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Consumption Behavior of Japanese Agricultural Households: An Almost Ideal Demand System Analysis

by

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Abstract:

The consumption behavior of Japanese agricultural households is analyzed by a linear approximate almost ideal demand system utilizing time series of aggregate consumption data on 15 commodity groups. Appreciable discrepancies are observed in consumption patterns between agricultural and non-agricultural households. Some of the results in terms of income and price elasticities, and of demand shifts differ to some extent from that of non-agricultural households. The second-order condition of the equilibrium is fulfilled at the sample means in this study. All cross-price elasticities are smailer than unity in absolute value. Tastes are rather conservative in agricultural households.

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This study aims to estimate a complete and flexible demand system for the Japanese agricultural households in the 1963-1988 period, dealing with 15 subgroups of consumer goods and services. The consumption behavior of agricultural households is analyzed from some aspects in comparison with that of non-agricultural households. Little is known about the interrelations of demand for many commodities in agricultural households. The annual data on prices and expenditures for agricultural households are sometimes published in different form. Therefore, in order to carry out a demand system analysis, the published data have to be rearranged appropriately for selected commodity groups using more detailed data.

In the allocation of total household expenditure among various goods and services, agricultural and non-agricultural households appear to differ to some extent, despite a widespread view that the two types of households have become much alike as most rural areas were considerably urbanized. The ratios of expenditures on cereals, transportation, and miscellaneous to total expenditure averaged at 7.3%, 11.1%, and 27.8%, respectively, for agricultural households in the 1963-1988 period. They are apparently greater than the corresponding ratios for non-agricultural households; 5.3%, 6.7%, and 20.4%. On the other hand, the ratios of expenditures on livestock products, eating-out, and on recreation and education were calculated at 3.1%, 1.8%, and 9.7%, respectively, for agricultural households which are smaller than that for non-agricultural households; 5.4%, 5.6%, and 12.1%.

It is evident that agricultural households consume more cereals, make greater use of private cars, and pay more expenses on such ceremonial occasions as marriage, funeral, ancestral worship, etc. than non-agricultural households do. Meanwhile, the former are inclined to expend less on animal protein food,

food away from home, and on recreation and education than the latter do. These differences may be largely due to the disparity of consumer tastes or life-style between the two categories of households. The total expenditure per capita is a little higher in agricultural households than in non-agricultural households.

There are already some empirical studies in the consumption patterns of non-agricultural households.[1] However, there are quite few evidences on the demand relations and structure for the households engaged in agriculture. Therefore, it is important to analyze their consumption behavior in its own right within the theoretical framework and to make clear the characteristics and implications of the empirical results.

This task is undertaken by the application of the almost ideal (ai) demand system, developed by Deaton and Muellbauer (1980a, 1980b). This demand system is derived from a flexible cost function with enough parameters to guarantee that its first and second derivatives with respect to all prices and utility exist. The underlying cost function is interpreted to provide an approximation to any arbitrary cost function. The linear approximate ai demand system is composed of linear equations in unknown parameters, so that its estimation is rather simple. It satisfies the adding-up, homogeneity, and symmetry. The last two restrictions can be tested empirically using the linear constraints on the estimated parameters. Further, this system has a couple of advantages over other systems, that the exact aggregation over individual consumers or households is possible and that the marginal budget share of each commodity is variable. The stability condition can be also tested with the estimated parameters and observed data. The empirical results obtained in this study are compared with the previous results for non-agricultural households.

Model

The linear approximate ai demand system with a vector of intercepts is represented as equation (1), taking its first-difference for a time-series analysis. Regarding the definition of variables and parameters, p_i, q_i and w_i denote nominal price, quantity purchased per capita and average budget share of the ith commodity, respectively, while p, q and m indicate consumer price index ($p = \Pi_k \ p_k^{\ wk}$), quantity index ($q = \Pi_k \ q_k^{\ wk}$) and income (or total expenditure) per capita, respectively. Further, α_i, β_i and γ_{ij} are interpreted as shift parameter, income parameter and price parameter.

