AN ALMOST IDEAL DEMAND SYSTEM ANALYSIS
OF MEAT DEMAND IN UAE

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Abstract

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The main objective of this research is to analyze demand for different kinds of meats (Beef, Lamb, Goat, Chicken, Camel, and Fish) and the factors affecting the consumers' preferences for each in UAE. A face-to-face survey technique was conducted on five hundred randomly selected respondents from UAE. A Linear Approximate Almost Ideal Demand System was utilized via seemingly unrelated regression model. According to the results, educated respondents demand more lamb and UAE nationals demand more beef. As household size increases and the respondent is employed by public or private sectors his/her demand for camel meat increases. On the other hand, as the income of respondents increases their demand for beef decreases but for goat increases. Marshallian and Hicksian elasticity calculated from the model were between 1 and -1 making the products less responsive to price changes. Cross price, elasticity indicates goat and beef, goat and chicken, camel and beef, and camel and fish as complements; but chicken and camel as substitutes. Having all significant expenditure elasticity for lamb, goat, and camel greater than one makes them luxury and the others necessity items in UAE household diet. As for income effect analysis, any increase in income of UAE households in the future would make them proportionally allocate more of their income to the purchase of fish, camel, goat, and lamb.

Key words: Meat Demand, Linear Approximate Almost Ideal Demand System (LA-AIDS), Marshallian Elasticity, Hicksian Elasticity, Expenditure Elasticity, Income Effect

Introduction

The global import value of meat and its derivatives reached 87.97 billion dollars in 2008. The major importers of the products were japan, Russia, Germany, Britain, Italy, and their share in total world import was roughly 40% in 2009. On the other hand, the major exporting countries were Brazil, USA, Netherlands, Germany, Australia, and their share in total world export was 48% in 2009 (FAO, 2012).

The import value of UAE meat and its derivatives reached to $ 973 million dollars in 2009. The major suppliers of UAE's meat and its derivatives were Brazil (42.5%), India (16.3%), Australia (13.9%), and USA (6.3%) (UAENSB, 2012).

According to 2011 census, the total population of UAE has reached to 8 million (UAENSB, 2012). According to the UAE Ministry of foreign trade per capita meat consumption (85.14 kg) in UAE was three times more than the amount rate in the major five importing countries, and 18 times more than the world average This is mainly a result of higher income per capita ($55 000) and being as a part of daily diet. Of the per capita income, 14.2 percent was allocated to food consumption per month and majority of it was allocated to the spending of meat and meat products. Poultry meat contributed almost half (48.91%) of per capita meat consumption and followed by lamb and goat (13.51), beef (12.05), and other meats. Of the total consumed meats roughly 26 percent was produced locally (FAO, 2012).

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UAE has a desert climate. There is a shortage in irrigation water. This characteristic of the country makes hard to produce most of agricultural products. On the other hand, there is a huge opportunity for livestock production; especially for meat purposes. Having 74%, imported meat from the other producer countries indicates a huge opportunity of producing the product locally for future food security purposes.

The main objective of this research is to analyze the UAE demand for different kinds of meats (Beef, Lamb, Goat, Chicken, Camel, and Fish) and factors affecting the consumption of each by using a linear approximate almost ideal demand system (LA-AIDS) framework.

In addition, the specific objectives are:

1) To incorporate socio-economic variables that would allow the estimation and modeling of structural change in the UAE meats demand.

2) To analyze consumer demand for each meat commodity with respect to its own-price, cross-prices, total expenditures and other possible demand shifters in UAE by using Almost Ideal Demand System

Literature Review

Meat is a perishable product and a significant number research has been conducted to analyze the effects of meat safety concerns starting from producer going through distribution channel all the way to consumer demand ((Henson and Northen, 2000; Latouche et al., 1998; Lloyd et al., 2006; McDonald and Roberts, 1998; Piggott and Marsh, 2004; Verbeke, 2000). Some well-known meat health risks are BSE (mad cow disease), overuse of growth hormones, the residues of antibiotics etc. Verbeke and Ward (2001) used AIDS model to analyze the effects of health risks and media coverage on the consumer behavior in Belgium. According to their results, Own-price elasticity for fresh meats were relatively lower which was dominated by news from media indicating health risk of consuming fresh meats.

