Demand Elasticity of Imported Fruits in the Kingdom of Saudi Arabia

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Abstract

The present research estimated the demand for imported fruits in the Kingdom of Saudi Arabia using time series data that spanned for a period of thirty-eight years (1979-2017). The data were sourced from the FAO and UNCTAD databases and they covered import quantities and values for apple, banana, grape, orange, pineapple and straw berry. The collected data were analyzed using descriptive statistics and Linear Approximate Almost Ideal Demand System (LA/AIDS) model. Based on the findings it was observed that apple has the highest average budget share while orange has the highest marginal budget share. The empirical evidence showed that all the fruit commodities are normal goods with apple, banana and grape been necessities while orange, pineapple and straw berry were luxuries. Furthermore, it was established that income effect waxed stronger effect than price in influencing demand for imported fruit commodities as evidenced from the high values of uncompensated cross-price elasticities over the compensated cross-price elasticities. Therefore, the study recommends that the country should embark on intensive local production of these fruit commodities especially the necessary ones so as to maximize their foreign exchange and take advantage of tourism population influx. By so doing the economy of the nation will be able to absorb any marketing shocks which might arise as a result of market imperfection from fruit exporting markets.

***Keywords**: Demand, Imported fruits, LA/AIDS, Saudi Arabia*

Suudi Arabistan Krallığında İthal Meyvelerin Talep Esnekliği

Öz

Mevcut araştırma, otuz sekiz yıllık (1979-2017) bir dönem için yayılan zaman serisi verilerini kullanarak Suudi Arabistan Krallığı'ndaki ithal meyvelere olan talebi tahmin etmektedir. Veriler FAO ve UNCTAD veri tabanlarından elde edilmiş olup elma, muz, üzüm, portakal, ananas ve çilek için ithalat miktar ve değerlerini kapsamaktadır. Toplanan veriler, tanımlayıcı istatistikler ve Lineer Yaklaşık İdeal Talep Sistemi (LA / AIDS) modeli kullanılarak analiz edilmiştir. Elde edilen bulgulara göre ortalama bütçe payının elmada, marjinal bütçe payının ise portakalda en yüksek olduğu görülmüştür. Ampirik kanıtlar, elma, muz ve üzümün normal mallar olduğunu, portakal, ananas ve çileğin ise lüks mallar olduğunu göstermiştir. Ayrıca, telafi edilmemiş çapraz fiyat esnekliklerinin telafi edilmiş çapraz fiyat esneklikleri üzerindeki yüksek değerlerinden de anlaşılacağı üzere, gelir etkisinin ithal meyvelere olan talebi etkilemede fiyattan daha güçlü bir etki yarattığı tespit edilmiştir. Bu nedenle çalışma, ülkenin bu meyveleri, özellikle de gerekli olanları, dövizini en üst düzeye çıkarmak ve turizm nüfusu akışından yararlanmak için yoğun yerel üretime başlaması gerektiğini önermektedir. Böylelikle ülke ekonomisi, meyve ihraç eden pazarlardan gelen noksanlıkların bir sonucu olarak ortaya çıkabilecek her türlü pazarlama şokunu absorbe edebilecektir.

***Anahtar Kelimeler**: Talep, İthal meyveler, LA/AIDS, Suudi Arabistan*
JEL: C19, Q17, Q18
Received (Geliş Tarihi): 06.06.2020 Accepted (Kabul Tarihi): 02.12.2020

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INTRODUCTION

In the Gulf Cooperation Council (GCC) countries, between the years 2012 and 2017, the rise in food consumption stood at around 3.1 percent a year; reaching 49.1 million MT by the end of 2017 (Euro-fresh Distribution Magazine, 2016). The Kingdom of Saudi Arabia accounted for 60 percent of the total consumption in the GCC region (Adam *et al.*, 2019). Rapid population growth and tourism were identified to be the factor that triggered growth in food consumption in the GCC region. In addition to an increase in income levels in the region, prediction showed that food consumption per capita grew from 971.2 kg in 2015 to 983 kg in 2017 (Euro-fresh Distribution Magazine, 2016).

The food and beverages sectors recorded an increase of 2.1%, with imports into Saudi Arabia coming from 40 countries around the world, mainly with fruit and vegetables. The local consumer market for these worth \$6 billion a year; the main sources being Chile, the Philippines, South Africa, India, Pakistan, France, the United States, China, Egypt and Italy, among others (Euro-fresh Distribution Magazine, 2016; FAO, 2019). More than 200 varieties of fruit are sold in local markets, 40% of which are bananas, apples and oranges (FAO, 2017). The estimated market growth per annum is over 5% with fruit and vegetables been the most imported food. The size of the Kingdom of Saudi Arabia fruit market, which represents European fruit consumption of more than 50 thousand tons, is valued at \$ 133 million (Euro-fresh Distribution Magazine, 2016).

In the year 2018, the market of fruits and vegetables in the Kingdom of Saudi Arabia has been valued at \$11.86 billion and it is projected to grow at a CAGR of 4.4% over the forecasted periods of 2019 to 2024 (Anonymous, 2019).

Consequently, this research was conceptualized to determine the dietary diversity of fruit consumption in the country with the aim of devising a way forward that would protect the nation's economy from external market shocks and pilfering of its foreign reserve. Therefore, the research determined the demand elasticity of imported fruits in the Kingdom of Saudi Arabia.

METHODOLOGY

Time series data that spanned for a period of 38 years (1979 to 2017), sourced from FAO and UNCTAD databases were used. The collected data covered consumer price index (CPI), import quantities and expenditures of six fruits *viz.* apple, banana, grape, orange, pineapple and straw berry. Descriptive statistics and Linear Approximate Almost Ideal Demand System (LA/AIDS) model were used to analyze the data collected.

