CONSUMPTION, INCOME DISTRIBUTION AND AGE STRUCTURE: AN EMPIRICAL STUDY OF THE UNITED STATES

Ekrem DÖNEK*, Ruzita Mohd. AMIN** and J. Randy NORSWORTHY***

1. INTRODUCTION

Consumption expenditure is an important macroeconomic variable, comprising more than 60 percent of Gross National Product (GNP) of the United States, while in some other countries, it constitutes a much larger share, up to about 80 - 90 percent. Because of its significance in the economy, a favorable long-term model of GNP should represent consumption in terms of the underlying factors that affect consumption behavior. The income distribution and age structure are often omitted from the consumption model.

In this paper, we examine in particular, the evidence from cross-section household data for the U.S. to assess the effects of the income distribution and the age structure of the population on consumption expenditures. We divide consumption expenditures into its three major components: durable and nondurable goods and services. The immediate objective of the study is to test the hypotheses concerning the effects of these factors - the income and age distributions - on expenditure patterns as represented by the shares of these three categories in the total consumption expenditure. The longer term goal, toward which this paper is an initial step, is to respecify consumption for long-term macroeconomic modeling so as to include the effects of income and age. A further difference from the conventional macroeconomic modeling in our approach is the explicit simultaneous estimation of the consumption equation. This procedure allows us to take account the interdependence of different types of consumption as it is demonstrated in time series studies of consumption, by, for example, Christensen and Manser (1977).

In section two of the paper, we review the literature concerning the consumption function and the effects of income and age. Section three of this paper describes the model specification of the translog function beginning from the direct and indirect utility functions. Section four describes the variables that are used in the model and the data sources. Section V presents and discusses the estimation results. Section five presents our conclusions.

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* Erciyes University, Faculty of Economics and Administrative Sciences Department of Economics, Kayseri, Turkey.

** International Islamic University, Department of Economics, Kuala Lumpur, Malaysia.

*** Rensselaer Polytechnic Institute, Department of Economics and School of Management, Troy, NY, U.S.A.

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2. CONSUMPTION, INCOME AND AGE IN THE MACROECONOMY

In 1936, Keynes proposed the idea of the consumption function being the basic element of "effective demand" which determines national income. This income-expenditure approach has, henceforth, become the theoretical macroeconomic textbook tradition after the World War II. In this analysis, the consumption function is simply assumed to be a function of income as follows:

$$c = c(y) = a + by \qquad (1)$$

where c is the real consumption, y the real income, and $0<b<1$ the marginal propensity to consume. This simple form of the function indicates that as income increases, consumption expenditures increase but not as much as the increase in income.

Consumption expenditures have been shown to respond to changes in the distribution of income (Cutler and Katz (1992)). With increasing family income inequality in the United States in recent years, the study on the determinants of consumption behavior has also become a major concern (Cutler and Katz (1992)).

The Life-Cycle Hypothesis of Ando and Modigliani (1963) and Modigliani and Brumberg (1955) introduces the idea of optimizing utility over an individual's entire lifetime, rather than over a short period of time (Houthakker (1987)). According to this hypothesis, the typical individual has an income stream which is relatively low at the beginning and at the end of his life, but high during the middle of his life span. In other words, in the early years of the individual's life, he is a "net borrower"; in the middle years, he "saves" to repay the earlier debts and provide for retirement; while in the later years, he "dissaves" (Branson (1976)). The present value of his total consumption does not exceed the present value of his total lifetime sources (lifetime consumption equals lifetime income). So, the age structure of the population is also an important determinant of consumption expenditures in this context.

The Life-Cycle hypothesis thus influences the Engel Curve as well (Houthakker (1987)), which relates consumption expenditures to levels of income. Therefore, the income distribution of a given population is another important determinant of consumption expenditures.

Friedman's Permanent Income Hypothesis (1957) also begins with the assumption of utility maximization of rational consumers, but differs from the others by distinguishing "both current income and current consumption into a permanent and transitory components" (Houthakker (1987)).

Disaggregation is a useful way to better understand the variables determining the consumption function. The analysis will be more satisfactory since the effects of important variables on the different components, e.g. the effects of changes in the interest rate can be examined. In this connection, the Wharton model (McCarthy (1972)), disaggregates the consumption function into the consumption of automobiles, the consumption of durables excluding the automobiles and a combined consumption function for nondurables and services in the earlier version of the model. In the later version, the model was modified by further disaggregating the third equation into consumption expenditures of nondurables and services. Transfer and nontransfer incomes are also treated separately in specifying the consumption function.

Fair (1984) disaggregates consumption into three components: Consumption of durable goods, consumption of nondurable goods, and consumption of services.

In this paper, a similar disaggregated consumption model is used in the analysis for durables, nondurables and services. However, in contrast to Fair's model, the disaggregated consumption model is estimated simultaneously employing the transcendental logarithmic (translog) indirect utility function. The formal hypothesis tested is that income distribution and age structure do not have substantial effects on the consumption of durables, nondurables and services. Wealth effects and savings are excluded from the model, and income after tax is used in place of wages. The relationship between consumption expenditure and income distribution and age structure is analyzed, while at the same time seeking to verify some of the implications of the Life-Cycle and Permanent Income hypotheses using a cross-section data.

