.7632 | 14.9674 | 16.1396 | 23.3364 |
| South | -8.6684 | -8.4027 | -13.2580 | -7.9572 | -4.9037 | -11.0148 |
| West | -5.9446 | -6.7303 | -12.6903 | 17.1042 | 11.5383 | 23.0485 |
| Education: | | | | | | |
| College | 16.7510 | 15.3932 | 19.7096 | -10.3250 | -15.8670 | -27.1481 |
| Noncollege (=base) | | | | | | |
| Working Spouse: | | | | | | |
| Yes | 5.0128 | 4.6098 | 2.6972 | -0.5219 | -1.4350 | -1.9910 |
| No (=base) | | | | | | |
| Family Size: | | | | | | |
| 1 | -33.0544 | -24.6710 | 34.9920 | -182.6130 | -136.0452 | 72.9265 |
| 2 | 3.1191 | 6.8288 | 31.8290 | -29.9492 | -7.2574 | 14.5667 |
| 3-4 (=base) | | | | | | |
| 5+ | 3.9351 | 2.0087 | -3.1748 | -8.0279 | -7.5156 | -35.3654 |
| Age of Householder: | | | | | | |
| 35- | -3.7134 | -3.5078 | -5.0089 | 8.3219 | -4.7267 | -15.7373 |
| 35-55 (=base) | | | | | | |
| 55+ | 0.3280 | 0.2767 | 4.0308 | 0.1339 | 1.1021 | 55.2370 |
| Adult Equivalency Weights: | | | | | | |
| 0 - 5 | 0.4665 | 0.3721 | 0.4870 | 0.9767 | 1.3926 | 1.0017 |
| 6 - 15 | 1.5135 | 1.5218 | 1.3890 | 0.8149 | 0.8830 | 0.7793 |
| 16 - 20 | 0.5853 | 0.5893 | 0.5007 | 0.0832 | 0.0984 | 0.0577 |
| 21 - 30 | 0.6845 | 0.6533 | 0.6745 | 0.7606 | 0.7211 | 0.7381 |
| 31 - 40 | 1.0000 | 1.0000 | 1.0000 | 1.0000 | 1.0000 | 1.0000 |
| 41 - 50 | 1.1837 | 1.1153 | 1.0373 | 0.1797 | 0.1374 | 0.1744 |
| 51 - 65 | 1.1297 | 0.9978 | 1.0121 | 0.3732 | 0.3308 | 0.3508 |
| 66 - 99 | 1.5432 | 1.3084 | 1.4496 | 0.3690 | 0.2648 | 0.3873 |
| Nonzero Observations: | | | 2101 | | | 1876 |

1The least squares method using total observations
2The least squares method using nonzero observations

## TABLE 2.4

## Estimated Coefficients by the Big-Ticket-Item Analysis (Continued)

| Equation | 20. Kitchen and Household Applia | | | 21. China, Glassware, and Tab | | |
|---|---|---|---|---|---|---|
| Independent Variable | Probit | Least Squares1 | Least Squares2 | Probit | Least Squares1 | Least Squares2 |
| Intercept | -22.6592 | -17.9660 | 2.9993 | -15.2742 | -10.0589 | -5.9379 |
| Income ($): | | | | | | |
| 0-3310 | 0.0132 | 0.0123 | 0.0121 | 0.0048 | 0.0035 | 0.0043 |
| 3310-4639 | 0.0104 | 0.0112 | 0.0087 | 0.0065 | 0.0066 | 0.0102 |
| 4639-6277 | 0.0091 | 0.0065 | 0.0082 | 0.0077 | 0.0066 | 0.0098 |
| 6277-8848 | 0.0128 | 0.0127 | 0.0131 | 0.0143 | 0.0125 | 0.0184 |
| 8848-infinity | 0.0045 | 0.0043 | 0.0055 | 0.0024 | 0.0023 | 0.0035 |
| Region: | | | | | | |
| Northeast (=base) | | | | | | |
| North Central | 9.6081 | 10.1322 | 9.0779 | 7.3085 | 7.2466 | 9.0723 |
| South | 16.2805 | 17.1424 | 21.7212 | 2.2494 | 3.8402 | 4.8501 |
| West | 9.5158 | 8.6291 | 7.5148 | 32.0259 | 28.3270 | 46.4714 |
| Education: | | | | | | |
| College | -4.3473 | -3.9850 | -6.4093 | 5.8803 | 6.4763 | 1.5068 |
| Noncollege (=base) | | | | | | |
| Working Spouse: | | | | | | |
| Yes | 2.0205 | 2.5889 | 1.5183 | -6.2891 | -5.5401 | -12.2335 |
| No (=base) | | | | | | |
| Family Size: | | | | | | |
| 1 | -19.3439 | -10.3024 | 59.4118 | -50.6923 | -40.7854 | -55.1680 |
| 2 | -5.3950 | -1.7752 | 13.8428 | -25.4203 | -20.8801 | -32.7071 |
| 3-4 (=base) | | | | | | |
| 5+ | 0.2651 | -1.4111 | -12.6468 | 7.9195 | 2.9921 | 8.3550 |
| Age of Householder: | | | | | | |
| 35- | 10.6675 | 9.9430 | 13.9710 | 9.6106 | 5.6967 | 20.0923 |
| 35-55 (=base) | | | | | | |
| 55+ | -2.1304 | -3.5072 | 1.1840 | 9.0169 | 7.3107 | 18.5798 |
| Adult Equivalency Weights: | | | | | | |
| 0 - 5 | 0.8393 | 0.7799 | 0.8919 | -0.4925 | -0.4322 | -0.5342 |
| 6 - 15 | 0.8563 | 0.8617 | 1.0915 | -0.2592 | -0.2490 | -0.2438 |
| 16 - 20 | 0.7005 | 0.6780 | 0.8219 | -0.0759 | -0.0873 | -0.0951 |
| 21 - 30 | 1.1158 | 1.0836 | 1.1251 | 0.9879 | 1.0685 | 0.9993 |
| 31 - 40 | 1.0000 | 1.0000 | 1.0000 | 1.0000 | 1.0000 | 1.0000 |
| 41 - 50 | 1.0704 | 1.0010 | 1.1214 | 0.7185 | 0.7219 | 0.7334 |
| 51 - 65 | 1.2154 | 1.2040 | 1.1617 | 0.4837 | 0.5073 | 0.4862 |
| 66 - 99 | 1.1106 | 1.0270 | 1.1179 | 0.3673 | 0.2902 | 0.4067 |
| Nonzero Observations: | | | 2410 | | | 1994 |

1The least squares method using total observations
2The least squares method using nonzero observations

## TABLE 2.4

## Estimated Coefficients by the Big-Ticket-Item Analysis (Continued)

| Equation | 22. Other Durable House Furnishi | | | 23. Floor Coverings | | |
|---|---|---|---|---|---|---|
| Independent Variable | Probit | Least Squares1 | Least Squares2 | Probit | Least Squares1 | Least Squares2 |
| Intercept | -26.0964 | -22.4421 | -5.9744 | -1.5529 | -2.0018 | 3.0736 |
| Income ($): | | | | | | |
| 0-3310 | 0.0093 | 0.0103 | 0.0086 | 0.0005 | 0.0014 | 0.0016 |
| 3310-4639 | 0.0137 | 0.0138 | 0.0136 | 0.0014 | 0.0021 | 0.0061 |
| 4639-6277 | 0.0241 | 0.0248 | 0.0242 | 0.0011 | 0.0019 | 0.0024 |
| 6277-8848 | -0.0012 | -0.0011 | -0.0034 | 0.0019 | 0.0035 | 0.0062 |
| 8848-infinity | 0.0270 | 0.0297 | 0.0312 | 0.0049 | 0.0058 | 0.0200 |
| Region: | | | | | | |
| Northeast (=base) | | | | | | |
| North Central | 16.8464 | 16.6858 | 14.8656 | 0.7017 | 0.9132 | -0.1994 |
| South | 8.7446 | 9.7691 | 9.2399 | 0.5603 | 0.1727 | 6.1776 |
| West | 13.5255 | 11.4073 | 9.2397 | -0.3569 | -2.2466 | -1.1777 |
| Education: | | | | | | |
| College | 2.6602 | 1.4635 | 0.2544 | 0.2913 | 0.5186 | 4.6001 |
| Noncollege (=base) | | | | | | |
| Working Spouse: | | | | | | |
| Yes | 9.6103 | 9.9264 | 14.2075 | 1.0187 | 1.3789 | 7.9211 |
| No (=base) | | | | | | |
| Family Size: | | | | | | |
| 1 | -30.9621 | -15.3287 | 59.6582 | 0.0270 | 1.9402 | 83.3115 |
| 2 | 0.4612 | 1.6889 | 17.1852 | -0.3449 | -0.9284 | 1.2213 |
| 3-4 (=base) | | | | | | |
| 5+ | 2.5954 | -0.2716 | -4.6911 | -0.2273 | -0.2384 | -10.0799 |
| Age of Householder: | | | | | | |
| 35- | -1.4288 | -6.9369 | -9.0525 | 0.5282 | -1.2668 | 2.3943 |
| 35-55 (=base) | | | | | | |
| 55+ | 0.0007 | 2.0234 | 13.4386 | 2.8997 | 3.4094 | 18.5359 |
| Adult Equivalency Weights: | | | | | | |
| 0 - 5 | 1.3650 | 1.4216 | 1.4026 | 4.8670 | 4.9868 | 2.8555 |
| 6 - 15 | 0.3587 | 0.3754 | 0.3871 | 5.8279 | 1.7968 | 3.3055 |
| 16 - 20 | 0.2433 | -0.0222 | 0.2383 | 1.2210 | -0.1496 | 0.4081 |
| 21 - 30 | 0.7239 | 0.6623 | 0.7066 | 0.4662 | 0.4042 | 0.3973 |
| 31 - 40 | 1.0000 | 1.0000 | 1.0000 | 1.0000 | 1.0000 | 1.0000 |
| 41 - 50 | 0.9863 | 0.8644 | 0.9464 | 1.8070 | 0.7523 | 1.4237 |
| 51 - 65 | 0.6304 | 0.5796 | 0.6056 | 0.6499 | 0.5770 | 0.4900 |
| 66 - 99 | 0.4604 | 0.3281 | 0.4456 | 1.9422 | 0.9859 | 1.6969 |
| Nonzero Observations: | | | 2626 | | | 739 |

1The least squares method using total observations
2The least squares method using nonzero observations

# TABLE 2.4

## Estimated Coefficients by the Big-Ticket-Item Analysis (Continued)

| Equation | 24. Semidurable House Furnishing | | | 25. Electricity | | |
|---|---|---|---|---|---|---|
| Independent Variable | Probit | Least Squares1 | Least Squares2 | Probit | Least Squares1 | Least Squares2 |
| Intercept | 0.3073 | 1.4805 | 8.1596 | 13.9975 | 13.3658 | 33.3306 |
| Income ($): | | | | | | |
| 0-3310 | 0.0045 | 0.0047 | 0.0050 | 0.0437 | 0.0435 | 0.0400 |
| 3310-4639 | 0.0144 | 0.0127 | 0.0147 | 0.0185 | 0.0188 | 0.0190 |
| 4639-6277 | 0.0047 | 0.0050 | 0.0031 | 0.0060 | 0.0061 | 0.0041 |
| 6277-8848 | 0.0119 | 0.0117 | 0.0125 | 0.0151 | 0.0150 | 0.0147 |
| 8848-infinity | 0.0068 | 0.0067 | 0.0069 | 0.0116 | 0.0114 | 0.0116 |
| Region: | | | | | | |
| Northeast (=base) | | | | | | |
| North Central | 2.0561 | 1.7195 | 1.2266 | -1.5491 | -1.2345 | -3.8389 |
| South | -3.3922 | -3.6342 | -4.0014 | 58.6112 | 57.6522 | 59.0916 |
| West | 12.3905 | 11.3364 | 11.9219 | -31.0597 | -30.5997 | -32.9774 |
| Education: | | | | | | |
| College | 8.3061 | 7.8473 | 7.9827 | 3.5484 | 2.5419 | 4.2731 |
| Noncollege (=base) | | | | | | |
| Working Spouse: | | | | | | |
| Yes | -3.7197 | -3.8662 | -4.8805 | -5.0374 | -4.4756 | -5.3931 |
| No (=base) | | | | | | |
| Family Size: | | | | | | |
| 1 | -22.0815 | -16.2153 | 11.1654 | 6.1794 | 7.8696 | 43.2380 |
| 2 | -3.8790 | -2.8103 | 4.3171 | 4.0107 | 3.9871 | 13.3289 |
| 3-4 (=base) | | | | | | |
| 5+ | 0.2348 | -1.1915 | -3.3173 | -18.2000 | -17.4599 | -22.7974 |
| Age of Householder: | | | | | | |
| 35- | -1.6722 | -2.5110 | -3.0141 | 18.9444 | 17.4950 | 18.3581 |
| 35-55 (=base) | | | | | | |
| 55+ | -1.0009 | -0.5163 | -1.1809 | -16.0403 | -15.9383 | -17.9069 |
| Adult Equivalency Weights: | | | | | | |
| 0 - 5 | 1.4411 | 1.5537 | 1.4045 | 0.5861 | 0.6017 | 0.5766 |
| 6 - 15 | 0.6205 | 0.6536 | 0.5663 | 0.6210 | 0.6377 | 0.6254 |
| 16 - 20 | 0.5881 | 0.6262 | 0.6101 | 0.6964 | 0.6805 | 0.7238 |
| 21 - 30 | 0.7802 | 0.7846 | 0.7827 | 0.7827 | 0.7836 | 0.7721 |
| 31 - 40 | 1.0000 | 1.0000 | 1.0000 | 1.0000 | 1.0000 | 1.0000 |
| 41 - 50 | 0.7188 | 0.6764 | 0.7377 | 1.1220 | 1.1204 | 1.1147 |
| 51 - 65 | 0.9924 | 0.9905 | 0.9973 | 1.1571 | 1.1660 | 1.1234 |
| 66 - 99 | 0.7436 | 0.7171 | 0.7636 | 1.0954 | 1.0977 | 1.0754 |
| Nonzero Observations: | | | 3098 | | | 4129 |

1The least squares method using total observations
2The least squares method using nonzero observations

## TABLE 2.4

## Estimated Coefficients by the Big-Ticket-Item Analysis (Continued)

| Equation | 26. Natural Gas | | | 27. Fuel Oil and Coal | | |
|---|---|---|---|---|---|---|
| Independent Variable | Probit | Least Squares1 | Least Squares2 | Probit | Least Squares1 | Least Squares2 |
| Intercept | 74.2966 | 61.6927 | 124.1793 | 73.6107 | 66.2490 | 72.5403 |
| Income ($): | | | | | | |
| 0-3310 | 0.0091 | 0.0096 | 0.0123 | 0.0082 | 0.0127 | 0.0366 |
| 3310-4639 | 0.0030 | 0.0005 | 0.0020 | 0.0030 | -0.0009 | -0.0028 |
| 4639-6277 | 0.0156 | 0.0149 | 0.0149 | 0.0056 | 0.0060 | 0.0347 |
| 6277-8848 | 0.0013 | 0.0015 | 0.0023 | 0.0086 | 0.0098 | 0.0205 |
| 8848-infinity | 0.0052 | 0.0042 | 0.0070 | 0.0002 | -0.0004 | 0.0071 |
| Region: | | | | | | |
| Northeast (=base) | | | | | | |
| North Central | 35.4080 | 31.9321 | -2.4791 | -100.6176 | -103.8725 | -85.0086 |
| South | -45.1680 | -38.0092 | -65.8306 | -100.0115 | -101.5392 | -79.1026 |
| West | -40.1874 | -34.6178 | -84.0829 | -114.4671 | -119.0088 | -145.7288 |
| Education: | | | | | | |
| College | 7.5575 | 6.8368 | 7.1863 | 5.8307 | 7.0866 | 22.5920 |
| Noncollege (=base) | | | | | | |
| Working Spouse: | | | | | | |
| Yes | -7.5434 | -4.1223 | -6.0815 | 3.7783 | 4.9138 | 11.1641 |
| No (=base) | | | | | | |
| Family Size: | | | | | | |
| 1 | 8.2370 | 16.5401 | 89.9709 | 15.0575 | 10.1523 | 283.9551 |
| 2 | 3.0862 | 7.1765 | 30.8664 | 2.6056 | -0.9117 | 74.3778 |
| 3-4 (=base) | | | | | | |
| 5+ | -14.4886 | -16.4711 | -23.3869 | 7.7368 | 9.8045 | -18.6947 |
| Age of Householder: | | | | | | |
| 35- | -0.7380 | -1.1108 | -4.4729 | -1.3046 | -2.0324 | -2.6719 |
| 35-55 (=base) | | | | | | |
| 55+ | 3.6063 | 3.0300 | -0.4809 | 16.6624 | 7.0618 | 33.7085 |
| Adult Equivalency Weights: | | | | | | |
| 0 - 5 | 0.7133 | 0.9304 | 0.8308 | 0.3793 | -0.1465 | 0.8702 |
| 6 - 15 | 0.6605 | 0.8350 | 0.7122 | 0.9068 | 0.2516 | 1.0774 |
| 16 - 20 | 0.6689 | 0.7939 | 0.7285 | 1.2420 | 1.2221 | 1.1557 |
| 21 - 30 | 0.7793 | 0.8070 | 0.8459 | 0.7199 | 0.9135 | 0.8888 |
| 31 - 40 | 1.0000 | 1.0000 | 1.0000 | 1.0000 | 1.0000 | 1.0000 |
| 41 - 50 | 1.1287 | 1.1974 | 1.1201 | 1.1891 | 0.9617 | 1.1568 |
| 51 - 65 | 1.0455 | 1.1442 | 1.0546 | 1.3727 | 1.3634 | 1.2179 |
| 66 - 99 | 1.1421 | 1.2182 | 1.1074 | 1.5834 | 2.2069 | 1.6474 |
| Nonzero Observations: | | | 2894 | | | 658 |

1The least squares method using total observations
2The least squares method using nonzero observations

## TABLE 2.4

## Estimated Coefficients by the Big-Ticket-Item Analysis (Continued)

| Equation | 28. Wood, Other Fuel, and Bottle | | | 29. Water and Other Sanitary | | |
|---|---|---|---|---|---|---|
| Independent Variable | Probit | Least Squares1 | Least Squares2 | Probit | Least Squares1 | Least Squares2 |
| Intercept | 4.8007 | 7.6201 | 35.7122 | 2.3966 | 1.5648 | 25.7446 |
| Income ($): | | | | | | |
| 0-3310 | -0.0004 | -0.0011 | 0.0014 | 0.0086 | 0.0088 | 0.0059 |
| 3310-4639 | 0.0000 | 0.0002 | -0.0149 | 0.0022 | 0.0024 | 0.0015 |
| 4639-6277 | 0.0007 | 0.0004 | 0.0090 | 0.0027 | 0.0025 | 0.0009 |
| 6277-8848 | -0.0004 | -0.0002 | -0.0074 | 0.0043 | 0.0040 | 0.0056 |
| 8848-infinity | 0.0007 | 0.0009 | 0.0029 | 0.0013 | 0.0013 | 0.0007 |
| Region: | | | | | | |
| Northeast (=base) | | | | | | |
| North Central | 0.3103 | 0.6254 | 9.3016 | 8.0682 | 7.7889 | 3.0226 |
| South | 0.6490 | 1.1067 | 8.7361 | 19.9011 | 19.3945 | 17.9207 |
| West | -2.1024 | -2.5432 | -7.5845 | 14.7122 | 13.8261 | 12.8666 |
| Education: | | | | | | |
| College | -0.1371 | -0.7268 | -0.2119 | 2.4328 | 2.6449 | 0.9399 |
| Noncollege (=base) | | | | | | |
| Working Spouse: | | | | | | |
| Yes | 1.4426 | 1.4039 | 7.2172 | 2.8378 | 3.0609 | 1.4001 |
| No (=base) | | | | | | |
| Family Size: | | | | | | |
| 1 | 10.6899 | 8.6932 | 151.1930 | 2.3649 | 0.9826 | 53.6141 |
| 2 | 3.8835 | 2.4363 | 37.6814 | 0.9410 | -0.2133 | 13.5063 |
| 3-4 (=base) | | | | | | |
| 5+ | -1.2226 | -1.6648 | -10.5342 | -3.5110 | -3.7282 | -9.7834 |
| Age of Householder: | | | | | | |
| 35- | -0.6280 | -1.1510 | -5.4960 | -2.7138 | -1.5359 | -0.7883 |
| 35-55 (=base) | | | | | | |
| 55+ | -0.3694 | -0.7734 | -3.3870 | 1.5088 | 0.2175 | -4.1739 |
| Adult Equivalency Weights: | | | | | | |
| 0 - 5 | 2.3627 | 1.6259 | 2.2065 | 0.8116 | 0.7883 | 0.7176 |
| 6 - 15 | 0.6417 | 0.6022 | 0.7608 | 0.8043 | 0.8098 | 0.8158 |
| 16 - 20 | 1.7439 | 1.5951 | 1.7420 | 0.5718 | 0.5633 | 0.6797 |
| 21 - 30 | 0.7777 | 0.6885 | 1.1196 | 0.8936 | 0.8360 | 0.9911 |
| 31 - 40 | 1.0000 | 1.0000 | 1.0000 | 1.0000 | 1.0000 | 1.0000 |
| 41 - 50 | 1.6601 | 1.3320 | 1.1628 | 1.1038 | 1.1099 | 1.0671 |
| 51 - 65 | 2.3184 | 2.3707 | 1.8179 | 1.0985 | 1.1431 | 1.0449 |
| 66 - 99 | 1.9911 | 1.7737 | 1.7892 | 1.0817 | 1.2082 | 1.0560 |
| Nonzero Observations: | | | 482 | | | 3160 |

1The least squares method using total observations
2The least squares method using nonzero observations

## TABLE 2.4

## Estimated Coefficients by the Big-Ticket-Item Analysis (Continued)

| Equation | 30. Telephone and Telegraph | | | 31. Domestic Services | | |
|---|---|---|---|---|---|---|
| Independent Variable | Probit | Least Squares1 | Least Squares2 | Probit | Least Squares1 | Least Squares2 |
| Intercept | 64.2882 | 63.2736 | 68.6554 | -4.2661 | -2.5894 | 4.7036 |
| Income ($): | | | | | | |
| 0-3310 | 0.0182 | 0.0187 | 0.0170 | 0.0062 | 0.0016 | 0.0122 |
| 3310-4639 | 0.0073 | 0.0071 | 0.0075 | 0.0124 | 0.0050 | 0.0267 |
| 4639-6277 | 0.0104 | 0.0104 | 0.0100 | 0.0105 | 0.0057 | 0.0176 |
| 6277-8848 | 0.0120 | 0.0121 | 0.0117 | 0.0021 | 0.0002 | 0.0068 |
| 8848-infinity | 0.0134 | 0.0134 | 0.0133 | 0.0125 | 0.0127 | 0.0219 |
| Region: | | | | | | |
| Northeast (=base) | | | | | | |
| North Central | -7.0740 | -7.1488 | -6.9932 | -2.6229 | -0.7100 | -6.8073 |
| South | 0.8520 | 0.5878 | 1.5684 | 13.7668 | 2.9881 | 33.0125 |
| West | -11.5950 | -11.5833 | -11.6633 | -3.9796 | -1.1604 | -6.9848 |
| Education: | | | | | | |
| College | 11.9851 | 11.9764 | 11.7507 | -2.0913 | 1.4072 | -12.8705 |
| Noncollege (=base) | | | | | | |
| Working Spouse: | | | | | | |
| Yes | -13.0329 | -12.6913 | -13.5090 | 8.9548 | 4.6538 | 13.0614 |
| No (=base) | | | | | | |
| Family Size: | | | | | | |
| 1 | 88.1180 | 88.6047 | 96.8380 | -56.3157 | -17.0447 | -136.9320 |
| 2 | 25.0518 | 25.0468 | 26.1204 | -45.4922 | -9.3035 | -116.0437 |
| 3-4 (=base) | | | | | | |
| 5+ | -18.1001 | -17.9047 | -19.1021 | -11.4533 | -3.3074 | -27.1541 |
| Age of Householder: | | | | | | |
| 35- | 5.4000 | 5.1961 | 5.4273 | 4.2870 | 1.5032 | 7.0101 |
| 35-55 (=base) | | | | | | |
| 55+ | -14.5906 | -14.7254 | -14.5303 | 5.6877 | 0.4905 | 25.1970 |
| Adult Equivalency Weights: | | | | | | |
| 0 - 5 | 0.4742 | 0.4752 | 0.4829 | 9.2928 | 32.2522 | 5.1700 |
| 6 - 15 | 0.4912 | 0.4883 | 0.4980 | 2.1176 | 4.7494 | 1.5948 |
| 16 - 20 | 0.9757 | 0.9684 | 0.9939 | 1.3481 | 2.9292 | 1.7234 |
| 21 - 30 | 1.0052 | 1.0035 | 1.0013 | 0.8750 | 0.4177 | 1.1766 |
| 31 - 40 | 1.0000 | 1.0000 | 1.0000 | 1.0000 | 1.0000 | 1.0000 |
| 41 - 50 | 1.0077 | 1.0053 | 1.0055 | 1.1641 | 1.7057 | 1.5121 |
| 51 - 65 | 0.8736 | 0.8710 | 0.8804 | 1.1921 | 0.9217 | 0.9819 |
| 66 - 99 | 0.7868 | 0.7809 | 0.7910 | 8.0074 | 10.9734 | 8.1948 |
| Nonzero Observations: | | | 4321 | | | 1155 |

1The least squares method using total observations
2The least squares method using nonzero observations

# TABLE 2.4

## Estimated Coefficients by the Big-Ticket-Item Analysis (Continued)

| Equation | 32. Other Household Operations | | | 33. Household Insurance | | |
|---|---|---|---|---|---|---|
| Independent Variable | Probit | Least Squares1 | Least Squares2 | Probit | Least Squares1 | Least Squares2 |
| Intercept | -10.9262 | -8.1720 | 2.5948 | -9.5196 | -8.7656 | 43.1899 |
| Income ($): | | | | | | |
| 0-3310 | 0.0039 | 0.0039 | 0.0038 | 0.0092 | 0.0102 | 0.0042 |
| 3310-4639 | 0.0223 | 0.0194 | 0.0278 | 0.0055 | 0.0062 | 0.0085 |
| 4639-6277 | 0.0064 | 0.0068 | 0.0049 | 0.0053 | 0.0062 | 0.0038 |
| 6277-8848 | 0.0157 | 0.0162 | 0.0210 | 0.0079 | 0.0085 | 0.0070 |
| 8848-infinity | 0.0458 | 0.0479 | 0.0502 | 0.0034 | 0.0034 | 0.0049 |
| Region: | | | | | | |
| Northeast (=base) | | | | | | |
| North Central | 18.6342 | 16.0784 | 21.9643 | 5.5789 | 5.8808 | -1.8143 |
| South | 11.0996 | 9.1127 | 14.4186 | 1.4301 | 0.6795 | 3.1311 |
| West | 23.4372 | 19.3384 | 26.8982 | -3.8053 | -4.4358 | -3.6901 |
| Education: | | | | | | |
| College | 20.4822 | 18.7007 | 20.6319 | 9.6734 | 9.1542 | 5.4105 |
| Noncollege (=base) | | | | | | |
| Working Spouse: | | | | | | |
| Yes | -11.7038 | -9.7580 | -18.3059 | 1.0449 | 3.2737 | -2.4367 |
| No (=base) | | | | | | |
| Family Size: | | | | | | |
| 1 | -7.0719 | 8.4321 | 37.1383 | -7.7026 | -0.7850 | 55.4654 |
| 2 | -18.0173 | -14.0679 | -13.1813 | -1.5206 | -0.2895 | 9.2655 |
| 3-4 (=base) | | | | | | |
| 5+ | 4.5858 | 3.4005 | 1.5579 | -0.2436 | -0.2462 | -12.8922 |
| Age of Householder: | | | | | | |
| 35- | -2.4957 | -4.0268 | -3.1722 | 0.4188 | 3.9988 | 2.9519 |
| 35-55 (=base) | | | | | | |
| 55+ | -0.9494 | -0.8333 | -9.5195 | 9.7095 | 5.7489 | 3.6737 |
| Adult Equivalency Weights: | | | | | | |
| 0 - 5 | 1.4714 | 1.6804 | 1.4280 | 0.6967 | 0.6645 | 0.6857 |
| 6 - 15 | 0.8541 | 0.8795 | 0.7130 | 0.6816 | 0.4889 | 0.6880 |
| 16 - 20 | 0.0757 | 0.0787 | 0.0796 | 0.3116 | 0.0416 | 0.3142 |
| 21 - 30 | 0.3985 | 0.2835 | 0.4293 | 0.9450 | 0.6290 | 0.8782 |
| 31 - 40 | 1.0000 | 1.0000 | 1.0000 | 1.0000 | 1.0000 | 1.0000 |
| 41 - 50 | 0.4662 | 0.4272 | 0.4433 | 1.1564 | 1.0406 | 1.0988 |
| 51 - 65 | 1.1921 | 1.1776 | 1.1241 | 1.1579 | 1.0730 | 1.1069 |
| 66 - 99 | 1.1256 | 1.0311 | 1.0230 | 1.2982 | 1.3387 | 1.2143 |
| Nonzero Observations: | | | 2973 | | | 2224 |

1The least squares method using total observations
2The least squares method using nonzero observations

## TABLE 2.4

## Estimated Coefficients by the Big-Ticket-Item Analysis (Continued)

| Equation | 34. Prescription Drug and Sundri | | | 35. Physicians | | |
|---|---|---|---|---|---|---|
| Independent Variable | Probit | Least Squares1 | Least Squares2 | Probit | Least Squares1 | Least Squares2 |
| Intercept | -6.0803 | -5.6302 | 2.7040 | -3.7454 | -4.3192 | 12.7249 |
| Income($): | | | | | | |
| 0-3310 | 0.0055 | 0.0056 | 0.0042 | 0.0135 | 0.0133 | 0.0123 |
| 3310-4639 | 0.0055 | 0.0055 | 0.0068 | 0.0151 | 0.0144 | 0.0139 |
| 4639-6277 | 0.0024 | 0.0022 | 0.0019 | 0.0099 | 0.0084 | 0.0093 |
| 6277-8848 | 0.0016 | 0.0023 | 0.0020 | 0.0010 | 0.0019 | 0.0012 |
| 8848-infinity | 0.0016 | 0.0013 | 0.0019 | 0.0142 | 0.0143 | 0.0155 |
| Region: | | | | | | |
| Northeast (=base) | | | | | | |
| North Central | 5.3047 | 6.0196 | 5.2319 | -3.6021 | -3.6659 | -3.6355 |
| South | 9.5362 | 10.1365 | 10.2420 | 4.2528 | 2.0242 | 7.2128 |
| West | -0.4192 | -0.4873 | 0.9009 | -3.7223 | -3.7344 | 4.2633 |
| Education: | | | | | | |
| College | -2.9772 | -3.4141 | -3.9953 | 6.2254 | 3.1648 | 9.7638 |
| Noncollege (=base) | | | | | | |
| Working Spouse: | | | | | | |
| Yes | -0.9820 | -0.9361 | -2.3060 | -12.5763 | -10.3375 | -18.7181 |
| No (=base) | | | | | | |
| Family Size: | | | | | | |
| 1 | -6.8292 | -5.8689 | 2.8809 | -31.3460 | -23.5264 | 9.6922 |
| 2 | -1.7150 | -1.5823 | 1.2625 | 7.9643 | 9.0244 | 23.5113 |
| 3-4 (=base) | | | | | | |
| 5+ | -0.4743 | -0.2713 | -2.4711 | 1.4393 | -1.0076 | -2.0636 |
| Age of Householder: | | | | | | |
| 35- | -0.6844 | 0.0667 | -0.4796 | -0.7152 | 1.2349 | -2.7533 |
| 35-55 (=base) | | | | | | |
| 55+ | 4.6330 | 3.7498 | 3.8022 | 9.9095 | 9.8597 | 6.9458 |
| Adult Equivalency Weights: | | | | | | |
| 0 - 5 | 0.8537 | 0.7687 | 0.6638 | 1.0885 | 1.5257 | 1.2420 |
| 6 - 15 | 0.5941 | 0.5099 | 0.6127 | 0.4066 | 0.4081 | 0.4111 |
| 16 - 20 | 1.0100 | 0.8687 | 1.0571 | 1.3015 | 1.5280 | 1.3401 |
| 21 - 30 | 0.8396 | 0.7592 | 0.8535 | 0.7674 | 0.7124 | 0.8285 |
| 31 - 40 | 1.0000 | 1.0000 | 1.0000 | 1.0000 | 1.0000 | 1.0000 |
| 41 - 50 | 1.8186 | 1.8278 | 1.7573 | 0.9261 | 0.8960 | 0.9284 |
| 51 - 65 | 2.2630 | 2.1533 | 2.2210 | 0.7172 | 0.7060 | 0.7475 |
| 66 - 99 | 4.3908 | 4.4220 | 3.6583 | 1.4214 | 1.4414 | 1.2826 |
| Nonzero Observations: | | | 3384 | | | 3252 |

1The least squares method using total observations
2The least squares method using nonzero observations

## TABLE 2.4

## Estimated Coefficients by the Big-Ticket-Item Analysis (Continued)

| Equation | 36. Dental and Eyes | | | 37. Other Medical Services | | |
|---|---|---|---|---|---|---|
| Independent Variable | Probit | Least Squares1 | Least Squares2 | Probit | Least Squares1 | Least Squares2 |
| Intercept | -15.1272 | -10.6795 | -2.2001 | 6.0034 | 4.0706 | 23.2295 |
| Income($): | | | | | | |
| 0-3310 | 0.0134 | 0.0121 | 0.0150 | 0.0010 | 0.0006 | 0.0000 |
| 3310-4639 | 0.0114 | 0.0108 | 0.0095 | 0.0045 | 0.0023 | 0.0086 |
| 4639-6277 | 0.0077 | 0.0076 | 0.0055 | 0.0036 | 0.0023 | 0.0046 |
| 6277-8848 | 0.0082 | 0.0078 | 0.0081 | 0.0014 | 0.0006 | 0.0030 |
| 8848-infinity | 0.0074 | 0.0075 | 0.0073 | 0.0028 | 0.0019 | 0.0042 |
| Region: | | | | | | |
| Northeast (=base) | | | | | | |
| North Central | -2.5555 | -2.6702 | -4.8977 | -3.5994 | -2.1400 | -7.1589 |
| South | -0.0574 | 0.5108 | 1.9997 | -0.3973 | -0.4206 | 0.4289 |
| West | -1.7007 | -1.3419 | 2.0474 | -0.9532 | -0.5665 | -1.8402 |
| Education: | | | | | | |
| College | 18.8224 | 18.0592 | 18.1980 | 1.8600 | 0.2595 | 2.8875 |
| Noncollege (=base) | | | | | | |
| Working Spouse: | | | | | | |
| Yes | -2.9859 | -3.1345 | -7.1686 | -3.0683 | -1.1283 | -6.2078 |
| No (=base) | | | | | | |
| Family Size: | | | | | | |
| 1 | -13.7479 | -11.3700 | 18.0577 | -5.1713 | -2.8497 | 8.5916 |
| 2 | 0.9616 | 1.0033 | 16.1597 | -2.4749 | -0.5882 | -1.4032 |
| 3-4 (=base) | | | | | | |
| 5+ | 4.9418 | 3.4396 | 1.1778 | -1.3136 | -1.6118 | -5.7747 |
| Age of Householder: | | | | | | |
| 35- | -3.5657 | -4.7188 | -1.6875 | -0.0348 | -0.7564 | -1.1518 |
| 35-55 (=base) | | | | | | |
| 55+ | -6.4794 | -6.6439 | -9.4230 | -1.2233 | -2.0716 | -8.1614 |
| Adult Equivalency Weights: | | | | | | |
| 0 - 5 | 0.4137 | 0.4503 | 0.4114 | 1.4777 | 3.0029 | 1.2896 |
| 6 - 15 | 1.5026 | 1.5748 | 1.3474 | 0.8537 | 2.0089 | 0.7735 |
| 16 - 20 | 1.2706 | 1.3495 | 1.2824 | 0.0340 | -0.0162 | -0.0616 |
| 21 - 30 | 0.7501 | 0.7076 | 0.8041 | 0.9128 | 1.4442 | 0.8739 |
| 31 - 40 | 1.0000 | 1.0000 | 1.0000 | 1.0000 | 1.0000 | 1.0000 |
| 41 - 50 | 1.4795 | 1.4701 | 1.4749 | 2.0161 | 2.6013 | 1.9068 |
| 51 - 65 | 1.8290 | 1.8589 | 1.7053 | 1.7076 | 2.4677 | 1.6308 |
| 66 - 99 | 2.0694 | 2.1090 | 1.8173 | 3.7946 | 7.7549 | 3.7362 |
| Nonzero Observations: | | | 3033 | | | 1819 |

1The least squares method using total observations
2The least squares method using nonzero observations

## TABLE 2.4

## Estimated Coefficients by the Big-Ticket-Item Analysis (Continued)

| Equation | 38. Hospitals and Sanitariums | | | 39. Health Insurance | | |
|---|---|---|---|---|---|---|
| Independent Variable | Probit | Least Squares1 | Least Squares2 | Probit | Least Squares1 | Least Squares2 |
| Intercept | -0.8514 | -1.2992 | 15.7134 | -4.8592 | -14.3868 | 32.3418 |
| Income($): | | | | | | |
| 0-3310 | 0.0011 | 0.0011 | 0.0064 | 0.0140 | 0.0152 | 0.0157 |
| 3310-4639 | 0.0018 | 0.0017 | 0.0090 | 0.0199 | 0.0207 | 0.0297 |
| 4639-6277 | 0.0030 | 0.0019 | 0.0167 | 0.0057 | 0.0063 | 0.0060 |
| 6277-8848 | -0.0053 | -0.0045 | -0.0224 | 0.0038 | 0.0025 | 0.0105 |
| 8848-infinity | 0.0077 | 0.0095 | 0.0264 | 0.0027 | 0.0027 | 0.0038 |
| Region: | | | | | | |
| Northeast (=base) | | | | | | |
| North Central | 0.1147 | 0.1214 | -9.5271 | 15.5410 | 14.3642 | 23.8358 |
| South | 2.3871 | 1.9394 | 2.1228 | 20.9693 | 24.1743 | 17.7064 |
| West | 0.3207 | 0.7004 | -6.6435 | 9.4555 | 8.3058 | 12.5525 |
| Education: | | | | | | |
| College | -0.6231 | -1.7250 | -2.8514 | -4.2058 | -1.3632 | -9.0181 |
| Noncollege (=base) | | | | | | |
| Working Spouse: | | | | | | |
| Yes | -1.8003 | -0.3043 | -10.0335 | -7.9219 | -4.5889 | -15.9392 |
| No (=base) | | | | | | |
| Family Size: | | | | | | |
| 1 | 7.2801 | 5.8649 | 254.6240 | 11.1624 | 6.2384 | 45.1533 |
| 2 | 4.3461 | 6.6017 | 51.7363 | 16.1595 | 11.8222 | 40.5197 |
| 3-4 (=base) | | | | | | |
| 5+ | -0.0369 | -0.8478 | -8.2762 | -8.8244 | -5.3148 | -25.0936 |
| Age of Householder: | | | | | | |
| 35- | 1.2908 | -0.1830 | 2.4232 | 5.4459 | 9.4806 | 13.3617 |
| 35-55 (=base) | | | | | | |
| 55+ | 1.8460 | 1.3256 | 2.7674 | 19.8882 | 18.9322 | 8.1026 |
| Adult Equivalency Weights: | | | | | | |
| 0 - 5 | 2.4946 | 0.5754 | 0.9694 | 0.8325 | 0.6358 | 0.7434 |
| 6 - 15 | 3.4781 | 4.5840 | 2.0847 | 0.5024 | 0.3674 | 0.5813 |
| 16 - 20 | 10.2838 | 8.8355 | 4.0998 | 0.8785 | 0.6784 | 1.0732 |
| 21 - 30 | 1.2659 | 0.5364 | 1.0550 | 0.7584 | 0.7828 | 0.7891 |
| 31 - 40 | 1.0000 | 1.0000 | 1.0000 | 1.0000 | 1.0000 | 1.0000 |
| 41 - 50 | 1.5664 | 1.4513 | 0.8974 | 1.2712 | 1.3726 | 1.1219 |
| 51 - 65 | 2.1717 | 0.4990 | 1.2777 | 1.4571 | 1.5466 | 1.2217 |
| 66 - 99 | 2.0042 | 1.8158 | 1.1153 | 1.9976 | 2.2580 | 1.2568 |
| Nonzero Observations: | | | 853 | | | 2834 |

1The least squares method using total observations
2The least squares method using nonzero observations

# TABLE 2.4

## Estimated Coefficients by the Big-Ticket-Item Analysis (Continued)

| Equation | 40. Personal Business | | | 41. Life Insurance | | |
|---|---|---|---|---|---|---|
| Independent Variable | Probit | Least Squares1 | Least Squares2 | Probit | Least Squares1 | Least Squares2 |
| Intercept | -26.3247 | -26.1584 | 6.6585 | -43.2150 | -41.3503 | 8.0188 |
| Income ($): | | | | | | |
| 0-3310 | 0.0164 | 0.0161 | 0.0106 | 0.0363 | 0.0362 | 0.0298 |
| 3310-4639 | 0.0200 | 0.0190 | 0.0209 | 0.0188 | 0.0215 | 0.0186 |
| 4639-6277 | 0.0169 | 0.0169 | 0.0150 | 0.0145 | 0.0119 | 0.0116 |
| 6277-8848 | 0.0198 | 0.0193 | 0.0182 | 0.0351 | 0.0367 | 0.0365 |
| 8848-infinity | 0.0139 | 0.0137 | 0.0138 | 0.0230 | 0.0206 | 0.0244 |
| Region: | | | | | | |
| Northeast (=base) | | | | | | |
| North Central | 12.4794 | 13.1181 | 6.8850 | 8.4692 | 10.0195 | 6.7978 |
| South | 15.3226 | 16.7056 | 11.6525 | 29.8888 | 30.5601 | 27.3707 |
| West | 9.1963 | 9.9664 | 3.7113 | -6.5034 | -4.1205 | 9.2914 |
| Education: | | | | | | |
| College | -5.8738 | -6.0353 | -9.1059 | 28.5561 | 29.9093 | 25.1947 |
| Noncollege (=base) | | | | | | |
| Working Spouse: | | | | | | |
| Yes | 0.0351 | 1.4176 | -6.0433 | 15.6284 | 17.8114 | 11.2941 |
| No (=base) | | | | | | |
| Family Size: | | | | | | |
| 1 | -52.6404 | -41.1187 | -27.2939 | -134.5011 | -105.4879 | -11.1526 |
| 2 | -15.1334 | -13.6508 | -6.3044 | -37.3324 | -30.6307 | -12.9127 |
| 3-4 (=base) | | | | | | |
| 5+ | 11.9995 | 10.3704 | 8.0386 | -0.6546 | 0.3060 | -12.9231 |
| Age of Householder: | | | | | | |
| 35- | 16.7332 | 15.0983 | 16.7798 | 0.4861 | 1.8484 | 5.2075 |
| 35-55 (=base) | | | | | | |
| 55+ | 8.9446 | 9.1027 | 13.2371 | 11.6977 | 13.4896 | 4.6153 |
| Adult Equivalency Weights: | | | | | | |
| 0 - 5 | 0.4470 | 0.4892 | 0.4596 | 0.8437 | 0.8091 | 0.8242 |
| 6 - 15 | 0.1864 | 0.2092 | 0.2183 | 0.4176 | 0.3450 | 0.4747 |
| 16 - 20 | 0.1792 | 0.1733 | 0.2353 | 0.6486 | 0.5630 | 0.7653 |
| 21 - 30 | 0.6992 | 0.7074 | 0.7096 | 0.5406 | 0.4972 | 0.5793 |
| 31 - 40 | 1.0000 | 1.0000 | 1.0000 | 1.0000 | 1.0000 | 1.0000 |
| 41 - 50 | 1.0160 | 0.9874 | 1.0395 | 0.9478 | 0.9375 | 0.9456 |
| 51 - 65 | 1.1009 | 1.1097 | 1.1062 | 1.0946 | 1.0680 | 1.1185 |
| 66 - 99 | 1.1134 | 1.0814 | 1.1016 | 0.4818 | 0.4031 | 0.6067 |
| Nonzero Observations: | | | 3537 | | | 2882 |

1The least squares method using total observations
2The least squares method using nonzero observations

## TABLE 2.4

## Estimated Coefficients by the Big-Ticket-Item Analysis (Continued)

| Equation | 42. New Cars | | | 43. Used Cars | | |
|---|---|---|---|---|---|---|
| Independent Variable | Probit | Least Squares1 | Least Squares2 | Probit | Least Squares1 | Least Squares2 |
| Intercept | -110.1007 | -65.0519 | 814.9602 | -308.3176 | -247.5727 | -295.2920 |
| Income ($): | | | | | | |
| 0-3310 | 0.0195 | 0.0244 | 0.2562 | 0.0858 | 0.0874 | 0.1989 |
| 3310-4639 | 0.0776 | 0.1006 | 0.5895 | 0.0738 | 0.0592 | 0.2022 |
| 4639-6277 | 0.1079 | 0.1466 | 0.2535 | 0.0746 | 0.0823 | 0.2186 |
| 6277-8848 | 0.1782 | 0.1984 | 0.3900 | 0.0543 | 0.0306 | 0.1800 |
| 8848-infinity | 0.1138 | 0.1225 | 0.1743 | 0.0446 | 0.0290 | 0.1475 |
| Region: | | | | | | |
| Northeast (=base) | | | | | | |
| North Central | 35.6797 | 30.1251 | 505.9614 | 120.2847 | 117.1247 | 258.0220 |
| South | -9.9602 | -6.6551 | 502.9802 | 88.9815 | 62.8541 | 246.5538 |
| West | -18.7117 | -46.3409 | 466.1824 | 84.6340 | 86.6313 | 217.6908 |
| Education: | | | | | | |
| College | -62.5468 | -49.2736 | -568.5730 | -78.1449 | -74.0680 | 41.4491 |
| Noncollege (=base) | | | | | | |
| Working Spouse: | | | | | | |
| Yes | -27.2799 | -37.2396 | -475.9866 | 28.1630 | 16.6172 | -29.8643 |
| No (=base) | | | | | | |
| Family Size: | | | | | | |
| 1 | -543.0374 | -584.1165 | 2533.0942 | -97.2628 | -69.2766 | 1147.1633 |
| 2 | -230.6186 | -241.6310 | 399.5923 | -76.6704 | -75.1813 | 400.8611 |
| 3-4 (=base) | | | | | | |
| 5+ | 107.8634 | 77.3945 | 53.1620 | 129.7850 | 120.5218 | 87.8452 |
| Age of Householder: | | | | | | |
| 35- | 64.2933 | 38.6084 | 541.1436 | 9.0267 | -7.0773 | 64.4651 |
| 35-55 (=base) | | | | | | |
| 55+ | 39.9267 | 3.3022 | -438.8684 | 37.6257 | 34.0295 | 66.7103 |
| Adult Equivalency Weights: | | | | | | |
| 0 - 5 | 1.7656 | 1.1331 | 0.3987 | 0.7223 | 0.2265 | 0.5572 |
| 6 - 15 | 1.4714 | 0.6116 | 0.3175 | 0.7956 | 0.2925 | 0.5626 |
| 16 - 20 | 1.7064 | 1.0088 | 0.4720 | 0.9973 | 1.0791 | 0.4169 |
| 21 - 30 | 1.2577 | 1.2199 | 0.9176 | 1.1461 | 1.4427 | 0.8680 |
| 31 - 40 | 1.0000 | 1.0000 | 1.0000 | 1.0000 | 1.0000 | 1.0000 |
| 41 - 50 | 1.2101 | 0.7121 | 0.9232 | 0.7999 | 0.7504 | 0.7251 |
| 51 - 65 | 1.1491 | 0.8646 | 0.9154 | 0.7251 | 0.5732 | 0.8220 |
| 66 - 99 | 1.8959 | 0.8252 | 0.9847 | 0.4297 | 0.3671 | 0.7527 |
| Nonzero Observations: | | | 313 | | | 690 |

1The least squares method using total observations
2The least squares method using nonzero observations

## TABLE 2.4

## Estimated Coefficients by the Big-Ticket-Item Analysis (Continued)

| Equation | 44. New and Used Trucks or Vans | | | 45. Tires and Tubes | | |
|---|---|---|---|---|---|---|
| Independent Variable | Probit | Least Squares1 | Least Squares2 | Probit | Least Squares1 | Least Squares2 |
| Intercept | -76.4970 | -94.5436 | -204.0645 | -41.2200 | -35.3009 | -18.4741 |
| Income ($): | | | | | | |
| 0-3310 | 0.0146 | 0.0224 | 0.1500 | 0.0188 | 0.0189 | 0.0175 |
| 3310-4639 | 0.0195 | 0.0378 | 0.1226 | 0.0115 | 0.0119 | 0.0113 |
| 4639-6277 | 0.0430 | 0.0745 | 0.3714 | 0.0081 | 0.0077 | 0.0056 |
| 6277-8848 | 0.0313 | 0.0384 | 0.1687 | 0.0081 | 0.0078 | 0.0081 |
| 8848-infinity | 0.0127 | 0.0114 | 0.1405 | 0.0029 | 0.0028 | 0.0026 |
| Region: | | | | | | |
| Northeast (=base) | | | | | | |
| North Central | 18.0351 | 30.2619 | 102.9469 | 3.1601 | 2.3039 | 5.2388 |
| South | 25.3204 | 37.5888 | 59.9460 | 13.7651 | 14.3558 | 12.0040 |
| West | 41.8011 | 71.5741 | 60.3368 | 20.4164 | 21.2464 | 20.9370 |
| Education: | | | | | | |
| College | -31.9780 | -68.6793 | 34.0851 | -4.8095 | -4.4300 | -4.8426 |
| Noncollege (=base) | | | | | | |
| Working Spouse: | | | | | | |
| Yes | 5.9912 | 13.3914 | 23.5457 | 5.3608 | 3.6996 | 2.9260 |
| No (=base) | | | | | | |
| Family Size: | | | | | | |
| 1 | -39.3654 | -66.8461 | 2250.6279 | -14.3951 | -4.2225 | 68.0260 |
| 2 | -43.2134 | -86.7107 | -1.7774 | 0.4613 | 2.9886 | 20.0939 |
| 3-4 (=base) | | | | | | |
| 5+ | 32.9735 | 44.0080 | -26.3202 | 12.1167 | 9.4962 | 1.5236 |
| Age of Householder: | | | | | | |
| 35- | 15.5352 | 18.0062 | -41.4766 | 7.0371 | 2.9278 | 4.1795 |
| 35-55 (=base) | | | | | | |
| 55+ | 6.7527 | 5.7687 | -126.7626 | -2.2796 | 0.9354 | 5.2910 |
| Adult Equivalency Weights: | | | | | | |
| 0 - 5 | 3.1896 | 2.8183 | 2.2334 | 0.2958 | 0.2346 | 0.4269 |
| 6 - 15 | 2.5555 | 0.4957 | 1.6531 | 0.5052 | 0.4661 | 0.6453 |
| 16 - 20 | 1.4238 | 0.0224 | 0.9215 | 0.9967 | 0.9049 | 1.0593 |
| 21 - 30 | 1.1864 | 0.7328 | 0.9562 | 1.0642 | 1.0553 | 1.0459 |
| 31 - 40 | 1.0000 | 1.0000 | 1.0000 | 1.0000 | 1.0000 | 1.0000 |
| 41 - 50 | 0.9801 | 0.9775 | 0.9792 | 1.0046 | 0.9303 | 1.0663 |
| 51 - 65 | 1.0967 | 0.4916 | 1.5581 | 0.8067 | 0.7137 | 0.8032 |
| 66 - 99 | 0.9368 | 0.3401 | 1.7862 | 0.7531 | 0.5308 | 0.7351 |
| Nonzero Observations: | | | 189 | | | 2573 |

1The least squares method using total observations
2The least squares method using nonzero observations

## TABLE 2.4

## Estimated Coefficients by the Big-Ticket-Item Analysis (Continued)

| Equation | 46. Auto Accessories and Parts | | | 47. Auto Repairs | | |
|---|---|---|---|---|---|---|
| Independent Variable | Probit | Least Squares1 | Least Squares2 | Probit | Least Squares1 | Least Squares2 |
| Intercept | -6.4535 | -5.9110 | 7.5877 | -3.0666 | 0.8922 | 22.3554 |
| Income ($): | | | | | | |
| 0-3310 | 0.0062 | 0.0062 | 0.0047 | 0.0070 | 0.0066 | 0.0067 |
| 3310-4639 | 0.0123 | 0.0121 | 0.0114 | 0.0091 | 0.0090 | 0.0081 |
| 4639-6277 | 0.0049 | 0.0052 | 0.0036 | 0.0074 | 0.0073 | 0.0068 |
| 6277-8848 | 0.0085 | 0.0081 | 0.0082 | 0.0054 | 0.0054 | 0.0053 |
| 8848-infinity | 0.0026 | 0.0026 | 0.0025 | 0.0072 | 0.0072 | 0.0082 |
| Region: | | | | | | |
| Northeast (=base) | | | | | | |
| North Central | 2.8394 | 3.1109 | -0.3172 | -5.3865 | -5.4308 | -12.7163 |
| South | 1.2408 | 1.3728 | -1.1506 | -4.8124 | -5.5508 | -11.5805 |
| West | 5.8722 | 6.4571 | 3.9502 | -1.6123 | -1.3637 | -5.9696 |
| Education: | | | | | | |
| College | 4.2671 | 4.2875 | 3.5945 | 4.8391 | 4.7259 | 5.7670 |
| Noncollege (=base) | | | | | | |
| Working Spouse: | | | | | | |
| Yes | 2.1961 | 2.3055 | 0.8379 | 8.3769 | 7.1971 | 6.2518 |
| No (=base) | | | | | | |
| Family Size: | | | | | | |
| 1 | -6.4006 | -0.8121 | 28.7206 | -1.5381 | 9.7796 | 68.0767 |
| 2 | 4.1488 | 5.1216 | 10.4455 | 2.1474 | 4.8960 | 15.6556 |
| 3-4 (=base) | | | | | | |
| 5+ | 1.1159 | 0.8571 | -3.2004 | -3.5055 | -5.1940 | -13.5792 |
| Age of Householder: | | | | | | |
| 35- | 1.2031 | 1.0769 | -0.5595 | -1.1450 | -2.8554 | -4.2440 |
| 35-55 (=base) | | | | | | |
| 55+ | -0.9787 | -1.0274 | 0.3020 | -2.5174 | -0.5347 | -1.3895 |
| Adult Equivalency Weights: | | | | | | |
| 0 - 5 | 0.4955 | 0.4762 | 0.6159 | 0.8533 | 0.7761 | 0.9556 |
| 6 - 15 | 0.4222 | 0.4067 | 0.5060 | 1.0484 | 1.1239 | 1.1052 |
| 16 - 20 | 0.8693 | 0.8364 | 0.9288 | 1.8366 | 1.7747 | 1.6682 |
| 21 - 30 | 0.8803 | 0.8670 | 0.8618 | 1.2201 | 1.2042 | 1.1800 |
| 31 - 40 | 1.0000 | 1.0000 | 1.0000 | 1.0000 | 1.0000 | 1.0000 |
| 41 - 50 | 1.0315 | 1.0256 | 1.0095 | 0.9223 | 0.8814 | 0.9312 |
| 51 - 65 | 0.8942 | 0.8740 | 0.8628 | 1.2822 | 1.1643 | 1.2603 |
| 66 - 99 | 1.0012 | 0.9471 | 0.9489 | 1.1648 | 0.9484 | 1.1024 |
| Nonzero Observations: | | | 3353 | | | 2602 |

1The least squares method using total observations
2The least squares method using nonzero observations