The estimation equation is written as follows, with t as time and ε_i as a disturbance term.

$$\Delta w_{it} = \alpha_i + \beta_i \Delta \log q_t + \Sigma_j \gamma_{ij} \Delta \log p_{jt} + \varepsilon_{it}, \qquad (1)$$

(i, j=1, 2, . . . , N),

(t=1, 2, . . . , T),

where

$\Delta w_{it} = w_{it} - w_{i,t-1}$,

$w'_{it} = (w_{it} + w_{i,t-1})/2$,

$\Delta \log x_t = \log x_t - \log x_{t-1}$, (x: any positive variable)

and

$$\Delta \log q_t = \Delta \log m_t - \Delta \log p_t, \ (\Delta \log q_t = \Sigma_k w'_{kt} \Delta \log q_{kt};$$
$$\Delta \log p_t = \Sigma_k w'_{kt} \Delta \log p_{kt}), \quad (k=1, 2, \ldots, N).$$

The following theoretical restrictions are placed on the behavioral parameters:

$$\Sigma_i \alpha_i = 0, \ \Sigma_i \beta_i = 0, \ \Sigma_i \gamma_{ij} = 0, \qquad \text{(Adding-up)}, \quad (2)$$

$$\Sigma_j \gamma_{ij} = 0, \qquad \text{(Homogeneity)}, \quad (3)$$

and

$$\gamma_{ij} = \gamma_{ji}, \qquad \text{(Symmetry)}. \quad (4)$$

Since they are expressed by linear equations in parameters, all of the restrictions are incorporated into the estimation procedure.
The annual rate of shift in demand r_i $(=(\Delta q_i/q_i)/\Delta t)$, income elasticity E_i, price elasticity e_{ij} and Slutsky substitution parameter $k_{ij}\equiv(p_i\ p_j/m)(\partial q_i/\partial p_j)_{u=const.}$ for the ith commodity are given by the following equations.

$$r_i = \alpha_i/w_i, \tag{5}$$

$$E_i = (\beta_i + w_i)/w_i, \tag{6}$$

$$e_{ij} = (\gamma_{ij} - \beta_i w_j - w_i \delta_{ij})/w_i, \tag{7}$$

and

$$k_{ij} = \gamma_{ij} - w_i \delta_{ij} + w_i w_j \quad (\delta_{ij}=1(i=j) \text{ or } 0(i\neq j)). \tag{8}$$

The second-order condition of the equilibrium entails the negativity of the own-price Slutsky substitution term:

$$k_{ii}<0 \qquad \text{(Negativity)}, \tag{9}$$

which gives rise to a downward-sloping demand curve for a nomal good, and for an inferior good so far as the substitution effect surpasses the income effect. More generally, the second-order condition indicates that the Slutsky substitution matrix $[k_{ij}]$ is negative semidefinite of rank (N-1).

The ε_{it} is the disturbance term with zero mean $(E(\varepsilon_{it})=0)$ and constant variances and contemporaneous covariances $(E(\varepsilon_{it}\varepsilon_{jt'})=\omega_{ij}$ $(t=t')$ or 0 $(t\neq t'))$. All lagged covariances of disturbances are assumed to be zero. The adding-up restriction implies that one of the N equations in the expression (1) is not independent, and that the variance-covariance matrix of disturbances is singular $(\Sigma_j\ \omega_{ij}=0)$. Hence, one equation is omitted from the system, and the variance-covariance matrix of rank (N-1) is used in the system estimation with theoretical constraints across equations.

Data

The model uses time-series data on the agricultural household consumption for the 15 selected subgroups of goods and services, covering the years 1963 through 1988. Expenditure data are taken from the Statistics on Living Expenditures of Farm Household, published by the Statistics and Information Department at the Ministry of Agriculture, Forestry and Fisheries (MAFF). Recent national census data show that the farm household population in 1990 occupies 14.0% of Japan's total population, and that farm households amount to 9.4% of all households. It should be reckoned with that the agricultural sector shows an appreciable share when estimating the market demand for consumer goods and services.

In reference to the consumption statistics, the definition of commodity groups was not unified through the observation period, and there was a major change in the commodity classification in 1980. Hence, the expenditure data before 1980 are revised in accordance with the new classification adopted in 1980, utilizing the detailed published data. All the expenditure data are rearranged for the practical purpose of analyzing the 15 commodities in terms of annual expenditures per capita (in 1,000 yen), dividing annual expenditures per household by the number of family members.

Price data are obtained from the Statistical Survey of Prices and Wages in Rural Areas, provided by the MAFF. Price indexes are available for various commodities and commodity groups, which are calculated in the Laspeyres form. They are also rearranged for the 15 commodities by using the 1985 average budget shares as the weights of constituent items. Thus the price data for each commodity are calculated as the weighted means of the price indexes of the related items (1985=1).

The commodity list is as follows:

1, cereals; 2, fish; 3, livestock products (meat, dairy products, eggs); 4, vegetables; 5, fruits; 6, processed food (oils, fats, condiments, cakes, cooked food); 7, beverages; 8, eating-out; 9, housing & furniture, inclusive of household utensils; 10, fuel, light & water charges; 11, clothing, inclusive of footwear; 12, medical care; 13, transportation, inclusive of communication; 14, recreation & education; 15, miscellaneous.

