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CHARACTERISTICS OF JAPANESE HOUSEHOLD'S DEMAND

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Abstract

This paper estimates and analyzes the characteristics of Japanese household's demand on goods and services, i.e. (1) Food, (2) Housing, (3) Fuel, light and water charges, (4) Furniture and household utensils, (5) Clothes and footwear, (6) Medical care, (7) Transportation and communication, (8) Education, (9) Reading and recreation, and (10) Other living expenditure. This paper applies Linear Expenditure System (LES) model and seemingly uncorrelated regression (SUR) estimation method. Put (10) other living expenditure aside, this paper has exhibited some conclusions. First, increases in income (above supernumerary income) will be proportionally allocated more for (1) Food, (5) Clothes and footwear, (9) Reading and recreation, (7) Transportation and communication and (8) Education. Second, both demand and cross-price elasticities are inelastic. Third, demand on (4) Furniture and household utensils, (5) Clothes and footwear and (6) Education are income elastic.

Keywords: *elasticity, Linear Expenditure System (LES), Seemingly Uncorrelated Regression (SUR)*

INTRODUCTION

Two important economic agents in a market are consumer and producer/supplier. The numbers of consumers and producers determine market characteristics (Moschandreas, 2000). In the extreme situation, a market can be in the form of monopoly or perfect competition. The characteristics of supply are ascertained by various factors such as prices of inputs, technology, government policy, expectation, etc. Meanwhile, the characteristics of demand are a result of interactions of many individual consumer's or household's aspects, such as income, tastes, expectation, preferences, prices, etc (Samuelson & Nordhaus, 2001).

Identifying the characteristics of demand becomes very important for decision making of individual firm or policy analysis. All econometric studies of demand are related to the three basic objectives of econometrics, i.e. (1) structural analysis, (2) forecasting and (3) policy evaluation (Griffiths *et al.,* 1993; Intriligator *et al.,* 1996; Gujarati, 2000). *First,* the structural analysis is connected with the use of an estimated econometric model for the quantitative measurement of economic relationships. Many researches of demand focus on some aspects of structural analysis, particularly the estimation of the impacts of the change in prices and income on the quantity demanded, as measured by elasticity. *Second,* forecasting concerns with the use of an estimated econometric model to predict quantitative values of certain variables outside the sample of data actually observed. Many researches of demand are oriented toward forecasting, in particular forecasting quantities, and/or prices of specific commodities in either the short or the long period. *Third,* policy evaluation is related to the use of an estimated econometric model to choose between alternative policies. Researches of demand are sometimes oriented toward policy evaluation, in particular, the impact of policies (such as taxes and subsidies) that may affect markets for consumer goods. From the estimated demand function, it is possible to predict the impacts of taxes or subsidies on the quantities demanded, welfare changes, for example (Widodo, 2006).

The idea of standard of living of Japanese households relates to various elements of household's livelihood and varies by income. When income was low as in Japan in the 1950s, the standard of living could be indicated mainly by the consumption level, especially foods. After most of the households were able to meet basic needs in the 1960s, household consumption on semi-durable and durable goods became an appropriate measure of the standard of living (Mizoguchi, 1995). In parallel with the increase in income as much higher as developed countries in the 1970s, Japanese household's interest shifted from current expenditures to financial and real assets for maintaining a stable life in the present and in the future (Hayes, 2000). Further, in a higher income level country as Japan in the present, households have started preferring leisure hours to overtime payments.

Japan might probably be considered as one of the expensive country in the world. This can be observed from the fact that Japan has an extremely high cost of living including food, housing, gasoline, apparel, consumer packaged goods and services in general. Table 1 shows the prices of selected goods and services in Japan, the United States (US), and the United Kingdom (UK) in 1993, expressed as an index relative to the average of OECD (Organization for Economic Co-operation and Development). Japanese prices are much higher than those of the US and the UK in every area but health care, where the government prices restrain costs but work against quality, innovation in treatment and new drug development (Porter *et al.,* 2000). Therefore, Japan provides an interesting case study for a research of the characteristics of household demand.

Table 1. Comparative Dollar Price Levels of Selected Goods and Services, 1993 (the OECD average=100)

No.	Components of Expenditure	Japan	US	UK
1.	Food	205	78	74
2.	Restaurant, cafes and hotels	178	68	121
3.	Household equipment and operation	171	81	101
4.	Clothing and footwear	165	77	73
5.	Rent, fuel and power	156	91	78
6.	Construction	155	84	74
7.	Transport and communication	141	81	110
8.	Medical and health care	87	136	70

Source: the OECD (1995) as cited by Porter *et al.* (2000)

This paper aims to analyze the characteristics of Japanese household's demand for groups of living expenditures. In this paper, the groups consist of (1) Food, (2) Housing, (3) Fuel, light and water charges, (4) Furniture and household utensils, (5) Clothes and footwear, (6) Medical care, (7) Transportation and communication, (8) Education, (9) Reading and recreation, and (10) Other living expenditure. The rest of this paper is organized as follows. Section 2 describes the characteristics of demand under linear expenditure system (LES). The methodology is presented in Section 3. Results and analysis are described in Section 4. Finally, several conclusions are presented in part 5.

