Tropical Agricultural Research Vol. 2 1990

Demand Systems of Food Using Cross-section Data: Evidence from Badulla District, Sri Lanka

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ABSTRACT: The objective of this study is to determine the demand for food among the urban, estate, and rural households in Badulla district of Sri Lanka. The study is based on a cross section study of 200 households in Badulla electorate. The linear version of Almost Ideal Demand System (AIDS) was used to estimate own price, cross price, expenditure, and household elasticities of food. Even though price variation is limited in a single cross-section, this study demonstrates that it is possible to estimate complete systems food demand. The own price and expenditure elasticities for most of the commodities in the three sectors are inelastic. However they vary across sectoral levels. The cross price elasticities indicate that consumers demand for most of the foods are responsive to changes in the price of rice. But change in the price of other food groups have less of an impact on the demand for rice.

INTRODUCTION

Developing countries such as Sri Lanka have used producer subsidies (*e.g.* fertilizer) and consumer subsidies (*e.g.* food stamps) to protect the low income households. The beneficiaries of these policies are at near subsistence level and some of them may be the producers of foods affected by policy changes. With changes in agricultural production technology, level of foreign debt, import of major foods and raw materials of the industries, civil unrest in the country, the Sri Lankan government has been forced to restrict the subsidies on chemical fertilizers to farmers, curtail operation and maintenance costs of irrigation systems, plan for pricing of water to at least recover some cost of irrigation investments, reduce imports and raw materials, and to increase defense spending. The buffering of domestic rice price relative to the

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world price of rice has never been practiced in Sri Lanka as in other South Asian countries. The weak agricultural information base existing in the developing countries may lead to the poor prediction of the anticipating responses from the economic sectors due to changes in food policies (Timmer and Alderman, 1979).

The outcome of the changes in pricing and income policies could be measured by the consumer demand elasticities for food. The own price, cross price, and income elasticities are necessary to co-ordinate agricultural, food and income policies. In the developing countries food researchers have assumed strong prior conditions due to the lack of empirical or suitable information in analyzing demand systems (Swamy and Binswanger, 1983). The main objective of this study is to determine the demand for food commodities among the urban, estate, and rural households in the Badulla District. This study is based on cross section study of 200 households in the Badulla electorate during 1987/88.

METHOD

The linear version of the Almost Ideal Demand System (AIDS) model (Tyrell and Mount, 1981; Ray, 1982) was used in the estimation of the demand system of food. The AIDS model allows for a range of tests for consumer preferences (Deaton and Muelbauer, 1980). The AIDS model could be represented as follows:

$$W_i = a_i + \Sigma a_{ij} \ln P_j + b_i \ln Y + O_i \ln S$$

$$i = 1, 2, 3 \ldots n$$

where

W_i = Average budget shares of the ith commodity;

P_j = jth commodity price;

Y = Per capita food expenditure; and

S = Household size.

The above structural equation must satisfy the Engel aggregation

$(\Sigma a_i = 1, \Sigma b_i = 0, \Sigma_i a_{ij} = 0, \Sigma O_i = 0)$,

homogeneity ($\Sigma_j a_{ij} = \Sigma O_i = 0$), and symmetry ($a_{ij} = a_{ji}$)

The demand elasticities corresponding to the AIDS model are:

$e_{ii} = [(a_{ii} - b_i w_i) / w_i] - 1$ (own price)

$e_{ij} = (a_{ij} - b_i w_j) / w_i$ (cross price)

$e_{if} = (b_i / w_i) + 1$ (real food expenditure)

$e_{is} = (O_i - b_i) / w_i$ (household size).

DATA COLLECTION

Badulla district was selected purposely for the study. Of the 9 electorates in this district the study was limited to Badulla electorate. The total population in the electorate was classified in terms of urban, rural, and estate sectors for the selection of the sample. On the basis of the household distribution 16 households from urban, 51 households from estate and,133 households from rural sectors were selected randomly for a total of 200 households. The sample information were obtained by means of a structural questionnaire for the period 1987/88. Only information from the survey sections on household food expenditure and demographic characteristics was utilized for the estimation of the demand system. Household expenditures on each food group were the value of food consumed. Total food expenditure was used as a measure of income variables in the food demand system. Household expenditures on each food group as a fraction of total good expenditure were calculated as household specific food budget shares. The weighted average prices were used for each food group, and the sample mean prices were used for the missing prices of the non-consume households. The possible quality effects from the weighted average prices of the commodities were corrected by using quality adjusted prices to estimate the demand system (Cox and Wohlgenant, 1986).