Empirical Model

Following Anwarul-Huq *et al.*(2004); Awal *et al.*(2008) Babar *et al.*(2011), using the budget share form, the LA/AIDS model is given below:

$$\omega_i = \alpha_i + \sum_j \gamma_{ij}\, lnP_j + \beta_i ln\left[\frac{X}{P^*}\right] + \varepsilon_i \qquad (1)$$

$$lnP^* = \sum_j w_j lnP_j \qquad (2)$$

$$\omega_i = \alpha_i + \sum_{j=1}^{n=6} \gamma_{ij} lnP_j + \beta_i ln\left[\frac{X}{P^*}\right] + \varepsilon_i \qquad (3)$$

The restrictions on the parameters of the AIDS equation (1) are:

$$\sum_i \alpha_i = 1. \sum_i \beta_i = 0. \sum_j \gamma_{ij} = 0, (Addding - up\ condition, Engel\ Aggregation \qquad (4)$$

$$\sum_j \gamma_{ij} = 0\ (homogeneity\ condition) \qquad (5)$$

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

Where, ω_i= budget share of the i[th] commodity (i.e. $\omega_i = P_i Q_i / X$); P_j= is the price of the j[th] commodity; X = total household expenditure on all the food items considered for the study; P^*= stone price index; ε_i= stochastic term, and it is assumed to be zero and has constant variance; α_i= intercept; γ_{ij} = price coefficient; and, β_i= expenditure coefficient. Blanciforti and Green (1983); Awal *et al.(*2008) stated that the model that uses Stone's geometric price index is referred to as the "Linear Approximate Almost Ideal Demand System (LA/AIDS)". The demand elasticities are calculated as the functions of the estimated parameters and they have standard implications. The expenditure elasticity ($\in_i$) which measures the sensitivity of demand in response to changes in consumption expenditure is specified as follow:

$$\in_i = 1 + \left(\frac{\beta_i}{\omega_i}\right) \quad (7)$$

$$\in_i = \frac{MBS}{ABS} \quad (8)$$

MBS and ABS means marginal budget share and average budget share, respectively.

Price elasticity is estimated in two ways *viz.* uncompensated (Marshallian) elasticity that contains both price and income effects, and the compensated (Hicksian) elasticity which contain only price effect.

The uncompensated own-price elasticity ($\in_{ii}$) and the cross-price elasticity ($\in_{ij}$) measures how a change in the price one product affects the demand of itself and that of the other products respectively, with the total expenditure and other prices being held constant i.e. *ceteris paribus*. The Marshallian own and cross-price elasticities are shown below (Babar *et al*., 2011):

$$\in_{ii} = \left(\frac{\gamma_{ii}}{\omega_i}\right) - (\beta_i + 1) \quad (9)$$

$$\in_{ij} = \left(\frac{\gamma_{ij}}{\omega_i}\right) - (\beta_i \omega_i / \omega_j) \quad (10)$$

The Hicksian own and cross-price elasticities ($\in_{ii}^* \ and \ \in_{ij}^*$) which measures the price effects on the demand assuming the real expenditure ($^{X}/_{P^*}$) is constant is given as follows (Babar *et al*. 2011):

$$\in_{ii}^* = \left(\frac{\gamma_{ii}}{\omega_i}\right) + (\omega_i - 1) \quad (11)$$

$$\in_{ij}^* = \left(\frac{\gamma_{ij}}{\omega_i}\right) + \omega_j \quad (12)$$

Besides, the compensated price elasticity can be estimated by using $\in_i$, $\in_{ii}$ and $\in_{ij}$, and the permutation is as follow:

$$\in_{ij}^* = \in_{ij} + \in_i * \omega_i \quad (13)$$

Babar *et al*.(2011) reported that the sign of the estimated $\in_{ij}^*$ indicates the substitutability or complementarily between the destinations under consideration. A commodity pair is denoted as a complement or substitute if their compensated cross-price elasticity is negative or positive respectively.

Based on the value of expenditure elasticity, a food item is classified as a necessity/necessary commodity ($0 < \in_i < 1$), a luxury commodity ($\in_i > 1$) or a Giffen / inferior commodity ($\in_i < 0$).

In absolute term, the demand for a particular commodity is price elastic (inelastic) if the elasticity value of its own-price is larger than unity (less than unity).

The Hicksian elasticity indicates the change in demand for a commodity due to a price variation, when the real expenditure change caused by the aforementioned price variation is compensated by an expenditure variation so that satisfaction/utility is kept constant.

When the objective is to use a tax instrument to limit consumption of a certain item by raising its price to consumers, the value of the price elasticity of demand is the key (Clements and Si, 2015). Below is the formula:

$$Required\ price\ increase = \frac{Required\ reduction\ in\ consumption}{Price\ elasticity} \quad (14)$$

RESULTS AND DISCUSSION

Average and Marginal Budget Shares

A perusal of Table 1 showed the average budget share incurred on imported fruits *viz.* apple, banana, grape, orange, pineapple and straw berry to be 0.275, 0.265, 0.081, 0.35, 0.009 and 0.017 respectively with a conditional expenditure of \$293832.80. Thus, this implies that the country expended\$0.275, \$0.265, \$0.081, \$0.35, \$0.009 and \$0.017 in respect of the above specified commodities for a \$1.00 budget on imported fruit commodities annually. It is very obvious that orange had the highest cut in the budget share and followed behind in descending order by apple and banana while pineapple had the least share.