Our prior expectations are that the model should show higher consumption expenditure on durables for those in higher income groups and those in the younger age groups. The economic sense of this expectation is that those in higher income groups have a higher residual income to be spent on durables after providing for their basic necessities, as compared to those in the lower income groups. In comparison to younger people, the older people will have a lower tendency to purchase these goods as they approach the end of their life span, due to the fact that durables expenditures are a kind of investment. It might also be expected on similar grounds that interest rate should have a negative effect on the expenditures of durables.

3. THE MODEL

The discussion in this section follows very closely that of Christensen and Manser (1975). As in Christensen, Jorgensen and Lau (1972), they have also chosen the transcendental logarithmic (translog) function to represent consumer preferences with no a priori restrictions of homotheticity or additivity. However, these two conditions can still be satisfied by imposing linear restrictions on the parameters of the translog function. Under these conditions, it becomes possible to apply the statistical tests to check the validity. The translog function can be used to represent consumer preferences either through a direct or indirect utility function. In this study, the indirect utility function is used as the most general representation of consumer behavior.

A direct utility function, together with the necessary conditions for utility maximization, imply the existence of an indirect utility function (V) defined on total expenditure and the prices of all goods. This indirect utility function is homogeneous to degree zero and can be expressed as a function of the ratio of prices of all commodities to total expenditure, such as the one that follows:

$$\ln V = G (\ln P_1^*, ..., \ln P_n^*) \qquad (3)$$

where $P_\alpha^* = P_\alpha/E$ are the normalized prices, and E is the total expenditure on all goods, $\Sigma_\alpha p_\alpha C_\alpha$.

The indirect translog utility function is used in this paper since it is more convenient for estimating true cost-of-living indexes. The function can be written in general logarithmic form as :

$$- \ln V = \Sigma_\alpha a_\alpha \ln P_\alpha^* + 1/2 \Sigma_\alpha \Sigma_\beta b_{\alpha\beta} \ln P_\alpha^* \ln P_\beta^*, \text{ where } b_{\alpha\beta} = b_{\beta\alpha} \qquad (4)$$

Since the disaggregated consumption model is used in this study and a few additional variables are included to find out their effects on the consumption of durables, nondurables

and services (α, β), the translog function can be written as:

$$\ln E = a_0 + \Sigma_\alpha b_\alpha \ln P_\alpha + 1/2\, \Sigma_\alpha \Sigma_\beta b_{\alpha\beta} \ln P_\alpha \ln P_\beta + b_y \ln Y + \Sigma_\alpha b_{\alpha y} \ln P_\alpha \ln Y + 1/2\, b_{yy} \ln^2 Y + b_r \ln r + \Sigma_\alpha b_{\alpha r} \ln P_\alpha \ln r + 1/2\, b_{rr} \ln^2 r + \Sigma_k c_k \ln K + 1/2\, \Sigma_k \Sigma_l c_{kl} \ln K \ln L + \Sigma_\alpha \Sigma_k c_{\alpha k} \ln P_\alpha \ln K + \Sigma_k c_{ky} \ln K \ln Y + \Sigma_k c_{kr} \ln K \ln r \qquad (5)$$

where a_0, b_y, $b_{y\,y}$, b_r, b_{rr} are scalars, b_α, $b_{\alpha y}$, $b_{\alpha r}$, c_k, $c_{\alpha k}$, c_{ky}, c_{kr} are vectors of coefficients, and $b_{\alpha\beta}$ and c_{kl} are matrices of coefficients. K and L are the other factors that affect expenditure, and in this model they consist of the age and income distributions of consumers.

A set of budget share equations associated with the translog expenditure function is implied by the duality theory. Employing Roy's identity, the translog function is partially differentiated with respect to the price of each good to obtain the following budget share equations corresponding to the translog function:

$$\frac{\partial \ln E}{\partial \ln P_\alpha} = \frac{\partial E}{\partial P_\alpha} \cdot \frac{P_\alpha}{E} = \frac{P_\alpha C_\alpha}{E} = S_\alpha \qquad (6)$$

$$\text{where} \quad S_\alpha = b_\alpha + \Sigma_\beta b_{\alpha\beta} \ln P_\beta + b_{\alpha y} \ln Y + b_{\alpha r} \ln r + \Sigma_k c_{\alpha k} \ln K \qquad (7)$$

$$\text{and} \quad \sum_{\alpha=1}^{n} P_\alpha C_\alpha = E; \quad C_\alpha \text{ is in real terms.} \qquad (8)$$

From the definitions in equations (2) and (4), follows the expression which is also called the "adding-up" condition: $\sum_{\alpha=1}^{n} S_\alpha = 1$. Each of the right-hand-side variables is normalized around the sample mean (i.e. each variable is divided by its sample mean), in such a manner that its average value equals 1.

The symmetry condition must hold for the translog function (equality of the cross derivatives):

$$b_{\alpha\beta} = b_{\beta\alpha} \qquad \text{for all } \alpha, \beta, \ \alpha \neq \beta.$$

In order for the equations to be well-behaved, the budget share equations are also subject to the following restrictions:

(i) Linear homogeneity in prices: When prices of all goods double, the total expenditure for a fixed basket of goods must double, and this implies:

$$\Sigma_\alpha b_\alpha = 1; \ \Sigma_\alpha b_{\alpha\beta} = \Sigma_\beta b_{\beta\alpha} = \Sigma_\alpha b_{\alpha y} = \Sigma_\alpha b_{\alpha r} = \Sigma_\alpha c_{\alpha k} = 0 \qquad \text{for all } \alpha, \beta;$$

(ii) Monotonicity: The function must be a decreasing function of the prices of goods, implying: $\frac{\partial \ln E}{\partial \ln P_\alpha} \leq 0$;

(iii) Concavity in prices: This implies that the matrix $\left[\frac{\partial^2 E}{\partial P_\alpha \partial P_\beta}\right]$ must be negative semidefinite within the range of prices.

