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ANALYZING UAE'S IMPORTS OF FRESH FRUITS UTILIZING AN ALMOST IDEAL DEMAND SYSTEM

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Abstract

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This paper provides estimates of expenditure and price elasticity for imported fresh fruits in UAE using a Linear Approximate Almost Ideal Demand System (LA/AIDS) over the period 1990-2007. Results showed that uncompensated or Marshallain own price elasticity of import demand have negative signs and inelastic except for grapes and oranges. All cross-price elasticity among the six commodities is inelastic. Grape imports are substitutes for banana, date, mango and orange imports. Apple imports are substitutes for date and orange imports. Results also show that apple imports are complements to banana, mango and grape imports. Banana imports complement the imports of all the other five fruits. However, there is no cross-price elasticity between orange imports and date imports. All Compensated or Hicksian own price elasticity have the expected signs and inelastic except for grapes. All compensated own price elasticity is relatively inelastic except for grapes, which is greater than one at -1.44. Banana and dates are complementary goods with mango and orange imports. Grape imports are substitute with apple, banana, date, and mango imports. Apple imports are substitute for banana, date, grape and orange imports. From the expenditure elasticity, both banana and grape imports appear to be luxury fresh fruits with expenditure elasticity greater than one. Other three fresh fruits are to be considered necessities as their expenditure elasticity are less than one while date imports had negative expenditure elasticity.

Key words: LA/AIDS model, import demand, fresh fruits, uncompensated and compensated elasticity

Introduction

United Arab Emirates (UAE) is an important net importer of fresh fruits among the members of the Gulf Cooperative Council (GCC) countries. The relative importance of UAE imports of fresh fruits for the years 1990, 2000 and 2007 are presented in Table 1. The total values recorded indicate a steady rise for six fresh fruit imports (apples, bananas, dates, grapes, mangoes and oranges) from $106.6 million in year 1990 to $144.19 million in year 2000 and to $ 224.32 million in year 2007. These figures represent 74.4 percent of total imports of all fresh fruits in 1990, 86.6 percent in 2000 and 79.43 percent in year 2007, respectively. In 1990, the expenditures of UAE on oranges, dates and apples imports were $24, $ 21.6 and $ 21 million comprising 16.9 percent, 15.21 percent and 14.79 percent of total expenditures on all six fresh fruits, respectively. Meanwhile, the expenditure values on bananas, mangoes and grapes imports occupied the fourth, fifth and sixth ranks with ratios 9.8 percent, 9.1 percent and 8.45 percent of total expenditures on all six fresh fruits respectively, for the same year.

An important point to note is that the expenditures on apples, oranges, mangoes and grapes imports increased from $21, $ 24, $13 and $12 in year 1990 to $94.57, $46.47, $34.45 and $30.56 million in year 2007, respectively. By contrast, the expenditures on bananas and dates imports declined from $14 million and $21.6 million in year 1990 to $3.62 million and $14.65 million in year 2007, respectively.

Figure 1 represents the summary statistics of expenditure shares for the six fresh fruits imports of UAE during 1990-2007. The expenditure share of apple imports showed a gradual increase through the period 1990- to 2007 from 0.199 in 1990 to 0.422 in 2007.

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The expenditure share of bananas illustrated steady increase with 0.133 in 1990 to reach a maximum with ratio 0.363 in 2001, and then declined to 0.016 in 2007. The expenditure share of dates reached its maximum in year 2005 with 0.235 and it was at a minimum in year 2002 with a share of 0.03. Meanwhile these shares declined from 0.147 in 1996 until year 2004 with a ratio of 0.056. The highest expenditure share for mango imports was in year 2005 with a share of 0.223, it was at a minimum of 0.055 in year 1993.The expenditure shares declined through years 1994 to 2001, and they increased from years 2002 to 2006. It can be observed from the same figure that the expenditure shares of oranges imports ranged between 0.254 as upper limit in year 2003 and 0.088 as a lower limit in year 2000. Moreover, these expenditure shares declined for years 1991 to 1994, 1996 to 1999 and 2004 to 2005. As can be seen from Figure 1, the expenditure shares of grape imports reached a maximum with a share of 0.205 in year 2000 and it was at minimum in year 1997 with a 0.061 (Table 1 and Figure 1).

