An Experimental Comparison between Demand Systems of Major Food Groups in Urban Economics

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Abstract: Problem statement: This study examined the eleven major food groups demand for urban areas of Iran during1361-1386. **Approach:** AIDS, ROTTERDAM, CBS and NBR models was compare together and Sur method was applied for estimating of systems, too. **Results:** Results of study showed cream and fresh fruits have smallest and largest income elasticity, respectively. Also, cream, bread, dairy, egg, fresh vegetables, oils and fats and sugar and products, are necessary, meat, fresh fruits and dried fruit are luxury and grain is only inferior group, too. The exception meat, dried fruit and sugar and its products, other groups are inelastic than own price changes. Also, among them, grain and dried fruit are most inelastic and most elastic, respectively. That means that demand for them has smallest and largest sensitivity than own price influences. Also, cross price elasticity's represented that nor of the groups, are gross strictly substitute, together and gross substitute among them is weak. About complement relation, should say fresh fruits and oils and fats are gross strictly complement for cereal and sugar and its products, respectively and gross complement relation among other groups is found weak. **Conclusion:** AIDS was better than other models and should be apply for analysis of major food group demand for urban areas of Iran, alternatively.

Key words: Demand systems, model selection, major food groups, Iran

INTRODUCTION

Always, the economists and makers policies, were have considered to selection of suitable functional form for demand that, it is capable to represent consumers rational behavior hypothesis, goodly and it is compatible to demand theory. That means its price and income elasticity's and coefficients, be rational and agreement to fact.

In the article, is studied the major food groups demand in urban areas of Iran for the period 1361-1386 and experimental are compared AIDS, ROTTERDAM, CBS, NBR models. Eleven major food groups are survey in the study, include: 1- creal 2-bread 3-grain 4-dairy 5-egg 6-meat 7-fresh fruits 8-fresh vegetables 9-dried fruit 10-oils and fats 11-sugar and its products. In the field of demand, is studied many.

Fousekis and Revell (2000) analyze demand for meat in the UK and found Rotterdam and CBS better explain consumers' retail purchase allocation decisions for beef, lamb, pork, bacon and poultry compared with models NBR and differential AIDS. Erkan (2006) study three demand systems with their extensions for agricultural products in OECD countries, namely the Rotterdam, AIDS and CBS model by SUR method. He understood significant empirical regularities for agricultural products in OECD countries and the superiority of AIDS and CBS models over the Rotterdam model. Blanciforti *et al.* (1986) with data during 1978-1984 for USA estimate consumer demand by using AIDS and LES and showed AIDS have rational coefficient and estimation of it is simplest than AIDS, by applying linear techniques and comparing the linear and nonlinear AIDS to Rotterdam model and fond out the models relative supremacy depended to substitute elasticity's of commodities. For example, when substitute among all of commodities is very high, nonlinear AIDS is better than Rotterdam and otherwise, both of them are suitable. Zhang *et al.* (2006), in analyzing demand for commonly and organic vegetables in US. Were found AIDS is better than other functional forms.

MATERIALS AND METHODS

Earlier studies use single equation techniques to estimate commodity demand by consumers. But in the last several decades, consumer demand analysis has

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moved toward system-wide approaches (Lee *et al.*, 1994). System-wide approaches ensure that the demand system is consistent with consumer theory. On the other hand, single equation specifications are primarily concerned with estimating elasticity and paid little attention to consumer theory. Because of existence of correlation among residuals of demand equations, Sur method (Zellner, 1962) was applied for estimating of systems.

