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Estimating the Almost Ideal Demand System Model for Rural Households in Iran

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Abstract

This paper valuates the price and income sensitivity of demand for consumer goods in rural households over the period 1971 to 2008 using the linear almost ideal demand system (LAIDS) and the iterative seemingly unrelated regressions (ISUR). The results of this study show that the based on the Marshalian price elasticity, the highest price sensitivity is in the transportation group and lowest price sensitivity is in the clothing group. The absolute value of price elasticity for clothing, food, health, furniture and housing groups is less than unit, in other words, this group of goods, are low elasticity goods, that is if their price change by a percent, the demand for that goods will change less than one percent. The sign of income elasticity is positive for all commodity groups which suggest that all commodity groups are normal goods for the rural consumers. In other words, if income increases, the demand for these commodity groups will be increased. The value of this elasticities shows that the three groups of food, shelter and health have less than unit income elasticity indicates that they are placed in the category of essential goods and income elasticity for the three groups of clothing, furniture and transportation is greater than unit indicates that they are placed in the category of luxury goods.

Keywords: demand, the system of equations, SURE, rural households

Introduction

The basic aim of this paper is Analysis of behavior of rural consumers in relation to consumption of various goods in the consumption bundle of rural households. Since the consumers uses large number of goods, it is not possible to evaluate each of them; so we classify the rural goods and services in different groups and evaluate consumer behavior with respect to any of the commodity groups. The commodities under study include the following

seven commodity groups: 1. Food, drinking and tobacco groups (food); 2. Housing and fuels groups (housing); 3. Clothing and footwear groups (clothing); 4. Appliances and furniture groups (furniture); 5. Health group; 6.Transportation and communications group; 7. Other goods . In this paper, we first estimate the ideal demand system as non-restricted and without imposing the homogeneity and symmetry restrictions. Then, after checking homogeneity restriction for each equation of the system, we examine accuracy of this assumption and providing rejection of homogeneity assumption, The model restricted to homogeneity restriction will be estimated and then we also specify accuracy of symmetry assumption with testing the symmetry restriction of system, and finally the model restricted to homogeneity and symmetry restrictions will be estimated. After the process, the most appropriate model to explain the consumption behavior of rural households will be determined and finally Marshallian as well as total expenditure elasticity will be calculated.

LAIDS System Of Equations

In this paper, the almost ideal demand system is used to estimate the demand functions for different commodity groups. This model has considerable advantages than demand system model and it obtain a significant generalization. This system does not derived directly from a specific utility function but it has been derived by the expenditure function. This function represents the minimum expenditure necessary to achieve a certain level of utility with certain prices that is shown as c (p, u). The expenditure function defined for this model is as follow:

$$\log c(p,u) = \alpha_0 + \sum_i \alpha_i \log p_i + \frac{1}{2}\sum_i \sum_j \gamma_{ij}^{*} \log p_i \log p_j + u\beta_0 \prod_{i=1}^{n} p_i^{\beta_i}$$

According to Shephard Lemma, the first derivative of expenditure function ($Q_i = \frac{\partial c(u, p_i)}{\partial p_i}$), is compensatory demand function as follow:

$$w_i = \alpha_i + \sum_j \gamma_{ij} \log p_j + \beta_i \left[\frac{\log m - (\alpha_0 + \sum \alpha_i \log p_i + \frac{1}{2}\sum_i \sum_j \gamma_{ij}^{*} \log p_i \log p_j)}{\beta_0 \prod_{i=1}^{n} p_i^{\beta_i}} \right]$$

Where w_i represents the share of expenditure of each group of goods in total household expenditures, p_j represents Price index of i^{th} commodity group, m and p are average annual total expenditures of a rural household and Stone index, respectively. The important point is that almost ideal demand system is a non-linear model in its general form and given the real price index. But since many observations are needed to estimate this model, we should make it linear and estimate the linear model, as many studies conducted in other countries. To achieve this purpose, we use Stone index instead of the real price index which is defined as follows:

$$\log P^{*} = \sum_i w_{it} \log p_i$$

It is notably that this system has following restrictions:

restrictions	Restrictions in AIDS
Adding- up	$\sum \alpha_i = 1, \quad \sum_j \gamma_{ij} = 0, \sum \beta_i = 1$
Homogeneity	$\sum_j \gamma_{ij} = 0$
Slutsky symmetry	$\gamma_{ij} = \gamma_{ji}$

In this paper, the statistics related to the consumption expenditures of rural households has been collected from detailed results of statistics from expenditure and income of rural households during 1971- 2008which is published each year by the Iranian Statistics Center and the consumer price index of goods and services is derived from statistics published by the Central Bank of Iran. In this study, the following commodity groups have been investigated in model estimation: 1. Food, drinking and tobacco groups (food); 2. Housing and fuels groups (housing); 3.Clothing and footwear groups (clothing); 4.appliances and furniture groups (furniture); 5. Health group; 6.Transport and communications group; 7.Other goods.