The remainder of this paper is organized as follows. Section 2 illustrates the data sources. Section 3 is concerned with theoretical framework. In section 4, the empirical re-

Table 1
Expenditures on fresh fruits imports of UAE for years 1990, 2000, and 2007

	1990		2000		2007	
	Import values, $ millions	%	Import values, $ millions	%	Import values, $ millions	%
(1) - Six fresh fruits						
A. Apples	21	14.79	49.466	29.69	94.566	33.49
B. Bananas	14	9.8	40	24.02	3.62	1.28
C. Dates	21.6	15.21	7.9	4.74	14.654	5.19
D. Grapes	12	8.45	32.25	19.363	30.555	10.82
E. Mango	13	9.1	13.2	7.92	34.451	12.2
F. Orange	24	16.91	1.37	0.82	46.47	16.45
Total values for the mentioned six fruits	106.6	74.38	144.186	86.56	224.316	79.43
(2) - Other fresh fruits*	36.37	26.62	22.385	13.44	58.093	20.57
Total Import values (1+2)	141.97	100	166.571	100	282.409	100

*Other fresh fruits include pears, apricots, avocados, Kiki peaches and nectarines, pineapples, grapefruits, citrus fruits, tropical fresh fruits,…….etc
Sources: Collected and computed from FAO database.

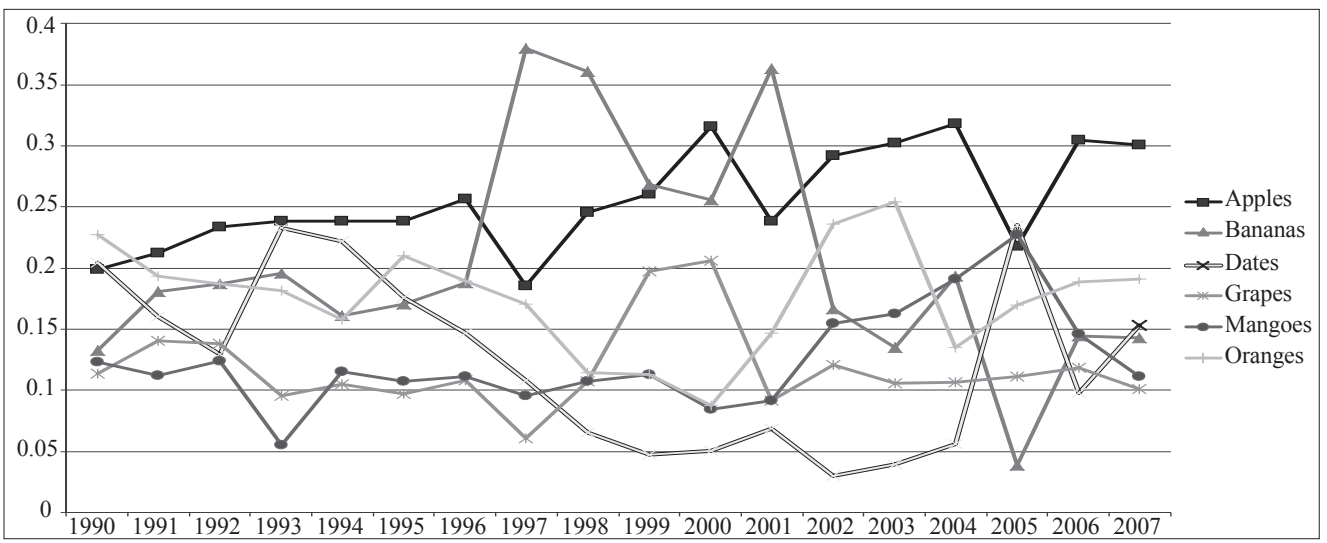

Fig. 1. Expenditure shares of UAE fruits imports (1990-2007)

sults are reported and discussed. Section 5 wraps up with conclusions.