In addition, on the average, the quantity of imported orange was the highest with approximated metric tons of 251932.1 while pineapple had the least import quantity. Therefore, it can be suggested that imported fruits *viz*. orange, apple and banana had more consumption in the studied area, possibly because of the low price regimes attributable to them in relative to the other fruit commodities imported into the country.

Furthermore, the price coefficient of variations for the fruits ranged from 0.205 to 0.693 with straw berry recording the largest value of variation. The large variation in the price of straw berry may be attributed to the different grades of the commodity, thus creating wide variation in the price of this commodity in the country. The price of pineapple fruit had the least coefficient, an indication of little or no grading of the good, thus the reason for low variation in the price of the commodity. Besides, it was observed that there was no inconsistency in the budget shares of the selected commodities as evidenced from their respective standard deviation values which were not above 0.028. This implies that the budget shares of the imported fruit crops actually summarize the behavior of the consumers. However, evidence showed high variation in the average conditional expenditure on the imported fruits, implying that the country exhibited an inconsistency behavior about the expenditure incurred on imported fruits. Thus, this may be attributed to the relatively unstable conditions of supply and demand for imported fruits in the country.

The empirical evidence showed the marginal budget shares for the imported fruit commodities to be 22.39%, 25.86%, 6.87%, 41.64%, 1.09% and 2.16% for apple, banana, grape, orange, pineapple and straw berry, respectively (Table 2). This marginal budget shares are the marginal propensity to consume for the imported fruit *viz.* 0.22, 0.26, 0.069, 0.42, 0.11 and 0.02 for apple, banana, grape, orange, pineapple and straw berry, respectively. Therefore, it can be inferred that there is moderate diversification of expenditure on fruit with three comkmodities viz. apple, banana and orange having an overwhelming effect.

Parameter Estimates of Demand Function

The ordinary least square (OLS) estimation showed the semi-log functional form to be suitable for the specified LA/AIDS model as it satisfied the economic, statistical and econometric theory (Table 3). In addition, the diagnostic tests revealed the reliability of the parameter estimates as indicated by the Durbin-Watson and Langrage Multiplier (LM) test statistics for serial correlation, LM test for heteroscedasticity and Arch LM test statistic for the presence of Arch effect (co-variance) which were within the plausible margin of 10% degree of freedom. Also, the CUSUM test statistic for parameter stability, Chow test statistic for structural break at observation 1998 and RESET test statistic for adequacy of the specified equation were within the acceptable margin (less than 10% degree of freedom). Though, the CUSUM test statistic indicated there was no change in the parameters, the structural break across the year for each commodity was examine.

According to Jha and Sharma (2001) as cited by Gheblawi *et al*.(2013), a variable series which is specified as non-stationary in the absence of structural break become trend stationary once structural break is computed in the regression parameters of the model. A structural break occurs during the period(s) where the standard deviations of the residual(s) exceed the value of two (Taljaard *et al*., 2003; Gheblawi *et al*., 2013). The empirical evidence revealed absence of structural break across the years(1979 to 2017) for the selected fruits as indicated by their respective residuals standard deviation values which were less than 2.00 (Table 4). For normality test, with the exception of the LA/AIDS models for pineapple and straw berry, the residuals of all the remaining fruit demand models were not within the acceptable margin of 10% degree of freedom. However, non-normality of the residual is not considered a serious problem as data in their natural forms are mostly not normally distributed (Sadiq *et al.* 2017). The properties of homogeneity and symmetry of the demand function were not violated as postulated by consumer theory, thus the estimated parameters were consistent and reliable for predictions.

The results showed that the coefficient of multiple determinations (R^2) for the selected fruit items ranged from 0.437 to 0.757 with pineapple having the highest while grape recorded the lowest value. Thus, these imply that 43.7% and 75.7% variations in the demand for grape and pineapple were influenced by the price and income parameters included in the model. Generally, it was observed that a reasonable number of the parameter estimates were different from zero at 10% degree of freedom. Out of the forty-two estimated parameters, seventeen were within the plausible margin of 10% degree of freedom. The intercept parameters for apple, banana and grape demand function were significant at various probability levels within the acceptable margin of 10% probability level and all were positively signed. These showed evidence of exogenous growths in the demand for apple, banana and grape, which are independent of the movements from prices and income. In addition, it shows that the exogenous growths in the share of these fruit commodities have increased. Thus, the observed increases in the demand for apple, banana and grape fruits may be due to changes in tastes.

The results showed that as the demand for apple increased with an increase in own-price so also it decreased with an increase in the prices of banana and orange. The demand for banana decreased with an increase in the prices of apple and grape; while it increased with an increase in its own-price. The demand for grape was observed to respond directly to an increase in its own-price while demand for orange responded negatively to the price increase of own-price and that of apple and banana. The budget share of pineapple increased with an increase in the prices of apple, banana and grape, and decreased with an increase in its own-price and price of orange.Lastly, the demand for straw berry increased with an increase in the prices of apple, banana and grape; and decreased with an increase in the price of orange.