Housing expenses include the depreciation of house and other buildings used for household consumption, repairs and maintenance, and fire insurance.

Empirical Analysis

All of the behavioral parameters of equation (1) are estimated simultaneously by the iteration of Zellner's efficient method (or seemingly unrelated regression: sur, in short), with the three theoretical restrictions (2), (3), and (4) incorporated into the model. The last equation for the commodity group of miscellaneous in the system (1) is omitted from the iterative estimation since parameter estimates are invariant whichever equation is dropped (see Barten (1969)). The estimation procedure used is quite similar to that for the Rotterdam system which has a different term on the left-hand side of demand equation (1) (see Theil (1971) ch.7). In this system estimation, there are T observations on each of the N=15 commodities, (N-1)T=350 samples in total, and (N-1)(N+4)/2=133 unknown parameters. There are 217 degrees of freedom. The parameter estimates of the omitted equation are derived from the estimated parameters of the other equations.

The convergent estimates of those parameters are maximum likelihood estimates (see Barten (1969), Parks (1969))[2], which give rise to the annual rates of demand shifts, income elasticities, and price elasticities for all commodities under consideration by means of equations (5), (6), and (7). Estimated parameters of equation (1) are not manifested here. Instead, the estimates of demand elasticities and shifts are tabulated below. They are more important than the original estimated parameters in the interpretation of the results.

Table 1 presents income elasticity, own-price elasticity, and annual rate of shift in demand for each of the 15 commodities, estimated at the sample means of all variables in the 1963-1988 period, together with sample mean average budget share. It also mentions the multiple correlation coefficient and the

Durbin-Watson statistic for reference, which are calculated equation by equation. Standard errors for all the estimated demand elasticities and shifts are computed making use of the linear equations (5), (6), and (7).[3] The significance test of all elasticities and rates of shift is conducted, as is shown in Tables 1 and 2.

Income elasticity is positive and significant at a 5% level or better for the 13 commodities except for cereals and vegetables. It is worthy to note that the negative income elasticity for cereals is not statistically significant in agricultural households. It presents a striking contrast to the large negative income elasticity estimates for cereals of non-agricultural households[4] (see Sasaki and Fukagawa (1987) -0.91; Sasaki (1993) -1.02, (forthcoming) -1.12). Fruits, eating-out, housing and furniture, and miscellaneous show a high income elasticity. Moreover, livestock products, and transportation are also income-elastic while the income elasticities for beverages, medical care, and for recreation and education are around 1.0.

Own-price elasticity is negative and significant at 5% or better for all of the 15 commodities. There are 5 price-elastic commodities, such as beverages, housing and furniture, medical care, transportation, and miscellaneous, while eating-out indicates an own-price elasticity of nearly -1.0.

Own-price elasticities for cereals, beverages, clothing, transportation, and miscellaneous of agricultural households are larger in absolute value, compared with the estimates of the non-agricultural households investigated in previous studies (Sasaki (1991), (forthcoming); -0.20 ～-0.29, -0.90～-1.04, -0.25 ～-0.33, -0.39～-0.57, and -0.95～-1.02, respectively). Those for livestock products and fish, eating-out, and the recreation and education group are more or less smaller than the respective estimates of non-agricultural households. It should be also noted that the income elasticities for medical care and clothing, and the elasticities for eating-out of agricultural households with respect to income and to its own-price are lower than the non-agricultural counterparts.

The average annual rate of shift in demand is statistically significant for only 4 commodities, 3 commodities at 5% and one at 10%. Fuel, light and water are the only commodity group with a positive time trend effect. These results indicate that agricultural households proved to be rather conservative in taste changes, admitting that rural areas have been substantially urbanized.

Table 2 shows cross-price elasticities calculated at the sample means of all variables in the estimation period. The level of statistical significance of elasticity estimates is denoted by either asterisk or circle. Nearly half of all the cross-price elasticities are significant at 10% or better, mainly at 5% or better. The striking features of the cross-price elasticities are that all of the estimates are less than 1 in absolute value and that they are almost symmetric in sign, setting aside the level of significance.