Data

Data used in this study are readily available online. Annual time series data from 1990 to 2007 were obtained from FAOSTAT. Data of import values in million dollars were used as expenditures from UAE on six fresh fruits: apples, bananas, dates, grapes, mangoes and oranges. The import prices per ton in dollars for each commodity were calculated as import values in million dollars divided by the import quantities in tones.

Theoretical Framework

The Almost Ideal Demand System (AIDS) was introduced by Deaton and Muellbauer (1980) and later its variant the linear approximation of AIDS (LA /AIDS)**.** AIDS provides a useful framework for modeling demand systems. It is based on economic theory and satisfies the axioms of choice. It can also be used to test homogeneity and symmetry restrictions. The coefficients in a LA/AIDS model are easy to estimate and interpret.

The AIDS model was applied in several studies to analyze the world import demand for agricultural products (Yang and Koo, 1994; Andayani and Tilley, 1997; Soshnin et al., 1999; Dameus et al., 2000; Schmitz and Seale, 2002; Poudel and Keithy, 2008; and Nzaku and Houston, 2009).

In order to provide empirical measures of the sensitivity of the demand for imported fresh fruits in UAE to changes in prices and income, the paper concentrated on the estimation of demand equations system by applying a dynamic LA-AIDS to data on imports of six fresh fruit types over the period of 1990-2007. The general specification of the AIDS model indicates that the demand for imported fresh fruits in UAE can be given by:

$$S_{it} = \alpha_i + \beta_{it} \ln\left(\frac{Xi}{P^*}\right) + \sum_{j=1}^{n} \gamma_{ij} \ln P_{jt} + u_i , \qquad (1)$$

where S_{it} represents the expenditure share of the import good in the period t; P_{jt} represents the import price of the j^{th} good in time t; X_i represents the total expenditures on all fresh fruit imports included in the system in time period t; $\ln P_{jt}$ is translog price index; α_i, β_{it} and γ_{ij} are parameters associated with the system and μ_i is the error term. Deaton and Muellbaur used a translog price index (P*), which makes the demand system non-linear as follows

$$\ln P^* = \alpha_0 + \sum_{j=1}^{n} \alpha_i \ln P_j + \frac{1}{2} \sum_{i=1}^{n} \sum_{j=1}^{n} \gamma_{ij} \ln P_i \ln P_j, \quad (2)$$

This price index makes the demand non-linear, which normally complicates the estimation process. To overcome the non-linearity problem, Deaton and Muellbaur modified the translog price to be approximated using a Stone price index to replace the translog price index that it can be expressed as:

$$\ln P_i = \Sigma_1^n S_{it} \ln P_j , \qquad (3)$$

This substitution will cause a simultaneity bias (measurement error), because the dependent variable (S_{it}) also appears on the right hand side. Hence following Eales and Unnevehr (1988) and to avoid this problem, we use the lagged expenditure share (S_{it}) in Stone's geometric price index by one period *(*S_{it-1}*)* for equation 3, and then replacement of equation (3) with the lagged dependent share into equation (1) yields the LA/AIDS, defined as follows:

$$S_{it} = \alpha_1 + \Sigma_{j=1}^{n} \gamma_{ij} \ln P_j + \beta_{it} (\ln(X) - \Sigma_{i=1}^{n} S_{it-1} \ln P_j) + u_i, \quad (4)$$

Equation (4) of LA/AIDS can be used in estimating the parameters of the import demand system equations for six fresh fruits in UAE and then they can be used to compute the own price, cross- price and expenditure elasticity. The regularity conditions implied by expenditure constraints and utility maximization impose the following restrictions to the system:

Adding up: $\sum_{i=1}^{n} \alpha_i = 1 \qquad \sum_{i=1}^{n} \beta_i = 0 \qquad \sum_{i=1}^{n} \gamma_{ij} = 0$

Homogeneity: $\sum_{i=1}^{n} \gamma_{ij} = 0$

Symmetry: $\gamma_{ij} = \gamma_{ij}$; $i \neq j$ for any two commodities.