The restricted budget share equations implied by the indirect linear logarithmic utility function are identical to those obtained by maximizing the direct linear logarithmic function,

$$\ln U = Sa\ aa \ln ca \qquad (9)$$

subject to the budget constraint. Since the relationship between consumption expenditure and income and age structure examined here is in terms of the distributions of these variables, income and age are represented in the model by dummy variables. The income levels are classified into seven income groups (Y) while the age into three age groups (A) as follows:

Table 1: Income and Age Group Classification

Dummy Variable	Group	Income / Age Range
d_1	Y_5	\$0 £ Y < \$5,000
d_2	Y_{10}	\$5,000 £ Y < \$10,000
d_3	Y_{15}	\$10,000 £ Y < \$15,000
d_4	Y_{20}	\$15,000 £ Y < \$20,000
d_5	Y_{30}	\$20,000 £ Y < \$30,000
d_6	Y_{40}	\$30,000 £ Y < \$40,000
$d_{base(Y)}$	Y_{base}	Y ≥ \$40,000
-	A_{18}	0 < A £18
$d_{base(A)}$	A_{base}	18 < A £ 64
d_7	A_{65}	A > 64

Note: Y and A denote income and age respectively.

Individual consumers below or equal to the age of 18 are excluded from the model since they are not really income earners, and therefore considered irrelevant to the study. Only six of the seven income dummy variables (d_1, ..., d_6), and one of the two age dummy variables (d_7) are included in the equations, transforming the expenditure-share equations into the form:

$$P_\alpha C_\alpha, E) = S_\alpha = D_i [b_\alpha + \Sigma_\beta\ b_{\alpha\beta} \ln P_\beta + b_{\alpha r} \ln r\ ], \quad \text{where } i = 1, ..., 7 \qquad (10)$$

(Notice that the variables Y and K no longer appear in equation (5) since the income and age distributions have been represented by the income and age dummy variables, D_i.)

Rather than estimating two of the three share equations, as is normally done in studies using translog specification, this study estimates the demand equations.[1] These demand equations are derived from the share equations by multiplying each right-hand-side variable in each of the equations by the ratio,

$$\frac{E}{P_\alpha}.$$[2]

Consumption expenditures, C_α, on each good is in real terms. Therefore, defining $T_\alpha = \frac{E}{P_\alpha}$, the share equations (5) are transformed into demand equations of the form:

$$C_\alpha = T_\alpha \cdot D_i \cdot [b_\alpha + \Sigma_\beta\, b_{\alpha\beta} \ln P_\beta + b_{\alpha r} \ln r\,], \quad \text{where } i = 1, \ldots, 7 \qquad (11)$$

To estimate the unknown parameters of the demand equations, the iterative-Zellner (1963) estimation procedure, which is usually called the iterative Seemingly Unrelated Regression Equations (ISUR) estimation, is employed. This procedure has been used by Berndt and Christensen (1973) for the homothetic version of the translog model which is linear in its parameters.

Unlike the case with the share equations, all three demand equations are estimated simultaneously. However, the same restrictions still apply to the model, and all the shift coefficients of the price of durables for the different income and age groups in the three equations are dropped depending on the homogeneity restrictions. The R^2 for the nondurables equation is found to be very low, and there are some problems in obtaining concavity in prices. An attempt was made to overcome these problems by restricting b_{dd} and b_{ss} to be one-half of the share of durables and services respectively. The R^2 for nondurables was still very low as will be shown in section V of this paper, but the overall concavity problem was resolved.

The estimates of the b_{ab} coefficients can be converted into point estimates of Allen Partial Elasticities of Substitution ($\sigma_{\alpha\beta}$) and of Price Elasticities and Cross Price Elasticities of Demand ($\xi_{\alpha\beta}$), as given by Berndt (1991):

$$\sigma_{\alpha\beta} = \frac{b_{\alpha\beta} + S_\alpha S_\beta}{S_\alpha S_\beta}, \qquad \text{for all } \alpha \neq \beta \qquad (12)$$

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1. See Norsworthy and Jang (1992) for a detailed argument for this approach in the context of production modeling.
2. This can be shown as follows: We have defined earlier that $\frac{P_\alpha C_\alpha}{E} = S_\alpha$, therefore $C_\alpha = S_\alpha \cdot \frac{E}{P_\alpha}$. The C_α are stochastically independent.

$$\sigma_{\alpha\alpha} = \frac{b_{\alpha\alpha} + S_\alpha^2 S_\alpha}{S_\alpha^2}, \qquad \text{for all } \alpha \tag{13}$$

$$\xi_{\alpha\beta} = \frac{b_{\alpha\beta} + S_\alpha S_\beta}{S_\alpha}, \qquad \text{for all } \alpha \neq \beta \tag{14}$$

$$\xi_{\alpha\alpha} = \frac{b_{\alpha\alpha} + S_\alpha^2 S_\alpha}{S_\alpha}, \qquad \text{for all } \alpha \tag{15}$$

The parameter estimates and fitted shares are used in computing estimates of $\sigma_{\alpha\beta}$ and $\varepsilon_{\alpha\beta}$. The $b_{\alpha\beta}$ coefficients have little direct intuitive meaning, except that their signs indicate substitution (+) or complementarity (-) for the pair of goods. It is easier to assess their impacts through their implications for cross elasticities of substitution.