Because of the international safety standard concerns, almost all countries of the world check meat and meat products before supplying to the domestic and/or international markets recently. The research conducted on the meat demand generally focused on the effects of different attributes on the preferences of the consumers

(Al-Shuaibi, 2011; Bharumshah and Mohamed, 1993; Chalfant et al., 1991; Clark, 2006; Feleke and Kilmer, 2007; Garcia, 2006; Jabarin, 2005; Jung and Koo, 2002; Karagiannis et al., 2000){Holt, 2009, The Almost Ideal and Translog Demand Systems}. Such studies have been done to estimate the demand relations for meat products in different countries of the world. There are two approaches of demand analysis in the literature. The first approach is all about the utility function, which maximizes the satisfaction of consumer because of choosing/consuming a certain goods or services. The demand analysis can be conducted by maximizing a utility function subjected to a budget constraint (Theil, 1965){Theil, 1965, The information approach to demand analysis}.

An alternative approach implements arbitrary demand systems, which includes restrictions on the system of demand functions. Compared with the first approach, this system is closer to the theory of economics for consumer demand analysis. During the last few decades, consumer demand analysis has been conducted by using multiple system equations such as linear and quadratic expenditure systems (Pollak and Wales, 1978), Working model (Working, 1943), the Rotterdam model (Theil, 1965), Translog model (Christensen et al., 1975), and Almost Ideal Demand System (AIDS) (Deaton and Muellbauer, 1980). The AIDS model found to be more appropriate analysis technique to be used in this study. More explanation about the model will be provided in methodology section.

Various studies have been conducted in the other countries of the world using the AIDS model to analyze demand for meat and meat products. Some selected researches are summarized below.

Olowolayemo et al. (1993) analyzed the demand for eight meat categories using two different functional forms in US. They used an inverse AIDS and linear double-log price dependent meat consumption. According to their results, in most cases, ideal demand system flexibilities obtained from both methods were comparable and showed that the demand for meat products was price inflexible. In addition, there were regional as well as seasonal variations in the demand for meat products.

Rickertsen (1996) analyzed the structural change in the consumption of four meats and fish in Norway. According to a dynamic switching AIDS model results

prices found to be endogenous in the system of demand equations. A gradual structural change was detected in 1980s, which was biased for chicken and fish and against beef.

Taljaard et al. (2003) used a linear approximated Almost Ideal Demand System to estimate the demand relations of beef, chicken, pork and mutton in South Africa for 1970 –2000 period. According to their result, beef and mutton found to be luxury and pork close to be seen as a luxury product. Chicken was found to be the only necessity product in budget share group.

Wadud (2006) used AIDS to analyze meat demand in Bangladesh. Beef, chicken, and mutton were chosen for analysis. According to his results, all three types of meat showed inelastic demand. Cross price elasticity indicated dominance of substitutability.

Yeong-Sheng et al. (2008) analyzed demand for meat in Malaysia by using LA-AIDS model. According to estimated positive and inelastic income elasticities all meat products were found to be normal and necessity goods with an exception of other meats. The estimated own-price elasticities of all meat demand were greater than one indicating increasing demand for major meat products among Malaysians in the future.

In addition to above literature, many researches have been done on demand for meat and meat products by using different demand analysis methods. As for the UAE, the researcher is not aware of any noticeable research indicates the topic. That is why, this research will be very important to analyze demand for different kinds of meat by adding the socio-economic variables to the LA-AIDS model. Thus, beside the effects of own and cross price elasticities the effects of socio-economic factors on UAE meat demand can be estimated.

Research Methodology

The population was the whole UAE household. The respondents were randomly selected and interviewed in all seven Emirates. 500 face-to-face questionnaires were conducted. The number of questionnaires allotted for each Emirate was determined according to its population. The survey included the quantity of different kinds of meats purchased per week and their prices. In addition to quality and prices some socio-economic

questions, as indicated in analysis section were asked to the respondents. Students and research assistant were trained first and then the survey was conducted.

There were some difficulties associated with estimation of zero consumption of some meats. In order to get over of such problem, the procedure proposed by Cox and Wohlgenant (1986) and used by some researchers such as Agbola (2003) and Haq et al. (2011) were followed. The cluster prices of meats were substituted for missing prices. Thus, the household with zero consumption are assumed to face with average meat price for that cluster.