Differential demand systems: The Almost Ideal Demand System (Deaton and Muellbauer, 1980), the Rotterdam model (Barten, 1964; Zhang *et al.*, 2006) and their variants are probably the most commonly used functional forms in empirical demand analysis. The Rotterdam model, developed by Barten (1964) and Theil (1965), takes the following differential form:

$$w_i d\log q_i = \theta_i d\log Q + \sum_j \pi_{ij} d\log p_j \quad i = 1, 2,...,n, \qquad (1)$$

Where:
q_i = The quantity of good i
P_i = The unit price of good i
$w_i = \dfrac{p_i x_i}{m}$ = The expenditure share for commodity i
$d\log q_i$ = The log change in the consumption level for commodity i
$d\log p_j$ = The log change in the price for commodity i

The term $d\log Q$ is an index number (Divisia volume index) for the change in real income and can be written as:

$$d\log Q = \sum_i w_i d\log q_i \qquad (2)$$

The demand parameters θ_i and π_{ij} are given by:

$$\theta_i = (\frac{\partial p_i q_i}{\partial m}) \qquad (3)$$

and:

$$\pi_{ij} = \left(\frac{p_i p_j}{m}\right) S_{ij} \qquad (4)$$

$$S_{ij} = \frac{\partial q_i}{\partial p_j} + q_j \frac{\partial q_i}{\partial m} \qquad (5)$$

Where:
m = The total outlay or the budget
s_{ij} = The (i,j)th element of the Slutsky substitution matrix parameter

θ_i = The marginal budget share of commodity i
π_{ij} = A compensated price effect

The constraints of demand theory can be directly applied to the Rotterdam parameters. In particular, we have adding-up:

$$\sum_i \theta_{ij} = 1, \quad \sum \pi_{ij} = 0 \qquad (6)$$

Homogeneity:

$$\sum \pi_{ij} = 0 \qquad (7)$$

Slutsky symmetry:

$$\pi_{ij} = \pi_{ji} \qquad (8)$$

The Rotterdam model is a particular parameterization of a system of differential demand equations where demand parameters θ_i and π_{ij} are assumed to be constant. However, there is no strong a priori reason that the θ_i and π_{ij} should be held constant. By relaxing the marginal budget share parameter to be variable, Keller and Van Driel (1985) further proposed the CBS (Central Bureau of Statistics) model:

$$w_i d\log q = \theta_i d\log Q + \sum_j \pi_{ij} d\log p_j \qquad (9)$$

by substituting $\theta_i = \beta_i + w_i$ and moving it to the left, in (7), we have CBS form:

$$w_i(d\log q_i - d\log Q) = \beta_i d\log Q + \sum_j \pi_{ij} d\log p_j \qquad (10)$$

Where:
β_i and π_{ij} = Constant coefficients
$\beta_i + w_i$ = The marginal budget share

Different from the Rotterdam model, the original AIDS model, in its original formulation, is not a differential function. It is specified as:

$$w_i = \alpha_i + \sum_j \gamma_{ij} \log p_j + \beta_j \log(\frac{m}{P}) \qquad (11)$$

where, P is a price index defined by:

$$\log P = \alpha_0 + \sum_{k=1}^{n} \alpha_k \log p_k + 0.5 \sum_{j=1}^{n}\sum_{k=1}^{n} \gamma_{kj} \log p_k \log p_j \qquad (12)$$

Transformating nonlinear AIDS to linear form, there are price indexs including: Stone, Laspyres, Passchet and Tornqvist Price Index, alternatively. For example, Laspyres Price Index is defined as:

$$\log P^L = \sum_{k=1}^{n} w_{k0} \log p_{kt} \qquad (13)$$

Where:

p_{kt} = The price of good k

w_{k0} = The expenditure share for commodity k in benchmark year

The adding-up restriction requires that:

$$\sum_{i=1}^{n} \alpha_i^* = 1, \sum_{i=1}^{n} \gamma_{ij} = 0, \sum_{i=1}^{n} \beta_i = 0 \qquad (14)$$

Homogeneity is satisfied when:

$$\sum \gamma_{ij} = 0 \qquad (15)$$

and symmetry is satisfied if:

$$\gamma_{ij} = \gamma_{ji} \qquad (16)$$

A fourth alternative, the National Bureau of Research (NBR) model (Lee *et al.*, 1994) can be derived by substituting $\theta_i - w_i$ for first differential AIDS that is fallowing:

$$dw_i = \beta_i d \log Q + \sum_j \gamma_{ij} d \log p_j \qquad (17)$$

the NBR is obtained as:

$$dw_i + w_i d \log Q = \theta_i d \log Q + \sum_j \gamma_{ij} d \log p_j \qquad (18)$$

So that it has the Rotterdam income coefficients but the AIDS price coefficients. Specifically, the four models have the same left-hand side variable wide log q_i and right-hand side variables d logQ and d log p_i.