Table 1. Summary statistics of the variables

Items	Mean	SD	Minimum	Maximum	CV
		Import quantity (Metric ton)			
Apple	129648.2	38579.33	42134	204292	0.29757
Banana	169910.9	59416.04	55581	307420	0.34969
Grape	30907.18	9595.021	6541	53076	0.31045
Orange	251932.1	91334.43	65691	418446	0.36254
Pineapple	5181.667	6823.019	577	21924	1.3168
Straw berry	3720.872	3614.536	58	12901	0.97142
		Budget share			
ω_{Apple}	0.274524	0.050803	0.11107	0.379041	0.18506
ω_{Banana}	0.265017	0.055421	0.073112	0.382239	0.20912
ω_{Grape}	0.081339	0.021151	0.021284	0.12723	0.26004
ω_{Orange}	0.35363	0.049939	0.251709	0.473886	0.14122
$\omega_{Pineapple}$	0.008998	0.007541	0.001796	0.027397	0.83811
$\omega_{Strawberry}$	0.016493	0.016069	0.001033	0.065202	0.97430
		Prices (₦)			
P_{Apple}	585.9699	243.9222	306.3811	1057.192	0.41627
P_{Banana}	422.9243	148.1246	242.8788	744.1395	0.35024
P_{Grape}	709.5247	268.1245	374.5373	1302.243	0.37789
P_{Orange}	382.8351	93.9849	269.1233	571.0932	0.24550
$P_{Pineapple}$	649.5002	132.8565	421.0863	954.5455	0.20455
$P_{Strawberry}$	1706.384	1183.268	300	5477.81	0.69344

Table 1 (cont.) Summary statistics of the variables

Items	Mean	SD	Minimum	Maximum	CV
		Average annual expenditure (₦)			
Apple	81350.44	56098.88	19778	194887	0.68960
Banana	76793.64	48215.31	19730	176394	0.62786
Grape	23109.77	15455.28	5988	67894	0.66878
Orange	101673.4	56474.93	20027	199756	0.55545
Pineapple	3770.128	5438.871	387	17314	1.4426
Straw berry	7135.436	11254.86	121	41541	1.5773
Expenditure	293832.8	182380.6	70592	671407	0.62070

Source: Authors' own computation, 2020
ω and P means budget share and price respectively.

Table 2. Marginal budget share (marginal propensity to consume) for the selected fruits

Commodity	ABS	MBS	ABS%	MBS%
ω_{Apple}	0.274524	0.223897	27.45243	22.38968
ω_{Banana}	0.265017	0.258557	26.50166	25.85573
ω_{Grape}	0.081339	0.068695	8.133855	6.869545
ω_{Orange}	0.35363	0.416375	35.36297	41.6375
$\omega_{Pineapple}$	0.008998	0.010913	0.899757	1.091297
$\omega_{Strawberry}$	0.016493	0.021562	1.649327	2.156247
Total	1	1	100	100

Source: Authors' own computation, 2020
ABS and MBS means average budget share and marginal budget share respectively.

Table 3. Parameter estimates of the LA/AIDS

Items	D_{Apple}	D_{Banana}	D_{Grape}	D_{Orange}	$D_{Pineapple}$	$D_{Strawberry}$
Intercept	0.66716	0.3461	0.15159	-0.1178	-0.0108	-0.0363
	(0.1849)	(0.2041)	(0.08286)	(0.1333)	(0.0194)	(0.0466)
	3.61***	1.70*	1.83*	0.88^{NS}	0.55^{NS}	0.78^{NS}
P_{Apple}	0.19045	-0.0955	-0.02509	-0.1051	0.01450	0.0207
	(0.04157)	(0.0459)	(0.0186)	(0.0299)	(0.0044)	(0.0105)
	4.58***	2.08**	1.35^{NS}	3.51^{NS}	3.33***	1.98**
P_{Banana}	-0.0919	0.213671	-0.02892	-0.1359	0.0106	0.03249
	(0.04598)	(0.0508)	(0.0206)	(0.0332)	(0.0048)	(0.0116)
	2.00**	4.21***	1.40^{NS}	4.10***	2.20**	2.81***
P_{Grape}	0.015035	-0.10208	0.066052	-0.0098	0.01113	0.01969
	(0.0445)	(0.0491)	(0.0199)	(0.0321)	(0.0047)	(0.0112)
	0.34^{NS}	2.08**	3.32***	0.31^{NS}	2.39**	1.76*
P_{Orange}	-0.12808	0.013068	-0.02727	0.21969	-0.0261	-0.0513
	(0.0469)	(0.0518)	(0.0210)	(0.0339)	(0.0049)	(0.0118)
	2.73***	0.25^{NS}	1.30^{NS}	6.49***	5.30***	4.34***
$P_{Pineapple}$	0.001219	-0.01661	0.007441	0.03382	-0.009	-0.0169
	(0.0426)	(0.0471)	(0.0191)	(0.0307)	(0.0045)	(0.0107)
	0.03^{NS}	0.35^{NS}	0.39^{NS}	1.10^{NS}	2.01**	1.57^{NS}
$P_{Strawberry}$	-0.01001	-0.00361	0.003304	0.01392	-0.00095	-0.0027
	(0.0192)	(0.0212)	(0.0086)	(0.0138)	(0.002)	(0.0048)
	0.52^{NS}	0.17^{NS}	0.38^{NS}	1.01^{NS}	0.47^{NS}	0.55^{NS}
Expenditure	-0.05063	-0.00646	-0.01264	0.06275	0.00192	0.00507
	(0.0258)	(0.0285)	(0.0116)	(0.0186)	(0.0027)	(0.0065)
	1.96**	0.23^{NS}	1.09^{NS}	3.38***	0.71^{NS}	0.78^{NS}
R2	0.5141	0.5024	0.4371	0.7386	0.7574	0.6920