**TABLE 2.4**

**Estimated Coefficients by the Big-Ticket-Item Analysis (Continued)**

| Equation | 48. Auto Insurance | | | 49. Gasoline Oil | | |
|---|---|---|---|---|---|---|
| Independent Variable | Probit | Least Squares1 | Least Squares2 | Probit | Least Squares1 | Least Squares2 |
| Intercept | -27.0838 | -25.4915 | 37.2414 | -107.3667 | -116.9843 | -41.8983 |
| Income($): | | | | | | |
| 0-3310 | 0.0326 | 0.0328 | 0.0235 | 0.1662 | 0.1676 | 0.1537 |
| 3310-4639 | 0.0317 | 0.0314 | 0.0221 | 0.0848 | 0.0851 | 0.0767 |
| 4639-6277 | 0.0171 | 0.0170 | 0.0165 | 0.0705 | 0.0711 | 0.0682 |
| 6277-8848 | 0.0118 | 0.0085 | 0.0102 | 0.0499 | 0.0510 | 0.0456 |
| 8848-infinity | 0.0093 | 0.0078 | 0.0087 | 0.0227 | 0.0228 | 0.0212 |
| Region: | | | | | | |
| Northeast (=base) | | | | | | |
| North Central | -8.2380 | -10.0915 | -17.8062 | 58.6006 | 62.6950 | 49.8253 |
| South | -8.0767 | -9.3987 | -11.5756 | 75.6155 | 79.5352 | 68.5317 |
| West | -1.2303 | -1.9323 | -2.4653 | 25.7548 | 29.9251 | 18.4594 |
| Education: | | | | | | |
| College | -4.2393 | -5.1988 | -7.1599 | -94.0046 | -92.5977 | -97.9424 |
| Noncollege (=base) | | | | | | |
| Working Spouse: | | | | | | |
| Yes | 4.7692 | 11.1885 | -2.1188 | 46.9485 | 49.2596 | 42.4872 |
| No (=base) | | | | | | |
| Family Size: | | | | | | |
| 1 | -51.5771 | -23.6880 | 45.4672 | -49.2499 | -54.3079 | 72.3928 |
| 2 | -20.8076 | -11.5688 | 1.7301 | -15.9554 | -19.0302 | -0.5409 |
| 3-4 (=base) | | | | | | |
| 5+ | -0.2265 | -2.6234 | -15.0342 | 11.4638 | 16.2727 | -6.7558 |
| Age of Householder: | | | | | | |
| 35- | 14.9653 | 12.7615 | 9.3636 | 37.8410 | 38.6619 | 31.4664 |
| 35-55 (=base) | | | | | | |
| 55+ | -5.3306 | -4.0244 | -2.9505 | -54.5561 | -58.5031 | -53.0592 |
| Adult Equivalency Weights: | | | | | | |
| 0 - 5 | 0.3814 | 0.4049 | 0.4637 | 0.3087 | 0.3024 | 0.3410 |
| 6 - 15 | 0.2934 | 0.2689 | 0.3823 | 0.3298 | 0.3254 | 0.3529 |
| 16 - 20 | 1.1416 | 1.0521 | 1.4541 | 0.6424 | 0.6360 | 0.6687 |
| 21 - 30 | 0.9539 | 0.9196 | 0.9716 | 0.9023 | 0.9002 | 0.8998 |
| 31 - 40 | 1.0000 | 1.0000 | 1.0000 | 1.0000 | 1.0000 | 1.0000 |
| 41 - 50 | 1.1615 | 1.1564 | 1.2030 | 0.9790 | 0.9767 | 0.9788 |
| 51 - 65 | 1.0962 | 1.0688 | 1.0667 | 0.8763 | 0.8793 | 0.8788 |
| 66 - 99 | 0.9866 | 0.8721 | 0.9448 | 0.6143 | 0.6184 | 0.6457 |
| Nonzero Observations: | | | 3122 | | | 4011 |

1The least squares method using total observations
2The least squares method using nonzero observations

## TABLE 2.4

## Estimated Coefficients by the Big-Ticket-Item Analysis (Continued)

| Equation | 50. Tolls, Parking Fees, Registr | | | 51. Local Transportation | | |
|---|---|---|---|---|---|---|
| Independent Variable | Probit | Least Squares1 | Least Squares2 | Probit | Least Squares1 | Least Squares2 |
| Intercept | -6.9022 | -8.2720 | 0.3571 | 7.3755 | 9.7563 | 28.0247 |
| Income($): | | | | | | |
| 0-3310 | 0.0077 | 0.0083 | 0.0063 | -0.0002 | -0.0016 | 0.0029 |
| 3310-4639 | 0.0130 | 0.0123 | 0.0126 | 0.0000 | 0.0012 | -0.0029 |
| 4639-6277 | 0.0071 | 0.0073 | 0.0064 | -0.0007 | -0.0009 | -0.0040 |
| 6277-8848 | 0.0120 | 0.0115 | 0.0117 | 0.0007 | 0.0008 | 0.0014 |
| 8848-infinity | 0.0073 | 0.0073 | 0.0069 | 0.0008 | 0.0014 | 0.0010 |
| Region: | | | | | | |
| Northeast (=base) | | | | | | |
| North Central | -4.8924 | -4.8483 | -5.5862 | -1.1574 | -1.1535 | 1.0230 |
| South | -6.5481 | -6.3262 | -7.1664 | -0.5726 | -0.5507 | 1.6872 |
| West | 5.6545 | 5.2030 | 5.8220 | -1.7344 | -1.9854 | -3.9668 |
| Education: | | | | | | |
| College | 8.3131 | 8.2337 | 7.4971 | -1.3321 | -0.1680 | -9.2004 |
| Noncollege (=base) | | | | | | |
| Working Spouse: | | | | | | |
| Yes | 0.3876 | 0.7865 | -0.4491 | -0.1370 | -0.1887 | -1.6414 |
| No (=base) | | | | | | |
| Family Size: | | | | | | |
| 1 | -9.5845 | -3.3921 | 14.0361 | 2.6114 | 7.5425 | 8.0827 |
| 2 | -4.7749 | -3.2577 | -2.5835 | -1.2570 | -0.2766 | -4.7518 |
| 3-4 (=base) | | | | | | |
| 5+ | 4.8490 | 4.1419 | 2.9874 | -1.3570 | -1.4080 | -9.8281 |
| Age of Householder: | | | | | | |
| 35- | 8.7135 | 6.9438 | 9.2957 | -0.4814 | -1.1905 | 1.7952 |
| 35-55 (=base) | | | | | | |
| 55+ | 0.6418 | 0.2371 | 1.6009 | -1.3745 | 1.7020 | -8.7482 |
| Adult Equivalency Weights: | | | | | | |
| 0 - 5 | 0.2204 | 0.2369 | 0.2339 | 0.5361 | 1.0113 | 0.5283 |
| 6 - 15 | 0.4675 | 0.4989 | 0.4992 | 0.3473 | 0.7003 | 0.1846 |
| 16 - 20 | 0.6990 | 0.6786 | 0.7723 | -0.0986 | -0.0876 | -0.1056 |
| 21 - 30 | 0.8804 | 0.8968 | 0.8838 | 0.5881 | 0.3682 | 0.6073 |
| 31 - 40 | 1.0000 | 1.0000 | 1.0000 | 1.0000 | 1.0000 | 1.0000 |
| 41 - 50 | 0.9410 | 0.9257 | 0.9460 | 1.0329 | 0.7464 | 1.0170 |
| 51 - 65 | 0.7970 | 0.7907 | 0.7962 | 1.1321 | 0.5401 | 1.1839 |
| 66 - 99 | 0.7422 | 0.7162 | 0.7538 | 1.7720 | 0.8207 | 1.9036 |
| Nonzero Observations: | | | 3713 | | | 907 |

1The least squares method using total observations
2The least squares method using nonzero observations

# TABLE 2.4

## Estimated Coefficients by the Big-Ticket-Item Analysis (Continued)

| Equation | 52. Intercity Transportation | | | 53. Books, Magazines, and News | | |
|---|---|---|---|---|---|---|
| Independent Variable | Probit | Least Squares1 | Least Squares2 | Probit | Least Squares1 | Least Squares2 |
| Intercept | 7.2476 | 6.7671 | 5.9102 | 10.7895 | 9.6802 | 13.8507 |
| Income ($): | | | | | | |
| 0-3310 | 0.0028 | 0.0019 | 0.0100 | 0.0064 | 0.0066 | 0.0060 |
| 3310-4639 | 0.0071 | 0.0083 | 0.0101 | 0.0102 | 0.0104 | 0.0094 |
| 4639-6277 | 0.0130 | 0.0104 | 0.0197 | 0.0049 | 0.0048 | 0.0049 |
| 6277-8848 | 0.0146 | 0.0141 | 0.0226 | 0.0091 | 0.0092 | 0.0086 |
| 8848-infinity | 0.0256 | 0.0281 | 0.0304 | 0.0050 | 0.0050 | 0.0050 |
| Region: | | | | | | |
| Northeast (=base) | | | | | | |
| North Central | -15.7262 | -11.2538 | -17.1661 | -3.4615 | -3.4950 | -3.6021 |
| South | -17.1015 | -13.1496 | -13.2796 | -12.6424 | -12.9189 | -12.1412 |
| West | 13.3729 | 7.5491 | 8.4963 | -6.3471 | -6.4015 | -6.3129 |
| Education: | | | | | | |
| College | 14.8360 | 9.3350 | 11.2593 | 15.1702 | 15.4381 | 14.7148 |
| Noncollege (=base) | | | | | | |
| Working Spouse: | | | | | | |
| Yes | 4.8139 | 2.7148 | 7.7646 | 0.8865 | 1.0802 | 0.5687 |
| No (=base) | | | | | | |
| Family Size: | | | | | | |
| 1 | 1.6953 | 19.9260 | 33.0258 | 17.1336 | 17.4768 | 25.2942 |
| 2 | 20.7297 | 31.6981 | 62.3606 | 12.5399 | 11.9039 | 14.6665 |
| 3-4 (=base) | | | | | | |
| 5+ | 1.6471 | 2.1011 | -5.6845 | -5.8708 | -5.5201 | -6.9512 |
| Age of Householder: | | | | | | |
| 35- | -1.9068 | -1.4032 | 12.6699 | -1.5667 | -1.0670 | -2.0309 |
| 35-55 (=base) | | | | | | |
| 55+ | 6.9222 | 9.3122 | 8.2782 | -4.2252 | -3.8978 | -4.2833 |
| Adult Equivalency Weights: | | | | | | |
| 0 - 5 | 1.3235 | 0.8515 | 1.4095 | 0.4494 | 0.4316 | 0.4810 |
| 6 - 15 | 1.6502 | 2.6220 | 1.6103 | 0.6517 | 0.6458 | 0.6623 |
| 16 - 20 | 1.7308 | 2.4259 | 1.7559 | 0.4435 | 0.4371 | 0.4694 |
| 21 - 30 | 0.9318 | 0.8992 | 0.9542 | 0.8689 | 0.8566 | 0.8572 |
| 31 - 40 | 1.0000 | 1.0000 | 1.0000 | 1.0000 | 1.0000 | 1.0000 |
| 41 - 50 | 1.4843 | 1.2809 | 1.3222 | 0.9082 | 0.9135 | 0.9209 |
| 51 - 65 | 1.2017 | 0.9892 | 1.1475 | 0.9643 | 0.9677 | 0.9581 |
| 66 - 99 | 1.5594 | 1.3096 | 1.6222 | 1.0335 | 1.0302 | 1.0219 |
| Nonzero Observations: | | | 2215 | | | 4118 |

1The least squares method using total observations
2The least squares method using nonzero observations

## TABLE 2.4

## Estimated Coefficients by the Big-Ticket-Item Analysis (Continued)

| Equation | 54. Boats, RV, and Pleasure Airc | | | 55. Wheel Goods, Toys, and | | |
|---|---|---|---|---|---|---|
| Independent Variable | Probit | Least Squares1 | Least Squares2 | Probit | Least Squares1 | Least Squares2 |
| Intercept | -33.0230 | -58.3764 | 443.8323 | -9.0706 | -7.8269 | -3.5982 |
| Income($): | | | | | | |
| 0-3310 | 0.0048 | 0.0110 | -0.1718 | 0.0110 | 0.0123 | 0.0121 |
| 3310-4639 | 0.0078 | 0.0128 | 0.0862 | 0.0093 | 0.0100 | 0.0085 |
| 4639-6277 | 0.0233 | 0.0544 | 0.2276 | 0.0189 | 0.0185 | 0.0188 |
| 6277-8848 | 0.0005 | -0.0071 | 0.0184 | -0.0039 | -0.0044 | -0.0057 |
| 8848-infinity | 0.0204 | 0.0361 | 0.3224 | 0.0156 | 0.0166 | 0.0165 |
| Region: | | | | | | |
| Northeast (=base) | | | | | | |
| North Central | 29.3470 | 66.7292 | 511.4766 | 4.1227 | 4.0437 | 3.2224 |
| South | 18.9372 | 25.8005 | 168.7797 | -2.5559 | -2.7231 | -1.9828 |
| West | 28.3310 | 39.1322 | 201.2904 | 3.2424 | 3.0370 | 3.0597 |
| Education: | | | | | | |
| College | -6.8094 | -14.1285 | 162.0239 | 5.3089 | 6.1206 | 4.9400 |
| Noncollege (=base) | | | | | | |
| Working Spouse: | | | | | | |
| Yes | 5.3210 | 1.1683 | 183.7574 | -4.6556 | -6.5675 | -5.7524 |
| No (=base) | | | | | | |
| Family Size: | | | | | | |
| 1 | -110.5992 | -144.8419 | -1607.3381 | -35.6989 | -18.3831 | 18.2916 |
| 2 | -48.1336 | -97.2006 | -444.8030 | -4.7032 | -5.1388 | 8.0739 |
| 3-4 (=base) | | | | | | |
| 5+ | 4.7813 | 28.8564 | 35.6262 | 1.0051 | 0.5214 | -1.8783 |
| Age of Householder: | | | | | | |
| 35- | 1.9137 | -3.6854 | -227.5737 | 3.1253 | 0.9496 | 0.8534 |
| 35-55 (=base) | | | | | | |
| 55+ | 0.4899 | 2.9607 | -46.2125 | -8.3246 | -3.0540 | -0.9515 |
| Adult Equivalency Weights: | | | | | | |
| 0 - 5 | 2.1641 | 1.6481 | 1.1954 | 2.2595 | 2.1256 | 2.0506 |
| 6 - 15 | 0.6145 | -0.6716 | -0.1908 | 1.9964 | 1.7822 | 1.8935 |
| 16 - 20 | 1.2780 | -0.4248 | -0.1540 | 0.5660 | 0.6075 | 0.5616 |
| 21 - 30 | 2.5162 | 1.3989 | 1.7276 | 1.2764 | 1.2922 | 1.2741 |
| 31 - 40 | 1.0000 | 1.0000 | 1.0000 | 1.0000 | 1.0000 | 1.0000 |
| 41 - 50 | 1.8717 | 1.4853 | 0.1744 | 0.4226 | 0.2750 | 0.5054 |
| 51 - 65 | 1.9485 | 0.4705 | 1.2605 | 0.5795 | 0.4709 | 0.6262 |
| 66 - 99 | 0.3621 | -0.0123 | 1.2526 | 0.3335 | 0.2283 | 0.4216 |
| Nonzero Observations: | | | 209 | | | 2927 |

1The least squares method using total observations
2The least squares method using nonzero observations

## TABLE 2.4

## Estimated Coefficients by the Big-Ticket-Item Analysis (Continued)

| Equation | 56. Radio, TV, Recorders, and Mu | | | 57. Radio, TV Repairs and Rental | | |
|---|---|---|---|---|---|---|
| Independent Variable | Probit | Least Squares1 | Least Squares2 | Probit | Least Squares1 | Least Squares2 |
| Intercept | -6.7133 | -16.8039 | 13.9544 | -6.9999 | -4.6276 | -2.4075 |
| Income ($): | | | | | | |
| 0-3310 | 0.0097 | 0.0205 | 0.0212 | 0.0033 | 0.0025 | 0.0083 |
| 3310-4639 | 0.0008 | 0.0033 | 0.0006 | 0.0000 | -0.0001 | 0.0000 |
| 4639-6277 | 0.0082 | 0.0180 | 0.0165 | 0.0023 | 0.0020 | 0.0042 |
| 6277-8848 | -0.0069 | -0.0109 | -0.0163 | 0.0000 | 0.0000 | -0.0012 |
| 8848-infinity | 0.0123 | 0.0273 | 0.0274 | 0.0003 | 0.0002 | 0.0012 |
| Region: | | | | | | |
| Northeast (=base) | | | | | | |
| North Central | -1.8308 | -0.0178 | -8.3506 | 0.6684 | 0.4930 | -1.2513 |
| South | -2.3530 | -5.0768 | -7.3654 | 1.5564 | 1.0835 | 5.0842 |
| West | -2.9076 | 1.3495 | -10.0008 | -0.0291 | -0.2735 | -0.0057 |
| Education: | | | | | | |
| College | 7.8523 | 14.3702 | 18.7711 | 0.1590 | 0.3228 | -2.4883 |
| Noncollege (=base) | | | | | | |
| Working Spouse: | | | | | | |
| Yes | -4.3409 | -6.0893 | -18.4081 | -0.3128 | -0.2292 | -2.6479 |
| No (=base) | | | | | | |
| Family Size: | | | | | | |
| 1 | 7.2853 | -3.1828 | 41.9984 | 2.6059 | 1.7185 | 27.6939 |
| 2 | 0.7526 | -0.8021 | 16.0342 | 1.0492 | 0.7287 | 9.1488 |
| 3-4 (=base) | | | | | | |
| 5+ | 3.7515 | 8.1988 | 3.5390 | 2.2684 | 1.6843 | -0.3103 |
| Age of Householder: | | | | | | |
| 35- | -9.2340 | 6.1054 | 11.3450 | 0.7518 | 1.2510 | 5.6884 |
| 35-55 (=base) | | | | | | |
| 55+ | -0.1361 | -24.8241 | -25.9742 | 0.6225 | -0.0005 | -0.7234 |
| Adult Equivalency Weights: | | | | | | |
| 0 - 5 | 1.3931 | 0.4365 | 0.2297 | 0.5780 | 0.5240 | 0.3953 |
| 6 - 15 | 1.6108 | 0.7074 | 0.5234 | 0.7972 | 0.8713 | 0.4638 |
| 16 - 20 | 2.3585 | 0.6008 | 0.5263 | 0.8723 | 1.1142 | 0.6687 |
| 21 - 30 | 2.2139 | 0.7475 | 0.8199 | 0.7165 | 0.6270 | 0.7635 |
| 31 - 40 | 1.0000 | 1.0000 | 1.0000 | 1.0000 | 1.0000 | 1.0000 |
| 41 - 50 | 3.4348 | 0.3413 | 0.5124 | 1.1057 | 1.2452 | 1.1146 |
| 51 - 65 | 1.2108 | 1.5195 | 1.8137 | 1.1349 | 1.4408 | 1.0521 |
| 66 - 99 | -0.0664 | 0.3216 | 0.7747 | 1.3046 | 1.7622 | 1.1009 |
| Nonzero Observations: | | | 2681 | | | 990 |

1The least squares method using total observations
2The least squares method using nonzero observations

## TABLE 2.4

## Estimated Coefficients by the Big-Ticket-Item Analysis (Continued)

| Equation | 58. Fees and Admissions | | | 59. Other Recreational Supplies | | |
|---|---|---|---|---|---|---|
| Independent Variable | Probit | Least Squares1 | Least Squares2 | Probit | Least Squares1 | Least Squares2 |
| Intercept | -10.4231 | -10.2823 | -7.9443 | -34.0903 | -32.5638 | -20.3373 |
| Income($): | | | | | | |
| 0-3310 | 0.0149 | 0.0145 | 0.0157 | 0.0232 | 0.0224 | 0.0213 |
| 3310-4639 | 0.0247 | 0.0242 | 0.0234 | 0.0271 | 0.0274 | 0.0249 |
| 4639-6277 | 0.0172 | 0.0167 | 0.0171 | 0.0136 | 0.0133 | 0.0116 |
| 6277-8848 | 0.0294 | 0.0295 | 0.0285 | 0.0284 | 0.0278 | 0.0266 |
| 8848-infinity | 0.0300 | 0.0294 | 0.0300 | 0.0156 | 0.0157 | 0.0145 |
| Region: | | | | | | |
| Northeast (=base) | | | | | | |
| North Central | -2.4199 | -1.3922 | -3.8642 | -3.2080 | -2.5457 | -5.1358 |
| South | -19.1682 | -18.1718 | -20.0412 | 0.5658 | 0.8253 | 1.4916 |
| West | 0.3388 | 0.7505 | -0.3073 | 23.4893 | 22.1755 | 21.3149 |
| Education: | | | | | | |
| College | 33.5853 | 32.5047 | 32.2769 | 11.0050 | 11.8708 | 9.1893 |
| Noncollege (=base) | | | | | | |
| Working Spouse: | | | | | | |
| Yes | -5.0161 | -4.0015 | -6.8126 | -1.6590 | -1.3931 | -3.6379 |
| No (=base) | | | | | | |
| Family Size: | | | | | | |
| 1 | -65.4581 | -48.9155 | -37.4414 | -31.9537 | -16.6514 | 30.1449 |
| 2 | -19.6934 | -17.1275 | -11.7062 | 14.0697 | 16.6210 | 30.7338 |
| 3-4 (=base) | | | | | | |
| 5+ | 7.0776 | 6.0047 | 6.1396 | 9.4325 | 8.3170 | 3.6523 |
| Age of Householder: | | | | | | |
| 35- | -3.7741 | -4.6257 | -3.8660 | 17.6965 | 15.8661 | 15.8194 |
| 35-55 (=base) | | | | | | |
| 55+ | -1.1186 | -0.1844 | 2.2742 | -4.2285 | -3.8292 | -0.3941 |
| Adult Equivalency Weights: | | | | | | |
| 0 - 5 | 0.5094 | 0.5360 | 0.5349 | 0.2802 | 0.2769 | 0.3533 |
| 6 - 15 | 1.6176 | 1.6686 | 1.6262 | 0.7836 | 0.8160 | 0.8473 |
| 16 - 20 | 0.7501 | 0.7824 | 0.7494 | 0.7350 | 0.7456 | 0.8219 |
| 21 - 30 | 0.7383 | 0.7397 | 0.7237 | 0.7947 | 0.7908 | 0.8070 |
| 31 - 40 | 1.0000 | 1.0000 | 1.0000 | 1.0000 | 1.0000 | 1.0000 |
| 41 - 50 | 0.8815 | 0.8689 | 0.8995 | 0.6682 | 0.6583 | 0.6803 |
| 51 - 65 | 0.7129 | 0.6975 | 0.7224 | 0.6453 | 0.6409 | 0.6503 |
| 66 - 99 | 0.7963 | 0.7758 | 0.8405 | 0.4687 | 0.4407 | 0.4924 |
| Nonzero Observations: | | | 3611 | | | 3544 |

1The least squares method using total observations
2The least squares method using nonzero observations

## TABLE 2.4

### Estimated Coefficients by the Big-Ticket-Item Analysis (Continued)

| Equation | 60. Education | | | 61. Cash Contribution | | |
|---|---|---|---|---|---|---|
| Independent Variable | Probit | Least Squares1 | Least Squares2 | Probit | Least Squares1 | Least Squares2 |
| Intercept | -1.6419 | -1.4282 | 10.8032 | -25.8301 | -24.3227 | -12.9903 |
| Income($): | | | | | | |
| 0-3310 | 0.0024 | 0.0011 | 0.0080 | 0.0177 | 0.0172 | 0.0192 |
| 3310-4639 | 0.0077 | 0.0031 | 0.0297 | 0.0154 | 0.0176 | 0.0150 |
| 4639-6277 | 0.0021 | 0.0017 | 0.0078 | 0.0170 | 0.0181 | 0.0174 |
| 6277-8848 | 0.0073 | 0.0051 | 0.0366 | 0.0223 | 0.0252 | 0.0247 |
| 8848-infinity | 0.0014 | 0.0009 | 0.0059 | 0.0243 | 0.0240 | 0.0266 |
| Region: | | | | | | |
| Northeast (=base) | | | | | | |
| North Central | -4.7257 | -1.4407 | -28.0596 | 26.3707 | 28.6292 | 30.0253 |
| South | -4.3786 | -1.2015 | -26.1768 | 22.5192 | 21.7824 | 28.0479 |
| West | -7.5470 | -2.5632 | -38.9494 | 15.1330 | 14.8231 | 19.7755 |
| Education: | | | | | | |
| College | 6.6311 | 3.7908 | 24.2340 | 47.3378 | 48.0479 | 51.0479 |
| Noncollege (=base) | | | | | | |
| Working Spouse: | | | | | | |
| Yes | -0.6689 | -0.6379 | -3.2730 | -11.9211 | -11.1061 | -16.6781 |
| No (=base) | | | | | | |
| Family Size: | | | | | | |
| 1 | -10.5513 | -12.5515 | -6.4711 | -25.8314 | -29.4866 | -23.4210 |
| 2 | -10.3444 | -7.4310 | -35.2428 | -28.7138 | -29.0007 | -29.3270 |
| 3-4 (=base) | | | | | | |
| 5+ | 4.0282 | 1.9420 | 10.9405 | -2.9413 | -1.7808 | -8.9936 |
| Age of Householder: | | | | | | |
| 35- | -0.9104 | 0.1277 | 4.3122 | -21.8549 | -20.4664 | -22.3031 |
| 35-55 (=base) | | | | | | |
| 55+ | -1.4907 | -0.1819 | -4.2448 | 14.8977 | 7.4813 | 2.4988 |
| Adult Equivalency Weights: | | | | | | |
| 0 - 5 | 0.5235 | 2.1224 | 0.2225 | 1.5645 | 1.3436 | 1.3607 |
| 6 - 15 | 9.5702 | 20.5807 | 2.2337 | 1.1158 | 0.9953 | 0.9652 |
| 16 - 20 | 9.2370 | 25.0265 | 2.6055 | 0.6284 | 0.5717 | 0.5949 |
| 21 - 30 | 4.1668 | 6.6906 | 1.9069 | 0.9810 | 0.9549 | 1.0229 |
| 31 - 40 | 1.0000 | 1.0000 | 1.0000 | 1.0000 | 1.0000 | 1.0000 |
| 41 - 50 | 7.5789 | 19.4832 | 4.0341 | 1.7977 | 1.7817 | 1.6839 |
| 51 - 65 | 4.0222 | 10.6078 | 3.2673 | 2.6052 | 2.3784 | 2.3905 |
| 66 - 99 | 0.0108 | -0.3451 | 0.7225 | 3.7383 | 3.4696 | 3.3888 |
| Nonzero Observations: | | | 1569 | | | 3479 |

1The least squares method using total observations
2The least squares method using nonzero observations

# CHAPTER 3

## INCOME DISTRIBUTION MODEL AND TAX SYSTEM

## - A TRANSITION FROM CROSS-SECTION TO TIME SERIES

The ultimate goal of our study is to estimate and forecast personal consumption expenditures in a long-term forecasting model. The functions estimated from the cross-section data enable us to predict what would happen as a result of changes in income distribution. To use these functions in conjunction with time series data, we need historical data on the distribution of personal income after tax. For forecasting, we need forecasts of that distribution. In this chapter, we shall move towards these goals in two steps: first we forecast the distribution of personal income. Then we apply tax rates to reach the distribution of disposable income.

In Chapter 2 we saw that the Survey of Consumer Expenditures provides cross-section data on the relation of household expenditures to demographic characteristics. It gives no information about the effects of prices. The time series data, on the other hand, reflect both the price and the income variations over time but offer little information about the influences of demographic variables, since they have changed slowly in the past. Accordingly, by combining the time-series data with the cross-section estimation results, we can simultaneously take into account the effects of three major factors: income, price, and demographic characteristics.

The cross-section parameters are used to create variables for use in the time-series analysis in two ways. Firstly, the weighted populations for each of the consumption categories are obtained by using the adult equivalency weights. Secondly, "cross-section-parameter predictions" of the per capita consumption are calculated from the distribution of income and the demographic composition of the population by using the estimated income and demographic coefficients from the cross-section equations. That is, we calculate for both the past and the future what consumption would have been in each CES category if it had responded, as predicted from the cross-section parameters, to the demographic changes and changes in income distribution which actually occurred. These two variables will be later constructed in Chapter 4 for use in the time-series equations.

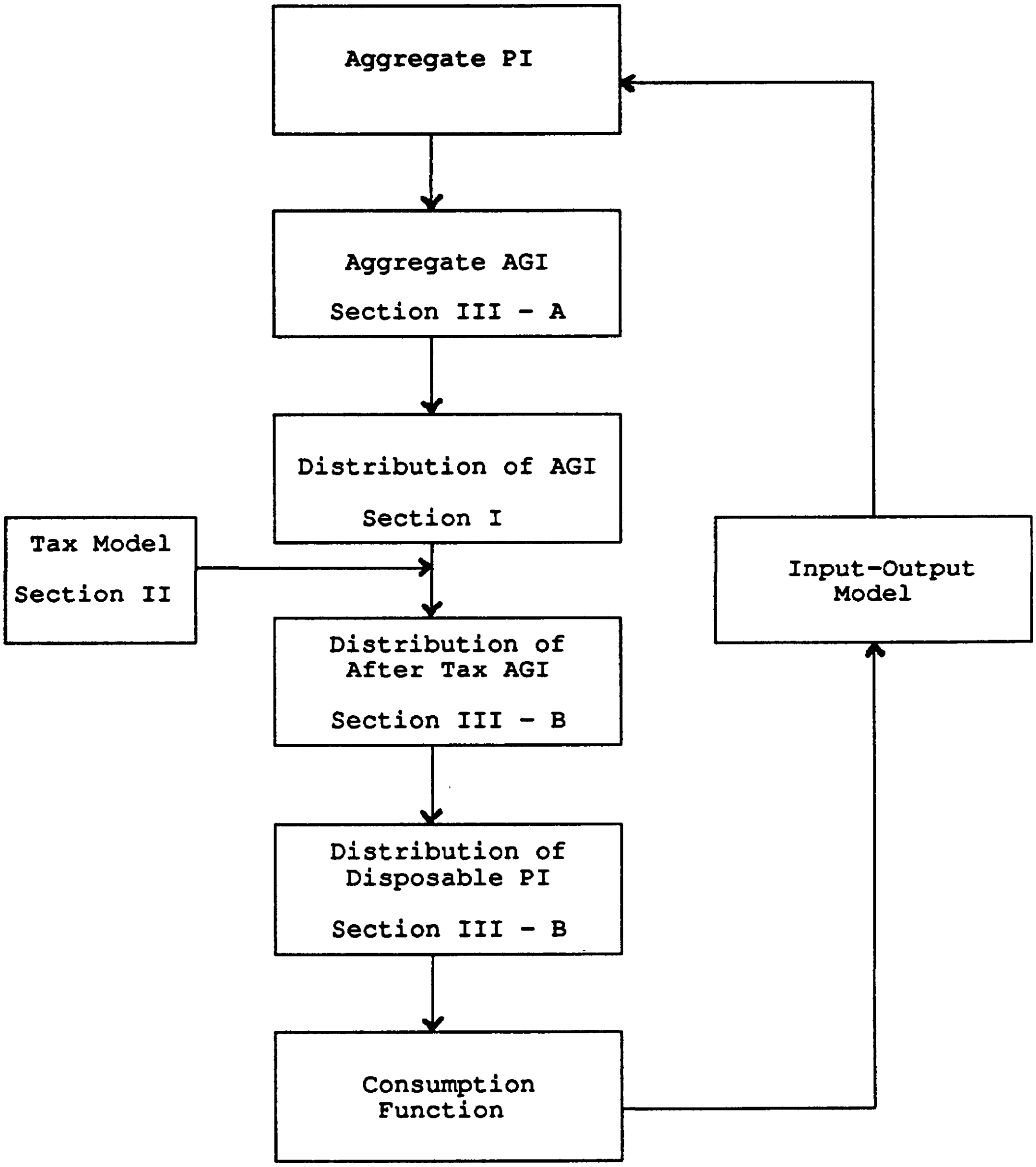
To get the "cross-section parameter predictions" requires the construction of historical series on the size distribution of average income within households. We shall first build the income distributions for different household sizes; then they will be converted to a single distribution of average income within households. To model the income distribution for each household size, the distribution of Adjusted Gross Income (AGI) is first estimated by using the historical data published by the IRS. The data are reported by the six household sizes. The tax model is formed by using the same data. In the tax model, the income tax rate is calculated separately for each household size. To apply the tax liability to the single distribution of income, the income tax rates for the six household sizes are transformed into a weighted-average rate within each income ventile.

The estimation of our income distribution and tax models are based on the grouped data of AGI. However, the income variable used to account for the time-series consumption activity is Personal Income (PI). Thus, an adjustment is made between AGI and PI for some of their differences. For instance, transfer payments, which are a component of PI, are largely not in AGI, whereas some capital gains are in AGI but not in PI. Therefore, these two categories need to be either subtracted from or added to PI in calculating AGI. In our model the distribution of pre-tax and after-tax income are derived for both AGI and PI.

Before going into the presentation of the income distribution model and the tax system, we will provide a flow chart in Figure 3.1, which may help clarify the structure of this chapter and facilitate following the connections among these models.

**FIGURE 3.1**

**Flow Chart for Income Distribution and Tax Models**



## I. Distribution of Income

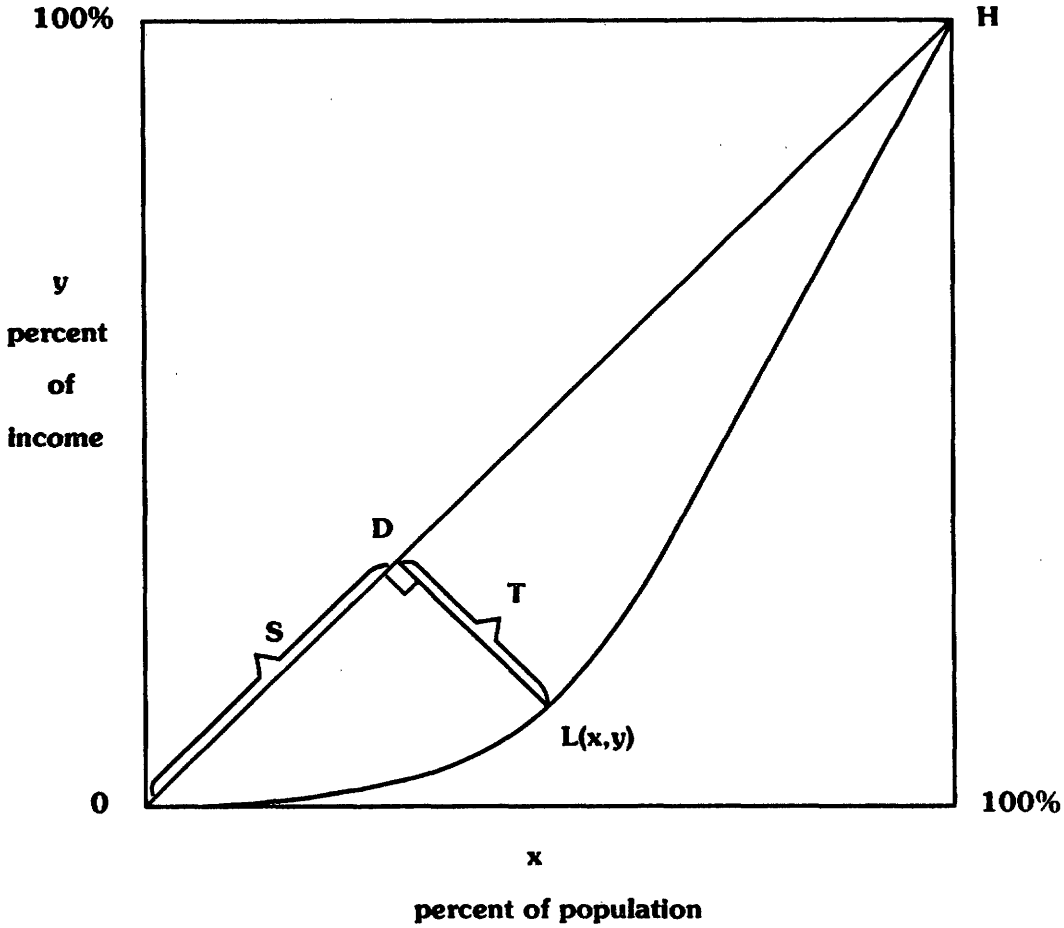
### A. The Model

Since the distribution of income is central to this chapter, we begin by describing exactly how it will be represented mathematically. As is usually done, the percentages of population, x, on the horizontal axis are plotted against the percentages of income they receive, y, on the vertical axis. This line is known as a Lorenz curve. A graphical representation might be helpful before the functional form is explicitly introduced. Figure 3.2 shows the relative positions of the Lorenz curve and the diagonal line. If everyone had the same income, the Lorenz curve would be simply the diagonal line. The distribution in the real world, however, is represented by a curve which bows downward. The more unequally is the income distributed, the more bowed is the Lorenz curve.

Any point on the Lorenz curve can be designated by the usual (x,y) coordinates. For many functional forms, however, it is simpler to write the function in terms of the alternative, "diagonal" coordinates (S,T) shown in Figure 3.2. It is easy to convert between them. By the Pythagorean theorem, the distance between O and D along the diagonal line, S, is $(x+y)/\sqrt{2}$, and that of segment DL, T, is $(x-y)/\sqrt{2}$. Thus, x and y can also be expressed in terms of S and T, namely, $x = (S+T)/\sqrt{2}$ and $y = (S-T)/\sqrt{2}$. Therefore, the form of the Lorenz curve can be represented either by the relation of T to S or by the relation of y to x. The specific forms of the Lorenz curve will be shortly discussed.

**FIGURE 3.2**

**The Lorenz Curve Transformation**



Within the Lorenz curve framework, Pollock (1986) examined several different types of functions, for instance, the Cobb-Douglas function and various polynomial forms. Of the various analytic functions tried, the constant elasticity of substitution (CES) function had the best performance. However, a much closer fit could be obtained by using a linear combination of an actual base-year distribution and a smooth function representing deviations from that base.

In the income distribution model, instead of building a unique income distribution for the overall population, the size distributions of income for different household sizes are formed. The rationale of estimating a Lorenz curve for each household size is to meet the requirement that income taxes be levied on the basis of household income. The number of total exemptions reported by the IRS is the population base for the use of estimating income distribution and tax liabilities. In addition, the data are available to estimate each distribution because the returns reported in Statistics of Income are grouped by the number of exemptions other than age or blindness. The number of these exemptions for each household is just the household size. For use in the time-series consumption model, this population base will be later enlarged to include the entire population

The goal of modeling income distributions is to find an approach that not only fits the historical data well, but gives sensible forecasts. Our approach begins with a curve that fits one year of the history perfectly. The distribution in other years will be represented as a linear combination of this base-year distribution and a "perturbation" function. The weights of the two components then become, themselves, a time series. We forecast the income distribution by forecasting these two weights.

The Lorenz curve equation used for modeling is expressed by T as a function of S. The exact income distribution from historical data for the base year is the first part of the Lorenz curve. In this model the base year was chosen as 1981. Thus, the first part of the function is just the exact 1981 income distribution. This part consists of the actual values of T at different points along the x axis. The values of T for 1981 are denoted as T81.

The second component of the function is a "skewed" curve to be added to or subtracted from the base. This curve represents values of T as a function of S. To see the explicit form of the Lorenz curve, let t be the year, h be the household size, and i be the point ventile along the distribution at which the function is evaluated. The entire formula can be expressed as

$$T_{thi} = A_{th}T81_{hi} + B_{th}\{(S_{thi})^{1.5}(\sqrt{2} - S_{thi})^{.5}\} \tag{3.1}$$

In Equation (3.1), $A_{th}$ and $B_{th}$ are the parameters to be estimated. For the year 1981, coefficient A equals 1 and coefficient B equals 0, since the curve matches the historical data perfectly for that year.

The reason for using different values for the exponent of S and ($\sqrt{2}$-S) is to generate the "skewed" curve shown in Figure 3.2. The actual "T81" curves were generally symmetric. The distribution could be given more or less symmetric bow by changing $A_{th}$. To allow the possibility of an asymmetric shift, a skewed second term is used.

To see the relation of T to S at the base year, which is the first part of the function, and the deviations curve from the base, which is the second part of the formula, we drew the curves for household size one. Figure 3.3 shows the actual 1981 household-size-one distribution. Figure 3.4 represents the skewed curve which can be scaled and added or subtracted in Figure 3.3. The curve is skewed more at the upper end. The curve of T, which is plotted against S, varies with the values of parameters A and B. To be more specific, if A is relatively higher and B is relatively lower, then the curve will be more bowed toward the lower end of the distribution, since the increase in inequality for the entire distribution will be partially offset at the upper end by the lower value of B while the increase in A for the lower end will remain. Likewise, if A is relatively lower and B is relatively higher, then the curve will become more bowed at the upper end of the distribution because the effect of parameter B is dominant.

To show that adding the skewed curve to the base curve will yield the curves which can run both ways, we will draw a few graphs by taking different values on the parameters A and B. In Figure 3.5, parameters A and B move in opposite directions from their base values of 1 and 0 so that the lower end is unchanged because the movement of A and B is offset. However, the change in B was not cancelled at the upper end; thus, the overall curve is more skewed toward the upper end of the distribution. In contrast, Figure 3.6 shows that the movement of A and B is offset at the upper end of the curve and the curve is more skewed toward the lower end of the distribution.

FIGURE 3.3

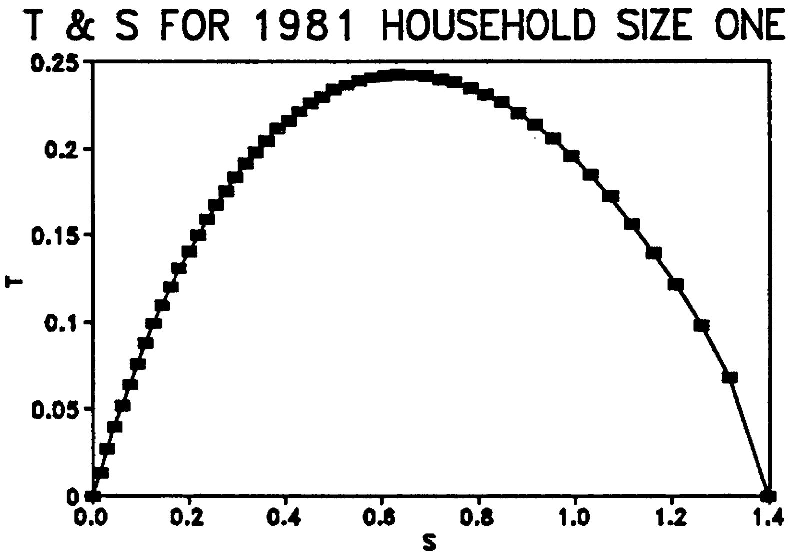



FIGURE 3.4

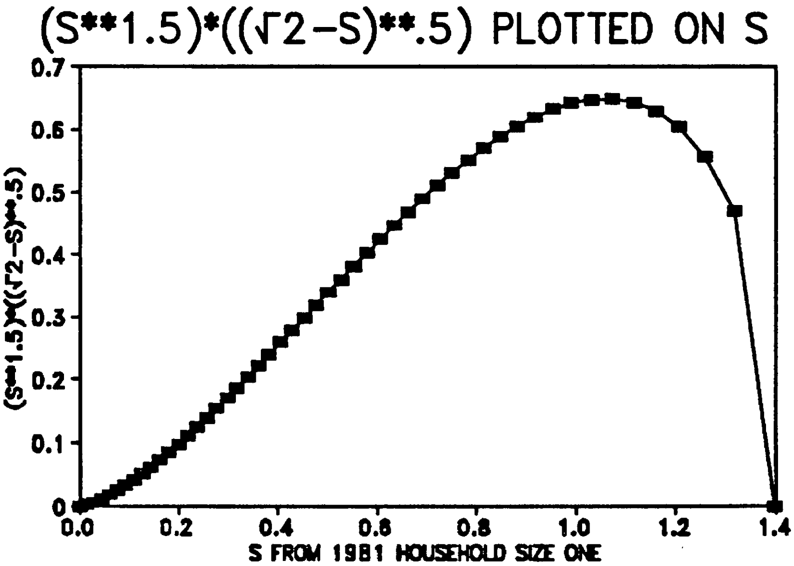


**FIGURE 3.5**

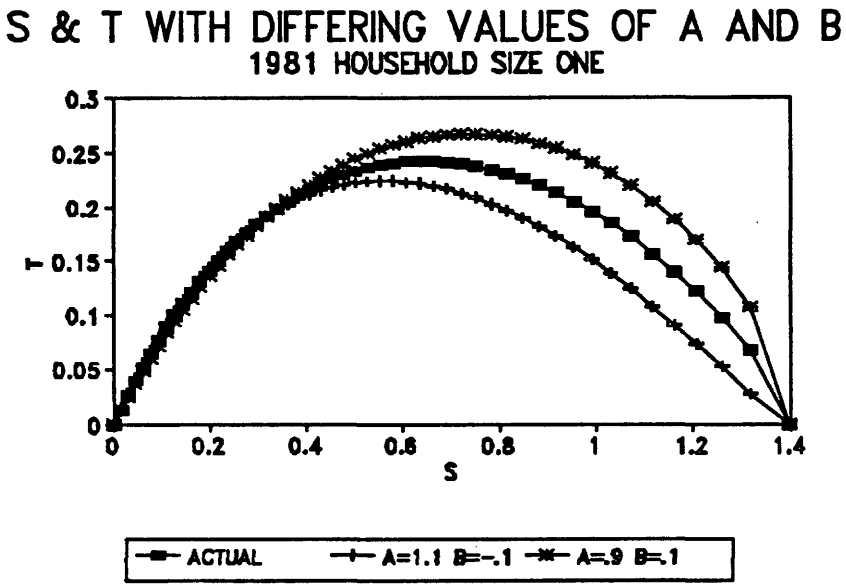
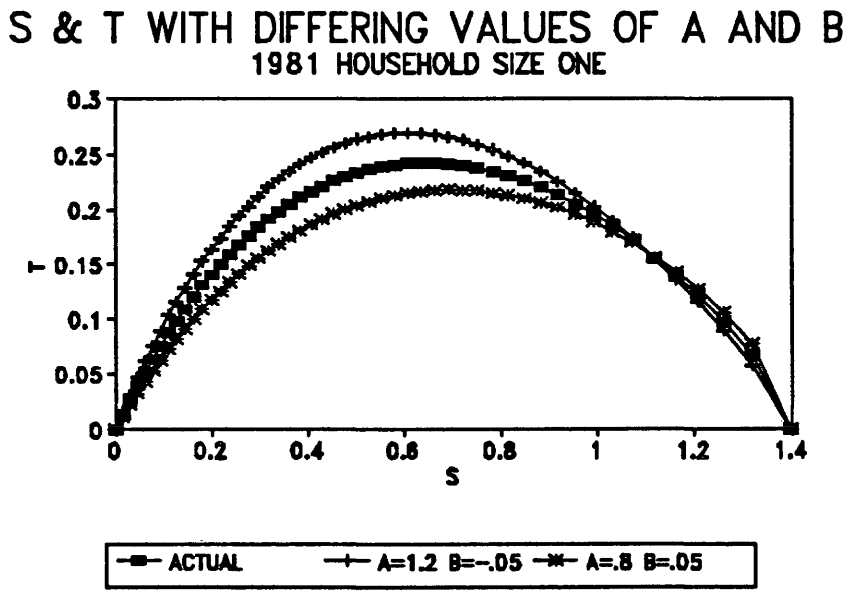



**FIGURE 3.6**



## B. Data and Estimation Procedure

The data used to estimate the size distribution of Adjusted Gross Income is reported in Statistics of Income (SOI), Individual Income Tax Returns, published annually by the IRS. The data come from the section, "Deductions and Exemptions" from tables titled: "All Returns: Exemptions by Type, Number of Exemptions, Sources of Income, by Size of Adjusted Gross Income, returns classified by number of exemptions other than age or blindness." The distribution of grouped data are reported in SOI by the six household sizes. The household sizes are categorized by one through five and six and over. We utilize the data for estimation from 1966 to 1982.[1]

To yield the functional relationship of income distribution from historical data, the parameters A and B have to be estimated for each year and each household size. Firstly, for year t, household size h, and the number of published income brackets i, the cumulative percentages of population, $x_{thi}$, and the corresponding cumulative percentages of income, $y_{thi}$, need to be calculated from raw data for the use of estimation. The number of published income brackets ranged from 15 to 31 for the grouped data in different years.

To determine the cumulative percentages of population for each income bracket, the percent of returns within brackets has to be calculated for each household size. That is, the number of returns in each of the brackets for different household sizes is divided by the total number of returns in the corresponding household size. The cumulative percentage of the total returns in the $j^{th}$ bracket for year t and household size h, $x_{thj}$, is then computed by summing up the percent of

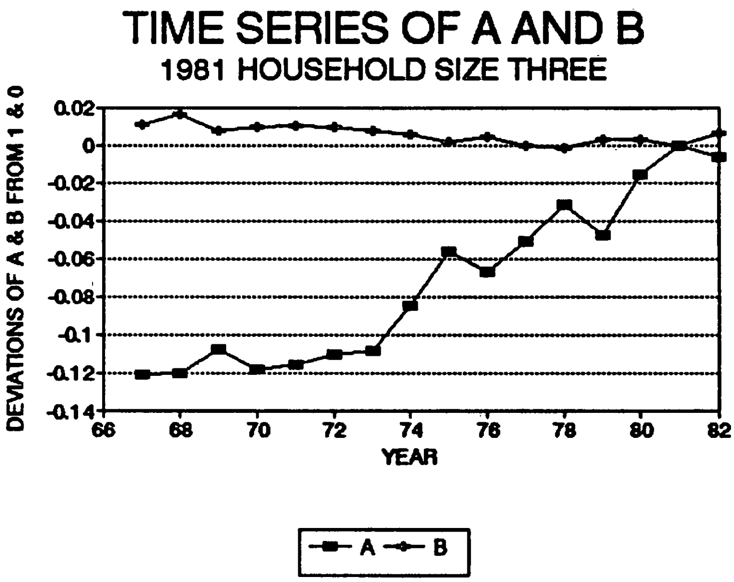
[1]Data on 1967 is left out because it was not published by household size. The more recent data were not used because they were reported by different household size categories. More precisely, the household sizes for later years are categorized by one through four and five and over.

returns from the first to the $j^{th}$ income bracket for household size h in year t. Moreover, to obtain the cumulative number of individuals in each income bracket, the cumulative percentage of the number of returns in that bracket is multiplied by the appropriate household size and the total number of returns in that household size. The corresponding cumulative percentage of income for year t, household size h, and income bracket j, $y_{thj}$, is determined by the procedure used for $x_{thj}$ except that the number of returns is replaced by the amount of income in each bracket.

The cumulative percentages derived for the number of returns and the corresponding amount of income, however, are not equally spaced with respect to the distribution of population. To obtain a distribution which is equally spaced in respect of population, a linear interpolation has to be performed. The object of the linear interpolation is to provide a set of forty equally spaced values of x ranged from .025 to 1.0 and the corresponding set of forty values of y for each year and each household size. The equally spaced values of x and the interpolated values of y are subsequently used to calculate the forty corresponding values of S and T. The values of S and T for each year and each household size are the data required for the estimation of Equation (3.1). Equation (3.1) is regressed by the ordinary least squares. The resulting values for A and B are shown in Table 3.1.

To illustrate the shift in income distribution by looking at the values of A and B, we will provide the time series of these two parameters for the selected household size. Figure 3.7 represents the time series of the deviations of A and B from their base values 1 and 0 for household size 3. The history shows that parameters A and B moved in the opposite directions with A rising while B was falling. Moreover, the variation in parameter A was relatively larger than that of parameter B. Thus, parameter B offset the effect of parameter A at the upper end of the distribution; and the curve became more skewed toward the lower end over this time period.' More precisely, the distribution of income has been getting more unequal at the lower end of the AGI distribution.

**FIGURE 3.7**



The functional relationship between S and T is determined for each curve by estimating Equation (3.1) for each year and each household size. However, this relationship has to be transformed into the cumulative percentages of population and the cumulative percentages of income, since the Lorenz curve is defined in percentage terms. The transformation is done numerically. In Equation (3.1), repeated here for easy reference,

$$T_{thi} = A_{th}T81_{hi} + B_{th}\{(S_{thi})^{1.5}(\sqrt{2} - S_{thi})^{.5}\} \tag{3.1}$$

the constant values of $S_{hi}$ and the estimated values of $A_{th}$ and $B_{th}$ for each curve and each year are used to calculate the values of the transformed T for each year and each household size. The function is then transformed to (x,y) coordinates and a linear interpolation is performed to provide the equally spaced values of x and the corresponding values of y. These interpolated values of x and y are termed grid values. In principle, the number of grid values determines the smoothness of the curve. In our model, fifty grid values of x and y gave a good approximation for the curvature of the Lorenz curve.

### C. Forecasting the Income Distribution

To project the income distribution in the future, the functional parameters, A and B, have to be forecasted. Generally speaking, A and B measure the equality of the distribution of income relative to the base year. If A increases, the Lorenz curve becomes more bowed overall. Namely, the entire distribution of income becomes less equal. If B increases, the curve becomes more bowed particularly at the upper end of the distribution. That is, the income distribution becomes less equal within the high income groups. Thus, increasing either A or B will increase inequality.

In our model, the effects of economic variables on the income distribution are indicated by the magnitude of the parameters A and B. For forecasting, A and B are estimated as functions of the economic variables and are then used to forecast the income distribution. To relate A and B to economic variables, the values of A and B estimated from the historical cross-section data are regressed on unemployment, inflation and the shares of interest and dividend income in total income.

In general, the upper income groups in an income distribution receive a relatively large proportion of their income from investment income, while the lower income groups earn a relatively high proportion of their income from employment or wage income. Thus, unemployment will probably hit the low income groups hardest. As for inflation, its influence on the size distribution may work through several channels, but the overall effect is unclear a priori. In other words, incomes from different sources respond to a general price increase to different degrees. Since the proportions of employment and investment income vary over the distribution, the impact of inflation on the distribution is hard to anticipate.

We formulate the parameters A and B as the linear functions of the unemployment rate, the proportion of net interest and dividend income in aggregate personal income, the inflation rate, and a time trend. The equations estimated for each household size are written as

$$A = c_0 + c_1 * UN + c_2 * PCTINC + c_3 * INFL + c_4 * TIME \tag{3.2}$$

$$B = d_0 + d_1 * UN + d_2 * PCTINC + d_3 * INFL + d_4 * TIME \tag{3.3}$$

In Equation (3.2) and (3.3), UN is the unemployment rate; PCTINC is the percentage of aggregate personal income made up of net interest and dividend income; INFL is the annual percentage change in the GNP deflator; TIME is the time trend; and the

$c_i$'s and $d_i$'s are the parameters to be estimated.

To see how the income distribution is affected by the different variables, we turn to the discussion of the effects of the factors on the parameters A and B. The time trend variable is used in the estimation equations to catch the secular trends and separate them from the cyclical fluctuations. The distribution of income becomes more unequal if income is defined to exclude transfer payments. On the other hand, the income distribution remains roughly constant if the income concept includes transfer payments (Pechman, 1985). Thus, we would expect the overall distribution of Adjusted Gross Income to be less equal over time, since transfer payments are mostly not in AGI. That is, the values of parameter A will be increasing over time; and the estimated coefficient on the time trend variable will be positive. As for parameter B, we expect the coefficient of the time trend for parameter B to be negative so that the higher value of A can be partially offset at the upper end of the distribution but allows the increase in A for the lower part to remain, because we believe that the distribution of personal income has rarely changed and transfer payments have been accruing at the lower end of the distribution. In other words, a negative value for the time trend coefficient for B would mean that the AGI distribution is getting relatively more bowed at the lower end.

The relation of unemployment to the income distribution can be described by the empirical findings of Murphy and Topel (1987): "...Persons who experience unemployment now remain unemployed for a much longer period, on average, and persons with past unemployment are more likely to experience future unemployment spells. Both of the latter forces tend to increase inequality as unemployment rises." Therefore, taking into account the facts that unemployment means low or no income and the impact of unemployment is greater on lower income groups, we expect that unemployment rate is positively correlated with A while negatively correlated with B.