Model Estimation

The ISUR method of system of simultaneous equations has been used to estimating model and the parameters of the model. The common method for estimating equations is that one of the demand equations is excluded from system of simultaneous equations and the parameters of other equations are estimated. Then parameters of excluded equation can be calculated in terms of other parameters using the Adding– up restriction. Since the sum of demand equations is equal to one ($\sum_i w_i = 1$), eliminating each of the equations could be arbitrary. So we eliminate the other goods and services group from our system of equations and calculate the values of its parameters via Adding–up restriction. Based on the final form of LAIDS model, the following variables has been entered into the demand model: the share of expenditure on each commodity group (w_i) from total expenditure of household as dependent variable, price index of each commodity group (p_j) and real expenditure with real household budget$\left(\frac{x}{p^*}\right)$as effective variables. The AIDS system demand function is estimated for each commodity group as follow:

wcloth=c(1)+c(11)*log(pcloth)+c(12)*log(peat)+c(13)*log(pfur)+c(14)*log(phealth)+c(15)*log(phouse)+c(16)*log(ptrans)+c(17)*log(pother)+c(111)*(log(m)-logp)

weat=c(2)+c(21)*log(pcloth)+c(22)*log(peat)+c(23)*log(pfur)+c(24)*log(phealth)+c(25)*log(phouse)+c(26)*log(ptrans)+c(27)*log(pother)+c(211)*(log(m)-logp)

wfur=c(3)+c(31)*log(pcloth)+c(32)*log(peat)+c(33)*log(pfur)+c(34)*log(phealth)+c(35)*log(phouse)+c(36)*log(ptrans)+c(37)*log(pother)+c(311)*(log(m)-logp)

whealth=c(4)+c(41)*log(pcloth)+c(42)*log(peat)+c(43)*log(pfur)+c(44)*log(phealth)+c(45)*log(phouse)+c(46)*log(ptrans)+c(47)*log(pother)+c(411)*(log(m)-logp)

whouse=c(5)+c(51)*log(pcloth)+c(52)*log(peat)+c(53)*log(pfur)+c(54)*log(phealth)+c(55)*log(phouse)+c(56)*log(ptrans)+c(57)*log(pother)+c(511)*(log(m)-logp)

wtrans=c(6)+c(61)*log(pcloth)+c(62)*log(peat)+c(63)*log(pfur)+c(64)*log(phealth)+c(65)*log(phouse)+c(66)*log(ptrans)+c(67)*log(pother)+c(611)*(log(m)-logp)

Where, Wcloth denotes the share of clothing group expenditure from total household expenditure, weat denotesthe share of food group expenditure from total household expenditure, wfur denotes the share of furniture group expenditure from total household expenditure, whealth denotes the share of health group expenditure from total household expenditure, whouse denotes the share of housing group expenditure from total household expenditure, wtrans denotes the share of transportation group expenditure from total household expenditure, pcloth denotes the consumer price index of clothing group, peat denotes the consumer price index of food group, pfur denotes the consumer price index of furniture group, Phealth denotes the consumer price index of health group, Phouse denotes the consumer price index of housing group and ptrans denotes the consumer price index of transportation group.

$$\begin{bmatrix} wcloth \\ weat \\ wfur \\ whealth \\ whouse \\ wtrans \end{bmatrix} = \begin{bmatrix} c(1)c(11)c(12)c(13)c(14)c(15)c(16)c(111) \\ c(2)c(21)c(22)c(23)c(24)c(25)c(26)c(211) \\ c(3)c(31)c(32)c(33)c(34)c(35)c(36)c(311) \\ c(4)c(41)c(42)c(43)c(44)c(45)c(46)c(411) \\ c(5)c(51)c(52)c(53)c(54)c(55)c(56)c(511) \\ c(6)c(61)c(62)c(63)c(64)c(65)c(66)c(611) \end{bmatrix} \begin{bmatrix} 1 \\ logpcloth \\ logpeat \\ logpfur \\ logphealth \\ logphouse \\ logptrans \\ \log(m-p) \end{bmatrix} + \begin{bmatrix} u_1 \\ u_2 \\ u_3 \\ u_4 \\ u_5 \\ u_6 \end{bmatrix}$$