The own price and cross price elasticities of meat demand in UAE were estimated by using LA-AIDS developed by Deaton and Muellbauer (1980) from an expenditure function. The model provides arbitrary first-order approximation to almost all demand system equations. The axiom of choice exactly is satisfied; its functional form is consistent with household-budget data in demand analysis; it is simple to estimate and homogeneity/symmetry through linear restrictions on fixed parameters can be tested simultaneously (Byrne et al., 1996; Deaton and Muellbauer, 1980).

Following Deaton and Muellbauer the system of LA-AIDS demand equation can be written as follows:

$$w_i = \alpha_i \sum_{j=1}^{n} \gamma_{ij} \ln(P_j) + \beta_i \ln\left(\frac{X}{P}\right) + e_i \qquad (1)$$

Where w_i is the budget share of goods (i) (i.e. $w_i = P_i Q_i / X_i$). P_j is the price of good j, X is the total expenditure of the goods being analyzed, n is the number of goods, P is a price index and can be calculated as follows:

$$lnP = \alpha_0 + \sum_j \alpha_i lnP_j + \frac{1}{2} \sum_j \sum_i lnP_i lnP_j \qquad (2)$$

Calculating the price index via equation (2) mostly raises some empirical difficulties. The index is commonly approximated by using Stone Price Index as: $ln(P) = \sum_j w_j ln(p_j)$ (Green and Alston, 1991).

In order to account for socio-economic variables of householders, equation 3 is conducted by following Pollack and Wales (1978) as follows

$$w_i = \alpha_i \sum_{j=1}^{n} \gamma_{ij} \ln(P_j) + \beta_i \ln\left(\frac{X}{P}\right) + \delta_{ij} z_j + e_i \quad (3)$$

The equation 3 is a socio-economic flexible LA-AIDS model (Agbola, 2003; Haq et al., 2011; Stavkova et al., 2007).

In order to estimate α_i, γ_{ij}, and β_i parameters in equation (3), some theoretical restrictions on the demand equations were conducted during estimation procedure. These restrictions are as follows:

Adding-up:

$$\sum_i^n \alpha_i = 1, \qquad \sum_i^n \gamma_{ij} = 0, \qquad \sum_i^n \beta_i = 0 \qquad \forall i \quad (4)$$

Homogeneity:

$$\sum_i^n \gamma_{ij} = 0, \qquad (5)$$

Symmetry:

$$\gamma_{ij} = \gamma_{ji} \qquad (6)$$

By using the equation 3, uncompensated (Marshalian) and compensated (Hicksian) own and cross-price elasticities and expenditure elasticities can be derived. The Marshallian own and cross price elasticity for good *i* with respect to good *j* can be calculated via equation 7:

$$e_{ij} = \frac{\gamma_{ij} - \beta_i}{w_i} - \delta_{ij} \qquad (7)$$

Hicksian own and cross-price elasticities for good *i* with respect to good *j* can be estimated by equation 8:

$$e_{ij} = \frac{\gamma_{ij}}{w_i} + w_j - \delta_{ij} \qquad (8)$$

Where δ_{ij} is the Kronecker delta and equals "1" for own price and "0" for cross-price elasticities. Finally, the expenditure elasticity can be calculated as follows:

$$E_i = 1 + \frac{\beta_i}{w_i} \qquad (9)$$

The expenditure elasticities are very important determinants in estimating of future demand for different kinds of meats. Estimating the expenditure elasticities accurately helps decision makers to forecast short, medium, and long run demand for meats, and make appropriate decisions (Chern, 2003) .

The seemingly unrelated regression estimation (SUR) method developed by Zellner (1963) was utilized to estimate the system of equations using SAS 9.1 Econometric Program. The results from this study will help decision makers to design programs, which will enhance promoting different kinds of meat products in UAE to develop the industry.

Results and Discussions

The LA/AIDS model was estimated by utilizing SUR methodology in SAS econometric software. The budget shares of 6 different meat expenditures were normalized to one (unity). By following Barten (1969) since there were no difference which equation to drop from the system, the fish share equation was dropped and the analysis was conducted by using maximum likelihood estimation technique. The independent variables were the log of own and the other meat prices. The socioeconomic part of equation included variables such as:

EDUCATION: The education level of respondent (0: No Education, 1: Less than High School, 2: High School Graduate, 3: College Degree, 4: Post Graduate,)

NATIONAL: The nationality of respondents (1: Emirati, 0: Otherwise)

HOUSEHOLD: Household size of the respondent (including himself/herself)

EMPLOYEE: The employment status of respondents (1: if employed by public or private sector; 0: otherwise)

INCOME: The net monthly household income of respondents in UEA dirhams (AED).