The elasticity has been computed at the sample means of expenditure shares. The uncompensated (Marshallian) own-price elasticity (ε_{ii}) and cross-price elasticity (ε_{ij}) are derived from Alston et al. (1994) as follows:

$$\varepsilon_{ii} = -1 + \frac{\gamma_{ii}}{S_i} + S_i , \qquad (5)$$

$$\varepsilon_{ij} = \frac{\gamma_{ii}}{S_i} - \beta_i \frac{S_j}{S_i}, i \neq j , \qquad (6)$$

The formula used to calculate the expenditure elasticity could be written as:

$$\eta_i = 1 + \frac{\beta_i}{S_i} , \qquad (7)$$

A positive value shows that commodity i is normal. The income compensated (Hicksian) own-price elasticity (ℓ_{ii}) and cross-price elasticity (ℓ_{ij}) respectively are obtained by applying the Slutsky decomposition to (7) and using the price index in equation (3). These can be written as:

$$\ell_{ij} = \frac{\gamma_{ij}}{S_i} + S_j \quad , i \neq j \qquad (8)$$

The consumer theory suggests that compensated own-price elasticities are negative for normal goods. Moreover, if (6) and (8) are positive, the two goods are substitution, otherwise they are complements.

Empirical Results

This section is divided into two subsections; first is concerned with the test results of the demand system model. Second is focused on parameter and elasticity estimates of the model. All the estimates of the model using Zellner's (1962) iterative restricted seemingly unrelated regression (IRSUR) for total of 18 observations, the period 1990- to 2007 with E-views 7 software package.

Results of the tests

This subsection shows the results for the following tests: (1) the structural break, (2) unit root, and (3) co-integration in the residuals of the demand system model.

Structural break

The first test is concerned with the structural breaks in the import demand equations for six fresh fruits. The structural breaks have taken place when a change is noticed in the model parameters. A series, which was specified as non-stationary in the absence of structural break, was actually trend stationary once structural break was computed in the regression parameters of the model (Jha and Sharma, 2001).

In order to find out years in which structural breaks appear a set of residuals from the fitted LA/AIDS expenditure shares (equation 4) were examined. A structural break occurs during the period(s) where the residuals exceeded two standard deviations (Taljaard et al., 2003).

Table 2 presents the results of structural breaks of the expenditure shares for six fresh fruit imports by UAE for years 1990-2007. The maximum structural breaks occurred for dates in 1993 by -1.99 and for oranges in 2004 by 1.99. It is interesting to observe from the same table that all values are less than two. This means that there are no indications of structural breaks from 1990-2007.

Unit root test

A time series is said to be a stationary process if its mean and variance are both constant over time. This means that the series is not a random walk and it has no unit root. By contrast, a time series is described as being a non-stationary, which it is a random walk, and it has a unit root. Accordingly, stationary of a time series is important because it can influence its behavior. If a series is stationary without any differencing, it is integrated order zero, d(0). On other hand, a time series that has stationary first difference is designated of order one, d(1). Therefore, any time a series is used in econometric analysis, it must be stationary (Granger and Newbold, 1986).

Table 2
Structural breaks of the expenditure shares for six fresh fruit imports by UAE for years 1990-2007

Years	Apples	Banana	Dates	Grapes	Mangos	Oranges
1990	0.62	0.41	-1.96	1.95	1.36	-1.63
1991	0.47	-0.85	-0.49	1.09	1.87	-0.28
1992	0.29	-0.79	0.23	0.66	1.06	0.01
1993	1.14	-0.63	-1.99	1.59	1.83	-0.61
1994	1.49	-0.56	-1.34	1.41	1.1	1.57
1995	0.47	0.52	-1.76	1.83	0.35	-1.31
1996	-0.02	0.67	-1.62	1.89	0.28	-0.76
1997	1.32	-0.57	-0.81	1.71	0.16	-1.41
1998	0.08	-0.46	0.68	1.4	-0.48	0.18
1999	0.17	-0.34	1.68	-1.26	-0.14	1.81
2000	-1.05	0.36	1.13	-1.23	-0.15	1.78
2001	0.56	-0.94	0.98	1.74	0.4	1.04
2002	-0.35	0.16	1.98	0.15	0.45	-1.13
2003	-0.38	0.51	1.58	1.06	0.05	-1.73
2004	0.11	0.87	-0.2	0.56	-1.17	1.99
2005	-0.26	-0.05	-1.16	1.73	-1.95	0.75
2006	0	-0.76	1.72	0.05	-1.15	0.77
2007	-1.97	0.78	1.69	1.02	-1.88	-0.75

