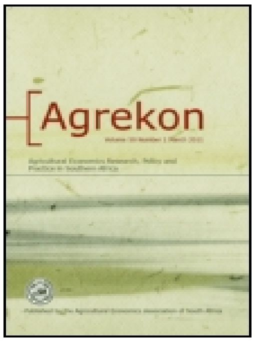

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COMPARISON OF ROTTERDAM MODEL VERSUS ALMOST IDEAL DEMAND SYSTEM FOR FISH AND RED MEAT

Habibeh Sherafatmand* **(corresponding author) and Ali Akbar Baghestany****

ABSTRACT

The Rotterdam and the almost ideal demand systems (AIDS) are often used to model consumer demand system. The present study determined which model performed better in recovering the true elasticities of consumer demand for red meat and fish. For the linearised AIDS model, Stone, Paasche, Laspeyres, and Turnquist price indexes were used. This study also compared the results of the linearised AIDS and the full nonlinear AIDS (NLAIDS) models. According to Lutkepohl, normality test for joint residuals, the linearised AIDS model that used Turnquist price index, was the best system and, based on the Akaike criteria, the linear approximate (LA) AIDS outperformed NLAIDS. The results of the non-nested test for LAAIDS versus Rotterdam showed that LAAIDS is more appropriate for red meat and fish demand in Iran. Price elasticity for fish and red meat showed that they are elastic. Cross elasticity from LAAIDS and NLAIDS showed that fish and red meat are substitutes. Allen-Uzawa elasticity results indicate that the two goods are strong substitutes. Income elasticity indicated that red meat and fish are considered to be luxury goods.

Keywords: Rotterdam model, (NL) AIDS model, fish, red meat

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1. INTRODUCTION

The Iranian livestock industry accounts for 27% of agricultural value added. This industry provides more than 50% of the protein consumed by Iranians. The average per capita red meat consumption in developed countries is 24.7kg, but it is 12.6kg in Iran. The average per capita fish consumption in developed countries is 25kg, but it is 10kg in Iran. The difference between actual and reasonable (in developed countries) in per capita consumption of red meat and fish results from factors such as the decline in the purchasing power of households and an increase in the retail price of these two goods.

Figure 1 shows the rise in the price index of red meat and fish at the retail level in Iran from 1984 to 2012. It can be seen that prices in recent years have risen sharply (red meat and fish price indexes). As prices increased, per capita consumption decreased, which may result in nutritional deficiencies in the near future. The figure charts the red meat and fish price indices at the retail level in Iran using 2011 as the constant price (P 2011 = 100). The figure shows that both price indexes rose over time. The real price indexes of red meat and fish during this period fluctuated and fish prices were generally higher.

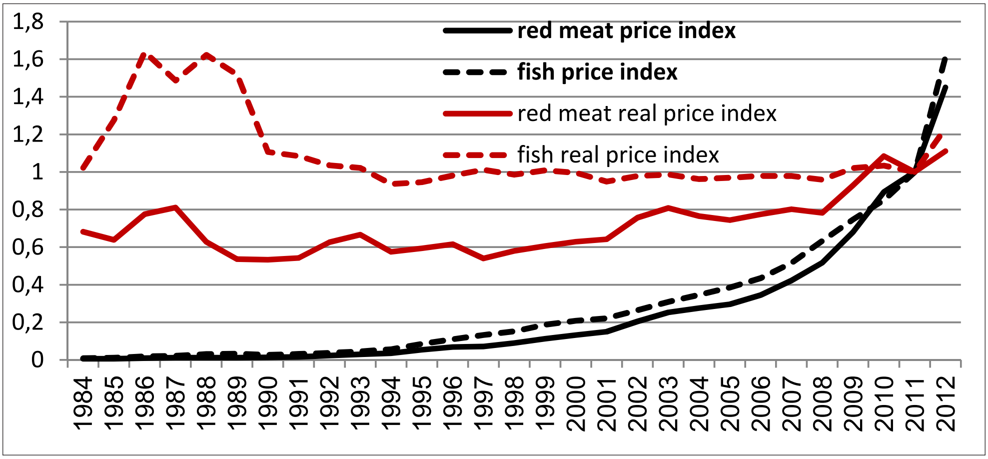

Figure 1: Annual price indexces in Iran from 1984 to 2012

Successive drought, inappropriate trade policies and skyrocketing input prices have brought about a sharp increase in the prices of some products after 1994. The price of barley, as basic livestock forage, has also increased, which increases the price of red meat. The major reasons for the increase in fish prices are the lack of government support of organisations that raise fish, bad weather conditions, and the number of middlemen between farm and market.