Substitution, Complementarity and Stability

A look at the pairs of statistically significant cross-price elasticities in Table 2 produces the following interesting relationships among different commodities. Cereals are a gross substitute for fish, and a gross complement for processed food; fuel, light and water; etc., and vice versa. In the same context, fish and livestock products are substitutes for processed food while livestock products are a complement for beverages; fuel, light and water; etc. Fruits are a substitute for beverages, and a complement for processed food, miscellaneous, etc. Beverages are a substitute for eating-out, and for recreation and education, and a complement for fuel, light and water; medical care, and miscellaneous. It may be also interesting to note that eating-out is a substitute for housing and furniture, and a complement for clothing.

Similarly, the housing and furniture group is substitutional for transportation, and is complementary for fuel, light and water; and recreation and education. Clothing is substitutional for medical care, and is complementary for transportation. Additionally, medical care is substitutive for recreation and education, and miscellaneous, and vice versa. The relationships of gross substitution and complementarity described above would coincide with our expectation to a considerable extent. All pairs of the significant cross-price elasticities show a single sign, either positive or negative, respectively.

Table 3 gives the Slutsky substitution matrix, estimated at the sample means by making use of equation (8). Since the substitution parameters $\bar{k}_{ij}$'s are symmetric in i and j, only the upper triangle is written. Equation (8) suggests that the standard error of the substitution parameter $\bar{k}_{ij}$ is equal to that of the parameter estimate $\hat{\gamma}_{ij}$. Hence it is easy to test the statistical significance of all the substitution parameters. There are 69 significant parameter estimates at 10% or better, which amount to 58% of the 120 substitution parameter estimates. Own-price substitution parameters are all negative and significant at 5% or better, revealing that indifference curves are strictly convex to the origin for all commodities. Fifty four of the 105 cross-price substitution parameters are significant at 10% or better.

A similar analysis can be made of the relationships of substitutes and complements in the net context, as described in the argument of gross substitutes and complements. Many relationships stated in the gross context correspond to the relationships of net substitution and complementarity. Further, in the net context, cereals are a substitute for fruits, clothing, and miscellaneous, and vice versa. Vegetables are a substitute for processed food and eating-out. Processed food is substitutional for beverages, medical care, and miscellaneous. Three commodity groups of housing and furniture; fuel, light and water; and clothing are in a substitutional relation to miscellaneous, respectively.

The Slutsky substitution matrix also serves for testing the fulfillment of the stability condition. Since the matrix is of rank (N-1), the (N-1)x(N-1) submatrix is used to compute (N-1) eigenvalues, dropping the last row and column. The 14 eigenvalues turned out to be all negative. Hence, the original substitution matrix is negative semidefinite, and the consumer equilibrium is ascertained to be stable at the sample means in this study. Generally, however, it does not seem easy for a flexible demand system to fully satisfy the stability condition with empirical data.

Besides, the stability of consumer equilibrium could be examined through the whole observation period in the light of a dynamic simulation by the estimated system. In the interpolation test of the system, there are N・T=375 measures of goodness-of-fit which are calculated as the ratios of estimated to observed quantities. All measures except only one indicate an accuracy of 80% or more in prediction, with the remaining one being 75%. The extrapolation test can also be done with the 1989 data. Its result shows that the accuracy of prediction is 90% or more. Accordingly, the system fits the empirical data pretty well. The data required for the extrapolation test beyond 1989 are not available because the data compilation was markedly reduced by the Ministry of Agriculture, Forestry and Fisheries. Estimated quantities of practically all commodities vary gradually or smoothly, reflecting the actual changes in demands. No drastic variations of predicted quantities emerge from this system.

The average information inaccuracy is calculated for the estimated system as stated below. It is reciprocally related to the goodness-of-fit of the model as a whole. It reduces to zero in the case of perfect prediction. The average information inaccuracy over the estimation period $\overline{I}$ and its corrected value for the degrees of freedom $\overline{I}_c$ are obtained as follows[5]:

$\overline{I}=2048$ (10^{-6}Nits), (1963-1988)

and

$\overline{I}_c=3288$ (10^{-6}Nits).

The information inaccuracy in the extrapolation test for 1989 is mentioned below:

$I=1032$ (10^{-6}Nits).

These values appear to be somewhat high in comparison with the measures of goodness-of-fit in the simulation test.

The statistic of likelihood ratio to test the symmetry restriction is calculated at

$F(g, h)=0.869$,

which has an F distribution with g=91(=(N-1)(N-2)/2) and h=126(=(N-1)T-(N-1)(N+1)) degrees of freedom if the null hypothesis of symmetry restriction is true (see Johnston (1984) chs. 5 & 8, Theil (1971) ch. 7). The 5% significance limit is about 1.47, and the symmetry restriction is considered to be empirically acceptable.