Table 3 (cont.). Parameter estimates of the LA/AIDS

Items	D_{Apple}	D_{Banana}	D_{Grape}	D_{Orange}	$D_{Pineapple}$	$D_{Strawberry}$
F-stat	4.68 (0.001)***	4.47 (0.001)***	3.44 (0.007)***	12.51 (0.000)***	13.82 (0.000)***	9.95 (0.000)***
D-W stat	2.04 (0.291)^{NS}	1.856 (0.129)^{NS}	1.585 (0.022)**	2.023 (0.273)^{NS}	1.586 (0.023)**	1.826 (0.110)^{NS}
Autcr. test	0.029 (0.865)^{NS}	0.194 (0.662)^{NS}	1.588 (0.217)^{NS}	0.005 (0.942)^{NS}	1.126 (0.296)^{NS}	0.062 (0.803)^{NS}
Hetero (LM)	36.62 (0.39)^{NS}	37.33 (0.36)^{NS}	37.37 (0.360)^{NS}	38.13 (0.328)^{NS}	37.55 (0.352)^{NS}	37.98 (0.334)^{NS}
Arch test(LM)	0.032 (0.857)^{NS}	1.441 (0.229)^{NS}	0.158 (0.690)^{NS}	5.990 (0.199)^{NS}	0.277 (0.598)^{NS}	0.035 (0.850)^{NS}
Norm. test (χ^2)	15.11 (0.0005)***	11.01 (0.004)***	19.63 (5.4e-5)***	10.27 (0.005)***	1.058 (0.589)^{NS}	3.254 (0.196)^{NS}
RESET test	0.395 (0.67)^{NS}	5.337 (0.279)^{NS}	1.890 (0.169)^{NS}	2.065 (0.144)^{NS}	4.999 (0.136)^{NS}	5.292 (0.109)^{NS}
CUSUM test	-1.278 (0.210)^{NS}	0.199 (0.843)^{NS}	-1.633 (0.112)^{NS}	0.931 (0.358)^{NS}	3.797 (0.664)^{NS}	3.463 (0.162)^{NS}
Chow test	1.287 (0.297)^{NS}	0.778 (0.625)^{NS}	2.446 (0.445)^{NS}	1.278 (0.302)^{NS}	3.432 (0.961)^{NS}	1.400 (0.248)^{NS}

Source: Computer's printout, 2020

*Values in ( ) are standard deviation while ***, **, * , ^{NS} means significant at 1%, 5%, 10% and non-significant, respectively.*

Table 4. Structural break of the expenditure shares for the imported fruits

Year	w_{Apple}	w_{Banana}	w_{Grape}	w_{Orange}	$w_{Pineapple}$	$w_{Strawberry}$
1979	-0.00437	0.003125	-0.00322	0.001794	0.001126	0.001543
1980	-0.0331	0.027707	0.011113	-0.02033	0.005064	0.009546
1981	-0.02389	0.00838	0.010674	0.016865	-0.00404	-0.00799
1982	0.00375	0.002342	0.006097	-0.0013	-0.00419	-0.0067
1983	0.046632	-0.02533	0.01937	-0.03136	-0.00314	-0.00617
1984	0.028413	-0.01398	0.034565	-0.04018	-0.0006	-0.00823
1985	0.001426	-0.00146	0.004163	-6.6E-05	0.001264	-0.00532
1986	-0.05769	0.032548	-0.01659	0.035053	0.003583	0.003103
1987	0.040771	-0.00475	-0.01985	-0.02605	0.001637	0.008233
1988	0.015256	-0.00771	0.015325	-0.0055	-0.00647	-0.0109
1989	0.053163	-0.05316	0.014502	-0.011	-0.00254	-0.00096
1990	0.034996	-0.03054	-0.0038	-0.00856	0.00421	0.003687
1991	0.053709	-0.02515	-0.00168	-0.0141	-0.00487	-0.0079
1992	0.01009	-0.03636	0.005927	0.010259	0.002366	0.007718
1993	0.033037	-0.04753	-0.00565	0.016918	-0.00153	0.004761
1994	-0.01854	0.013439	0.005473	0.002079	-0.00079	-0.00167
1995	-0.02253	0.009654	0.009514	0.015891	-0.00309	-0.00944
1996	0.015869	-0.01501	0.010661	-0.01031	0.002844	-0.00405
1997	-0.00682	0.013708	0.00406	-0.00426	-0.00171	-0.00498
1998	0.000193	0.014126	-0.00147	-0.00856	-0.00206	-0.00223
1999	-0.00173	-0.0316	-0.00698	0.026438	0.002252	0.011625
2000	-0.03249	0.058669	-0.01382	-0.002	-0.00463	-0.00573
2001	-0.02579	0.056958	-0.00734	-0.02647	0.000228	0.002412
2002	-0.01513	0.016916	0.010867	-0.01929	0.002385	0.004244
2003	-0.02947	-0.01468	-0.00303	0.034591	0.003313	0.009278
2004	-0.0154	0.007329	-0.00414	0.006599	0.001518	0.004096
2005	0.001863	-0.01885	-0.00776	0.010993	0.003976	0.00977
2006	-0.00557	0.019971	-0.00411	0.010211	-0.00639	-0.01412
2007	-0.00701	0.037912	-0.00443	-0.00229	-0.00761	-0.01657

Table 4 (cont.). Structural break of the expenditure shares for the imported fruits

Year	w_{Apple}	w_{Banana}	w_{Grape}	w_{Orange}	$w_{Pineapple}$	$w_{Strawberry}$
2008	0.048231	-0.07049	-0.00109	0.027109	-0.00363	-0.00013
2009	-0.14498	0.14746	-0.07017	0.086055	-0.00302	-0.01534
2010	0.013403	0.037412	-0.00155	-0.05567	0.003559	0.002842
2011	0.004727	0.053116	-0.01964	-0.04862	0.006792	0.003624
2012	0.018608	-0.02761	-0.00398	0.003029	0.001638	0.00832
2013	0.02432	-0.03939	0.010418	0.001727	0.004465	-0.00154
2014	0.003271	-0.03158	0.005957	0.019699	0.001582	0.00107
2015	0.005898	-0.01731	0.014563	-0.01691	-0.00052	0.014276
2016	0.012282	-0.03521	0.002505	0.027584	0.000234	-0.0074
2017	-0.02539	-0.01308	0.004542	-8.1E-05	0.006802	0.027211