This study determined consumer demand for red meat and fish. The increase in population and resulting rise in demand for meat have increased the importance of estimating the demand function and significant factors affecting demand. It is crucial to estimate the demand function to identify consumer preferences, develop coherent policies for consumption, and to forecast and plan for future consumer needs. The results may help policy makers to predict demand and control the prices of these two important products.

Figure 2 shows household expenditure on red meat and fish. This provides information on how consumers allocate their income among competing commodities. While both red meat and fish expenditures increased, household expenditure on red meat was generally higher than that for fish, indicating the Iranian preference for red meat. Household expenditure for red meat was about eight times that for fish. The way in which consumers allocate their income among competing meats is closely related to the expenditure share allocation. Data shows that the share of total expenditure on red meat is 6% and on fish is 0.7%.

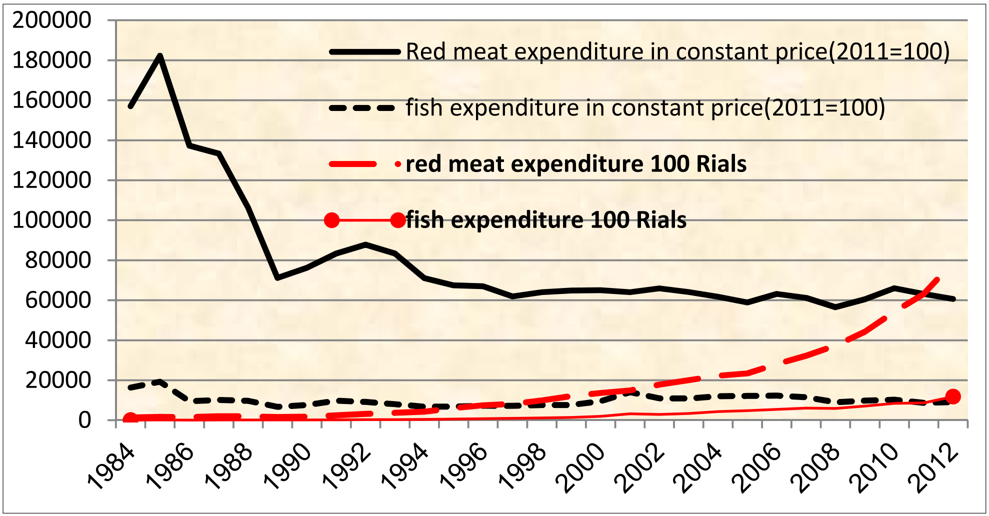

Figure 2: Annual red meat and fish expenditure in Iran from 1984 to 2011 using 2011 as the base year

The present study estimated the demand function for red meat and fish with respect to:

- The most appropriate demand pattern
- The most suitable index for the linearisation of the AIDS model

- The best formula for calculating income and price elasticity

In the five-year development plan, government policies have sought to protect domestic producers and forecast consumer demand. Study results suggest that policy makers can make appropriate policies in response to household need. If estimates of demand are done properly and appropriate policies are implemented, a good percentage of the red meat requirement can be provided from domestic products.