It is well known that most economic variables are non-stationary and the presence of unit root in the residuals may be invalid asymptotic distributor of the estimators. Therefore, the expenditure shares dealt with the demand system model need to be tested for unit root.

In this paper, Augmented Dickey –Fuller (1979 &1981) is used to test for the unit root residuals for demand model system (equation 4) as follows:

$$\Delta y_t = c + \partial \mathrm{T} + \alpha y_{t-1} + \sum_{j=1}^{k} d_j \Delta y_{t-j} + \varepsilon_t \quad \text{for j = 1,2… k} \quad (9)$$

This augmented specification is used to test the following hypothesis:

The null hypothesis (H_0) α= 0; and he alternative hypothesis (H_a) α<0. If we could not reject the null hypothesis, this means that series α contains a unit root; where α= p-1 and calculated using conventional t-ratio for α.

The order for Augment Dickey Fuller (ADF) tests were ascertained on minimum Akaike Information Criterion (AIC). Table 3 presents the ADF test results for both the level series and first difference of the variables used to estimate the expenditure share equations for fresh fruit imports by UAE when a time trend and no time trend are included in the import demand system model.

As may be seen in Table 3, an important result obtained by ADF is to reject the null hypothesis at the level series and all the variables used to estimate the demand system are generated by a unit root process except import price of banana when a time and no time trend are included in the model. This means that the time series is a non-stationary when tested at level series. Once we fail to reject the null hypothesis, we will carry out the ADF test of the series stationary at its first differenced value. It can be observed that the time series data of all the variables used to estimate the import demand equations at the first difference were the stronger the rejection of null hypothesis of unit root when a time trend and no time trend are included in the model. This means that no unit root is present. In other words, all the variables used to estimate the demand system are stationary.

Co-integration test

Testing of co-integration is necessary to examine whether six expenditure shares are jointly determined with their respective prices. This is because the literature points out the possibility of a linear combination of non-stationary variables might be stationary. Once the expenditure shares are integrated of the same order, d(1) with the exogenous variables, then co-integration can be established. In this paper, two residuals-based tests are used to test for co-integration namely; Augment Dickey –Fuller (ADF) and Phillips-Perron (PP) tests.

Philips-Perron (1988) estimated the following equation

$$X_t = \alpha + \beta_1 X_{t-1} + \beta_2 (T - \frac{N}{2}) + \varepsilon_t, \quad (10)$$

Table 3
ADF test results for Expenditure shares, import prices and total expenditures

Series	Level series			First differences		I(d)
	No trend	trend	lags	No trend	trend	
Expenditure shares						
Apple	-0.612	-2.15	4	-6.903	-6.85	
Banana	-1.406	-1.741	4	-6.43	-6.124	
Dates	-2.175	-1.75	2	-6.362	-5.237	
Grapes	-2.892	-2.818	3	-4.239	-3.99	
Mango	-1.69	-2.638	2	-5.603	-4.113	
Oranges	-2.941	-2.456	4	-3.84	-4.874	
Logarithm of prices						
Apple	-0.366	-2.352	4	-4.405	-4.351	
Banana	-4.173	-4.03	4	-5.73	-4.632	
Dates	-2.242	-0.799	4	-0.602	-0.554	
Grapes	-1.761	-2.297	3	-4.88	-5.737	
Mango	-1.61	-1.657	3	-4.36	-4.863	
Oranges	-2.467	-2.367	4	-5.53	-5.53	
Total expenditure	-2.097	-0.296	4	-4.136	-4.856	
Critical values	-3.052	-3.71		-3.052	-3.71	