That is, the increase in unemployment rate will cause the entire distribution to be more unequal, but the upper end of the distribution will become relatively more equal.

The percent of interest and dividend income in the aggregate personal income is expected to have positive impact on both A and B. Although some aged persons in the lower income groups receive relatively large portions of their income from the interest and dividends, most of this type income goes to those in the top income groups. Thus, as the percentage of net interest and dividend income increases, it is expected that the distribution of income becomes more unequal both for the entire and the upper end of the distribution.

The evidence of the impact of inflation on income distribution is limited, so we can hardly identify the expected results. Some studies show that inflation has little effect on the distribution of money income (Minarik, 1970), while others indicate that inflation has an adverse effect on some lower income groups (Metcalf, 1969).

The historical values of the inflation rate together with the unemployment rate and the share of net interest and dividend income in aggregate personal income are listed in Table 3.2. The time-series regression results for Equation (3.2) and (3.3) for each household size are shown in Table 3.3. Most of the estimated coefficients have the signs which are consistent with our prior expectations. Table 3.3 shows the values of all the coefficients and those which are significant at 10% level are indicated by an asterisk (*). Inflation is significant only for household size one. Thus, our result seems to be close to Minarik's study.

To complete the projection of the income distribution, a few other variables need to be forecasted. In our income distribution model, income is distributed over the population represented on tax returns with positive AGIs. This population is referred to as "total exemptions", or more precisely total exemptions other than age or blindness. This population has to be forecasted with non-institutional population. The forecasts of "total exemptions" are shown in Table 3.4. In addition, the share of total population and the share of total AGI from each of the household size categories has to be forecasted. These shares are formulated as a linear function of a constant term and the percent of the population sixty-five years or older. This explanatory variable is used because it catches the time trend and, more importantly, it provides reasonable looking forecasts. The forecasting results are represented in Table 3.5 and Table 3.6 respectively.

## II. Income Tax Model

The income distribution model has been built for before-tax income. For the consumption function, we need the distribution of after-tax income. The income tax model provides the way from one to the other.

The basic idea in calculating the income tax is to compute the "standard taxes" based on the standard deductions, and rates and brackets from the tax forms, and then to compare these "standard taxes" with taxes actually collected, the "effective taxes". In forecasting, we need the tax schedules as found on the tax returns, and functions for the ratio of effective taxes to standard taxes.

In general, "effective" taxes will always be less than "standard" taxes. The fraction of the effective tax rates to the standard tax rates varies by income ventiles; moreover, it changes over time. It is expected that the larger discrepancies of standard taxes and effective taxes arise in the higher income ventiles. In the historical work, the standard tax rates paid by the average member of each income group were calculated by assuming that this average household takes the standard deduction and has no other special items. These taxes were computed by using the tax rate schedules in the form 1040.

The effective tax rates, on the other hand, were calculated by dividing the amount of income taxes by the amount of AGI in each bracket reported in SOI. These rates were then linearly interpolated to get a distribution over the twenty income ventiles. Both the standard and the actual tax rates were calculated for each household size separately.

Since the consumption functions do not require the distribution of income by household size, the standard and effective taxes distribution were collapsed to a single distribution of these taxes by income per capita. Thus, the tax model estimates the ratios of effective-to-standard tax rates for each of the twenty ventiles in the single distribution of income, not for twenty ventiles for each of six household sizes. These ratios are to be used in forecasting.

How is this collapsing from six to one distributions done? The fundamental procedure is to obtain the single distribution of income by determining the cutoff per capita incomes in the aggregate ventiles. We define cutoff per capita income as the upper bound of per capita income in that income ventile. Since the notion of the cutoff incomes will be repeatedly used in the following, we will derive here the cutoff incomes for easy reference.

Before calculating the cutoff incomes, we will introduce some definitions to be used in the computation. Firstly, we will convert the percentages of population and income in our income distributions into the number of people and the dollar amount of income for each year and each household size in each grid cell. To make this transformation, let $X_{thg}$ be the number of individuals and $Y_{thg}$ be the dollar amount of income for year t, household size h, and grid cell g. Further, we assume that $N_{th}$ is the total number of population and $Q_{th}$ is the total amount of income for year t and household size h. Thus, the formulas can be written as follows:

$$X_{thg} = (x_{thg} - x_{thg-1}) * N_{th}$$

$$Y_{thg} = (y_{thg} - y_{thg-1}) * Q_{th}$$

Per capita income, PCI, is then calculated by

$$PCI_{thg} = \frac{Y_{thg}}{X_{thg}} \tag{3.4}$$

for year t, household size h, and grid cell g.

Lastly, the cutoff per capita income, PCC, between grid cell g and g+1 is defined by

$$PCC_{thg} = \frac{(PCI_{thg} + PCI_{thg+1})}{2} \tag{3.5}$$

for year t and household size h.

We now can go into the computation of the cutoff per capita incomes in the aggregate distribution. The cutoff per capita income for aggregate ventile i, $PCC_i$, will be determined such that ventile i contains exactly one twentieth of the total population whose income fell between the PCC in the current ventile, $PCC_i$, and the PCC in the previous one, $PCC_{i-1}$ ( By definition, $PCC_0 = 0$ ). To calculate this for year t, an initial guess is first made for $PCC_{ti}$. $PCC_{ti}$ is the same for all the household sizes. For year t and household size h, we will denote $X^c_{thg}$ the cumulative number of people in grid cell g, and $X^v_{thi}$ the cumulative number of people in ventile i. Thus, if the value of $PCC_{ti}$ falls between the grid values of $PCC_{thg}$ and $PCC_{thg+1}$, the corresponding cumulative number of individuals is given by a linear interpolation

$$X^v_{thi} = \frac{(PCC_{ti} - PCC_{thg})}{(PCC_{thg+1} - PCC_{thg})} * (X^c_{thg+1} - X^c_{thg}) + X^c_{thg} \tag{3.6}$$

for year t, household size h, and ventile i.

Therefore, the number of people in the $i^{th}$ ventile of household size h in year t, $X_{thi}$, is the difference of $X^v_{thi}$ and $X^v_{thi-1}$, $X^v_{thi} - X^v_{thi-1}$. This has to be done for each year and each household size. The $X_{thi}$'s are then summed over the household sizes h for the given year. If this amount is lower than 5 percent of the total population of that year, another guess is made at a higher value of $PCC_{ti}$. On the other hand, if that sum is greater than 5 percent of the population, $PCC_{ti}$ is lowered by a small amount. The process is repeated until the convergence is achieved. This approach has to be done for each of the first nineteen income ventiles.

The computed $PCC_{ti}$'s are then used to determine the amount of income in ventile i for year t and household size h, $Y^v_{thi}$. The calculation is done by Equation (3.6) with X being replaced by Y. Since the top income ventile cannot be expressed by the cutoff per capita income, the amount of income in it falls as a residual. For the index of the distribution of income, the cutoff incomes of the first nineteen ventiles are divided by the average income, and the top ventile is represented by an overall percentage of total income. The details of population and income distribution for the selected years are shown in Table 3.7. Table 3.8 shows the distribution of ventile's cutoff per capita AGI. Table 3.9 shows the indexes of the distribution of AGI for the selected years.

We now turn to the forecasting of effective tax rates. For forecasting, the tax parameters for the standard taxes are given by the tax law assumptions. The standard tax rates were calculated for each household size, and then aggregated into a single rate for each income ventile over the six household sizes. The income shares of the household sizes were the weights for the weighted-average scheme. The estimated ratios of effective-to-standard tax rates were then applied to the aggregate distribution of the standard tax rates to obtain the distribution of the effective tax rates.

The forecasted effective tax rates were incorporated in the aggregate distribution of AGI to determine the after-tax AGI distribution. To provide the effective tax rates at cutoff incomes, a linear interpolation was performed. The effective tax rates at cutoff incomes were then used to remove federal income taxes from the cutoff AGIs. Table 3.10 shows the average effective and standard tax rates for some selected income ventiles. Table 3.11 represents the estimated ratios of effective-to-standard tax rates.

### III. Distribution of Disposable Income

#### A. Adjustment Between AGI and PI

The SOI data used for estimating income distribution is AGI. In the consumption model, however, consumption expenditures are determined by the level of personal income. More specifically, it is the disposable personal income that affects the consumption tendencies. However, if we can get the distribution of PI, we can use our tax function to convert it to disposable personal income. Therefore, we have to reconcile between the distribution of AGI and the distribution of PI.

The differences between AGI and PI come from several items. Table 8.14 in National Income and Product Accounts (NIPA) shows the details of the relationship between PI and AGI. We rearrange those divergences by combining some and disaggregating others. In our model the reconciliation items are summarized by 12 categories. The first five categories are the items of transfer payments. They are: 1) OASDI - Old age, survivors and disability insurance, 2) HI - Hospital and supplementary medical insurance, 3) UI - Unemployment insurance, 4) RET - Retirement income and other items, and 5) WELF - Welfare and all the other means-tested programs. The rest of the categories are: 6) OLI - Other labor income, 7) IMPU - Imputed income in personal income, 8) VESI - Retained investment and other income, 9) EXCL - Other items which are exempt or excluded from AGI, 10) CONTR - Personal contributions for social insurance, 11) CAPG - Capital gains, and 12) GAP - AGI gap.

The relation of PI, AGI, and these reconciliation items can be represented by the following table:

| | | |
|---|---|---|
| AGI | = PI | |
| | - OASDI | (Old age, survivors and disability insurance) |
| | - HI | (Hospital and supplementary medical insurance) |
| | - UI | (Unemployment insurance) |
| | - RET | (Retirement income and other items) |
| | - WELF | (Welfare and all the other means-tested programs) |
| | - OLI | (Other labor income) |
| | - IMPU | (Imputed income in personal income) |
| | - VESI | (Retained investment and other income) |
| | - EXCL | (Other items which are exempt or excluded from AGI) |
| | + CONTR | (Personal contributions for social insurance) |
| | + CAPG | (Capital gains) |
| | - GAP | (AGI gap) |

The aggregate PI is determined in the macro model. To calculate the aggregate AGI, all the items except Personal contributions for social insurance and Capital gains are subtracted from PI. To convert from the size distribution of AGI to the size distribution of personal income, the reconciliation items have to be forecasted individually and then distributed over the twenty income ventiles. The forecasts in the reconciliation items are presented in the following section.

According to NIPA table 3.11, transfer payments are composed of twelve principal elements. The twelve transfer payment components are formulated individually in the macro model as a function of time, the price level, and the population aged 65 and over and are forecasted separately at the aggregate level. Further, some of the forecasted items are combined into one category and others are used individually to provide our five transfer payment categories. The relationship between the transfer payment components in NIPA table 3.11 along with the reconciliation items from NIPA table 8.14 and our definitions for reconciliation items is shown in Table 3.12. The NIPA tables 3.11 and 8.14 are reproduced in Figure 3.8 and Figure 3.9 for the purpose of reference.

# FIGURE 3.8

## NIPA Table 3.11

### Table 3.11.—Government Transfer Payments to Persons

[Billions of dollars]

| | Line | 1986 | 1987 | 1988 | 1989 |
|---|---|---|---|---|---|
| Government transfer payments to persons | 1 | 496.8 | 521.3 | 557.4 | 604.5 |
| Federal | 2 | 386.0 | 401.6 | 425.7 | 458.6 |
| Benefits from social insurance funds | 3 | 338.0 | 352.8 | 373.0 | 402.1 |
| Old-age, survivors, and disability insurance | 4 | 193.6 | 201.0 | 213.9 | 227.3 |
| Hospital and supplementary medical insurance | 5 | 75.6 | 81.9 | 86.7 | 97.9 |
| Unemployment insurance | 6 | 16.5 | 14.6 | 13.6 | 14.8 |
| State | 7 | 16.0 | 14.2 | 13.1 | 14.4 |
| Railroad employees | 8 | .2 | .1 | .1 | .1 |
| Federal employees | 9 | .3 | .3 | .3 | .3 |
| Special unemployment benefits | 10 | | | | ...... |
| Federal employee retirement | 11 | 42.2 | 44.9 | 48.1 | 50.6 |
| Civilian [1] | 12 | 24.4 | 26.5 | 28.6 | 29.9 |
| Military [2] | 13 | 17.9 | 18.4 | 19.5 | 20.7 |
| Railroad retirement | 14 | 6.4 | 6.5 | 6.7 | 7.0 |
| Veterans life insurance | 15 | 1.7 | 1.7 | 1.7 | 1.8 |
| Workers' compensation | 16 | 1.1 | 1.2 | 1.3 | 1.4 |
| Military medical insurance [3] | 17 | .9 | 1.0 | 1.2 | 1.3 |
| Veterans benefits | 18 | 14.9 | 14.8 | 15.0 | 15.3 |
| Pension and disability | 19 | 14.2 | 14.2 | 14.6 | 15.0 |
| Readjustment | 20 | .7 | .6 | .4 | .4 |
| Other [4] | 21 | | | | ...... |
| Food stamp benefits | 22 | 10.6 | 10.6 | 11.2 | 12.2 |
| Black lung benefits | 23 | 1.6 | 1.5 | 1.5 | 1.5 |
| Supplemental security income | 24 | 9.5 | 10.0 | 10.7 | 11.6 |
| Direct relief | 25 | | | | ...... |
| Earned income credit | 26 | 1.4 | 1.4 | 2.9 | 4.0 |
| Other [5] | 27 | 10.1 | 10.5 | 11.4 | 11.9 |
| State and local | 28 | 110.9 | 119.7 | 131.6 | 145.9 |
| Benefits from social insurance funds | 29 | 33.9 | 37.6 | 42.6 | 46.9 |
| State and local employee retirement | 30 | 28.7 | 31.4 | 35.9 | 39.5 |
| Temporary disability insurance | 31 | 1.3 | 1.5 | 1.6 | 1.8 |
| Workers' compensation | 32 | 3.9 | 4.7 | 5.0 | 5.6 |
| Public assistance | 33 | 70.7 | 75.6 | 82.0 | 91.2 |
| Medical care | 34 | 45.4 | 49.8 | 55.0 | 62.9 |
| Aid to families with dependent children | 35 | 16.4 | 16.7 | 17.3 | 18.0 |
| Supplemental security income | 36 | 2.6 | 2.9 | 3.1 | 3.4 |
| General assistance | 37 | 2.5 | 2.6 | 2.7 | 2.8 |
| Energy assistance | 38 | 2.0 | 1.7 | 1.8 | 1.5 |
| Other [6] | 39 | 1.7 | 1.9 | 2.3 | 2.7 |
| Education | 40 | 3.9 | 4.0 | 4.3 | 4.8 |
| Employment and training | 41 | 1.0 | .9 | .9 | 1.0 |
| Other [7] | 42 | 1.5 | 1.6 | 1.8 | 2.0 |

1. Consists of civil service, foreign service, Public Health Service officers, Tennessee Valley Authority, and several small retirement programs.
2. Includes the Coast Guard.
3. Consists of payments for medical services for dependents of active duty military personnel at nonmilitary facilities.
4. Consists of mustering out pay, terminal leave pay, and adjusted compensation benefits.
5. Consists largely of payments to nonprofit institutions, aid to students, and payments for medical services for retired military personnel and their dependents at nonmilitary facilities.
6. Consists of emergency assistance and medical insurance premium payments paid on behalf of indigents.
7. Consists largely of foster care, veterans benefits, Alaska dividends, and crime victim payments.

# FIGURE 3.9

## NIPA Table 8.14

**Table 8.14.—Comparison of Personal Income in the National Income and Product Accounts (NIPA's) with Adjusted Gross Income as Published by the Internal Revenue Service (IRS)**

[Billions of dollars]

| | Line | 1986 | 1987 | 1988 | 1989 |
|---|---|---|---|---|---|
| **Personal income, NIPA's** | 1 | 3,526.2 | 3,766.4 | 4,070.8 | 4,384.3 |
| Less: Portion of personal income not included in adjusted gross income. | 2 | 1,100.6 | 1,093.9 | 1,153.7 | ........ |
| Transfer payments except taxable military retirement and taxable government pensions. | 3 | 440.8 | 458.4 | 486.3 | ........ |
| Other labor income except fees | 4 | 195.7 | 205.5 | 221.2 | ........ |
| Imputed income in personal income | 5 | 71.1 | 87.1 | 87.4 | 82.6 |
| Investment income of life insurance carriers and private noninsured pension plans [1]. | 6 | 119.0 | 136.2 | 148.7 | 161.9 |
| Investment income received by nonprofit institutions or retained by fiduciaries. | 7 | 33.0 | 33.4 | 36.5 | ........ |
| Differences in accounting treatment between NIPA's and tax regulations, net. | 8 | 97.7 | 108.1 | 109.9 | ........ |
| Other personal income exempt or excluded from adjusted gross income. | 9 | ·143.3 | 65.3 | 63.6 | ........ |
| Plus: Portion of adjusted gross income not included in personal income. | 10 | 397.8 | 432.0 | 550.3 | ........ |
| Personal contributions for social insurance | 11 | 161.9 | 172.9 | 194.1 | 212.8 |
| Net gain from sale of assets | 12 | 133.6 | 138.0 | 165.6 | ........ |
| Taxable private pensions | 13 | 94.1 | 110.0 | 127.6 | ........ |
| Small business corporation income | 14 | 7.5 | 17.9 | 39.8 | ........ |
| Other types of income | 15 | .6 | −6.9 | 23.2 | ........ |
| **Equals: BEA-derived adjusted gross income** | 16 | 2,823.4 | 3,104.4 | 3,467.4 | ........ |
| **Adjusted gross income, IRS** | 17 | 2,481.7 | 2,773.8 | 3,130.7 | ........ |
| **Adjusted gross income (AGI) gap [2]** | 18 | 341.7 | 330.6 | 336.7 | ........ |
| AGI gap (line 18) as a percentage of BEA-derived AGI (line 16). | 19 | 12.1 | 10.6 | 9.7 | ........ |
| AGI of IRS (line 17) as a percentage of BEA-derived AGI (line 16). | 20 | 87.9 | 89.4 | 90.3 | ........ |

1. Equals imputed interest received by persons from life insurance carriers and private noninsured pension plans as shown in table 8.8 (line 50).

2. Consists of income earned by low-income individuals who are not required to file income tax returns, unreported income that is included in the NIPA measure, and gross errors and omissions in lines 2 through 15. Also includes the net effect of errors in the IRS adjusted gross income (line 17) and NIPA personal income (line 1) measures. Such errors can arise from the sample used by IRS to estimate line 17 and from the data sources used by BEA to estimate line 1.

The sixth reconciliation item, other labor income, is estimated as a function of labor compensation for private workers, federal workers, and state and local government workers. Those labor compensation categories are forecasted in the macro model. The next item, imputed income in personal income, is estimated as a function of interest income, the mortgage rate, and time. Interest income and the mortgage rate are also forecasted in the macro model.

The eighth item, retained investment and other income, is calculated as a function of treasury-bill rate, personal income, and time. The ninth item, other items which are exempt or excluded from AGI, is calculated as a fixed percentage of personal income. The following item, personal contribution for social insurance, is calculated as a function of private labor compensation.

Capital gains are forecasted by the variable of the AAA bond rate minus the lagged percent change in the GNP deflator and PI. The last item, the AGI gap, is estimated to be a flat percentage of PI. The estimation results of the reconciliation items other than transfer payments are shown in Table 3.13.

The next step is to transform the aggregate amount of the reconciliation items into the size distribution. The conversion from the distribution of AGI to the distribution of PI is to add to each AGI ventile's $PCC_{ti}$ the corresponding aggregate amount of the per capita reconciliation cutoffs. Therefore, the distribution of each of the reconciliation items over twenty income ventiles has to be determined.

In the model, the size distribution of reconciliation items are either assumed to be identical or similar to that of AGI or derived from the particular data sources. The distribution of UI (unemployment insurance), CAPG (capital gains), and RET (retirement income) were constructed by the data reported in SOI by AGI bracket. The distribution of OASDI (old age, survivors and disability income) and WELF (welfare) were obtained by using the data reported by the Census Bureau and Social

Security Administration. HI (hospital and supplementary medical insurance) was assumed to be distributed equally over the twenty income ventiles. EXCL (exclusion) was assumed to be distributed less equally than capital gains. CONTR (contributions for social insurance) was assumed to be distributed much like AGI except the top two ventiles. VESI (retained investment income) was assumed to be distributed similarly as pension and annuity income. OLI (other labor income), IMPU (imputed income), and GAP (AGI gap) were assumed to be distributed in a similar pattern with AGI. The resulting distributions are represented by a matrix whose columns contain the share of each item going to each ventile.[2] The matrix is shown in Table 3.14.

To calculate the aggregate amount of per capita reconciliation cutoffs, the vector of reconciliation items is multiplied by the corresponding column of the individual shares. Thus, summing over the twelve items for each of the ventiles, we may obtain a 20x1 vector with each element representing the total dollar amount of the reconciliation items for that ventile. The per capita cutoff reconciliation is then determined by a linear interpolation and is added to the corresponding AGI cutoff by the income distribution model.

**B. Distribution of Disposable PI**

To generate the distribution of after-tax AGI, all the taxes have to be removed. Federal income taxes at each cutoff income are determined by multiplying the pre-tax cutoff AGI by the effective tax rates on that cutoff income. The effective tax rates at the cutoff income level are calculated by linear interpolation. Further, four other types of personal taxes need to be removed. They are: State and local income taxes, State and local other taxes, Federal nontaxes, and State and local

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[2]This matrix, reconciliation bridge, was derived in Pollock (1986).

nontaxes. In our tax model, state and local income tax is calculated as a fixed percentage of federal income taxes, and other taxes are calculated as percentages of personal income.

The distribution of disposable PI can then be obtained by adding the aggregate amount of per capita reconciliation cutoffs to the corresponding after-tax AGI cutoffs. However, an adjustment must be made for the cutoff PI's. The population reported by the IRS contains only the tax filers who have positive AGIs. In our consumption model, we need the distribution of disposable personal income over the entire population. The historical data show that about 7.5 percent of the total population was left out of the population in SOI. Thus, let $v_i$ be the unadjusted and $v_i^*$ the adjusted cutoff income for ventile i, the adjustment can be expressed as follows

$$v_2^* = .65 v_1 \tag{3.7}$$

$$v_i^* = v_{i-1} - (.075*(20-i)-1)*(v_{i-1}-v_{i-2}) \qquad i=3,\ldots,6 \tag{3.8}$$

$$v_i^* = v_i - .075*(20-i)*(v_i - v_{i-1}) \qquad i=7,\ldots,19 \tag{3.9}$$

The adjusted cutoff income for the first ventile is computed by the census data on money income. As for the top income ventile, the number of individuals in this ventile is increased by part of the tax filers who were in the nineteenth ventile. Thus, the proportion of income received by the individuals in the adjusted top income ventile in total income will increase by about 7.5 percent.

Finally, an index of disposable personal income distribution has to be constructed for use in the consumption model. The index for the first nineteen ventiles is defined as the cutoff per capita personal income divided by the average per capita personal income. The twentieth index is defined as an overall average of the total personal income. Table 3.15 shows the indexes for some selected years.

**TABLE 3.1**

**Estimation Results for Parameters A and B**

| | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| YEAR | 1966 | HH SIZE | 1 | YEAR | 1966 | HH SIZE | 2 | YEAR | 1966 | HH SIZE | 3 |
| RSQ | 0.9977 | RBARSQ | 0.9976 | RSQ | 0.9980 | RBARSQ | 0.9979 | RSQ | 0.9960 | RBARSQ | 0.9959 |
| RHO | 0.9191 | MAPE | 2.9376 | RHO | 0.7895 | MAPE | 1.3637 | RHO | 0.8620 | MAPE | 2.3768 |
| A | 1.0024 | T-STAT | 152.20 | A | 0.9737 | T-STAT | 175.82 | A | 0.8791 | T-STAT | 129.28 |
| B | 0.0254 | T-STAT | 8.24 | B | 0.0013 | T-STAT | 0.60 | B | 0.0113 | T-STAT | 4.73 |
| YEAR | 1966 | HH SIZE | 4 | YEAR | 1966 | HH SIZE | 5 | YEAR | 1966 | HH SIZE | 6 |
| RSQ | 0.9956 | RBARSQ | 0.9954 | RSQ | 0.9963 | RBARSQ | 0.9962 | RSQ | 0.9946 | RBARSQ | 0.9944 |
| RHO | 0.5675 | MAPE | 2.1708 | RHO | 0.4519 | MAPE | 2.0788 | RHO | 0.6079 | MAPE | 3.0645 |
| A | 0.8655 | T-STAT | 118.50 | A | 0.8573 | T-STAT | 124.24 | A | 0.7901 | T-STAT | 95.50 |
| B | 0.0180 | T-STAT | 7.75 | B | 0.0186 | T-STAT | 8.41 | B | 0.0216 | T-STAT | 7.60 |
| YEAR | 1968 | HH SIZE | 1 | YEAR | 1968 | HH SIZE | 2 | YEAR | 1968 | HH SIZE | 3 |
| RSQ | 0.9989 | RBARSQ | 0.9989 | RSQ | 0.9968 | RBARSQ | 0.9967 | RSQ | 0.9913 | RBARSQ | 0.9910 |
| RHO | 0.8881 | MAPE | 1.5134 | RHO | 0.8905 | MAPE | 1.6565 | RHO | 0.9393 | MAPE | 3.1845 |
| A | 1.0181 | T-STAT | 228.22 | A | 0.9676 | T-STAT | 138.08 | A | 0.8801 | T-STAT | 87.97 |
| B | 0.0208 | T-STAT | 9.96 | B | 0.0088 | T-STAT | 3.15 | B | 0.0162 | T-STAT | 4.60 |
| YEAR | 1968 | HH SIZE | 4 | YEAR | 1968 | HH SIZE | 5 | YEAR | 1968 | HH SIZE | 6 |
| RSQ | 0.9916 | RBARSQ | 0.9914 | RSQ | 0.9936 | RBARSQ | 0.9934 | RSQ | 0.9917 | RBARSQ | 0.9915 |
| RHO | 0.8964 | MAPE | 2.9870 | RHO | 0.8814 | MAPE | 2.5788 | RHO | 0.9151 | MAPE | 3.2916 |
| A | 0.8688 | T-STAT | 87.55 | A | 0.8430 | T-STAT | 92.66 | A | 0.7956 | T-STAT | 77.93 |
| B | 0.0243 | T-STAT | 7.73 | B | 0.0308 | T-STAT | 10.37 | B | 0.0269 | T-STAT | 7.69 |
| YEAR | 1969 | HH SIZE | 1 | YEAR | 1969 | HH SIZE | 2 | YEAR | 1969 | HH SIZE | 3 |
| RSQ | 0.9987 | RBARSQ | 0.9987 | RSQ | 0.9947 | RBARSQ | 0.9948 | RSQ | 0.9903 | RBARSQ | 0.9900 |
| RHO | 0.9054 | MAPE | 1.6240 | RHO | 0.9192 | MAPE | 2.0067 | RHO | 0.9194 | MAPE | 3.2512 |
| A | 1.0215 | T-STAT | 213.01 | A | 0.9828 | T-STAT | 114.38 | A | 0.8924 | T-STAT | 84.93 |
| B | 0.0173 | T-STAT | 7.71 | B | -0.0063 | T-STAT | -1.84 | B | 0.0079 | T-STAT | 2.14 |
| YEAR | 1969 | HH SIZE | 4 | YEAR | 1969 | HH SIZE | 5 | YEAR | 1969 | HH SIZE | 6 |
| RSQ | 0.9904 | RBARSQ | 0.9901 | RSQ | 0.9908 | RBARSQ | 0.9905 | RSQ | 0.9868 | RBARSQ | 0.9864 |
| RHO | 0.9234 | MAPE | 3.1548 | RHO | 0.8665 | MAPE | 3.1815 | RHO | 0.9123 | MAPE | 3.9820 |
| A | 0.8685 | T-STAT | 83.46 | A | 0.8483 | T-STAT | 78.81 | A | 0.8115 | T-STAT | 63.96 |
| B | 0.0166 | T-STAT | 5.03 | B | 0.0253 | T-STAT | 7.33 | B | 0.0197 | T-STAT | 4.54 |
| YEAR | 1970 | HH SIZE | 1 | YEAR | 1970 | HH SIZE | 2 | YEAR | 1970 | HH SIZE | 3 |
| RSQ | 0.9993 | RBARSQ | 0.9992 | RSQ | 0.9990 | RBARSQ | 0.9989 | RSQ | 0.9979 | RBARSQ | 0.9979 |
| RHO | 0.8481 | MAPE | 1.0799 | RHO | 0.7542 | MAPE | 1.2057 | RHO | 0.8058 | MAPE | 1.9257 |
| A | 1.0118 | T-STAT | 287.17 | A | 0.9646 | T-STAT | 245.98 | A | 0.8824 | T-STAT | 176.85 |
| B | 0.0017 | T-STAT | 1.05 | B | -0.0026 | T-STAT | -1.67 | B | 0.0099 | T-STAT | 5.62 |
| YEAR | 1970 | HH SIZE | 4 | YEAR | 1970 | HH SIZE | 5 | YEAR | 1970 | HH SIZE | 6 |
| RSQ | 0.9978 | RBARSQ | 0.9977 | RSQ | 0.9979 | RBARSQ | 0.9978 | RSQ | 0.9977 | RBARSQ | 0.9976 |
| RHO | 0.6584 | MAPE | 1.6616 | RHO | 0.6288 | MAPE | 1.3586 | RHO | 0.6911 | MAPE | 2.0974 |
| A | 0.8755 | T-STAT | 166.01 | A | 0.8985 | T-STAT | 165.83 | A | 0.8491 | T-STAT | 150.29 |
| B | 0.0163 | T-STAT | 9.69 | B | 0.0150 | T-STAT | 8.57 | B | 0.0154 | T-STAT | 7.88 |
| YEAR | 1971 | HH SIZE | 1 | YEAR | 1971 | HH SIZE | 2 | YEAR | 1971 | HH SIZE | 3 |
| RSQ | 0.9993 | RBARSQ | 0.9993 | RSQ | 0.9988 | RBARSQ | 0.9987 | RSQ | 0.9982 | RBARSQ | 0.9982 |
| RHO | 0.8351 | MAPE | 1.0061 | RHO | 0.8079 | MAPE | 1.4283 | RHO | 0.7961 | MAPE | 1.3183 |
| A | 1.0106 | T-STAT | 294.19 | A | 0.9590 | T-STAT | 223.78 | A | 0.8844 | T-STAT | 191.79 |
| B | 0.0050 | T-STAT | 3.10 | B | -0.0020 | T-STAT | -1.18 | B | 0.0107 | T-STAT | 6.60 |
| YEAR | 1971 | HH SIZE | 4 | YEAR | 1971 | HH SIZE | 5 | YEAR | 1971 | HH SIZE | 6 |
| RSQ | 0.9981 | RBARSQ | 0.9980 | RSQ | 0.9984 | RBARSQ | 0.9984 | RSQ | 0.9979 | RBARSQ | 0.9978 |
| RHO | 0.5579 | MAPE | 1.4739 | RHO | 0.4606 | MAPE | 1.1835 | RHO | 0.6807 | MAPE | 2.1363 |
| A | 0.9000 | T-STAT | 180.83 | A | 0.9194 | T-STAT | 194.81 | A | 0.8658 | T-STAT | 158.26 |
| B | 0.0151 | T-STAT | 9.52 | B | 0.0141 | T-STAT | 9.27 | B | 0.0157 | T-STAT | 8.31 |

**TABLE 3.1**

**Estimation Results for Parameters A and B (Continued)**

| | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| YEAR | 1972 | HH SIZE | 1 | YEAR | 1972 | HH SIZE | 2 | YEAR | 1972 | HH SIZE | 3 |
| RSQ | 0.9995 | RBARSQ | 0.9995 | RSQ | 0.9992 | RBARSQ | 0.9992 | RSQ | 0.9985 | RBARSQ | 0.9984 |
| RHO | 0.8311 | MAPE | 1.3489 | RHO | 0.7192 | MAPE | 1.1668 | RHO | 0.8460 | MAPE | 1.7184 |
| A | 1.0200 | T-STAT | 345.39 | A | 0.9566 | T-STAT | 276.29 | A | 0.8900 | T-STAT | 206.22 |
| B | 0.0008 | T-STAT | 0.55 | B | 0.0001 | T-STAT | 0.05 | B | 0.0094 | T-STAT | 6.20 |
| YEAR | 1972 | HH SIZE | 4 | YEAR | 1972 | HH SIZE | 5 | YEAR | 1972 | HH SIZE | 6 |
| RSQ | 0.9986 | RBARSQ | 0.9986 | RSQ | 0.9992 | RBARSQ | 0.9992 | RSQ | 0.9979 | RBARSQ | 0.9979 |
| RHO | 0.4009 | MAPE | 1.3960 | RHO | 0.3375 | MAPE | 1.1064 | RHO | 0.8013 | MAPE | 2.1303 |
| A | 0.8951 | T-STAT | 215.01 | A | 0.8842 | T-STAT | 269.19 | A | 0.8616 | T-STAT | 162.15 |
| B | 0.0155 | T-STAT | 11.66 | B | 0.0176 | T-STAT | 16.68 | B | 0.0148 | T-STAT | 8.05 |
| YEAR | 1973 | HH SIZE | 1 | YEAR | 1973 | HH SIZE | 2 | YEAR | 1973 | HH SIZE | 3 |
| RSQ | 0.9995 | RBARSQ | 0.9994 | RSQ | 0.9991 | RBARSQ | 0.9990 | RSQ | 0.9987 | RBARSQ | 0.9986 |
| RHO | 0.8335 | MAPE | 1.3485 | RHO | 0.8470 | MAPE | 1.1621 | RHO | 0.7979 | MAPE | 1.4881 |
| A | 1.0163 | T-STAT | 333.80 | A | 0.9609 | T-STAT | 259.51 | A | 0.8916 | T-STAT | 221.60 |
| B | 0.0027 | T-STAT | 1.93 | B | -0.0063 | T-STAT | -4.29 | B | 0.0078 | T-STAT | 5.46 |
| YEAR | 1973 | HH SIZE | 4 | YEAR | 1973 | HH SIZE | 5 | YEAR | 1973 | HH SIZE | 6 |
| RSQ | 0.9981 | RBARSQ | 0.9980 | RSQ | 0.9979 | RBARSQ | 0.9979 | RSQ | 0.9975 | RBARSQ | 0.9975 |
| RHO | 0.6354 | MAPE | 1.7425 | RHO | 0.7287 | MAPE | 1.4209 | RHO | 0.8118 | MAPE | 1.9108 |
| A | 0.8894 | T-STAT | 184.83 | A | 0.9045 | T-STAT | 168.91 | A | 0.8635 | T-STAT | 148.29 |
| B | 0.0101 | T-STAT | 6.58 | B | 0.0159 | T-STAT | 9.20 | B | 0.0141 | T-STAT | 7.01 |
| YEAR | 1974 | HH SIZE | 1 | YEAR | 1974 | HH SIZE | 2 | YEAR | 1974 | HH SIZE | 3 |
| RSQ | 0.9997 | RBARSQ | 0.9997 | RSQ | 0.9984 | RBARSQ | 0.9984 | RSQ | 0.9976 | RBARSQ | 0.9975 |
| RHO | 0.7210 | MAPE | 0.9930 | RHO | 0.7616 | MAPE | 1.3547 | RHO | 0.7666 | MAPE | 1.7588 |
| A | 1.0165 | T-STAT | 476.32 | A | 0.9587 | T-STAT | 200.89 | A | 0.9155 | T-STAT | 168.71 |
| B | 0.0007 | T-STAT | 0.74 | B | -0.0054 | T-STAT | -2.85 | B | 0.0054 | T-STAT | 2.81 |
| YEAR | 1974 | HH SIZE | 4 | YEAR | 1974 | HH SIZE | 5 | YEAR | 1974 | HH SIZE | 6 |
| RSQ | 0.9973 | RBARSQ | 0.9972 | RSQ | 0.9970 | RBARSQ | 0.9970 | RSQ | 0.9972 | RBARSQ | 0.9972 |
| RHO | 0.7173 | MAPE | 1.7248 | RHO | 0.8084 | MAPE | 1.5627 | RHO | 0.8221 | MAPE | 1.8918 |
| A | 1.9123 | T-STAT | 156.70 | A | 0.9279 | T-STAT | 144.41 | A | 0.8798 | T-STAT | 141.78 |
| B | 0.0086 | T-STAT | 4.65 | B | 0.0121 | T-STAT | 5.84 | B | 0.0127 | T-STAT | 5.91 |
| YEAR | 1975 | HH SIZE | 1 | YEAR | 1975 | HH SIZE | 2 | YEAR | 1975 | HH SIZE | 3 |
| RSQ | 0.9998 | RBARSQ | 0.9998 | RSQ | 0.9989 | RBARSQ | 0.9989 | RSQ | 0.9979 | RBARSQ | 0.9979 |
| RHO | 0.7668 | MAPE | 0.9102 | RHO | 0.6911 | MAPE | 0.9148 | RHO | 0.7985 | MAPE | 1.4767 |
| A | 1.0136 | T-STAT | 511.76 | A | 0.9799 | T-STAT | 244.33 | A | 0.9440 | T-STAT | 182.47 |
| B | -0.0022 | T-STAT | -2.36 | B | -0.0083 | T-STAT | -5.15 | B | 0.0019 | T-STAT | 1.03 |
| YEAR | 1975 | HH SIZE | 4 | YEAR | 1975 | HH SIZE | 5 | YEAR | 1975 | HH SIZE | 6 |
| RSQ | 0.9975 | RBARSQ | 0.9974 | RSQ | 0.9972 | RBARSQ | 0.9972 | RSQ | 0.9969 | RBARSQ | 0.9968 |
| RHO | 0.7690 | MAPE | 1.3978 | RHO | 0.8215 | MAPE | 1.4801 | RHO | 0.8638 | MAPE | 1.9450 |
| A | 0.9501 | T-STAT | 165.44 | A | 0.9637 | T-STAT | 151.75 | A | 0.9401 | T-STAT | 138.06 |
| B | 0.0058 | T-STAT | 3.15 | B | 0.0075 | T-STAT | 3.65 | B | 0.0065 | T-STAT | 2.73 |
| YEAR | 1976 | HH SIZE | 1 | YEAR | 1976 | HH SIZE | 2 | YEAR | 1976 | HH SIZE | 3 |
| RSQ | 0.9998 | RBARSQ | 0.9998 | RSQ | 0.9990 | RBARSQ | 0.9990 | RSQ | 0.9981 | RBARSQ | 0.9980 |
| RHO | 0.2747 | MAPE | 0.6381 | RHO | 0.7718 | MAPE | 0.9036 | RHO | 0.7888 | MAPE | 1.4527 |
| A | 1.0046 | T-STAT | 620.82 | A | 0.9877 | T-STAT | 250.80 | A | 0.9447 | T-STAT | 188.12 |
| B | -0.0027 | T-STAT | -3.58 | B | -0.0101 | T-STAT | -6.42 | B | 0.0009 | T-STAT | 0.53 |
| YEAR | 1976 | HH SIZE | 4 | YEAR | 1976 | HH SIZE | 5 | YEAR | 1976 | HH SIZE | 6 |
| RSQ | 0.9971 | RBARSQ | 0.9970 | RSQ | 0.9975 | RBARSQ | 0.9974 | RSQ | 0.9970 | RBARSQ | 0.9969 |
| RHO | 0.8159 | MAPE | 1.7866 | RHO | 0.7795 | MAPE | 1.2468 | RHO | 0.7857 | MAPE | 1.7795 |
| A | 0.9597 | T-STAT | 154.91 | A | 0.9704 | T-STAT | 159.45 | A | 0.9329 | T-STAT | 140.50 |
| B | 0.0036 | T-STAT | 1.79 | B | 0.0050 | T-STAT | 2.52 | B | 0.0043 | T-STAT | 1.88 |

**TABLE 3.1**

**Estimation Results for Parameters A and B (Continued)**

```
YEAR  1977 HH SIZE      1 |YEAR  1977 HH SIZE      2 |YEAR  1977 HH SIZE      3
RSQ 0.9993 RBARSQ 0.9992 |RSQ 0.9994 RBARSQ 0.9994 |RSQ 0.9990 RBARSQ 0.9990
RHO 0.7929 MAPE   1.6768 |RHO 0.4026 MAPE   0.7927 |RHO 0.3608 MAPE   0.8874
A    0.9883 T-STAT 282.22 |A    0.9834 T-STAT 327.04 |A    0.9493 T-STAT 264.60
B   -0.0002 T-STAT  -0.12 |B   -0.0104 T-STAT  -8.60 |B    0.0001 T-STAT   0.07

YEAR  1977 HH SIZE      4 |YEAR  1977 HH SIZE      5 |YEAR  1977 HH SIZE      6
RSQ 0.9980 RBARSQ 0.9979 |RSQ 0.9966 RBARSQ 0.9966 |RSQ 0.9979 RBARSQ 0.9978
RHO 0.6634 MAPE   1.2446 |RHO 0.7337 MAPE   1.5245 |RHO 0.6181 MAPE   1.1751
A    0.9406 T-STAT 182.23 |A    0.9415 T-STAT 134.92 |A    0.9725 T-STAT 167.61
B    0.0035 T-STAT   2.12 |B    0.0052 T-STAT   2.32 |B    0.0033 T-STAT   1.63

YEAR  1978 HH SIZE      1 |YEAR  1978 HH SIZE      2 |YEAR  1978 HH SIZE      3
RSQ 0.9995 RBARSQ 0.9995 |RSQ 0.9990 RBARSQ 0.9990 |RSQ 0.9986 RBARSQ 0.9985
RHO 0.7160 MAPE   1.3619 |RHO 0.5786 MAPE   0.7821 |RHO 0.6492 MAPE   1.1773
A    0.9823 T-STAT 349.99 |A    0.9789 T-STAT 248.79 |A    0.9683 T-STAT 220.67
B   -0.0011 T-STAT  -0.88 |B    0.0056 T-STAT  -3.56 |B   -0.0019 T-STAT  -1.24

YEAR  1978 HH SIZE      4 |YEAR  1978 HH SIZE      5 |YEAR  1978 HH SIZE      6
RSQ 0.9966 RBARSQ 0.9965 |RSQ 0.9959 RBARSQ 0.9958 |RSQ 0.9970 RBARSQ 0.9969
RHO 0.7191 MAPE   1.6871 |RHO 0.5369 MAPE   1.5906 |RHO 0.5533 MAPE   1.8359
A    0.9426 T-STAT 142.44 |A    0.9490 T-STAT 122.98 |A    0.9502 T-STAT 141.68
B   -0.0021 T-STAT  -0.97 |B    0.0042 T-STAT   1.67 |B   -0.0009 T-STAT  -0.41

YEAR  1979 HH SIZE      1 |YEAR  1979 HH SIZE      2 |YEAR  1979 HH SIZE      3
RSQ 0.9998 RBARSQ 0.9998 |RSQ 0.9994 RBARSQ 0.9994 |RSQ 0.9988 RBARSQ 0.9988
RHO 0.6773 MAPE   0.5128 |RHO 0.6534 MAPE   0.7935 |RHO 0.6711 MAPE   1.1275
A    0.9914 T-STAT 559.59 |A    0.9805 T-STAT 312.79 |A    0.9532 T-STAT 241.72
B   -0.0051 T-STAT  -6.23 |B   -0.0005 T-STAT  -0.39 |B    0.0033 T-STAT   2.34

YEAR  1979 HH SIZE      4 |YEAR  1979 HH SIZE      5 |YEAR  1979 HH SIZE      6
RSQ 0.9977 RBARSQ 0.9977 |RSQ 0.9985 RBARSQ 0.9984 |RSQ 0.9985 RBARSQ 0.9985
RHO 0.6138 MAPE   1.5121 |RHO 0.6322 MAPE   1.0149 |RHO 0.7019 MAPE   1.2856
A    0.9464 T-STAT 176.47 |A    0.9538 T-STAT 204.24 |A    0.9757 T-STAT 200.95
B    0.0038 T-STAT   2.24 |B    0.0102 T-STAT   6.75 |B    0.0105 T-STAT   6.18

YEAR  1980 HH SIZE      1 |YEAR  1980 HH SIZE      2 |YEAR  1980 HH SIZE      3
RSQ 0.9999 RBARSQ 0.9999 |RSQ 0.9996 RBARSQ 0.9996 |RSQ 0.9992 RBARSQ 0.9992
RHO 0.3615 MAPE   0.3303 |RHO 0.3039 MAPE   0.5081 |RHO 0.3628 MAPE   0.6293
A    1.0030 T-STAT 889.79 |A    0.9906 T-STAT 384.88 |A    0.9845 T-STAT 301.91
B   -0.0007 T-STAT  -1.33 |B    0.0005 T-STAT   0.50 |B    0.0035 T-STAT   3.01

YEAR  1980 HH SIZE      4 |YEAR  1980 HH SIZE      5 |YEAR  1980 HH SIZE      6
RSQ 0.9984 RBARSQ 0.9983 |RSQ 0.9990 RBARSQ 0.9990 |RSQ 0.9992 RBARSQ 0.9992
RHO 0.5981 MAPE   1.1892 |RHO 0.5268 MAPE   0.6725 |RHO 0.5358 MAPE   0.8314
A    0.9652 T-STAT 209.01 |A    1.0051 T-STAT 255.50 |A    0.9755 T-STAT 268.14
B    0.0037 T-STAT   2.53 |B    0.0092 T-STAT   7.21 |B    0.0103 T-STAT   8.08

YEAR  1982 HH SIZE      1 |YEAR  1982 HH SIZE      2 |YEAR  1982 HH SIZE      3
RSQ 0.9968 RBARSQ 0.9967 |RSQ 0.9996 RBARSQ 0.9996 |RSQ 0.9994 RBARSQ 0.9994
RHO 0.8809 MAPE   3.4056 |RHO 0.5622 MAPE   0.8070 |RHO 0.4857 MAPE   0.9196
A    0.9377 T-STAT 124.89 |A    0.9707 T-STAT 364.66 |A    0.9938 T-STAT 327.55
B    0.0226 T-STAT   6.52 |B    0.0089 T-STAT   8.33 |B    0.0062 T-STAT   5.68

YEAR  1982 HH SIZE      4 |YEAR  1982 HH SIZE      5 |YEAR  1982 HH SIZE      6
RSQ 0.9993 RBARSQ 0.9993 |RSQ 0.9993 RBARSQ 0.9993 |RSQ 0.9994 RBARSQ 0.9994
RHO 0.6251 MAPE   0.9040 |RHO 0.7719 MAPE   1.0147 |RHO 0.8720 MAPE   0.9410
A    1.0116 T-STAT 326.57 |A    1.0269 T-STAT 305.29 |A    1.0259 T-STAT 313.11
B    0.0039 T-STAT   3.92 |B    0.0053 T-STAT   4.80 |B    0.0084 T-STAT   7.29
```

**TABLE 3.2**

**Historical Values of Explanatory Variables**

| YEAR | UN | PCTINC | INFL |
|---|---|---|---|
| 1966 | 3.792 | 10.595 | 3.551 |
| 1967 | 3.841 | 10.601 | 2.840 |
| 1968 | 3.558 | 10.626 | 4.881 |
| 1969 | 3.492 | 10.782 | 5.476 |
| 1970 | 4.984 | 10.990 | 5.552 |
| 1971 | 5.950 | 10.883 | 5.648 |
| 1972 | 5.600 | 10.682 | 4.718 |
| 1973 | 4.858 | 10.872 | 6.563 |
| 1974 | 5.641 | 11.632 | 8.959 |
| 1975 | 8.475 | 11.518 | 9.723 |
| 1976 | 7.700 | 11.560 | 6.396 |
| 1977 | 7.050 | 12.034 | 6.685 |
| 1978 | 6.067 | 12.441 | 7.324 |
| 1979 | 5.850 | 13.244 | 8.740 |
| 1980 | 7.175 | 14.385 | 9.058 |
| 1981 | 7.616 | 15.723 | 9.548 |
| 1982 | 9.708 | 16.239 | 6.591 |
| 1983 | 9.600 | 16.256 | 3.889 |
| 1984 | 7.508 | 16.730 | 3.732 |
| 1985 | 7.192 | 16.743 | 3.002 |
| 1986 | 6.983 | 16.479 | 2.741 |
| 1987 | 6.175 | 16.283 | 3.209 |

**TABLE 3.3**

**Time-Series Regression Results of Functional Parameters for Each Household Size**

| | UN | | PCTINC | | INFL | | TIME | |
|---|---|---|---|---|---|---|---|---|
| | A | B | A | B | A | B | A | B |
| Household Size | | | | | | | | |
| 1 | -.0014 | -.0000 | -.0083* | .0086* | .0062* | -.0023* | -.0017 | -.0032* |
| 2 | -.0009 | -.0007 | .0022 | .0053* | .0015 | -.0010 | .0004 | -.0013* |
| 3 | .0018 | -.0002 | .0064 | .0024* | .0023 | -.0007 | .0051* | -.0014* |
| 4 | .0105* | -.0001 | .0077* | .0023* | .0005 | -.0006 | .0033* | -.0020* |
| 5 | .0142* | -.0020* | .0049 | .0015 | .0020 | -.0006 | .0043* | -.0012* |
| 6+ | .0090* | -.0012 | -.0023 | .0029* | -.0007 | -.0008 | .0138* | -.0017* |

* Significant at 10% level.