CHARACTERISTICS OF DEMAND UNDER LINEAR EXPENDITURE SYSTEM (LES)

Theoretically, a household's demand for goods and services is a function of prices and income (by the definition of Marshallian demand function). The problem of the household is to choose quantity of goods and services that maximize its utility function subject to the given budget constraint. Therefore, some changes in income and prices of goods and services will directly affect the number of goods and services demanded. This section describes a utility function, which derives the linear expenditure system (LES), and shows formulas of elasticities under the LES.

Direct Utility Function

In this paper, we assume that Japanese households have a utility function following the more general Cobb-Douglas (CD) for a simplicity reason[11]. Stone (1954) makes the first attempt to estimate an equation system incorporating explicitly the budget constraint, namely the linear expenditure system (LES). Klein and Rubin (1948) formulate the LES as the most general linear formulation in prices and income satisfying the budget constraint, homogeneity and the Slutsky symmetry (Mas-Colell, *et al.,* 1995) Samuelson (1948) and Geary (1950) derive the LES from the following utility function:

$$U(x_1 \cdots x_n) = (x_1 - x_1^o)^{\alpha_1}(x_2 - x_2^o)^{\alpha_2}(x_3 - x_3^o)^{\alpha_3} \cdots (x_n - x_n^o)^{\alpha_n} \quad (1)$$

The problem of individual household is to choose the combination of x_i that can maximize its utility $U(x_i)$ subject to its budget constraint. Therefore, the optimal choice of x_i is obtained as a solution to the constrained optimization problem as follows:

$$\underset{x_i}{\text{Maxize}} \quad U(x_i) = \prod_{i=1}^{n} (x_i - x_i^o)^{\alpha_i}$$

Subject to:

$\mathbf{PX} \leq M$

Where:

$\sum_{i=1}^{n} \alpha_i = 1$

$x_i - x_i^o > 0$

$0<\alpha_i<1$

Π is product operator

x_i is consumption of commodity i

x_i^o and α_i are the parameters of the utility function

x_i^o is minimum quantity of commodity i consumed

$i \in [1,2,3 \ldots\ldots n]$

P is a row vector of prices

[11] In fact, we can choose the appropriate utility function by conducting a non-nested test of comparison between two demand systems (See for examples - as they are cited by Katchova and Chern (2004): between the linear and the quadratic expenditure systems (LES and QES) by Polak and Wales (1978), between the QES and the translog demand system by Pollak and Wales (1980), between the translog demand system and the AIDS by Lewbel (1989), between the AIDS and the Rotterdam demand system by Alston & Chalfant (1993), between alternative demand system combining the Rotterdam model and the AIDS by Lee *et al.* (1994), between the absolute price Rotterdam model and the first differenced linear approximate AIDS by Kastens & Brester (1996).

X is a column vector of quantity of commodity

M is income

The Marshallian Demand

Solving the above optimization problem, we can find the Marshallian (uncompensated) demand function for each commodity x_i as follows:

$$x_i = x_i^o + \frac{\alpha_i\left(M - \sum_{j=1}^{n} p_j x_j^o\right)}{p_i \sum_{i=1}^{n} \alpha_i}$$

for all i and j (2)

Where:

$i \in (1,2,\ldots\ldots.n)$
$j \in (1,2,\ldots\ldots.n)$

Since the restriction that the sum of parameters α_i equals one, $\sum_{i=1}^{n} \alpha_i = 1$, is imposed, Equation (2) simply becomes:

$$x_i = x_i^o + \frac{\alpha_i\left(M - \sum_{j=1}^{n} p_j x_j^o\right)}{p_i}$$

for all i and j (3)

Equation (3) can be also reflected as the linear expenditure system as follows:

$$p_i x_i = p_i x_i^o + \alpha_i\left(M - \sum_{j=1}^{n} p_j x_j^o\right)$$

for all i and j (4)

Equation (4) shows that the expenditure on good i , denoted as $p_i x_i$, can be divided into two components. The first component is the expenditure on a certain base amount x_i^o of good i, which is the minimum expenditure to which the consumer is committed (*subsistence expenditure*), $p_i x_i^o$ (Stone, 1954). Samuelson (1948) interprets x_i^o as a necessary set of goods resulting in an informal convention of viewing x_i^o as non-negative quantity.