The family sizes were converted to adult (male aged 20-59 years) equivalent calorie consumption scale. For this purpose the number of members in a household was weighted by age and sex to reflect calorie consumption. The calorie requirements for different age and sex categories recommended by the Medical Research Institute of Sri Lanka

was used for this purpose (Food and Nutrition Statistics, 1982). The inclusion of family size in the equation is supported by the previous estimation of the AIDS model of Teklu and Johnson (1988) and Deaton and Muelbaeur (1980).

ESTIMATION

The linear AIDS was estimated with additive error terms. The additive error terms for each equation was assumed normal with zero means and constant variance. The covariance used recognized that the specifications used are approximations and the food expenditure for each household levels were related. The fitted model was estimated by using the Three Stage Least Squares method. The model was estimated with restrictions of homogeneity and symmetry. The estimation procedure adopted ensured the non-singularity of the covariance matrix.

RESULTS

The estimated parameters of the AIDS model for urban, rural and estate sectors are presented in Tables 1-3, respectively. Most of the structural parameters were statistically significant. This indicated that food demands were responsive to prices, household expenditure, and household size. The nature of the demand for food commodities can be directly inferred from the signs of the AIDS parameters. Commodities with negative expenditure parameters, $b_i < 0$ were income inelastic and those with positive parameters, $b_i > 0$ were income elastic. The commodities with positive price parameters, $a_{ii} > 0$, were price inelastic and those with negative parameters, $a_{ii} < 0$, were price elastic.

Table 4 shows the elasticities with respect to real food expenditure, total food expenditure,and household size. The total expenditure (income) elasticities were based on the expressions $E_{iy} = E_{if}.E_{fy}$; where E_{iy} is the elasticity of commodity i with respect to income; E_{if} is the demand elasticity with respect to food expenditure, and E_{fy} is the aggregate food elasticity with respect to total income. Except for the other cereal group in urban and estate, the expenditure elasticities were statistically significant and positive. For the other cereal group in the urban and estate, the expenditure elasticities were statistically significant, but negative. This implied that the other cereal group was considered

as an inferior commodity by the consumers of these sectors. Among the food expenditure elasticities, all except for milk and meat in the urban and for milk and fish in the rural were less than unity. The result indicated that, milk and meat in the urban, and milk and fish in the rural to be the highest ranking among food commodities in terms of household income responses.

With the exception of pulses and the other cereal group in the urban; and pulses and meat in the rural, the household size variable was significantly different from zero and positive for rice, wheat and bread, and negative for the other food groups in all the three sectors. The estimated results suggested that increased household size induces a re-allocation away from fish, meat, sugar, pulses and milk to rice, wheat and bread and other cereals in these sectors. For instance, in the urban sector, a 10 per cent increase in household size may result in the increase in demand for rice, wheat and bread by 4.9 per cent and 0.4 per cent respectively. The demand for sugar, milk, fish and meat may decrease by 1.0 per cent, 1.0 per cent, 3.4 per cent and 6.2 per cent respectively.

The price elasticities for food groups in the AIDS model for urban, rural and estate sectors are shown in Table 5. With the exception of pulses in the estate sector own price elasticities were statistically significant, and negative; that is, changes in own price had inverse impacts on quantities demanded. For pulses in the estate sector, the own elasticity was negative but not significantly different from zero. For most of the food groups, the estimated elasticities were less than unity in all three sectors; exceptions were pulses, milk and meat in the urban; milk and fish in the rural ; and the other cereal group, sugar and fish in the estate, which had elasticities exceeding unity. For all commodities except sugar, fish and the other cereal group the own price elasticities were relatively higher in the urban sector than rural and estate sectors, and with the exceptions of sugar, milk and fish the own price elasticities were relatively low in the rural sector.