## TABLE 3.4

### Regression Equation for Forecasting Total Exemptions (Number of Exemptions Other Than Age or Blindness)

```
SEE    =      2.08 RSQ   = 0.9856 RHO =    0.54 Obser   =   26 from 1957.000
SEE+1  =      1.77 RBSQ  = 0.9850 DW  =    0.93 DoFree  =   24 to   1982.000
MAPE   =      0.84
  Variable name           Reg-Coef  Mexval t-value  Elas    Beta       Mean
0 nex                   - - - - - - - - - - - - - - - - - - - - -    191.69
1 popt                    0.93451  3175.0 160.366   0.99   0.948     203.48
2 time                    0.09949     4.2   1.439   0.00   0.043      15.50
```

nex = IRS reported number of exemptions other than age or blindness
popt = noninstitutional population of U.S.
time = time trend, 1 in 1955, 2 in 1956, etc.

| actual nex | | | | | |
|---|---|---|---|---|---|
| 57.000 | 161.490 | 162.000 | 165.300 | 168.540 | 171.600 |
| 62.000 | 172.580 | 176.170 | 179.510 | 182.710 | 186.550 |
| 67.000 | 189.510 | 192.330 | 196.750 | 195.100 | 195.090 |
| 72.000 | 197.570 | 200.390 | 205.330 | 202.050 | 205.170 |
| 77.000 | 204.520 | 208.680 | 213.200 | 215.890 | 217.870 |
| 82.000 | 217.980 | 219.280 | | | |

| predicted | | | | | |
|---|---|---|---|---|---|
| 57.000 | 161.018 | 163.826 | 166.681 | 169.435 | 172.357 |
| 62.000 | 175.117 | 177.743 | 180.316 | 182.672 | 184.880 |
| 67.000 | 186.991 | 188.954 | 190.895 | 193.214 | 195.752 |
| 72.000 | 197.940 | 199.921 | 201.838 | 203.917 | 205.944 |
| 77.000 | 208.103 | 210.395 | 212.803 | 215.427 | 217.752 |
| 82.000 | 220.077 | 222.306 | 224.464 | 226.692 | 228.973 |
| 87.000 | 231.223 | 232.619 | 234.771 | 236.888 | 238.959 |
| 92.000 | 240.974 | 242.927 | 244.815 | 246.639 | 248.402 |
| 97.000 | 250.109 | 251.770 | 253.392 | 254.982 | |

| residual | | | | | |
|---|---|---|---|---|---|
| 57.000 | -0.472 | 1.826 | 1.381 | 0.895 | 0.757 |
| 62.000 | 2.537 | 1.573 | 0.806 | -0.038 | -1.670 |
| 67.000 | -2.519 | -3.376 | -5.855 | -1.886 | 0.662 |
| 72.000 | 0.370 | -0.469 | -3.492 | 1.867 | 0.774 |
| 77.000 | 3.583 | 1.715 | -0.397 | -0.463 | -0.118 |
| 82.000 | 2.097 | 0.000 | 0.000 | 0.000 | 0.000 |
| 87.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 |
| 92.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 |
| 97.000 | 0.000 | 0.000 | 0.000 | 0.000 | |

## TABLE 3.5

### Results of Forecasting the Share of Total Population for Each of the Household Size Categories

```
SEE    =       0.43 RSQ    = 0.9437 RHO =    0.41 Obser  =    16 from 1967.000
SEE+1  =       0.39 RBSQ   = 0.9397 DW  =    1.18 DoFree =    14 to   1982.000
MAPE   =       2.43
  Variable name            Reg-Coef  Mexval t-value  Elas    Beta        Mean
0 rnex1                   - - - - - - - - - - - - - - - - - - - - -    15.93
1 intercept                44.04338   548.2  23.962  2.76   0.000       1.00
2 rcpop65                  -2.93225   321.6 -15.325 -1.76  -0.971       9.59
```

```
rnex1    =  the share of population from household size one
rcpop65  =  reciprocal of the percent of the population 65 years or older
```

```
actual rnex1
67.000      13.390      14.130      14.290      13.610      13.620
72.000      14.610      15.480      15.950      15.630      16.170
77.000      17.270      17.930      18.290      18.170      18.220
82.000      18.110

predicted
67.000      13.313      13.651      13.845      14.141      14.428
72.000      14.762      15.177      15.619      16.141      16.578
77.000      17.013      17.406      17.788      18.062      18.320
82.000      18.627      18.941      19.198      19.458      19.754
87.000      20.071      20.482      20.720      20.948      21.128
92.000      21.274      21.402      21.491      21.584      21.632
97.000      21.614      21.600      21.559      21.543

residual
67.000      -0.077      -0.479      -0.445       0.531       0.808
72.000       0.152      -0.303      -0.331       0.511       0.408
77.000      -0.257      -0.524      -0.502      -0.108       0.100
82.000       0.517       0.000       0.000       0.000       0.000
87.000       0.000       0.000       0.000       0.000       0.000
92.000       0.000       0.000       0.000       0.000       0.000
97.000       0.000       0.000       0.000       0.000
```

## TABLE 3.5

### Results of Forecasting the Share of Total Population for Each of the Household Size Categories (Continued)

```
SEE    =       0.17 RSQ    = 0.9852 RHO =   -0.08 Obser  =   16 from 1967.000
SEE+1  =       0.17 RBSQ   = 0.9841 DW  =    2.16 DoFree =   14 to   1982.000
MAPE   =       0.73

  Variable name            Reg-Coef  Mexval t-value  Elas    Beta       Mean
0 rnex2                   - - - - - - - - - - - - - - - - - - - -       18.95
1 intercept                40.80329  1421.8  56.817  2.15   0.000       1.00
2 rcpop65                  -2.27901   720.8 -30.485 -1.15  -0.993       9.59

rnex2    =  the share of population from household size two
rcpop65  =  reciprocal of the percent of the population 65 years or older
```

| | | | | | |
|---|---|---|---|---|---|
| actual rnex2 | | | | | |
| 67.000 | 16.960 | 17.240 | 17.500 | 17.480 | 17.600 |
| 72.000 | 18.080 | 18.670 | 18.390 | 19.170 | 19.350 |
| 77.000 | 19.710 | 20.110 | 20.220 | 20.460 | 21.050 |
| 82.000 | 21.250 | | | | |
| predicted | | | | | |
| 67.000 | 16.919 | 17.182 | 17.333 | 17.562 | 17.785 |
| 72.000 | 18.045 | 18.368 | 18.711 | 19.117 | 19.456 |
| 77.000 | 19.795 | 20.100 | 20.397 | 20.610 | 20.810 |
| 82.000 | 21.049 | 21.293 | 21.493 | 21.695 | 21.925 |
| 87.000 | 22.172 | 22.491 | 22.676 | 22.853 | 22.993 |
| 92.000 | 23.106 | 23.206 | 23.275 | 23.348 | 23.385 |
| 97.000 | 23.370 | 23.360 | 23.328 | 23.316 | |
| residual | | | | | |
| 67.000 | -0.041 | -0.058 | -0.167 | 0.082 | 0.185 |
| 72.000 | -0.035 | -0.302 | 0.321 | -0.053 | 0.106 |
| 77.000 | 0.085 | -0.010 | 0.177 | 0.150 | -0.240 |
| 82.000 | -0.201 | 0.000 | 0.000 | 0.000 | 0.000 |
| 87.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 |
| 92.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 |
| 97.000 | 0.000 | 0.000 | 0.000 | 0.000 | |

## TABLE 3.5

**Results of Forecasting the Share of Total Population for Each of the Household Size Categories (Continued)**

```
SEE    =       0.16 RSQ    = 0.9667 RHO =    0.09 Obser  =    16 from 1967.000
SEE+1  =       0.16 RBSQ   = 0.9644 DW  =    1.82 DoFree =    14 to   1982.000
MAPE   =       0.76
  Variable name            Reg-Coef  Mexval t-value  Elas    Beta       Mean
0 rnex3                   - - - - - - - - - - - - - - - - - - - -      16.02
1 intercept                29.70871  1072.0  43.692   1.85   0.000      1.00
2 rcpop65                  -1.42797   448.4 -20.174  -0.85  -0.983      9.59
```

```
rnex3    =  the share of population from household size three
rcpop65  =  reciprocal of the percent of the population 65 years or older
```

| actual rnex3 | | | | | |
|---|---|---|---|---|---|
| 67.000 | 14.790 | 14.850 | 14.770 | 15.010 | 15.460 |
| 72.000 | 15.460 | 15.940 | 15.930 | 16.160 | 16.310 |
| 77.000 | 16.590 | 16.400 | 16.890 | 17.150 | 17.400 |
| 82.000 | 17.170 | | | | |

| predicted | | | | | |
|---|---|---|---|---|---|
| 67.000 | 14.744 | 14.908 | 15.002 | 15.146 | 15.286 |
| 72.000 | 15.449 | 15.651 | 15.866 | 16.121 | 16.333 |
| 77.000 | 16.545 | 16.737 | 16.922 | 17.056 | 17.182 |
| 82.000 | 17.331 | 17.484 | 17.609 | 17.736 | 17.880 |
| 87.000 | 18.035 | 18.234 | 18.350 | 18.461 | 18.549 |
| 92.000 | 18.620 | 18.683 | 18.726 | 18.771 | 18.795 |
| 97.000 | 18.786 | 18.779 | 18.759 | 18.751 | |

| residual | | | | | |
|---|---|---|---|---|---|
| 67.000 | -0.046 | 0.058 | 0.232 | 0.136 | -0.174 |
| 72.000 | -0.011 | -0.289 | -0.064 | -0.039 | 0.023 |
| 77.000 | -0.045 | 0.337 | 0.032 | -0.094 | -0.218 |
| 82.000 | 0.161 | 0.000 | 0.000 | 0.000 | 0.000 |
| 87.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 |
| 92.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 |
| 97.000 | 0.000 | 0.000 | 0.000 | 0.000 | |

## TABLE 3.5

### Results of Forecasting the Share of Total Population for Each of the Household Size Categories (Continued)

```
SEE    =       0.24 RSQ   = 0.9230 RHO =    0.30 Obser  =    16 from 1967.000
SEE+1  =       0.23 RBSQ  = 0.9175 DW  =    1.41 DoFree =    14 to   1982.000
MAPE   =       1.00
  Variable name          Reg-Coef  Mexval t-value  Elas    Beta       Mean
0 rnex4                 - - - - - - - - - - - - - - - - - - - - -     20.18
1 intercept              33.46344   776.1  32.566  1.66   0.000       1.00
2 rcpop65                -1.38551   260.3 -12.953 -0.66  -0.961       9.59
```

```
rnex4    =  the share of population from household size four
rcpop65  =  reciprocal of the percent of the population 65 years or older
```

| | | | | | |
|---|---|---|---|---|---|
| actual rnex4 | | | | | |
| 67.000 | 18.840 | 18.740 | 19.000 | 19.550 | 19.550 |
| 72.000 | 19.920 | 19.720 | 19.940 | 20.670 | 20.900 |
| 77.000 | 20.730 | 20.750 | 21.080 | 20.930 | 20.940 |
| 82.000 | 21.610 | | | | |
| predicted | | | | | |
| 67.000 | 18.943 | 19.103 | 19.195 | 19.334 | 19.470 |
| 72.000 | 19.628 | 19.824 | 20.033 | 20.279 | 20.486 |
| 77.000 | 20.691 | 20.877 | 21.057 | 21.187 | 21.309 |
| 82.000 | 21.454 | 21.602 | 21.724 | 21.847 | 21.986 |
| 87.000 | 22.137 | 22.330 | 22.443 | 22.550 | 22.636 |
| 92.000 | 22.705 | 22.765 | 22.807 | 22.851 | 22.874 |
| 97.000 | 22.865 | 22.859 | 22.839 | 22.832 | |
| residual | | | | | |
| 67.000 | 0.103 | 0.363 | 0.195 | -0.216 | -0.080 |
| 72.000 | -0.292 | 0.104 | 0.093 | -0.391 | -0.414 |
| 77.000 | -0.039 | 0.127 | -0.023 | 0.257 | 0.369 |
| 82.000 | -0.156 | 0.000 | 0.000 | 0.000 | 0.000 |
| 87.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 |
| 92.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 |
| 97.000 | 0.000 | 0.000 | 0.000 | 0.000 | |

## TABLE 3.5

### Results of Forecasting the Share of Total Population for Each of the Household Size Categories (Continued)

```
SEE    =       0.16 RSQ    = 0.9735 RHO =    0.13 Obser  =    16 from 1967.000
SEE+1  =       0.16 RBSQ   = 0.9716 DW  =    1.74 DoFree =    14 to   1982.000
MAPE   =       0.96
  Variable name          Reg-Coef  Mexval t-value  Elas    Beta       Mean
0 rnex5                 - - - - - - - - - - - - - - - - - - - - -    13.86
1 intercept              -2.09087    27.6  -2.967  -0.15   0.000      1.00
2 rcpop65                 1.66359   514.2  22.675   1.15   0.987      9.59
```

rnex5 = the share of population from household size five
rcpop65 = reciprocal of the percent of the population 65 years or older

actual rnex5

| | | | | | |
|---|---|---|---|---|---|
| 67.000 | 15.340 | 15.060 | 14.740 | 14.930 | 15.050 |
| 72.000 | 14.710 | 14.060 | 14.050 | 13.770 | 13.690 |
| 77.000 | 13.170 | 12.910 | 12.720 | 12.760 | 12.630 |
| 82.000 | 12.160 | | | | |

predicted

| | | | | | |
|---|---|---|---|---|---|
| 67.000 | 15.344 | 15.152 | 15.042 | 14.874 | 14.711 |
| 72.000 | 14.522 | 14.286 | 14.035 | 13.739 | 13.492 |
| 77.000 | 13.245 | 13.022 | 12.805 | 12.649 | 12.503 |
| 82.000 | 12.329 | 12.151 | 12.005 | 11.857 | 11.690 |
| 87.000 | 11.509 | 11.277 | 11.142 | 11.012 | 10.910 |
| 92.000 | 10.827 | 10.754 | 10.704 | 10.651 | 10.624 |
| 97.000 | 10.635 | 10.642 | 10.666 | 10.675 | |

residual

| | | | | | |
|---|---|---|---|---|---|
| 67.000 | 0.004 | 0.092 | 0.302 | -0.056 | -0.339 |
| 72.000 | -0.188 | 0.226 | -0.015 | -0.031 | -0.198 |
| 77.000 | 0.075 | 0.112 | 0.085 | -0.111 | -0.127 |
| 82.000 | 0.169 | 0.000 | 0.000 | 0.000 | 0.000 |
| 87.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 |
| 92.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 |
| 97.000 | 0.000 | 0.000 | 0.000 | 0.000 | |

**TABLE 3.5**

**Results of Forecasting the Share of Total Population for Each of the Household Size Categories (Continued)**

```
SEE    =       0.29 RSQ   = 0.9942 RHO =   0.27 Obser  =   16 from 1967.000
SEE+1  =       0.28 RBSQ  = 0.9938 DW  =   1.45 DoFree =   14 to   1982.000
MAPE   =       1.52
  Variable name          Reg-Coef  Mexval t-value  Elas    Beta       Mean
0 rnex6                 - - - - - - - - - - - - - - - - - - - - -    15.07
1 intercept             -45.83835   887.8 -36.771  -3.04   0.000      1.00
2 rcpop65                 6.35227  1212.1  48.951   4.04   0.997      9.59
```

rnex6 = the share of population from household size six or more
rcpop65 = reciprocal of the percent of the population 65 years or older

| | | | | | |
|---|---|---|---|---|---|
| actual rnex6 | | | | | |
| 67.000 | 20.680 | 19.980 | 19.710 | 19.420 | 18.730 |
| 72.000 | 17.220 | 16.120 | 15.750 | 14.590 | 13.580 |
| 77.000 | 12.520 | 11.900 | 10.800 | 10.530 | 9.750 |
| 82.000 | 9.780 | | | | |
| predicted | | | | | |
| 67.000 | 20.733 | 20.002 | 19.581 | 18.941 | 18.319 |
| 72.000 | 17.596 | 16.696 | 15.738 | 14.608 | 13.662 |
| 77.000 | 12.719 | 11.868 | 11.041 | 10.446 | 9.888 |
| 82.000 | 9.222 | 8.543 | 7.985 | 7.421 | 6.781 |
| 87.000 | 6.093 | 5.204 | 4.689 | 4.195 | 3.804 |
| 92.000 | 3.488 | 3.210 | 3.018 | 2.816 | 2.712 |
| 97.000 | 2.752 | 2.782 | 2.872 | 2.905 | |
| residual | | | | | |
| 67.000 | 0.053 | 0.022 | -0.129 | -0.479 | -0.411 |
| 72.000 | 0.376 | 0.576 | -0.012 | 0.018 | 0.082 |
| 77.000 | 0.199 | -0.032 | 0.241 | -0.084 | 0.138 |
| 82.000 | -0.558 | 0.000 | 0.000 | 0.000 | 0.000 |
| 87.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 |
| 92.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 |
| 97.000 | 0.000 | 0.000 | 0.000 | 0.000 | |

## TABLE 3.6

**Results of Forecasting the Share of Total AGI for Each of the Household Size Categories**

```
SEE    =       0.32 RSQ    = 0.9769 RHO =    0.57 Obser  =   16 from 1967.000
SEE+1  =       0.28 RBSQ   = 0.9753 DW  =    0.86 DoFree =   14 to   1982.000
MAPE   =       1.46
  Variable name          Reg-Coef  Mexval t-value  Elas    Beta       Mean
0 ragil                 - - - - - - - - - - - - - - - - - - - -       19.30
1 intercept              53.24560   923.0  38.094  2.76   0.000        1.00
2 rcpop65                -3.54080   558.0 -24.335 -1.76  -0.988        9.59
```

ragil = the share of total AGI from household size one
rcpop65 = reciprocal of the percent of the population 65 years or older

| | | | | | |
|---|---|---|---|---|---|
| **actual ragil** | | | | | |
| 67.000 | 16.600 | 17.020 | 17.040 | 17.040 | 16.940 |
| 72.000 | 17.790 | 18.070 | 19.000 | 19.020 | 19.580 |
| 77.000 | 20.520 | 21.130 | 21.730 | 21.980 | 22.520 |
| 82.000 | 22.770 | | | | |
| **predicted** | | | | | |
| 67.000 | 16.138 | 16.546 | 16.780 | 17.137 | 17.484 |
| 72.000 | 17.887 | 18.388 | 18.922 | 19.553 | 20.080 |
| 77.000 | 20.605 | 21.080 | 21.541 | 21.872 | 22.183 |
| 82.000 | 22.555 | 22.933 | 23.244 | 23.558 | 23.915 |
| 87.000 | 24.299 | 24.794 | 25.081 | 25.356 | 25.574 |
| 92.000 | 25.751 | 25.906 | 26.013 | 26.125 | 26.184 |
| 97.000 | 26.161 | 26.144 | 26.094 | 26.076 | |
| **residual** | | | | | |
| 67.000 | -0.462 | -0.474 | -0.260 | 0.097 | 0.544 |
| 72.000 | 0.097 | 0.318 | -0.078 | 0.533 | 0.500 |
| 77.000 | 0.085 | -0.050 | -0.189 | -0.108 | -0.337 |
| 82.000 | -0.215 | 0.000 | 0.000 | 0.000 | 0.000 |
| 87.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 |
| 92.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 |
| 97.000 | 0.000 | 0.000 | 0.000 | 0.000 | |

## TABLE 3.6

### Results of Forecasting the Share of Total AGI for Each of the Household Size Categories (Continued)

```
SEE    =       0.23 RSQ    = 0.9595 RHO =    0.17 Obser  =    16 from 1967.000
SEE+1  =       0.23 RBSQ   = 0.9566 DW  =    1.66 DoFree =    14 to   1982.000
MAPE   =       0.67
  Variable name           Reg-Coef   Mexval t-value  Elas    Beta        Mean
0 ragi2                  - - - - - - - - - - - - - - - - - - - - -       27.38
1 intercept               45.41847  1126.9  45.754   1.66   0.000        1.00
2 rcpop65                 -1.88145   396.8 -18.207  -0.66  -0.980        9.59

ragi2    =  the share of total AGI from household size two
rcpop65  =  reciprocal of the percent of the population 65 years or older
```

| | | | | | |
|---|---|---|---|---|---|
| actual ragi2 | | | | | |
| 67.000 | 25.720 | 25.900 | 26.380 | 25.960 | 26.360 |
| 72.000 | 26.620 | 27.300 | 27.010 | 27.580 | 27.630 |
| 77.000 | 27.790 | 28.200 | 28.310 | 28.620 | 29.130 |
| 82.000 | 29.560 | | | | |
| predicted | | | | | |
| 67.000 | 25.701 | 25.918 | 26.042 | 26.232 | 26.416 |
| 72.000 | 26.630 | 26.897 | 27.180 | 27.515 | 27.795 |
| 77.000 | 28.075 | 28.327 | 28.572 | 28.748 | 28.913 |
| 82.000 | 29.110 | 29.312 | 29.477 | 29.644 | 29.833 |
| 87.000 | 30.037 | 30.300 | 30.453 | 30.599 | 30.715 |
| 92.000 | 30.809 | 30.891 | 30.948 | 31.008 | 31.039 |
| 97.000 | 31.027 | 31.018 | 30.991 | 30.981 | |
| residual | | | | | |
| 67.000 | -0.019 | 0.018 | -0.338 | 0.272 | 0.056 |
| 72.000 | 0.010 | -0.403 | 0.170 | -0.065 | 0.165 |
| 77.000 | 0.285 | 0.127 | 0.262 | 0.128 | -0.217 |
| 82.000 | -0.450 | 0.000 | 0.000 | 0.000 | 0.000 |
| 87.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 |
| 92.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 |
| 97.000 | 0.000 | 0.000 | 0.000 | 0.000 | |

## TABLE 3.6

**Results of Forecasting the Share of Total AGI for Each of the Household Size Categories (Continued)**

```
SEE    =      0.14 RSQ    = 0.4368 RHO =   0.15 Obser  =   16 from 1967.000
SEE+1  =      0.14 RBSQ   = 0.3965 DW  =   1.71 DoFree =   14 to   1982.000
MAPE   =      0.70
  Variable name          Reg-Coef  Mexval t-value  Elas    Beta       Mean
0 ragi3                 - - - - - - - - - - - - - - - - - - - -      16.72
1 intercept              18.75244   716.4  30.315  1.12   0.000       1.00
2 rcpop65                -0.21218    33.2  -3.295 -0.12  -0.661       9.59
```

```
ragi3    =  the share of total AGI from household size three
rcpop65  =  reciprocal of the percent of the population 65 years or older
```

```
actual ragi3
67.000      16.570     16.420     16.290     16.530     16.820
72.000      16.590     16.900     16.770     16.830     16.880
77.000      16.790     16.590     16.930     16.910     16.940
82.000      16.730

predicted
67.000      16.529     16.553     16.567     16.589     16.609
72.000      16.634     16.664     16.696     16.733     16.765
77.000      16.797     16.825     16.853     16.872     16.891
82.000      16.913     16.936     16.955     16.973     16.995
87.000      17.018     17.048     17.065     17.081     17.094
92.000      17.105     17.114     17.121     17.127     17.131
97.000      17.129     17.128     17.125     17.124

update resid
67.000      -0.041      0.133      0.277      0.059     -0.211
72.000       0.044     -0.236     -0.074     -0.097     -0.115
77.000       0.007      0.235     -0.077     -0.038     -0.049
82.000       0.183      0.000      0.000      0.000      0.000
87.000       0.000      0.000      0.000      0.000      0.000
92.000       0.000      0.000      0.000      0.000      0.000
97.000       0.000      0.000      0.000      0.000
```

## TABLE 3.6

**Results of Forecasting the Share of Total AGI for Each of the Household Size Categories (Continued)**

```
SEE    =       0.19 RSQ   = 0.3795 RHO =    0.43 Obser  =   16 from 1967.000
SEE+1  =       0.18 RBSQ  = 0.3352 DW  =    1.14 DoFree =   14 to   1982.000
MAPE   =       0.88
  Variable name          Reg-Coef  Mexval t-value  Elas    Beta       Mean
0 ragi4                - - - - - - - - - - - - - - - - - - - - -      18.01
1 intercept              20.44244   563.8  24.552  1.14   0.000       1.00
2 rcpop65                -0.25363    27.0  -2.926 -0.14  -0.616       9.59
```

ragi4 = the share of total AGI from household size four
rcpop65 = reciprocal of the percent of the population 65 years or older

actual ragi4

| | | | | | |
|---|---|---|---|---|---|
| 67.000 | 17.710 | 17.540 | 17.600 | 18.090 | 17.900 |
| 72.000 | 18.020 | 17.870 | 17.990 | 18,330 | 18.330 |
| 77.000 | 18.190 | 18.270 | 18.280 | 18.170 | 17.820 |
| 82.000 | 18.060 | | | | |

predicted

| | | | | | |
|---|---|---|---|---|---|
| 67.000 | 17.784 | 17.814 | 17.830 | 17.856 | 17.881 |
| 72.000 | 17.910 | 17.946 | 17.984 | 18.029 | 18.067 |
| 77.000 | 18.104 | 18.138 | 18.171 | 18.195 | 18.217 |
| 82.000 | 18.244 | 18.271 | 18.293 | 18.316 | 18.341 |
| 87.000 | 18.369 | 18.404 | 18.425 | 18.445 | 18.460 |
| 92.000 | 18.473 | 18.484 | 18.492 | 18.500 | 18.504 |
| 97.000 | 18.502 | 18.501 | 18.498 | 18.496 | |

residual

| | | | | | |
|---|---|---|---|---|---|
| 67.000 | 0.074 | 0.274 | 0.230 | -0.234 | -0.019 |
| 72.000 | -0.110 | 0.076 | -0.006 | -0.301 | -0.263 |
| 77.000 | -0.086 | -0.132 | -0.109 | 0.025 | 0.397 |
| 82.000 | 0.184 | 0.000 | 0.000 | 0.000 | 0.000 |
| 87.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 |
| 92.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 |
| 97.000 | 0.000 | 0.000 | 0.000 | 0.000 | |

## TABLE 3.6

### Results of Forecasting the Share of Total AGI for Each of the Household Size Categories (Continued)

```
SEE    =        0.14 RSQ    = 0.9863 RHO =    0.63 Obser  =    16 from 1967.000
SEE+1  =        0.12 RBSQ   = 0.9854 DW  =    0.75 DoFree =    14 to   1982.000
MAPE   =        1.12
  Variable name            Reg-Coef  Mexval t-value  Elas    Beta        Mean
0 ragi5                  - - - - - - - - - - - - - - - - - - - - - -    10.40
1 intercept                -8.52227   294.9 -14.294  -0.82   0.000       1.00
2 rcpop65                   1.97311   755.5  31.792   1.82   0.993       9.59
```

ragi5 = the share of total AGI from household size five
rcpop65 = reciprocal of the percent of the population 65 years or older

| | | | | | |
|---|---|---|---|---|---|
| actual ragi5 | | | | | |
| 67.000 | 11.950 | 11.860 | 11.660 | 11.620 | 11.560 |
| 72.000 | 11.300 | 10.840 | 10.670 | 10.360 | 10.080 |
| 77.000 | 9.850 | 9.500 | 9.130 | 9.000 | 8.710 |
| 82.000 | 8.240 | | | | |
| predicted | | | | | |
| 67.000 | 12.156 | 11.929 | 11.798 | 11.599 | 11.406 |
| 72.000 | 11.181 | 10.902 | 10.604 | 10.253 | 9.959 |
| 77.000 | 9.666 | 9.402 | 9.145 | 8.961 | 8.787 |
| 82.000 | 8.580 | 8.369 | 8.196 | 8.021 | 7.822 |
| 87.000 | 7.608 | 7.332 | 7.172 | 7.019 | 6.897 |
| 92.000 | 6.799 | 6.713 | 6.653 | 6.590 | 6.558 |
| 97.000 | 6.571 | 6.580 | 6.608 | 6.618 | |
| residual | | | | | |
| 67.000 | 0.206 | 0.069 | 0.138 | -0.021 | -0.154 |
| 72.000 | -0.119 | 0.062 | -0.066 | -0.107 | -0.121 |
| 77.000 | -0.184 | -0.098 | 0.015 | -0.039 | 0.077 |
| 82.000 | 0.340 | 0.000 | 0.000 | 0.000 | 0.000 |
| 87.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 |
| 92.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 |
| 97.000 | 0.000 | 0.000 | 0.000 | 0.000 | |

## TABLE 3.6

**Results of Forecasting the Share of Total AGI for Each of the Household Size Categories (Continued)**

```
SEE    =       0.13 RSQ    = 0.9971 RHO =    0.19 Obser  =   16 from 1967.000
SEE+1  =       0.13 RBSQ   = 0.9969 DW  =    1.62 DoFree =   14 to   1982.000
MAPE   =       1.25
  Variable name           Reg-Coef  Mexval t-value  Elas    Beta        Mean
0 ragi6                  - - - - - - - - - - - - - - - - - - - -        8.18
1 intercept             -29.48727  1362.1 -54.578  -3.60   0.000        1.00
2 rcpop65                 3.92904  1769.8  69.860   4.60   0.999        9.59

ragi6    =  the share of total AGI from household size six or more
rcpop65  =  reciprocal of the percent of the population 65 years or older
```

| | | | | | |
|---|---|---|---|---|---|
| actual ragi6 | | | | | |
| 67.000 | 11.450 | 11.250 | 11.020 | 10.760 | 10.430 |
| 72.000 | 9.680 | 9.020 | 8.550 | 7.870 | 7.490 |
| 77.000 | 6.670 | 6.310 | 5.620 | 5.320 | 4.870 |
| 82.000 | 4.630 | | | | |
| predicted | | | | | |
| 67.000 | 11.689 | 11.237 | 10.977 | 10.580 | 10.196 |
| 72.000 | 9.748 | 9.192 | 8.600 | 7.900 | 7.315 |
| 77.000 | 6.732 | 6.205 | 5.694 | 5.326 | 4.981 |
| 82.000 | 4.569 | 4.149 | 3.804 | 3.455 | 3.059 |
| 87.000 | 2.634 | 2.084 | 1.765 | 1.460 | 1.218 |
| 92.000 | 1.022 | 0.850 | 0.731 | 0.606 | 0.542 |
| 97.000 | 0.567 | 0.586 | 0.641 | 0.662 | |
| residual | | | | | |
| 67.000 | 0.239 | -0.013 | -0.043 | -0.180 | -0.234 |
| 72.000 | 0.068 | 0.172 | 0.050 | 0.030 | -0.175 |
| 77.000 | 0.062 | -0.105 | 0.074 | 0.006 | 0.111 |
| 82.000 | -0.061 | 0.000 | 0.000 | 0.000 | 0.000 |
| 87.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 |
| 92.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 |
| 97.000 | 0.000 | 0.000 | 0.000 | 0.000 | |

## TABLE 3.7

## Population and Income Distribution By Ventile and Household Size - 1982

Exemptions Other than Age or Blindness in Thousands

| Household Size<br>Ventile | 1 | 2 | 3 | 4 | 5 | 6 | Total |
|---|---|---|---|---|---|---|---|
| 1 | 1886.4 | 1249.1 | 1674.8 | 2137.4 | 1521.6 | 2314.1 | 10783.5 |
| 2 | 2426.0 | 1110.9 | 1350.3 | 1750.8 | 1549.6 | 2595.9 | 10783.5 |
| 3 | 1365.1 | 1130.2 | 1677.1 | 2465.4 | 1828.5 | 2317.1 | 10783.5 |
| 4 | 2363.5 | 1459.7 | 1821.8 | 2066.3 | 1464.3 | 1608.3 | 10783.8 |
| 5 | 973.7 | 1458.8 | 1665.5 | 2097.9 | 1720.5 | 2867.4 | 10783.8 |
| 6 | 2018.1 | 1632.2 | 1524.7 | 2319.4 | 1358.0 | 1931.4 | 10783.8 |
| 7 | 1037.8 | 1758.4 | 1609.3 | 2427.3 | 3282.6 | 668.6 | 10783.8 |
| 8 | 1728.3 | 1873.1 | 1746.7 | 1753.9 | 687.0 | 2994.9 | 10783.8 |
| 9 | 794.7 | 1234.9 | 1355.3 | 4105.4 | 2914.9 | 378.6 | 10783.8 |
| 10 | 1973.5 | 2513.1 | 2455.9 | 2593.0 | 688.1 | 559.8 | 10783.5 |
| 11 | 1494.6 | 1528.3 | 802.8 | 5172.3 | 959.4 | 826.6 | 10783.8 |
| 12 | 1217.1 | 1798.0 | 3092.9 | 736.3 | 3640.3 | 299.2 | 10783.8 |
| 13 | 2283.3 | 2835.7 | 2361.3 | 2138.5 | 753.2 | 411.8 | 10783.7 |
| 14 | 1016.0 | 1329.4 | 1082.5 | 6129.6 | 1018.5 | 208.0 | 10783.8 |
| 15 | 2844.5 | 2528.2 | 2845.7 | 1537.5 | 762.4 | 265.2 | 10783.5 |
| 16 | 1367.8 | 3963.2 | 2492.3 | 2564.9 | 354.2 | 40.9 | 10783.5 |
| 17 | 2989.8 | 2688.6 | 3087.6 | 1254.8 | 656.6 | 106.0 | 10783.5 |
| 18 | 3162.7 | 3499.1 | 2186.0 | 1598.6 | 170.2 | 166.9 | 10783.5 |
| 19 | 3046.8 | 5844.3 | 913.9 | 453.9 | 255.0 | 269.6 | 10783.5 |
| 20 | 3185.6 | 4208.3 | 1320.3 | 1271.3 | 589.1 | 209.3 | 10783.8 |
| Totals | 39175.2 | 45643.5 | 37066.7 | 46574.5 | 26174.2 | 21039.5 | 215673.6 |

Adjusted Gross Income in millions of Dollars

| Household Size<br>Ventile | 1 | 2 | 3 | 4 | 5 | 6 | Total |
|---|---|---|---|---|---|---|---|
| 1 | 1832.4 | 1300.8 | 1351.4 | 1726.9 | 1081.1 | 1755.8 | 9048.4 |
| 2 | 4155.2 | 1643.5 | 2196.2 | 2845.8 | 2451.8 | 4062.0 | 17354.5 |
| 3 | 2832.6 | 2529.7 | 3709.9 | 5433.7 | 4014.9 | 5077.5 | 23589.3 |
| 4 | 6770.3 | 4102.6 | 5044.4 | 5748.0 | 4102.2 | 4406.4 | 30173.9 |
| 5 | 3266.7 | 4901.9 | 5624.7 | 7076.6 | 5789.0 | 9534.0 | 36192.9 |
| 6 | 7856.3 | 6349.5 | 5919.3 | 9066.1 | 5168.0 | 7797.0 | 42156.2 |
| 7 | 4661.5 | 7801.8 | 7175.2 | 10760.0 | 14903.3 | 2874.5 | 48176.3 |
| 8 | 8534.1 | 9320.3 | 8754.0 | 8677.5 | 3410.5 | 15572.3 | 54268.7 |
| 9 | 4433.7 | 6849.4 | 7447.0 | 23327.8 | 16316.7 | 1992.8 | 60367.4 |
| 10 | 11905.2 | 15427.8 | 15122.1 | 15320.2 | 4159.0 | 3536.9 | 65471.2 |
| 11 | 10306.1 | 10448.4 | 5364.9 | 36281.3 | 6736.0 | 5611.2 | 74747.9 |
| 12 | 9135.1 | 13369.4 | 23850.9 | 5297.4 | 26118.4 | 2087.6 | 79858.8 |
| 13 | 18904.5 | 23620.0 | 18828.6 | 18465.5 | 6323.0 | 3520.8 | 89662.4 |
| 14 | 9273.3 | 12167.6 | 10205.1 | 54535.2 | 9349.3 | 1918.5 | 97449.0 |
| 15 | 29234.8 | 25610.4 | 27747.4 | 15973.0 | 7589.3 | 2531.1 | 108686.0 |
| 16 | 15800.9 | 46263.4 | 29638.8 | 29453.6 | 4235.8 | 446.0 | 125838.5 |
| 17 | 38938.8 | 36153.0 | 38044.3 | 16399.9 | 8229.4 | 1154.7 | 138921.1 |
| 18 | 50420.7 | 53890.9 | 33804.6 | 24577.3 | 2488.8 | 1818.6 | 167000.9 |
| 19 | 62936.3 | 111019.7 | 18407.4 | 7728.7 | 3728.7 | 6393.3 | 210213.5 |
| 20 | 124235.8 | 161632.7 | 45567.6 | 40552.8 | 19007.6 | 5699.5 | 396696.0 |
| Totals | 425434.3 | 554402.8 | 313803.8 | 339247.3 | 155202.8 | 87790.5 | 1875881.5 |

## TABLE 3.8

### The Distribution of Cutoff Per Capita AGI in Current Dollars for Selected Years

| Ventile | 1966 | 1975 | 1982 |
|---|---|---|---|
| 1 | 455.1 | 739.6 | 1212.1 |
| 2 | 682.4 | 1136.1 | 1886.4 |
| 3 | 830.8 | 1443.1 | 2509.5 |
| 4 | 990.3 | 1780.3 | 3079.0 |
| 5 | 1127.8 | 2088.3 | 3628.8 |
| 6 | 1283.3 | 2392.5 | 4168.0 |
| 7 | 1415.6 | 2694.8 | 4704.2 |
| 8 | 1575.7 | 3040.3 | 5301.8 |
| 9 | 1691.4 | 3322.8 | 5722.4 |
| 10 | 1852.2 | 3553.5 | 6554.5 |
| 11 | 2050.4 | 4070.5 | 7131.2 |
| 12 | 2246.7 | 4278.6 | 7763.3 |
| 13 | 2483.2 | 4828.2 | 8883.9 |
| 14 | 2751.7 | 5196.0 | 9463.1 |
| 15 | 3014.1 | 5907.6 | 11111.6 |
| 16 | 3516.4 | 6769.1 | 11987.0 |
| 17 | 3890.6 | 7816.2 | 14253.7 |
| 18 | 4839.6 | 9672.9 | 17823.6 |
| 19 | 6538.3 | 12807.8 | 23171.9 |
| 20 | $\infty$ | $\infty$ | $\infty$ |

## TABLE 3.9

**The Distribution of Cutoff Per Capita AGI Relative to Average AGI for Selected Years**

| Ventile | 1966 | 1975 | 1982 |
|---|---|---|---|
| 1 | 18.12 | 15.54 | 13.94 |
| 2 | 27.17 | 23.87 | 21.69 |
| 3 | 33.08 | 30.32 | 28.85 |
| 4 | 39.44 | 37.40 | 35.40 |
| 5 | 44.91 | 43.87 | 41.72 |
| 6 | 51.10 | 50.26 | 47.92 |
| 7 | 56.37 | 56.61 | 54.08 |
| 8 | 62.75 | 63.87 | 60.96 |
| 9 | 67.36 | 69.81 | 65.79 |
| 10 | 73.76 | 74.65 | 75.36 |
| 11 | 81.65 | 85.51 | 81.99 |
| 12 | 89.47 | 89.88 | 89.26 |
| 13 | 98.89 | 101.43 | 102.14 |
| 14 | 109.58 | 109.16 | 108.80 |
| 15 | 120.03 | 124.11 | 127.75 |
| 16 | 140.03 | 142.21 | 137.82 |
| 17 | 154.93 | 164.20 | 163.88 |
| 18 | 192.73 | 203.21 | 204.92 |
| 19 | 260.37 | 269.07 | 266.41 |
| 20* | 20.65 | 19.69 | 21.15 |
| Average AGI | 2511.13 | 4760.04 | 8697.75 |

*The overall percentage of the total income held by the richest 5% of population

## TABLE 3.10

### Effective and Standard Tax Rates

| | Ventile 2 | | Ventile 5 | | Ventile 10 | |
|---|---|---|---|---|---|---|
| Year | ETR | STR | ETR | STR | ETR | STR |
| 1966 | 0.45 | 0.00 | 3.19 | 4.02 | 7.18 | 8.65 |
| 1968 | 0.52 | 0.00 | 4.53 | 5.88 | 8.95 | 10.66 |
| 1969 | 0.64 | 0.00 | 5.03 | 6.67 | 9.51 | 11.43 |
| 1970 | 0.54 | 0.00 | 4.74 | 5.81 | 8.70 | 10.46 |
| 1971 | 0.35 | 0.00 | 4.06 | 4.47 | 8.10 | 9.52 |
| 1972 | 0.26 | 0.13 | 3.70 | 5.09 | 7.86 | 9.52 |
| 1973 | 0.41 | 0.42 | 4.19 | 5.60 | 8.47 | 10.22 |
| 1974 | 0.43 | 0.49 | 4.47 | 6.02 | 8.93 | 10.73 |
| 1975 | 0.02 | 0.00 | 2.63 | 3.06 | 7.83 | 9.34 |
| 1976 | 0.07 | 0.00 | 3.17 | 5.45 | 8.24 | 10.46 |
| 1977 | 0.16 | 0.00 | 3.17 | 2.88 | 8.29 | 9.25 |
| 1978 | 0.28 | 0.00 | 3.93 | 3.64 | 8.80 | 9.93 |
| 1979 | 0.14 | 0.00 | 3.64 | 3.76 | 9.10 | 10.38 |
| 1980 | 0.21 | 0.00 | 4.20 | 4.46 | 9.77 | 11.34 |
| 1981 | 0.34 | 0.01 | 4.66 | 5.30 | 10.31 | 12.28 |
| 1982 | 1.01 | 0.00 | 4.58 | 4.81 | 9.26 | 11.20 |

| | Ventile 14 | | Ventile 17 | | Ventile 20 | |
|---|---|---|---|---|---|---|
| Year | ETR | STR | ETR | STR | ETR | STR |
| 1966 | 9.63 | 11.15 | 11.79 | 13.20 | 20.72 | 22.65 |
| 1968 | 11.44 | 13.17 | 13.59 | 15.26 | 23.54 | 25.50 |
| 1969 | 12.09 | 13.98 | 14.29 | 16.22 | 23.93 | 26.58 |
| 1970 | 11.25 | 13.15 | 13.32 | 15.10 | 22.17 | 24.95 |
| 1971 | 10.64 | 12.29 | 12.66 | 14.17 | 21.48 | 24.27 |
| 1972 | 10.37 | 12.00 | 12.58 | 14.12 | 21.55 | 24.65 |
| 1973 | 10.95 | 12.73 | 13.15 | 14.87 | 22.04 | 25.84 |
| 1974 | 11.36 | 13.26 | 13.65 | 15.51 | 22.76 | 26.91 |
| 1975 | 10.66 | 12.35 | 13.39 | 15.14 | 22.75 | 27.12 |
| 1976 | 10.90 | 13.06 | 13.25 | 15.26 | 23.21 | 28.09 |
| 1977 | 11.07 | 12.55 | 13.71 | 15.61 | 23.93 | 29.61 |
| 1978 | 11.78 | 13.67 | 14.61 | 17.14 | 24.84 | 31.14 |
| 1979 | 12.22 | 14.15 | 14.62 | 16.80 | 25.50 | 30.97 |
| 1980 | 12.64 | 14.77 | 15.49 | 18.31 | 26.32 | 32.69 |
| 1981 | 13.27 | 16.07 | 15.93 | 19.38 | 26.34 | 34.13 |
| 1982 | 12.18 | 14.92 | 14.59 | 17.65 | 24.60 | 31.40 |

**TABLE 3.11**

**Ratios of Effective-to-Standard Tax Rates**

| Ventile | Ratio |
|---|---|
| 1 | * |
| 2 | * |
| 3 | 1.0301 |
| 4 | 0.9694 |
| 5 | 0.9100 |
| 6 | 0.8687 |
| 7 | 0.8558 |
| 8 | 0.8566 |
| 9 | 0.8531 |
| 10 | 0.8524 |
| 11 | 0.8500 |
| 12 | 0.8474 |
| 13 | 0.8451 |
| 14 | 0.8394 |
| 15 | 0.8381 |
| 16 | 0.8334 |
| 17 | 0.8377 |
| 18 | 0.8292 |
| 19 | 0.8185 |
| 20 | 0.7738 |

*Ratio is undefined.

## TABLE 3.12

### The Twelve Reconciliation Items vs. the NIPA Tables

| Item | Title | NIPA Tables and Contents |
|---|---|---|
| 1 | OASDI | Table 3.11 : Old-age, survivors, and disability insurance (line 4) |
| 2 | HI | Table 3.11 : Hospital and supplementary medical insurance (line 5) |
| 3 | UI | Table 3.11 : Unemployment insurance (line 6) |
| 4 | RET | Table 3.11 : Federal employee retirement (line 11), Railroad retirement (line 14), Veterans benefits (line 18), Benefits from social insurance funds (line 29), Education (line 40), Employment and training (line 41), and Other (line 42) |
| 5 | WELF | Table 3.11 : Food stamp benefits (line 22), Black lung benefits (line 23), Supplemental security income (line 24), Direct relief (line 25), Earned income credit (line 26), Other (line 27), and Public assistance (line 33) |
| 6 | OLI | Table 8.14 : Other labor income except fees (line 4) |
| 7 | IMPU | Table 8.14 : Imputed income in personal income (line 5) |
| 8 | VESI | Table 8.14 : Investment income of life insurance carriers and private noninsured pension plans (line 6), Investment income received by nonprofit institutions or retained by fiduciaries (line 7), (minus) Taxable private pensions (line 13), (minus) Small business corporation income (line 14), and (minus) Other types of income (line 15) |
| 9 | EXCL | Table 8.14 : Differences in accounting treatment between NIPA's and tax regulations, net (line 8), and Other personal income exempt or excluded from adjusted gross income (line 9) |
| 10 | CONTR | Table 8.14 : Personal contributions for social insurance (line 11) |
| 11 | CAPG | Table 8.14 : Net gain from sale of assets (line 12) |
| 12 | GAP | Table 8.14 : Adjusted gross income (AGI) gap (line 18) |

## TABLE 3.13

## Estimation Results for the Reconciliation Items

1. The dependent variable, oli, is other labor income. nice is total labor compensation.

```
SEE    =         5.25 RSQ    = 0.9928 RHO =    0.78 Obser   =    28 from 1959.000
SEE+1  =         3.49 RBSQ   = 0.9925 DW  =    0.45 DoFree  =    26 to   1986.000
MAPE   =         9.95
  Variable name                Reg-Coef  Mexval t-value  Elas    Beta       Mean
0 oli                        - - - - - - - - - - - - - - - - - - - - -      72.37
1 intercept                   -18.25168   119.5  -9.963  -0.25   0.000       1.00
2 nice                          0.08896  1077.2  59.808   1.25   0.996    1018.66
```

2. The dependent variable, impu, is imputed income in personal income. pii is personal interest income, rmotg is the mortgage interest rate, and time is time trend variable.

```
SEE    =         1.51 RSQ    = 0.9762 RHO =    0.14 Obser   =    18 from 1966.000
SEE+1  =         1.50 RBSQ   = 0.9710 DW  =    1.73 DoFree  =    14 to   1983.000
MAPE   =         3.42
  Variable name                Reg-Coef  Mexval t-value  Elas    Beta       Mean
0 impu                       - - - - - - - - - - - - - - - - - - - - -      33.55
1 intercept                     6.24399    14.4   2.077   0.19   0.000       1.00
2 pii                           0.04043    47.6   4.065   0.19   0.462     156.80
3 rmotg[1]                     -0.10330     0.6  -0.396  -0.03  -0.028       8.28
4 time                          1.06447    52.6   4.311   0.65   0.566      20.50
```

3. The dependent variable, vesi, is retained investment and other income. rtb is the three-month treasury bill rate, pi is personal income, and time is time trend variable.

```
SEE    =         3.67 RSQ    = 0.9692 RHO =    0.30 Obser   =    28 from 1959.000
SEE+1  =         3.65 RBSQ   = 0.9654 DW  =    1.41 DoFree  =    24 to   1986.000
MAPE   =        19.37
  Variable name                Reg-Coef  Mexval t-value  Elas    Beta       Mean
0 vesi                       - - - - - - - - - - - - - - - - - - - - -      21.61
1 intercept                    -0.28091     0.0  -0.109  -0.01   0.000       1.00
2 rtb[1]                        2.36805    45.3   5.165   0.67   0.339       6.09
3 pi                            0.02840   156.0  11.544   1.85   1.323    1408.40
4 time                         -1.75822    52.2  -5.619  -1.51  -0.678      18.50
```

4. The dependent variable, excl, is other items which exempt or excluded from AGI. pi is personal income.

```
SEE    =        30.28 RSQ    = 0.7797 RHO =    0.79 Obser   =    28 from 1959.000
SEE+1  =        19.71 RBSQ   = 0.7797 DW  =    0.42 DoFree  =    27 to   1986.000
MAPE   =        57.71
  Variable name                Reg-Coef  Mexval t-value  Elas    Beta       Mean
0 excl                       - - - - - - - - - - - - - - - - - - - - -      57.07
1 pi                            0.04706   184.4  13.837   1.16   0.712    1408.40
```

## TABLE 3.13

## Estimation Results for the Reconciliation Items (Continued)

5. The dependent variable, contr, is personal contribution for social insurance. plc is private labor compensation.

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| SEE = | 3.34 | RSQ = | 0.9946 | RHO = | 0.62 | Obser = | 28 from 1959.000 |
| SEE+1 = | 2.75 | RBSQ = | 0.9944 | DW = | 0.77 | DoFree = | 26 to 1986.000 |
| MAPE = | 6.09 | | | | | | |

| Variable name | Reg-Coef | Mexval | t-value | Elas | Beta | Mean |
|---|---|---|---|---|---|---|
| 0 contr | - - - - - | - - - - - | - - - - - | - - - - | - - - - | 54.43 |
| 1 intercept | -14.35906 | 156.4 | -12.037 | -0.26 | 0.000 | 1.00 |
| 2 plc | 0.08093 | 1256.2 | 68.963 | 1.26 | 0.997 | 849.92 |

6. The dependent variable, capg, is capital gains. raaa is the AAA bond rate, infl is the percent change in the GNP deflator, and pi is personal income.

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| SEE = | 14.37 | RSQ = | 0.7064 | RHO = | 0.57 | Obser = | 28 from 1959.000 |
| SEE+1 = | 13.25 | RBSQ = | 0.6829 | DW = | 0.85 | DoFree = | 25 to 1986.000 |
| MAPE = | 29.93 | | | | | | |

| Variable name | Reg-Coef | Mexval | t-value | Elas | Beta | Mean |
|---|---|---|---|---|---|---|
| 0 capg | - - - - - | - - - - - | - - - - - | - - - - | - - - - | 24.43 |
| 1 intercept | -9.39706 | 5.9 | -1.746 | -0.38 | 0.000 | 1.00 |
| 2 (raaa-infl[1]) | 1.98249 | 2.1 | 1.040 | 0.24 | 0.153 | 2.99 |
| 3 pi | 0.01981 | 40.6 | 4.943 | 1.14 | 0.729 | 1408.40 |

7. The dependent variable, gap, is the AGI gap. pi is personal income.

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| SEE = | 6.90 | RSQ = | 0.9934 | RHO = | 0.41 | Obser = | 28 from 1959.000 |
| SEE+1 = | 6.32 | RBSQ = | 0.9934 | DW = | 1.18 | DoFree = | 27 to 1986.000 |
| MAPE = | 4.71 | | | | | | |

| Variable name | Reg-Coef | Mexval | t-value | Elas | Beta | Mean |
|---|---|---|---|---|---|---|
| 0 sd | - - - - - | - - - - - | - - - - - | - - - - | - - - - | 119.30 |
| 1 pi | 0.08535 | 2021.3 | 110.102 | 1.01 | 0.981 | 1408.40 |

**TABLE 3.14**

**The Distribution of Reconciliation Items between AGI and PI**

| Ventile | oasdi | hi | ui | ret | welf | oli | impu | vesi | excl | contr | capg | gap |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 8.18 | 7.00 | 15.43 | 2.09 | 19.70 | 0.43 | 0.43 | 2.09 | 0.00 | 0.00 | 3.12 | 0.43 |
| 2 | 7.36 | 7.00 | 14.79 | 3.37 | 12.20 | 0.93 | 0.93 | 3.37 | 0.00 | 1.00 | 1.99 | 0.93 |
| 3 | 7.82 | 7.00 | 11.27 | 3.77 | 12.10 | 1.30 | 1.30 | 3.77 | 0.00 | 2.00 | 1.67 | 1.30 |
| 4 | 7.05 | 7.00 | 9.97 | 4.97 | 10.00 | 1.64 | 1.64 | 4.97 | 0.00 | 2.00 | 1.55 | 1.64 |
| 5 | 6.85 | 7.00 | 7.90 | 3.83 | 8.60 | 1.98 | 1.98 | 3.83 | 0.00 | 2.00 | 1.35 | 1.98 |
| 6 | 6.44 | 5.00 | 6.77 | 5.02 | 6.80 | 2.30 | 2.30 | 5.02 | 1.00 | 3.00 | 1.55 | 2.30 |
| 7 | 6.07 | 5.00 | 6.53 | 5.06 | 5.80 | 2.62 | 2.62 | 5.06 | 1.00 | 3.00 | 1.66 | 2.62 |
| 8 | 5.26 | 5.00 | 3.45 | 4.85 | 4.50 | 2.95 | 2.95 | 4.85 | 2.00 | 3.00 | 1.16 | 2.95 |
| 9 | 4.26 | 5.00 | 3.45 | 4.85 | 4.50 | 3.29 | 3.29 | 4.85 | 2.00 | 4.00 | 1.16 | 3.29 |
| 10 | 4.34 | 5.00 | 3.45 | 4.82 | 4.30 | 3.63 | 3.63 | 4.82 | 3.00 | 5.00 | 1.39 | 3.63 |
| 11 | 3.64 | 5.00 | 3.05 | 4.84 | 3.50 | 4.01 | 4.01 | 4.84 | 3.00 | 6.00 | 1.57 | 4.01 |
| 12 | 3.29 | 5.00 | 2.12 | 4.00 | 3.50 | 4.40 | 4.40 | 4.00 | 4.00 | 7.00 | 1.23 | 4.40 |
| 13 | 3.39 | 5.00 | 2.05 | 4.36 | 2.50 | 4.84 | 4.84 | 4.36 | 4.00 | 7.00 | 1.40 | 4.84 |
| 14 | 3.17 | 5.00 | 2.05 | 4.66 | 1.50 | 5.38 | 5.38 | 4.66 | 5.00 | 7.00 | 2.25 | 5.38 |
| 15 | 3.54 | 5.00 | 2.21 | 5.29 | 0.50 | 5.99 | 5.99 | 5.29 | 5.00 | 8.00 | 2.33 | 5.99 |
| 16 | 3.47 | 3.00 | 2.16 | 5.90 | 0.00 | 6.78 | 6.78 | 5.90 | 6.00 | 8.00 | 2.49 | 6.78 |
| 17 | 3.50 | 3.00 | 1.16 | 5.85 | 0.00 | 7.78 | 7.78 | 5.85 | 7.00 | 8.00 | 2.92 | 7.78 |
| 18 | 4.18 | 3.00 | 1.68 | 6.90 | 0.00 | 9.21 | 9.21 | 6.90 | 8.00 | 8.00 | 4.54 | 9.21 |
| 19 | 3.36 | 3.00 | 0.51 | 6.33 | 0.00 | 11.64 | 11.64 | 6.33 | 10.00 | 9.00 | 6.03 | 11.64 |
| 20 | 4.83 | 3.00 | 0.00 | 9.24 | 0.00 | 18.91 | 18.91 | 9.24 | 39.00 | 10.00 | 58.66 | 18.91 |

**TABLE 3.15**

**Index of Ventile Limits for Personal Income**

| Ventile | 1966 | 1975 | 1982 | 1990 | 1995 | 2000 |
|---|---|---|---|---|---|---|
| 1 | 16.63 | 18.30 | 17.19 | 16.38 | 16.31 | 16.27 |
| 2 | 20.47 | 29.80 | 29.42 | 27.44 | 26.59 | 26.10 |
| 3 | 37.67 | 49.63 | 48.53 | 46.10 | 45.19 | 43.84 |
| 4 | 44.77 | 55.26 | 54.45 | 52.40 | 51.30 | 50.91 |
| 5 | 50.97 | 60.33 | 59.18 | 57.39 | 56.46 | 56.34 |
| 6 | 56.21 | 64.52 | 63.13 | 62.34 | 61.25 | 61.42 |
| 7 | 62.27 | 68.89 | 67.54 | 67.29 | 66.85 | 66.91 |
| 8 | 67.38 | 73.39 | 71.98 | 72.23 | 71.31 | 71.38 |
| 9 | 72.88 | 78.08 | 76.12 | 76.86 | 76.38 | 76.94 |
| 10 | 77.48 | 82.56 | 80.30 | 81.39 | 81.64 | 81.98 |
| 11 | 83.81 | 87.28 | 86.94 | 88.10 | 88.09 | 88.57 |
| 12 | 91.06 | 93.44 | 91.76 | 92.38 | 93.38 | 93.49 |
| 13 | 99.77 | 100.16 | 100.56 | 100.95 | 101.37 | 101.77 |
| 14 | 110.24 | 109.04 | 109.56 | 109.29 | 110.10 | 110.64 |
| 15 | 121.27 | 119.91 | 121.92 | 123.04 | 124.16 | 124.46 |
| 16 | 138.89 | 136.17 | 133.73 | 134.00 | 135.57 | 136.37 |
| 17 | 155.85 | 156.93 | 155.82 | 155.11 | 156.05 | 157.07 |
| 18 | 190.10 | 190.40 | 190.79 | 188.58 | 188.14 | 187.99 |
| 19 | 251.25 | 247.74 | 244.18 | 240.36 | 242.07 | 240.30 |
| 20* | 18.90 | 17.04 | 18.07 | 17.10 | 17.01 | 16.65 |
| Average PI | 3055.50 | 6080.63 | 11482.97 | 17874.50 | 23670.92 | 29868.45 |

*The overall percentage of the total income held by the richest 5% of population

## CHAPTER 4

## TIME-SERIES CONSUMPTION FUNCTIONS

The time-series consumption model in this dissertation is an integration of the previous two chapters. In Chapter 2, we estimated from cross-section data the effects of a family's income and demographic attributes on household consumption, but we did not account for price effects. In the time series, we shall incorporate the cross-section results into a system of consumption functions which has flexible price interactions.

To implement the PLEC in the time-series consumption functions, we need a time-series for the distribution of personal income after tax. In Chapter 3, we developed these series. With them and with time series on the demographic variables, we can calculate how consumption of item i would have evolved over time if only the income and demographic effects found in the cross-section study had been operative. This series we call $C^*_{it}$. This "cross-section-parameter predictions", $C^*_{it}$, will be used in the time-series consumption functions to represent the effects of changes in income and demographic factors. Thus, $C^*_{it}$ conveys to the time series equations what we learned in Chapter 2 about the effects of changes in income, income distribution and demographic factors on consumption.

The weighted populations, on the other hand, are used to create the commodity-specific, per-adult-equivalent expenditures on different goods. The consumption expenditures are estimated and forecasted per adult equivalent. To be used in the input-output model, this amount is then multiplied by the corresponding weighted populations to obtain the aggregate consumption. Thus, this aggregate total is able to account for the shift in the age structure. That is, when one particular age group grows relatively faster, the consumption demand for the goods which have the most weight for that group will grow rapidly.

The price effect in our time-series study is based on Almon's symmetric consumption functions in "A System of Consumption Functions and its Estimation for Belgium."[1] The distinctive feature of Almon's functional form is its ability to express either substitution or complementarity among goods. The model was extended by Devine (1983) to allow even greater flexibility in price interactions. Our time-series consumption function has the same form as that used in Devine (1983). In our model, "soft" constraints on the price parameters are employed to assure reasonable estimates.

The system of demand equations will be estimated and forecasted for the aggregate expenditures on the 78 detailed components of the Personal Consumption Expenditures in the National Income and Product Accounts, which will be later presented in Table 4.1. We will estimate the system of time-series consumption functions in this chapter, and forecast each PCE component in the next chapter.

## I. A System of Consumption Functions

### A. The System

Before introducing our time-series consumption functions, we shall first present the notion and the basic form of consumption functions in Almon (1979). Almon's system is developed such that it possesses the main characteristics a consumption function should have but was not derived by explicit utility maximization. In particular, a consumption function should have homogeneity of

[1]Clopper Almon, "A System of Consumption Functions and its Estimation for Belgium," Southern Economic Journal 46 (July 1979) : 85 - 106.

degree zero in all prices and income, adding-up, and flexibility in expressing price interactions. Furthermore, prices should affect the budget shares and the marginal propensity to consume a particular product. The marginal propensity to consume for different goods should be affected differently as income rises. Lastly, price changes should affect in approximately equal proportion the income and the non-income determinants of demand. Although Slutsky symmetry has been included in most consumption functions, it is by no means necessary for market demand functions. However, we will use "approximate" Slutsky symmetry in our equations to cut down the number of parameters to be estimated.

To express the fundamental equation for the demand system, let $q_i$ be the quantity of consumption on good i; Y be income; $p_j$ be the price of good j; and $P$ be an index of average prices. The demand function can be written as follows:

$$q_i = ( a_i(t) + b_i \frac{Y}{P} ) \prod_j p_j^{c_{ij}} \tag{4.1}$$

In Equation (4.1), the $a_i(t)$ is used to capture the effects of all the non-price and non-income factors; and $a_i$, $b_i$ and $c_{ij}$ are the parameters to be estimated.

We now turn to the discussion of the characteristics and the constraints for our consumption functions represented by Equation (4.1).

1) <u>Homogeneity</u>

To guarantee the homogeneity of degree zero in income and prices, that is, that multiplying all the prices and income by a same factor will lead to no changes in the magnitude of consumption expenditures, we need the following restriction for parameters $c_{ij}$:

$$\sum_{j=1}^{N} c_{ij} = 0 \tag{4.2}$$

where N is the total number of goods in the system.

2) Adding-Up

Theoretically, we expect consumption to exhaust income at all prices. In practice, it is difficult to build the general form of the functions without using an explicit "spreader" to allocate the unused income. A "spreader" can be thought of as a device to eliminate the discrepancy between income and first-guess expenditure. Thus, the consumption functions should contain a basic part and a "spreader" function. In the basic part, both prices and income affect consumption. In the "spreader" function, the unused income is allocated, in proportion to the income elasticities, among all goods to guarantee that the expenditures to add up to income. "Spreading" is more desirable than "squeezing", which scales all the first estimates proportionally to fit into the total, because it is able to protect items with little income or price sensitivity from the spreader by assigning a small coefficient to them. Since spreading is not very economically meaningful, we will minimize the reliance on the "spreader" by requiring that the exhaustion of income be achieved at base prices. We will denote this condition as "constant-price adding-up".

The "constant-price adding-up" can be represented by the following conditions:

$$\sum_{i=1}^{N} b_i = 1, \qquad \sum_{i=1}^{N} a_i(t) = 0 \tag{4.3}$$

3) Slutsky Symmetry

Slutsky Symmetry states that the income-compensated partial derivative of the demand for good i with respect to the price of good j is equivalent to the income-compensated partial derivative of the demand for good j with respect to the price of good i. This symmetry is a property of individual demand curve, but it is not a property of market demand curve. We show in Appendix D that the Slutsky symmetry for market demand cannot be derived from the individuals' Slutsky equation.