The restriction of x_i^o to be non-negative however is unnecessarily strict. In fact, the utility function is still defined whenever $x_i - x_i^o > 0$. Thus, Pollak (1968) argues that the interpretation of x_i^o as a *necessary level of consumption* is misleading. Allowing x_i^o to be negative provides an additional flexibility in the possibility of price-elastic goods. The usefulness of this generality in price elasticity depends on the level of aggregation at which the system is treated. The broader is the category of goods, the more probable is the price elastic. Solari (1971) (in Howe, 1974:13) interprets negativity of x_i^o as *superior* or *deluxe* commodities.

In order to preserve the committed quantity interpretation of the x_i^o when some x_i^o are negative, Solari (1971) redefines the quantity $\sum_{j=1}^{n} p_j x_j^o$ as "*augmented supernumerary income*" (in contrast to the usual interpretation as supernumerary income, regardless of the signs of the x_i^o). Then, by defining n* such that all goods with i≤n* have positive x_i^o and goods for i>n* are superior with negative x_i^o, Solari interprets $\sum_{j=1}^{n^*} p_j x_j^o$ as *supernumerary income* and $\sum_{j=n^*+1}^{n} p_j x_j^o$ as *fictitious income*. The sum of "*Solary-supernumerary income*" and fictitious income equals augmented supernumerary income. Although somewhat convoluted, these redefinition allow the interpretation of '*Solari-supernumerary income*' as expenditure in excess of the necessary to cover committed quantities.

The second component is a fraction α_i of the *supernumerary income*, defined as the income above the "subsistence income"

$\sum_{j=1}^{n} p_j x_j^o$ that is needed to purchase a base amount of all goods. The sum of coefficients α_i equals one to simplify the demand functions. The coefficients α_i are referred to as the *marginal budget share*, $\alpha_i/\sum\alpha_i$. They indicate the proportions in which the incremental income is allocated.

Characteristics of Demand: Price and Income Elasticities

The values of elasticities summarize the responsiveness of the quantity demanded with respect to the specific determinants such as prices and income. Under the LES, the own-price elasticity of demand for good i is formulated as follows (measured at the average price, $\bar{p}_i$, and the quantity demanded, $\bar{x}_i$):

$$\varepsilon_i = \frac{\partial x_i}{\partial p_i} \frac{\bar{p}_i}{\bar{x}_i} \frac{\bar{p}_i}{\bar{x}_i}$$

$$= \frac{-\alpha_i x_i^o p_i - \alpha_i (M - \sum_j p_j x_j^o)}{P_i^2} \quad (5)$$

This own-price elasticity gives information about the percentage change in the quantity demanded for the 1 per cent change in price of the good. The own-price elasticity is negative, since there is a negative relationship between price and quantity demanded. Frequently, the magnitude of the price elasticity of demand is reported as a positive number, referring to its absolute value and not to its sign. The good is said to be price elastic if $|\varepsilon_i| > 1$ and price inelastic if $|\varepsilon_i| < 1$.

Under the LES, the cross-price elasticity of demand for good i with respect to price of good j is formulated as follows (measured at the average price, $\bar{p}_j$, and the average quantity demanded, $\bar{x}_i$):

$$\varepsilon_{ij} = \frac{\partial x_i}{\partial p_j} \frac{\bar{p}_j}{\bar{x}_i} = -\frac{\alpha_i x_j^o}{p_i} \frac{\bar{p}_j}{\bar{x}_i} \quad (6)$$

The value of cross-price elasticity indicates the effect of a change in the price of one good on the demand for the other good.

Under the LES, the income elasticity of demand for good i is formulated as follows (measured at the average income, $\bar{M}$, and the average quantity demanded, $\bar{x}_i$):

$$\eta_j = \frac{\partial x_i}{\partial M} \frac{\bar{M}}{\bar{x}_i} = \frac{\alpha_i}{p_i} \frac{\bar{M}}{\bar{x}_i} \quad (7)$$

The income elasticity shows the percentage change in the quantity demanded for the 1% change in income. Under the LES, the income elasticity is positive. The good is said to be income elastic if $\eta_j > 1$ and income inelastic if $0 < \eta_j < 1$. The elasticity is negative for an inferior good, for which demand falls as income rises.

RESEARCH METHODOLOGY

Data

To estimate the coefficients and constants in the LES model requires data on prices, quantities, and incomes. This paper uses time-series secondary data. Data on yearly average monthly receipts and disbursement per household (in Japanese Yen, JPY) are taken from the Annual Report on the Family Income and Expenditure (Two or More Person Household) 1963-2004 published by the Statistics Bureau Ministry of Internal Affairs and Communication, Japan (SBMIAC-J). The living expenditures cover: (1) Food, (2) Housing, (3) Fuel, light and water charges, (4) Furniture and household utensils, (5) Clothes and footwear, (6) Medical care, (7) Transportation and communication, (8) Education, (9) Reading and recreation, and (10) Other living expenditure. The group "Other living expenditure" consists of personal care, toilet articles, personal effects, tobacco, etc.

