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ESTIMATION AND ANALYSIS OF THE JORDANIAN CONSUMER EXPENDING PATTERN BY USING THE QUADRATIC EXPENDITURE SYSTEM (QES)

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ABSTRACT

The attention has been focused in recent years on using methods of the economic measuring as one of the quantitative analysis methods and these methods specifically is the quadratic expenditure system (QES) which has an active and important role in the economic phenomena analysis field, in order to assist the specialists in the field of planning and development to reach the highest welfare levels of the social and economic community. And economic themes, which has received wide attention in advanced planning is the subject of consumption, as occupies his study in the present day great importance in the statistical and economic studies because its important in the production planning on the level of the economic unity. Therefore, the study of consumption and its planning as accurate require the provision of the statistical and economic indicators very accurate, such as the indicators can be a cornerstone of making any decision about the consumer spending pattern.

In light of the above, the study aims to estimate and analyze of the Jordanian consumer spending pattern by using the Quadratic Expenditure System (QES) and their elasticities.

KEYWORDS: *Consumer Expending, Quadratic Expenditure System, Income Elasticity, Price Elasticities of Demand, Jordanian Economy.*

INTRODUCTION

The subject of consumption Leads to a prominent role in the theories of building the human resource development models, as the study of the family food consumption and the average of per capita it is one of the basic indicators that reveal far the process of the economic development, which requires the knowledge of the affecting factors on it, in order to study them and its analysis to reach for the required indicators to adoption it in the planning process. One of the new orientations which involved on it is the economic measuring models which dealt with the subject of consumption is to address this subject is that takes into account the interrelationships for the affecting factors of the consumption and embodiment it's in form of systems for demand where each of them is made up on a certain number of mathematical equations to express on economic relationship between the entering variables and which affect as featured prominently in the consumption. In this study we focus on the most system from the demand systems to analysis the spending of consumer which is Quadratic Expenditure System (QES), and the most prominent of the Quadratic Expenditure System (QES) feature that being not interested to analyze the demand for a particular commodity or commodity group apart from goods or other commodity groups, but the system (QES) is interested in analysis of the demand for all goods or commodity groups required by the consumer in the same time.

METHODOLOGY

1. STUUDY IMPORTANCE:

The importance of this study is manifested by using the demand systems in the consumer behavior analysis in being take into account of the overlap in the demand for the commodity groups among themselves which affect clearly and a great on trends of the consumer behavior, which reflected this effect on the accredited economic indexes values in the planning process, on the other hand the demand systems achieved all conditions of the economic theory (aggregation condition, homogeneity zero condition, and the symmetry condition) that failed to achieve it the single linear regression equation models, in spite the quality of the statistical fit.

2. STUUDY OBJECTIVES:

This study aims to achieve a number of sub-objectives, among them the following:

a. Use the economic measuring methods through which application of the most important system of spending systems represented by the Quadratic Expenditure System (QES) for use it in assessment of the Jordanian consumer spending pattern and their analysis of the expenditure data on the animal products in Jordan for the period (2000-2015).

b. To reach for some economic and statistical indicators necessary for planning purposes To reach for some of the statistical and economic indicators required for the planning purposes, and that can be adopted as planning tools to help

the Jordanian scheme in making decisions related to the consumer spending pattern, and also in the formulation of the price and income of the State policies.

LITERATURE REVIEW

1. Quadratic Expenditure System (QES):

Houthakker (1952), is the first who proposed the Quadratic Expenditure System (QES) through his research (Econometrics models for the family budget), who explained it that quadratic Angel functions cannot be derived depending on the specific type of benefit functions, but it can be obtained thought some of Polynomial forms. Gorman (1961) for the first time, he applied the Quadratic Expenditure System (QES), after reconstructing its theoretical basis by relying on the proposed indirect utility function by him. After that Howe, Pollak and Wales (1979), was introduced the system (QES), which explained that is the additional squared expenditure terms is upgrade the basic Linear Expenditure System (LES) to a rank three demand system. However the Engel-flexibility is still limited because of the linearity of marginal expenditure.