In practice, the greatest advantage of the Slutsky symmetry is to reduce the number of parameters to be estimated. Thus, although the market demand functions do not have this symmetry if individual consumers have different shapes of Engel curves, we will use this condition closely enough to help us economize on parameters. To be more specific, we shall estimate our equations such that they will give this symmetry at the base prices. To express this symmetry mathematically, we will first define the income compensated price derivative of the demand for $q_i$ with respect to $p_j$ by the following equation:

$$\left(\frac{\partial q_i}{\partial p_j}\right)_{\frac{Y}{P} = constant} = \frac{c_{ij} q_i}{p_j} \tag{4.4}$$

In Equation (4.4), the income compensated partial derivative is derived by holding real income, $Y/P$, constant. In effect, we have presumed that $P$ is a price index sufficiently good that if $Y/P$ is unchanged so is utility.

Given Equation (4.4), the Slutsky symmetry can be written as

$$\frac{c_{ij} q_i}{p_j} = \frac{c_{ji} q_j}{p_i} \tag{4.5}$$

or

$$\frac{c_{ij}}{s_j} = \frac{c_{ji}}{s_i} \tag{4.6}$$

where $s_i$, which is defined by $p_i q_i/Y$, is the budget share of good i in a given year.

We can rewrite Equation (4.6) in a simpler form. That is, we define a variable $\tau_{ij}$ by $\tau_{ij} = c_{ij}/s_j$. Thus, the Slutsky symmetry is represented by $\tau_{ij} = \tau_{ji}$. Equation (4.1) can then be rewritten as

$$q_i = (\ a_i(t)\ +\ b_i\frac{Y}{P}\ )\ p_i^{c_{ii}} \prod_{j \neq i} p_j^{s_j \tau_{ij}} \tag{4.7}$$

In contrast to $N^2$ price parameters in Equation (4.1), there are only $(N^2\text{-}N)/2 + N$, or $(N^2\text{+}N)/2$, price parameters to be estimated in Equation (4.7). However, this reduction seems to be not enough for our 78-equation system. There are still too many parameters to be estimated, in this case 3081. To solve this problem, a grouping scheme will be introduced.

Basically, the commodities are grouped by their characteristics in consumption. In our system, we combined the 78 items into 10 groups. For any commodity i in group I and any commodity j in group J, we assume $\tau_{ij} = \tau_{ji} = \tau_{IJ}$. There will then be $45 = (10^2 - 10)/2$ values of $\tau_{IJ}$ to be estimated. Since $\tau_{ij}$ is the same for all commodities i and j within given I and J groups, all commodities in one group are either all complements or all substitutes for all the goods in the other and all to the same degree. However, the commodities in one group could be substitutes for the goods in the second group while being complements for those in some third. We will, furthermore, divide each group into subgroups to yield more flexible price effects. This will be shortly discussed.

To form the system of consumption functions with the group structure, we will assume that the 78 commodities are combined into M groups, $G_1$ through $G_M$. Since the value of $\tau$ is the same within a particular group, for any commodity i in group I and any commodity j in group J, we may replace the corresponding $\tau_{ij}$'s in Equation (4.7) with $\tau_{IJ}$. Thus, to include this group structure, Equation (4.7) can be rewritten as

$$q_i = ( a_i(t) + b_i\frac{Y}{P} )\, p_i^{c_{ii}} \prod_{j\in G_1} p_j^{s_j\tau_{I1}} \cdots \prod_{j\in G_I, j\neq i} p_j^{s_j\tau_{II}} \cdots \prod_{j\in G_M} p_j^{s_j\tau_{IM}} \tag{4.8}$$

If we define

$$P_L = ( \prod_{j\in G_L} p_j^{s_j} )^{\frac{1}{S_L}}, \qquad S_L = \sum_{j\in G_L} s_j \tag{4.9}$$

for group L, and use the following expression

$$\prod_{j\in G_I, j\neq i} p_j^{s_j\tau_{II}} = \frac{P_I^{S_I\tau_{II}}}{p_i^{s_i\tau_{II}}} \tag{4.10}$$

for group I, then Equation (4.8) can be further simplified as follows:

$$q_i = ( a_i(t) + b_i\frac{Y}{P} )\, p_i^{c_{ii}-s_i\tau_{II}} \prod_{L=1}^{M} P_L^{S_L\tau_{IL}} \tag{4.11}$$

The homogeneity of a consumption function will reduce Equation (4.11) to the final form of our time-series consumption function

$$q_i = ( a_i(t) + b_i\frac{Y}{P} ) \prod_{L=1}^{M} ( \frac{p_i}{P_L} )^{-S_L\tau_{IL}}, \qquad i\in G_I \tag{4.12}$$

where

$P_L$ is the specific average price of group L; and

$S_L$ is the sum of the budget shares of each commodity in group L.

*since* $\sum_{j=1}^{N} c_{ij} = c_{ii} + \sum_{j=1}^{N} s_j\tau_{ij} = c_{ii} + \sum_{L=1}^{M} S_L\tau_{IL} - s_i\tau_{II} = 0,\;\; c_{ii} - s_i\tau_{II} = -\sum_{L=1}^{M} S_L\tau_{IL}$

In Equation (4.12), the consumption on good i depends on income, and its relative prices to each of the M groups' specific average prices, $p_i/P_L$, $L = 1,\dots,M$. In other words, the prices of the commodities in group L affect the demand for good i by the weighted average price index $P_L$ with budget shares being the weights.

An easy example may help interpreting the meaning of the price terms in Equation (4.12). In a two-group commodity system, let one group consist of butter and margarine, and the other contain bread and other wheat products. Demand for bread, therefore, depends upon its own price and the weighted average prices of butter and margarine. If margarine accounts for two-thirds of the total expenditure in its group, then the consumption of bread will be more significantly affected by the changes in the price of margarine than by the changes in the price of butter.

We will now introduce the technique for subgroups. Suppose we have already built 10 groups; and each of the goods in one group is either substitutes or complements for that in another to the same degree. We will call this the inter-group effect, and denote the price parameter for this $\tau_{IJ}$, $I \neq J$. The intra-group effect, on the other hand, is represented by $\tau_{II}$. To build the intra-subgroup and the inter-subgroup price relationships, we will need a new notation $\mu$. $\mu_{ST}$ describes the price interactions between subgroup S and subgroup T within a particular group.

The basic idea of constructing subgroups within each group is to yield a more flexible pattern of price interactions. The fundamental procedure of subgroups is very similar to the grouping scheme. The details of the derivation can be found in Devine (1983). An example of subgroups may be helpful here. In our model, we combined the 78 commodities into 10 groups. The second group contains the following items:

Group 2

a) Women's clothing

b) Men's clothing

c) Shoes and Footwear

d) Luggage

e) Jewelry

f) Toilet articles and preparations

g) Barbershops and beauty shops

h) Cleaning, laundering and shoe repair

We then combined these items into three subgroups

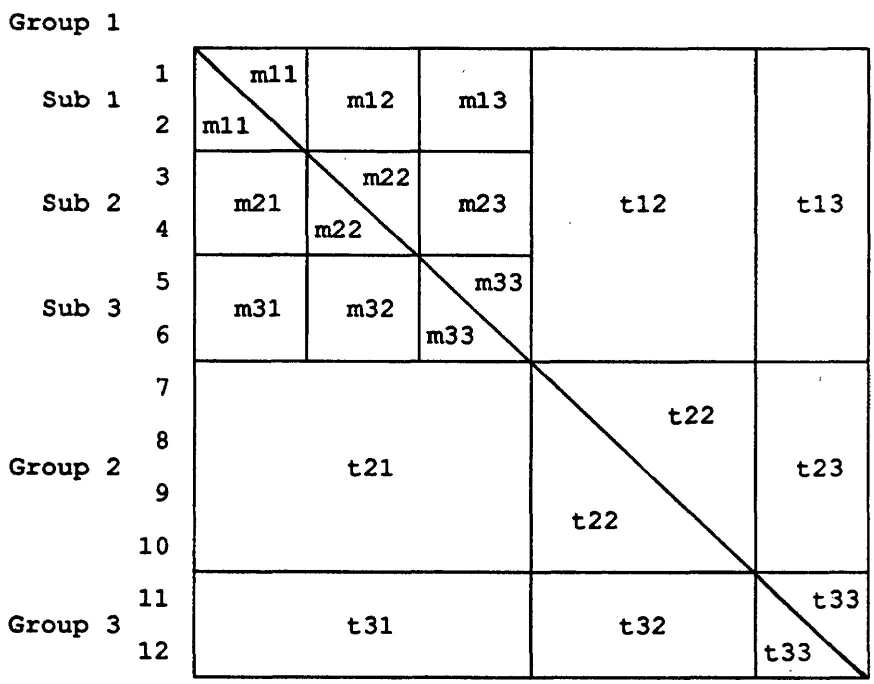
| | | |
|---|---|---|
| Subgroup 1: | Clothing | (a and b) |
| Subgroup 2: | Accessories | (c, d, and e) |
| Subgroup 3: | Personal care items | (f, g, and h) |

Any commodity in one group is either a complement or a substitute for the goods in the other groups to the same degree. However, a particular subgroup may contain either complements or substitutes independently of the other subgroups. Moreover, it is possible that the goods in the first subgroup are substitutes for the goods in the second subgroup while being complements to the goods in the third. Our results will show that Accessories items c, d, and e are substitutes within Subgroup 2, while Personal care items f, g, and h are complements within Subgroup 3. Subgroup 2, Accessories, are complements to Subgroup 1, Clothing, while being substitutes for Subgroup 3, Personal care items.

To see the relationship among groups and subgroups, we show the substitution matrices in Figure 4.1. This figure represents a special case where twelve commodities are combined into three groups; and the first group has three subgroups and the others have none. In the figure, $\mu$'s are denoted by m's and $\tau$'s by t's. The matrices also show the possibility that the goods in the first subgroup are substitutes for the second subgroup while being complements for the third. The $m_{12}$, $m_{13}$, and $m_{23}$ parameters represent the inter-subgroup price relationships; and the intra-subgroup effects are indicated by $m_{11}$, $m_{22}$, and $m_{33}$.

**FIGURE 4.1**

**The Grouping Scheme**



## B. Income and Price Elasticities

In this section, we shall derive the income and price elasticities for our time-series consumption functions. These elasticities will be needed later to present our estimation results.

### a. Income Elasticities

Our income elasticities are considerably dependent upon the distribution of income, because the income variables in the time-series consumption functions, $C^{*}_{it}$, were derived from a nonlinear Engel curve (PLEC). To be more specific, for a given good, because the slope of each Engel curve changes from one income level to another, the same amount of increase in income for individuals at different income levels will affect the changes in their consumption expenditures differently. In general, we would expect that the income elasticities of luxuries are typically high if the persons who were rich become even wealthier. On the other hand, the income elasticities of necessities would be rather low for these people.

Since consumption may be sensitive to the changes in the income distribution and to the changes in the level of average income, we will derive aggregate income elasticities by four different assumptions. In all cases, aggregate income increases by one percent. The first case assumes that the increase in total income is entirely acquired by the poorest persons. In the second case, it is assumed that each individual is given the same absolute increase in income. In case three, all incomes are assumed to increase by one percent. In the fourth case, the whole increase in total income is given to the richest individuals.

b. Price Elasticities

We will derive the price elasticities by the usual definitions. The price elasticity of good i with respect to the price of good j, $\varepsilon_{ij}$, can be written as follows:

$$\varepsilon_{ij} = \frac{\partial \log q_i}{\partial \log p_j} \tag{4.13}$$

To derive the price elasticities for our consumption functions, we will first take the logarithm of Equation (4.12). The result can be written as follows:

$$\log q_i = \log( \; a_i(t) + b_i \frac{Y}{P} \;) - \sum_L S_L \tau_{IL} \; ( \; \log p_i - \log P_L \; ) \tag{4.14}$$

We now can derive the own-price and the cross-price income-compensated elasticities. For the own-price elasticity of good i, we take the partial differential of the (log $q_i$) term with respect to the (log $p_i$) term. This can be done, however, more straightforward to Equation (4.8) than to Equation (4.12). From Equation (4.8), the own-price elasticity for good i is

$$\varepsilon_{ii} = - \sum_{L=1}^{M} S_L \tau_{IL} + s_i \tau_{II} \tag{4.15}$$

$$\text{since} \quad \frac{\partial \log q_i}{\partial \log p_i} = c_{ii} = -\sum_{L=1}^{M} S_L \tau_{IL} + s_i \tau_{II}$$

Equation (4.15) can be rewritten as

$$\varepsilon_{ii} = -\sum_{j=1, j\neq i}^{N} s_j \tau_{IJ}, \qquad j \in G_J \tag{4.16}$$

In Equation (4.16), the own-price elasticity of good i is dependent upon its price interactions with all the groups and subgroups weighted by the budget shares of that group or subgroup.

For the cross-price elasticity, we take the partial derivative of (log $q_i$) with respect to (log $p_j$) such that

$$\varepsilon_{ij} = s_j \tau_{IJ} \tag{4.17}$$

is the elasticity of demand for good i with respect to the price of good j. Thus, the cross-price elasticity of demand is determined by the price relationship between the two commodities and the budget share of the good whose price is changing. Obviously, any commodity in group I will be equally affected by the changes in the price of good j in group J.

## C. Creating "Cross-Section-Parameter Predictions" and Weighted Populations

### a. "Cross-Section-Parameter Predictions" of Consumption

The "cross-section-parameter prediction", which is denoted as $C^*_{it}$ for good i and year t, will be used to represent the effects of changes in income and demographic factors. $C^*_{it}$ will show what would have happened had income and demographic variables had exactly the effects which the cross-section parameters predicted. We shall first present the formula for this $C^*_{it}$ variable. Let $Y_{jt}$ be the average amount of income received in the $j^{th}$ income bracket in year t, $D_{jt}$ the population proportion falling into $j^{th}$ demographic category in year t, and $b_{ij}$'s and

$d_{ij}$'s the estimated cross-section parameters for good i. Then, $C^*_{it}$ can be calculated as follows:

$$C^*_{it} = b_{i0} + \sum_{j=1}^{5} b_{ij} Y_{jt} + \sum_{j=1}^{10} d_{ij} D_{jt} \tag{4.18}$$

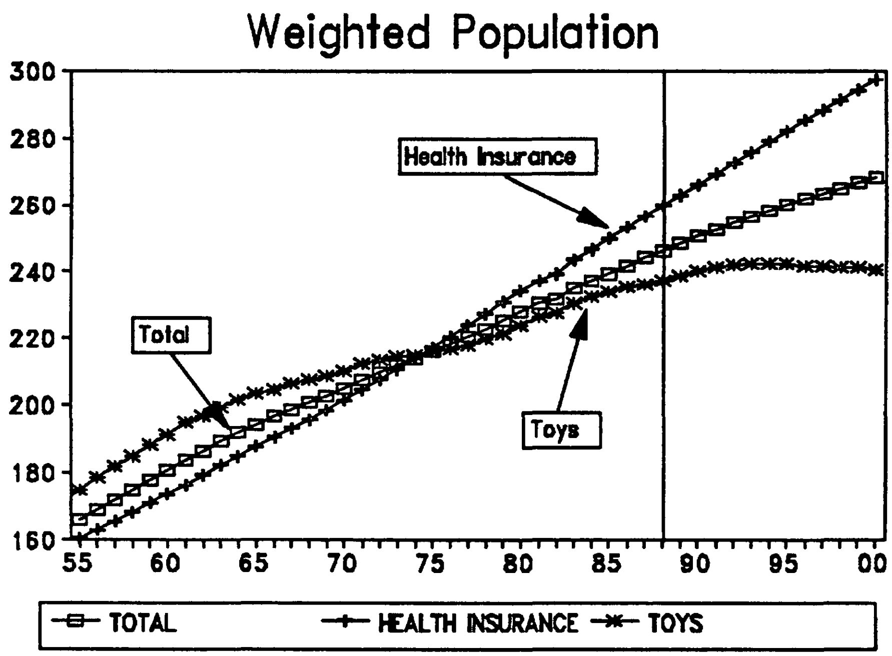
The variables used to calculate the income component of $C^*_{it}$ are per capita income for five income brackets, $Y_{jt}$'s. They can be viewed as being calculated by summing the amount of income over all individuals in each income bracket and then dividing the total amount of income in that bracket by the population. To compute the five $Y_{jt}$'s for each year, the index of distribution of disposable personal income is used. We then assume that the time-series consumption will respond to the changes in income as would the cross-section. That is, we use the MPC's in the cross-section, $b_{ij}$'s, to calculate the income component of this prediction.

The second component of the $C^*_{it}$ variables is demographic effects. It is necessary to incorporate the demographic impacts in the time-series consumption functions, because the cross-section results show that they are significant in determining consumption expenditures. To include the ten demographic effects from the cross-section in the time-series analysis, the proportion of population falling into each of the demographic categories in each year is given a weight, $d_{ij}$, determined from the cross-section. We did not include the ten demographic factors as explanatory variables in the consumption function because the proportion of population for each category changes slowly from year to year. Even if we were to use the ten demographic variables individually in the system, the degrees of freedom would be a restriction.

b. Weighted Populations

In the cross-section, we estimated the adult equivalency weights for each of the 61 consumption categories. In the time series, those equivalency weights will be used to construct the relevant population sizes for different items of consumption expenditures. In contrast to the population totals, the weighted populations not only account for the shift in the age structure, but indicate the differences in demand for different commodities by age groups. This difference can be illustrated by giving an intuitive example. The group of age 0 to 5 years old has highest adult equivalency weight in Wheel goods and Toys. Therefore, as the size in this group decreases, the weighted population for toys will grow slowly or decline. In the case of medical expenses, longer life expectancy will lead to an increase in weighted population for medical services and health insurance. Figure 4.2 shows the contribution of the changing age structure of the population to the growth of consumption expenditures for toys and health insurance.

**FIGURE 4.2**



Weighted Population
300
280
260
240
220
200
180
160
55
60
65
70
75
80
85
90
95
00
Health Insurance
Total
Toys
TOTAL
HEALTH INSURANCE
TOYS

The Current Population Reports published by the Bureau of the Census contains a series of annual estimates of population by age[2]. By using these data, we can calculate the number of people in each of the eight age groups according to the classification in the cross-section. To form the computation, let $N_{gt}$ be the number of people in age group g and year t and $w_{ig}$ the cross-section adult equivalency weight for $i^{th}$ good in age group g. Thus, the weighted size of population for good i in year t, $WP_{it}$, is calculated by the following equation:

$$WP_{it} = \sum_{g=1}^{8} w_{ig} N_{gt} \tag{4.19}$$

Both the weighted populations and the "cross-section-parameter predictions" have to be calculated for each of the 61 cross-section consumption categories. That is, we may have 61 commodity-specific weighted populations and the $C^*_{it}$'s. However, in the time series we have more than 61 items of consumption expenditures, and some of the time-series categories do not exactly match the cross-section consumption items. In this case, the weighted population and the $C^*_{it}$ for the time-series equation is calculated by using the estimated adult equivalency weights for the commodity which most closely matches that of the equation. For the items which have no correspondence in the cross-section, the single population total and disposable personal income per capita will be used. The details of the correspondence between the cross-section and the time series sectors will be represented Table 4.2.

[2]U.S. Bureau of the Census, Current Population Reports, Population Estimates and Projections, Series P-25.

**D. Incorporating the Cross-Section Variables**

In order to make use of the cross-section information in the time-series demand functions, Equation (4.12) has to be modified to include the cross-section Engel curve and the demographic variables. That is, we will incorporate the $C^{*}_{it}$ and the $WP_{it}$ variables in the time-series consumption functions. The new equation is of the form

$$\frac{q_{it}}{WP_{it}} = ( a_i + b_i C^{*}_{it} + c_i \Delta C^{*}_{it} + d_i t ) \prod_{L} ( \frac{p_{it}}{P_{Lt}} )^{-S_L \tau_{iL}} \tag{4.20}$$

where

$q_{it}$ = quantity of commodity i consumed in year t

$WP_{it}$ = weighted population size relevant to commodity i in year t

$C^{*}_{it}$ = cross-section prediction of consumption on good i in year t

t = time trend

$p_{it}$ = price of good i in year t

$P_{Lt}$ = average price for group L in year t

$S_L$ = share in total consumption of group L in the base period (1982)

$a_i$, $b_i$, $c_i$, $d_i$, $\tau_{iL}$ = parameters to be estimated

In Equation (4.20), the $C^{*}_{it}$ and the $WP_{it}$ variables are substituted for the income and the population variables used in the usual demand functions. The advantages of using the $C^{*}_{it}$ and the $WP_{it}$ variables are noteworthy. The $C^{*}_{it}$ variable contains more information than the simple average of income does. For instance, the Engel curves obtained in the cross-section possess the feature that the marginal propensity to consume is different over different income groups by different commodities. Further, the demographic compositions of the population affect the consumption tendencies over time by the shifts in the proportions of households by region of residence, educational achievement of the household head, labor force participation of spouse, household size, and age of the household head.

The $WP_{it}$ variable, on the other hand, provides the information on the changing distribution of the population by using the Adult Equivalency Weights. As we perceived in the cross-section analysis, different age groups have different needs for different commodities. The most significant examples are the medical expenses and the demand for furniture where the former is extremely high for the aged while the latter is higher for children under five years. In view of the fact that the proportion of the population under five years is decreasing while the elderly population over sixty-five years is increasing, the weighted populations are indeed valuable for forecasting.

The $a_i(t)$ term in Equation (4.12) is approximated in Equation (4.20) by a constant, a cyclical variable, and a time trend. The change in $C^*_{it}$, $\Delta C^*_{it}$, is used to capture the cyclical patterns in consumptions. The time trend is used to capture secular changes in consumption which were not accounted for by the demographic composition and the age and income distributions, such changes might be shifts in tastes and preferences.

One of the usual constraints for a consumption function is that the sum across products of income coefficients must be less than or equal to 1. We will impose this restriction on the coefficient of our "income" variable $C^*_{it}$. That is, we want to ensure the appropriate properties of our consumption function by constraining the $b_i$ parameters. The basic idea of imposing the restriction is to choose the coefficient such that elasticity of consumption of product i with respect to $C^*_{it}$ is equal to unity. Because the data used for estimating the variable $C^*_{it}$ differ from that for calculating the dependent variable in Equation (4.20), $q_{it}$, there are discrepancies in the shares of total consumption for a particular good. To correct this difference, we differentiate log( $q_i/WP_i$ ) with respect to log( $C^*_i$ ) in the base period, and then set the value equal to one. This can be expressed as follows:

$$\frac{\partial \log(\frac{q_i}{WP_i})}{\partial \log C_i^*} = \frac{\partial (\frac{q_i}{WP_i})}{\partial C_i^*} \frac{C_i^*}{(\frac{q_i}{WP_i})} = b \frac{C_i^*}{(\frac{q_i}{WP_i})} = 1$$

Thus,

$$b = \frac{(\frac{q_i}{WP_i})}{C_i^*}$$

It is obvious that if the shares in consumption between these two data sources are the same, then b is equal to 1.

## II. Estimation and Data

### A. Estimation Procedure

The system of Equation (4.20) has approximately 400 parameters to be estimated. These equations are nonlinear; and they are interdependent one on another because the price parameters are constrained by Slutsky symmetry. Therefore, we have to estimate the entire system jointly rather than estimating them equation by equation. However, to make the joint estimation, we have to solve the associated problem of heteroscedasticity. This will be shortly discussed.

Before we estimate the equations by least squares, we first approximate the linear form of each equation by Taylor series. The system can then be estimated by least square method and an iterative procedure. The details of the nonlinear estimation technique can be found in Section II.B of Chapter 2. The same approach will be applied to the time-series demand equations. The iterations will continue until the parameters which minimize the error sum of squares are obtained.

To correct heteroscedasticity, which violates the homoscedasticity assumption for the least squares method, we will divide the data for each consumption category by an estimate of the standard deviation of the disturbance term in that equation. These estimates are obtained by regressing the linear approximation form for each of the 78 equations.

The size of the cross-product of the regressor matrix in Equation (4.20) is 400 by 400. The least squares approach, therefore, needs to invert this huge matrix to generate the estimated parameters. In our estimation process, an alternative is adopted to make the inversion easier, namely, an application of matrix partition. The inverse of the partitioned matrix can be made by inverting each piece of the block diagonal portions separately. Thus, the effort of inverting a 400 by 400 matrix is avoided. It has to be mentioned, however, that the matrix partition method needs less memory but no less computation.

## B. Data

The data for the dependent variable used to estimate Equation (4.20) come from the Personal Consumption Expenditure (PCE) component of the National Income and Product Accounts from 1966 to 1987. The items of consumption expenditures are reported both in current and in constant 1982 dollars. The data for $q_{it}$ is PCE in 1982 constant dollars. The data for the price variables are obtained by taking the ratios of current dollar PCE to constant 1982 dollar PCE.

To create the per adult equivalent expenditures for the dependent variables in Equation (4.20), the PCE in 1982 dollars are divided by the corresponding weighted populations, $WP_{it}$. The primary explanatory variables are the $C^{*}_{it}$ variables, which were created by the cross-section parameters. The estimated cross-section parameters of a specific commodity should be used in conjunction with the equations in the time series which most closely match each other. Table 4.2 lists the correspondence between the time-series and the cross-section sectors. It shows from the table that some of the cross-section sectors are used for more than one time-series sectors while some of the time-series sectors do not match any cross-section sectors. In this case, a single average per capita income and an unweighted population total are used for those which do not have the corresponding sectors in the cross-section.

**TABLE 4.1**

**Time-Series Consumption Items**

1. New cars and trucks
2. Net purchases of used cars
3. New and used trucks
4. Tires and tubes
5. Accessories and parts (auto)
6. Furniture, mattresses, and bedsprings
7. Kitchen and other household appliances
8. China, glassware, tableware, and utensils
9. Radio, TV, records, and musical instruments
10. Floor coverings
11. Durable housefurnishings nec
12. Writing equipment
13. Hand tools
14. Jewelry
15. Ophthalmic and orthopedic appliances
16. Books and maps
17. Wheel goods and durable toys
18. Boats, recreational vehicles, and aircraft
19. Food, off premise
20. Food, on premise
21. Alcohol, off premise
22. Alcohol, on premise
23. Shoes and footwear
24. Women's clothing
25. Men's clothing
26. Luggage
27. Gasoline and oil
28. Fuel oil and coal
29. Tobacco
30. Semidurable housefurnishings
31. Drug preparations and sundries
32. Toilet articles and preparations
33. Stationery and writing supplies
34. Nondurable toys and sport supplies
35. Flowers, seeds, and potted plants
36. Lighting supplies
37. Cleaning preparations
38. Household paper products
39. Magazines and newspaper
40. Other nondurables -- identity
41. Owner occupied space rent
42. Tenant occupied space rent
43. Hotels and motels
44. Other housing -- educational housing
45. Electricity
46. Natural gas
47. Water and other sanitary services

**TABLE 4.1**

**Time-Series Consumption Items (Continued)**

48. Telephone and telegraph
49. Domestic services
50. Household insurance
51. Other household operations - repair
52. Postage
53. Auto repair
54. Bridge, tolls, etc.
55. Auto insurance
56. Taxicabs
57. Local public transport
58. Intercity railroad
59. Intercity buses
60. Airlines
61. Travel agents and other transportation services
62. Cleaning, laundering and shoe repair
63. Barbershops and beauty shops
64. Physicians
65. Dentists and other professional services
66. Private hospitals and sanitariums
67. Health insurance
68. Brokerage and investment counseling
69. Bank services charges and services without payment
70. Life insurance
71. Legal services
72. Funeral expenses and other personal business
73. Radio and television repair
74. Movies, legitimate theatre, and spectator sports
75. Other recreational services
76. Education
77. Religious and welfare services
78. Foreign travel

## TABLE 4.2

## The Correspondence Between the Cross-Section and the Time-Series Sectors

| Time Series | Cross-Section |
|---|---|
| 1 New cars | 42 New cars |
| 2 Used cars | 43 Used cars |
| 3 New and used trucks | 44 New and used trucks or vans |
| 4 Tires and tubes | 45 Tires and tubes |
| 5 Auto accessories and parts | 46 Auto accessories & parts |
| 6 Furniture, mattresses, & bedsprings | 19 Furniture |
| 7 Kitchen and other household applian | 20 Kitchen & household appliances |
| 8 China, glassware, tableware, & uten | 21 China, glassware, & tableware |
| 9 Radio, TV, records, & musical instr | 56 Radio, TV, & musical instrumen |
| 10 Floor coverings | 23 Floor coverings |
| 11 Durable housefurnishings | 22 Other durable house furnishing |
| 12 Writing equipment | * |
| 13 Hand tools | 22 Other durable house furnishing |
| 14 Jewelry | 10 Jewelry and watches |
| 15 Ophthalmic & orthopedic appliances | 36 Dental & eyes |
| 16 Books & maps | 53 Books, magazines & newspaper |
| 17 Wheel goods & durable toys | 55 Wheel goods, toys, & sport equ |
| 18 Boats, recreational vehicle, & airc | 54 Boats, RV, & pleasure aircraft |
| 19 Food, off premise | 1 Food, off premise |
| 20 Food, on premise | 2 Food, on premise |
| 21 Alcohol, off premise | 3 Alcoholic beverages, off premi |
| 22 Alcohol, on premise | 4 Alcoholic beverages, on premis |
| 23 Shoes & footwear | 6 Shoes & footwear |
| 24 Women's clothing | 7 Women's & children's clothing |
| 25 Men's clothing | 8 Men's & boy's clothing |
| 26 Luggage | 9 Luggage |
| 27 Gasoline & oil | 49 Gasoline & oil |
| 28 Fuel oil & coal | 27 Fuel oil & coal |
| 29 Tobacco | 5 Tobacco |
| 30 Semidurable house furnishings | 24 Semidurable house furnishings |
| 31 Drug preparations & sundries | 34 Prescription drug & sundries |
| 32 Toilet articles & preparations | * |
| 33 Stationery & writing supplies | * |
| 34 Nondurable toys & sport supplies | 55 Wheel goods, toys, & sport equ |
| 35 Flowers, seed, and potted plants | 32 Other household operations |
| 36 Lighting supplies | 22 Other durable house furnishing |
| 37 Cleaning preparations | 32 Other household operations |
| 38 Household paper products | * |
| 39 Magazines & newspaper | 53 Books, magazines, & newspaper |
| 40 Other nondurables -- Identity | * |
| 41 Owner occupied space rent | 14 Owner-occupied housing |
| 42 Tenant occupied space rent | 15 Tenant-occupied housing |
| 43 Hotels & motels | 18 Hotels & motels |
| 44 Other housing -- Educational housin | 16 Other housing |
| 45 Electricity | 25 Electricity |
| 46 Natural gas | 26 Natural gas |
| 47 Water & other sanitary services | 29 Water & other sanitary service |
| 48 Telephone & telegraph | 30 Telephone & telegraph |
| 49 Domestic services | 31 Domestic services |
| 50 Household insurance | 33 Household insurance |
| 51 Other household operations | 32 Other household operations |
| 52 Postage | 32 Other household operations |
| 53 Auto repair | 47 Auto repairs |

## TABLE 4.2

## The Correspondence Between the Cross-Section and the Time-Series Sectors (Continued)

| Time Series | Cross-Section |
|---|---|
| 54 Bridge, tolls, etc. | 50 Tolls, parking fees, etc. |
| 55 Auto insurance | 48 Auto insurance |
| 56 Taxicab | 51 Local transportation |
| 57 Local public transportation | 51 Local transportation |
| 58 Intercity railroad | 52 Intercity transportation |
| 59 Intercity buses | 52 Intercity transportation |
| 60 Airlines | 52 Intercity transportation |
| 61 Travel agents & other transportatio | 52 Intercity transportation |
| 62 Cleaning laundering & shoe repair | 11 Laundries & repair of clothing |
| 63 Barbershops & beauty shops | 13 Personal care |
| 64 Physicians | 35 Physicians |
| 65 Dentists & other professional serve | 36 Dental & eyes |
| 66 Private hospitals & sanitariums | 38 Hospitals & sanitariums |
| 67 Health insurance | 39 Health insurance |
| 68 Brokerage & investment counseling | 40 Personal business |
| 69 Bank service charges & services wit | 40 Personal business |
| 70 Life insurance | 41 Life insurance |
| 71 Legal services | 40 Personal business |
| 72 Funeral expenses and other personal | 40 Personal business |
| 73 Radio & television repair | 57 Radio & TV repairs & rental |
| 74 Movies, legitimate theatre, & spect | 58 Fees & admissions |
| 75 Other recreational services | 59 Other recreational supplies |
| 76 Education | 60 Education |
| 77 Religious & welfare services | 61 Cash contribution |
| 78 Foreign travel | * |

--------------------------------

* Indicates no corresponding cross-section sector.

## III. Results

In this section, we shall summarize the estimation results of Equation (4.20) by three groups of parameters: income, prices, and non-prices. Income elasticities are given in Table 4.3 for each equation. Four cases of income elasticities are presented according to the four different assumptions about the distribution of the income increment. The estimates of price parameters are shown in Table 4.4 by groups and subgroups for own and cross price elasticities. The estimates of non-price parameters are given in Table 4.5. Table 4.5 also shows the major statistics of the estimation results for each individual equation.

### A. Income Elasticities

Our estimation results of income elasticities are based on four different assumptions about the distribution of the income increments. There is no unique measure for our income elasticity because the nonlinearity of the Engel curve makes the effect of a given increase in aggregate income depend upon which income groups receive increases. In general, we would expect that the income elasticities of luxuries will be typically high if high-income persons get the extra income, while the income elasticities of necessities will be relatively low in this case.

Table 4.3 shows that the income elasticities of a particular item are rather different by four varying assumptions of the increase in income. The budget share of each item in total expenditures, denoted as SHARE, is also listed in the table. Generally, the poorest people tend to increase spending on necessities as they get better off. For instance, the income elasticities of Off premise consumption on food and alcohol and Medical care are highest in Case 1, which assumes that the increase in total income is entirely acquired by the poorest persons. On the other hand, the income elasticities of Jewelry, Recreational expenses, Intercity transportation, and Travel agent services are extremely high in Case 4 in which the richest individuals are even wealthier.

Since there are no corresponding cross-section sectors for some of the time-series equations, we use a simple linear income variable as a substitute of the $C^{*}_{it}$ for these sectors. Thus, these equations have the same value of income elasticities across the four different assumptions. These equations are indicated in Table 4.3 by an asterisk (*). We shall repeat the four assumptions of income increment as follows for easy reference:

CASE 1 - The one-percent increase in total income is entirely acquired by the poorest persons.

CASE 2 - Each individual is given the same absolute increase in income.

CASE 3 - All incomes increase by one percent.

CASE 4 - The one-percent increase in total income is entirely given to the richest individuals.

## TABLE 4.3

### Income Elasticities

| | CASE 1 | CASE 2 | CASE 3 | CASE 4 | SHARE |
|---|---|---|---|---|---|
| 1 NEW CARS | 0.483 | 2.429 | 2.664 | 2.427 | 3.210 |
| 2 NET PURCHASES OF USED CARS | 2.272 | 1.486 | 0.167 | 0.754 | 1.230 |
| 3 NEW AND USED TRUCKS | 1.709 | 2.909 | 2.375 | 0.870 | 1.020 |
| 4 TIRES AND TUBES | 2.139 | 1.091 | 0.761 | 0.317 | 0.610 |
| 5 ACCESSORIES AND PARTS (AUTO) | 1.088 | 1.222 | 0.980 | 0.456 | 0.480 |
| 6 FURNITURE, MATTRESSES, AND BEDSPRINGS | 0.607 | 1.224 | 1.557 | 2.217 | 1.150 |
| 7 KITCHEN AND OTHER HOUSEHOLD APPLIANCES | 1.468 | 1.127 | 0.930 | 0.513 | 1.030 |
| 8 CHINA, GLASSWARE, TABLEWARE, AND UTENSILS | 0.943 | 1.766 | 1.563 | 0.619 | 0.520 |
| 9 RADIO, TV, RECORDS, AND MUSICAL INSTRUMENTS | 2.273 | 1.193 | 1.569 | 3.027 | 2.250 |
| 10 FLOOR COVERINGS | 0.546 | 1.143 | 1.550 | 2.263 | 0.420 |
| 11 DURABLE HOUSEFURNISHINGS | 0.783 | 1.155 | 1.453 | 2.257 | 0.520 |
| 12*WRITING EQUIPMENT | 1.301 | 1.301 | 1.301 | 1.301 | 0.050 |
| 13 HAND TOOLS | 1.431 | 2.111 | 2.655 | 4.125 | 0.170 |
| 14 JEWELRY | 1.001 | 1.319 | 1.650 | 2.715 | 0.900 |
| 15 OPHTHALMIC AND ORTHOPEDIC APPLIANCES | 1.514 | 1.136 | 1.033 | 0.939 | 0.300 |
| 16 BOOKS AND MAPS | 0.722 | 0.797 | 0.726 | 0.547 | 0.320 |
| 17 WHEEL GOODS AND DURABLE TOYS | 1.325 | 1.106 | 1.213 | 1.789 | 0.860 |
| 18 BOATS, RV, AND AIRCRAFT | 1.207 | 2.334 | 2.769 | 3.961 | 0.510 |
| 19 FOOD, OFF PREMISE | 1.285 | 0.551 | 0.394 | 0.225 | 11.070 |
| 20 FOOD, ON PREMISE | 0.924 | 1.081 | 1.182 | 1.429 | 4.850 |
| 21 ALCOHOL, OFF PREMISE | 1.186 | 0.739 | 0.684 | 0.650 | 1.250 |
| 22 ALCOHOL, ON PREMISE | 0.659 | 0.742 | 0.914 | 1.349 | 0.750 |
| 23 SHOES AND FOOTWEAR | 1.142 | 0.915 | 0.846 | 0.704 | 0.990 |
| 24 WOMEN'S CLOTHING | 1.024 | 1.126 | 1.257 | 1.540 | 3.550 |
| 25 MEN'S CLOTHING | 0.972 | 1.190 | 1.215 | 1.202 | 1.720 |
| 26 LUGGAGE | 0.533 | 1.765 | 1.901 | 1.066 | 0.100 |
| 27 GASOLINE AND OIL | 1.679 | 0.776 | 0.528 | 0.228 | 4.030 |

## TABLE 4.3

### Income Elasticities (Continued)

| | CASE 1 | CASE 2 | CASE 3 | CASE 4 | SHARE |
|---|---|---|---|---|---|
| 28 FUEL OIL AND COAL | 1.627 | 0.690 | 0.454 | -0.051 | 0.850 |
| 29 TOBACCO | 1.277 | 0.312 | 0.163 | 0.092 | 0.940 |
| 30 SEMIDURABLE HOUSE-FURNISHINGS | 0.664 | 1.178 | 1.150 | 0.947 | 0.520 |
| 31 DRUG PREPARATIONS AND SUNDRIES | 1.347 | 0.802 | 0.584 | 0.313 | 0.900 |
| 32*TOILET ARTICLES AND PREPARATIONS | 1.982 | 1.982 | 1.982 | 1.982 | 0.860 |
| 33*STATIONERY AND WRITING SUPPLIES | 0.566 | 0.566 | 0.566 | 0.566 | 0.270 |
| 34 NONDURABLE TOYS AND SPORT SUPPLIES | 0.983 | 0.783 | 0.858 | 1.265 | 0.900 |
| 35 FLOWERS, SEEDS, AND POTTED PLANTS | 0.366 | 1.746 | 2.668 | 4.496 | 0.270 |
| 36 CLEANING PREPARATIONS | 0.376 | 1.792 | 2.738 | 4.614 | 0.100 |
| 37 LIGHTING SUPPLIES | 0.904 | 1.334 | 1.678 | 2.607 | 0.500 |
| 38*HOUSEHOLD PAPER PRODUCTS | 0.939 | 0.939 | 0.939 | 0.939 | 0.370 |
| 39 MAGAZINES AND NEWSPAPER | 0.674 | 0.744 | 0.678 | 0.511 | 0.470 |
| 40*OTHER NONDURABLES -- IDENTITY | 0.000 | 0.000 | 0.000 | 0.000 | 0.120 |
| 41 OWNER OCCUPIED SPACE RENT | 0.545 | 1.156 | 1.297 | 1.561 | 10.180 |
| 42 TENANT OCCUPIED SPACE RENT | -0.213 | 0.063 | 0.087 | 0.127 | 3.670 |
| 43 HOTELS AND MOTELS | 0.318 | 1.381 | 1.545 | 1.508 | 0.370 |
| 44 OTHER HOUSING -- EDUCATIONAL HOUSING | 0.507 | 2.434 | 2.136 | 0.253 | 0.160 |
| 45 ELECTRICITY | 1.465 | 0.614 | 0.476 | 0.384 | 2.180 |
| 46 NATURAL GAS | 0.687 | 0.433 | 0.369 | 0.300 | 0.930 |
| 47 WATER AND OTHER SANITARY SERVICES | 1.343 | 0.563 | 0.405 | 0.198 | 0.550 |
| 48 TELEPHONE AND TELEGRAPH | 0.741 | 0.479 | 0.483 | 0.531 | 1.380 |
| 49 DOMESTIC SERVICES | 0.443 | 1.364 | 2.012 | 3.514 | 0.380 |
| 50 HOUSEHOLD INSURANCE | 1.214 | 0.819 | 0.678 | 0.405 | 0.080 |
| 51 OTHER HOUSEHOLD OPERATIONS - REPAIR | 0.236 | 1.124 | 1.718 | 2.895 | 0.430 |
| 52 POSTAGE | 0.265 | 1.264 | 1.932 | 3.256 | 0.220 |
| 53 AUTO REPAIR | 0.922 | 0.991 | 0.979 | 1.006 | 1.870 |
| 54 BRIDGE, TOLLS, ETC. | 0.871 | 0.990 | 0.932 | 0.766 | 0.050 |

## TABLE 4.3

### Income Elasticities (Continued)

| | CASE 1 | CASE 2 | CASE 3 | CASE 4 | SHARE |
|---|---|---|---|---|---|
| 55 AUTO INSURANCE | 1.562 | 0.913 | 0.655 | 0.371 | 0.390 |
| 56 TAXICABS | -1.891 | 0.253 | 0.834 | 1.655 | 0.120 |
| 57 LOCAL PUBLIC TRANSPORT | -2.091 | 0.280 | 0.922 | 1.829 | 0.140 |
| 58 INTERCITY RAILROAD | 0.165 | 1.092 | 1.589 | 2.440 | 0.020 |
| 59 INTERCITY BUSES | 0.119 | 0.788 | 1.147 | 1.762 | 0.030 |
| 60 AIRLINES | 0.177 | 1.169 | 1.700 | 2.612 | 0.830 |
| 61 TRAVEL AGENTS AND OTHER TRANSPORTATION SERVICES | 0.172 | 1.138 | 1.655 | 2.542 | 0.070 |
| 62 CLEANING, LAUNDERING AND SHOE REPAIR | -0.252 | 0.736 | 1.026 | 1.371 | 0.610 |
| 63 BARBERSHOPS AND BEAUTY SHOPS | 1.209 | 0.978 | 0.842 | 0.655 | 0.600 |
| 64 PHYSICIANS | 1.255 | 0.959 | 1.001 | 1.349 | 2.510 |
| 65 DENTISTS AND OTHER PROFESSIONAL SERVICES | 1.608 | 1.207 | 1.097 | 0.997 | 2.100 |
| 66 PRIVATE HOSPITALS AND SANITARIUMS | 0.491 | 0.770 | 1.696 | 4.244 | 5.250 |
| 67 HEALTH INSURANCE | 1.168 | 0.718 | 0.473 | 0.207 | 0.700 |
| 68 BROKERAGE AND INVESTMENT COUNSELING | 1.436 | 1.528 | 1.446 | 1.222 | 0.940 |
| 69 BANK SERVICES CHARGES AND SERVICES WITHOUT PAYMENT | 1.132 | 1.204 | 1.140 | 0.963 | 2.430 |
| 70 LIFE INSURANCE | 1.639 | 1.141 | 1.076 | 0.933 | 1.250 |
| 71 LEGAL SERVICES | 1.136 | 1.209 | 1.144 | 0.967 | 0.920 |
| 72 FUNERAL EXPENSES AND OTHER PERSONAL BUSINESS | 1.048 | 1.115 | 1.056 | 0.892 | 0.650 |
| 73 RADIO AND TELEVISION REPAIR | 1.925 | 0.676 | 0.415 | 0.154 | 0.110 |
| 74 MOVIES, LEGITIMATE THEATRE, AND SPECTATOR SPORTS | 0.759 | 1.206 | 1.355 | 1.538 | 0.540 |
| 75 OTHER RECREATIONAL SERVICES | 1.258 | 1.204 | 1.111 | 0.881 | 2.170 |
| 76 EDUCATION | 1.030 | 2.326 | 2.082 | 0.842 | 1.650 |
| 77 RELIGIOUS AND WELFARE SERVICES | 1.018 | 1.213 | 1.311 | 1.421 | 2.360 |
| 78*FOREIGN TRAVEL | 2.235 | 2.235 | 2.235 | 2.235 | 0.480 |

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* Indicates no corresponding cross-section sector.

## B. Price Elasticities

In Table 4.4, price elasticities are presented for each of the 78 time-series sectors. By the grouping scheme, price relationships among ten groups and their corresponding subgroups are also provided in the table. In each of the groups, an individual equation is identified by its equation number (EQ #), the subgroup it belongs to (SUBGROUP), and its title. The estimation results for each item are then listed in the following order: budget share (SHARE), income elasticity (YELAS), own price elasticity (OWN), and cross price elasticities (SG #1, SG #2, etc.). The titles of subgroups are also shown in the table. Income elasticities, which are the results of Case 3, are listed for the purpose of reference. The cross price elasticities measure the effect of an increase in the price of a given commodity on the consumption of the items in the subgroups designated by subgroup numbers.

In general, our estimation results of the price parameters are satisfying. Most interpretations of the estimates make intuitive sense. The exceptions come from the positive own price elasticities for some items, although these positive own price elasticities are very close to zero. To ensure the reasonableness of our forecasts, we shall put the "soft" constraint on these positive own price elasticities. That is, we shall force all positive own price elasticities in our model to zero.

GROUP 1: FOOD, ALCOHOL, AND TOBACCO

The results show that Off and On premise consumption of food and Off premise consumption of alcohol have positive own price elasticities. These results contradict one of the properties of the usual demand curve that the normal goods have negative price elasticities. In general, the positive cross price elasticities imply the substituting while the negative cross price elasticities indicate the complementary relationships between these two commodities. For the items with positive own price elasticities, the cross price elasticities among them, therefore, have to be inversely interpreted. Given the estimated upward sloping demand curves, the price effects among Group 1 can be interpreted as follows: food and alcohol are complementary items for On premise consumption; although Tobacco is quite price inelastic, it is a complement to the consumption of On premise alcohol and Off premise food and alcohol; and On premise food and alcohol are substitutes for Off premise food and alcohol respectively.

GROUP 2: CLOTHING, ACCESSORIES, AND PERSONAL CARE

The own price elasticities show that Women's clothing is slightly price inelastic (-0.977) while Men's clothing is rather price elastic (-1.359) items. This could be explained by the fact that women's clothing is more fashion oriented than is men's clothing. Therefore, an increase in the prices of apparel will significantly decrease the purchase of men's clothing, but does not have a great impact on the demand for women's garments. The cross price elasticity shows that these two items are substitutes.

The own price elasticities of Accessories and Personal care items are all less than 1.0 in absolute value. Accessories and Personal care items are complementing to Apparel, although the price interactions among three subgroups are not substantial.

GROUP 3: HOUSEHOLD DURABLES

All the items in the major durables subgroup are price elastic (with own price elasticities between -1.598 and -1.361). But the items in the minor durables, whose own price elasticities are only about -0.5, are price inelastic. These results might be explained by the fact that the price variation in the more expensive durables is greater than that in the less expensive durables, thus the consumption of the more costly major durable items is more sensitive to price changes than is that of the minor durables like China and glassware.

The items in the major durables subgroup are substitutes with one another within the same subgroup. The cross price elasticities for those in the minor durables subgroup, on the other hand, show that they are complements to the other items in the same subgroup. The results also show that the substitution effect between the major and the minor durables is very weak.

GROUP 4: HOUSEHOLD OPERATION

Except Household insurance (EQ #50, OWN = -1.015) and Postage (EQ #52, OWN = -1.412), all the other items in this group are price inelastic. The result shows that the commodities within each of the subgroups have different substitution effects. The highest substitution effect, as expected, is between Postage and Telephone and telegraph. The cross price elasticities among subgroups, however, are insignificant.

GROUP 5: HOUSING AND HOUSEHOLD UTILITIES

The own price elasticities for Owner-occupied space rent and Tenant-occupied space rent both came out positive. The results of the cross price effects show that Owner and Tenant occupied space rent, as expected, are substitutes. The elements in the subgroup Household utilities, including Electricity, Natural gas, and Fuel oil and coal, are substitutes with each other within the subgroup.

The cross price elasticities show that the subgroup Household utilities are complementing to the subgroup Housing expenditures although the price effects among them are not substantial.

GROUP 6: MEDICAL SERVICES

The subgroup Drugs and equipment is more price elastic than the subgroup Physicians and hospitals. In fact, the own price elasticities of Physicians and Hospitals are only about -0.4. The results might be explained by the fact that the need of Physicians and Hospitals is more urgent than that of Drug preparations and Ophthalmic and orthopedic appliances in most cases. Therefore, Physicians and Hospitals will be less affected by their own price increases. The highest own price elasticities are in Ophthalmic and orthopedic appliances (-1.116). Thus, if there is an overall increase in the prices of medical services, the purchase of Ophthalmic and orthopedic appliances is most likely to be delayed among the medical services.

The cross price elasticities show that all the items are substitutes for the other commodities both between and within subgroups.

GROUP 7: PERSONAL BUSINESS SERVICES

In general, all items in this group are price inelastic. Bank service charges and services without payment (EQ #69) has near zero but positive own price elasticities. The signs of the cross price elasticities show that except EQ #69, the subgroup Banking services and the subgroup Other personal business are substitutes with each other and the items within each of the subgroups are also substitutes for the other items in the same subgroup.

GROUP 8: TRANSPORTATION

The subgroup Durable purchases, including new and used cars and trucks, is a complement to all the other subgroups. The items in the subgroup Maintenance expenses except gasoline and in the subgroup Public transportation are complements within the same subgroup. Gasoline is a complement to new and used cars while being a substitute for the other two subgroups. That is, an increase in the price of gasoline will decrease the purchases of new and used vehicles while increasing the expenditures on car maintenance and public transportation. This increase in the amount spent on car maintenance might be explained by the fact that people will postpone the purchase of automobiles by maintaining their old cars when the price of gasoline rises.

GROUP 9: RECREATION AND TRAVEL

The own price elasticities of this group do not have the magnitude we anticipated. We have expected that the recreational and travel expenses are greatly responsive to the changes in their prices. The own price elasticities show that except Movies, legitimate theatre, and spectator sports, all the other items are price inelastic. In addition, the subgroup Hotels etc. has positive but very close to zero own price elasticity. There are almost no price interactions between hotels etc. and the other three subgroups.

GROUP 10: READING AND EDUCATION

Reading and education are all price inelastic items. The cross price elasticities show that reading materials are complements to the other items within the subgroup Reading while items in the subgroup Education and religious are substitutes. Moreover, the cross price elasticities show that items in these two subgroups are substitutes.

GROUP PRICE ELASTICITIES

The group price elasticities measure the inter-group cross price elasticities. In the matrix form of group price elasticities presented at the bottom of Table 4.4, the effect of price interactions between each pair of groups are given by the average effect over all the items in the designated groups. For example, the $(i,j)^{th}$ entry of the matrix indicates the effect of an one percent increase in the price of an item in group j on group i.

The table shows that the pattern of price interactions are quite diverse but the effects are not significant, because the grouping scheme has combined the close substitutes or complements into the same group. The substitution or complementary relationships between any given two groups are not dictated by any uniform parameters. Furthermore, they could be either substitutes or complements to different extents.