The estimated regression coefficients of the model are given in Table 1. Some of the parameters were significant at 90 percent level. The estimated R^2 ranged from 0.089 for the chicken to 0.237 for beef. The hypothesis that the socio-economic variables did not have combined effects on the demand for different meats were rejected at the 95 percent significance level, indicating the importance of such factors in influencing UAE meat demand. Because of getting such significant results, one can easily say that the LA/AIDS model with socio-economic variables can be chosen as preferred model for UAE meat demand discussions.

Education had negative and significant effects on the demand for lamb. It seems that the nationals prefer more beef. Household size and being employed by public or private sectors had positive and significant effects on the demand for camel meat. On the other hand, as the income of respondents increases their demand for beef decreases but for goat increases.

Table 1
Parameter Estimates of the LA-AIDS Model for UAE Meat Demand

	Beef	Lamb	Goat	Chicken	Camel	Fish
Constant	0.296*	0.201*	-0.041	0.382*	-0.046	0.207*
Log of Price of Beef	0.145*	-0.035***	-0.041***	-0.039**	-0.028	-0.001
Log of Price of Lamb	-0.035***	0.159*	0.005	-0.012	-0.015	-0.102
Log of Price of Goat	-0.041***	0.005	0.111*	-0.023	-0.010	-0.042
Log of Price of Chicken	-0.039	-0.012	-0.023	0.036**	0.021	0.016
Log of Price of Camel	-0.028	-0.015	-0.010	0.021	0.073***	-0.040
Log of Price of Fish	-0.001	-0.102	-0.042	0.016	-0.040***	0.169*
Log of Meat Expenditure	-0.019	0.002	0.029***	-0.030**	0.028**	-0.009
EDUCATION	0.004	-0.010***	0.002	-0.006	0.001	0.009
NATIONAL	0.032**	-0.018	0.002	0.007	-0.005	-0.018
HOUSEHOLD	-0.001	-0.003	-0.003	-0.001	0.004**	0.003
EMPLOYEE	-0.012	-0.007	0.002	-0.006	0.019***	0.004
INCOME	-0.004***	0.001	0.005*	0.001	-0.003	-0.001
R Square	0.237	0.189	0.207	0.089	0.165	0.158

*significant at 0.01, **Significant at 0.05, ***Significant at 0.10

Marshallian (uncompensated), Hicksian (compensated) own and cross price elasticities and expenditure elasticities were estimated at sample means. Some of uncompensated and compensated elasticities and all of the expenditure elasticities were significant at 90 percent level. The Marshallian elasticities are given in Table 2. According to the table the own price elasticities of all meat demand is between -1 and 1; and own price elasticity of beef is positive. Having a positive own price elasticity makes beef a necessity good for UAE consumers. As for the other 5 meats the own price elasticities ranged from -0.041 to -0.975 indicating all as normal goods. Having elasticity negative and greater than -1 suggests that even if the price of the meats increases, the decrease in amount demanded will be less than the proportionate. Of the 30 uncompensated cross price elasticities in Table 2, 23 were negative making the meats complements and 7 were positive making them substitute. As indicated in the table, goat and beef, goat and chicken, camel and beef, and fish and camel seems to be complements and statistically significant. On the other hand, the cross price elasticity of chicken and camel was positive and statistically significant making the products substitutes. Having majority of meats as complements seems to be unique characteristics of the UAE householders who have high per capita income.

The results for Hicksian own and cross price elasticities are given in Table 3. Being less responsive to the price changes is similar to the results of previous researchers indicated in the literature review section. The hicksian own price elasticities were similar to the Marshallian own price elasticities. All own price elasticities of meat demands were between -1 and 1; indicating that even if the prices of meats increases there will not be a significant decrease/increase in quantity demanded. The positive own price elasticity of beef makes the product a necessity good. The second significant own price elasticity belonged to chicken and makes the product as a normal good. Of the 30 compensated cross price elasticities 14 were negative, making the products complement, and 16 was positive making the product substitutes.