Data on Consumer Price Indexes (CPI) on living expenditures are taken from the Annual Report on the Consumer Price Index 1963-2004 published by the SBMIAC-J. There are three year-basis, 1980=100, 1990=100 and 2000=100. Therefore, we convert the index into the same base year 2000=100 (base year shifting). Data on prices of the groups of expenditure are taken from the Annual Report on the Price Survey 2000 published by the SBMIAC-J.

Data on prices of the groups of living expenditures are derived from the weighted average of the items in 49 towns and villages in Japan. We use the weights from the Annual Report on the Consumer Price Index in 2000. Once the prices in 2000 are derived, prices in the other years can be calculated by using the corresponding Consumer Price Index. Data on quantity of goods or services can be obtained by dividing the expenditure of good or services with the corresponding prices.

Estimation Methods

The estimation of a linear expenditure system (LES) shows certain complications because while it is linear in the variables, it is non-linear in the parameters, involving the products of α_i and x_i^o in Equation systems (3) and (4). There are several approaches to estimate the system (Intriligator *et al.,* 1996).

The first approach determines the minimum quantities x_i^o based on extraneous information or prior judgments. Equation system (4) then implies that expenditure on each good in excess of the minimum expenditure $(p_i x_i - p_i x_i^o)$ is a linear function of supernumerary income, so each of the marginal budget shares (α_i) can be estimated by applying the usual single-equation simple linear regression methods.

The second approach reverses the first one by determining the marginal budget shares α_i based on extraneous information or prior judgments (or Engel curve studies, which estimate α_i from the relationship between expenditure and income). It then estimates the minimum quantities (x_i^o) by estimating the system in which the expenditure less the marginal budget shares time income $(p_i x_i - \alpha_i x_i^o)$ is a linear function of all prices. The total sum of squared errors -over all goods as well all observations- is then minimized by choice of the x_i^o.

The third approach is an iterative one, by using an estimate of α_i conditional on the x_i^o (as in the first approach) and the estimates of the x_i^o conditional on α_i (as in the second approach) iteratively so as to minimize the total sum of squares. The process would continue, choosing α_i based on estimate x_i^o and choosing x_i^o based on the last estimated α_i, until convergence of the sum of squares is achieved.

The fourth approach selects α_i and x_i^o simultaneously by setting up a grid of possible values for the 2n-1 parameters (the –1 based on the fact that the sum of α_i tends to unity, $\sum_{i=1}^{n} \alpha_i = 1$) and obtaining that point on the grid where the total sum of squares over all goods and all observations is minimized.

Seemingly Unrelated Regression (SUR)

This paper applies the fourth approach. The reason is that when estimating a system of equation seemingly unrelated regression (SUR), the estimation may be iterated. In this case, the initial estimation is done to estimate variance. A new set of residuals is generated and used to estimate a new variance-covariance matrix. The matrix is then used to compute a new set of parameter estimator. The iteration proceeds until the parameters converge or until the maximum number of iteration reached. When the random errors follow a multivariate normal distribution these estimators will be the maximum likelihood estimators (Judge *et al.,* 1982).

Rewriting Equation (4) to accommodate a sample t=1,2,3,…..T and 10 goods yields the following econometric non-linear system:

$$p_{1t}x_{1t} = p_{1t}x_{1t}^{o} + \alpha_1\left(M - \sum_{j=1}^{10} p_j x_j^o\right) + e_{1t}$$

$$p_{2t}x_{2t} = p_{2t}x_{2t}^{o} + \alpha_2\left(M - \sum_{j=1}^{10} p_j x_j^o\right) + e_{2t}$$

....

....

$$p_{10t}x_{10t} = p_{10t}x_{10t}^{o} + \alpha_{10}\left(M - \sum_{j=1}^{10} p_j x_j^o\right) + e_{10t}$$

for all i and j (8)

Where: e_{it} is error term equation (good) i at time t.

Given that the covariance matrix $E[e_t e_t^{'}] = \xi$ where $e_t^{'} = (e_{1t}, e_{2t}, ...e_{10t})$ and ξ is not diagonal matrix, this system can be viewed as a set of non-linear seemingly unrelated regression (SUR) equations. There is an added complication, however. Because $\sum_{i=1}^{10} p_{it}x_{it} = M$ the sum of the dependent variables is equal to one of the explanatory variables for all t, it can be shown that $(e_{1t} + e_{2t} + ... + e_{10t}) = 0$ and hence ξ is singular, leading to a breakdown in both estimation procedures. The problem is overcome by estimating only 9 of the ten equations, say the first nine, and using the constraint that $\sum_{i=1}^{10} \alpha_i = 1$, to obtain an estimate of the remaining coefficient α_{10} (Barten, 1977).