Further, in testing the homogeneity restriction (3), each equation of the demand system (1) is estimated separately by the least squares method. Since there are many explanatory variables, the variances for the parameter estimates are large. Therefore, the variance for the sum of all price parameter estimates is relatively high, and the sum of those estimates is not significantly different from zero. It does not contradict with the homogeneity restriction.

Concluding Remarks

A dynamic version of the linear approximate ai demand system in first-difference form is estimated with time series of annual data on consumption expenditures and prices for Japanese agricultural households. The estimation period covers from 1963 to 1988. The demand system is specified on a per capita basis, including an intercept for each commodity. The consumption behavior of agricultural households is analyzed through the calculation of income and price elasticities, demand shifts, and average budget shares.

Major findings of the empirical estimation are stated as follows.

Firstly, in the empirical tests of theoretical restrictions, both of the homogeneity and symmetry are supported to be acceptable. The sum of all price parameter estimates is not significantly different from zero, so that there is no reason to reject equation (3). The likelihood ratio test of the symmetry restriction shows that the F-value is apparently less than the 5% critical value, indicating that the null hypothesis of symmetry restriction is not rejected.

Secondly, all of the fourteen eigenvalues are enumerated to be negative, utilizing the Slutsky substitution matrix evaluated at the sample means of all variables. It is indeed fortunate from the analytical point of view that the stability condition is satisfied in the empirical application of a flexible demand system.

Thirdly, there are 6 income-elastic commodities and 5 price-elastic ones in this 15-commodity classification. Cross-price elasticities are all less than unity in absolute value, and it implies that the substitutional and complementary relations appear to be somewhat weaker than that of non-agricultural households. Nearly half of the cross-price elasticities prove to be statistically significant at a 10% level or better. In addition, there are only 4 commodities with statistically significant time trend effects, and the commodity group related to energy solely exhibits a positive effect. Accordingly, it may be safe to say that tastes change in a modest way in agricultural households.

Fourthly, it should be remarked that transportation, miscellaneous, and the housing and furniture group are elastic with respect to both income and own-price. The income elasticity of cereals as an inferior good is smaller in absolute value, and its own-price elasticity is larger in absolute terms, as compared with the corresponding elasticities of non-agricultural households. On the other hand, livestock products and eating-out are income-elastic while the recreation and education group, beverages, and medical care show an income elasticity of unity.

Hence, livestock products and eating-out are expected to expand in consumption as well as transportation, miscellaneous, and the housing and furniture group, as income grows. Meanwhile, decreases in rice consumption will decelerate or even stop if its relative price falls in the near future.

Notes

1. See Maki (1983), Sasaki (1991, forthcoming), Sasaki and Fukagawa (1987), Sato (1970), Tsujimura and Kuroda (1974 ch.5), etc.
2. Buse (1994) demonstrated that the estimators obtained by sur and instrumental variable method are not consistent ones in the estimation of the la/ai demand system, and recommend the use of the nonlinear ai demand system. However, the nonlinear ai demand system with such many commodities as in this study does not seem to yield convergent estimates of parameters.
3. Standard errors for the annual rate of shift, income elasticity and price elasticity are calculated as the square roots of their respective variances:

   $Var(r_i)=(1/w_i)^2 Var(\alpha_i)$,

   $Var(E_i)=(1/w_i)^2 Var(\beta_i)$, and

   $Var(e_{ij})=(1/w_i)^2 Var(\gamma_{ij})-2(1/w_i)(w_j/w_i)Cov(\gamma_{ij}, \beta_i)$
   $+(w_j/w_i)^2 Var(\beta_i)$.
4. The income elastiacity for cereals is estimated at -1.119 in Sasaki (forthcoming). In other studies, it is calculated by the Engel aggregation of the income elasticities for rice and other cereals, with their average budget shares as weights; it is equal to -0.909 in Sasaki and Fukagawa (1987) and -1.019 in Sasaki (1993).
5. Theil's information inaccuracy (in Nit: Natural logarithmic digit) is defined as follows. The average information inacuuracy over T periods and the value adjusted for the degree of freedom are writtern as, respectively,

   $\overline{I}=\Sigma_t \Sigma_i w_{it}\log(w_{it}/\hat{w}_{it})/T$, and

   $\overline{I}_c=(\Sigma_t \Sigma_i (w_{it}-w_{it})^2/Tw_{it})((N-1)T/((N-1)T-K)$

   where w_{it} and $\hat{w}_{it}$ are observed and estimated (average) budget shares, and the number of unknown parameters $K=(N-1)(N+4)/2$ (see Theil (1971), pp.644-650.).