Numerous studies have estimated demand function consistent with economic theory. The majority have adopted flexible functional forms that rely heavily on duality theory. The generalised Leontief, translog, and Rotterdam models (Theil, 1965; 1975; Barten, 1964; 1968; 1977), and the almost-ideal demand system (AIDS) (Deaton and Muellbauer, 1980a; 1980b) are the most popular demand models. Their functional forms are locally flexible because they do not put *a priori* restrictions on possible elasticities at a given point. They also use sufficient parameters to approximate elasticities at a given point; however, locally flexible functional forms often exhibit small regular regions consistent with macroeconomic theory. In applied microeconomics, the AIDS and the Rotterdam models are most commonly used, mainly because each can be estimated in a linearised form and theoretical restrictions can be easily imposed and tested (Barnett and Seck, 2007).

The Rotterdam model was proposed by Barten (1964) and developed by Theil (1965). Practical applications for this model test the empirical validity of restrictions for demand theory (Deaton and Muealbauer, 1980b; Tridimas, 2000). Barten (1968) carried out the first tests of homogeneity and symmetry employing Dutch data, applied the Rotterdam model to four broad groups, and found little conflict between data and theory. His study, however, used informal testing procedures.

A number of other studies have used the static AIDS specification, including Jones (1989), Nelson and Moran (1995), Gao *et al.* (1995), Andrikopoulous *et al.* (1997), Mojaver-Hosseini (2007), Samadi (2007), Bakhshoodeh (2005), Holt and Goodvin (1970), and Hayes *et al.* (1990). AIDS has been widely used in studies on meat demand, including those conducted in the US (Brester and Schroeber, 1995), Canada (Reynonds and Goddard, 1991; Xu and Veeman, 1996), Japan (Hayes *et al.*, 1990), and the UK (Burton *et al.*, 1996; Tiffin and Tiffin, 1999). Other studies have compared the Rotterdam model with the AIDS system, as in Deaton (1978), Davidson and Mackinnon (1981), Alston and Chalfant (1993), Barten (1993), Lee *et al.* (1994), Kastens and Brester (1996), Tridimas (2000), Jung and Koo (2000), Fousekis and Revell (2002), Taljaard *et al*. (2006), Divina (2006), Hossinipour *et al.* (2008), and Mousavi *et al.* (2008).

2. OBJECTIVE OF THE STUDY

The focus of this research was to select the demand model that best estimates and explains the variation in Iranian demand for red meat and fish. The gap between this study and other studies is that different price indices for the linearised AIDS model were compared and the best price index was selected. The study:

- Compared and analysed the approximate almost ideal demand system (AAIDS) and the Rotterdam model
- Examined the Stone, Paasche, Laspeyres and Turnquist price indices for the linearised AIDS model and chose the best linear approximation price index
- Tested theoretical demand restrictions and applied system-wise diagnostics to support the selection of the best-fitted model
- Used Allen-Uzawa elasticity of substitution to determine the degree of strength of substitution goods. Cross-price elasticity gives useful information about substitution or complementation, but it does not measure the strength of substitution.

3. DATA

Data on red meat and fish expenditure in Iran were provided by annual statistics from 1984–2012. The following data is from the statistical office of the Central Bank of Iran:

- Red meat expenditure in rials using a constant price of 2011 = 100
- Fish expenditure in rials using a constant price of 2011 = 100
- Red meat and fish price indexes using a constant price of 2011 = 100

4. MODEL DESCRIPTION

4.1. The full AIDS model

The AIDS model in budget shares is

$$W_i = \alpha_i + \sum \gamma_{ij} \log P_j + \beta_i \log(\frac{X}{P^*}) \quad (1)$$

W_i is share of budget that allocate to commodity i from total budget, P_j is the price of commodity j, X is total expenditure and P^* is the price index or price deflator.

Where the price deflator of the logarithm of income is

$$\log P_t^* = \alpha_0 + \sum_k \alpha_k \log P_k + \frac{1}{2}\sum_k \sum_j \gamma_{kj} \log P_k \log P_j \qquad (2)$$

In applications, the nonlinearity of the AIDS model is usually viewed as a technical problem to be circumvented by a linearising approximation to income's price deflator. Deaton and Muellbauer (1980a; 1980b) suggest Stone's price index. Moschini (1995) shows the Stone price index leads to problems of omitted variables and, thereby, to inconsistent parameter estimates. So, this article examines the various indexes of the linear approximation. These price indexes that linearised AIDS system are in table1:

Table 1: Different price indexes for linearised AIDS model

Stone's index	$\log P_t^s = \log P^*{}_t = \sum_{k=1}^{n} w_{kt} \log P_{kt}$
Passhe index	$\log P_t^p = \sum_{k=1}^{n} w_{kt} \log\left(\frac{P_{kt}}{P_{k0}}\right) = \log P_t^s - \sum_{k=1}^{n} w_{kt} \log P_{k0}$
Laspeyres index	$\log P_t^l = \sum_{k=1}^{n} w_{ko} \log P_{kt}$
Turnquist index	$\log P_t^T = \frac{1}{2}\sum_{k=1}^{n}\sum_{k=1}^{n}(w_{kt} + w_{k0})\log\left(P_{kt} / P_{k0}\right) = \frac{1}{2}\left[\log_t^p + \log\left(P_t^l / P_0^l\right)\right]$

w_{k0} = budget share of commodity k in base year

P_{k0} = price of commodity k in base year

Ref: Barnett and Ousmane 2007.

The restrictions on the demand functions are deduced from the cost function, using Shephard's duality lemma. The following are the resulting conditions imposed during estimation of the constrained model:

$\sum_{i=1}^{n} \alpha_i = 1$ for adding up, $\sum_{i=1}^{n} \gamma_{ij} = 0$ and $\sum_{i=1}^{n} \beta_i = 0$ for linear Homogeneity, $\gamma_{ij} = \gamma_{ji}$ for symmetry.

4.2. The absolute price version of the Rotterdam model

The absolute price version of the model is

$$\bar{w}_{it} Dq_{it} = \mu_i DQ_t + \sum_{j=1}^{n} \Pi_{ij} DP_{jt} + U_{it} \tag{3}$$

Where $\bar{w}_{it} = \frac{1}{2}(w_{i,t} + w_{i,t-1})$ is the average budget share of good i between the periods t- 1 and t ,U_{it} is a stochastic disturbance, and $DQ_t = \sum_{i=1}^{n} \bar{w}_{it} Dq_{it}$ is the log change in real income.

The model is estimated subject to the following theoretical restrictions:

$\sum_{i=1}^{n} \mu_i = 1$ For Engel aggregation, $\sum_{i=1}^{n} \Pi_{ij} = 0$ for linear Homogeneity and $\Pi_{ij} = \Pi_{ji}$ for symmetry. With this model, the Slutsky substitution matrix is $\left[\Pi_{ij}\right]$

When the linear homogeneity restriction is imposed, each equation has N unknown Parameters and N independent variables. The system can be estimated with one equation deleted after imposing Engel aggregation and symmetry.

Equation (3) subject to the homogeneity restriction becomes

$$\bar{w}_{it} Dq_{it} = \mu_i DQ_t + \sum_{j=1}^{n-1} \Pi_{ij} (DP_{jt} - DP_{nt}) + U_{it} \tag{4}$$

Estimation can be subject to the restriction of symmetry. The theory also requires negative semi-definiteness of the Slutsky matrix; but, rather than being imposed, that restriction usually is just checked at the point of approximation. With imposed linear homogeneity restriction, the rank of $\left[\Pi_{ij}\right]$ becomes N-1.

The condition of this matrix to be negative semi-definite in the two-good case is

$$\Pi_{11} \langle 0 \text{ an det} \begin{bmatrix} \Pi_{11} & \Pi_{12} \\ \Pi_{21} & \Pi_{22} \end{bmatrix} = \Pi_{11}\Pi_{22} - \Pi_{12}\Pi_{21} \rangle 0 \tag{5}$$

These restrictions could be imposed during estimation. However, as the number of goods increases, that imposition becomes computationally burdensome and hence rarely is imposed but rather just checked after estimation (Barnet and Ousmane, 2007).