The expenditure elasticities results are given in Table 4. All elasticities were significant at 99 percent level and the values of only lamb, goat, and camel were greater than one. Having expenditure elasticities greater than one; makes lamb, goat, and camel luxury goods for UAE households. However, the expenditure for beef, chicken, and fish was less than one, indicating them as necessity items in UAE household diet.

In order to estimate how any change in income can affect the demand for different kinds of meats, marginal expenditure shares were calculated by following Agbo-

Table 2
Estimated Uncompensated (Marshalian) Own Price and Cross Price Elasticities for UAE Meat Demand

	Beef	Lamb	Goat	Chicken	Camel	Fish
Beef	0.666***	-0.157	-0.225	-0.204	-0.089	-0.167
Lamb	-0.223	-0.041	0.018	-0.085	-0.105	0.018
Goat	-0.432*	-0.149	-0.499**	-0.319**	-0.243	-0.164
Chicken	-0.090	0.188	0.078	-0.319	0.528**	0.232
Camel	-0.377**	-0.291	-0.257	-0.042	-0.695**	-0.386*
Fish	0.469	-0.078	-0.099	-0.092	-0.058*	-0.975

*significant at 0.01, **Significant at 0.05, ***Significant at 0.10

Table 3
Estimated Compensated (Hicksian) Own Price and Cross Price Elasticities for UAE meat Demand

	Beef	Lamb	Goat	Chicken	Camel	Fish
Beef	0.568***	-0.189	-0.258	-0.302	-0.138	-0.035
Lamb	-0.113	0.134	0.194	0.025	0.054	0.358*
Goat	-0.155*	0.194	-0.156	-0.041*	0.084	0.343*
Chicken	-0.302	0.042	-0.068	-0.531**	0.366***	0.250
Camel	-0.092*	0.060	0.093	0.244***	-0.360	0.129
Fish	-0.332	0.046	0.023	-0.071	-0.273*	-0.392

*significant at 0.01, **Significant at 0.05, ***Significant at 0.10

Table 4
Expenditure Elasticities of Meat for UAE

Meats	Elasticity	Marginal expenditure share, %
Beef	0.804*	7.91
Lamb	1.012*	16.59
Goat	1.179*	19.33
Chicken	0.690*	6.79
Camel	1.187*	17.51
Fish	0.972*	31.88

*significant at 0.01, **Significant at 0.05, ***Significant at 0.10

la (2003) and Powell's (1974) approach. The shares were estimated by multiplying the expenditure elasticities by expenditure shares of different meat demands. According to the results, an increase in income of households in the future would make them proportionally allocate more of their income on the purchase of fish, goat, camel, and lamb. On the other hand, chicken and beef would get the least proportionate amount from income increase in the future.

Conclusion and Recommendations

The primary data collected via survey from randomly selected respondents were analyzed econometrically.

According to the results for LA-AIDS, educated respondents demand more lamb and UAE nationals demand more beef. As household size increases and the respondent is employed by public or private sectors his/her demand for camel meat increases. On the other hand, as the income of respondents increases their demand for beef decreases but for goat increases.

The elasticity values of both Marshallian and Hicksian were between -1 and 1 making them less responsive to any price changes. Positive own price elasticity of beef and negative values of the others makes beef a necessity product and the other normal good for UAE consumers. Cross price elasticities of meat prices indicates goat and beef, goat and chicken, camel and beef, and camel and fish as complements; but chicken and camel as substitutes. Unlike the previous researches, the majority of meats seem to be complement for UAE householders. Having all significant expenditure elasticities for lamb, goat, and camel greater than one makes them luxury goods for UAE households. However, the expenditure elasticity for beef, chicken, and fish was less than one; indicating them as necessity items in UAE household diet.

In addition to elasticities the income effect on future meat demand were analyzed. According to the results,

an increase in income of UAE households in the future would make them proportionally allocate more of their income on the purchase of fish, goat, camel, and lamb. On the other hand, chicken and beef would get the least proportionate amount from income increase in the future.

UAE has a desert climate. There is a shortage in irrigation water for agricultural production. This characteristic of the country makes hard to produce most of agricultural products. On the other hand, there is a huge opportunity for livestock production; especially for meat purposes. That is why; more attention should be given to the meat industry to secure the country's future demand. Having majority of meats imported and lower level of price sensitivity of demand can provide a huge opportunity for local product industry to develop. Such an industry can contribute to the future food security of the country.

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