With few exceptions, the cross price elasticities for the respective commodities were statistically significant. The values of the estimated cross-price elasticities suggested that the food demand was responsive to relative price changes. All food groups (other than milk and other cereals in the urban sector; pulses and meat in the rural sector; and other cereals and meat in the estate sector) were particularly responsive

Table 1. Parameters estimates for the aids model, urban households

Commodity	Intercept	Price								Real food Expenditure	House hold size
		Rice	W & B	Oth. C.	Pulses	Sugar	Milk	Fish	Meat		
Rice	1.260	0.047	0.015	0.011	−0.012	−0.025	−0.008	−0.014	−0.008	−0.176	−0.068
	(25.63)	(4.20)	(1.03)	(5.33)	(−2.41)	(−0.78)	(−1.89)	(−3.41)	(−2.54)	(−11.23)	(−5.10)
W & B	0.112	0.015	0.007	−0.000	−0.001	−0.010	−0.001	−0.002	−0.001	−0.020	−0.016
	(3.25)	(2.93)	(29.43)	(−3.12)	(−1.20)	(−0.96)	(−3.95)	(−0.07)	(−1.34)	(−4.83)	(−13.86)
Oth. C.	0.860	0.011	−0.000	0.029	−0.003	0.006	0.005	−0.003	−0.002	−0.011	−0.006
	(9.93)	(1.15)	(−1.99)	(3.91)	(−4.79)	(1.70)	(14.30)	(−0.51)	(−1.29)	(−13.25)	(−0.99)
Pulses	−0.693	−0.012	−0.001	−0.003	−0.002	−0.003	0.000	−0.000	0.003	−0.031	−0.005
	(−2.00)	(−2.00)	(−1.97)	(−0.63)	(−3.14)	(1.45)	(0.87)	(−2.31)	(−1.99)	(−3.01)	(−1.85)
Sugar	0.333	−0.025	−0.010	0.006	−0.003	0.036	−0.011	−0.000	−0.005	−0.047	−0.055
	(5.00)	(−11.25)	(−3.40)	(1.43)	(−0.03)	(5.21)	(−9.14)	(−0.84)	(−1.13)	(−3.45)	(−2.45)
Milk	−0.156	−0.008	−0.001	0.005	0.000	−0.011	−0.021	0.009	0.007	0.006	0.001
	(−3.91)	(−1.03)	(−0.67)	(3.82)	(0.73)	(−11.20)	(−7.21)	(2.31)	(2.63)	(10.75)	(4.15)
Fish	−0.426	−0.014	−0.002	−0.003	−0.000	−0.000	0.009	0.006	0.031	−0.002	−0.029
	(−5.00)	(−2.48)	(−0.95)	(−6.15)	(3.14)	(−0.72)	(2.31)	(8.14)	(5.14)	(−24.35)	(−5.67)
Meat	−0.281	−0.008	−0.001	−0.002	0.003	−0.005	0.007	0.031	−0.036	0.044	0.013
	(−6.98)	(−7.15)	(−1.73)	(−1.05)	(6.53)	(−1.32)	(1.97)	(7.15)	(−2.89)	(13.72)	(7.13)

t − Ratios in parentheses

Table 2. Parameters estimates for the aids model, rural households

Commodity	Intercept	Price								Real food Expenditure	House hold size
		Rice	W & B	Oth. C.	Pulses	Sugar	Milk	Fish	Meat		
Rice	1.073	0.118	−0.005	−0.005	−0.006	−0.011	−0.004	−0.007	−0.004	−0.182	0.031
	(5.23)	(6.84)	(−2.12)	(−1.73)	(−2.48)	(−3.12)	(−3.43)	(−1.07)	(−0.92)	(−16.78)	(−4.32)
W & B	−0.152	−0.005	0.016	0.001	−0.000	−0.002	−0.001	−0.001	−0.000	−0.020	−0.020
	(−3.32)	(−7.34)	(5.22)	(0.17)	(−0.96)	(−0.82)	(−2.46)	(−3.14)	(−0.36)	(−3.41)	(−2.17)
Oth. C.	0.631	−0.005	0.001	0.021	−0.001	−0.004	−0.001	−0.000	−0.000	−0.009	−0.012
	(2.14)	(−3.05)	(1.93)	(3.14)	(−1.99)	(−1.23)	(−2.43)	(−0.63)	(−1.72)	(−2.86)	(−3.43)
Pulses	0.232	−0.006	−0.000	−0.001	0.003	−0.002	0.001	0.001	−0.001	−0.016	−0.032
	(6.21)	(−1.92)	(−0.26)	(−1.36)	(3.43)	(−0.76)	(1.41)	(3.81)	(−2.43)	(−6.78)	(−1.24)
Sugar	−0.105	−0.011	−0.002	−0.004	−0.002	0.009	−0.010	−0.001	−0.001	−0.017	−0.024
	(−1.12)	(−2.11)	(−2.63)	(−1.01)	(−0.56)	(5.83)	(−3.14)	(−2.63)	(−0.82)	(−11.23)	(−3.68)
Milk	−0.075	−0.004	−0.001	−0.001	0.001	−0.010	−0.003	0.002	0.003	0.015	0.002
	(−7.32)	(−2.72)	(−0.63)	(−3.43)	(−1.19)	(−4.21)	(−2.36)	(1.99)	(2.10)	(5.30)	(2.41)
Fish	−0.112	−0.007	−0.001	−0.000	0.001	−0.001	0.002	−0.036	0.002	0.003	−0.017
	(−1.06)	(−3.43)	(−0.41)	(−1.73)	(2.04)	(−2.00)	(3.18)	(−2.98)	(2.63)	(4.18)	(−2.86)
Meat	−0.493	−0.004	−0.000	−0.000	−0.001	−0.001	0.003	0.002	0.015	−0.014	0.001
	(−3.43)	(−1.44)	(−1.38)	(−1.05)	(−3.63)	(−1.86)	(2.61)	(1.98)	(2.85)	(−2.01)	(1.65)