4. DATA

The estimation in this study is made on a cross-sectional basis using completely disaggregated household data for the four quarters of 1988. This particular year is chosen due to the fact that it is the year relatively unaffected by the economic recession of the late 1980's. The sample data set used in the estimation is obtained from a detailed Consumer Expenditure Survey (CES), Interview Survey 1988, conducted by the U.S. Department of Labor, Bureau of Labor Statistics (BLS) for detailed expenditure, income and age data of the consumer units, while the data for prices and long-term interest rates are obtained from various issues of the Survey of Current Business and the Federal Reserve Bulletin respectively.

The CES program provides a continuous and comprehensive flow of data on the buying habits of American consumers, and these data are extensively used in various economic research and analysis programs. Their most prominent use is in the periodic updating of the weights in the Consumer Price Index. This study uses the Quarterly Interview panel survey of the CES in which each consumer unit[3] in the sample is interviewed every three months over five consecutive quarters. The panel survey is designed to collect data on major items of expense, household characteristics and income. While for the initial interview information is collected on demographic and family characteristics and on the inventory of major durable goods of each consumer unit, uniform questionnaires are used in the second through the fifth interviews to collect information about the expenditures in each quarter. Each observation was treated independently. We did not link successive observations for household units into a time structure.

The population of interest is the total U.S. civilian population so that the eligible population is composed of all civilian noninstitutionalized persons and all those residing in housing facilities. In addition, the interview survey is a rotating panel survey where in each quarter one-fifth of the units interviewed are new to the survey.

A total of 500 observations were initially selected randomly for our study from the panel data. The income data used in the analysis is based on income after tax of consumer

3. The Consumer Unit consists of all members of a particular housing unit or other type of living quarters who are related.

units, and the income groups are then categorized in the same way as adopted by the BLS. These income groups are the dummy variables $d_1, ..., d_6$, as described in the previous section, with the omitted base income dummy, $Y \geq \$40000$. The age groups are divided into three large categories: A_{18}, A_{65} and the base age group ($18< A \pounds 64$). As mentioned in the previous section, the group A_{18} is dropped from the analysis since it comprises of college students who do not earn their own income. After this deletion, the total sample data contained 498 observations, which further indicates that the exclusion of A_{18} has no substantial effect on the analysis since the total sample data is hardly affected.

Detailed consumption categories were aggregated to the levels of durable, nondurable and services. The data for durables, nondurables and services are obtained from the CES, and each of their components is described in the Table 2 as follows:

Table 2: Components of Durables, Nondurables and Services

DURABLES	NONDURABLES	SERVICES
Household furnishings and equipment; Vehicle purchases; Reading.	Food; Alcoholic beverages; Housekeeping supplies; Apparel and related services; Personal care products and services; Tobacco products and smoking supplies.	Food away from home; Shelter; Household operations; Utilities, fuels and public services; Gasoline and motor oil; Other vehicle expenses; Health care; Entertainment; Education; Miscellaneous; Cash contributions; Personal insurance and pensions.

The prices for durables, nondurables and services (P_D, P_N and P_S) are consumer price indexes of these goods obtained for each quarter from various issues of the Survey of Current Business. Long-term interest rates are used as a proxy for the rate of interest on consumer loans, and the quarterly data for these is obtained from various issues of the Federal Reserve Bulletin.

5. ESTIMATION RESULTS

The goodness-of-fit statistics (R^2) for the durables, nondurables and services equations are:

$$R_D^2 = 0.6283,\ R_N^2 = 0.2505 \text{ and } R_S^2 = 0.5367,$$

respectively.

As mentioned earlier, there were still some problems with the nondurables equation in terms of its goodness-of-fit (R^2_N was too low) even after imposing some corrective measures, but two out of the three equations gave a reasonably good fit for a cross-section estimation.

The results of the estimation are tabulated in Table 3 as follows (the income groups are in thousand US$):

Table 3: Estimation Results for Durables, Nondurables and Services Equations.