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Table 1. Income and Own-Price Elasticities, Annual Rate of Shift in Demand Estimated at the Sample Means in 1963-1988, Sample Mean Average Budget Share, and Related Statistics of the Estimation Equation[a]

Commodity i=	Income Elasticity $\overline{E}_i$	Own-Price Elasticity $\overline{e}_{ii}$	Annual Rate of Shift $\overline{r}_i$ (%)	Average Budget Share $\overline{w}_i$	R	D.W.
1. Cereals	-0.265	-0.586*	-1.518	0.07289	0.842	1.35
	(0.169)	(0.227)	(1.121)			
2. Fish	0.759*	-0.673*	-0.404	0.03302	0.586	2.54
	(0.114)	(0.095)	(0.778)			
3. Livestock products	1.097*	-0.693*	-0.998	0.03082	0.724	2.47
	(0.094)	(0.057)	(0.644)			
4. Vegetables	0.344	-0.687*	0.487	0.02630	0.720	2.43
	(0.218)	(0.082)	(1.386)			
5. Fruits	1.689*	-0.850*	-3.425*	0.01347	0.759	2.61
	(0.195)	(0.073)	(1.312)			
6. Processed food	0.566*	-0.349*	0.704	0.04841	0.826	2.26
	(0.088)	(0.056)	(0.580)			
7. Beverages	1.012*	-1.503*	-1.504°	0.02560	0.767	2.06
	(0.113)	(0.113)	(0.810)			
8. Eating-out	1.200*	-0.967*	3.791	0.01766	0.497	2.58
	(0.433)	(0.215)	(2.872)			
9. Housing & furniture[b]	1.376*	-1.081*	-1.662	0.10883	0.538	1.77
	(0.215)	(0.147)	(1.361)			
10. Fuel, light & water	0.603*	-0.212*	1.677*	0.03880	0.930	2.31
	(0.118)	(0.053)	(0.774)			
11. Clothing[c]	0.948*	-0.722*	-2.280*	0.07599	0.687	2.03
	(0.133)	(0.176)	(0.886)			
12. Medical care	0.961*	-1.246*	-0.083	0.02234	0.588	1.93
	(0.195)	(0.096)	(1.203)			
13. Transportation[d]	1.076*	-1.090*	1.860	0.11069	0.550	1.12
	(0.207)	(0.124)	(1.322)			
14. Recreation & education	1.014*	-0.592*	0.556	0.09699	0.717	1.33
	(0.139)	(0.157)	(0.916)			
15. Miscellaneous	1.330*	-1.145*	0.600	0.27818	0.633	1.88
	(0.090)	(0.138)	(0.593)			

a. Multiple correlation coefficient R and Durbin-Watson statistics D.W. are those for estimation equations.
b. Housing & furniture includes household utensils.
c. Clothing includes footwear.
d. Transportation also includes communication.
* significant at 5%. o significant at 10%.
Figures in ( ) are estimated standard errors.

Table 2. Cross-Price Elasticities [$\bar{e}_{ij}$] Estimated at the Sample Means in 1963-1988