t − Ratios in parentheses

Table 3. Parameters estimates for the aids model, estate households

Commodity	Intercept	Price								Real food Expenditure	House hold size
		Rice	W & B	Oth. C.	Pulses	Sugar	Milk	Fish	Meat		
Rice	1.123	0.062	0.032	− 0.003	− 0.015	− 0.010	− 0.007	− 0.011	− 0.003	− 0.162	− 0.000
	(5.86)	(9.82)	(3.08)	(− 1.72)	(− 1.89)	(− 2.11)	(− 0.63)	(− 2.87)	(− 1.21)	(− 4.98)	(− 2.99)
W & B	1.041	0.032	0.058	− 0.003	− 0.006	− 0.006	− 0.013	− 0.001	− 0.002	− 0.121	0.003
	(7.18)	(3.63)	(4.10)	(− 1.01)	(− 1.33)	(− 0.76)	(− 1.06)	(− 2.00)	(− 1.90)	(− 5.83)	(− 3.14)
Oth. C.	− 0.642	− 0.003	− 0.003	− 0.005	0.010	0.002	0.000	− 0.001	− 0.000	− 0.010	− 0.020
	(− 1.43)	(− 1.08)	(− 1.32)	(− 2.96)	(2.11)	(3.11)	(1.12)	(− 0.96)	(− 1.26)	(− 2.01)	(− 2.43)
Pulses	− 0.110	− 0.015	− 0.006	0.010	0.008	− 0.001	− 0.000	0.009	− 0.001	− 0.028	− 0.044
	(− 2.86)	(− 2.86)	(− 3.43)	(1.01)	(0.76)	(− 2.43)	(− 3.86)	(2.94)	(− 2.99)	(− 5.96)	(− 4.05)
Sugar	0.432	− 0.010	− 0.006	0.002	− 0.001	− 0.009	− 0.002	− 0.002	− 0.001	− 0.021	− 0.033
	(4.63)	(− 5.78)	(− 4.16)	(2.22)	(− 0.65)	(− 16.83)	(− 7.65)	(− 1.86)	(− 1.77)	(− 6.86)	(− 3.66)
Milk	− 0.173	− 0.007	− 0.013	0.000	− 0.000	− 0.002	0.004	0.001	0.000	− 0.005	− 0.008
	(− 2.15)	(− 4.87)	(− 2.96)	3.84	(− 3.42)	(− 0.96)	(4.83)	(2.06)	(1.63)	(− 4.86)	(− 5.23)
Fish	− 0.271	− 0.011	− 0.001	− 0.001	0.009	− 0.002	0.001	− 0.023	0.003	− 0.011	− 0.021
	(− 5.86)	(− 4.07)	(− 5.22)	(− 0.96)	(3.14)	(− 0.76)	(1.98)	(− 9.88)	(2.34)	(− 11.56)	(− 4.26)
Meat	− 0.399	− 0.003	− 0.002	− 0.000	− 0.001	− 0.001	0.000	0.003	0.012	− 0.012	0.000
	(− 5.11)	(− 1.03)	(− 2.43)	(− 0.86)	(− 1.99)	(− 1.41)	(3.43)	(4.86)	(2.86)	(− 2.14)	(3.06)