The first nine equations were estimated using the data and the maximum likelihood estimation procedure. The nature of the model provides some guides as to what might be good starting values for an iterative algorithm[12]. Since the constraint the minimum observation of expenditure on good i at time t (x_{it}) greater than the minimum expenditure x_i^o should be satisfied, the minimum x_{it} observation seems a reasonable starting value for x_i^o in iteration process. Also the average budget share, $T^{-1}\sum_{t=1}^{T}\left(p_{it}x_{it}/M_t\right)$, is likely to be a good starting value for α_i in the iterating process (Judge et al, 1982). It is because the estimates of the budget share α_i will not much differ with the average budget share.

RESULTS AND ANALYSIS

Estimation Result

Table 2 describes the estimates of the LES for the United States (US), Canada and the United Kingdom (UK) for the period 1950-1961; and Japan for the period 1963-2004. The estimates for the first three are taken from Golberger and Hamaletsos (1970), meanwhile the estimate for Japan are our own calculation. Golberger and Hamaletsos (1970) use five groups of commodities i.e. (1) Food, (2) Rent, (3) Durables, (4) Clothing, and (5) Other. Meanwhile, we use ten groups of commodities groups i.e. (1) Food, (2) Housing, (3) Fuel, light and water charges, (4) Furniture and household utensils, (5) Clothes and footwear, (6) Medical care, (7) Transportation and communication, (8) Education, (9) Reading and recreation, and (10) Other living expenditure.

[12] For a detailed explanation about iterative algorithms, see Griffith *et al* (1982).

Table 2. Estimates of the LES for the US, Canada, the UK, and Japan

No.	Living Expenditure	United States[1]		Canada[1]		United Kingdom[1]		Japan[2]	
		Minimum Expenditure	Marginal Budget Share	Minimum Expenditure	Marginal Budget Share	Minimum Expenditure	Marginal Budget Share	Base quantity (Minimum Expenditure)	Marginal Budget Share
1.	Food	0.33	0.081	0.19	0.177	0.21	0.172	30.13* (JPY 36,080)	0.16*
2.	Housing (Rent)	0.14	0.19	0.06	0.279	0.06	0.052	2.13* (JPY 10,146)	0.03*
3.	Fuel, Light & Water Charges							4.41* (JPY 2,356)	0.03*
4.	Furniture & Household Utensils (Durables)	0.15	0.096	0.07	0.133	0.06	0.269	2.23* (JPY 8,781)	0.04*
5.	Clothes and Footwear (Clothing)	0.14	0.055	0.09	0.029	0.08	0.13	3.34*** (JPY 4,038)	0.09*
6.	Medical care							8.37* (JPY 4,245)	0.02*
7.	Transportation and Communication							15.22* (JPY 16,223)	0.07*
8.	Education							23.65* (JPY 4,373)	0.05*
9.	Reading and Recreation							13.13* (JPY 11,303)	0.08*
10.	Other living expenditure (Other)	0.52	0.578	0.32	0.382	0.3	0.377	1.89 (JPY 3,238)	0.43*

Source : [1] taken from Golberger and Gamaletsos (1970) and [2] the SBMIAC-J, *authors' calculation.*

Note : In the case of the US, Canada and the UK, units of measurement are thousands of US dollars, where use has been made of the 1961: US $ 98.73 / Canadian $1 ; and US $ 280.27 / UK pound sterling 1. 1%. In the case of Japan, minimum expenditures for are presented in Japanese Yen (JPY).

* significant at level of significance

** significant at level of significance 5%

*** significant at level of significance 10%

The detailed statistics are in the Appendix

Goldberger and Gamaletsos (1970) reports the estimated minimum quantities (x_j^o) measured in units of the domestic currency i.e. minimum expenditure $(p_j x_j^o)$, and the estimated marginal budget share where the sum is unity. In the case of the US, for example, the minimum expenditures are \$330 worth of food per capita, \$140 worth of clothing, and so on. Based on the estimates of the marginal budget shares, we can say that 8.1 per cent of income over supernumerary income is allocated for Food, 5.5 per cent for Clothes and footwear. For the US, Canada, and the UK, the base quantities for Clothing, Rent, and Durables are similar and significantly lower than the base quantity for Food, as might be expected. Putting the heterogeneous 'Other' category aside, the marginal budget shares indicate that in the United States and Canada incremental income (above supernumerary income) tends to go for Rent, while in the United Kingdom such income tends to go for Durables.

In the case of Japan, all estimators of both minimum quantities (x_j^o) and marginal budget share (α_i) have positive sign. Those fulfill the theoretical expectation. Putting the Other living expenditure aside, all estimators are significant at 1 per cent level of significance, excepting the estimated minimum quantity of Clothes and footwear, which is significant at 10 per cent level of significance. The highest value of estimate of maximum marginal budget share is that for the Other living expenditure, i.e. 0.39. If there is an additional supernumerary income, 39 per cent of it will go to the Other living expenditure, followed by 16 per cent for Food, 9 per cent for Clothes and footwear, 8 per cent for Reading and recreation and so on.