$\bar{e}_{ij}$[a] j= / i=	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
1. Cereals		0.180*	0.051	-0.055	0.097*	-0.175*	0.087	-0.088	-0.105	-0.106°	0.292°	-0.212*	0.216°	0.150	0.519*
		(0.068)	(0.056)	(0.053)	(0.044)	(0.064)	(0.057)	(0.057)	(0.079)	(0.060)	(0.148)	(0.059)	(0.120)	(0.150)	(0.240)
2. Fish	0.324*		-0.035	-0.075°	-0.022	0.131*	-0.032	-0.211*	-0.080	0.036	0.075	-0.051	0.038	-0.348*	0.164
	(0.147)		(0.055)	(0.040)	(0.036)	(0.065)	(0.060)	(0.068)	(0.116)	(0.051)	(0.138)	(0.055)	(0.091)	(0.122)	(0.163)
3. Livestock products	0.022	-0.049		-0.048	-0.008	0.230*	-0.174*	-0.116*	0.080	-0.087*	-0.372*	-0.047	0.048	0.302*	-0.185
	(0.130)	(0.059)		(0.033)	(0.033)	(0.053)	(0.054)	(0.052)	(0.088)	(0.040)	(0.104)	(0.044)	(0.072)	(0.102)	(0.137)
4. Vegetables	-0.198	-0.080	-0.033		-0.051	0.075	0.035	0.134°	0.482*	-0.050	-0.133	-0.133*	0.234°	0.411*	-0.350
	(0.150)	(0.051)	(0.040)		(0.034)	(0.053)	(0.041)	(0.076)	(0.165)	(0.061)	(0.126)	(0.052)	(0.139)	(0.152)	(0.253)
5. Fruits	0.381	-0.085	-0.036	-0.135*		-0.309*	0.268*	0.150	-0.095	0.008	-0.410*	0.188*	-0.344*	0.371°	-0.791*
	(0.235)	(0.090)	(0.077)	(0.066)		(0.093)	(0.081)	(0.101)	(0.178)	(0.074)	(0.198)	(0.077)	(0.147)	(0.196)	(0.276)
6. Processed food	-0.324*	0.096*	0.163*	0.035	-0.071*		0.061	-0.064	-0.181*	0.145*	0.208*	0.069°	-0.112°	-0.399*	0.157
	(0.095)	(0.044)	(0.034)	(0.028)	(0.026)		(0.045)	(0.045)	(0.077)	(0.032)	(0.084)	(0.037)	(0.065)	(0.089)	(0.124)
7. Beverages	0.154	-0.050	-0.207*	0.018	0.150*	0.094		0.239*	0.144	-0.221*	0.223	-0.318*	0.059	0.599*	-0.393*
	(0.160)	(0.079)	(0.065)	(0.042)	(0.042)	(0.086)		(0.081)	(0.117)	(0.053)	(0.145)	(0.066)	(0.094)	(0.141)	(0.165)
8. Eating-out	-0.472	-0.410*	-0.205*	0.177	0.121	-0.206	0.341*		0.934*	0.012	-0.770*	0.146	0.130	-0.243	0.212
	(0.328)	(0.129)	(0.093)	(0.113)	(0.077)	(0.126)	(0.119)		(0.319)	(0.112)	(0.311)	(0.121)	(0.276)	(0.307)	(0.490)
9. Housing & furniture[b]	-0.190*	-0.045	0.014	0.089*	-0.007	-0.120*	0.025	0.148*		-0.089*	-0.050	-0.029	0.225*	-0.257*	-0.009
	(0.094)	(0.036)	(0.026)	(0.039)	(0.022)	(0.035)	(0.028)	(0.051)		(0.034)	(0.093)	(0.033)	(0.109)	(0.102)	(0.164)
10. Fuel, light & water	-0.262*	0.036	-0.054°	-0.041	0.017	0.179*	-0.135*	0.016	-0.166°		0.024	-0.058	0.064	-0.236*	0.225
	(0.111)	(0.044)	(0.032)	(0.041)	(0.026)	(0.041)	(0.035)	(0.051)	(0.096)		(0.096)	(0.038)	(0.082)	(0.101)	(0.157)
11. Clothing[c]	0.191	0.026	-0.146*	-0.062	-0.063°	0.114*	0.077	-0.175*	-0.025	-0.001		0.100°	-0.400*	-0.083	0.221
	(0.143)	(0.061)	(0.043)	(0.043)	(0.035)	(0.054)	(0.050)	(0.073)	(0.133)	(0.047)		(0.055)	(0.105)	(0.127)	(0.184)
12. Medical care	-0.781*	-0.082	-0.060	-0.173*	0.123*	0.130	-0.363*	0.119	-0.096	-0.114°	0.339°		0.087	0.550*	0.606*
	(0.192)	(0.082)	(0.062)	(0.061)	(0.046)	(0.080)	(0.075)	(0.095)	(0.161)	(0.067)	(0.185)		(0.140)	(0.185)	(0.285)
13. Transportation[d]	0.044	0.001	0.014	0.036	-0.034°	-0.073*	0.012	0.023	0.254*	0.004	-0.284*	0.015		0.003	-0.001
	(0.080)	(0.028)	(0.021)	(0.033)	(0.018)	(0.030)	(0.022)	(0.044)	(0.109)	(0.029)	(0.073)	(0.028)		(0.093)	(0.125)
14. Recreation & education	0.021	-0.127*	0.099*	0.094*	0.061*	-0.221*	0.158*	-0.041	-0.249*	-0.110*	-0.070	0.125*	0.010		-0.172
	(0.114)	(0.043)	(0.034)	(0.041)	(0.027)	(0.045)	(0.038)	(0.057)	(0.116)	(0.041)	(0.100)	(0.043)	(0.106)		(0.175)
15. Miscellaneous	0.020	0.001	-0.028°	-0.059*	-0.033*	-0.010	-0.044*	0.011	0.002	0.003	0.031	0.040°	-0.028	-0.091	
	(0.064)	(0.020)	(0.016)	(0.024)	(0.013)	(0.022)	(0.016)	(0.031)	(0.065)	(0.022)	(0.051)	(0.023)	(0.059)	(0.061)	

a. $\bar{e}_{ij}$= Elasticity of the ith commodity with respect to the jth price estimated at the sample means ($i \neq j$).
b. Housing & furniture includes household utensils.
c. Clothing includes footwear.
d. Transportation also includes communication.
Figures in ( ) are standard errors.
* significant at 5%. ° significant at 10%.