The results of unrestricted LAIDS model estimation is shown in table (1). The value of R^2 statistic in all commodity groups is between 80 to 90 percent implying favorably of fitness and ability of model to explain a considerable portion of behavior of dependent variables. Durbin-Watson statistic is closed to two in all equations indicates that the autocorrelation hypothesis is rejected. The results of model restricted to homogeneity and Symmetry restrictions also has been shown in table (2) implying favorably of model fitness.

Table (1) - The results of unrestricted LAIDS model

Variable	name coefficient	Coefficient	Std. Error	t-Statistic	Prob.
clothing group	intercept	-0.112479	0.06815	-1.650467	0.1007
	clothing price coefficient	0.068652	0.012748	5.385155	0
	food price coefficient	-0.070111	0.01146	-6.117743	0
	furniture price coefficient	0.029569	0.01471	2.010156	0.046
	health price coefficient	-0.002736	0.007796	-0.350956	0.7261
	housing price coefficient	-0.011331	0.006709	-1.68895	0.0931
	transport price coefficient	0.00442	0.009351	0.472746	0.637
	other goods price coefficient	-0.022781	0.010173	-2.239447	0.0265
	clothing income coefficient	0.023488	0.006169	3.807137	0.0002

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food group	intercept	1.589244	0.304688	5.215974	0
	clothing price coefficient	-0.018166	0.060157	-0.301976	0.763
	food price coefficient	-0.01549	0.055093	-0.281162	0.7789
	furniture price coefficient	-0.084546	0.077129	-1.096159	0.2746
	health price coefficient	-0.062626	0.039538	-1.583958	0.1151
	housing price coefficient	-0.006156	0.03255	-0.18914	0.8502
	transport price coefficient	0.034629	0.043289	0.799955	0.4249
	other goods price coefficient	0.124041	0.051329	2.416587	0.0168
	food income coefficient	-0.089063	0.027318	-3.26021	0.0014
furniture group	intercept	-0.153564	0.064131	-2.394538	0.0178
	clothing price coefficient	-0.016945	0.01201	-1.410952	0.1601
	food price coefficient	-0.046548	0.01033	-4.506266	0
	furniture price coefficient	0.071412	0.014871	4.801968	0
	health price coefficient	0.045515	0.007384	6.164222	0
	housing price coefficient	-0.01114	0.006241	-1.785119	0.0761
	transport price coefficient	0.006199	0.008823	0.702601	0.4833
	other goods price coefficient	-0.049166	0.009764	-5.035282	0
	furniture income coefficient	0.02052	0.00583	3.519815	0.0006
health group	intercept	-0.048521	0.049646	-0.97734	0.3298
	clothing price coefficient	0.006369	0.009455	0.673609	0.5015
	food price coefficient	0.003475	0.008462	0.410601	0.6819
	furniture price coefficient	-0.017417	0.012083	-1.441435	0.1513
	health price coefficient	-0.000998	0.00619	-0.161164	0.8722
	housing price coefficient	0.013385	0.005162	2.592826	0.0104
	transport price coefficient	-0.014089	0.006853	-2.05587	0.0414
	other goods price coefficient	0.017139	0.007731	2.21691	0.028
	health income coefficient	0.006044	0.004474	1.350733	0.1786
housing group	intercept	0.042935	0.088846	0.483257	0.6295
	clothing price coefficient	-0.009657	0.016577	-0.582581	0.561
	food price coefficient	0.04072	0.015043	2.706972	0.0075
	furniture price coefficient	-0.015075	0.018791	-0.802249	0.4236
	health price coefficient	-0.035517	0.010086	-3.521267	0.0006
	housing price coefficient	0.018794	0.008719	2.155628	0.0326
	transport price coefficient	0.028499	0.012213	2.333494	0.0208

	other goods price coefficient	-0.01889	0.013157	-1.435738	0.153
	housing income coefficient	0.005474	0.008043	0.680554	0.4971
transportation group	intercept	-0.27737	0.096703	-2.868271	0.0047
	clothing price coefficient	-0.041505	0.018786	-2.209339	0.0285
	food price coefficient	0.028141	0.017885	1.573449	0.1175
	furniture price coefficient	0.028244	0.024504	1.152656	0.2507
	health price coefficient	0.002228	0.012762	0.174597	0.8616
	housing price coefficient	0.037694	0.010408	3.621481	0.0004
	transport price coefficient	-0.018864	0.013941	-1.353113	0.1779
	other goods price coefficient	-0.022292	0.016011	-1.392272	0.1657
	transport income coefficient	0.023844	0.008636	2.761077	0.0064