Source: Computer's printout, 2020

Expenditure Elasticity

Based on size and sign of the income (expenditure) elasticity, a commodity can be classified as necessity, luxury and inferior. Since elasticity of demand is independent of the units in which a demand is measured, thus elasticity is more meaningful in measuring the response of a demand to changes in price(s) or income. Literatures interpret expenditure elasticity as a percentage change in the quantity demand when the expenditure (income) changes by a percent, *ceteris paribus*. Thus, with the expenditure elasticities of apple, banana and grape fruits been 0.816, 0.976 and 0.845 respectively, it implies than an increase in income by 10% would increase the demand for apple, banana and grape by 8.16%, 9.76% and 8.45% respectively (Table 5). Also, the income elasticities of orange, pineapple and straw berry been 1.177, 1.213 and 1.307 respectively, means that if per capita income increased by 10% the demand for these commodities in respective order would increase by 11.77%, 12.13% and 13.07%. All the fruit items are normal goods as indicated by their respective income elasticities which have direct relationships with their respective demand.

The expenditure elasticity coefficients of apple, banana and grape fruits were inelastic i.e. less than unity, hence they are necessary commodities while that of orange, pineapple and straw berry were greater than unity i.e. elastic, thus, implying they are luxury commodities. It is expected that the luxury fruit items would witness an increase in demand when the per capita income of the consumers' increase in tandem with the overall economic growth of the country. However, if the consumers' annual real per capita incomes decrease, in relative terms, less expenditure would be allocated to these imported fruits. This implies that as households' per capita income increases and they diversify their fruit diet, they would tend to increase their consumption of imported orange, pineapple and straw-berry. Therefore, any policy aimed at increasing the per capita income of the people is likely to enhance their diversity for imported fruit diet towards orange, pineapple and straw berry. Comparatively, it was observed that apple and banana fruits had the lowest expenditure elasticities among the class of the imported fruits. The consumptions of these fruits are relatively little affected by changes in income and already they have occupied a special position in the fruit diets of the populace in the studied area.

Given fixed supplies for apple, banana and grape fruits, an upward shift in their respective demand curves would cause a hike in their own market prices. Since their respective own-price elasticities are lower than unity, it is anticipated that the increase in their prices due to the shifts in the demand curves for these fruit items would lead to a decrease in their demand by less than the proportionate changes in their respective prices. Also, if the supplies for pineapple and straw berry are fixed, an upward shift in their demand curves would lead to a rise in their respective market prices. Given the elastic status of their own-price elasticities, it is anticipated that the increase in their prices due to the shifts in their demand curves would result in decrease in their respective demand by more than the proportionate changes in their prices. However, orange would exhibit the same scenario with those commodities whose own-price elasticities were inelastic.

Demand's Response to Changes in Prices

According to economic theory, commodity own-price elasticity is expected to be negatively signed, an indication that the demand curve is negatively sloped. In the absence of any compensation in either price or income, any change in the demand for a commodity due to a price variation is termed as uncompensated elasticity (Awal *et al*., 2008). While compensated elasticity indicates a change in demand for a commodity due to a price variation when the real expenditure caused by the price variation is compensated by variation in the expenditure so as to keep the utility constant (Babar *et al*., 2011). Once the change in the price is compensated by total change in the quantity demand (of the uncompensated elasticity); what is left is income effect. Thus, price effect plus income effect equals total effect.

A cursory review of the results showed all the own-price elasticity coefficients for both the uncompensated and compensated to have negative signs thus conforming to the *a priori* expectation (Table 5). This implies that there exists inverse relationship between price of a normal commodity and its demand. The presence of substantial difference between the uncompensated and compensated own-price elasticities indicates that substantial income effect is present. These estimates revealed the responsiveness of imported fruit consumers to change in prices while adjusting their consumption of corresponding imported fruit commodities.

In absolute term, the uncompensated own-price elasticity of all the imported fruits with the exception of pineapple and straw berry were inelastic i.e. less than unity, indicating that changes in the prices of these commodities have little effect on their demand. However, for the pineapple and straw berry that reacts elastically to their own-price, any change in their respective prices would greatly affect their demand. In other words, it implies that the demand for apple, banana, grapes and orange reacts in-elastically to changes in their respective own-prices while the demand for pineapple and straw berry reacts elastically to changes in their respective own-prices.With the exception of straw berry, the uncompensated own-price elasticities for all the imported fruit commodities were lower than their respective expenditure elasticities, indicating that the responsiveness of demand to own-price changes for these fruits are lower than to the variations in the total expenditure.

The uncompensated own-price elasticity consists of two-fold *viz.* price or substitution effect and income effect. The estimated uncompensated own-price elasticity revealed that if the price of imported apple dampened by 10% then the demand for imported apple would increase by 2.56%. Of this surge in the demand, 0.32% is purely due to price effect (i.e. substitution effect) as indicated by compensated own-price elasticity. The income effect due to the decrease in the price accounted for the remaining 2.24% (i.e. 2.56-0.32) increase in imported apple demand and it owes to increase in the real income, though the absolute amount of money income remains unchanged. The relatively large income effect on the demand for imported apple owes to its large share in the budget for imported fruits. If the per capita income increased by 10% and subsequently it is accompanied by a 10% decline in the price of imported apple, then the demand for imported apple would hike by 10.71% (i.e. 2.56 + 8.16).