Table 3. Slutsky Substitution Matrix $[k_{ij}]$[a] Estimated at the Sample Means of All Variables

Commodity i =	j=1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
1. Cereals	-4.411*	1.251*	0.314	-0.454	0.679*	-1.371*	0.583	-0.678	-0.978	-0.848°	1.979°	-1.589*	1.359	0.917	3.247°
	(1.648)	(0.487)	(0.403)	(0.391)	(0.316)	(0.461)	(0.412)	(0.574)	(1.008)	(0.431)	(1.082)	(0.428)	(0.862)	(1.097)	(1.760)
2. Fish		-2.138*	-0.038	-0.181	-0.039	0.553*	-0.042	-0.654*	0.009	0.216	0.437	-0.111	0.405	-0.907*	1.239*
		(0.309)	(0.178)	(0.132)	(0.120)	(0.211)	(0.199)	(0.224)	(0.382)	(0.168)	(0.458)	(0.180)	(0.300)	(0.407)	(0.538)
3. Livestock products			-2.032*	-0.060	0.022	0.873*	-0.451*	-0.297°	0.613*	-0.138	-0.891*	-0.068	0.523*	1.260*	0.370
			(0.174)	(0.103)	(0.103)	(0.163)	(0.164)	(0.160)	(0.267)	(0.122)	(0.323)	(0.135)	(0.219)	(0.317)	(0.428)
4. Vegetables				-1.782*	-0.122	0.241°	0.115	0.368°	1.366*	-0.097	-0.280	-0.330*	0.717*	1.167*	-0.668
				(0.216)	(0.089)	(0.136)	(0.107)	(0.200)	(0.422)	(0.161)	(0.329)	(0.136)	(0.359)	(0.401)	(0.663)
5. Fruits					-1.114*	-0.306*	0.419*	0.242°	0.120	0.099	-0.379	0.303*	-0.212	0.721*	-0.432
					(0.098)	(0.124)	(0.108)	(0.135)	(0.236)	(0.099)	(0.267)	(0.103)	(0.195)	(0.266)	(0.372)
6. Processed food						-1.555*	0.365°	-0.261	-0.577	0.807*	1.213*	0.395*	-0.237	-1.665*	1.524*
						(0.271)	(0.219)	(0.218)	(0.366)	(0.155)	(0.407)	(0.176)	(0.308)	(0.432)	(0.600)
7. Beverages							-3.781*	0.657*	0.651*	-0.465*	0.767*	-0.756*	0.438°	1.785*	-0.285
							(0.287)	(0.207)	(0.295)	(0.136)	(0.375)	(0.167)	(0.237)	(0.366)	(0.424)
8. Eating-out								-1.670*	1.880*	0.103	-1.200*	0.304	0.464	-0.223	0.964
								(0.377)	(0.549)	(0.196)	(0.550)	(0.212)	(0.477)	(0.545)	(0.867)
9. Housing & furniture[b]									-10.134*	-0.388	0.590	0.020	4.103*	-1.346	4.071*
									(1.557)	(0.364)	(0.995)	(0.353)	(1.156)	(1.102)	(1.738)
10. Fuel, light & water										-0.733*	0.271	-0.172	0.507	-0.687°	1.525*
										(0.206)	(0.371)	(0.148)	(0.314)	(0.395)	(0.607)
11. Clothing[c]											-4.938*	0.921*	-2.239*	0.068	3.681*
											(1.343)	(0.416)	(0.786)	(0.971)	(1.402)
12. Medical care												-2.736*	0.431	1.438*	1.951*
												(0.212)	(0.307)	(0.415)	(0.639)
13. Transportation[d]													-10.749*	1.191	3.301*
													(1.352)	(1.002)	(1.599)
14. Recreation & education														-4.787*	1.068
														(1.537)	(1.692)
15. Miscellaneous															-21.557*
															(3.884)

a. All parameters and standard errors (in parentheses) are multiplied by 10^2 to save space.
b. Housing & furniture includes household utensils.
c. Clothing includes footwear.
d. Transportation also includes communication.
* significant at 5%. ° significant at 10%.