Source: The research findings

Table (2) - The results of model restricted to homogeneity and Symmetry restrictions

Variable	name coefficient	**Coefficient**	**Std. Error**	**t-Statistic**
clothing group	intercept	0.113494	0.009645	11.7676
	clothing price coefficient	0.077869	0.01217	6.398503
	food price coefficient	-0.059021	0.012218	-4.830689
	furniture price coefficient	0.009949	0.012909	0.770706
	health price coefficient	-0.00087	0.007383	-0.117856
	housing price coefficient	-0.02274	0.006702	-3.393237
	transport price coefficient	-0.008747	0.009234	-0.94729
food group	intercept	0.251742	0.058416	4.309498
	food price coefficient	0.081609	0.036098	2.260747
	furniture price coefficient	-0.028099	0.018612	-1.509717
	health price coefficient	-0.032191	0.016017	-2.00983
	housing price coefficient	0.01412	0.013512	1.045043
	transport price coefficient	6.06E-05	0.018225	0.003323
furniture group	intercept	0.079842	0.015108	5.284926
	furniture price coefficient	0.013779	0.020372	0.676368
	health price coefficient	0.01552	0.010891	1.425017
	housing price coefficient	0.00192	0.009296	0.206587
	transport price coefficient	-0.012767	0.012253	-1.041958
health group	intercept	0.119446	0.026419	4.521289
	health price coefficient	0.039947	0.012098	3.301941
	housing price coefficient	-0.016425	0.007559	-2.173098

	transport price coefficient	0.001757	0.009976	0.176081
housing group	intercept	0.210346	0.011574	18.17355
	housing price coefficient	0.004508	0.00958	0.470553
	transport price coefficient	0.027708	0.008773	3.158266
transportation group	intercept	0.150902	0.029511	5.113374
	transport price coefficient	0.003258	0.015922	0.204641

Source: The research findings

Calculation And Interpretation Of The Elasticities Based On The AIDS Model

In the AIDS model, it is not possible to present an interpretation about estimated parameters and we should use Marshallian price elasticity (MPE), Hicksian price elasticity (HPE), Allen elasticity of substitution (AES) and total expenditure elasticity (TEE). Each of the listed economic indicators offers appropriate criteria to more realistic understanding of consumer's behavior.

Marshallian Price Elasticity (MPE)

There are various relations to calculate the Marshallian price elasticity (non-compensatory price elasticity). For example, Chalfant (1987) calculated the Marshallian price elasticity using the following equation:

$$\varepsilon_{ij} = -\delta_{ij} + \{\gamma_{ij} - \beta_i w_j\}/w_i$$

Yeldz and Youner (1988) also used the following relationship to calculate the Marshallian price elasticity for LAIDS:

$$\varepsilon_{ij} = -\delta_{ij} + \gamma_{ij}/w_i$$

δ_{ij}Denotes the Kronecker delta which is equal to one for $i = j$ and zero for $i \neq j$.

The results of calculating the Marshallian price elasticity by Chalfant index for restricted model with considering the Slutsky symmetry requirement, is shown in table (3). The diagonal elements represent the own price elasticity. The values of Marshallian own price elasticities proves that Allen price elasticities related to all commodity groups are negative and this result suggests that this commodity groups satisfy the demand law. Also based on the Marshallian price elasticity, it can be concluded that the greatest price sensitivity is in the transportation group and lowest price sensitivity is in the clothing group. The absolute value of own price elasticity for clothing, food, health, furniture and housing is less than unit; In other words this group of commodities, are low elasticity goods; If their prices change by a percent, the demand for them will be changed less than one percent, namely a percent change in food price index leads to reducing in demand for this commodity group by 0.75 percent. However the transportation group has elastic demand and its absolute value of own price elasticity is greater

than unit. The non-diagonal elements in table (3) show the Marshallian cross price elasticity. The cross effects presented in the table indicates that the gross substitution and complementary effects of commodity groups has been poor($|\varepsilon_{ij}| < 1$). The positive sign of cross elasticity indicates that two goods are substitution and the negative sign indicates that two goods are complements. The food group is gross complementary with furniture, health and housing groups and is gross substitution with transportation group.