Elasticies formoula: Elasticities are computable as representing in Table 1.

RESULTS

In this study AIDS, CBS, NBR and Rotterdam models were applied and compared. AIDS, on the reason of having the most the numbers of significant coefficients, highest R^2 for each equation of the system, was selected Table 2.

Also, own price elasticity's were negative under AIDS, the homogeneity, symmetry and negativity was rejected for all. CBS can't provide the adding up and Rotterdam's own price elasticity's was positive, except in two cases. Also, NBR had the lesser the numbers of significant coefficients and lower R^2 for each equation of the system, than AIDS. Hence, AIDS was select Table 3.

Table 1: Income and price elasticities for demand models

Elasticity/model	AIDS	Rotterdam	CBS	NBR
Income elasticity	$\dfrac{\beta_i}{w_i} + 1$	$\dfrac{\theta_i}{w_i}$	$\dfrac{\beta_i}{w_i} + 1$	$\dfrac{\theta_i}{w_i}$
Uncompensated (Marshallian) price elasticity	$-\delta_{ij} + (\dfrac{\gamma_{ij}}{w_i}) - \beta_i (\dfrac{w_j}{w_i})$	$\dfrac{\pi_{ij}}{w_i} - \dfrac{\theta_i}{w_i} w_j$	$\dfrac{\pi_{ij}}{w_i} - \dfrac{\beta_i}{w_i} w_j - w_j$	$-\delta_{ij} + \dfrac{\gamma_{ij}}{w_i} + w_j - \dfrac{\beta_i}{w_i} w_j$

where, δ_{ij} is kronecker delta and $\delta = 1$ for $i = j$ and $\delta = 0$ otherwise

Table 2: The number of significant coefficients (without intercept)

Restricted (homogeneity), demand system	Levels of signification					
	1 (%)	5 (%)	10 (%)	15 (%)	25 (%)	30 (%)
AIDS	39	52	61	69	80	83
NBR	32	40	49	53	64	71

Resource: The paper's findings

Table 3: R^2 and SSR derived of each equation of system

		Creal	Bread	Grain	Dairy	Egg	Meat	Fresh fruits	Fresh vegetables	Dried fruit	Oils and fats	Sugar and its products
AIDS	SSR	0.0007	0.00004	0.00005	0.0002	0.00009	0.003	0.0004	0.0005	0.00004	0.0005	0.0004
	R^2	0.9800	0.96000	0.96000	0.7600	0.84000	0.940	0.9800	0.8500	0.97000	0.9100	0.9400
NBR	SSR	0.0009	0.00005	0.00005	0.0002	0.00006	0.005	0.0006	0.0010	0.00009	0.0010	0.0004
	R^2	0.7600	0.88000	0.94000	0.8800	0.89000	0.890	0.9000	0.8200	0.79000	0.4000	0.8100

Resource: The paper's finding

DISCUSSION

Results represent that creal and fresh fruits have smallest and largest income elasticity, respectively. Also creal, bread, dairy, egg, fresh vegetables, oils and fats and sugar and products, are necessary groups, meat, fresh fruits and dried fruit are luxury groups and grain is only inferior group, too. The exception meat, dried fruit and sugar and its products, other groups are inelastic than own price changes. Also, among them, grain and dried fruit are most inelastic and most elastic, respectively. That means that demand for them has smallest and largest sensitivity than own price influences. Also, Cross price elasticity's represented that nor of the groups, are gross strictly substitute, together and gross substitute among them is weak. About complement relation, should say fresh fruits and oils and fats are gross strictly complement for cereal and sugar and its products, respectively and gross complement relation among other groups is found weak.

CONCLUSION

This research, intended to find which system of demand, is fitter for explaining consumers demand for major food groups, in urban areas of Iran. On the basis of finding, AIDS model was better than other models and should be apply for analysis of major food groups' demand for urban areas of Iran.

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