t − Ratios in parentheses

Table 4. Average food budget shares, expenditure and household size elasticities

Food Group	Average food budget Share (wi)			Food Expenditure Elasticities (eif)			Total Expenditure Elasticities (eiy)			Household Size elasticites (eis)		
	U	R	E	U	R	E	U	R	E	U	R	E
Rice	0.22	0.29	0.24	0.20	0.37	0.33	0.16	0.32	0.27	0.49	0.73	0.67
Wheat & bread	0.09	0.04	0.14	0.77	0.50	0.14	0.61	0.43	0.11	0.04	0.00	0.88
Other cerials	0.01	0.01	0.01	−0.10	0.08	0.00	−0.01	0.07	−0.01	0.50	0.30	0.00
Pulses	0.07	0.04	0.05	0.56	0.60	0.44	0.44	0.52	0.36	−0.37	−0.40	−0.32
Sugar	0.08	0.06	0.06	0.41	0.72	0.65	0.32	0.62	0.53	−0.10	−0.12	−0.20
Milk	0.05	0.04	0.04	1.12	1.38	0.88	0.88	1.19	0.71	−0.10	−0.33	−0.08
Fish	0.08	0.06	0.05	0.98	1.05	0.78	0.77	0.90	0.63	−0.34	−0.04	−0.64
Meat	0.05	0.02	0.02	1.88	0.30	0.41	1.49	0.26	0.33	−0.62	−0.75	−0.60

U,R,E – Refers to Urban. Rural. and Estate sectors respectively.

Table 5. Matrix of food demand price elasticities based on aids

Sector	Food Group	Rice	W & B	Oth.C	Pulses	Sugar	Milk	Fish	Meat
Urban	RICE	−0.61	0.10	0.10	0.00	−0.05	0.00	0.00	0.00
	W & B	0.48	−0.81	0.00	0.00	−0.21	0.00	−0.01	0.00
	Oth. C.	0.34	0.03	−0.48	0.00	−0.16	0.12	0.00	0.00
	PULSES	−0.07	0.00	−0.02	−1.00	−0.01	0.03	0.03	0.07
	SUGAR	−0.18	−0.10	0.11	0.00	−0.45	−0.10	0.05	−0.03
	MILK	−0.19	−0.03	0.09	0.00	−0.22	−1.41	0.17	0.13
	FISH	−0.17	−0.02	−0.04	0.00	0.00	0.11	−0.92	0.39
	MEAT	−0.35	−0.06	−0.10	0.00	−0.17	0.09	0.55	−1.76
Rural	RICE	−0.41	0.00	0.00	0.01	0.00	0.01	0.01	0.00
	W & B	0.06	−0.18	0.08	0.04	−0.04	0.00	0.00	0.00
	Oth. C.	−0.01	0.05	−0.28	0.00	−0.10	−0.03	0.04	0.00
	PULSES	−0.02	0.01	−0.01	−0.91	−0.03	0.03	0.05	0.00
	SUGAR	−0.10	−0.03	−0.01	−0.02	−0.83	−0.15	0.00	0.00
	MILK	−0.20	−0.02	−0.03	0.00	−0.27	−1.14	0.07	0.07
	FISH	−0.13	−0.02	0.00	0.02	−0.02	0.03	−1.60	0.04
	MEAT	0.00	0.00	0.00	0.00	0.00	0.18	0.14	−0.22
Estate	RICE	−0.58	0.22	0.00	−0.02	0.00	0.00	−0.01	0.00
	W & B	0.47	−0.43	0.00	0.00	0.01	−0.06	0.03	0.00
	Oth. C.	0.08	−0.02	−1.23	0.55	0.16	0.04	0.00	0.00
	PULSES	−0.16	−0.05	0.23	−0.81	0.00	0.02	0.02	0.00
	SUGAR	−0.08	−0.02	0.04	0.00	−1.13	−0.02	−0.01	0.00
	MILK	−0.14	−0.30	0.00	0.00	−0.04	−0.90	0.03	0.00
	FISH	−0.27	0.01	−0.01	0.19	0.00	0.03	−1.45	0.06
	MEAT	−0.02	0.00	−0.01	−0.02	−0.01	0.02	0.18	−0.39

with respect to price changes of rice. But, changes in the price of other food groups had less of an impact on the demand for rice.