The lag length in the ADF test regression is determined by Akaike Information Criterion (AIC).

where T is number of observation and N is number of variables. The null hypothesis is $\beta_1 = 0$versus the alternative hypothesis of $\beta_1 < 0$. Two versions of ADF and PP regressions are estimated with intercept only ($\beta_2 = 0$) and time trend and intercept.This study uses ITSUR to get the residuals and test for stationary of the entire variables in the import demand system model. This is due to fact that using OLS does not control for correlation of errors across the equations and the results could lead to wrong implications for ADF and PP tests.

Table 4 indicates the results of the two alternatives tests: ADF and PP for co-integration between the expenditure shares and the corresponding exogenous variables.

The results of both ADF and PP tests reject the null hypothesis of no co-integration for six expenditure shares at five percent significant level when a time and no time trend are included in the model. Hence, these results for co-integration suggest that the expenditure shares are co-integrated with their exogenous variables. This means that all variables in the demand system are stationary.

We can conclude from the previous results that no indication of structural break is present. At the same time, unit root and co-integration tests reveal that the series are stationary and co-integrated with their explanatory variables. These results confirm that we do not need to use an error correction mechanism (ECM) in this study. Therefore, the import demand system for six fresh fruits by UAE (Equation 4) is considered valid to estimate the parameters.

Parameter and Elasticity Estimates

This subsection contains two parts: first includes parameter estimates and the second is concerned with the elasticity estimates.

Parameter Estimates

The imposition of homogeneity and symmetry conditions on the system may generate positive serial correlation in the residuals. Furthermore, the variance – covariance matrix of residuals play an important role in the estimation since symmetry involves cross- equation restrictions. To avoid a singular variance – covariance, one of six share equations (Grapes in this case) can be arbitrarily deleted and a system estimator can be applied to the reminder equations of the system (only five equations) by using IRSUR procedure and the parameters of the dropped equation may be estimated by using the adding-up property.

The estimation results for the linear approximate form of the Almost Ideal Demand System (LA/AIDS) for the import demand for six fresh fruits in the United Arab Emirates market are presented in Table 5. Values of R^2 ranged from 69 percent for apple as an upper limit and 28 percent for mangoes as a lower limit. About 60 percent of the estimated coefficients are statically significant at the one percent, five percent and ten percent levels. The expenditure coefficients for UAE imports of fresh fruits indicate whether commodities are necessities or luxuries. However, all statistically significant expenditure coefficients for UAE imports of fresh fruits with the exception of bananas are negative.

In addition, all expenditure coefficients are significant at the one percent, five percent and ten percent levels except for mangoes. Furthermore, the coefficients of grapes equation were calculated from the adding-up condition without any significance.

Elasticity Estimates

Researchers are mostly interested in the demand elasticities. The flexible functional form of the LA/AIDS model allows us to easily carry out the elasticity analysis. The demand elasticities are calculated as functions of the estimated parameters and they have standard implications. According to Green and Alston (1990), elasticities in LA/AIDS model can be expressed as expenditure elasticity as well as uncompensated and compensated own price and cross- price elasticities. The uncompensated and the compensated elasticities of

Table 4
Co-integration test for import demand series

Series	Dickey-fuller Co-integration test		Philips-Perron Co-integration test	
	No Trend	Trended	No Trend	Trended
Expenditure shares				
Apple	-5.161	-5.021	-7.525	-10.633
Banana	-4.491	4.775	-4.629	-8.968
Dates	-4.461	-3.178	-4.923	-4.67
Grapes	-4.173	-3.895	-7.096	-7.189
Mango	4.929	-4.754	-5.017	-4.903
Oranges	-3.829	-3.788	-5.438	-6.234
5% critical	-3.066	-3.761	-3.066	-3.761

demand for six fresh fruits imports by UAE were computed at sample means.