The above equations (1 to 4) could be interpreted as a Marshallian (uncompensated) demand function in budget shares. The Hicksian (compensated) price elasticities of good i with respect to good j can be derived from the Marshallian price elasticities by using the Slutsky equation in elasticities. Although the Marshallian and Hicksian cross-price elasticity gives useful information of substitution or complementarily, it does not mention about the degree of strength of substitution goods. So it is recommended to use the Allen-Uzawa elasticity of substitution, also. If the Allen-Uzawa elasticity is positive, the relationship is strong and if this elasticity of substitution is negative, there is a weak substitution and relationship (Layard and Walters 1978).

Table 2: (UN) compensated price elasticity in different models

model	ε_{ij}^{M} **Marshallian price Elasticity**	E_{ij} **Hicks price Elasticity**	η_i **income Elasticity**	**Allen – Uzalwa Elasticity**
LA-AIDS	$\frac{\gamma_{ij}}{w_i} - \beta_i (\frac{w_j}{w_i}) - \delta_{ij}$	$-\delta_{ij} + \frac{\gamma_{ij}}{w_i} + w_j$	$1 + \frac{\beta_i}{w_i}$	$1 + \frac{\gamma_{ij}}{w_i w_j}, i \neq j$
NL-AIDS	$-\delta_{ij} + \frac{\gamma_{ij}}{w_i} - (\frac{\beta_i}{w_i})(\alpha_i + \sum \gamma \ln P_k)$	$\varepsilon_{ij}^{M} + w_i \eta_i$	$1 + \frac{\beta_i}{w_i}$	
Rotterdam	$\frac{\gamma_{ij} - \beta_i w_j}{w_i}$	$\frac{\gamma_{ij}}{w_i}$	$\frac{\beta_i}{w_i}$	

Where δ_{ij} *is the Kronecker delta, defined as:* $\delta_{ij} = 1$ *if i=j ,* $\delta_{ij} = 0$ *Otherwise*

Ref: Buse (1996), (Barnett and Ousmane 2007).

4.3. Non-nested test for choosing between AIDS and Rotterdam

The theoretical specification of the non-nested test used in this study was obtained largely from Pesaran and Pesaran (1997), Greene (2000) and Johnston and Dinardo (1997).

Consider the following two models:

LA/AIDS: $f(y) = X\beta 1 + u1 \; u_1 \approx N(0, \delta_1^2 I)$ (6)

Rotterdam: $g(y) = Z\beta_2 + u_2 \; u_2 \approx N(0, \delta_2^2 I)$ (7)

Where X is a n × k vector and Z is a n × l vector.
Generally, the two distinct models may have some explanatory variables in common, so that:

$$X = [X_1 X_*] \qquad Z = [X_1 Z_*] \tag{8}$$

Testing is accomplished by setting up a composite or artificial model within which both models are nested. This composite model can be written as:

$$Composite: y = (1-\alpha)X\beta + \partial\alpha(Z\gamma) + u \tag{9}$$

Where α is a scalar parameter. When α = 0, the composite model reduces to the LA/AIDS model, and conversely, when α =1, the composite model reduces to the Rotterdam model.
The PE statistic, when testing LA/AIDS against Rotterdam, uses the t-ratio of α (LA/AIDS) in the following auxiliary regression:

$$f(y) = Xb + \alpha_f \left[Z\hat{\beta}_2 - g(f^{-1}\{X\hat{B}_1)\} \right] + Error \tag{10}$$

Similarly, the PE statistic for testing the Rotterdam model against LA/AIDS is given by the t-ratio α (Rotterdam) in the auxiliary regression:

$$g(y) = Zd + \alpha_g \left[X\hat{\beta}_1 - f(g^{-1}\{Z\hat{B}_2)\} \right] + Error \tag{11}$$

Where $\hat{\beta}_1$ and $\hat{\beta}_2$ represent the OLS estimators of β1 and β2 under LA/AIDS and Rotterdam, respectively. This statistic was first proposed by Davidson and MacKinnon (1981) (Taljaard *et al*., 2006).