For imported banana, grape and orange, if their respective own-prices declined by 10% then the demand for them would increase by 1.87%, 1.75% and 4.42% respectively, as evidenced by their respective uncompensated own-price elasticity values. Of this increase in the demands for these imported fruits, compensated own-price elasticity revealed that 0.71% for banana, 1.07% for grape and 0.25% for orange are purely due to substitution effect. The income effect due to fall in the price accounted for the remaining 1.16%, 0.69%, and 4.16% increase in the demand for banana, grape and orange respectively, and it owes to the increase in the real income, though the absolute amount of the money income remains unchanged. The income effect been relatively moderate and large for imported banana and orange respectively is due to the fact that the former had a moderate share in the budget while the latter had a large share in the budget. However, the budget share of grape been small made its income effect to be relatively small on demand for imported grape. Therefore, if an increase in the per capita income by 10% is accompanied by 10% decline in the price of these imported fruits each, then the demand for imported banana, imported grape and imported orange would increase by 11.63%, 10.20% and 16.19% respectively.

Lastly, the uncompensated own-price elasticity estimates for imported pineapple and straw berry indicated that if their respective prices declined by 10%, then the demand for the former and latter would increase by 20.0% and 11.66% respectively. Of these demand increase, it was observed from the compensated own-price elasticity that 19.91% for imported pineapple and 11.44% for imported straw berry were purely due to substitution effect. Thus, the income effect which owes to the decline in their respective prices accounted for the remaining 0.11% and 0.22% rise in the demand for imported pineapple and strawberry respectively, and were due to increase in the real income. However, the absolute amount of money income remains unchanged.

The income effects on both the imported fruits were relatively small because their budget shares in the consumer's expenditure were small. Thus, if an increase in the per capita income by 10% is accompanied by 10% decrease in the prices of imported pineapple and straw berry, then their demand would increase by 32.15% and 24.73% respectively. The increase in the per capita income represents a shift in the demand curve for imported fruits which normally leads to an increase in the price of the imported commodity. This is not desireable for the country because it would make the economy of the country porous-drain the foreign exchange reserve and endanger the health status due import reliance. For estimation of the imported fruits equilibrium level, information of the supply elasticity of respective imported fruits are required.

With the exception of apple, banana and orange, the uncompensated and compensated own-price elasticity estimates showed that the income effect of price changes was very small for grape, pineapple and straw berry. This reason is because these commodities *viz.* grape, pineapple and straw berry had small shares in the consumers' expenditure. Hence, their price changes had minimal effects on the real per capita income. In the case of apple, banana and orange, their respective income effects due to changes in their respective prices were higher owing to their respective large share in the consumers' expenditure budget.

The compensated own-price elasticities concurred with the predicted demand theory as evidenced by the negativity of virtually all their respective own-price elasticity estimates (Table 5).In addition, their values in absolute term were less than that of their corresponding uncompensated own-price elasticities, thus indicating that an increase or decrease in the prices of these commodities would have a considerable effect on the per capita real expenditure, thus the income effect is stronger than the price effect. In other words, it implies that the price responsiveness of these imported fruits were income-dependent, in that if income is held constant,*ceteris paribus* (i.e. income is not a constant in the decision process), consumers would tend to be less responsive to fruit prices.

To limit the consumption of these imported commodities, a 25 percent reduction in the importation of apple, banana, grape, orange, pineapple and straw berry each, would increase their respective prices by 97.80%, 133.49%, 142.61%, 56.63%, 12.49% and 21.45% respectively, thus a decrease in the demand for these commodities in the country.

Table 5. Expenditure (income), uncompensated and compensated own-price elasticities

Goods	Elasticity	Uncompensated	Compensated	Income effect	PP(%PR)
Apple	0.815581	-0.25563	-0.03173	2.238968074	97.79804
Banana	0.975627	-0.18728	-0.071273	2.585573265	133.4868
Grape	0.844562	-0.1753	-0.1066	0.686954462	142.6134
Orange	1.177432	-0.44148	-0.0251	4.163749803	56.62827
Pineapple	1.21288	-2.00209	-1.99117	0.109129716	12.48698
Straw berry	1.30735	-1.16554	-1.14398	0.21562468	21.44927

Source: Authors' own computation, 2020

PP and PR means protectionist policy and price rise, respectively.

Cross-Price Elasticity

Presented in Table 6 and 7 are the matrices of uncompensated and compensated cross-price elasticities for the selected imported fruits. The cross-price elasticity measures the degree of responsiveness of the demand for a particular commodity to a change in the price of a substitute(s). Negative and positive cross-price elasticities imply that commodity pair is a complement and substitute respectively.

The uncompensated cross-price elasticity provides the 'gross' cross effects that include both the substitution and the income effect. While the compensated cross-price elasticity represents the pure price effect i.e. only the substitution effect or the net effect of price change on demand. Of the fifteen Marshallian cross-price elasticities, eight commodity pairs are 'gross' complements while the remaining seven commodity pairs are 'gross' substitutes as indicated by the negativity and positivity of their respective cross-price elasticities, respectively. However, based on the compensated cross-price elasticities, six of the commodity pairs are 'net' complements' while the remaining nine commodity pairs are 'net' substitutes as indicated by the cross-price elasticities for the former and latter which were negatively and positively signed, respectively.