Uncompensated elasticities

By using the estimated coefficients in Table 5 and equations 5 and 6, the uncompensated or Marshallain own and cross-price elasticities are listed in Table 6. Uncompensated own price elasticities for six fresh fruit imports by UAE have negative signs as expected according to economic theory. The own price elasticity for fresh grapes import is -1.6 and slightly more than unitary for fresh oranges, i.e. -1.02, implying that their elasticities are elastic. This means that both fresh grapes and oranges imports are very sensitive to import prices changes. These results are also important for exporters since a one percent increase in own price would decrease import demand both grapes and oranges by 1.6 and 1.02 percent, respectively. Accordingly, a price increase for these fruits *ceteris paribus* would decrease total revenue for traders. By contrast, own price elasticities for apples, bananas, dates and mangoes imports are inelastic, which implies a one percent increase in own price would decrease import demand by 0.53, 0.82, 0.92 and 0.39 percent, respectively. Thus, a small increase in own price would increase total revenues from apples, bananas, dates and mangoes sales. Turning to the cross-price effects as shown in the same table, all cross-price elasticities among the six commodities are inelastic. It is also important for fruit exporters to know the effects on their products' demand from price changes of other competing fruits. Positive cross-price elasticities show that two commodities are substitutes, whereas negative elasticities indicate complementary products (Schmitz and Seale, 2002). The results show that grape imports are substitutes for banana, date, mango and orange imports. Apple imports are substitutes for date and orange imports. Results also show that apple imports are complements to banana, mango and grape imports. Banana imports complement the imports of all the other five fruits. However, there is no cross-price elasticity between orange imports and date imports.

Compensated elasticities

Compensated or Hicksian elasticities are calculated by using the parameter estimates in Table 6 and formula 8 while

Table 5
Parameter estimates of LA/ AIDS model for years 1990- to -2007

	Apples	Banana	Dates	Mangos	Oranges	Grapes
Apples	0.099 (6.60***)					
Banana	-0.049 (-2.50**)	0.104 (2.55**)				
Dates	0.023 -1.43	0.033 -1.27	-0.007 -0.19			
Mangos	-0.078 (3.75***)	-0.059 (-1.98*)	-0.033 (-1.38)	0.07 -1.22		
Oranges	0.035 (2.03*)	-0.053 (-2.33**)	-0.024 -1.31	0.051 (2.29**)	-0.023 (-0.57)	
Grapes	-0.03 (-1.584)	0.025 -1.19	-0.077 (-0.35)	0.052 (2.29**)	0.015 -0.42	-0.068
Expenditure	-0.099 (-2.91**)	0.369 (5.83***)	-1.34 (2.17*)	-0.062 (-1.2)	-1.109 (-2.66**)	0.0344
Constant	1.571 (3.68***)	-4.484 (-5.64***)	1.806 (2.29**)	0.0861 -1.33	1.523 (2.97**)	-0.277
R^2	0.69	0.66	0.53	0.37	0.28	
DW	1.28	1.76	1.75	1.46	1.63	
EL	36.4	24.6	23.98	29.34	33.39	
SL	184.4					
AIC	160.4					

Note: t-ratio are in parentheses where *, ** and *** denote significant at 0.10, 0.05 and 0.01 respectively.
The t-ratio does not appear for coefficients which have been obtained using relevant restrictions.
EL refers to equation log-likelihood, SL is the system log-likelihood, and AIC is system Akaike information criterion.

the expenditure elasticities are calculated utilizing formula in equation 7. The compensated own and cross- price and expenditure elasticities are indicated in Table 7. Consistent with economic theory, as for the case of uncompensated, all estimated own price elasticities of six fresh fruit imports by UAE have the expected negative signs as priori. All compensated own price elasticities are relatively inelastic except for grapes, which is greater than one at -1.44. This means that import demand of grapes is very sensitive to import price changes. It is clear from the same table that all cross-price elasticities among the six fresh fruit imports are inelastic as in the case of uncompensated. The estimated cross-price elasticities show mostly the expected relationships of import demand for pairs of six fresh fruits. Based on the negative signs of cross-price elasticities both banana and dates are complementary goods with mango and orange imports. Other complementary fresh fruit induce apple imports with mangoes imports. Results also indicate that some goods are substitutes. It is clear from the table that grape imports are substitute with apple, banana, date, and mango imports. Apple imports are substitute for banana, date, grape and orange imports.