5. ESTIMATION RESULTS

All variables used in this study were in time series form, so the augmented Dickey-Fuller (ADF) test was used to test the stationarity of variables (Table 3). The ADF unit root test results allowed acceptance of the null hypothesis of non-stationarity of the red meat price index (p red meat) and the fish price index (p fish). The two indexes were non-stationary at level, but they were stationary after the first difference. Red meat expenditure (x red meat) and fish expenditure (x fish) were stationary at level.

Table 3: Result of unit root test (ADF test) for variables

Variable Name	ADF in level	ADF with One difference
(p red meat)	-1.5	-4. 5*
(P fish)	-1.9	-4.4*
(x red meat)	-4.3*	-
(x fish)	-3.17*	-
Critical value 1%	-3.6	-4.3
5%	-2.9	-3.5
10%	-2.6	-3.2

**Indicate significance at the 5% level*

Ref: Research finding

For the linearised AIDS model, the Stone, Paasche, Laspeyres and Turnquist price indexes were used. The Lutkepohl normality test for joint residual showed that the AIDS model, which linearised based on the Turnquist price index, is the best system. The equations for red meat share expenditure (W_i) and fish share expenditure (W_j) were estimated using the seemingly unrelated regression (SUR) method (Table 4). The results of the red meat equation indicate that, during the studied period, as red meat price increased, red meat share expenditure decreased. The increase in the coefficient of disposable income in the red meat equation (budget coefficient or X/P) increased red meat share expenditure. In both budget share equations, red meat and fish were regarded as substitutes, as indicated by the positive cross-price coefficients. The cross-price coefficient of red meat equation was positive and significant; a 1% increase in the fish price index increased the red meat budget share 0.02%. A negative and significant own-price coefficient was found for red meat and fish in AIDS, which satisfies the law of demand. The Durbin-Watson (DW) model shows that there was no autocorrelation between error terms in the red meat equation.

Table 4: LAAIDS system coefficient for red meat and fish

	Intercept	Budget coefficient	Red meat price index coefficient	Fish price index coefficient	D.W	R2
Red meat	1.2* (0.14)	0.01* (0.004)	-0.02* (0.01)	0.02 (0.02)	2	0.9
Fish	0.2* (0.07)	0.01* (0.003)	0.03 (0.02)	-0.02* (0.01)	1.4	0.6

**indicate significance at the 5% level (Standard deviation in parentheses)*

Ref: Research finding

The theoretical restriction of symmetry was tested on the model in sequence and the homogeneity restriction was tested on both equations. The null hypothesis of homogeneity was not rejected at the 1% level. The results of the Wald test (Table 5) for homogeneity and symmetry in the AIDS system were not significant, so H_0 was accepted. This means that this system had inherent symmetry and homogeneity restrictions and it was not necessary to impose restrictions on the model.

Table 5: Wald test for homogeneity and symmetry restrictions in LAAIDS.

Homogeneity restriction	**Chi-square, Wald test**	**Probability**	**Result**
in red meat function	0.12	0.7	Accept H0
in fish function	0.07	0.8	Accept H0
Symmetry restriction	0.2	0.6	Accept H0

Ref: Research finding

Elasticities reflect the sensitivity of demand, which is important for policy makers. Table 6 shows price elasticities, cross-price elasticities, and income elasticities for AIDS. The uncompensated own price elasticities for the linear approximate (LA) AIDS model carry negative signs. The own-price elasticity of red meat and fish were -1.03 and -2.6, respectively, which indicate that these products were elastic goods. The LAAIDS uncompensated price elasticities have typical assumed signs. The Marshalian cross-price elasticity of red meat for fish was 0.13, which shows that these two goods were substitutes and a 1% increase in the price of red meat caused a 0.13% increase in fish demand. Since the income elasticity of fish was more than unity, fish is considered a luxury good.