Elasticities

Table 3 describes the own-price, cross-price and income elasticities. The rows represent 'elasticity of' and the columns represent 'with respect to'. Therefore, every cell of Table 3 shows a specific elasticity. For example, that of first row (Food) and second column (Housing) -0.03 shows that the cross-price elasticity of Food with respect to the price of Housing is -0.03. This implies that if there is an increase in the price of Housing by 1 per cent, the quantity of Food will decrease by 0.03 per cent. Own-price elasticities of demand for all good and services are presented in the shaded main diagonal of Table 3. The last column exhibits the income elasticity.

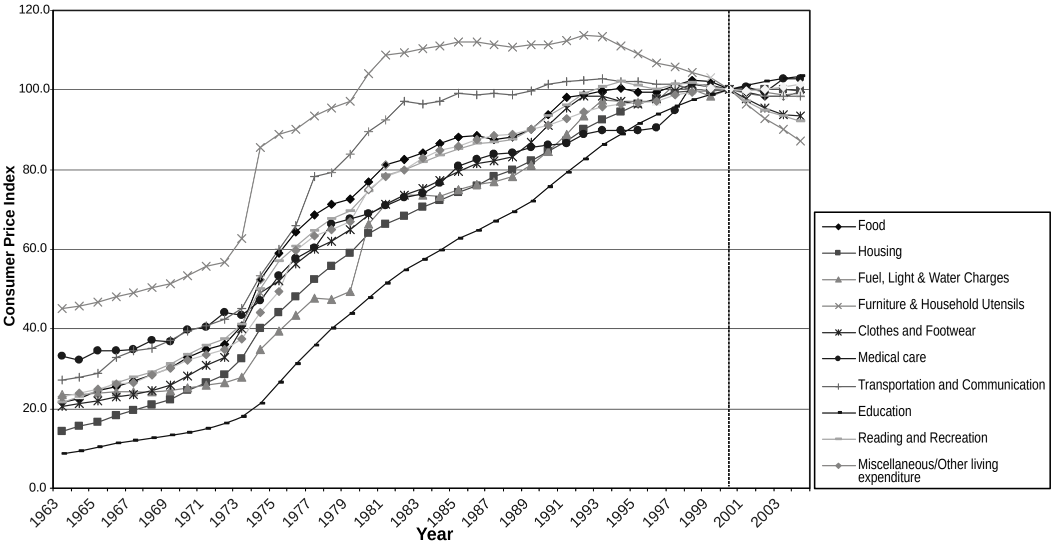
From the values of own-price elasticities, we can firmly state that the demand for all goods and services are inelastic (ε_i<1), except the Other living expenditure which has ε_i=1.02. This implies that the percentage changes of quantity demanded are less than the percentage changes of their own prices. This information might be very important for suppliers or producers in the decision-making. Theoretically, by knowing this information, if producers want to increase their total revenue, they might raise the price of goods and services. Have the prices increased? Figure 1 shows Consumer Price Index (CPI) for the all groups of living expenditures. It is interesting to analyse the change in CPI for the groups of living expenditures especially 'before' and 'after' 2000. The group of Furniture and household utensil has the highest index in the period before 2000; however it becomes the lowest in the period after 2000. The index fo Furniture and household has a downward tendency since 1993. In contrast, the group of Education has lowest index in the period before 2000 but it becomes the highest in the period after 2000. The index for Eduction has an upward trend. For the last four-year period (2001-2004), there have been significant changes in the living expenditures. There have been deflations in the groups of Furniture and household utensils; Reading and recreation; Clothes and footwear; Transportation and communication; Fuel, light and water charges; and Housing. In contrast, there have been inflations in the groups of Medical care; Education and Miscellaneous. The index for Housing is relatively stable.

Table 3. The Estimates of Own-price, Cross-price and Income Elasticities of Japanese Household, 1963-2004

Demand Elasticity	With Respect to: Price – Food	Housing	Fuel, Light & Water Charges	Furniture & Household Utensils	Clothes and Footwear	Medical care	Transportation and Communication	Education	Reading and Recreation	Other living expenditure	Income
Food	0.46	-0.03	-0.02	-0.01	-0.01	-0.01	-0.04	-0.01	-0.03	-0.01	0.64
Housing	-0.09	0.35	-0.02	-0.01	-0.01	-0.01	-0.04	-0.01	-0.03	-0.01	0.56
Fuel, Light & Water Charges	-0.09	-0.03	0.36	-0.01	-0.01	-0.01	-0.04	-0.01	-0.03	-0.01	0.60
Furniture & Household Utensils	-0.16	-0.05	-0.04	0.62	-0.01	-0.02	-0.07	-0.02	-0.05	-0.01	1.06
Clothes and Footwear	-0.20	-0.06	-0.05	-0.02	0.75	-0.02	-0.09	-0.02	-0.06	-0.02	1.29
Medical care	-0.12	-0.03	-0.03	-0.01	-0.01	0.48	-0.06	-0.02	-0.04	-0.01	0.81
Transportation and Communication	-0.12	-0.03	-0.03	-0.01	-0.01	-0.01	0.51	-0.01	-0.04	-0.01	0.80
Education	-0.17	-0.05	-0.04	-0.02	-0.01	-0.02	-0.08	0.67	-0.05	-0.02	1.14
Reading and Recreation	-0.14	-0.04	-0.04	-0.02	-0.01	-0.02	-0.07	-0.02	0.58	-0.01	0.94
Other living expenditure	-0.27	-0.08	-0.07	-0.03	-0.02	-0.03	-0.12	-0.03	-0.08	1.02	1.75