The expenditure elasticities

The expenditure elasticities of the imported demand for all the fresh fruits by UAE are positive with exception of date imports (Table 7). Both banana and grape imports appear to be luxury fresh fruits with expenditure elasticities greater than one. Other three fresh fruits are to be considered necessities as their expenditure elasticities are less than one. Negative expenditure elasticity of date imports is because there are annually significant increases in UAE dates production from 141 thousand tons in 1990 to reach 290 thousand tons in 1998, and then approximately doubled to 536 thousand tons in 1999. Since 2000 to 2007, UAE dates production ranged between 750 thousand tons as lower limit in 2005 and 760 thousand tons in 2004 as upper limit. At the same time, self-sufficiency of UAE dates since 1996 to 2007 was more than 100 (FAO). Self-sufficiency is equal to domestic production divided by domestic consumption. Accordingly, domestic consumption is equal to domestic production plus imports minus exports. Therefore, expenditures on date imports had a negative sign due to availability of the product domestically.

Conclusions

This paper estimated a demand system for imported fresh fruits in UAE using a Linear Approximate of Almost Ideal Demand System (LA/AIDS) over the period 1990-2007. Results showed that uncompensated and compensated own price elasticities for six fresh fruit imports have negative signs and inelastic except for uncompensated elasticities for grape and orange imports and compensated elasticity of grape imports

Table 6
Uncompensated (Marshallian) Own price and Cross price elasticities of LA/AIDS Model

	Apple	Banana	Dates	Mango	Oranges	Grapes
Apple	**-0.53**	-0.78	0.49	-0.49	0.36	-0.32
Banana	-0.12	**-0.82**	0.49	-0.37	-0.18	0.15
Dates	0.13	-0.06	**-0.92**	-0.2	-0.06	0.02
Mangos	-0.25	-0.56	-0.13	**-0.39**	0.36	0.38
Oranges	0.2	-0.63	0	0.48	**-1.02**	0.07
Grapes	-0.07	-0.11	0.19	0.45	0.16	**-1.6**

Note: the bold values are the own-price elasticities, otherwise are the cross-price elasticities

Table 7
Compensated (Hicksian) own and cross price elasticities and Expenditure elasticities of LA/AIDS Model

	Apples	Banana	Dates	Mangos	Oranges	Grapes
Apples	**-0.36**	0.003	0.46	-0.349	0.459	0.47
Banana	0.002	**-0.263**	0.466	-0.276	-0.107	0.247
Dates	0.208	0.295	**-0.935**	-0.138	-0.017	0.538
Mangos	-0.168	-0.187	-0.147	**-0.328**	0.412	0.25
Oranges	0.308	-0.101	-0.025	0.574	**-0.952**	-0.384
Grapes	0.01	0.253	0.18	0.517	0.204	**-1.441**
Expenditure	0.624	2.953	-0.12	0.518	0.38	1.284

Note: the bold values are the own-price and expenditure elasticities, otherwise are the cross-priceelasticities.

which were greater than unity. These results are important for exporters of these fruits because they illustrate whether or not an own price change would decrease or increase revenues. Moreover, if the prices of fresh fruit imports increase by a certain percentage, grape and orange imports would decline by more than the percentage increases in their prices. Accordingly, lowering the prices of both grapes and oranges exports to UAE would increase total revenue from both. By contrast, apple, banana and mango imports would drop by less than the percentage increases in their prices.

The results also indicated that uncompensated and compensated cross-price elasticities among the six commodities are less than unitary in absolute values. Banana imports seem to be complementing the imports of the remaining fruits. On the other hand, grape imports seem to be substitutes for imports of the other fruits except for apples.

Last finding of this empirical analysis was that both banana and grape imports are considered luxury fresh fruits with expenditure elasticities greater than one while apple, mangoe and orange imports are necessities as their expenditure elasticities are less than one.

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