## TABLE 4.4

## Price Elasticities

GROUP 1: FOOD, ALCOHOL, AND TOBACCO

| EQ # | SUBGROUP | SHARE | YELAS | OWN | SG #1 | SG #2 | SG #3 |
|---|---|---|---|---|---|---|---|
| 19 FOOD,OFF P | 1 | 11.07 | 0.394 | 0.246 | -0.440 | -0.589 | 0.115 |
| 21 ALCOHOL,OF | 1 | 1.25 | 0.684 | 0.636 | -0.050 | -0.066 | 0.013 |
| 20 FOOD,ON PR | 2 | 4.58 | 1.182 | 0.335 | -0.244 | 1.494 | -0.004 |
| 22 ALCOHOL,ON | 2 | 0.75 | 0.914 | -0.914 | -0.040 | 0.245 | -0.001 |
| 29 TOBACCO | 3 | 0.94 | 0.163 | -0.200 | 0.010 | -0.001 | 0.000 |

TITLE

| | | |
|---|---|---|
| EQUATION | 19 | FOOD, OFF PREMISE |
| | 21 | ALCOHOL, OFF PREMISE |
| | 20 | FOOD, ON PREMISE |
| | 22 | ALCOHOL, ON PREMISE |
| | 29 | TOBACCO |
| SUBGROUP | 1 | FOOD AND ALCOHOL, OFF PREMISE |
| | 2 | FOOD AND ALCOHOL, ON PREMISE |
| | 3 | TOBACCO |

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GROUP 2: CLOTHING, ACCESSORIES, AND PERSONAL CARE

| EQ # | SUBGROUP | SHARE | YELAS | OWN | SG #1 | SG #2 | SG #3 |
|---|---|---|---|---|---|---|---|
| 24 WOMEN'S CL | 1 | 3.55 | 1.257 | -0.977 | 0.741 | -0.005 | -0.016 |
| 25 MEN'S CLOT | 1 | 1.72 | 1.215 | -1.359 | 0.359 | -0.003 | -0.008 |
| 23 SHOES & FO | 2 | 0.99 | 0.846 | -0.844 | -0.001 | 0.070 | 0.072 |
| 26 LUGGAGE | 2 | 0.10 | 1.901 | -0.907 | -0.000 | 0.007 | 0.007 |
| 14 JEWELRY | 2 | 0.90 | 1.650 | -0.850 | -0.001 | 0.063 | 0.066 |
| 32 TOILET ART | 3 | 0.86 | 1.982 | -0.371 | -0.004 | 0.063 | -0.269 |
| 63 BARBERSHOP | 3 | 0.60 | 0.842 | -0.290 | -0.003 | 0.044 | -0.188 |
| 62 CLEANING,L | 3 | 0.61 | 1.026 | -0.293 | -0.003 | 0.045 | -0.191 |

TITLE

| | | |
|---|---|---|
| EQUATION | 24 | WOMEN'S CLOTHING |
| | 25 | MEN'S CLOTHING |
| | 23 | SHOES AND FOOTWEAR |
| | 26 | LUGGAGE |
| | 14 | JEWELRY |
| | 32 | TOILET ARTICLES AND PREPARATIONS |
| | 63 | BARBERSHOPS AND BEAUTY SHOPS |
| | 62 | CLEANING, LAUNDERING AND SHOE REPAIR |
| SUBGROUP | 1 | CLOTHING |
| | 2 | ACCESSORIES |
| | 3 | PERSONAL CARE |

## TABLE 4.4

### Price Elasticities (Continued)

GROUP 3: HOUSEHOLD DURABLES

| EQ # | SUBGROUP | SHARE | YELAS | OWN | SG #1 | SG #2 |
|---|---|---|---|---|---|---|
| 6 FURNITURE, | 1 | 1.15 | 1.557 | -1.575 | 0.223 | 0.083 |
| 7 KITCHEN AN | 1 | 1.03 | 0.930 | -1.598 | 0.200 | 0.074 |
| 9 RADIO,TV,R | 1 | 2.25 | 1.569 | -1.361 | 0.437 | 0.162 |
| 8 CHINA,GLAS | 2 | 0.52 | 1.563 | -0.528 | 0.038 | -0.209 |
| 10 FLOOR COVE | 2 | 0.42 | 1.550 | -0.487 | 0.030 | -0.168 |
| 11 DURABLE HO | 2 | 0.52 | 1.453 | -0.528 | 0.038 | -0.209 |
| 30 SEMIDURABL | 2 | 0.52 | 1.150 | -0.528 | 0.038 | -0.209 |

TITLE

| | | |
|---|---|---|
| EQUATION | 6 | FURNITURE, MATTRESSES, AND BEDSPRINGS |
| | 7 | KITCHEN AND OTHER HOUSEHOLD APPLIANCES |
| | 9 | RADIO, TV, RECORDS, AND MUSICAL INSTRUMENT |
| | 8 | CHINA, GLASSWARE, TABLEWARE, AND UTENSILS |
| | 10 | FLOOR COVERINGS |
| | 11 | DURABLE HOUSEFURNISHINGS NEC |
| | 30 | SEMIDURABLE HOUSEFURNISHINGS |
| SUBGROUP | 1 | MAJOR DURABLES |
| | 2 | MINOR DURABLES |

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GROUP 4: HOUSEHOLD OPERATION

| EQ # | SUBGROUP | SHARE | YELAS | OWN | SG #1 | SG #2 | SG #3 |
|---|---|---|---|---|---|---|---|
| 36 CLEANING P | 1 | 0.10 | 2.738 | -0.798 | 0.107 | -0.002 | 0.024 |
| 37 LIGHTING S | 1 | 0.50 | 1.678 | -0.371 | 0.533 | -0.012 | 0.118 |
| 38 HH PAPER P | 1 | 0.37 | 0.939 | -0.510 | 0.394 | -0.009 | 0.087 |
| 47 WATER & OT | 2 | 0.55 | 0.405 | -0.722 | -0.013 | 0.343 | 0.205 |
| 49 DOMESTIC S | 2 | 0.38 | 2.012 | -0.828 | -0.009 | 0.237 | 0.141 |
| 50 HH INSURAN | 2 | 0.08 | 0.678 | -1.015 | -0.002 | 0.050 | 0.030 |
| 51 OTHER HOUS | 2 | 0.43 | 1.718 | -0.796 | -0.010 | 0.268 | 0.160 |
| 73 RADIO & TE | 2 | 0.11 | 0.415 | -0.996 | -0.003 | 0.069 | 0.041 |
| 52 POSTAGE | 3 | 0.22 | 1.932 | -1.412 | 0.052 | 0.082 | 0.172 |
| 48 TELEPHONE | 3 | 1.38 | 0.483 | -0.506 | 0.325 | 0.513 | 1.078 |

TITLE

| | | |
|---|---|---|
| EQUATION | 36 | CLEANING PREPARATIONS |
| | 37 | LIGHTING SUPPLIES |
| | 38 | HOUSEHOLD PAPER PRODUCTS |
| | 47 | WATER AND OTHER SANITARY SERVICES |
| | 49 | DOMESTIC SERVICES |
| | 50 | HOUSEHOLD INSURANCE |
| | 51 | OTHER HOUSEHOLD OPERATIONS -- REPAIR |
| | 73 | RADIO AND TELEVISION REPAIR |
| | 52 | POSTAGE |
| | 48 | TELEPHONE AND TELEGRAPH |
| SUBGROUP | 1 | CLEANING AND PAPER PRODUCTS |
| | 2 | SERVICES AND INSURANCE |
| | 3 | COMMUNICATION |

## TABLE 4.4

### Price Elasticities (Continued)

GROUP 5: HOUSING AND HOUSEHOLD UTILITIES

| EQ # | SUBGROUP | SHARE | YELAS | OWN | SG #1 | SG #2 |
|---|---|---|---|---|---|---|
| 41 OWNER OCCU | 1 | 10.18 | 1.297 | 1.210 | -2.350 | 0.283 |
| 42 TENANT OCC | 1 | 3.67 | 0.087 | 2.713 | -0.847 | 0.102 |
| 45 ELECTRICIT | 2 | 2.18 | 0.476 | -0.057 | 0.061 | 0.177 |
| 46 NATURAL GA | 2 | 0.93 | 0.369 | -0.159 | 0.026 | 0.076 |
| 28 FUEL OIL & | 2 | 0.85 | 0.454 | -0.165 | 0.024 | 0.069 |

TITLE

EQUATION 41 OWNER OCCUPIED SPACE RENT
42 TENANT OCCUPIED SPACE RENT
45 ELECTRICITY
46 NATURAL GAS
28 FUEL OIL AND COAL

SUBGROUP 1 HOUSING
2 HOUSEHOLD UTILITIES

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GROUP 6: MEDICAL SERVICES

| EQ # | SUBGROUP | SHARE | YELAS | OWN | SG #1 | SG #2 |
|---|---|---|---|---|---|---|
| 64 PHYSICIANS | 1 | 2.51 | 1.001 | -0.409 | 0.102 | 0.223 |
| 65 DENTISTS & | 1 | 2.10 | 1.097 | -0.426 | 0.086 | 0.187 |
| 66 PRIVATE HO | 1 | 5.25 | 1.696 | -0.297 | 0.214 | 0.466 |
| 67 HEALTH INS | 1 | 0.70 | 0.473 | -0.483 | 0.029 | 0.062 |
| 15 OPHTHALMIC | 2 | 0.30 | 1.033 | -1.116 | 0.027 | 0.068 |
| 31 DRUG PREPA | 2 | 0.90 | 0.584 | -0.980 | 0.080 | 0.203 |

TITLE

EQUATION 64 PHYSICIANS
65 DENTISTS AND OTHER PROFESSIONAL SERVICES
66 PRIVATE HOSPITALS AND SANITARIUMS
67 HEALTH INSURANCE
15 OPHTHALMIC AND ORTHOPEDIC APPLIANCES
31 DRUG PREPARATIONS AND SUNDRIES

SUBGROUP 1 PHYSICIANS AND HOSPITALS
2 DRUGS AND EQUIPMENT

## TABLE 4.4

### Price Elasticities (Continued)

GROUP 7: PERSONAL BUSINESS SERVICES

| EQ # | SUBGROUP | SHARE | YELAS | OWN | SG #1 | SG #2 |
|---|---|---|---|---|---|---|
| 68 BROKERAGE | 1 | 0.94 | 1.446 | -0.258 | 0.179 | 0.011 |
| 69 BANK SERVI | 1 | 2.43 | 1.140 | 0.026 | 0.463 | 0.029 |
| 70 LIFE INSUR | 2 | 1.25 | 1.076 | -0.166 | 0.015 | 0.290 |
| 71 LEGAL SERV | 2 | 0.92 | 1.144 | -0.243 | 0.011 | 0.213 |
| 72 FUNERAL EX | 2 | 0.65 | 1.056 | -0.305 | 0.008 | 0.151 |

TITLE

| | | |
|---|---|---|
| EQUATION | 68 | BROKERAGE AND INVESTMENT COUNSELING |
| | 69 | BANK SERVICE CHARGES AND SERVICES WITHOUT PAYMENT |
| | 70 | LIFE INSURANCE |
| | 71 | LEGAL SERVICES |
| | 72 | FUNERAL EXPENSES AND OTHER PERSONAL BUSINESS |
| SUBGROUP | 1 | BANKING SERVICES |
| | 2 | OTHER PERSONAL BUSINESS |

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GROUP 8: TRANSPORTATION

| EQ # | SUBGROUP | SHARE | YELAS | OWN | SG #1 | SG #2 | SG #3 | SG #4 |
|---|---|---|---|---|---|---|---|---|
| 1 NEW CARS | 1 | 3.21 | 2.664 | -0.031 | 0.410 | -0.197 | -1.148 | -0.085 |
| 2 USED CARS | 1 | 1.23 | 1.167 | -0.284 | 0.157 | -0.076 | -0.440 | -0.033 |
| 3 TRUCKS | 1 | 1.02 | 2.375 | -0.311 | 0.130 | -0.063 | -0.365 | -0.027 |
| 4 TIRES & TU | 2 | 0.61 | 0.761 | -0.068 | -0.038 | -0.002 | 0.435 | 0.011 |
| 5 ACCESSORIE | 2 | 0.48 | 0.980 | -0.067 | -0.030 | -0.001 | 0.342 | 0.009 |
| 53 AUTO REPAI | 2 | 1.87 | 0.979 | -0.072 | -0.115 | -0.006 | 1.334 | 0.035 |
| 55 AUTO INSUR | 2 | 0.39 | 0.655 | -0.067 | -0.024 | -0.001 | 0.278 | 0.007 |
| 54 BRIDGE,TOL | 2 | 0.05 | 0.932 | -0.066 | -0.003 | -0.000 | 0.036 | 0.001 |
| 56 TAXICABS | 3 | 0.12 | 0.834 | -0.390 | -0.043 | 0.086 | -0.281 | 0.002 |
| 57 LOCAL PUBL | 3 | 0.14 | 0.922 | -0.437 | -0.050 | 0.100 | -0.328 | 0.003 |
| 27 GASOLINE & | 4 | 4.03 | 0.528 | -0.077 | -0.107 | 0.076 | 0.081 | 0.000 |

TITLE

| | | |
|---|---|---|
| EQUATION | 1 | NEW CARS |
| | 2 | NET PURCHASES OF USED CARS |
| | 3 | TRUCKS |
| | 4 | TIRES AND TUBES |
| | 5 | ACCESSORIES AND PARTS (AUTO) |
| | 53 | AUTO REPAIR |
| | 55 | AUTO INSURANCE |
| | 54 | BRIDGE, TOLLS, ETC |
| | 56 | TAXICABS |
| | 57 | LOCAL PUBLIC TRANSPORT |
| | 27 | GASOLINE AND OIL |
| SUBGROUP | 1 | DURABLE PURCHASES |
| | 2 | MAINTENANCE EXPENSES EXCEPT GASOLINE |
| | 3 | PUBLIC TRANSPORTATION |
| | 4 | GASOLINE |

## TABLE 4.4

### Price Elasticities (Continued)

GROUP 9: RECREATION AND TRAVEL

| EQ # | SUBGROUP | SHARE | YELAS | OWN | SG #1 | SG #2 | SG #3 | SG #4 |
|---|---|---|---|---|---|---|---|---|
| 74 MOVIES,LEG | 1 | 0.54 | 1.355 | -1.767 | 0.378 | -0.010 | 0.197 | 0.000 |
| 75 OTHER RECR | 1 | 2.17 | 1.111 | -0.625 | 1.521 | -0.041 | 0.793 | 0.001 |
| 18 BOATS,RECR | 2 | 0.51 | 2.769 | -0.816 | -0.010 | 0.211 | -0.008 | -0.000 |
| 17 WHEEL GOOD | 2 | 0.86 | 1.213 | -0.671 | -0.016 | 0.355 | -0.013 | -0.000 |
| 34 NONDURABLE | 2 | 0.90 | 0.858 | -0.654 | -0.017 | 0.372 | -0.014 | -0.000 |
| 35 FLOWERS,SE | 2 | 0.27 | 2.668 | -0.915 | -0.005 | 0.111 | -0.004 | -0.000 |
| 13 HAND TOOLS | 2 | 0.17 | 2.655 | -0.956 | -0.003 | 0.070 | -0.003 | -0.000 |
| 58 RAILROAD,I | 3 | 0.02 | 1.589 | -0.936 | 0.007 | -0.000 | 0.001 | -0.000 |
| 59 BUSES,INTE | 3 | 0.03 | 1.147 | -0.936 | 0.011 | -0.000 | 0.001 | -0.001 |
| 60 AIRLINES | 3 | 0.83 | 1.700 | -0.902 | 0.303 | -0.013 | 0.035 | -0.019 |
| 61 TRAVEL AGE | 4 | 0.07 | 1.655 | 0.039 | 0.000 | -0.000 | -0.002 | 0.001 |
| 78 FOREIGN TR | 4 | 0.48 | 2.235 | 0.043 | 0.000 | -0.000 | -0.011 | 0.005 |
| 43 HOTELS & M | 4 | 0.37 | 1.545 | 0.042 | 0.000 | -0.000 | -0.009 | 0.004 |

TITLE

| | | |
|---|---|---|
| EQUATION | 74 | MOVIES, LEGITIMATE THEATRE, SPECTATOR SPORTS |
| | 75 | OTHER RECREATIONAL SERVICES |
| | 18 | BOATS, RECREATIONAL VEHICLES, AND AIRCRAFT |
| | 17 | WHEEL GOODS AND DURABLE TOYS |
| | 34 | NONDURABLE TOYS AND SPORT SUPPLIES |
| | 35 | FLOWERS, SEEDS, AND POTTED PLANTS |
| | 13 | HAND TOOLS |
| | 58 | INTERCITY RAILROAD |
| | 59 | INTERCITY BUSES |
| | 60 | AIRLINES |
| | 61 | TRAVEL AGENTS AND OTHER TRANSPORTATION SERVICES |
| | 78 | FOREIGN TRAVEL |
| | 43 | HOTELS AND MOTELS |
| SUBGROUP | 1 | ADMISSIONS |
| | 2 | RECREATIONAL NONDURABLES AND DURABLE |
| | 3 | TRAVEL EXPENSES |
| | 4 | HOTELS ETC. |

## TABLE 4.4

### Price Elasticities (Continued)

GROUP 10: READING AND EDUCATION

| EQ # | | SUBGROUP | SHARE | YELAS | OWN | SG #1 | SG #2 |
|---|---|---|---|---|---|---|---|
| 16 | BOOKS & MA | 1 | 0.32 | 0.726 | -0.566 | -0.295 | 0.109 |
| 39 | MAGAZINES | 1 | 0.47 | 0.678 | -0.705 | -0.434 | 0.159 |
| 12 | WRITING EQ | 1 | 0.05 | 1.301 | -0.317 | -0.046 | 0.017 |
| 33 | STATIONERY | 1 | 0.27 | 0.566 | -0.520 | -0.249 | 0.092 |
| 76 | EDUCATION | 2 | 1.65 | 2.082 | -0.481 | 0.560 | 0.143 |
| 77 | RELIGIOUS | 2 | 2.36 | 1.311 | -0.420 | 0.801 | 0.205 |
| 44 | OTHER HOUS | 2 | 0.16 | 2.136 | -0.611 | 0.054 | 0.014 |

TITLE

EQUATION 16 BOOKS AND MAPS
39 MAGAZINES AND NEWSPAPER
12 WRITING EQUIPMENT
33 STATIONERY AND WRITING SUPPLIES
76 EDUCATION
77 RELIGIOUS AND WELFARE SERVICES
44 OTHER HOUSING -- EDUCATIONAL HOUSING

SUBGROUP 1 READING
2 EDUCATION AND RELIGIOUS

GROUP PRICE ELASTICITIES

| GROUP | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 |
|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 0.000 | -0.001 | -0.000 | 0.017 | 0.005 | -0.042 | -0.013 | 0.025 | -0.000 | -0.009 |
| 2 | -0.002 | 0.000 | 0.045 | -0.028 | 0.156 | 0.045 | -0.022 | -0.007 | -0.003 | -0.032 |
| 3 | -0.001 | 0.057 | 0.000 | 0.001 | 0.349 | -0.139 | -0.033 | -0.058 | -0.002 | 0.036 |
| 4 | 0.149 | -0.079 | 0.002 | 0.000 | -0.287 | 0.076 | 0.014 | 0.079 | 0.002 | -0.085 |
| 5 | 0.005 | 0.051 | 0.090 | -0.033 | 0.000 | -0.080 | -0.038 | -0.031 | -0.001 | -0.026 |
| 6 | -0.080 | 0.027 | -0.065 | 0.015 | -0.145 | 0.000 | 0.064 | 0.023 | 0.001 | 0.084 |
| 7 | -0.039 | -0.021 | -0.025 | 0.005 | -0.110 | 0.102 | 0.000 | 0.015 | -0.000 | 0.004 |
| 8 | 0.079 | -0.007 | -0.045 | 0.027 | -0.094 | 0.038 | 0.016 | 0.000 | 0.003 | -0.003 |
| 9 | -0.001 | -0.006 | -0.002 | 0.002 | -0.003 | 0.002 | -0.000 | 0.005 | 0.000 | -0.004 |
| 10 | -0.044 | -0.050 | 0.044 | -0.046 | -0.121 | 0.219 | 0.006 | -0.004 | -0.003 | 0.000 |

TITLE

GROUP 1 FOOD, ALCOHOL, & TOBACCO
2 CLOTHING, ACCESSORIES, & PERSONAL CARE
3 HOUSEHOLD DURABLE
4 HOUSEHOLD OPERATION
5 HOUSING & HOUSEHOLD UTILITIES
6 MEDICAL SERVICES
7 PERSONAL BUSINESS SERVICES
8 TRANSPORTATION
9 RECREATION AND TRAVEL
10 READING AND EDUCATION

### C. Estimates of Non-Price Parameters

Table 4.5 provides the results of the estimated non-price parameters in Equation (4.20). We shall repeat this equation for easy reference:

$$\frac{q_{it}}{WP_{it}} = ( a_i + b_i C^*_{it} + c_i \Delta C^*_{it} + d_i t ) \prod_L ( \frac{p_{it}}{P_{Lt}} )^{-s_L \tau_{IL}}$$

The parameter in column A is the constant term. The parameter in column B is constrained and is equal to the ratio of ( $q_i/WP_i$ ) to $C^*_i$ in Equation (4.20). The parameter in column C is the effect of the first difference of $C^*_i$ on consumption expenditures. In other words, it measures the impact of the cyclical changes in the economy on a consumption item. The parameter in column D measures the effect of time trend, which accounts for the impact of the factors other than income, price, and demographic variables on the amount of expenses of a given commodity. The parameter in column E is the coefficient of the equation-specific variables, which will be shortly discussed. The regression statistics for each of the equations include mean absolute percentage error (MAPE) and $R^2$. Error sum of squares (ESS) are also listed for each equation.

We have used additional variables in a linear form while estimating Equation (4.20) for some of the sectors. The extra variables and the corresponding equations using those variables are as follows:

a. <u>A dummy variable for natural gas supply constraints</u>

The dummy variable is given a value of one during the period 1974, 1975, and 1976 where gas was in short supply due to price regulation and zero otherwise. The variable is used in sector 28 of Fuel oil and coal, sector 45 of Electricity, and sector 46 of Natural gas. The results show that this variable has negative impact on Electricity and Natural gas but has very little effect on Fuel oil and coal.

b. A proxy for the potential stock of cars for the use-car market

This variable is used in sector 2 for the Used cars equation. It is calculated by a three year moving average of new car purchases lagged three years.

c. The mortality rate

The mortality rate is included in equation 72, Funeral expenses and other personal business, to capture the negative impact of the increasing longevity.

d. A proxy for the speculative demand for housing

This variable is computed as a ratio of M2 money supply to GNP. It is included in housing sector 41 of Owner occupied space rent and sector 42 of Tenant occupied space rent.

e. The short term bond rate

This variable is used in the following cyclical sectors: sector 1 of New cars, sector 3 of New and used trucks, and sector 18 of Boats, recreational vehicle, and aircraft. It is measured by the 4-6 month commercial paper rate.

f. <u>A time trend variable for the taste changes in alcohol consumption and the changes in the demand for public transportation</u>

In equations 21 and 22, a time trend starting with the value one is imposed on period 1980 through the rest of the periods to capture the taste changes in the off and the on premise consumption of alcohol. It is also used in equation 57 of Local public transportation and equation 58 of Intercity railroad to capture the downward trend of consumption in these two sectors.

## TABLE 4.5

## Estimates of Non-Price Parameters

GROUP 1: FOOD, ALCOHOL, AND TOBACCO

| EQ | SG | A | B | C | D | E | MAPE | RSQ | ESS | SHARE |
|---|---|---|---|---|---|---|---|---|---|---|
| 19 FOOD,OFF P | 1 | -143.331 | 0.662 | 1.729 | 2.096 | | 4.1% | -1.031 | 61821. | 11.1 |
| 21 ALCOHOL,OF | 1 | -338.747 | 1.233 | -0.755 | 4.649 | -8.018 | 1.7% | 0.933 | 514. | 1.2 |
| 20 FOOD,ON PR | 2 | 84.071 | 0.754 | -0.369 | -0.932 | | 2.0% | 0.962 | 2123. | 4.6 |
| 22 ALCOHOL,ON | 2 | 450.167 | 0.783 | -0.374 | -5.361 | 2.342 | 2.0% | 0.488 | 225. | 0.7 |
| 29 TOBACCO | 3 | 88.088 | 0.916 | 0.492 | -0.896 | | 1.5% | 0.871 | 184. | 0.9 |

TITLE

EQUATION 19 FOOD, OFF PREMISE
21 ALCOHOL, OFF PREMISE
20 FOOD, ON PREMISE
22 ALCOHOL, ON PREMISE
29 TOBACCO

GROUP 2: CLOTHING, ACCESSORIES, & PERSONAL CARE

| EQ | SG | A | B | C | D | E | MAPE | RSQ | ESS | SHARE |
|---|---|---|---|---|---|---|---|---|---|---|
| 24 WOMEN'S CL | 1 | -41.448 | 1.156 | -0.259 | 0.356 | | 1.9% | 0.993 | 655. | 3.5 |
| 25 MEN'S CLOT | 1 | -4.028 | 1.089 | -0.388 | 0.049 | | 1.4% | 0.991 | 121. | 1.7 |
| 23 SHOES & FO | 2 | 60.525 | 1.265 | -0.727 | -0.782 | | 2.5% | 0.959 | 149. | 1.0 |
| 26 LUGGAGE | 2 | 9.057 | 1.922 | -0.812 | -0.119 | | 3.4% | 0.918 | 3. | 0.1 |
| 14 JEWELRY | 2 | -52.593 | 1.497 | -0.912 | 0.605 | | 5.8% | 0.955 | 470. | 0.9 |
| 32 TOILET ART | 3 | 31.098 | 1.644 | -1.020 | -1.361 | | 1.9% | 0.922 | 67. | 0.9 |
| 63 BARBERSHOP | 3 | 61.105 | 0.554 | 0.216 | -0.736 | | 5.2% | 0.389 | 212. | 0.6 |
| 62 CLEANING,L | 3 | 164.865 | 1.325 | 0.096 | -1.981 | | 6.2% | 0.613 | 632. | 0.6 |

TITLE

EQUATION 24 WOMEN'S CLOTHING
25 MEN'S CLOTHING
23 SHOES AND FOOTWEAR
26 LUGGAGE
14 JEWELRY
32 TOILET ARTICLES AND PREPARATIONS
63 BARBERSHOPS AND BEAUTY SHOPS
62 CLEANING, LAUNDERING AND SHOE REPAIR

## TABLE 4.5

### Estimates of Non-Price Parameters (Continued)

GROUP 3: HOUSEHOLD DURABLES

| EQ | SG | A | B | C | D | E | MAPE | RSQ | ESS | SHARE |
|---|---|---|---|---|---|---|---|---|---|---|
| 6 FURNITURE, | 1 | -91.469 | 0.584 | -0.372 | 1.281 | | 3.1% | 0.893 | 877. | 1.1 |
| 7 KITCHEN & | 1 | -57.446 | 1.013 | -0.119 | 0.592 | | 3.6% | 0.949 | 200. | 1.0 |
| 9 RADIO,TV,R | 1 | -18.840 | 1.635 | -0.536 | -0.575 | | 7.3% | 0.989 | 1095. | 2.2 |
| 8 CHINA,GLAS | 2 | 116.240 | 2.790 | -1.828 | -1.412 | | 3.0% | 0.420 | 359. | 0.5 |
| 10 FLOOR,COVE | 2 | -9.455 | 1.235 | -0.991 | 0.125 | | 5.6% | 0.876 | 70. | 0.4 |
| 11 DURABLE HO | 2 | -33.833 | 0.534 | -0.348 | 0.432 | | 3.9% | 0.945 | 139. | 0.5 |
| 30 SEMIDURABL | 2 | 50.916 | 0.827 | -0.627 | -0.576 | | 2.8% | -0.501 | 106. | 0.5 |

TITLE

EQUATION 6 FURNITURE, MATTRESSES, AND BEDSPRINGS
7 KITCHEN AND OTHER HOUSEHOLD APPLIANCES
9 RADIO, TV, RECORDS, AND MUSICAL INSTRUMENT
8 CHINA, GLASSWARE, TABLEWARE, AND UTENSILS
10 FLOOR COVERINGS
11 DURABLE HOUSEFURNISHINGS NEC
30 SEMIDURABLE HOUSEFURNISHINGS

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GROUP 4: HOUSEHOLD OPERATION

| EQ | SG | A | B | C | D | E | MAPE | RSQ | ESS | SHARE |
|---|---|---|---|---|---|---|---|---|---|---|
| 36 CLEANING P | 1 | 37.137 | 0.120 | -0.031 | -0.523 | | 2.9% | 0.666 | 5. | 0.1 |
| 37 LIGHTING S | 1 | 337.004 | 0.745 | -0.011 | -4.251 | | 8.8% | 0.302 | 1900. | 0.5 |
| 38 HH PAPER P | 1 | 41.371 | 0.343 | -0.079 | -0.477 | | 4.7% | -0.060 | 97. | 0.4 |
| 47 WATER & OT | 2 | -110.852 | 0.845 | 1.276 | 1.323 | | 5.0% | 0.785 | 179. | 0.5 |
| 49 DOMESTIC S | 2 | 28.419 | 0.181 | 0.054 | -0.345 | | 5.3% | 0.847 | 7. | 0.4 |
| 50 HH INSURAN | 2 | -5.542 | 0.115 | 0.052 | 0.076 | | 10.2% | 0.490 | 32. | 0.1 |
| 51 OTHER HOUS | 2 | 22.353 | 0.322 | -0.215 | -0.216 | | 4.8% | 0.784 | 148. | 0.4 |
| 73 RADIO & TE | 2 | 35.044 | 0.913 | 2.108 | -0.408 | | 4.9% | 0.877 | 8. | 0.1 |
| 52 POSTAGE | 3 | 4.555 | 0.149 | -0.083 | -0.063 | | 4.1% | 0.275 | 34. | 0.2 |
| 48 TELEPHONE | 3 | -41.452 | 0.704 | 0.417 | 0.726 | | 1.8% | 0.991 | 234. | 1.4 |

TITLE

EQUATION 36 CLEANING PREPARATIONS
37 LIGHTING SUPPLIES
38 HOUSEHOLD PAPER PRODUCTS
47 WATER AND OTHER SANITARY SERVICES
49 DOMESTIC SERVICES
50 HOUSEHOLD INSURANCE
51 OTHER HOUSEHOLD OPERATIONS -- REPAIR
73 RADIO AND TELEVISION REPAIR
52 POSTAGE
48 TELEPHONE AND TELEGRAPH

## TABLE 4.5

## Estimates of Non-Price Parameters (Continued)

GROUP 5: HOUSING AND HOUSEHOLD UTILITIES

| EQ | SG | A | B | C | D | E | MAPE | RSQ | ESS | SHARE |
|---|---|---|---|---|---|---|---|---|---|---|
| 41 OWNER OCCU | 1 | 173.310 | 5.035 | -3.918 | -7.902 | 431.434 | 1.6% | 0.978 | 5315. | 10.2 |
| 42 TENANT OCC | 1 | -284.021 | 0.677 | -0.299 | 1.430 | 119.202 | 0.9% | 0.991 | 198. | 3.7 |
| 45 ELECTRICIT | 2 | -638.848 | 0.786 | 0.010 | 7.772 | -13.639 | 3.7% | 0.936 | 1592. | 2.2 |
| 46 NATURAL GA | 2 | -124.790 | 0.790 | 0.039 | 1.600 | -4.302 | 1.9% | 0.924 | 134. | 0.9 |
| 28 FUEL OIL & | 2 | 72.100 | 1.126 | 0.370 | -0.746 | -1.543 | 5.9% | 0.929 | 1341. | 0.8 |

TITLE

| | | |
|---|---|---|
| EQUATION | 41 | OWNER OCCUPIED SPACE RENT |
| | 42 | TENANT OCCUPIED SPACE RENT |
| | 45 | ELECTRICITY |
| | 46 | NATURAL GAS |
| | 28 | FUEL OIL AND COAL |

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GROUP 6: MEDICAL SERVICES

| EQ | SG | A | B | C | D | E | MAPE | RSQ | ESS | SHARE |
|---|---|---|---|---|---|---|---|---|---|---|
| 64 PHYSICIANS | 1 | 67.992 | 2.288 | -0.390 | -0.924 | | 2.1% | 0.956 | 674. | 2.5 |
| 65 DENTISTS & | 1 | -156.052 | 1.626 | 0.253 | 1.676 | | 6.9% | 0.948 | 1015. | 2.1 |
| 66 PRIVATE HO | 1 | -175.505 | 9.077 | -4.035 | 2.064 | | 3.6% | 0.971 | 1732. | 5.2 |
| 67 HEALTH INS | 1 | 15.669 | 0.474 | -0.363 | -0.150 | | 3.2% | 0.943 | 91. | 0.7 |
| 15 OPHTHALMIC | 2 | 24.343 | 0.232 | -0.136 | -0.315 | | 3.3% | 0.973 | 7. | 0.3 |
| 31 DRUG PREPA | 2 | 140.844 | 1.558 | -0.574 | -1.656 | | 1.8% | 0.970 | 34. | 0.9 |

TITLE

| | | |
|---|---|---|
| EQUATION | 64 | PHYSICIANS |
| | 65 | DENTISTS AND OTHER PROFESSIONAL SERVICES |
| | 66 | PRIVATE HOSPITALS AND SANITARIUMS |
| | 67 | HEALTH INSURANCE |
| | 15 | OPHTHALMIC AND ORTHOPEDIC APPLIANCES |
| | 31 | DRUG PREPARATIONS AND SUNDRIES |

# TABLE 4.5

## Estimates of Non-Price Parameters (Continued)

GROUP 7: PERSONAL BUSINESS SERVICES

| EQ | SG | A | B | C | D | E | MAPE | RSQ | ESS | SHARE |
|---|---|---|---|---|---|---|---|---|---|---|
| 68 BROKERAGE | 1 | 29.496 | 0.555 | 0.326 | -0.575 | | 28.8% | 0.240 | 8919. | 0.9 |
| 69 BANK SERVI | 1 | 137.669 | 2.028 | -0.881 | -1.714 | | 1.9% | 0.976 | 877. | 2.4 |
| 70 LIFE INSUR | 2 | 72.330 | 0.692 | -0.080 | -1.105 | | 3.2% | 0.962 | 484. | 1.3 |
| 71 LEGAL SERV | 2 | 128.631 | 0.765 | -0.316 | -1.587 | | 2.1% | 0.894 | 156. | 0.9 |
| 72 FUNERAL EX | 2 | 313.081 | 0.555 | -0.536 | -2.953 | -7.687 | 2.0% | 0.794 | 88. | 0.6 |

TITLE

EQUATION
68 BROKERAGE AND INVESTMENT COUNSELING
69 BANK SERVICE CHARGES AND SERVICES WITHOUT PAYMENT
70 LIFE INSURANCE
71 LEGAL SERVICES
72 FUNERAL EXPENSES AND OTHER PERSONAL BUSINESS

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GROUP 8: TRANSPORTATION

| EQ | SG | A | B | C | D | E | MAPE | RSQ | ESS | SHARE |
|---|---|---|---|---|---|---|---|---|---|---|
| 1 NEW CARS | 1 | 582.449 | 0.558 | 0.299 | -7.820 | 5.133 | 7.3% | 0.769 | 10999. | 3.2 |
| 2 USED CARS | 1 | 141.418 | 0.322 | 0.051 | -2.989 | 0.383 | 5.5% | 0.698 | 1706. | 1.2 |
| 3 TRUCKS | 1 | -240.785 | 0.570 | 0.650 | 2.761 | -3.496 | 17.8% | 0.903 | 2859. | 1.0 |
| 4 TIRES & TU | 2 | -38.823 | 0.742 | 1.293 | 0.331 | | 6.0% | 0.909 | 325. | 0.6 |
| 5 ACCESSORIE | 2 | -30.006 | 0.894 | 0.377 | 0.289 | | 3.5% | 0.973 | 66. | 0.5 |
| 53 AUTO REPAI | 2 | 278.514 | 2.121 | 1.501 | -3.426 | | 3.7% | 0.703 | 899. | 1.9 |
| 55 AUTO INSUR | 2 | 49.997 | 0.217 | -0.176 | -0.589 | | 2.3% | 0.922 | 27. | 0.4 |
| 54 BRIDGE,TOL | 2 | 25.139 | 0.075 | 0.070 | -0.294 | | 4.6% | 0.649 | 4. | 0.1 |
| 56 TAXICABS | 3 | 73.963 | 2.543 | 4.869 | -0.853 | | 5.8% | 0.740 | 74. | 0.1 |
| 57 LOCAL PUBL | 3 | 186.358 | 3.069 | 1.551 | -2.305 | 1.747 | 6.0% | 0.782 | 109. | 0.1 |
| 27 GASOLINE & | 4 | 855.341 | 0.534 | 0.152 | -10.387 | | 2.4% | 0.778 | 6257. | 4.0 |

TITLE

EQUATION
1 NEW CARS
2 NET PURCHASES OF USED CARS
3 TRUCKS
4 TIRES AND TUBES
5 ACCESSORIES AND PARTS (AUTO)
53 AUTO REPAIR
55 AUTO INSURANCE
54 BRIDGE, TOLLS, ETC
56 TAXICABS
57 LOCAL PUBLIC TRANSPORT
27 GASOLINE AND OIL

**TABLE 4.5**

**Estimates of Non-Price Parameters (Continued)**

GROUP 9: RECREATION AND TRAVEL

| EQ | SG | A | B | C | D | E | MAPE | RSQ | ESS | SHARE |
|---|---|---|---|---|---|---|---|---|---|---|
| 74 MOVIES,LEG | 1 | 33.107 | 0.300 | -0.087 | -0.345 | | 5.8% | 0.475 | 231. | 0.5 |
| 75 OTHER RECR | 1 | -458.226 | 1.444 | -0.422 | 5.304 | | 4.7% | 0.987 | 1478. | 2.2 |
| 18 BOATS,RECR | 2 | -119.255 | 0.731 | 0.244 | 1.670 | -3.261 | 11.3% | 0.815 | 1589. | 0.5 |
| 17 WHEEL GOOD | 2 | -106.512 | 0.749 | -0.188 | 1.245 | | 3.9% | 0.976 | 139. | 0.9 |
| 34 NONDURABLE | 2 | -102.443 | 0.590 | -0.154 | 1.481 | | 2.1% | 0.993 | 45. | 0.9 |
| 35 FLOWERS,SE | 2 | 24.565 | 0.246 | -0.160 | -0.432 | | 4.2% | 0.749 | 50. | 0.3 |
| 13 HAND TOOLS | 2 | -6.948 | 0.296 | -0.145 | -0.119 | | 5.6% | 0.962 | 22. | 0.2 |
| 58 RAILROAD,I | 3 | 7.663 | 0.012 | -0.021 | -0.101 | 0.153 | 7.5% | 0.773 | 1. | 0.0 |
| 59 BUSES,INTE | 3 | 7.115 | 0.022 | -0.045 | -0.075 | | 6.3% | 0.915 | 2. | 0.0 |
| 60 AIRLINES | 3 | -64.405 | 0.404 | -0.365 | 0.740 | | 5.0% | 0.915 | 216. | 0.8 |
| 61 TRAVEL AGE | 4 | -6.807 | 0.037 | -0.022 | 0.080 | | 3.7% | 0.980 | 1. | 0.1 |
| 78 FOREIGN TR | 4 | -19.025 | 0.493 | 2.471 | -0.109 | | 121.0% | 0.146 | 3955. | 0.5 |
| 43 HOTELS & M | 4 | 19.000 | 0.453 | -0.380 | -0.191 | | 6.1% | 0.775 | 148. | 0.4 |

TITLE

| | | |
|---|---|---|
| EQUATION | 74 | MOVIES, LEGITIMATE THEATRE, SPECTATOR SPORTS |
| | 75 | OTHER RECREATIONAL SERVICES |
| | 18 | BOATS, RECREATIONAL VEHICLES, AND AIRCRAFT |
| | 17 | WHEEL GOODS AND DURABLE TOYS |
| | 34 | NONDURABLE TOYS AND SPORT SUPPLIES |
| | 35 | FLOWERS, SEEDS, AND POTTED PLANTS |
| | 13 | HAND TOOLS |
| | 58 | INTERCITY RAILROAD |
| | 59 | INTERCITY BUSES |
| | 60 | AIRLINES |
| | 61 | TRAVEL AGENTS AND OTHER TRANSPORTATION SERVICES |
| | 78 | FOREIGN TRAVEL |
| | 43 | HOTELS AND MOTELS |

GROUP 10: READING AND EDUCATION

| EQ | SG | A | B | C | D | E | MAPE | RSQ | ESS | SHARE |
|---|---|---|---|---|---|---|---|---|---|---|
| 16 BOOKS & MA | 1 | 93.334 | 0.398 | 0.390 | -1.094 | | 4.8% | 0.042 | 137. | 0.3 |
| 39 MAGAZINES | 1 | 188.601 | 0.637 | -0.569 | -2.177 | | 3.2% | 0.718 | 126. | 0.5 |
| 12 WRITING EQ | 1 | 25.667 | 0.079 | -0.033 | -0.335 | | 3.5% | 0.805 | 2. | 0.1 |
| 33 STATIONERY | 1 | 48.195 | 0.140 | 0.238 | -0.459 | | 5.4% | 0.114 | 54. | 0.3 |
| 76 EDUCATION | 2 | 12.047 | 1.288 | -0.660 | -0.154 | | 3.7% | 0.920 | 6. | 1.7 |
| 77 RELIGIOUS | 2 | 81.641 | 0.738 | -0.553 | -1.032 | | 1.9% | 0.977 | 158. | 2.4 |
| 44 OTHER HOUS | 2 | 10.551 | 1.372 | -0.412 | -0.126 | | 4.1% | 0.690 | 1. | 0.2 |

TITLE

| | | |
|---|---|---|
| EQUATION | 16 | BOOKS AND MAPS |
| | 39 | MAGAZINES AND NEWSPAPER |
| | 12 | WRITING EQUIPMENT |
| | 33 | STATIONERY AND WRITING SUPPLIES |
| | 76 | EDUCATION |
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## CHAPTER 5

## FORECASTING PERSONAL CONSUMPTION EXPENDITURES

In this final chapter, we shall forecast personal consumption expenditures. In the previous chapters, we estimated equations for per-adult-equivalent consumption expenditures for each PCE component by using the $C^*_{it}$, the weighted population variables, and relative prices. To forecast these PCE components, therefore, we need to forecast the $C^*_{it}$, the weighted populations, and the prices.

To forecast the $C^*_{it}$ and the weighted populations, we need to have the forecasts for the demographic and economic variables. In this chapter, the forecasts of these variables come from the Bureau of the Census and the INFORUM's LIFT model. The Bureau of the Census gives the projections of the population growth and other demographic compositions, which are used to create the forecasts of our demographic variables. The LIFT model gives the projections of the economic variables such as prices, income, interest rate, and unemployment rate.

Our system of consumption equations is an integral part of the LIFT model for the U.S. economy. We shall present the interactive relationship among the economic activities in the LIFT model in Section I. Section II contains the forecast results. Personal consumption expenditures are forecasted through the year 2000. Section III includes an outlook and a summary of our forecasts. Finally, the suggestions for the further research are presented in Section IV.

### I. Forecasts of Personal Consumption Expenditures

Personal consumption expenditure is the largest component of GNP in the U.S. economy. The forecast of personal consumption expenditures, thus, will significantly affect the forecasts of other economic activities and the structure of the economy. To project personal consumption expenditures, we need to obtain the forecast of the economic variables. The economic variables in the LIFT model have to be forecasted simultaneously because of their interactive relationship. For instance, the changes in consumption patterns will result in the changes in industry output. The shifts in industry output, in turn, will cause the movement of prices and employment and, therefore, will affect the level of aggregate income. Income and prices, in turn, will affect consumption. The technique to forecast any economic variables, therefore, must be an interactive process.

### A. Forecasting Personal Consumption Expenditures in the LIFT Model

Our system of consumption equations is an integral part of the LIFT model of the U.S. economy. Therefore, the volume of consumption has to be simultaneously determined along with other economic variables like income and prices. We shall now present how to forecast consumption and how to incorporate the forecast of consumption into the LIFT model.

Firstly, we will discuss the forecast of the income component of the $C^*_i$. The aggregate personal income is determined in the macro model. The income distribution model developed in Chapter 3 is then used to distribute the aggregate income over the twenty income ventiles. This model of income distribution was derived by using macroeconomic variables, such as the inflation rate and the unemployment rate. This model will create five income variables as needed by our consumption functions.

Secondly, to create the demographic component of the $C^*_i$, the proportion of total population in each demographic category is calculated by using the Census forecasts. Thus, to create the forecast of the $C^*_i$, we take the estimated coefficients of the income and demographic variables from the cross-section, and then multiply them by the corresponding forecasts of the income and demographic factors. The $C^*_i$ can then be used along with the price indexes and the estimates of the price parameters to create the per-adult-equivalent expenditure.

To obtain the aggregate consumption expenditures, we need the weighted populations for each item. The sizes of the eight population groups defined in our model are calculated by using the Census projections for the population total by age group. The weights for these eight groups were estimated in the cross-section. Thus, the forecast of the weighted population for good i can be easily calculated by taking the product of the population size and the corresponding weight of i for each group and then summing over the eight age groups. The forecast of the per-adult-equivalent expenditure for good i can then be multiplied by the corresponding weighted population of good i to give the aggregate consumption expenditures of i.

We now turn to the integration of the consumption and other variables in the LIFT model. The aggregate consumption expenditures are used to determine industry output and employment. The industry output and employment are, in turn, used to project prices and income. However, these forecasts of prices and income might be different from the values of the initial assumptions for prices and income, which were used to create the $C^*_i$. In this case, these new forecasts of prices and income will be again used to determine the $C^*_i$ and the aggregate consumption in the model. This iterative procedure will continue until the convergence is achieved.

To ensure the exhaustion of income in the forecast, we will employ the "spreader" technique as described in Chapter 4. Our system of consumption functions guarantees that income, which is defined as total expenditures in our model, will be exhausted by consumptions at base prices. By using a "spreader" term, the sum of the predicted consumption expenditures will equal the projected income at all prices. This "spreader" technique distributes "unspent" income among the 78 consumption categories based on the income elasticities and the weighted population sizes. To be more specific, the factor of the "spreader" term for item i is determined by multiplying the income elasticity[1] of good i by the specific size of weighted population for i.

## B. Forecast Assumptions

The scheme of forecasting the LIFT model is a simultaneous procedure. Our forecasts of consumption, however, were made outside the LIFT model by taking the estimates of the economic variables as given. The reason of doing so is to concentrate on the subject of consumption rather than taking into account all the factors in the model as a whole.

The assumptions of the macroeconomic variables and the demographic compositions employed in our forecasting procedure are listed in Table 5.1 for the selected years. The projections of the economic variables are obtained from the LIFT model's forecast. The forecasts of the demographic variables come from the various reports by the Bureau of the Census. The LIFT model has endogenous savings rate. For this purpose of study, we will, however, simplify the analysis by fixing the savings rate. The constant savings rate will facilitate the comparisons between the growth of income and the growth of the consumption for a given item. The savings rate in this study is assumed to remain at its 1988 level (0.042). The listing of price projections is neglected because a huge number of prices are involved (There are 78

[1]We use the income elasticities derived from case 3, where all incomes are assumed to increase by one percent.

sectors, or 78 price components, in each of the periods).

## II. Results - Forecasts to 2000

Our forecasts of personal consumption expenditures (in constant 1982 dollars) are shown in Table 5.2. The forecasts are made from 1988 to 2000. The growth rates of the forecasts, which are measured by the percentage rate of change in annual consumption, are presented in Table 5.3. Our projected growth rate of total personal consumption expenditures is 1.6 percent per year. Thus, if the annual growth rate of a given item over the period 1988 and 2000 is greater than 1.6, then this item will have a larger share in the 2000 consumer budget than it was in the 1988 budget, and vice versa.

## TABLE 5.1

### Assumptions of Economic Variables and Demographic Compositions

| | 1975 | 1980 | 1985 | 1990 | 1995 | 2000 |
|---|---|---|---|---|---|---|
| Per Capita Disposable Income (in 82 Dollars) | 8945.46 | 9724.36 | 10626.00 | 11439.39 | 11930.99 | 12362.82 |
| Unemployment Rate(%) | 8.48 | 7.18 | 7.19 | 5.17 | 3.60 | 3.46 |
| Interest and Dividend Income in Personal Income(%) | 11.52 | 14.39 | 16.74 | 17.34 | 17.63 | 18.55 |
| Inflation Rate(%) | 9.72 | 9.01 | 3.00 | 4.31 | 4.16 | 3.32 |
| <u>Demographic Variables</u> (Percent of Total Population) | | | | | | |
| Household residing in: | | | | | | |
| .The Northeast | 23.20 | 22.10 | 21.10 | 21.00 | 21.00 | 21.20 |
| .The North Central | 27.00 | 26.50 | 25.00 | 24.80 | 24.50 | 24.20 |
| .The South | 31.90 | 32.60 | 34.00 | 33.70 | 33.50 | 33.00 |
| .The West | 17.80 | 18.70 | 19.90 | 20.50 | 21.10 | 21.80 |
| Households with: | | | | | | |
| .College Educated Household Head | 15.70 | 17.80 | 20.80 | 21.50 | 22.00 | 22.10 |
| .Two Earners | 37.00 | 41.30 | 43.30 | 47.60 | 51.50 | 55.40 |
| .One Member | 19.60 | 22.70 | 24.30 | 26.10 | 27.50 | 28.50 |
| .Two Members | 30.60 | 30.90 | 31.80 | 32.40 | 32.90 | 33.10 |
| .Three or Four Members | 33.00 | 32.40 | 33.20 | 31.00 | 29.30 | 28.20 |
| .Five or More Members | 16.80 | 13.80 | 11.10 | 10.90 | 10.60 | 10.30 |
| .Household Head Less than 35 | 29.20 | 30.80 | 29.80 | 30.90 | 30.40 | 29.00 |
| .Household Head Between 35 and 55 | 34.90 | 33.00 | 34.00 | 31.60 | 30.10 | 29.20 |
| .Household Head Greater than 55 | 36.00 | 36.30 | 36.40 | 38.00 | 39.70 | 41.90 |
| <u>Population by Age Group</u> (Percent of Total Population)* | | | | | | |
| .Ages 0 to 5 | 7.48 | 7.23 | 7.52 | 7.35 | 6.84 | 6.30 |
| .Ages 6 to 15 | 17.71 | 15.30 | 14.18 | 14.24 | 14.46 | 13.92 |
| .Ages 16 to 20 | 9.86 | 9.29 | 7.77 | 6.96 | 6.75 | 7.12 |
| .Ages 21 to 30 | 17.10 | 18.17 | 18.02 | 16.05 | 14.01 | 13.17 |
| .Ages 31 to 40 | 11.94 | 14.03 | 15.93 | 17.03 | 17.01 | 15.37 |
| .Ages 41 to 50 | 10.60 | 10.01 | 10.75 | 12.63 | 14.45 | 15.65 |
| .Ages 51 to 65 | 14.81 | 14.69 | 13.91 | 13.14 | 13.51 | 15.47 |
| .Ages 66 and over | 10.51 | 11.29 | 11.93 | 12.60 | 12.98 | 13.00 |

*Assumes a lifetime fertility of 2.1 children per woman.

### A. Impacts of Income, Price, and Non-Price Factors

There are four major factors in our demand equations. They are income, tastes and preferences, demographic variables, and prices. We shall summarize our results by these four categories.

a. Income

In general, the more income elastic items of consumption will increase their budget shares in total expenditures as income rises unless the income effect is offset by other factors. Our forecast results show the effect of high income elasticities for such items as New and used trucks (Sector 3), Boats, RV, and aircraft (Sector 18), and Foreign travel (Sector 78). However, not all high-income-elasticity sectors will be necessary growing. For example, the share of Domestic Services (Sector 49) is declining in the total consumption expenditures probably due to the rising relative prices and the change in life style.

On the other hand, the less income elastic consumption items will maintain a smaller share in consumer budget throughout the forecast period. They include the Food and Alcohol sectors (Sectors 19, 20, 21, and 22) and Tobacco (Sector 29).

b. Tastes and Preferences

For some sectors, the aggregate demand shows a secular declining trend, which is carried through the estimation and the forecast periods. For example, Writing equipment (Sector 12), the Alcohol consumption (Sectors 21 and 22), Domestic services (Sector 49), Taxicabs (Sector 56), and Local public transportation (Sector 57). These results can be properly explained by the changes in tastes and preference rather than the changes in income, prices, or demographic factors.

c. Demographic Effect

Our demographic effect in the demand equations is an integration of the effects of region of residence, education, two-earner household, family size, and age of household members. Thus, the shifts in the demographic composition of total population will result in the changes in the composition of the budget shares in total expenditures. For instance, the adult equivalency weight of Domestic services (Sector 49) is extremely high in the age group of under five years. If we were to assign the same weight to each of the population groups, then the volume of consumption expenditures on Domestic services would have been much smaller than what we have projected.

d. Prices

In general, increasing the real price of good i will result in a slower growth in sector i. But this effect might be offset by other impacts. Our results show that Gasoline and Oil (Sector 27) and Fuel oil and coal (Sector 28) have a slower growth. We might attribute this to their rising costs. Electricity (Sector 45) and Natural gas (Sector 46), on the other hand, are growing at a greater than 1.6 percent rate. This might be explained by the offsetting impacts caused by higher income elasticities or the changes in consumption pattern.

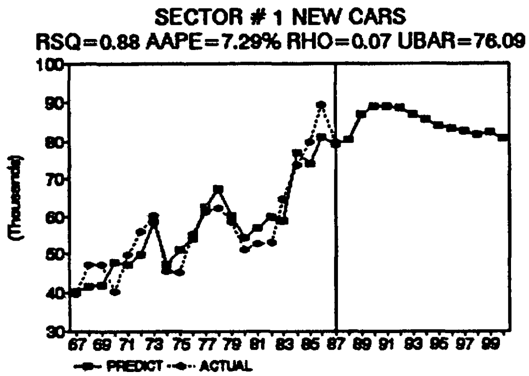
## B. Plots of the Forecasts

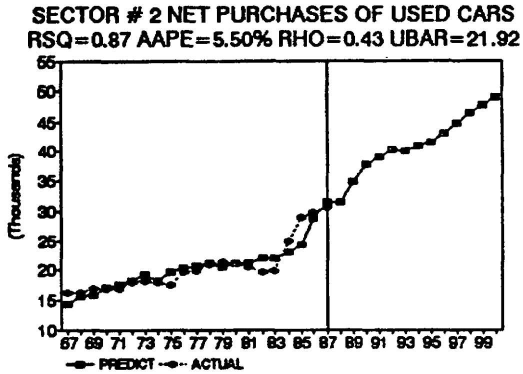
The plots for each of the 78 sectors are presented in Figure 5.1. In each picture, the summary statistics of the estimation of that consumption item are included at the top for reference. They are the $R^2$, the mean absolute percentage error (MAPE), the autocorrelation coefficient (RHO), and the average error term in the

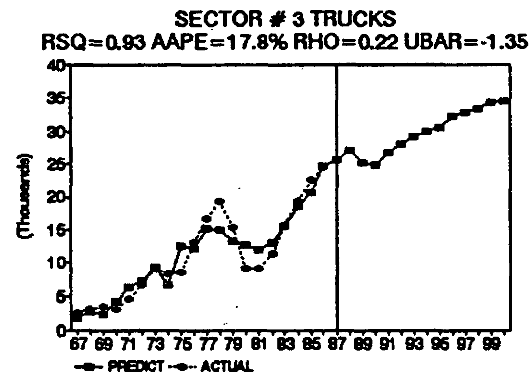
**estimation (UBAR). The estimation portion of plot goes from the year 1966 to 1987 while the forecast period of plot from the year 1988 to 2000.**

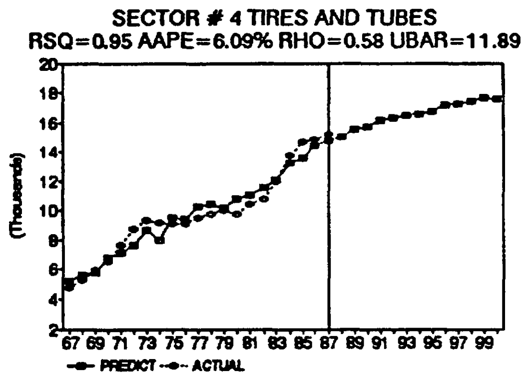
**FIGURE 5.1**

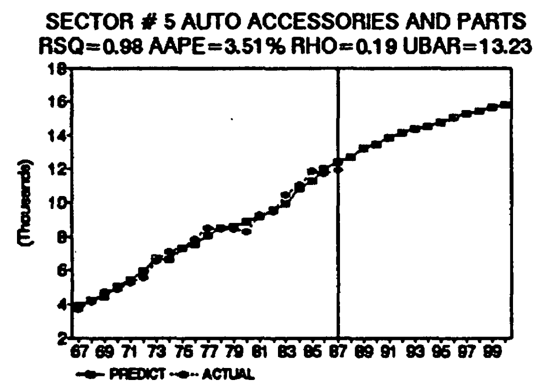
**Plots of the Forecasts**

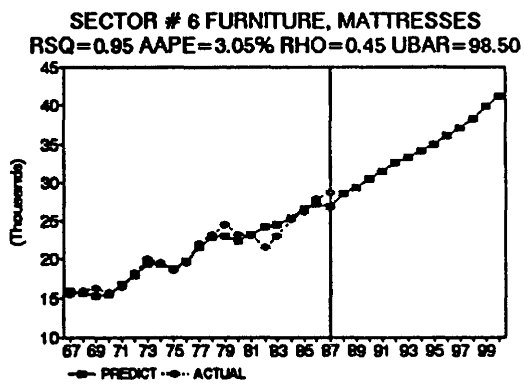


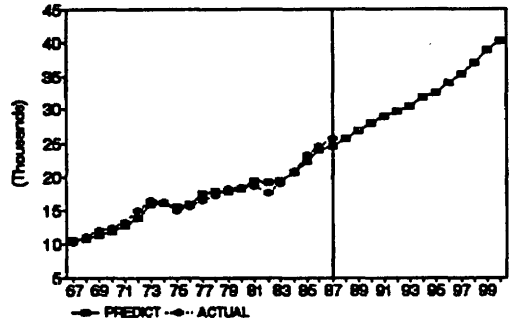



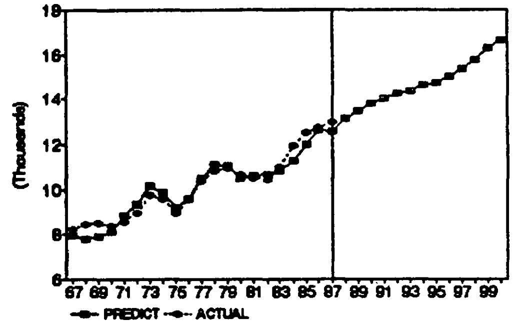
## FIGURE 5.1

**Plots of the Forecasts**
**(Contiuned)**

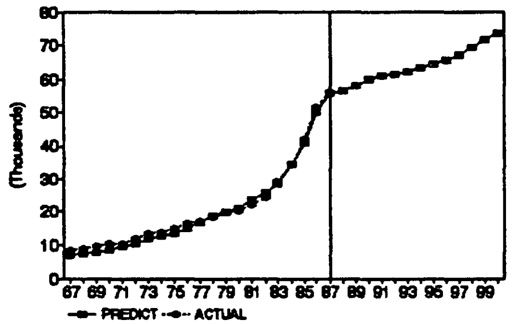
SECTOR # 7 KITCHEN & OTHER APPLIANCES
RSQ=0.97 AAPE=3.60% RHO=0.55 UBAR=107.9



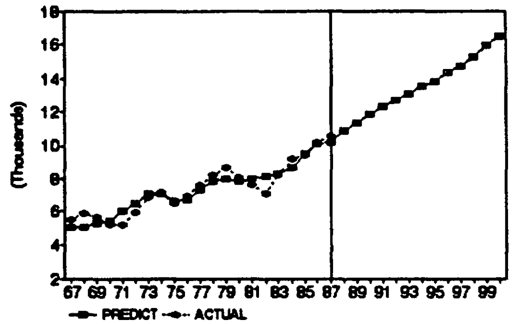

SECTOR # 8 CHINA, GLASSWARE, TABLEWARE
RSQ=0.94 AAPE=3.07% RHO=0.69 UBAR=69.87



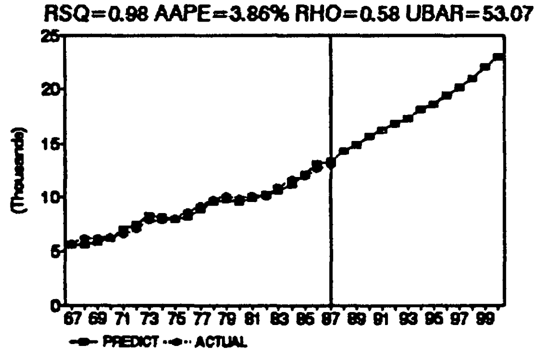

SECTOR # 9 RADIO, TV, RECORDERS
RSQ=0.99 AAPE=7.33% RHO=0.83 UBAR=672.