Source: the SBMIAC-J, *authors' calculation.*

Figure 1. Consumer Price Index: Living Expenditure Group, 1963-2004 (2000=100)



Source: the SBMIAC-J, authors' own calculation.

Any cells in Table 3 that are out of the shaded main diagonal represent cross-price elasticities. The all values of cross-price elasticities are negative. This means that there are complementary relationships among goods and services ($\varepsilon_{ij}<0$). One group is a complement for the others. For example, the cross-price elasticity of Food with respect to price of Housing is -0.03. This implies that the percentage increase 100 per cent in price of Housing will lead to the percentage decrease 3 per cent in quantity of Food demanded. Almost the entire cross elasticities are less than 10 per cent. Only changes in the price of Food will have relatively higher effect on quantity demanded for the other goods and services. For example, cross price elasticity of Clothes and footwear with respect to price of Food is -0.20. It indicates that the percentage change 100 per cent increase in Food will affect the percentage change 20 per cent decrease in quantity demanded of Clothes and footwear.

The last column of Table 3 reports the income elasticities. Food, Housing, Fuel, light and Water Charges, Medical care, Transportation and communication, and Reading and recreation are income inelastic. In contrast, Furniture and household utensil, Clothes and footwear, Education, and Other living expenditure are income elastic.

CONCLUSIONS

This paper analyses the characteristics of Japanese household's demand. By applying linear expenditure system (LES) and seemingly unrelated regression (SUR) in the estimation, we conclude that putting the heterogeneous the group of 'Other living expenditure' aside, the incremental income (above *supernumerary income*) tends to go relatively in the higher proportion for Food, Clothes and footwear, Reading and recreation, Transportation and communication, and Education. Demands for the groups of living expenditure are inelastic, except the group of 'Other living expenditure'. All cross-cross price elasticities are relatively small. For Japanese households, Furniture and household utensil, Clothes and footwear, Education and Other living expenditure are income elastic.

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APPENDIX: ESTIMATION RESULT OF THE LES

Estimation Method: Iterative Seemingly Unrelated Regression
Sample: 1963 2004
Simultaneous weighting matrix & coefficient iteration
Convergence achieved after: 182 weight matrices, 183 total coef Iterations

	Coefficient	Std. Error	t-Statistic	Prob.
C(1)	30.12914	1.443349	20.87447	0.0000
C(11)	0.159825	0.009160	17.44780	0.0000
C(2)	2.127116	0.268021	7.936365	0.0000
C(3)	4.406852	0.484444	9.096718	0.0000
C(4)	2.231857	0.149199	14.95893	0.0000
C(5)	3.338788	1.904799	1.752830	0.0804
C(6)	8.367445	0.504365	16.59005	0.0000
C(7)	15.21961	1.041232	14.61693	0.0000
C(8)	23.64671	2.465731	9.590142	0.0000
C(9)	13.12788	0.949276	13.82935	0.0000
C(10)	1.894845	1.874412	1.010901	0.3127
C(12)	0.025640	0.009217	2.782005	0.0057
C(13)	0.032139	0.006734	4.772926	0.0000
C(14)	0.039869	0.001916	20.80636	0.0000
C(15)	0.092085	0.007918	11.63033	0.0000
C(16)	0.018334	0.002016	9.093137	0.0000
C(17)	0.071557	0.010444	6.851537	0.0000
C(18)	0.049079	0.004059	12.09011	0.0000
C(19)	0.081227	0.005435	14.94490	0.0000
C(20)	0.431541	0.010056	42.91409	0.0000

Determinant residual covariance 5.43E+57

Equation: Q1*P1=C(1)*P1+C(11)*(M-P1*C(1)-P2*C(2)-P3*C(3)-P4*C(4)-P5 *C(5)-P6*C(6)-P7*C(7)-P8*C(8)-P9*C(9)-P10*C(10))
Observations: 42

R-squared	0.957140	Mean dependent var	59040.74
Adjusted R-squared	0.943314	S.D. dependent var	23432.43
S.E. of regression	5578.993	Sum squared resid	9.65E+08
Durbin-Watson stat	0.028467		