Table3. Chalfant Marshallian elasticity for commodity groups of LAIDS with impose the symmetry restriction

MPE	clothing	food	Furniture	health	housing	transportation
clothing	-0.292727273	-0.5436364	0.078181818	-0.1	-0.1145455	-0.10181818
food	___	-0.7571429	-0.026530612	-0.01020408	-0.0346939	0.053061224
Furniture	___	___	-0.801428571	0.121428571	-0.1985714	-0.12571429
health	___	___	___	-0.8008	0.19792	-0.20096
housing	___	___	___	___	-0.8662308	0.309076923
transportation	___	___	___	___	___	-1.35333333

Source: The research findings

Total Expenditure Elasticity

Another useful tool to analyzing consumers behavior and understanding the position of goods with them, is classification of goods to normal, essential and inferior goods based on income elasticity of demand. In the AIDS model, total expenditure elasticity is calculated by the following relationship:

$$\eta_i = 1 + \frac{\beta_i}{w_i}$$

The results of income elasticity for the various commodity groups is shown in Table (4).As the table shows, the sign of income elasticity for all commodity groups are positive which suggests that all commodity groups are placed in the category of normal goods among the rural consumers. In other words, if income increases, the demand for this commodity groups will be increased. The value of this elasticities indicates that food, housing and health groups, have less than unit income elasticity and are placed in the category of normal goods and also income elasticity for clothing, furniture and transportation groups is greater than unit and are placed in

the category of luxury goods. Given the value of income elasticity it can be concluded that with any increased income or economic prosperity, the greatest demand pressure is entered on the furniture group($\eta_i = 1.42$) in the first order and then on transportation group ($\eta_i = 1.33$).This means that if income increases, an higher percentage of it, will be guided toward the mentioned groups and households extremely increases their demand for this two groups.

Table4. Expenditure elasticity for commodity groups of LAIDS with impose the symmetry restriction

TEE	Coefficient
clothing	1.25
food	0.79
Furniture	1.42
health	1.01
housing	0.97
transportation	1.33

Source: The research findings

Conclusion

The basic aim of this paper, is analyzing the behavior of rural consumers in relation to consumption of various goods in the consumption bundle. In this study, we used the almost ideal demand system with imposing classical restrictions (symmetry, homogeneity, and adding – up). The results of this paper show that:

1.Based on the Marshalian price elasticity it can be concluded that the highest price sensitivity is in the transportation group and lowest price sensitivity is in the clothing group; The absolute value of price elasticity for clothing, food, health, furniture and housing groups is less than unit, so this commodity groups are placed in the category of low elasticity goods, that is if their price changes by a percent, the demand for them changes less than one percent; namely a percent change in food price index lead to reducing in demand for this commodity group by 0.75 percent. However the transportation group has elastic demand and its absolute value of own price elasticity is greater than unit; the non-diagonal elements in table (3) show the Marshallian cross price elasticity. The cross effects presented in the table indicates that the gross substitution and gross complementary effects of commodity groups has been weak($|\varepsilon_{ij}| < 1$). The positive sign of cross elasticity indicates that two goods are substitution and the negative sign indicates that two goods are complements. The food group is gross complementary with furniture, health and housing groups and is gross substitution with transportation group;

2. The sign of income elasticity is positive for all commodity groups, which suggests that all of the commodity groups are normal goods for rural consumers. In other words, if income increases, the demand for these commodity groups will be increased. The value of this elasticities shows that the three groups of food, shelter and health have less than unit income elasticity indicates that they are placed in the category of essential goods and income elasticity for the three groups of clothing, furniture and transportation is greater than unit indicates that they are placed in the category of luxury goods. Given the value of income elasticity it can be concluded that with any increased income or economic prosperity, the greatest demand pressure is entered on the furniture group($\eta_i = 1.42$) in the first order and then on transportation group ($\eta_i = 1.33$).This means that with increasing income, an higher percentage of it, willbe guided toward the mentioned groups and households extremely increases their demand for this two groups.

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