The demand elasticities for some selected foods in Indonesia, India and Bangladesh are shown in Table 6. The signs and magnitude of the price and income elasticities in these studies may be relevant to the findings of this study. The elasticities reflected the differences in income levels among these countries. For rice the price and income elasticities declined more in Bangladesh and India as compared to Indonesia with higher per capita incomes.

POLICY IMPLICATIONS

The demand estimates provide knowledge on the characteristic of food demand structure in addition to the framework to evaluate effect of policy changes in the different sectors focussed in this study. A change in price of a particular food commodity would result in the substitution effects among all the other commodities. The extent of adjustment vary with the relative price responses of the consumers and the relative shares of the commodity in the consumers' budget. A change in price has important policy implications because of its sizeable influence on food budgets and allocation patterns. Table 7, shows the simulated impact of a 10 percent decrease in the price of rice, on the expenditure of foods in the 3 sectors.

As the demand for rice was inelastic a reduction in the price of rice would result in the decrease of their budget for rice. The decrease was much higher in the rural sector due to their relative low response to change in rice price. However, with exception of wheat and bread, the expenditure on all other food groups would increase. The results also suggest that the urban consumers would increase relatively greater proportions of their food expenditure on meat and fish; the rural consumers on milk and the estate consumers on pulses and fish.

The changes in the relative price of rice also have differential impacts on distribution of income. Consumers obtain a real income gain from a decrease in the rice price. The consumers in the rural sector are more likely to benefit from such a change due to the importance of rice in their budgets. The results show that the consumers improve their income as a percentage of total food expenditure by an average of 2.91

Table 6. Estimateed price and income elasticities for some south asian countries

Country	Study	Data base	Commodiity	Elastiocities Own price	Income
Thailand	Kenner, 1983	1961 – 86	Rice	– 0.39	0.24
			Fish	– 0.81	0.54
			Vegetable	– 0.61	0.71
			Meat	– 0.39	1.06
Indonoesia	Timmer and Alderman	1976	Rice (rural)	– 0.84	0.58
			(urban)	– 0.81	0.27
		1980	Rice (urban)	– 0.58	0.33
			Vegetables	– 0.71	0.85
			Fish	– 0.85	0.81
			Meat	– 1.03	1.40
India	Swamy and Binswanger	1956 – 75	Rice	– 0.70	0.94

Table 7. Impact of 10% decrease in rice price on food expenditure

Food Group	Urban (%)	Rural (%)	Estate (%)
Rice	-4.57	-6.35	-4.81
W & B	-2.81	-0.66	-1.98
Oth. C.	*	-0.05	*
Pulses	1.00	*	1.53
Sugar	1.63	0.94	0.78
Milk	*	2.07	1.25
Fish	1.93	1.66	2.73
Meat	3.76	*	*
Price effect	1.38	2.97	2.46
Income gain as a % of food expenditure	2.21	2.91	2.41

* Insignificant

per cent, 2.41 per cent and 2.21 per cent, in the rural, estate, and urban sectors respectively. Since the fall in relative price of rice is associated with increase in demands for other food categories, the policy makers should take into account consumers adjustments to policy changes in their totality.

REFERENCES

Cox, T.L. and M.K. Wohlgenant, (1986), "Prices and Quality Effects in Cross-Sectional Demand Analysis". Amer. J. Agr. Econ., 68: P. 908-19.

Deaton, A. and J. Muelbauer (1980), "An Almost Ideal Demand System". American Economic Review, 70: P. 312-336.

Food and Nutrition Statistics (1982). Food and Nutrition Policy Planning Division, Ministry of Plan Implementationtation, Sri Lanka.

Ray, R., (1982). "The Testing and Estimation of Complete Demand Systems on Household Budget Surveys: An application of AIDS". Eur. Econ. Rev., 17, P. 349-69.

Swamy, G. and H.P. Binswanger, (1983). "Flexible Consumer Demand System and Linear Estimation; Food in India". Amer. J. Agr. Econ; 61.

Teklu, P.C. and S.R. Johnson (1988). "Demand Systems from Cross Section Data : An Application to Indonesia". Canadian Journal of Agric. Economics, 36: P.83-101.

Timmer, P.C. and H.A. Alderman, (1979). "Estimating Consumption Parameters for Food Policy Analysis". American Journal of Agric. Economics, 61. P. 982-7.

Tyrrell, T. and T. Mount, (1981). "A Nonlinear Expenditure System Using a Linear Logit Specification". Amer. J. Agr. Econ; 64.