Coefficient	40 Y, 18<Age 64	0 Y<5	5 Y<10	10 Y<15	15 Y<20	20 Y<30	30 Y<40	64<Age
bd	0.3224 [16.209]	-0.1315 [-1.144]	-0.2655 [-2.652]	-0.2177 [-2.589]	-0.1416 [-2.194]	-0.1366 [-2.924]	0.0846 [1.987]	-0.0417 [-0.816]
bdd	0.1612 [16.269]	–	–	–	–	–	–	–
bdn	5.9075 [4.467]	-114.7259 [-2.330]	-8.7183 [0.182]	-2.4746 [-0.069]	52.608 [1.915]	-91.1193 [-4.595]	-87.4367 [-5.001]	-2.0281 [-0.081]
bds	-5.0046 [-4.504]	109.7857 [1.903]	7.7326 [0.153]	-6.5203 [-0.178]	-73.4544 [-2.629]	90.2009 [4.154]	93.6198 [4.661]	18.3131 [0.663]
bdr	-3.2443 [-4.233]	21.4793 [3.254]	2.4122 [0.306]	6.8015 [1.158]	6.7309 [1.497]	14.2366 [4.678]	7.1344 [2.345]	-2.285 [-0.663]
bn	0.187 [23.023]	0.061 [1.081]	0.108 [4.095]	0.0066 [2.797]	0.0052 [2.060]	0.0072 [3.511]	0.0133 [0.763]	-0.0184 [-0.875]
bnd	5.9075 [4.467]	–	–	–	–	–	–	–
bnn	-11.7308 [-4.436]	47.3996 [2.341]	13.3578 [0.678]	16.5808 [1.119]	-17.8064 [-1.574]	22.7488 [2.757]	33.4852 [4.588]	-7.43 [-0.723]
bns	5.8233 [4.402]	-43.0106 [-1.841]	-5.7221 [-0.276]	-12.3006 [-0.822]	25.0566 [2.179]	-23.725 [-2.652]	-35.3322 [-4.206]	3.8703 [0.342]
bnr	3.0726 [5.778]	-9.2344 [-3.384]	-4.4688 [-1.509]	-4.151 [-1.706]	-2.7843 [-1.481]	-3.3857 [-2.732]	-2.7793 [-2.670]	0.7317 [0.517]
bs	0.4363 [32.023]	0.0805 [0.909]	0.0975 [1.258]	0.1212 [1.864]	0.0864 [1.730]	0.0094 [1.900]	-0.008 [-2.974]	0.0001 [1.518]
bsd	-5.0046 [-4.588]	–	–	–	–	–	–	–
bsn	5.8233 [4.402]	-67.3364 [-1.769]	-4.6306 [-0.125]	-14.1002 [-0.508]	-34.7215 [-1.636]	68.3705 [4.468]	53.9515 [4.004]	9.4581 [0.483]
bss	0.2453 [32.023]	-66.7561 [-1.517]	-2.0104 [-0.052]	18.9139 [0.667]	48.3978 [2.242]	-66.4756 [-3.965]	-58.2876 [-3.761]	-22.1834 [-1.039]
bsr	-0.4283 [-0.582]	-12.2448 [-2.399]	2.0567 [0.371]	-2.6506 [-0.583]	-3.9666 [-1.136]	-10.8509 [-4.790]	-4.3551 [-2.314]	1.5532 [0.583]

$R^2_D = 0.6283$; $R^2_N = 0.2505$; $R^2_S = 0.5367$

Note: Y, d, n, s denote income, durables, nondurables and services respectively.

For the durables, all the basic coefficients (for Y≥$40,000 and 18<Age£64) are highly significant.[4] For the estimated share, b_d, the shift coefficients for all income groups are significant except for the lowest income group ($0£Y<$5,000). The income groups between $5,000 and $30,000 show changes in the negative direction indicating a lower share of expenditure on durables relative to the base group, while the income group, $30,000£Y<$40,000, shows a change in the positive direction, indicating a relatively higher share of expenditure on durables. If we consider the groups with incomes lower than $30,000 as the low income group, these with incomes between $30,000 and $40,000 as the middle income group and those with incomes over $40,000 as the high income group, we can conclude that individuals with low income spend less on durable goods, while individuals in the middle and high income group spend more on these goods. This is consistent with our prior expectation that those in the higher income group would have a higher residual income to spend on durables after providing for their basic necessities.

Individuals in the base age group (18<Age£64) have a very significant expenditure on durables (t =16.269), while those over the age of 64 do not show a significantly different expenditure behaviour on these goods (t = -0.816). The direction, however, is negative, and can be used as an indication that those in the younger age group, rather the older age group, have a higher tendency to spend on durable goods which can be considered as a kind of investment good. This finding is consistent with our earlier expectation.

The coefficient, b_{dd}, is highly significant (t =16.269) with a positive value (0.1612). However, the shift coefficients for the different income and age groups were dropped from the equation depending on the homogeneity restrictions.

The coefficient, b_{dn} (and b_{nd}, for nondurables, due to the symmetry restriction), is also positive (5.9075) and significant (t = 4.467), indicating a price-related substitution. The income groups between $5,000 and $15,000 do not suggest a significant shift of the coefficient while the shift coefficient for the rest of the income groups are all significant with a negative direction for $0£Y<$5,000, positive for $15,000£Y<$20,000, and negative again for income between $20,000 and $30,000. For the base age group, b_{dn} is significant with a positive value while for the group above 64, the shift coefficient is not significant.

The coefficient b_{ds} (and b_{sd}, for services), is negative (-6.0686) and significant (t = -4.588) for the base income and age group, indicating complementarity between durables and services. Shifts for the income groups between $5,000 and $15,000 are not significant, while the rest of the income groups are significant in a positive direction for $0£Y<$5,000 (less complementarity), negative for $15,000£Y<$20,000 (greater complementarity) and positive again for the income groups between $20,000 and $40,000. For the age group above 64, the coefficient is again insignificant. It is interesting to note that all the significant coefficients for b_{ds} are opposite in sign from the significant coefficients of b_{dn}.

That the coefficient, b_{dr}, is negative and significant, is consistent with our earlier expectation that interest rates should have a negative effect on durables expenditure. For the income groups between $5,000 to $20,000, the shift is not significant. For the other income groups, all are significant with positive values, indicating reduced sensitivity to interest rates. For the base age group, the coefficient is positive and significant, while for the age group above 64, there is no significant change of the effect of interest rates on durables expenditure. In general, the results indicate that there is no significant difference in the durable goods expenditure behavior of individuals above 64 relative to the younger group. Based on the Life-Cycle hypothesis, we would expect them to reduce their spendings on durables.