Table 6: Marshalian price elasticity and income elasticity in LAAIDS

Product	Red meat	Fish	Income elasticity	Allen –Uzawa elasticity
Red meat	-1.03* (-0.9*)	0.02 (0.13*)	0.97*	1.3*
Fish	-1.1* (1.15*)	-2.6* (-0.3*)	2.6*	

*Compensated elasticities in parenthesis ().*indicate significance at the 1% level*

Ref: Research finding

Economic theory holds that the negative price elasticities of these two products indicate as their prices increased expenditure on them decreased. Since they are elastic, an increase in price led to a larger-than-proportional decrease in value demanded and a decrease in sales revenue. A decrease in income does not result in uniform changes in expenditure for all goods. Expenditure on fish decreased in a proportionately larger amount than any other demand. This may have been the result of fish being considered a luxury good. An increase in the price of fish increased the consumption of red meat because they were substitutes for one another.

Red meat and fish demand were examined using the NLAIDS model (Equation 1) where the parameter specification was nonlinear because of the aggregate price index. The NLAIDS was estimated (Table 7) and the results compared with LAAIDS. The equation for red meat indicates that all coefficients had typical assumed signs.

Table 7: NLAIDS system coefficient for red meat and fish

	Intercept	Budget coefficient	Red meat price index coefficient	Fish price index coefficient	D.W	R2
Red meat	0.78 (0.55)	0.003 (0.04)	-0.09* (0.03)	0.11* (0.03)	1.5	0.54
Fish	-0.58 (0.36)	0.05* (0.03)	-0.07* (0.03)	-0.003 (0.03)	1.9	0.8

**indicate significance at the 5% level (Standard deviation in parentheses)*

Ref: Research finding

The theoretical restrictions of homogeneity and symmetry were tested in sequence on the model and the homogeneity restriction for both equations. The null hypothesis of homogeneity was not rejected at the 1% level. The results of the Wald test (Table 8) for homogeneity in the NLAIDS system were not significant, so H_0 was accepted. The null hypothesis of symmetry was rejected at the 1% significance level; therefore, the symmetry restriction was imposed on the system. The results of the NLAIDS system coefficient for red meat and fish for the symmetry restriction are shown in Table 9 and the results of NLAIDS elasticities are shown in Table 10.

Table 8: Results of Wald test for homogeneity and symmetry limitations in NLAIDS

Homogeneity restriction	**Chi-square, Wald test**	**Prob**	**Result**
in red meat function	0.07*	0.79	Accept H_0
in fish function	3.09*	0.07	Accept H_0
Symmetry restriction	16.9	0.00	Reject H_0

**indicate significance at the 5% level. P<0.05 indicates that the null hypothesis of Symmetry can be rejected at the 95% confidence level.*

Ref: Research finding

Table 9: NLAIDS system coefficient for red meat and fish regarding the symmetry restriction

	Intercept	**Budget coefficient**	**Red meat price index coefficient**	**Fish price index coefficient**	**D.W**	**R2**
Red meat	0.78 (0.55)	0.003 (0.04)	-0.09* (0.03)	0.11* (0.03)	1.5	0.54
Fish	-0.02 (0.5)	0.01 (0.04)	0.01* (0.03)	-0.02 (0.5)	1.8	0.66

**indicate significance at the 5% level (Standard deviation in parentheses)*

Ref: Research finding

Table 10: Marshalian price elasticity and income elasticity in NLAIDS

Product	**Red meat**	**Fish**	**Income elasticity**
Red meat	-1.1* (-0.2*)	0.01 (0.89*)	1.003*
Fish	0.8* (0.96*)	-1.7* (-1.6*)	1.09*

*compensated elasticities in parenthesis ().*indicate significance at the 1% level*

Ref: Research finding

The Akaike criterion (AIC = 20 for LAAIDS; AIC = 13 for NLAIDS), residual sum of squares for LAAIDS regression (RSS for LAAIDS = 0.006; RSS for NLAIDS = 0.09), in accordance with the significant regression coefficients and maintaining the law of demand and elasticities, indicate that LAAIDS out performed NLAIDS.

The Rotterdam model was estimated using the SUR approach and the theoretical restrictions of homogeneity and symmetry were tested in sequence on the model. The null hypothesis of homogeneity and symmetry in these equations was not rejected at the 1% level. The results of the Wald test (Table 11) for homogeneity and symmetry in the Rotterdam system were not significant, so H_0 was accepted. Homogeneity and symmetry restrictions were not imposed on this system. The results of Rotterdam system are shown in Table 12.