Equation: Q2*P2=C(2)*P2+C(12)*(M-P1*C(1)-P2*C(2)-P3*C(3)-P4*C(4)-P5 *C(5)-P6*C(6)-P7*C(7)-P8*C(8)-P9*C(9)-P10*C(10))
Observations: 42

R-squared	0.942870	Mean dependent var	13303.00
Adjusted R-squared	0.924440	S.D. dependent var	7414.442
S.E. of regression	2038.088	Sum squared resid	1.29E+08
Durbin-Watson stat	0.367242		

Equation: Q3*P3=C(3)*P3+C(13)*(M-P1*C(1)-P2*C(2)-P3*C(3)-P4*C(4)-P5 *C(5)-P6*C(6)-P7*C(7)-P8*C(8)-P9*C(9)-P10*C(10))			
Observations: 42			
R-squared	0.956955	Mean dependent var	12759.76
Adjusted R-squared	0.943069	S.D. dependent var	7192.120
S.E. of regression	1716.049	Sum squared resid	91289531
Durbin-Watson stat	0.373301		
Equation: Q4*P4=C(4)*P4+C(14)*(M-P1*C(1)-P2*C(2)-P3*C(3)-P4*C(4)-P5 *C(5)-P6*C(6)-P7*C(7)-P8*C(8)-P9*C(9)-P10*C(10))			
Observations: 42			
R-squared	0.968221	Mean dependent var	9529.976
Adjusted R-squared	0.957970	S.D. dependent var	3783.543
S.E. of regression	775.6717	Sum squared resid	18651662
Durbin-Watson stat	1.056354		
Equation: Q5*P5=C(5)*P5+C(15)*(M-P1*C(1)-P2*C(2)-P3*C(3)-P4*C(4)-P5 *C(5)-P6*C(6)-P7*C(7)-P8*C(8)-P9*C(9)-P10*C(10))			
Observations: 42			
R-squared	0.682316	Mean dependent var	15840.24
Adjusted R-squared	0.579837	S.D. dependent var	6101.853
S.E. of regression	3955.219	Sum squared resid	4.85E+08
Durbin-Watson stat	0.034563		
Equation: Q6*P6=C(6)*P6+C(16)*(M-P1*C(1)-P2*C(2)-P3*C(3)-P4*C(4)-P5 *C(5)-P6*C(6)-P7*C(7)-P8*C(8)-P9*C(9)-P10*C(10))			
Observations: 42			
R-squared	0.922654	Mean dependent var	6389.881
Adjusted R-squared	0.897703	S.D. dependent var	3483.446
S.E. of regression	1114.141	Sum squared resid	38480640
Durbin-Watson stat	0.101254		
Equation: Q7*P7=C(7)*P7+C(17)*(M-P1*C(1)-P2*C(2)-P3*C(3)-P4*C(4)-P5 *C(5)-P6*C(6)-P7*C(7)-P8*C(8)-P9*C(9)-P10*C(10))			
Observations: 42			
R-squared	0.830853	Mean dependent var	23775.81
Adjusted R-squared	0.776290	S.D. dependent var	15321.30
S.E. of regression	7246.673	Sum squared resid	1.63E+09
Durbin-Watson stat	0.038749		
Equation: Q8*P8=C(8)*P8+C(18)*(M-P1*C(1)-P2*C(2)-P3*C(3)-P4*C(4)-P5 *C(5)-P6*C(6)-P7*C(7)-P8*C(8)-P9*C(9)-P10*C(10))			
Observations: 42			
R-squared	0.970861	Mean dependent var	10710.48
Adjusted R-squared	0.961461	S.D. dependent var	6780.964
S.E. of regression	1331.194	Sum squared resid	54934425
Durbin-Watson stat	0.155559		

Equation: Q9*P9=C(9)*P9+C(19)*(M-P1*C(1)-P2*C(2)-P3*C(3)-P4*C(4)-P5 *C(5)-P6*C(6)-P7*C(7)-P8*C(8)-P9*C(9)-P10*C(10))			
Observations: 42			
R-squared	0.975174	Mean dependent var	21680.40
Adjusted R-squared	0.967165	S.D. dependent var	11439.73
S.E. of regression	2072.920	Sum squared resid	1.33E+08
Durbin-Watson stat	0.113169		
Equation: Q10*P10=C(10)*P10+C(20)*(M-P1*C(1)-P2*C(2)-P3*C(3)-P4 *C(4)-P5*C(5)-P6*C(6)-P7*C(7)-P8*C(8)-P9*C(9)-P10*C(10))			
Observations: 42			
R-squared	0.988240	Mean dependent var	62163.55
Adjusted R-squared	0.984446	S.D. dependent var	31083.41
S.E. of regression	3876.528	Sum squared resid	4.66E+08
Durbin-Watson stat	0.140695		