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4. All the level of significance are measured at the 5% level.

For nondurables, all the basic coefficients are highly significant. For the estimated share coefficient, b_n, the income groups with incomes between \$0£Y<\$5,000 and \$30,000£Y<\$40,000 (i.e. the lowest and the middle income groups) do not have shift coefficients significantly different from zero. On the other hand, the other income groups are significant with all positive values, meaning that the shares for these groups are all higher relative to the base group. The age group 18<Age£64 is highly significant (t = 23.028) with a positive value, but the shift coefficient for the age group above 64 is not significant.

For the coefficient b_{nn}, the income groups between \$5,000 to \$20,000 are not significant while the other shift coefficients are significant, all with positive values. The age group 18<Age£64 is significant and negative, while the age group above 64 is insignificant.

For the coefficient b_{ns} (and b_{sn}, for services), the lowest income groups below \$15,000 suggest no significant shift, while the other shift coefficients are significant with a positive direction for the group \$15,000£Y<\$20,000, and a negative value for the group \$20,000£Y<\$40,000. The base age group shows a significant positive shift.

As for the effects of interest rates on nondurables, the shift coefficients for b_{nr} are not significant for the group with \$5,000£Y<\$20,000, while the rest of the income groups are significant with negative values for income below \$40,000 as compared to the positive shift coefficient of the base group for income above \$40,000. The basic result for b_{nr} is consistent with our earlier expectation that interest rates should have a positive effect on nondurables, depending on reallocation of spending away from durable goods.

For services, as is the case for durables and nondurables, all the basic coefficients are significant, except for the interest rate coefficient, b_{sr} (t = -0.582). For the estimated share for services, b_s, shifts for the income groups below \$20,000 are statistically insignificant, while those above \$20,000 are significant and positive, indicating a higher share for \$20,000£Y<\$30,000 and negative for \$30,000£Y<\$40,000, indicating a lower share relative to the base group. The age group above 64 is not significantly different, while the base age group is significant with a positive value.

For the coefficient b_{sn}, the income groups below \$20,000 are insignificant while the rest are significant, all with positive values. The base age group is significant with a positive value, while its shift coefficient for age group above 64 is insignificant.

For the coefficient, b_{ss}, the base group has a positive value, while only the income groups above \$15,000 are significant, with a positive value for \$15,000£Y<\$20,000 and negative values for \$20,000£Y<\$40,000. The shift coefficient for the age group above 64 is still insignificant relative to the positive value of the base age group.

The coefficient for the interest rate effects on the expenditures for services, b_{sr}, for the base group is the only insignificant one among the coefficients of the base group in all three equations. However, the shift coefficients for income groups \$0£Y<\$5,000 and between \$20,000 and \$40,000 are significant, all with negative directions. In this instance, contrary to the case in the other two equations, both of the age groups are found to have insignificant shifts.

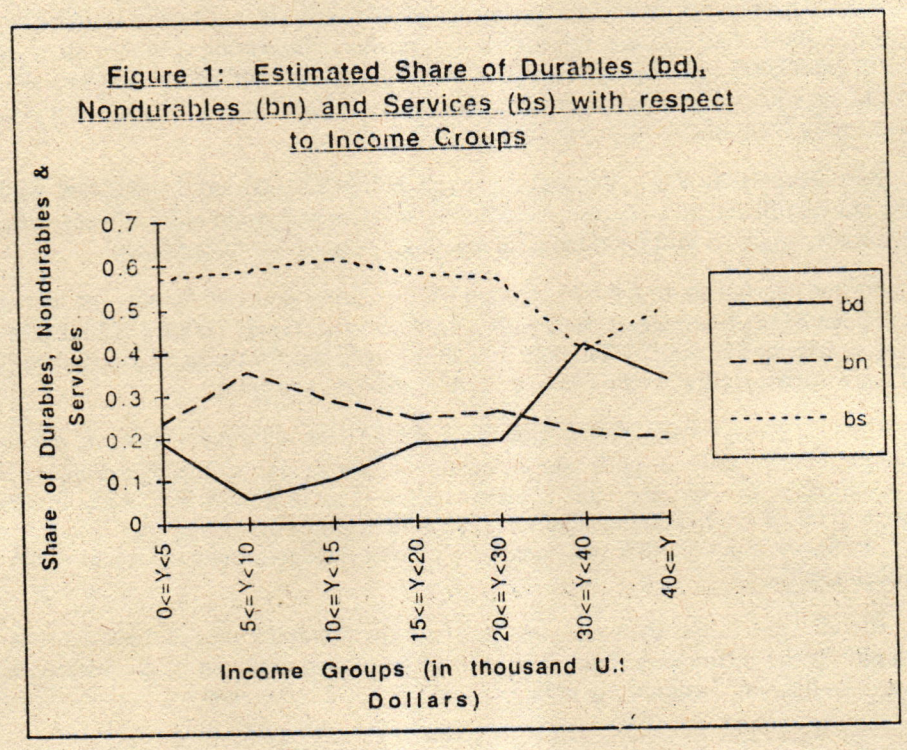
The changes in the shares of durables (b_d), nondurables (b_n) and services (b_s) expenditure in the different income classes and age groups as given by the estimation results can be illustrated graphically in Figure 1 and Figure 2 respectively.