The uncompensated cross-price elasticity of banana-to-apple been negative indicates that the two commodities are complement. In addition, this shows that the price of banana and demand for apple moved in different direction. The estimate reveals that the change in the price of banana had significant effect on the demand for apple as the cross-price elasticity was -0.286, thus implying that a 10% fall in the price of banana would cause an increase in the consumption of apple by 2.86%. On the other hand, the compensated cross-price elasticity of banana-to-apple i.e. the net effect of change in banana price on the demand for apple, shows that if the price of banana dampen by 10%, the consumers' demand for imported apple would surge by 0.70%. Thus, the first increase in the demand for apple by 2.86% is due to the effect of crash in the price of banana and increase in the real income. While the second increase in apple demand by 0.70% is pure due to price effect arising from the decline in the price of banana only. Therefore, an increase in the real per capita income that owes to decline in banana price would contribute to an increase in the demand for apple by 2.16%. (i.e. 2.86-0.70).

The grape-to-apple uncompensated cross-price elasticity was positively signed, an indication that the two commodities are substitutes; thus the two commodities moved in the same direction. The cross-price elasticity estimate of grape-to-apple been 0.070, means that a fall in the price of imported grape by 10% would decrease the demand for imported apple by 0.70%. Thus, the pure price effect of the decline in the price of imported grape would lead to a decrease in the demand for imported apple by 1.36%, as evidenced from the compensated cross-price elasticity for grape-to-apple. The rise in the per capita income due to the decrease in the price of imported grape (income effect) would induce the consumers to increase their demand for imported apple by 0.66% (i.e. 1.36-0.70).

Besides, the uncompensated cross-price elasticity of orange-to-apple been -0.401, it implies that a change in the price of imported orange had significant effect on the demand for imported apple. Thus, a decrease in the price of imported orange by 10% would lead to an increase in the demand for imported apple by 4.01%. While for the compensated cross-price elasticity, evidence shows that a decrease in the price of imported orange by 10% would lead to an increase in the consumption of imported apple by 1.13%. The increase in real per capita income due to the decrease in the price of imported orange (the income effect) would induce the consumers to increase their demand for imported apple by 2.88%. It was observed that some of the cross-price elasticities between the uncompensated and compensated had contrary signs. The negativity of the uncompensated cross-price elasticity of demand for banana (-0.013) due to the decrease in the in the price of straw berry i.e. total effect of a change in straw berry price implies that straw berry and banana are 'gross' complements. While on the other hand, the compensated cross-price elasticity been positive (0.0029), indicates that the two commodities are 'net' substitutes. The compensated cross-price elasticity is the most appropriate for information sorting with respect to substitution possibilities due too much ambiguity of uncompensated cross-price elasticity. However, expenditure effect plays an important role.

Table 6. Uncompensated cross-price elasticity for the selected fruits

Items	D_{Apple}	D_{Banana}	D_{Grape}	D_{Orange}	$D_{Pineapple}$	$D_{Strawberry}$
P_{Apple}	**-0.25563**	-0.35356	-0.26583	-0.34587	1.553272	1.170670444
P_{Banana}	-0.28594	**-0.18728**	-0.31438	-0.43144	1.122613	1.888866276
P_{Grape}	0.069769	-0.38322	**-0.1753**	-0.04221	1.219774	1.168748281
P_{Orange}	-0.40134	0.057928	-0.28024	**-0.44148**	-2.97656	-3.220048298
$P_{Pineapple}$	0.006098	-0.06246	0.092884	0.094042	**-2.00209**	-1.025552394
$P_{Strawberry}$	-0.03343	-0.01323	0.043179	0.036422	-0.10877	**-1.165540733**

Source: Authors' own computation, 2020
Own-price elasticities are written in bold letters

Table 7. Compensated cross-price elasticity for the selected fruits

Items	D_{Apple}	D_{Banana}	D_{Grape}	D_{Orange}	$D_{Pineapple}$	$D_{Strawberry}$
P_{Apple}	**-0.03173**	-0.08573	-0.03398	-0.02264	1.886237	1.529569699
P_{Banana}	-0.06979	**-0.071273**	-0.09056	-0.1194	1.444046	2.235335667
P_{Grape}	0.136107	-0.30386	**-0.1066**	0.053562	1.318428	1.275086201
P_{Orange}	-0.11293	0.402939	0.018421	**-0.0251**	-2.54765	-2.757730662
$P_{Pineapple}$	0.013437	-0.05369	0.100483	0.104636	**-1.99117**	-1.013789422
$P_{Strawberry}$	-0.01997	0.00286	0.057109	0.055841	-0.08877	**-1.143978265**

Source: Authors' own computation, 2020
Own-price elasticities are written in bold letters

CONCLUSION

The empirical evidence showed that imported apple has the largest share in the budgetary expenditure of imported fruit consumers in the studied area. However, it was discovered that the marginal propensity to consume for imported orange was the highest.

It was observed that all the selected commodities were normal goods with apple, banana and grape been necessary commodities while orange, pineapple and straw berry were luxury commodities. Furthermore, it can be inferred that the demand for imported fruits was much affected by income effect than the price effect as evidenced by the uncompensated own-price elasticities which were higher than their respective compensated own-price elasticities in absolute terms. The empirical evidence showed that eight of the commodity pairs were 'gross' complements while the remaining seven commodity pairs were 'gross' substitutes.

Therefore, since the income effect is stronger than the price effect in influencing the demand for imported fruits, it clearly shows that the gross national income of the country is being pilfered by the fruit exporting nations who sees Saudi Arabia as a potential export destination. Thus, the research strongly advise the country to embark on intensive agriculture so as maximize their foreign exchange earning given that the country is an epicenter host for pilgrimage and tourism activities. By so doing it would protect the economy of the nation from being vulnerable to external influence which can pose a threat to their fruit food security. In addition, the health status of the consumers would be protected as fruit exporters can violate the quality standard of the commodity and also the susceptibility of fruits to perishability makes the crops vulnerable to contamination.

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