SECTOR # 10 FLOOR COVERINGS
RSQ=0.91 AAPE=5.58% RHO=0.50 UBAR=39.93




SECTOR # 11 DURABLE HOUSEFURNISHING NEC
RSQ=0.98 AAPE=3.86% RHO=0.58 UBAR=53.07




SECTOR # 12 WRITING EQUIPMENT
RSQ=0.73 AAPE=3.55% RHO=0.55 UBAR=20.20

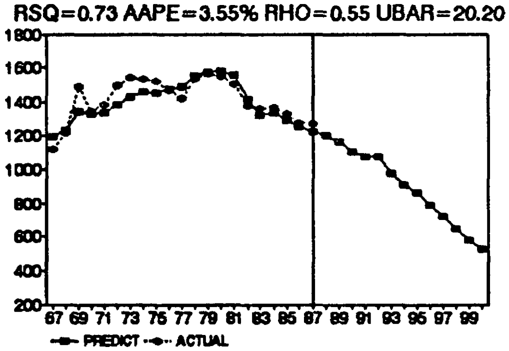
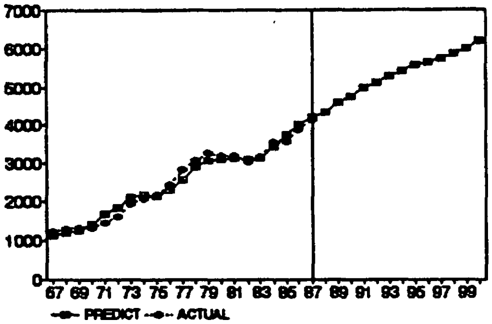


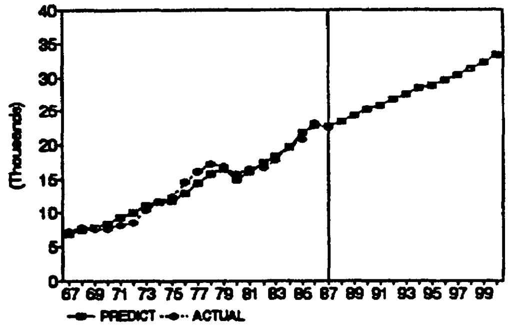
**FIGURE 5.1**

**Plots of the Forecasts (Contiuned)**

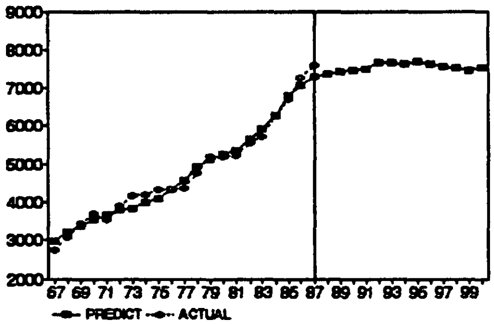
SECTOR # 13 HAND TOOLS
RSQ=0.98 AAPE=5.56% RHO=0.73 UBAR=2.38



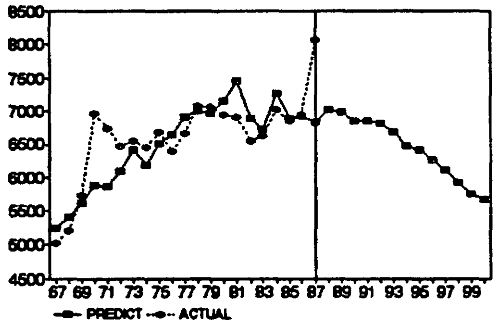

SECTOR # 14 JEWELERY
RSQ=0.97 AAPE=5.71% RHO=0.70 UBAR=34.60



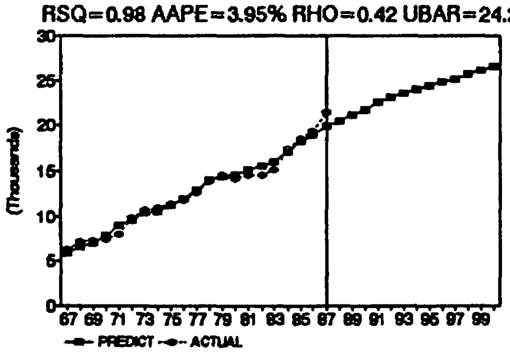

SECTOR # 15 OPHTHALMIC AND ORTHOPEDIC
RSQ=0.98 AAPE=3.27% RHO=0.30 UBAR=9.25




SECTOR # 16 BOOKS AND MAPS
RSQ=0.50 AAPE=4.73% RHO=0.44 UBAR=93.36




SECTOR # 17 WHEEL GOODS AND DURABLE TOY
RSQ=0.98 AAPE=3.95% RHO=0.42 UBAR=24.28




SECTOR # 18 BOATS, RV, AND AIRCRAFT
RSQ=0.89 AAPE=11.24% RHO=0.38 UBAR=4.41

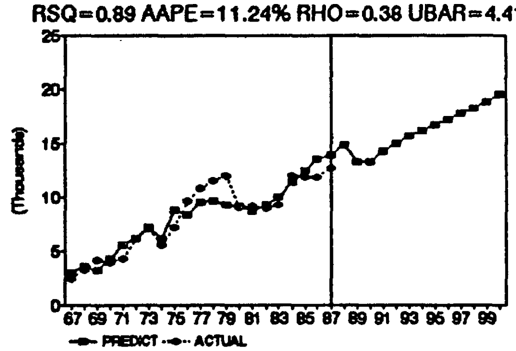
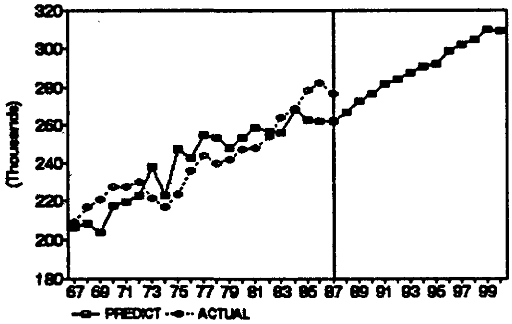


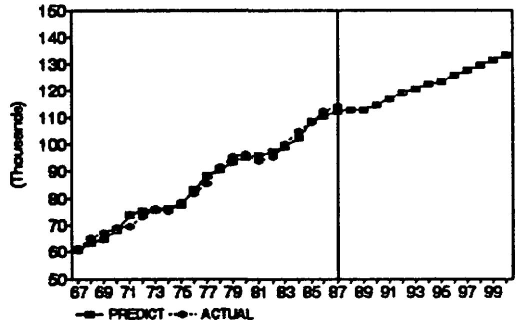
**FIGURE 5.1**

**Plots of the Forecasts**
**(Contiuned)**

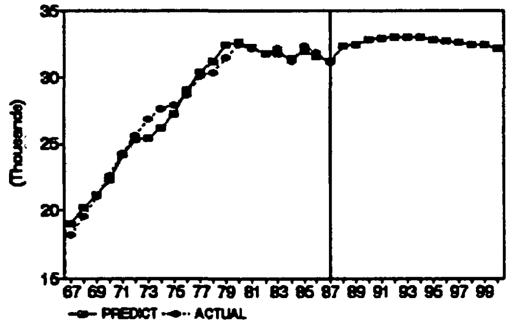
SECTOR # 19 FOOD, OFF PREMISE
RSQ=0.70 AAPE=4.21% RHO=0.61 UBAR=519.3



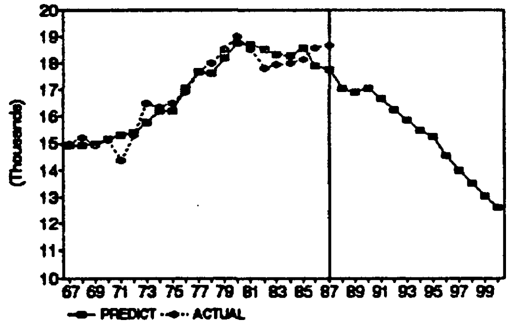

SECTOR # 20 FOOD, ON PREMISE
RSQ=0.99 AAPE=1.99% RHO=0.28 UBAR=122.1



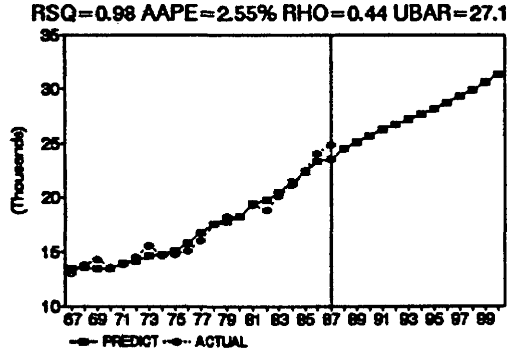

SECTOR # 21 ALCOHOL, OFF PREMISE
RSQ=0.98 AAPE=1.71% RHO=0.67 UBAR=36.17




SECTOR # 22 ALCOHOL, ON PREMISE
RSQ=0.91 AAPE=1.98% RHO=0.75 UBAR=27.61




SECTOR # 23 SHOES AND FOOTWEAR
RSQ=0.98 AAPE=2.55% RHO=0.44 UBAR=27.11




SECTOR # 24 WOMENS CLOTHING
RSQ=0.99 AAPE=1.94% RHO=0.55 UBAR=102.5

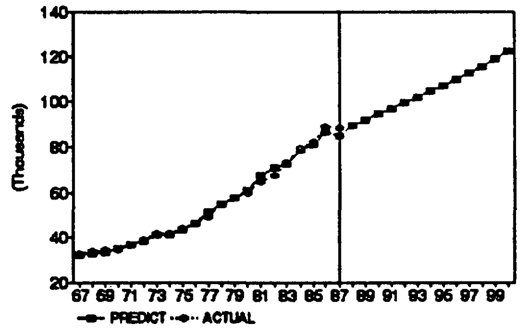
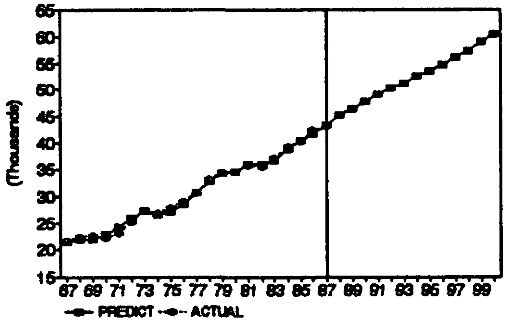


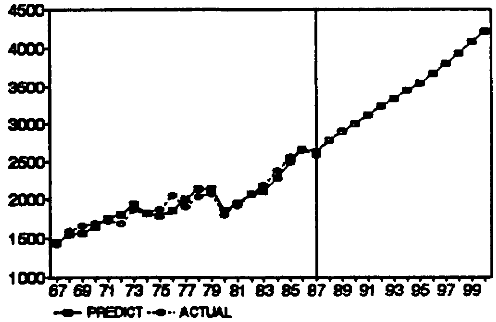
**FIGURE 5.1**

**Plots of the Forecasts (Contiuned)**

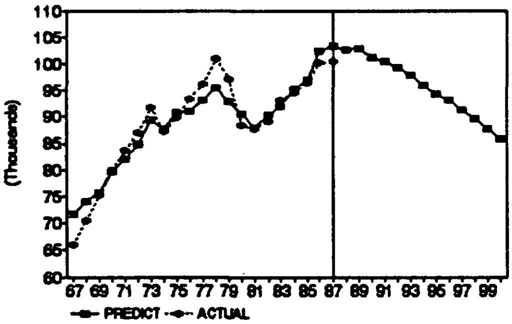
SECTOR # 25 MENS CLOTHING
RSQ=0.99 AAPE=1.42% RHO=0.28 UBAR=48.94



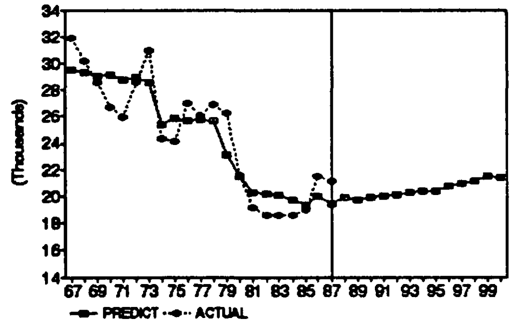

SECTOR # 26 LUGGAGE
RSQ=0.94 AAPE=3.35% RHO=0.42 UBAR=2.23



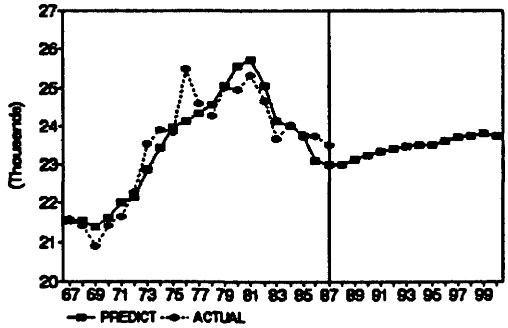

SECTOR # 27 GASOLINE AND OIL
RSQ=0.92 AAPE=2.35% RHO=0.64 UBAR=100.3




SECTOR # 28 FUEL OIL AND COAL
RSQ=0.85 AAPE=5.84% RHO=0.42 UBAR=30.26




SECTOR # 29 TOBACCO
RSQ=0.88 AAPE=1.51% RHO=0.33 UBAR=29.82




SECTOR # 30 SEMIDURABLE HOUSEFURNISHING
RSQ=0.76 AAPE=2.92% RHO=0.64 UBAR=76.30

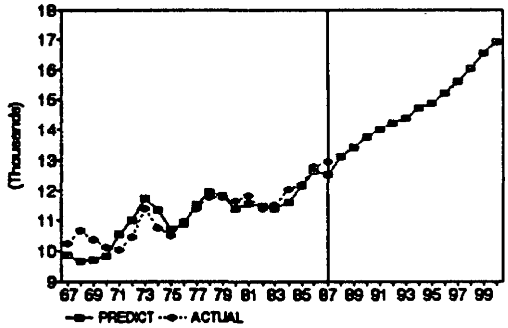
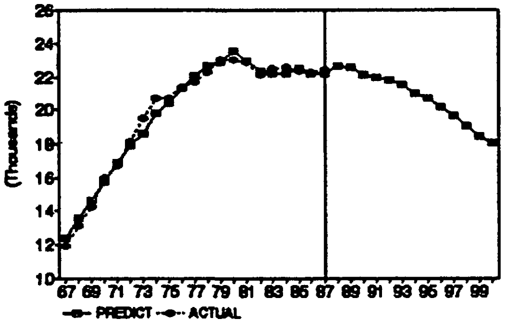


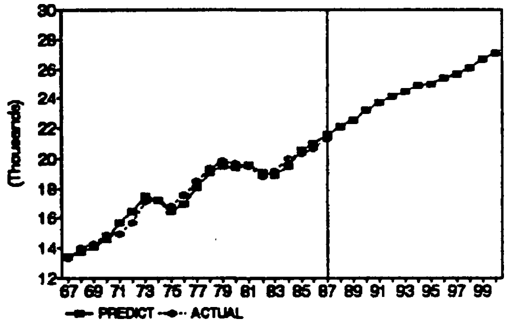
**FIGURE 5.1**

**Plots of the Forecasts (Continued)**

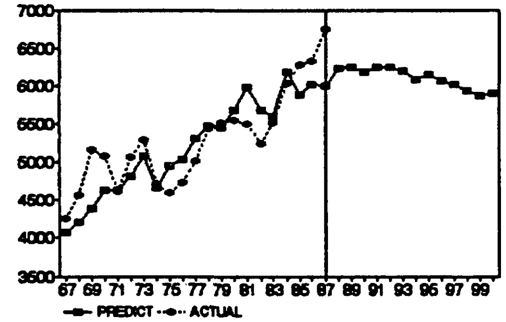
SECTOR # 31 DRUG PREPARATIONS
RSQ=0.99 AAPE=1.79% RHO=0.47 UBAR=17.76



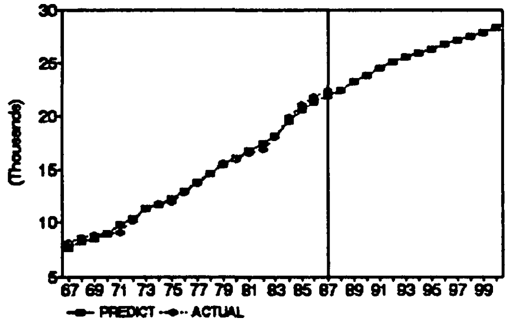

SECTOR # 32 TOILET ARTICLES
RSQ=0.97 AAPE=1.89% RHO=0.56 UBAR=26.63



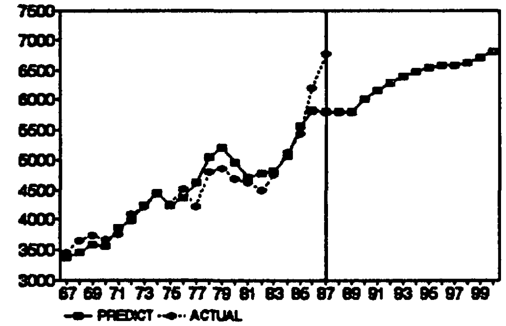

SECTOR # 33 STATIONERY AND WRITING
RSQ=0.68 AAPE=5.39% RHO=0.60 UBAR=70.72




SECTOR # 34 NONDURABLE TOYS AND SPORT
RSQ=0.99 AAPE=2.16% RHO=0.55 UBAR=20.03




SECTOR # 35 FLOWERS, SEEDS AND POTTED
RSQ=0.87 AAPE=4.17% RHO=0.39 UBAR=11.37




SECTOR # 36 CLEANING PREPARATIONS
RSQ=0.64 AAPE=2.89% RHO=0.11 UBAR=3.50

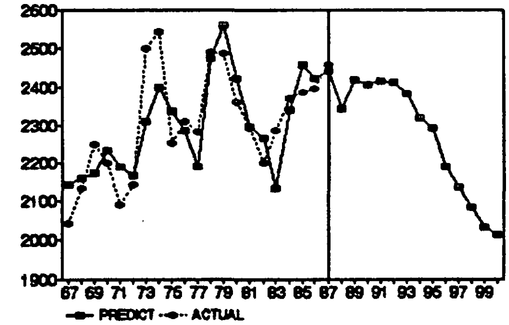
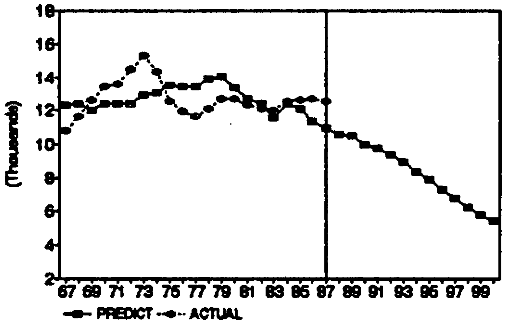


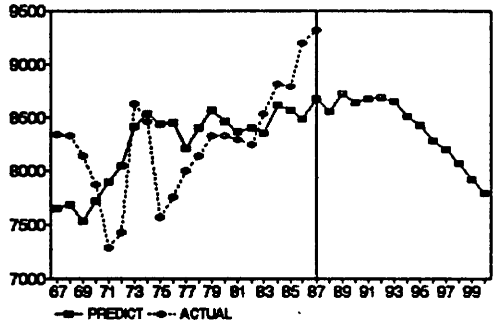
**FIGURE 5.1**

**Plots of the Forecasts**
**(Contiuned)**

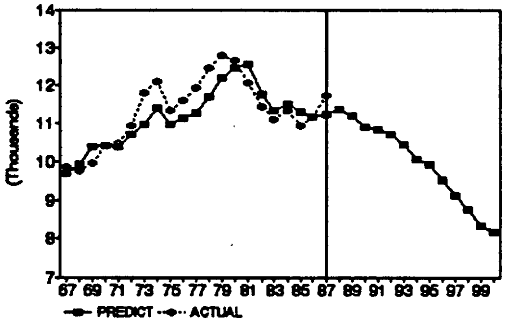
SECTOR # 37 LIGHTING SUPPLIES
RSQ=0.57 AAPE=8.88% RHO=0.80 UBAR=80.92



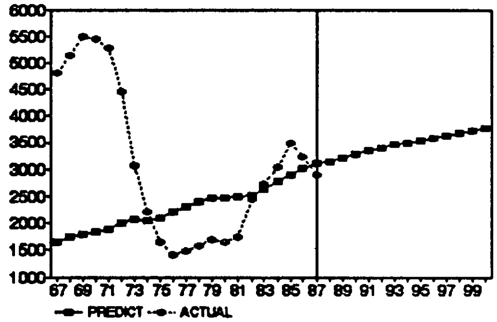

SECTOR # 38 HOUSEHOLD PAPER PRODUCTS
RSQ=0.16 AAPE=4.78% RHO=0.66 UBAR=17.57



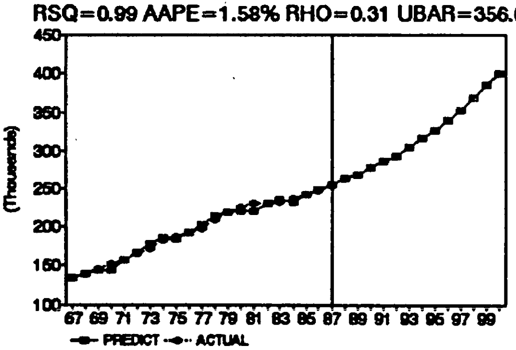

SECTOR # 39 MAGAZINES AND NEWSPAPER
RSQ=0.75 AAPE=3.11% RHO=0.72 UBAR=159.3




SECTOR # 40 OTHER NONDURABLES-IDENTITY
RSQ=-0.68 AAPE=38.6% RHO=1.0 UBAR=779.7




SECTOR # 41 OWNER OCCUPIED SPACE RENT
RSQ=0.99 AAPE=1.58% RHO=0.31 UBAR=356.0




SECTOR # 42 TENANT OCCUPIED SPACE RENT
RSQ=0.99 AAPE=0.89% RHO=0.32 UBAR=145.6

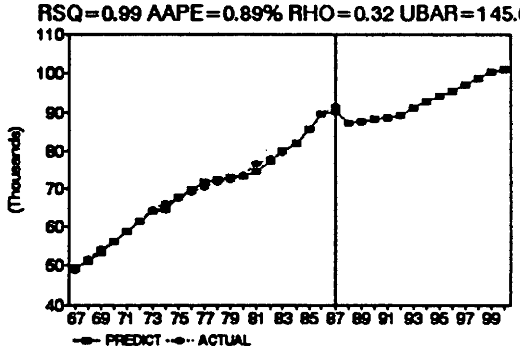
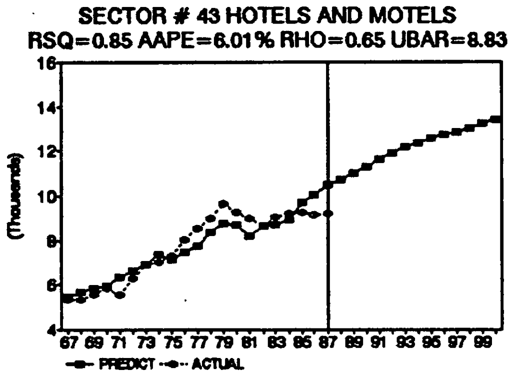
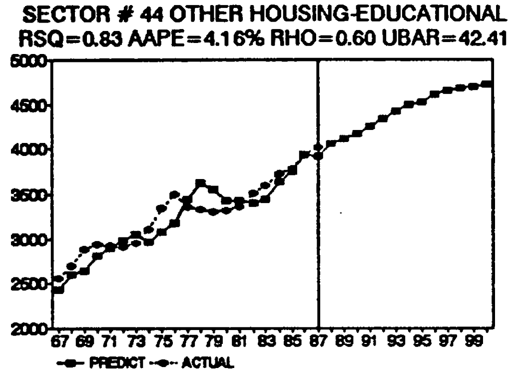
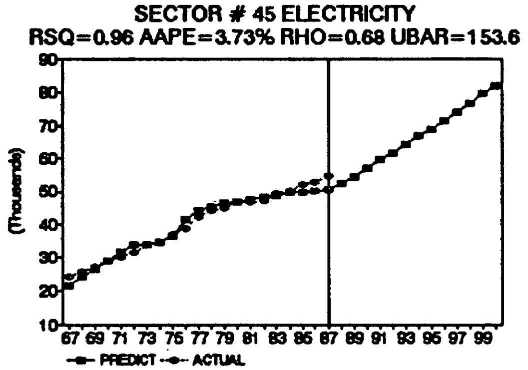


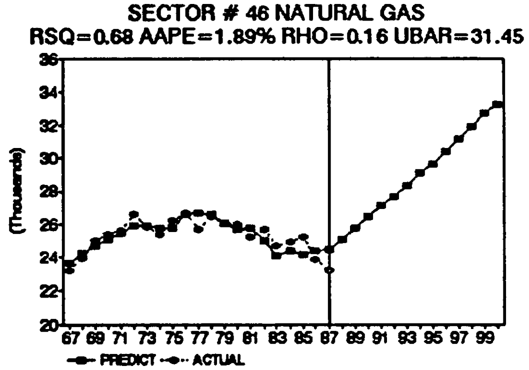
**FIGURE 5.1**

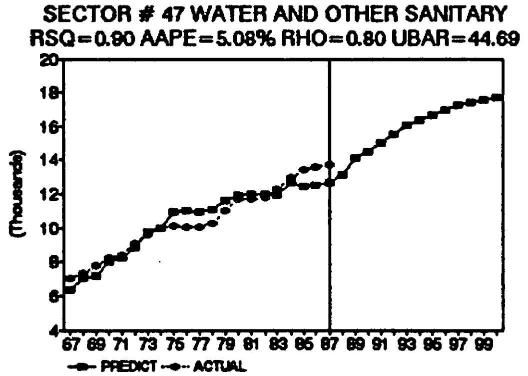
**Plots of the Forecasts (Contiuned)**



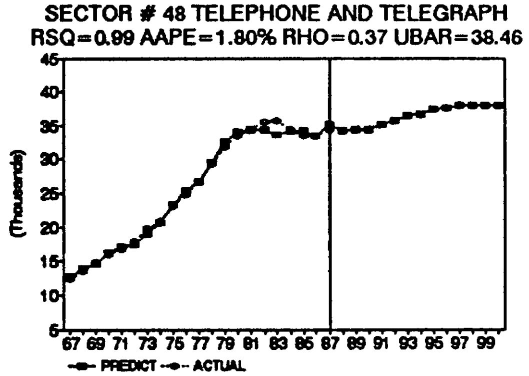



**FIGURE 5.1**

**Plots of the Forecasts**
**(Contiuned)**

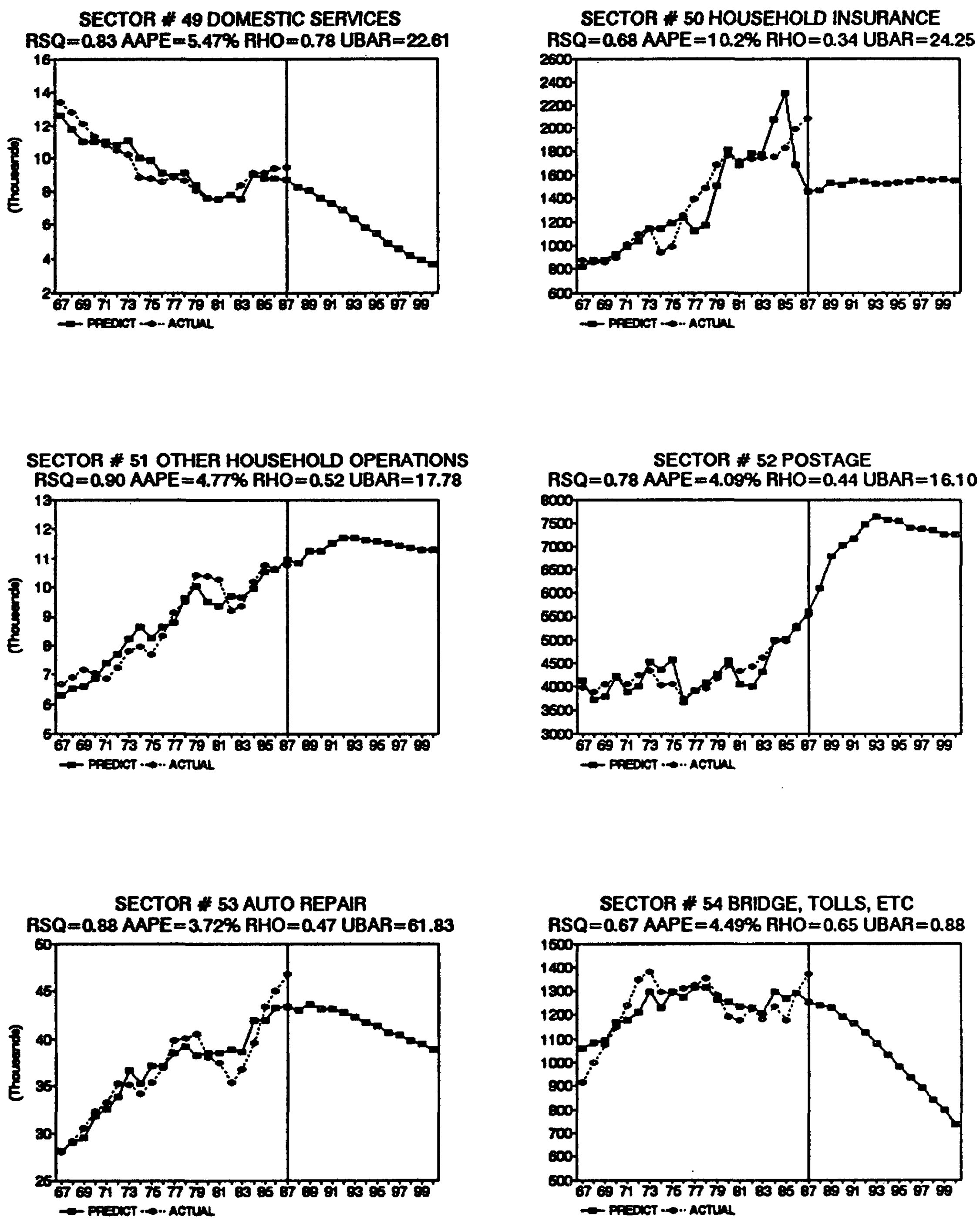
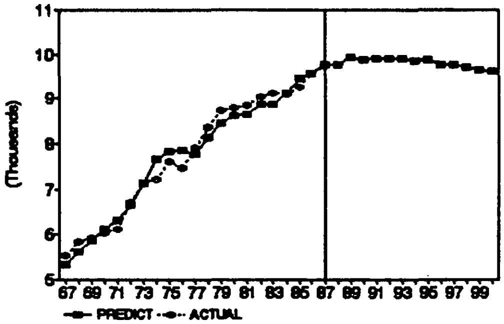


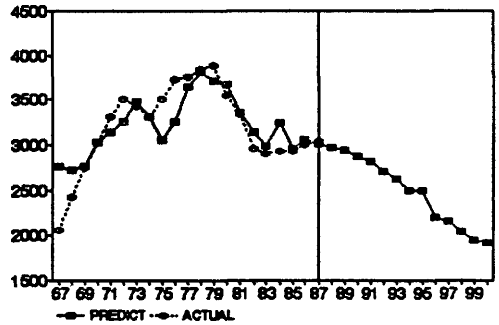
**FIGURE 5.1**

**Plots of the Forecasts (Contiuned)**

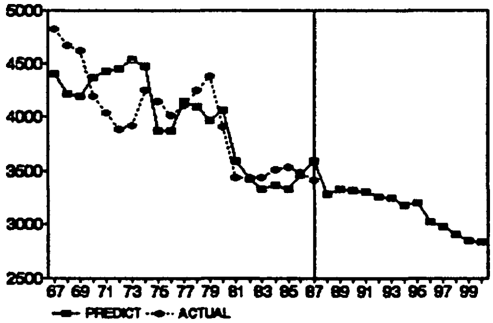
SECTOR # 55 AUTO INSURANCE
RSQ=0.98 AAPE=2.21% RHO=0.51 UBAR=15.13



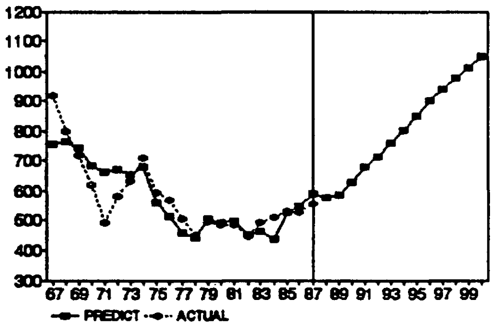

SECTOR # 56 TAXICABS
RSQ=0.71 AAPE=5.72% RHO=0.68 UBAR=-9.06



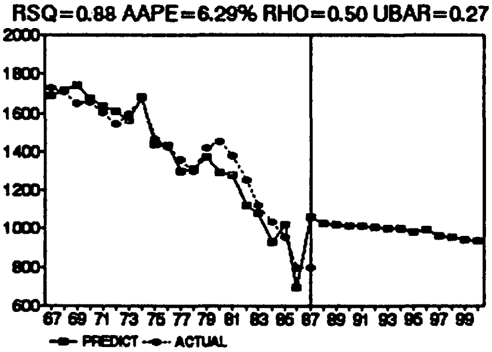

SECTOR # 57 LOCAL PUBLIC TRANSPORT
RSQ=0.51 AAPE=6.07% RHO=0.63 UBAR=11.72




SECTOR # 58 INTERCITY RAILROAD
RSQ=0.71 AAPE=7.52% RHO=0.72 UBAR=1.26




SECTOR # 59 INTERCITY BUSES
RSQ=0.88 AAPE=6.29% RHO=0.50 UBAR=0.27




SECTOR # 60 AIRLINES
RSQ=0.93 AAPE=5.03% RHO=0.49 UBAR=50.03

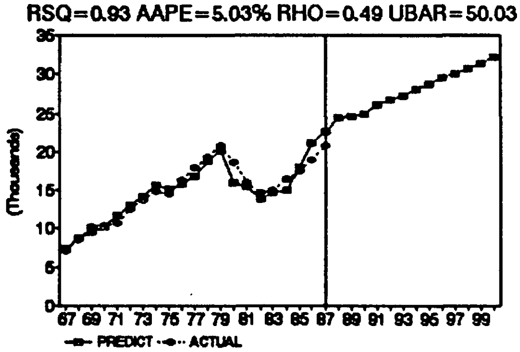
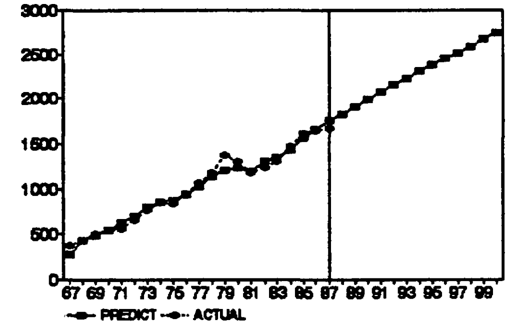


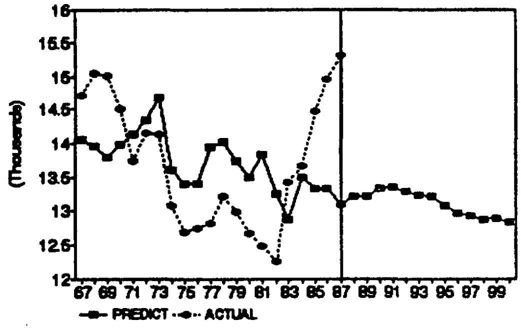
**FIGURE 5.1**

**Plots of the Forecasts (Contiuned)**

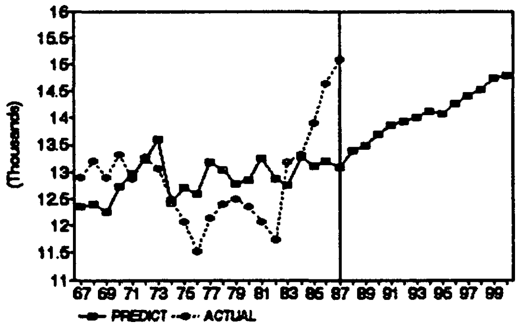
SECTOR # 61 TRAVEL AGENTS AND OTHER
RSQ=0.98 AAPE=3.72% RHO=0.49 UBAR=1.25



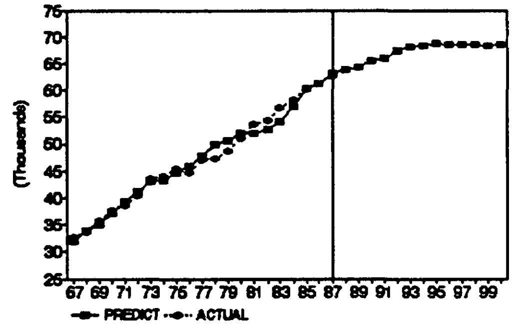

SECTOR # 62 CLEANING, LAUNDERING
RSQ=0.07 AAPE=6.24% RHO=0.72 UBAR=14.98



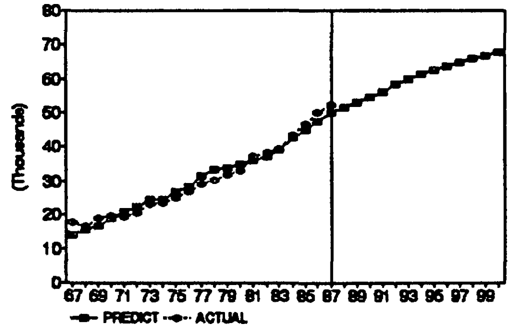

SECTOR # 63 BARBERSHOPS AND BEAUTY SHOP
RSQ=0.05 AAPE=5.30% RHO=0.64 UBAR=13.95




SECTOR # 64 PHYSICIANS
RSQ=0.98 AAPE=2.06% RHO=0.60 UBAR=73.04




SECTOR # 65 DENTISTS AND OTHER SERVICES
RSQ=0.96 AAPE=6.98% RHO=0.89 UBAR=48.57




SECTOR # 66 PRIVATE HOSPITALS
RSQ=0.97 AAPE=3.58% RHO=0.69 UBAR=195.1

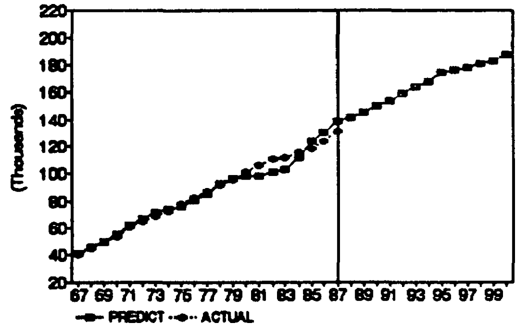
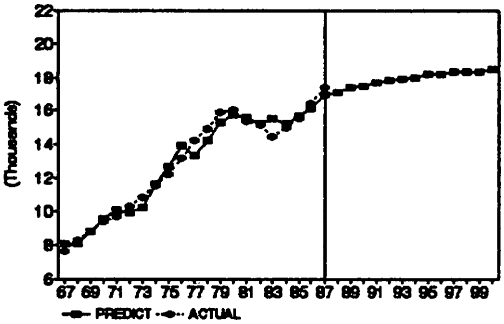


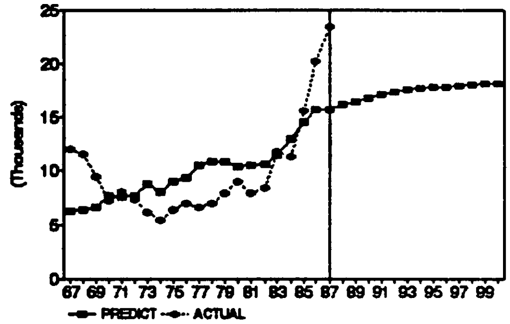
**FIGURE 5.1**

**Plots of the Forecasts
(Contiuned)**

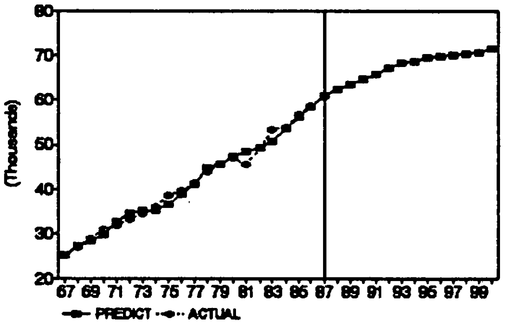
SECTOR # 67 HEALTH INSURANCE
RSQ=0.97 AAPE=3.19% RHO=0.30 UBAR=20.71



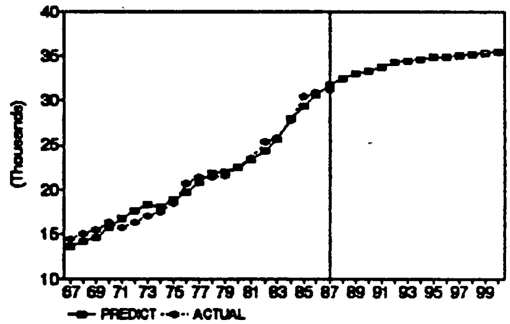

SECTOR # 68 BROKERAGE AND INVESTMENT
RSQ=0.47 AAPE=28.8% RHO=0.75 UBAR=-63.7



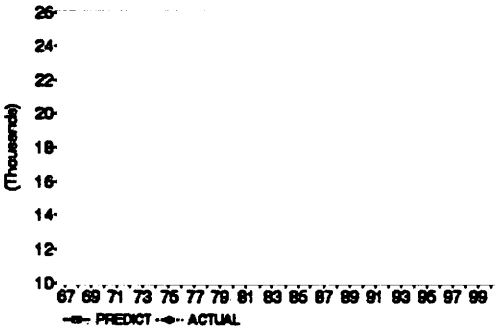

SECTOR # 69 BANK SERVICE CHARGES
RSQ=0.99 AAPE=1.95% RHO=0.22 UBAR=91.02




SECTOR # 70 LIFE INSURANCE
RSQ=0.99 AAPE=1.95% RHO=0.22 UBAR=91.02




SECTOR # 71 LEGAL SERVICES
RSQ=0.98 AAPE=2.22% RHO=0.53 UBAR=34.90




SECTOR # 72 FUNERAL EXPENSES AND OTHER
RSQ=0.97 AAPE=1.93% RHO=0.44 UBAR=24.66

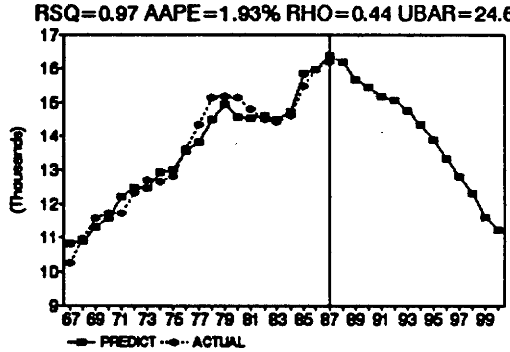
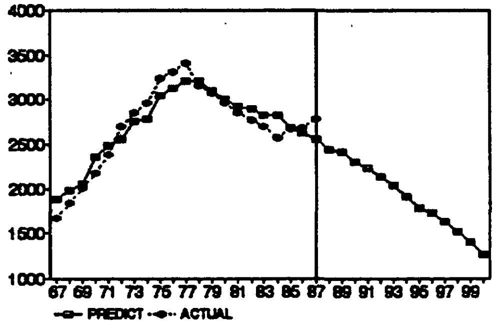


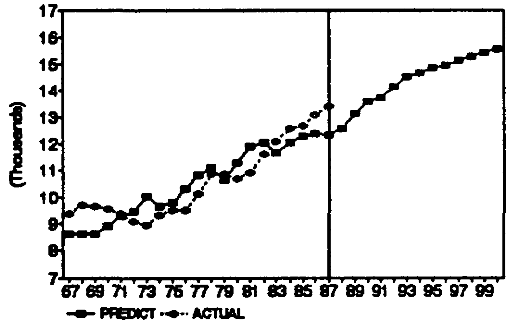
**FIGURE 5.1**

**Plots of the Forecasts
(Contiuned)**

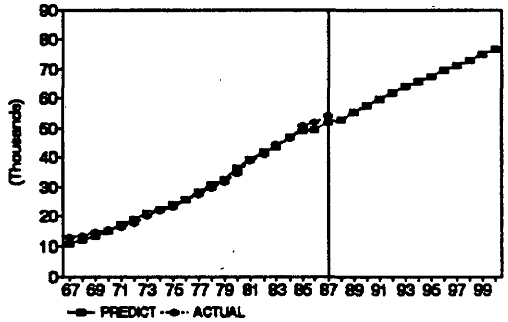
SECTOR # 73 RADIO AND TV REPAIR
RSQ=0.90 AAPE=4.89% RHO=0.64 UBAR=-3.81



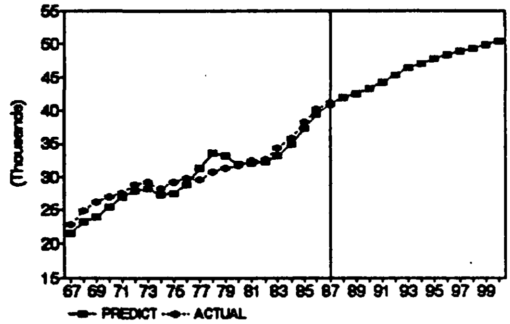

SECTOR # 74 MOVIES, LEGITIMATE THEATRE
RSQ=0.76 AAPE=5.84% RHO=0.71 UBAR=57.83



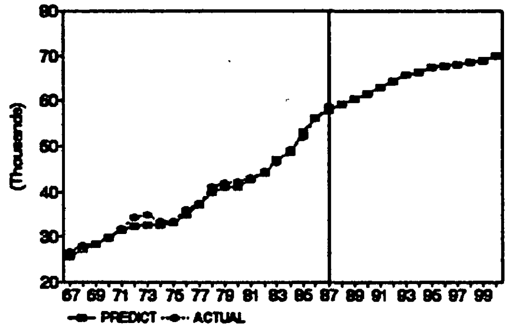

SECTOR # 75 OTHER RECREATIONAL SERVICES
RSQ=0.99 AAPE=4.78% RHO=0.68 UBAR=50.41



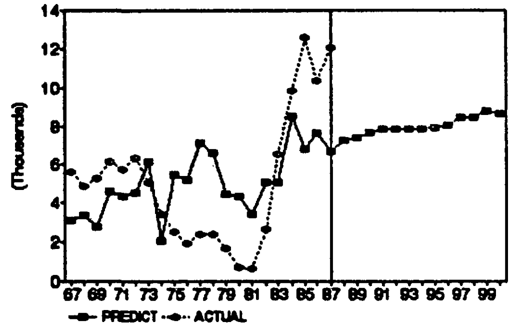

SECTOR # 76 EDUCATION
RSQ=0.92 AAPE=3.83% RHO=0.82 UBAR=515.1




SECTOR # 77 RELIGIOUS AND WELFARE
RSQ=0.99 AAPE=1.95% RHO=0.59 UBAR=564.4



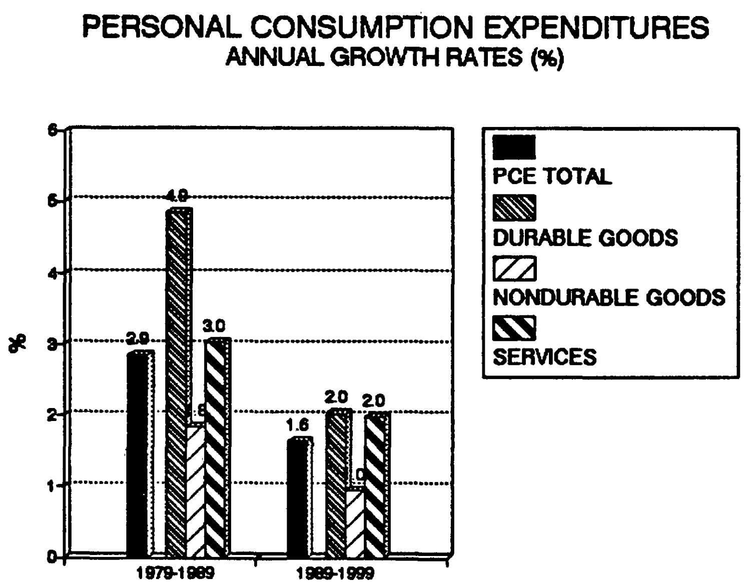

SECTOR # 78 FOREIGN TRAVEL
RSQ=0.23 AAPE=111.5% RHO=0.69 UBAR=59.0



## III. Outlook

The U.S. economy has continued to expand for seven years from 1983 to 1989. During this period, growth in real consumption averaged 3.8% per year. For the last decade, growth in consumer expenditures averaged 2.9% from 1979 to 1989. Our forecast results, however, show a tendency of somewhat weak consumer spending. The forecasted growth in consumption for the next decade is much slower than the growth in the 1980's. The forecasted average growth rate of total consumption is 1.6% for the 1989-1999 period. Figure 5.2 shows the bar chart of growth rates in PCE during the past and the next decades by total consumption, durable goods, nondurable goods, and services.

**FIGURE 5.2**



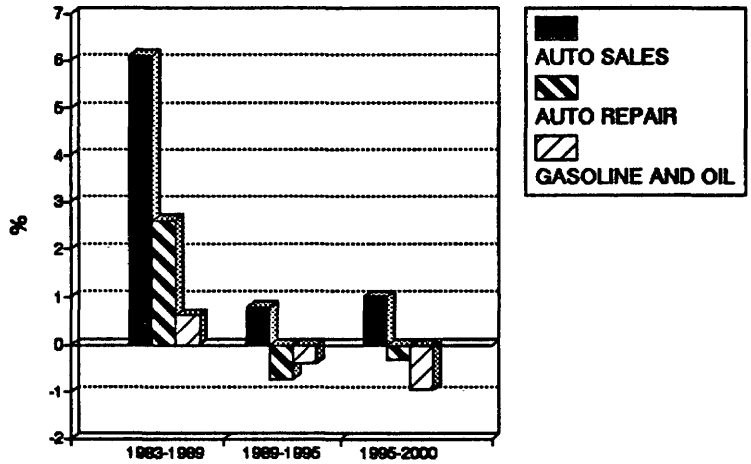
The relatively slower growth in consumer spending over the forecast period can be accounted for by income and demographic factors. The 1979-1989 period had strong growth in income, population, and the number of households. Real disposable income per capita grew at an average annual rate of 1.6%. The forecast for 1989-1999, however, is at much slower 0.8% annual growth. Total population and the number of households, compared with the past decade, will grow slowly over the next ten years. In addition, the proportion of the older age groups will increase in the age distribution of the population. This demographic change will particularly lower the demand for housing and housing-related consumption.

The shifts in population compositions may also account for the shrinking consumer budget shares for other sectors. For instance, the consumption item which is mostly consumed by the baby-boomers will decrease its budget share as the baby-boomers climb into the next age group. An example is the alcohol consumption on premises.

The sluggish growth in the Gasoline, Auto repair, and Auto insurance sectors are associated with the slow growth of the car sales over the forecast period. Auto sales are driven by population growth, real income, and other demographic factors. Slowing population growth and the decrease in the number of cars per adult may account for most of the slow growth in auto and auto-related expenditures. Figure 5.3 illustrates annual growth rates of consumer spending on auto sales, auto repair and insurance, and gasoline for the following periods: 1983-1989, 1989-1995, and 1995-2000.

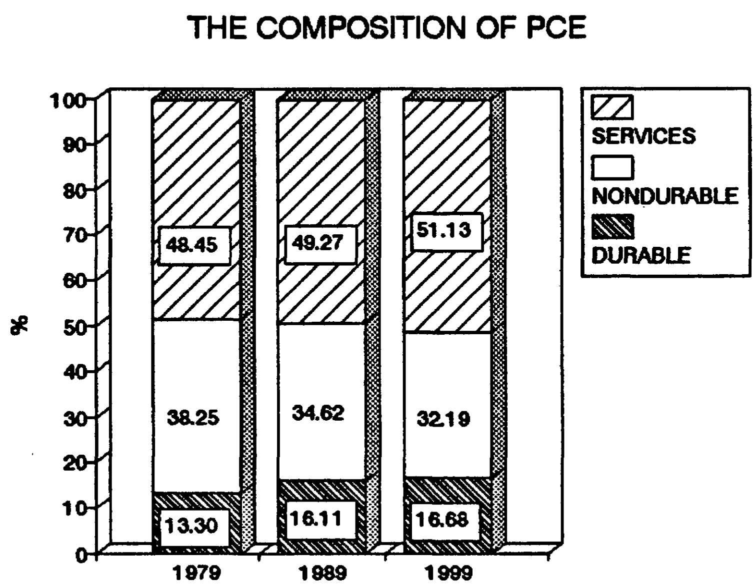
**FIGURE 5.3**

AUTO AND AUTO-RELATED CONSUMER SPENDING
ANNUAL GROWTH RATES (%)



Besides the slow growth in consumer spending, the composition of personal consumption expenditures will continue to shift. Figure 5.4 represents the chart of shares in PCE by three major categories: durable goods, nondurable goods, and services, for the years 1979, 1989, and 1999. The share of services will increase faster than that of nondurable and durable goods. Spending on nondurable goods has been the weakest among the three groups and will continue to decrease its share in total consumption. Durable goods will remain about the same proportion of total expenditures.

**FIGURE 5.4**



## IV. Conclusions

Our goal of estimating a system of demand equations and forecasting personal consumption expenditures is accomplished. We analyzed the cross-sectional effects of income and demographic variables, derived a technique for representing the size distribution of income, and estimated the price effects in the time series. These methods were effectively integrated into the forecasting scheme.

The great advantage of our system is its ability to accommodate almost all the available economic and demographic information. That is, every movement in the economic or the noneconomic factors will affect the aggregate demand through our specification of the model. However, there is still the possibility for our system to include some other detailed economic or noneconomic activities. For instance, interest rates and stock market variables can be utilized to estimate the sector Brokerage and investment counseling for a more accurate prediction.

The sector Foreign travel is the equation with the poorest fit over the estimation periods. This result is expected because the expenditure on Foreign travel is defined as net spending. It would be better if we can handle separately the amount U.S. citizens spent in the foreign countries and the amount foreigners consumed in the U.S. rather than dealing, as at present, with the net purchases. Thus, a further research may provide a great improvement in this sector.

In the section on income distribution, we should incorporate the latest data available from Statistics of Income (from 1983 to 1987) for constructing the updated size distribution of income. Our income-expenditure relationship might be very sensitive to the size distribution of income because of the functional form of the nonlinear Engel curve (PLEC). This effort will be undertaken in later research.

Furthermore, the data source used for the cross-sectional analysis, the

Consumer Expenditure Survey, Interview Survey, is available for 1989. A reestimation of the cross-section equations with new data may benefit the system by a set of updated "cross-section-prediction" parameters. This improvement will also be included in the further studies.