In Figure 1, it can clearly be seen that the share of durables are low in the lower income groups and increases in general, with the higher income groups. For the share of nondurables, it is relatively higher in the lower income groups, and then it maintains a rather constant (or slightly decreasing) pattern over higher income groups, while the expenditure on services has the largest share with a somewhat constant share for almost all of the income groups except $30,000£Y<$40,000 .

Figure 2 illustrates that individuals above the age of 64 have slightly lower share espenditures on durables and nondurables than those between 18 and 64, and slightly higher on services. However, as indicatd in Table 3, this study finds that individuals above the age of 64 do not have a significantly different expenditure behavior from those in the younger age group. This may be explained by the increasingly verified fact in the U.S. that individuals really behave in a more distinctly "elderly" manner only when they reach the age of 70. However, it would be interesting to make a more detailed analysis of the expenditure behaviors of several age groups of individual consumers rather than just two as done in this study.

The Allen Partial Elasticities of Substitution and the Price and Cross Price Elasticities for durables, nondurables and services are given in Table 4. In general, the condition for concavity in prices seems to be satisfied, with negative signs in most of the own price elasticities. There are, however, a few cases that violates this condition. The own price elasticies of durables for income groups below $30,000 have positive values, but these values are very small and very close to zero, with an exception for $5,000£Y<$10,000 (x_{DD} = 1.89). For nondurables, the condition is not satisfied for income groups below $15,000 and between $20,000 and $40,000 with very high positive values. For services, only the income groups between $10,000 and $20,000 do not satisfy this condition, also with high positive values.

Figure 1: Estimated Share of Durables (bd), Nondurables (bn) and Services (bs) with respect to Income Groups



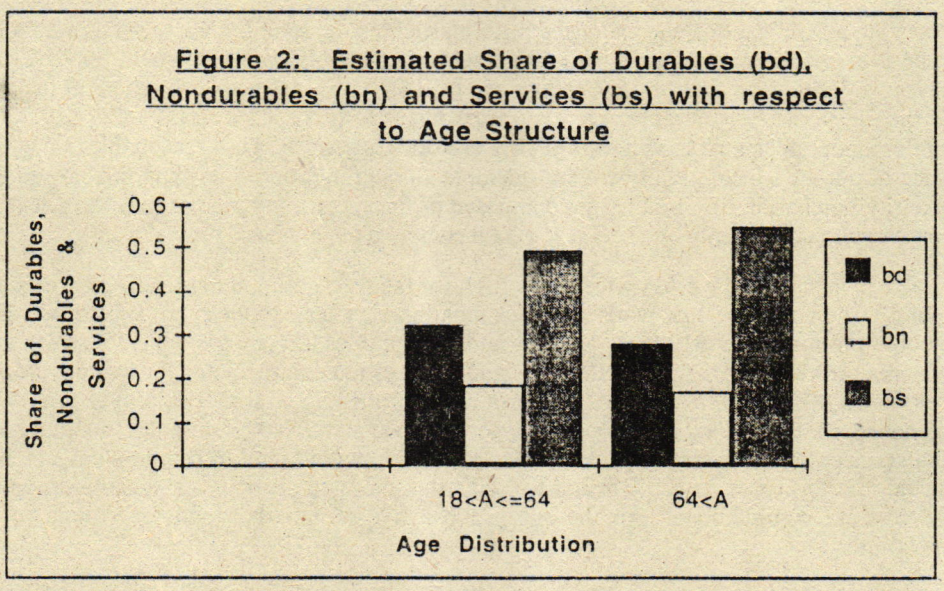


Table 4: Allen Partial Elasticities of Substitution and Price Elasticities for Durables (D), Nondurables (N) and Services (S)

Elasticity Coefficient	40<=Y, 18<Age<=64	0<=Y<5	5<=Y<10	10<=Y<15	15<=Y<20	20<=Y<30	30<=Y<40	64<Age
σ_{DN}	98.97	-2394.08	-138.15	116.65	1337.28	-1803.17	-999.09	82.97
σ_{DS}	-37.36	596.54	50.73	-195.53	-761.29	809.59	548.86	80.21
σ_{NS}	64.5	-272.74	1.48	4.53	221.97	-124.76	-374.25	105.4
σ_{DD}	-0.55	0.18	33.22	6.15	0.4	0.29	-0.48	-0.52
σ_{NN}	-339.81	626.5	11.09	57.82	-508.02	167.58	538.24	-678.99
σ_{SS}	-0.02	-204.67	-5.8	50.55	145.37	-211.98	-378.12	-73.15
ξ_{DN}	18.51	-569.79	-49.04	33.07	323.89	-458.37	-200.12	13.99
ξ_{DS}	-18.33	340.69	29.83	-119.63	-439.26	453.37	215.48	44.17
ξ_{NS}	31.64	-155.76	0.87	2.77	128.07	-69.86	-146.93	58.05
ξ_{DD}	-0.18	0.03	1.89	0.64	0.07	0.05	-0.2	-0.145
ξ_{NN}	-63.54	149.11	3.94	16.39	-123.04	42.6	107.81	-114.48
ξ_{SS}	-0.01	-116.89	-3.41	30.93	83.88	-118.71	-148.45	-40.29

Note: Y denotes income

In absolute terms, the estimated price elasticities for durables and services are found to be own price-inelastic for the base group, while nondurables are highly own-price elastic, having an absolute value of greater than one (-63.54). It is interesting to note that the rest of the elasticities for durables are own-price inelastic (except for $5,000£Y<$10,000), while nondurables and services are highly elastic. These results are reasonable, since the price of durables have to fall by a considerable amount in order to have an increase in the quantity purchased, for durables are composed of items considered more like "luxuries" as compared to nondurables and services, which comprise mainly basic provisions.