Table 11: Results of Wald test for homogeneity and symmetry restrictions in Rotterdam

Homogeneity restriction	**Wald test**	**Prob**	**Result**
in red meat function	3.8	0.04	Accept H_0
in fish function	1.3	0.2	Accept H_0
Symmetry restriction	0.8	0.3	Accept H_0

Ref: Research finding

Table 12: Rotterdam system coefficient for red meat and fish

	Intercept	**Budget coefficient**	**Red meat price index coefficient**	**Fish price index coefficient**	**D.W**	**R2**
Red meat	0.07 (0.04)	-0.2 (0.3)	0.4* (0.16)	0.14 (0.15)	2	0.3
Fish	0.03 (0.01)	-0.1 (0.07)	0.01 (0.03)	-0.05 (0.03)	1.9	0.3

**indicate significance at the 5% level (Standard deviation in parentheses)*

Ref: Research finding

In order to reach a conclusion, the PE test was used to test for the LAAIDS model versus the Rotterdam model. The PE test statistic for LAAIDS versus the Rotterdam model was 14.9 (0.0) and for Rotterdam versus LAAIDS was 0.4 (0.5). This indicates that the LAAIDS model is preferable for red meat and fish demand in Iran. The PE test favoured the LAAIDS model for red meat and fish share equations.

6. CONCLUSION

Successive drought, conflicting trade policies, the absence of subsidies for inputs and lack of government support for producers have increased the price of inputs. These have led to increases in the price of products. Red meat and fish prices have increased sharply, which have decreased per capita consumption of these products. These have led to insufficient consumption of protein to maintain nutritional health. Also, the increase in population and subsequent rise in demand for meat have emphasised the importance of estimating the demand function and significant factors affecting demand. Demand function identifies consumer preferences and helps to develop coherent policies on consumption, forecast future consumer needs and plans for the future.

This study examined the Rotterdam model and AIDS to determine the best model for calculating the true demand elasticity of Iranian red meat and fish. Results show that the share of red meat in the budget was greater than that of fish and increased from 1984 to 2012. The Stone, Paasche, Laspeyres, and Turnquist price indexes were used to linearised AIDS model and the Lutkepohl normality test for joint residual indicated that the linearised AIDS model based on the Turnquist index was the best system. Also, The Akaike criterion for LA/AIDS and NLAIDS shows that the best model was LAAIDS. The calculation of elasticities in LAAIDS showed that, during the test period, red meat and fish were elastic goods and that price was a good force for changing demand. The results of income elasticity tests show that fish was considered to be a luxury good. Cross-elasticity from LAAIDS and NLAIDS show that these two goods were substitutes. Allen-Uzawa elasticity results indicate that these two goods were strong substitutes.

This article used a non-nested test to choose between the LAAIDS and the Rotterdam model and the results of this test favour LAAIDS. Not all compensated and uncompensated own-price, cross-price and income elasticities had accurate signs. The reason for the unexpected signs for uncompensated elasticities was an increase in income that prompted consumers to save rather than spend it on goods such as meat.

The AIDS and NLAIDS models performed well when substitution among goods was low. The LAAIDS model better predicted true elasticities in own-price and cross-price elasticity in agreement with the theory. For the Rotterdam model, cross-price elasticity agreed with the theory for fish. The expenditure (income) elasticity for the LAAIDS and NLAIDS models had the expected positive signs and was significant at the 5% confidence level.

Since red meat and fish are elastic goods, to modify consumption patterns, the price tool can be recommended as effective. In addition, government policies such as decreasing subsidies should be carefully considered because they have resulted in unacceptably high prices for red meat and fish. The results of this study may help policymakers to predict demand and to control the prices of these two important products.

BIOGRAPHICAL INFORMATION

Corresponding author
* Ph.D. in Agricultural Economics, Email: sherafatmandm@gmail.com
** Ph.D. in Agricultural Economics, Email: a.baghestany@gmail.com

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