**TABLE 5.2**

**Forecast of Consumption (Millions of 1982 Dollars)**

| | | 1987 | 1988 | 1989 | 1990 | 1991 |
|---|---|---|---|---|---|---|
| 1 | NEW CARS | 79143 | 80382 | 86943 | 88925 | 89030 |
| 2 | NET PURCHASES OF USED CARS | 31339 | 31337 | 34829 | 37809 | 39103 |
| 3 | NEW AND USED TRUCKS | 25467 | 27046 | 25135 | 24817 | 26685 |
| 4 | TIRES AND TUBES | 14778 | 15011 | 15537 | 15719 | 16083 |
| 5 | ACCESSORIES AND PARTS (AUTO) | 12451 | 12715 | 13254 | 13481 | 13836 |
| 6 | FURNITURE, MATTRESSES, AND BEDSPRINGS | 26864 | 28508 | 29304 | 30466 | 31530 |
| 7 | KITCHEN AND OTHER HOUSEHOLD APPLIANCES | 24607 | 25691 | 26823 | 28022 | 28924 |
| 8 | CHINA, GLASSWARE, TABLEWARE, AND UTENSILS | 12588 | 13143 | 13438 | 13796 | 14060 |
| 9 | RADIO, TV, RECORDS, AND MUSICAL INSTRUMENTS | 55592 | 56323 | 57837 | 59702 | 60809 |
| 10 | FLOOR COVERINGS | 10199 | 10869 | 11325 | 11869 | 12334 |
| 11 | DURABLE HOUSEFURNISHINGS | 13272 | 14238 | 14904 | 15669 | 16328 |
| 12 | WRITING EQUIPMENT | 1223 | 1199 | 1165 | 1109 | 1076 |
| 13 | HAND TOOLS | 4186 | 4326 | 4586 | 4764 | 4969 |
| 14 | JEWELRY | 22719 | 23490 | 24407 | 25220 | 25954 |
| 15 | OPHTHALMIC AND ORTHOPEDIC APPLIANCES | 7304 | 7343 | 7446 | 7465 | 7520 |
| 16 | BOOKS AND MAPS | 6842 | 7020 | 6974 | 6846 | 6858 |
| 17 | WHEEL GOODS AND DURABLE TOYS | 19926 | 20458 | 21203 | 21811 | 22537 |
| 18 | BOATS, RV, AND AIRCRAFT | 13910 | 14899 | 13316 | 13329 | 14221 |
| 19 | FOOD, OFF PREMISE | 261402 | 266348 | 272056 | 276618 | 281478 |
| 20 | FOOD, ON PREMISE | 112262 | 112899 | 112712 | 114866 | 116827 |
| 21 | ALCOHOL, OFF PREMISE | 31170 | 32298 | 32421 | 32780 | 32882 |
| 22 | ALCOHOL, ON PREMISE | 17767 | 17043 | 16918 | 17026 | 16660 |
| 23 | SHOES AND FOOTWEAR | 23636 | 24531 | 25049 | 25632 | 26231 |
| 24 | WOMEN'S CLOTHING | 85402 | 89303 | 91629 | 94414 | 97121 |
| 25 | MEN'S CLOTHING | 43370 | 45277 | 46408 | 47765 | 49133 |
| 26 | LUGGAGE | 2636 | 2790 | 2887 | 2997 | 3109 |
| 27 | GASOLINE AND OIL | 103302 | 102671 | 102786 | 101139 | 100471 |

**TABLE 5.2**

**Forecast of Consumption**
**(Millions of 1982 Dollars)**
**(Continued)**

| | 1987 | 1988 | 1989 | 1990 | 1991 |
|---|---|---|---|---|---|
| 28 FUEL OIL AND COAL | 19393 | 19869 | 19679 | 19905 | 20046 |
| 29 TOBACCO | 23000 | 23018 | 23129 | 23235 | 23356 |
| 30 SEMIDURABLE HOUSE-FURNISHINGS | 12546 | 13132 | 13401 | 13761 | 14019 |
| 31 DRUG PREPARATIONS AND SUNDRIES | 22208 | 22667 | 22570 | 22120 | 21972 |
| 32 TOILET ARTICLES AND PREPARATIONS | 21557 | 22133 | 22577 | 23154 | 23701 |
| 33 STATIONERY AND WRITING SUPPLIES | 6001 | 6230 | 6243 | 6176 | 6245 |
| 34 NONDURABLE TOYS AND SPORT SUPPLIES | 21939 | 22393 | 23259 | 23800 | 24514 |
| 35 FLOWERS, SEEDS, AND POTTED PLANTS | 5802 | 5791 | 5801 | 6024 | 6158 |
| 36 CLEANING PREPARATIONS | 2443 | 2342 | 2419 | 2406 | 2415 |
| 37 LIGHTING SUPPLIES | 11004 | 10572 | 10498 | 10038 | 9770 |
| 38 HOUSEHOLD PAPER PRODUCTS | 8679 | 8556 | 8728 | 8641 | 8675 |
| 39 MAGAZINES AND NEWSPAPER | 11260 | 11395 | 11225 | 10920 | 10852 |
| 40 OTHER NONDURABLES -- IDENTITY | 3105 | 3144 | 3209 | 3275 | 3343 |
| 41 OWNER OCCUPIED SPACE RENT | 255531 | 263165 | 269394 | 278716 | 285822 |
| 42 TENANT OCCUPIED SPACE RENT | 90145 | 87343 | 87522 | 88139 | 88660 |
| 43 HOTELS AND MOTELS | 10515 | 10755 | 11043 | 11331 | 11633 |
| 44 OTHER HOUSING -- EDUCATIONAL HOUSING | 3924 | 4057 | 4124 | 4176 | 4254 |
| 45 ELECTRICITY | 50514 | 52538 | 54379 | 57146 | 59438 |
| 46 NATURAL GAS | 24477 | 25110 | 25751 | 26489 | 27146 |
| 47 WATER AND OTHER SANITARY SERVICES | 12643 | 13155 | 14128 | 14505 | 15025 |
| 48 TELEPHONE AND TELEGRAPH | 35162 | 34099 | 34513 | 34396 | 35198 |
| 49 DOMESTIC SERVICES | 8776 | 8283 | 8116 | 7653 | 7297 |
| 50 HOUSEHOLD INSURANCE | 1459 | 1470 | 1532 | 1515 | 1551 |
| 51 OTHER HOUSEHOLD OPERATIONS - REPAIR | 10948 | 10831 | 11227 | 11229 | 11513 |
| 52 POSTAGE | 5607 | 6100 | 6786 | 7015 | 7159 |
| 53 AUTO REPAIR | 43380 | 43004 | 43556 | 43150 | 43080 |
| 54 BRIDGE, TOLLS, ETC. | 1256 | 1239 | 1231 | 1194 | 1164 |

**TABLE 5.2**

**Forecast of Consumption (Millions of 1982 Dollars) (Continued)**

| | 1987 | 1988 | 1989 | 1990 | 1991 |
|---|---|---|---|---|---|
| 55 AUTO INSURANCE | 9778 | 9761 | 9953 | 9897 | 9931 |
| 56 TAXICABS | 3021 | 2969 | 2946 | 2882 | 2815 |
| 57 LOCAL PUBLIC TRANSPORT | 3591 | 3288 | 3326 | 3323 | 3312 |
| 58 INTERCITY RAILROAD | 591 | 579 | 589 | 631 | 679 |
| 59 INTERCITY BUSES | 1061 | 1033 | 1026 | 1016 | 1017 |
| 60 AIRLINES | 22575 | 24382 | 24533 | 25007 | 26051 |
| 61 TRAVEL AGENTS AND OTHER TRANSPORTATION SERVICES | 1749 | 1831 | 1911 | 1993 | 2075 |
| 62 CLEANING, LAUNDERING AND SHOE REPAIR | 13103 | 13214 | 13211 | 13319 | 13351 |
| 63 BARBERSHOPS AND BEAUTY SHOPS | 13096 | 13395 | 13485 | 13695 | 13867 |
| 64 PHYSICIANS | 63149 | 63714 | 64339 | 65300 | 65970 |
| 65 DENTISTS AND OTHER PROFESSIONAL SERVICES | 50094 | 51582 | 52987 | 54736 | 56312 |
| 66 PRIVATE HOSPITALS AND SANITARIUMS | 139083 | 141986 | 145659 | 150351 | 154100 |
| 67 HEALTH INSURANCE | 16898 | 17100 | 17334 | 17461 | 17669 |
| 68 BROKERAGE AND INVESTMENT COUNSELING | 15631 | 16083 | 16378 | 16673 | 17026 |
| 69 BANK SERVICES CHARGES AND SERVICES WITHOUT PAYMENT | 60853 | 62171 | 63367 | 64466 | 65757 |
| 70 LIFE INSURANCE | 31727 | 32486 | 32947 | 33294 | 33683 |
| 71 LEGAL SERVICES | 22413 | 22623 | 22947 | 23177 | 23604 |
| 72 FUNERAL EXPENSES AND OTHER PERSONAL BUSINESS | 16382 | 16221 | 15651 | 15435 | 15157 |
| 73 RADIO AND TELEVISION REPAIR | 2554 | 2449 | 2418 | 2305 | 2235 |
| 74 MOVIES, LEGITIMATE THEATRE, AND SPECTATOR SPORTS | 12319 | 12562 | 13114 | 13595 | 13724 |
| 75 OTHER RECREATIONAL SERVICES | 51870 | 52745 | 55266 | 57538 | 59741 |
| 76 EDUCATION | 40987 | 41819 | 42525 | 43254 | 441880 |
| 77 RELIGIOUS AND WELFARE SERVICES | 58044 | 59282 | 60422 | 61558 | 62942 |
| 78 FOREIGN TRAVEL | 6707 | 7258 | 7414 | 7639 | 7870 |

**TABLE 5.2**

**Forecast of Consumption**
**(Millions of 1982 Dollars)**
**(Continued)**

| | 1992 | 1994 | 1996 | 1998 | 2000 |
|---|---|---|---|---|---|
| 1 NEW CARS | 88477 | 85611 | 83284 | 81911 | 80914 |
| 2 NET PURCHASES OF USED CARS | 40302 | 40966 | 43167 | 46466 | 49059 |
| 3 NEW AND USED TRUCKS | 28024 | 29965 | 32086 | 33335 | 34442 |
| 4 TIRES AND TUBES | 16290 | 16579 | 17143 | 17405 | 17597 |
| 5 ACCESSORIES AND PARTS (AUTO) | 14110 | 14543 | 15039 | 15443 | 15774 |
| 6 FURNITURE, MATTRESSES, AND BEDSPRINGS | 32526 | 34137 | 35976 | 38235 | 41178 |
| 7 KITCHEN AND OTHER HOUSEHOLD APPLIANCES | 29673 | 31765 | 33932 | 36981 | 40316 |
| 8 CHINA, GLASSWARE, TABLEWARE, AND UTENSILS | 14230 | 14667 | 15036 | 15774 | 16616 |
| 9 RADIO, TV, RECORDS, AND MUSICAL INSTRUMENTS | 61301 | 63316 | 65421 | 69025 | 73376 |
| 10 FLOOR COVERINGS | 12691 | 13029 | 13513 | 13836 | 14348 |
| 11 DURABLE HOUSEFURNISHINGS | 16863 | 18098 | 19436 | 20964 | 22919 |
| 12 WRITING EQUIPMENT | 1037 | 907 | 788 | 649 | 524 |
| 13 HAND TOOLS | 5133 | 5422 | 5651 | 5872 | 6187 |
| 14 JEWELRY | 26761 | 28143 | 29679 | 31320 | 33331 |
| 15 OPHTHALMIC AND ORTHOPEDIC APPLIANCES | 7654 | 7612 | 7611 | 7542 | 7530 |
| 16 BOOKS AND MAPS | 6808 | 6470 | 6268 | 5934 | 5676 |
| 17 WHEEL GOODS AND DURABLE TOYS | 23088 | 24018 | 24807 | 25655 | 26602 |
| 18 BOATS, RV, AND AIRCRAFT | 14994 | 16187 | 17175 | 18223 | 19542 |
| 19 FOOD, OFF PREMISE | 284378 | 290691 | 298515 | 304798 | 309339 |
| 20 FOOD, ON PREMISE | 119163 | 122387 | 125807 | 129698 | 133307 |
| 21 ALCOHOL, OFF PREMISE | 33004 | 32962 | 32672 | 32456 | 32152 |
| 22 ALCOHOL, ON PREMISE | 16277 | 15500 | 14587 | 13502 | 12638 |
| 23 SHOES AND FOOTWEAR | 26709 | 27670 | 28732 | 29924 | 31279 |
| 24 WOMEN'S CLOTHING | 99435 | 104580 | 109806 | 115599 | 122382 |
| 25 MEN'S CLOTHING | 50246 | 52607 | 54912 | 57439 | 60419 |
| 26 LUGGAGE | 3220 | 3439 | 3670 | 3929 | 4212 |
| 27 GASOLINE AND OIL | 99290 | 95990 | 92981 | 89541 | 85709 |

**TABLE 5.2**

**Forecast of Consumption**
**(Millions of 1982 Dollars)**
**(Continued)**

| | 1992 | 1994 | 1996 | 1998 | 2000 |
|---|---|---|---|---|---|
| 28 FUEL OIL AND COAL | 20080 | 20402 | 20730 | 21120 | 21383 |
| 29 TOBACCO | 23405 | 23497 | 23603 | 23717 | 23727 |
| 30 SEMIDURABLE HOUSE-FURNISHINGS | 14204 | 14743 | 15247 | 16032 | 16946 |
| 31 DRUG PREPARATIONS AND SUNDRIES | 21848 | 21003 | 20181 | 19091 | 18116 |
| 32 TOILET ARTICLES AND PREPARATIONS | 24104 | 24865 | 25366 | 26100 | 27054 |
| 33 STATIONERY AND WRITING SUPPLIES | 6259 | 6088 | 6075 | 5932 | 5910 |
| 34 NONDURABLE TOYS AND SPORT SUPPLIES | 25096 | 25927 | 26685 | 27429 | 28231 |
| 35 FLOWERS, SEEDS, AND POTTED PLANTS | 6294 | 6475 | 6582 | 6631 | 6811 |
| 36 CLEANING PREPARATIONS | 2410 | 2319 | 2189 | 2084 | 2012 |
| 37 LIGHTING SUPPLIES | 9381 | 8332 | 7245 | 6255 | 5417 |
| 38 HOUSEHOLD PAPER PRODUCTS | 8681 | 8516 | 8283 | 8072 | 7798 |
| 39 MAGAZINES AND NEWSPAPER | 10727 | 10043 | 9518 | 8770 | 8192 |
| 40 OTHER NONDURABLES -- IDENTITY | 3401 | 3500 | 3585 | 3681 | 3780 |
| 41 OWNER OCCUPIED SPACE RENT | 292571 | 316488 | 339006 | 368266 | 399471 |
| 42 TENANT OCCUPIED SPACE RENT | 89151 | 92640 | 95408 | 98790 | 101094 |
| 43 HOTELS AND MOTELS | 11927 | 12395 | 12744 | 13082 | 13463 |
| 44 OTHER HOUSING -- EDUCATIONAL HOUSING | 4352 | 4497 | 4619 | 4686 | 4731 |
| 45 ELECTRICITY | 61445 | 66768 | 71346 | 76674 | 81869 |
| 46 NATURAL GAS | 27667 | 29118 | 30363 | 31871 | 33279 |
| 47 WATER AND OTHER SANITARY SERVICES | 15519 | 16407 | 16932 | 17417 | 17680 |
| 48 TELEPHONE AND TELEGRAPH | 35692 | 36685 | 37564 | 37951 | 38054 |
| 49 DOMESTIC SERVICES | 6886 | 5848 | 4926 | 4218 | 3660 |
| 50 HOUSEHOLD INSURANCE | 1541 | 1522 | 1547 | 1556 | 1557 |
| 51 OTHER HOUSEHOLD OPERATIONS - REPAIR | 11685 | 11612 | 11505 | 11373 | 11296 |
| 52 POSTAGE | 7472 | 7570 | 7394 | 7346 | 7270 |
| 53 AUTO REPAIR | 42707 | 41686 | 40717 | 39868 | 38909 |
| 54 BRIDGE, TOLLS, ETC. | 1124 | 1031 | 936 | 840 | 737 |

**TABLE 5.2**

**Forecast of Consumption (Millions of 1982 Dollars) (Continued)**

| | 1992 | 1994 | 1996 | 1998 | 2000 |
|---|---|---|---|---|---|
| 55 AUTO INSURANCE | 9931 | 9862 | 9794 | 9726 | 9634 |
| 56 TAXICABS | 2700 | 2494 | 2198 | 2036 | 1909 |
| 57 LOCAL PUBLIC TRANSPORT | 3266 | 3183 | 3026 | 2910 | 2837 |
| 58 INTERCITY RAILROAD | 716 | 803 | 903 | 979 | 1051 |
| 59 INTERCITY BUSES | 1013 | 1007 | 994 | 957 | 936 |
| 60 AIRLINES | 26666 | 28025 | 29490 | 30682 | 32096 |
| 61 TRAVEL AGENTS AND OTHER TRANSPORTATION SERVICES | 2157 | 2310 | 2459 | 2593 | 2743 |
| 62 CLEANING, LAUNDERING AND SHOE REPAIR | 13280 | 13213 | 12956 | 12877 | 12840 |
| 63 BARBERSHOPS AND BEAUTY SHOPS | 13932 | 14126 | 14273 | 14525 | 14794 |
| 64 PHYSICIANS | 67257 | 68143 | 68542 | 68498 | 68593 |
| 65 DENTISTS AND OTHER PROFESSIONAL SERVICES | 58367 | 61241 | 63610 | 65896 | 67880 |
| 66 PRIVATE HOSPITALS AND SANITARIUMS | 159854 | 168366 | 176707 | 181375 | 187799 |
| 67 HEALTH INSURANCE | 17834 | 17992 | 18237 | 18346 | 18510 |
| 68 BROKERAGE AND INVESTMENT COUNSELING | 17378 | 17619 | 17816 | 17978 | 18153 |
| 69 BANK SERVICES CHARGES AND SERVICES WITHOUT PAYMENT | 67311 | 68705 | 69589 | 70348 | 71314 |
| 70 LIFE INSURANCE | 34172 | 34557 | 34892 | 35060 | 35438 |
| 71 LEGAL SERVICES | 24004 | 24186 | 24216 | 24189 | 24206 |
| 72 FUNERAL EXPENSES AND OTHER PERSONAL BUSINESS | 15069 | 14340 | 13316 | 12335 | 11216 |
| 73 RADIO AND TELEVISION REPAIR | 2140 | 1911 | 1718 | 1508 | 1264 |
| 74 MOVIES, LEGITIMATE THEATRE, AND SPECTATOR SPORTS | 14182 | 14694 | 14981 | 15275 | 15574 |
| 75 OTHER RECREATIONAL SERVICES | 61874 | 65720 | 69276 | 72909 | 76530 |
| 76 EDUCATION | 45267 | 47024 | 48244 | 49302 | 50307 |
| 77 RELIGIOUS AND WELFARE SERVICES | 64323 | 66451 | 67756 | 68551 | 70027 |
| 78 FOREIGN TRAVEL | 7867 | 7900 | 8045 | 8408 | 8656 |

## TABLE 5.3

**Growth Rates**
**(Percent)**

| | | 87-88 | 88-89 | 89-90 | 90-91 | 91-92 |
|---|---|---|---|---|---|---|
| 1 | NEW CARS | 1.565 | 8.162 | 2.280 | 0.117 | -0.620 |
| 2 | NET PURCHASES OF USED CARS | -0.008 | 11.143 | 8.557 | 3.424 | 3.065 |
| 3 | NEW AND USED TRUCKS | 6.200 | -7.066 | -1.266 | 7.525 | 5.021 |
| 4 | TIRES AND TUBES | 1.576 | 3.502 | 1.175 | 2.315 | 1.286 |
| 5 | ACCESSORIES AND PARTS (AUTO) | 2.125 | 4.233 | 1.172 | 2.636 | 1.975 |
| 6 | FURNITURE, MATTRESSES, AND BEDSPRINGS | 6.121 | 2.792 | 3.966 | 3.492 | 3.159 |
| 7 | KITCHEN AND OTHER HOUSEHOLD APPLIANCES | 4.403 | 4.407 | 4.471 | 3.219 | 2.588 |
| 8 | CHINA, GLASSWARE, TABLEWARE, AND UTENSILS | 4.409 | 2.246 | 2.669 | 1.906 | 1.216 |
| 9 | RADIO, TV, RECORDS, AND MUSICAL INSTRUMENTS | 1.315 | 2.687 | 3.225 | 1.854 | 0.808 |
| 10 | FLOOR COVERINGS | 6.566 | 4.203 | 4.796 | 3.917 | 2.896 |
| 11 | DURABLE HOUSEFURNISHINGS | 7.278 | 4.679 | 5.135 | 4.205 | 3.274 |
| 12 | WRITING EQUIPMENT | -2.025 | -2.848 | -4.787 | -2.924 | -3.703 |
| 13 | HAND TOOLS | 3.349 | 6.001 | 3.885 | 4.306 | 3.292 |
| 14 | JEWELRY | 3.390 | 3.905 | 3.332 | 2.910 | 3.108 |
| 15 | OPHTHALMIC AND ORTHOPEDIC APPLIANCES | 0.537 | 1.399 | 0.258 | 0.737 | 1.775 |
| 16 | BOOKS AND MAPS | 2.598 | -0.652 | -1.839 | 0.187 | -0.737 |
| 17 | WHEEL GOODS AND DURABLE TOYS | 2.668 | 3.643 | 2.868 | 3.327 | 2.445 |
| 18 | BOATS, RV, AND AIRCRAFT | 7.113 | -10.624 | 0.091 | 6.699 | 5.434 |
| 19 | FOOD, OFF PREMISE | 1.892 | 2.143 | 1.677 | 1.757 | 1.030 |
| 20 | FOOD, ON PREMISE | 0.568 | -0.166 | 1.911 | 1.708 | 1.999 |
| 21 | ALCOHOL, OFF PREMISE | 3.617 | 0.382 | 1.106 | 0.312 | 0.372 |
| 22 | ALCOHOL, ON PREMISE | -4.074 | -0.732 | 0.636 | -2.144 | -2.301 |
| 23 | SHOES AND FOOTWEAR | 3.784 | 2.115 | 2.326 | 2.338 | 1.822 |
| 24 | WOMEN'S CLOTHING | 4.568 | 2.604 | 3.039 | 2.867 | 2.283 |
| 25 | MEN'S CLOTHING | 4.396 | 2.498 | 2.924 | 2.864 | 2.266 |
| 26 | LUGGAGE | 5.857 | 3.470 | 3.812 | 3.731 | 3.597 |
| 27 | GASOLINE AND OIL | -0.611 | 0.112 | -1.603 | -0.660 | -1.176 |

**TABLE 5.3**

**Growth Rates**
**(Percent)**
**(Continued)**

| | 87-88 | 88-89 | 89-90 | 90-91 | 91-92 |
|---|---|---|---|---|---|
| 28 FUEL OIL AND COAL | 2.457 | -0.959 | 1.151 | 0.705 | 0.170 |
| 29 TOBACCO | 0.076 | 0.484 | 0.458 | 0.522 | 0.207 |
| 30 SEMIDURABLE HOUSE-FURNISHINGS | 4.674 | 2.046 | 2.686 | 1.876 | 1.324 |
| 31 DRUG PREPARATIONS AND SUNDRIES | 2.069 | -0.428 | -1.993 | -0.671 | -0.562 |
| 32 TOILET ARTICLES AND PREPARATIONS | 2.674 | 2.004 | 2.556 | 2.362 | 1.703 |
| 33 STATIONERY AND WRITING SUPPLIES | 3.821 | 0.198 | -1.071 | 1.121 | 0.232 |
| 34 NONDURABLE TOYS AND SPORT SUPPLIES | 2.068 | 3.869 | 2.324 | 2.999 | 2.377 |
| 35 FLOWERS, SEEDS, AND POTTED PLANTS | -0.194 | 0.176 | 3.853 | 2.224 | 2.197 |
| 36 CLEANING PREPARATIONS | -4.132 | 3.251 | -0.534 | 0.377 | -0.188 |
| 37 LIGHTING SUPPLIES | -3.921 | -0.705 | -4.384 | -2.668 | -3.984 |
| 38 HOUSEHOLD PAPER PRODUCTS | -1.415 | 2.019 | -1.004 | 0.395 | 0.069 |
| 39 MAGAZINES AND NEWSPAPER | 1.199 | -1.490 | -2.718 | -0.624 | -1.146 |
| 40 OTHER NONDURABLES -- IDENTITY | 1.235 | 2.070 | 2.068 | 2.053 | 1.751 |
| 41 OWNER OCCUPIED SPACE RENT | 2.988 | 2.367 | 3.460 | 2.550 | 2.361 |
| 42 TENANT OCCUPIED SPACE RENT | -3.109 | 0.204 | 0.706 | 0.591 | 0.554 |
| 43 HOTELS AND MOTELS | 2.279 | 2.678 | 2.610 | 2.663 | 2.530 |
| 44 OTHER HOUSING -- EDUCATIONAL HOUSING | 3.379 | 1.648 | 1.268 | 1.865 | 2.300 |
| 45 ELECTRICITY | 4.006 | 3.504 | 5.089 | 4.010 | 3.376 |
| 46 NATURAL GAS | 2.586 | 2.552 | 2.868 | 2.477 | 1.921 |
| 47 WATER AND OTHER SANITARY SERVICES | 4.047 | 7.399 | 2.668 | 3.584 | 3.289 |
| 48 TELEPHONE AND TELEGRAPH | -3.024 | 1.216 | -0.340 | 2.332 | 1.403 |
| 49 DOMESTIC SERVICES | -5.619 | -2.008 | -5.711 | -4.648 | -5.633 |
| 50 HOUSEHOLD INSURANCE | 0.713 | 4.214 | -1.066 | 2.348 | -0.639 |
| 51 OTHER HOUSEHOLD OPERATIONS - REPAIR | -1.067 | 3.660 | 0.016 | 2.527 | 1.497 |
| 52 POSTAGE | 8.782 | 11.258 | 3.368 | 2.049 | 4.382 |
| 53 AUTO REPAIR | -0.867 | 1.285 | -0.932 | -0.163 | -0.864 |
| 54 BRIDGE, TOLLS, ETC. | -1.319 | -0.613 | -3.039 | -2.494 | -3.421 |

**TABLE 5.3**

**Growth Rates**
**(Percent)**
**(Continued)**

| | 87-88 | 88-89 | 89-90 | 90-91 | 91-92 |
|---|---|---|---|---|---|
| 55 AUTO INSURANCE | -0.167 | 1.963 | -0.559 | 0.344 | -0.004 |
| 56 TAXICABS | -1.715 | -0.777 | -2.155 | -2.347 | -4.087 |
| 57 LOCAL PUBLIC TRANSPORT | -8.434 | 1.136 | -0.084 | -0.321 | -1.386 |
| 58 INTERCITY RAILROAD | -1.937 | 1.749 | 7.090 | 7.490 | 5.581 |
| 59 INTERCITY BUSES | -2.628 | -0.736 | -0.988 | 0.133 | -0.374 |
| 60 AIRLINES | 8.006 | 0.619 | 1.930 | 4.177 | 2.358 |
| 61 TRAVEL AGENTS AND OTHER TRANSPORTATION SERVICES | 4.716 | 4.338 | 4.276 | 4.138 | 3.974 |
| 62 CLEANING, LAUNDERING AND SHOE REPAIR | 0.845 | -0.027 | 0.820 | 0.243 | -0.533 |
| 63 BARBERSHOPS AND BEAUTY SHOPS | 2.282 | 0.668 | 1.557 | 1.255 | 0.471 |
| 64 PHYSICIANS | 0.894 | 0.980 | 1.494 | 1.026 | 1.952 |
| 65 DENTISTS AND OTHER PROFESSIONAL SERVICES | 2.971 | 2.723 | 3.301 | 2.880 | 3.649 |
| 66 PRIVATE HOSPITALS AND SANITARIUMS | 2.088 | 2.587 | 3.221 | 2.494 | 3.734 |
| 67 HEALTH INSURANCE | 1.192 | 1.372 | 0.729 | 1.196 | 0.930 |
| 68 BROKERAGE AND INVESTMENT COUNSELING | 2.891 | 1.835 | 1.803 | 2.116 | 2.066 |
| 69 BANK SERVICES CHARGES AND SERVICES WITHOUT PAYMENT | 2.166 | 1.923 | 1.736 | 2.001 | 2.363 |
| 70 LIFE INSURANCE | 2.394 | 1.420 | 1.051 | 1.169 | 1.451 |
| 71 LEGAL SERVICES | 0.936 | 1.429 | 1.008 | 1.834 | 1.695 |
| 72 FUNERAL EXPENSES AND OTHER PERSONAL BUSINESS | -0.986 | -3.511 | -1.380 | -1.804 | -0.582 |
| 73 RADIO AND TELEVISION REPAIR | -4.104 | -1.300 | -4.638 | -3.057 | -4.250 |
| 74 MOVIES, LEGITIMATE THEATRE, AND SPECTATOR SPORTS | 1.970 | 4.394 | 3.671 | 0.945 | 3.341 |
| 75 OTHER RECREATIONAL SERVICES | 1.687 | 4.781 | 4.111 | 3.828 | 3.571 |
| 76 EDUCATION | 2.031 | 1.688 | 1.714 | 2.160 | 2.442 |
| 77 RELIGIOUS AND WELFARE SERVICES | 2.133 | 1.923 | 1.881 | 2.247 | 2.195 |
| 78 FOREIGN TRAVEL | 8.202 | 2.152 | 3.038 | 3.027 | -0.036 |

## TABLE 5.3

**Growth Rates**
**(Percent)**
**(Continued)**

| | 92-94 | 94-96 | 96-98 | 98-00 | 88-00 |
|---|---|---|---|---|---|
| 1 NEW CARS | -1.633 | -1.369 | -0.828 | -0.605 | 0.089 |
| 2 NET PURCHASES OF USED CARS | 0.826 | 2.660 | 3.752 | 2.753 | 3.847 |
| 3 NEW AND USED TRUCKS | 3.408 | 3.496 | 1.927 | 1.652 | 2.098 |
| 4 TIRES AND TUBES | 0.884 | 1.690 | 0.762 | 0.554 | 1.338 |
| 5 ACCESSORIES AND PARTS (AUTO) | 1.523 | 1.693 | 1.334 | 1.068 | 1.816 |
| 6 FURNITURE, MATTRESSES, AND BEDSPRINGS | 2.448 | 2.659 | 3.092 | 3.778 | 3.114 |
| 7 KITCHEN AND OTHER HOUSEHOLD APPLIANCES | 3.468 | 3.357 | 4.397 | 4.415 | 3.830 |
| 8 CHINA, GLASSWARE, TABLEWARE, AND UTENSILS | 1.569 | 1.252 | 2.427 | 2.635 | 1.976 |
| 9 RADIO, TV, RECORDS, AND MUSICAL INSTRUMENTS | 1.632 | 1.649 | 2.718 | 3.104 | 2.232 |
| 10 FLOOR COVERINGS | 3.192 | 3.044 | 3.083 | 3.810 | 3.506 |
| 11 DURABLE HOUSEFURNISHINGS | 3.599 | 3.632 | 3.858 | 4.560 | 4.409 |
| 12 WRITING EQUIPMENT | -6.432 | -6.815 | -9.247 | -10.127 | -6.625 |
| 13 HAND TOOLS | 2.777 | 2.096 | 1.934 | 2.649 | 3.033 |
| 14 JEWELRY | 2.550 | 2.693 | 2.728 | 3.162 | 2.960 |
| 15 OPHTHALMIC AND ORTHOPEDIC APPLIANCES | 0.262 | -0.004 | -0.786 | -0.076 | 0.213 |
| 16 BOOKS AND MAPS | -2.507 | -1.576 | -2.701 | -2.195 | -1.750 |
| 17 WHEEL GOODS AND DURABLE TOYS | 1.995 | 1.629 | 1.695 | 1.830 | 2.215 |
| 18 BOATS, RV, AND AIRCRAFT | 3.907 | 3.008 | 3.008 | 3.555 | 2.379 |
| 19 FOOD, OFF PREMISE | 1.104 | 1.340 | 1.047 | 0.746 | 1.257 |
| 20 FOOD, ON PREMISE | 1.344 | 1.389 | 1.535 | 1.382 | 1.396 |
| 21 ALCOHOL, OFF PREMISE | -0.065 | -0.440 | -0.332 | -0.469 | -0.036 |
| 22 ALCOHOL, ON PREMISE | -2.415 | -2.982 | -3.790 | -3.252 | -2.452 |
| 23 SHOES AND FOOTWEAR | 1.784 | 1.901 | 2.053 | 2.240 | 2.046 |
| 24 WOMEN'S CLOTHING | 2.555 | 2.468 | 2.604 | 2.893 | 2.661 |
| 25 MEN'S CLOTHING | 2.323 | 2.168 | 2.275 | 2.562 | 2.434 |
| 26 LUGGAGE | 3.340 | 3.299 | 3.473 | 3.535 | 3.492 |
| 27 GASOLINE AND OIL | -1.676 | -1.580 | -1.868 | -2.163 | -1.491 |

**TABLE 5.3**

**Growth Rates**
**(Percent)**
**(Continued)**

| | 92-94 | 94-96 | 96-98 | 98-00 | 88-00 |
|---|---|---|---|---|---|
| 28 FUEL OIL AND COAL | 0.800 | 0.807 | 0.937 | 0.626 | 0.617 |
| 29 TOBACCO | 0.197 | 0.226 | 0.241 | 0.021 | 0.253 |
| 30 SEMIDURABLE HOUSE-FURNISHINGS | 1.880 | 1.696 | 2.543 | 2.813 | 2.149 |
| 31 DRUG PREPARATIONS AND SUNDRIES | -1.952 | -1.974 | -2.739 | -2.587 | -1.846 |
| 32 TOILET ARTICLES AND PREPARATIONS | 1.565 | 1.006 | 1.437 | 1.812 | 1.688 |
| 33 STATIONERY AND WRITING SUPPLIES | -1.379 | -0.101 | -1.184 | -0.182 | -0.434 |
| 34 NONDURABLE TOYS AND SPORT SUPPLIES | 1.641 | 1.452 | 1.385 | 1.451 | 1.952 |
| 35 FLOWERS, SEEDS, AND POTTED PLANTS | 1.433 | 0.820 | 0.374 | 1.348 | 1.367 |
| 36 CLEANING PREPARATIONS | -1.909 | -2.829 | -2.427 | -1.732 | -1.241 |
| 37 LIGHTING SUPPLIES | -5.751 | -6.743 | -7.080 | -6.941 | -5.397 |
| 38 HOUSEHOLD PAPER PRODUCTS | -0.953 | -1.381 | -1.282 | -1.708 | -0.764 |
| 39 MAGAZINES AND NEWSPAPER | -3.238 | -2.642 | -4.007 | -3.342 | -2.703 |
| 40 OTHER NONDURABLES -- IDENTITY | 1.439 | 1.209 | 1.340 | 1.331 | 1.548 |
| 41 OWNER OCCUPIED SPACE RENT | 4.008 | 3.497 | 4.227 | 4.152 | 3.542 |
| 42 TENANT OCCUPIED SPACE RENT | 1.983 | 1.483 | 1.757 | 1.160 | 1.228 |
| 43 HOTELS AND MOTELS | 1.942 | 1.397 | 1.321 | 1.445 | 1.891 |
| 44 OTHER HOUSING -- EDUCATIONAL HOUSING | 1.655 | 1.355 | 0.719 | 0.477 | 1.291 |
| 45 ELECTRICITY | 4.242 | 3.373 | 3.667 | 3.334 | 3.767 |
| 46 NATURAL GAS | 2.589 | 2.117 | 2.455 | 2.185 | 2.376 |
| 47 WATER AND OTHER SANITARY SERVICES | 2.823 | 1.588 | 1.423 | 0.753 | 2.509 |
| 48 TELEPHONE AND TELEGRAPH | 1.386 | 1.192 | 0.515 | 0.136 | 0.922 |
| 49 DOMESTIC SERVICES | -7.843 | -8.176 | -7.458 | -6.846 | -6.554 |
| 50 HOUSEHOLD INSURANCE | -0.627 | 0.848 | 0.268 | 0.044 | 0.493 |
| 51 OTHER HOUSEHOLD OPERATIONS - REPAIR | -0.312 | -0.463 | -0.578 | -0.338 | 0.360 |
| 52 POSTAGE | 0.661 | -1.171 | -0.323 | -0.515 | 1.530 |
| 53 AUTO REPAIR | -1.203 | -1.169 | -1.047 | -1.210 | -0.827 |
| 54 BRIDGE, TOLLS, ETC. | -4.246 | -4.721 | -5.275 | -6.300 | -4.221 |

**TABLE 5.3**

**Growth Rates**
**(Percent)**
**(Continued)**

| | 92-94 | 94-96 | 96-98 | 98-00 | 88-00 |
|---|---|---|---|---|---|
| 55 AUTO INSURANCE | -0.347 | -0.345 | -0.348 | -0.476 | -0.107 |
| 56 TAXICABS | -3.882 | -5.950 | -3.733 | -3.181 | -3.571 |
| 57 LOCAL PUBLIC TRANSPORT | -1.283 | -2.437 | -1.944 | -1.258 | -1.208 |
| 58 INTERCITY RAILROAD | 5.902 | 6.027 | 4.107 | 3.602 | 5.099 |
| 59 INTERCITY BUSES | -0.300 | -0.639 | -1.871 | -1.110 | -0.817 |
| 60 AIRLINES | 2.518 | 2.580 | 2.002 | 2.279 | 2.320 |
| 61 TRAVEL AGENTS AND OTHER TRANSPORTATION SERVICES | 3.475 | 3.166 | 2.705 | 2.828 | 3.426 |
| 62 CLEANING, LAUNDERING AND SHOE REPAIR | -0.253 | -0.979 | -0.305 | -0.145 | -0.238 |
| 63 BARBERSHOPS AND BEAUTY SHOPS | 0.696 | 0.522 | 0.877 | 0.923 | 0.832 |
| 64 PHYSICIANS | 0.657 | 0.295 | -0.032 | 0.070 | 0.619 |
| 65 DENTISTS AND OTHER PROFESSIONAL SERVICES | 2.434 | 1.917 | 1.781 | 1.495 | 2.317 |
| 66 PRIVATE HOSPITALS AND SANITARIUMS | 2.629 | 2.452 | 1.314 | 1.758 | 2.361 |
| 67 HEALTH INSURANCE | 0.443 | 0.682 | 0.299 | 0.446 | 0.664 |
| 68 BROKERAGE AND INVESTMENT COUNSELING | 0.692 | 0.893 | 0.452 | 0.487 | 1.017 |
| 69 BANK SERVICES CHARGES AND SERVICES WITHOUT PAYMENT | 1.031 | 0.642 | 0.545 | 0.686 | 1.152 |
| 70 LIFE INSURANCE | 0.561 | 0.485 | 0.116 | 0.537 | 0.728 |
| 71 LEGAL SERVICES | 0.380 | 0.069 | -0.057 | 0.036 | 0.568 |
| 72 FUNERAL EXPENSES AND OTHER PERSONAL BUSINESS | -2.447 | -3.636 | -3.754 | -4.634 | -3.018 |
| 73 RADIO AND TELEVISION REPAIR | -5.499 | -5.181 | -6.286 | -8.444 | -5.339 |
| 74 MOVIES, LEGITIMATE THEATRE, AND SPECTATOR SPORTS | 1.751 | 0.974 | 0.977 | 0.972 | 1.815 |
| 75 OTHER RECREATIONAL SERVICES | 3.061 | 2.670 | 2.589 | 2.454 | 3.153 |
| 76 EDUCATION | 1.924 | 1.289 | 1.092 | 1.014 | 1.553 |
| 77 RELIGIOUS AND WELFARE SERVICES | 1.642 | 0.979 | 0.585 | 1.073 | 1.400 |
| 78 FOREIGN TRAVEL | 0.209 | 0.913 | 2.256 | 1.510 | 1.496 |

## APPENDIX A

## REVIEW OF EMPIRICAL CONSUMPTION FUNCTIONS

The functional forms for the empirical demand systems must be appropriate for both theoretical specification and empirical estimation techniques. We shall not attempt to provide a detailed review of the literature on consumer demand, because many reviews already exist. Among these are "Models of Consumer Behavior: A Survey" by Brown and Deaton[1] and "The Systems of Consumer Demand Functions Approach: A Review" by Barten.[2]

The more recent comprehensive work includes Economics and Consumer Behavior by Deaton and Muellbauer.[3] In "A System of Consumption Functions and its Estimation for Belgium," Almon[4] investigated the shortcomings of the existing demand systems and suggested an improved functional form. The most recent survey, "Theory and Empirical Evidence - A Survey," by Blundell[5] emphasizes on the areas of disaggregate consumer behavior and of dynamic and life-cycle consumer behavior.

The exhaustive French article, "The Interdependent Systems of Consumption

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[1]Brown, J. A. C. and A. S. Deaton (1972), "Models of Consumer Behavior: A Survey," Economic Journal, Vol. 82, pp. 1145-1236.

[2]Barten, A. P. (1977), "The Systems of Consumer Demand Functions Approach: A Review," Econometrica, Vol. 45, pp. 23-51.

[3]Deaton, A. S. and J. Muellbauer (1980b), Economics and Consumer Behavior, Cambridge: Cambridge University Press.

[4]Almon, C. (1979), "A System of Consumption Functions and its Estimation for Belgium," Southern Economic Journal, Vol. 46, pp. 85-106.

[5]Blundell, C. (1988), "Consumer Behavior: Theory and Empirical Evidence - A Survey," Economic Journal, Vol. 98, pp. 16-65.

Functions," by Daniel Gauyacq[6] reviews and summarizes almost all the existing functions of consumer demand, including the "Almost Ideal Demand System" developed by Deaton and Muellbauer.[7] Gauyacq estimated each system of demand functions using the French data. A general conclusion of the study is that only the Almon model is, from a practical point of view, convenient for determination of disaggregated demand functions.

Since the appearance of Almon's article, there is great attention paid to the "Almost Ideal Demand System" model. We shall, based on Almon's criteria, extend the investigation of the functional forms to this demand system and show that it lacks important features of a truly ideal demand system.

Almost Ideal Demand System:

To express this "Almost Ideal" form, let $w_i$ = budget share of good i; y = total expenditure; and $p_i$ = price of good i. The system can then be written as follows:

$$w_i = \alpha_i + \sum_j \gamma_{ij} \log p_j + \beta_i \log(\frac{y}{P}) \qquad \text{(A.1)}$$

where $P$ is price index defined by

$$\log P = \alpha_0 + \sum_k \alpha_k \log p_k + \frac{1}{2}\sum_k \sum_l \gamma_{kl} \log p_k \log p_l \qquad \text{(A.2)}$$

The following constraints on the parameters

$$\sum_k \alpha_k = 1, \ \sum_k \beta_k = 0, \ \sum_k \gamma_{kj} = 0, \ \textit{and} \ \ \gamma_{ij} = \gamma_{ji} \qquad \text{(A.3)}$$

ensure that the model satisfies adding-up, homogeneity, and symmetry.

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[6]Gauyacq, D. (1985), "Les Systemes Interdependants de Fonctions de Consommation," Prevision et Analyse Economique, Vol. 6, No.2.

[7]Deaton, A. S. and J. Muellbauer (1980a), "An Almost Ideal Demand System," American Economic Review, Vol. 70, pp. 312-326.

The first thing to notice is that if any $\beta_k > 0$, then some $\beta_i < 0$. For this i, increasing income with constant prices eventually produces a negative budget share.

Secondly, this system fails Almon's requirement 6, which says that as income increases, the budget shares should depend upon prices. The derivative of the budget share, $w_i$, with respect to income, (log y), is

$$\frac{\partial w_i}{\partial \log y} = \beta_i \tag{A.4}$$

Clearly, the parameter $\beta_i$ does not depend upon price. Alternatively, we may write the marginal propensity to consume good i out of real income, $(y/P)$, as follows:

$$\frac{\partial q_i}{\partial (\frac{y}{P})} = \beta_i (\frac{P}{p_i}) \tag{A.5}$$

Thus, this MPC is assumed to have an elasticity of -1.0 with respect to $p_i$, neglecting the effect of $p_i$ on $P$. It is obvious that this system fails the second half of Almon's requirement 7, which desires the effects of prices on the marginal propensities to consume as income increases.

## APPENDIX B

## THE DEFINITIONS OF THE REGIONS

The geographic regions in the Consumer Expenditure Survey 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. |

# APPENDIX C

## THE TOBIT ANALYSIS MODEL

Tobit analysis is formulated for the censored regression to provide consistent estimators. The model incorporates probit analysis, a binary choice model, for the limited dependent variables. In this appendix, we shall introduce the model and the estimation schemes for both the tobit and the probit analyses.

The tobit model can be defined as follows:

$$\begin{aligned} y_i &= x_i\beta + u_i \quad \textit{if} \;\; y_i > 0 \\ &= 0 \qquad\qquad \textit{otherwise} \end{aligned} \tag{C.1}$$

where $x_i$ is a vector of independent variables, $y_i$ is the dependent variable, $\beta$ is a vector of coefficients, and $u_i$, the disturbance term, is independently normally distributed with zero mean and constant variance $\sigma^2$.

The probability that $y_i > 0$ given observations on $x_i$ is[1]

$$Prob(y_i>0 \mid x_i\beta) = F(\frac{x_i\beta}{\sigma}) \qquad \textit{for all } i \tag{C.2}$$

where F(.) is the cumulative density function of standard normal distribution.

The expected value of $y_i$ for $y_i > 0$ is[2]

$$E(y_i \mid y_i>0) = x_i\beta + \frac{\sigma f(z)}{F(z)} \tag{C.3}$$

where $z = x_i\beta/\sigma$ and f(z) is the unit normal density function, the derivative of F(z).

Using Equations (C.2) and (C.3), the expected value of $y_i$ is

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[1]James Tobin, "Estimation of Relationships for Limited Dependent Variables," Econometrica 26 (Jan. 1958) : 24-36.

[2]Takeshi Amemiya, "Regression Analysis When the Dependent Variable is Truncated Normal," Econometrica 41 (Nov. 1973) : 997-1016.

$$E(y_t) = E(y_t \mid y_t>0)F(z) = F(z)x_t\beta + \sigma f(z) \qquad \textit{for all } t \qquad (C.4)$$

In Equation (C.3), it is obvious that the biasedness of estimating limited dependent variables by using the least squares method results from the second term of the right-hand side in (C.3), $\sigma f(z)/F(z)$. Thus, the goal of the Tobit analysis is to provide the consistent estimators of $\beta$ and $\sigma$ by adjusting the estimated bias.

Although the tobit coefficient $\beta$ is a consistent estimator, it is not the marginal effect of $x_i$ on $y_i$, $y_i > 0$. The partial derivative of the expected value of $y_i$ being above zero with respect to the explanatory variable $x_j$, or the "conditional" marginal propensity to consume, is[3]

$$\frac{\partial E(y \mid y>0)}{\partial x_j} = \beta_j\left[1 - \frac{zf(z)}{F(z)} - \frac{f(z)^2}{F(z)^2}\right] \qquad (C.5)$$

And the marginal propensity to consume is

$$\frac{\partial E(y)}{\partial x_j} = F(z)\beta_j \qquad \textit{for all } t \qquad (C.6)$$

We shall now introduce one of the estimation techniques for the tobit model. The estimation procedure for the tobit model can be done by the two-step estimation scheme (Heckman, 1976). The first step proposed by Heckman is to estimate a probit model. In general, probit analysis is appropriate when data on the dependent variable is measured by an all or nothing response. It estimates the probability of a response to the explanatory variables. The probit analysis model can be described by a regression relationship, Equation (C.1),

[3]John F. McDonald and Robert A. Moffitt, "The Uses of Tobit Analysis," The Review of Economics and Statistics LXII no. 2, (May 1980) : 318-321.

$$y_t = x_t\beta + u_t \quad \text{if } y_t > 0$$
$$= 0 \qquad \text{otherwise}$$

and a dummy variable I defined by

$$I = 1 \quad \text{if } y_t > 0$$
$$= 0 \quad \text{otherwise} \tag{C.7}$$

The estimation of the probit model is to maximize the likelihood function

$$L = \prod_{I=0} F(-x_t\beta) \prod_{I=1} [1 - F(-x_t\beta)] \tag{C.8}$$

$$\text{where } F(-x_t\beta) = \frac{1}{\sqrt{2\pi}} \int_{-\infty}^{-\frac{x_t\beta}{\sigma}} e^{-\frac{t^2}{2}}\, dt$$

Since the objective function of the probit model is a nonlinear form, the Newton-Raphson iterative procedure has to be used. This iterative procedure for maximizing a nonlinear objective function leads to the recursive relation

$$\beta^{n+1} = \beta^n - \left[\frac{\partial^2 \ln L}{\partial\beta\, \partial\beta'}\Big|_{\beta=\beta^n}\right]^{-1} \left[\frac{\partial \ln L}{\partial\beta}\Big|_{\beta=\beta^n}\right] \tag{C.9}$$

where $\beta^n$ is the estimate at the $n^{th}$ iteration, and the matrix of second partials and the gradient vector are evaluated at $\beta^n$.

In this step, the model provides a consistent estimator of $\beta/\sigma$, which is then used to create the consistent estimators of f(z) and F(z). f(z) can be calculated directly from the normal distribution function. F(z) can be computed by the polynomial interpolation based on the values of statistical tables.

The second step of estimating the tobit model is to include the estimated values of $f(z)$ and $F(z)$ in Equation (C.3) and then to estimate the model by the least squares method. By doing this, the consistent estimators of $\beta$ and $\sigma$ can be easily obtained.

## APPENDIX D

## THE SLUTSKY SYMMETRY FOR MARKET DEMAND

The Slutsky symmetry has been included as one of the major properties for most demand functions. In this appendix, however, we will show that this symmetry is not necessary for market demand, because the Slutsky symmetry for market demand cannot be derived from the individuals' Slutsky equation.

We shall first derive the symmetry for the individual's demand function. An individual consumer maximizes his utility subject to the budget constraint. This can be expressed as follows:

$$\max u^k(q^k) \quad \textit{subject to} \quad \sum_{i=1}^{M} p_i q_i = y^k \tag{D.1}$$

where $u^k$ is the utility function for consumer k; $q_k = q_k(q_1, q_2, ...., q_M)$; $q_i$ is the consumer k's demand for good i; $p_i$ is the price of $q_i$; and $y^k$ is the consumer k's income. In the following equations of the individual consumer behavior, we shall omit the superscript k for the convenience of notation.

The Lagrange form for this maximization problem can be written as

$$L = u(q) + \lambda[\sum_i p_i q_i - y] \tag{D.2}$$

where $\lambda$ is an undetermined multiplier.

The first-order conditions for Equation (D.2) are

$$\frac{\partial L}{\partial q_i} = u_i(q) - \lambda p_i = 0 \qquad i = 1, ....,M \tag{D.3}$$

and

$$\frac{\partial L}{\partial \lambda} = \sum_{i} p_i q_i - y = 0 \qquad \text{(D.4)}$$

where $u_i = \dfrac{\partial u}{\partial q_i}$

Suppose that we are only interested in the effect of the changes in the price of good j on the demand of good i, and we assume that all the prices except $p_j$ and income will remain unchanged. Then, the partial derivative of the first-order equations with respect to $p_j$ are of the following forms:

$$\sum_{r=1}^{M} u_{ir}\frac{\partial q_r}{\partial p_j} - p_i\frac{\partial \lambda}{\partial p_j} = \begin{pmatrix} 0 \\ \cdot \\ \cdot \\ 0 \\ \lambda \\ 0 \\ \cdot \\ \cdot \\ 0 \end{pmatrix} \qquad i = 1,\ldots,M \qquad \text{(D.5)}$$

and

$$\sum_{i=1}^{M} p_i\frac{\partial q_i}{\partial p_j} + q_j = 0 \qquad \text{(D.6)}$$

where $u_{ir} = \dfrac{\partial u_i}{\partial q_r}$

Equations (D.5) and (D.6) can be written in the matrix form as follows:

$$\begin{pmatrix} u_{ir} & -P \\ -P' & 0 \end{pmatrix} \begin{pmatrix} \dfrac{\partial q_i}{\partial p_j} \\ \dfrac{\partial \lambda}{\partial p_j} \end{pmatrix} = \begin{pmatrix} 0 \\ . \\ 0 \\ \lambda \\ 0 \\ . \\ 0 \\ -q_j \end{pmatrix} \qquad i=1,\dots,M,\ r=1,\dots,M \tag{D.7}$$

Solving for Equation (D.7) gives

$$\frac{\partial q_i}{\partial p_j} = \lambda s_{ij} + s_{i,m+1} q_j, \qquad i=1,\dots,M \tag{D.8}$$

and

$$\frac{\partial q_i}{\partial y} = -s_{i,m+1} \tag{D.9}$$

where $s_{ij}$ is the element (i,j) of the inverse of the matrix on the left-hand side of Equation (D.7).

Thus, the Slutsky symmetry for the individual can be written as follows:

$$\lambda s_{ij} = \frac{\partial q_i}{\partial p_j} + q_j \frac{\partial q_i}{\partial y} = \frac{\partial q_j}{\partial p_i} + q_i \frac{\partial q_j}{\partial y} = \lambda s_{ji} \tag{D.10}$$

since $s_{ij} = s_{ji}$.

We now turn to the symmetry for market demand. The symmetry of market demand means

$$\frac{\partial Q_i}{\partial p_j} + Q_j \frac{\partial Q_i}{\partial y} = \frac{\partial Q_j}{\partial p_i} + Q_i \frac{\partial Q_j}{\partial y} \tag{D.11}$$

where $Q_i = \sum_{k=1}^{N} (q_i)_k$ *and* $Q_j = \sum_{k=1}^{N} (q_j)_k$ are the market demand for good i and j.

We shall now show that Equation (D.11) cannot be derived from the individuals' Slutsky symmetry equation unless some specific assumptions are made. We first repeat the individual's symmetry equation as follows:

$$\frac{\partial q_i}{\partial p_j} + q_j\frac{\partial q_i}{\partial y} = \frac{\partial q_j}{\partial p_i} + q_i\frac{\partial q_j}{\partial y} \tag{D.12}$$

We then take the sum of the above equation over all the individuals k = 1,....,N,

$$\sum_{k=1}^{N}(\frac{\partial q_i}{\partial p_j} + q_j\frac{\partial q_i}{\partial y})_k = \sum_{k=1}^{N}(\frac{\partial q_j}{\partial p_i} + q_i\frac{\partial q_j}{\partial y})_k \tag{D.13}$$

Equation (D.13) can be written as

$$\sum_{k=1}^{N}(\frac{\partial q_i}{\partial p_j})_k + \sum_{k=1}^{N}(q_j\frac{\partial q_i}{\partial y})_k = \sum_{k=1}^{N}(\frac{\partial q_j}{\partial p_i})_k + \sum_{k=1}^{N}(q_i\frac{\partial q_j}{\partial y})_k \tag{D.14}$$

or

$$\frac{\partial Q_i}{\partial p_j} + \sum_{k=1}^{N}(q_j\frac{\partial q_i}{\partial y})_k = \frac{\partial Q_j}{\partial p_i} + \sum_{k=1}^{N}(q_i\frac{\partial q_j}{\partial y})_k \tag{D.15}$$

Equation (D.11) cannot be derived from (D.15), because it is obvious that the second term of the left-hand side of (D.15)

$$\sum_{k=1}^{N}(q_j\frac{\partial q_i}{\partial y})_k \neq \sum_{k=1}^{N}(q_j)_k \ \sum_{k=1}^{N}(\frac{\partial q_i}{\partial y})_k = Q_j\frac{\partial Q_i}{\partial y} \tag{D.16}$$

unless $(q_j)_k$ or $(\frac{\partial q_i}{\partial y})_k$ is constant.

This relationship also holds for the second term of the right-hand side of (D.15).

In Equation (D.16), if $( q_j )_k$ is constant, then $(q_j)_k = Q_j/n$, k = 1,....,N. That is, all individuals have the same amount spent on good j. On the other hand, if $(\partial q_i / \partial y)_k$ is constant, then all individuals have the same shape of Engel curve for good i. Since these two assumptions are clearly inappropriate, the Slutsky symmetry, in general, does not hold for market demand.

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