In analysing the cross price elasticities, for the base group, durables and services are found to be complements, while durables, nondurables and services are substitutes. For income groups below $10,000, durables and nondurables are complements, durables and services are substitutes, and nondurables and services are complements for income groups below $5,000 and substitutes for groups $5,000£Y<$10,000 (although not very pronounced). For the income groups between $10,000 and $20,000, durables, nondurables, and services are substitutes while durables and services are found to be complements. For income groups between $20,000 and $40,000, durables and services are substitutes, while the rest are complements. For the age group above 64, all the goods are found to be substitutes.

In general, durables and services, and nondurables and services tend to be substitutes for most of the income groups, while durables and nondurables tend to be complements. The results obtained for the higher income groups seem to be more definite than those for the lower income groups. This may be due to the difficulty in accounting for some unreported income for those in the latter group, who may be receiving some unreported governmental assistance such as food stamps and the like.

6. CONCLUSION

From the estimation results obtained, we have attempted to analyze changes in expenditure behavior on durables, nondurables and services of different income and age groups using cross-sectional data. We have also used the translog function and estimated the three demand equations derived from the expenditure share equations using Zellner's iterative seemingly unrelated regression method.

The results that we obtained are generally good and consistent with our earlier expectations. Income distribution is important in determining consumption behavior on durables, nondurables and services. Expenditure on durables are higher for the higher income groups and also for the younger individuals. Interest rates have a negative effect on durables, supporting the idea that these are investment goods. Durables and services are found to be substitutes, while durables and nondurables as well as nondurables and services are found to be complements for most income groups. In any case, it will be possible to make a more detailed analysis if the upper end of the income distribution is not wide and is broken down into narrower income groups.

The elderly individuals, however, do not have a significantly different pattern from the younger group. As mentioned earlier, this may be due to the fact that individuals really behave in a more typically elderly way when they reach the age of 70. In this respect, further analysis can be made if the age distribution is classified into several, and not just two, age groups, so that the young, the middle-aged and the older individuals in the society can really be distinguished. Also, the analysis can be further refined if the number of

dependents in a family is taken into consideration as this is expected to have a significant effect on the expenditure behavior of individuals.

It is important to analyze how expenditure patterns change in relation to different income groups and age structure in the society. At the micro level, the information obtained can be used by producers to identify target markets for the particular good or services produced or provided. At the macro level, the results will provide some valuable insights for policies towards income redistribution as one of the means to increase aggregate consumption as a major component of a country's GNP.

It should also be noted that the price indexes are a possible source of specification error. The indexes are based on aggregation from more detailed prices based on weights for all consumers. As our study shows, these weights differ significantly across income classes, and so the prices are likely to be also. These problems may account for some of the observed nonconcavity in prices. The availability of more detailed information about the expenditures would partially resolve this problem.

Even though the results of this study do have some limitations, it has managed to provide a rather clear picture of the expenditure behavior on durables, nondurables and services by various income groups. However, they don't apply to the patterns by age groups, but further suggestions have been given so as to refine this part of the analysis in the future. The results of this study has shown that macroeconomic consumption equations are better specified as simultaneous systems, and that additional information on income distribution in such cross-sectional studies does improve the model. For future research, however, it will be useful to integrate savings into the model of disposable income to obtain better evidence on Life-Cycle hypothesis and better explanation of spending on durables. It will also be useful to examine the same data set in a pooled time series-cross section model to understand the changes in prices.

ÖZET

Bu çalışmada, Amerika Birleşik Devletleri için kesitli hanehalkı verisi kullanılarak gelir dağılımı ve yaş yapısının tüketim harcamaları üzerindeki etkileri ekonometrik bir analizle incelenmiştir. Çalışma, aynı zamanda Ando ve Modigliani'nin Yaşam-Boyu Gelir Hipotezi ile Friedman'ın Sürekli Gelir Hipotezi'nin de bir testi niteliğindedir. Dayanıklı tüketim malları, dayanıksız tüketim malları ve hizmetlere olan talep, translog dolaylı fayda fonksiyonuna dayanarak eş-anlı olarak tahmin edilmiştir.

Çalışmanın sonunda ulaşılan bulgular aşağıdaki gibi özetlenebilir: Gelir dağılımının dayanıklı, dayanıksız ve hizmet tüketimini önemli bir ölçüde etkilediği ortaya çıkmıştır. Dayanıklı tüketim mallarına yapılan harcamalar, genç ve yüksek gelir grubuna sahip bireyler için daha yüksek çıkmıştır. Ayrıca, faiz oranlarının dayanıklı tüketim malları talebini olumsuz yönde etkilediği görülmüştür. Son olarak, çoğu gelir grubu için dayanıklı tüketim malları ile hizmetlerin birbirini ikame ettiği, ancak dayanıklı ve dayanıksız tüketim malları ile, dayanıksız tüketim malları ve hizmetlerin birbirini tamamlar nitelikte olduğu bulunmuştur.

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