Touama (1995) explained the estimation and analysis of the linear and quadratic expenditure system to analyze the consumer spending pattern in Iraq. Ryan and Wales (1999), following Howe, et al. (1979), and Van & Merkies (1989), they introduce three flexible consumer demand systems in which expenditures on goods are quadratic functions of income, also, they explained that for a quadratic demand system to be theoretically reasonable.

The most prominent characteristic of Quadratic Expenditure System (QES) being not interested to analyze the demand for a particular commodity or commodity group apart from goods or other commodity groups, but are interested in analysis of the demand for all goods or commodity groups required by the consumer at the same time. The general formula of Quadratic Expenditure System (QES) is given as follows:

$$q_i = \gamma_i + \frac{\beta_i}{p_i}(m - \Sigma_j P_j \gamma_j) + \frac{[e_i - \frac{\beta_i}{P_i}\Sigma j\, Pjej][m - \Sigma j\, Pj\, \gamma j]^2}{\Pi j\, P_i^2 \beta j} \quad \ldots. (1)$$

$$i, j = 1,2,\ldots,n \quad , \quad \beta_i > 0 \quad , \quad \Sigma_i \beta_i = 1$$

2- Estimation of the (QES) Parameters Based on Time Series Data

We can estimates the parameters (γ_i , $é_i$, β_i) of Quadratic Expenditure System (QES) in the same time based on time series data, by using the Modified Steepest Decent (MSD) method**,** in light of the following steps (Touama, 1995: 93-98):

a- Use of initial values for all parameters of (QES) and their number (3n) depending on the prior information related to the estimates of (γ_i , β_i) which obtained by the traditional estimation methods (OLS), and assume that $(e_i = 0, \forall i)$.

b- Iteration the estimation process for the parameters (γ_i , β_i , $é_i$) until the stability of the estimates is achieved.

c- Stop the estimation process until we have on (convergence) of the estimates for the last iteration with the previous one.

3. Derive the Elasticities of Quadratic Expenditure System (QES):

In this section will be derive the final versions of the most important economic indicators represented by the income elasticity of demand (η_{i0}) and the price elasticities of demand in both types which are [own-price elasticity (η_{ii}), and cross-price elasticity (η_{ij})] of Quadratic Expenditure System(QES) as follows:

3.1. Income Elasticity of Demand (η_{i0})

The income elasticity of demand (η_{i0}) can be obtained through the following formula:

$$\eta_{i0} = MPC * \frac{m}{E_i} = \frac{\partial E_i}{\partial m} * \frac{m}{E_i} \quad (e_i = 0, \forall i). \quad \ldots. (2)$$

Whereas:

MPC: Marginal Propensity to Consume.

m: Income.

E_i: Expenditure.

Re-write the Quadratic Expenditure System (QES), we get the following formula:

$$E_i = p_i \gamma_i + \beta_i (m - \Sigma_j P_j \gamma_j) + \frac{[Pie_i - \beta i\, \Sigma j\, Pjej][m - \Sigma j\, Pj\, \gamma j]^2}{\Pi j\, P_i^2 \beta j} \quad \ldots. (3)$$

Whereas:

$E_i = p_i q_i$

And by conduct the partial differentiation on the relationship (3) according to income (m), and simplification we get the marginal propensity to consume (MPC), as follows:

$$MPC = \frac{\partial E_i}{\partial m} = \frac{2(E_i - Pj\, \gamma j)}{(m - \Sigma r\, Pj\, \gamma j)} - \beta_i \quad \ldots. (4)$$

And by compensation a result of the relationship (4) in the formula (2) we get the income elasticity of demand (η_{i0}) of the Quadratic Expenditure System (QES), as follows:

$$\eta_{i0} = \frac{m}{E_i}\left[\frac{2(E_i - Pj\, \gamma j)}{(m - \Sigma r\, Pj\, \gamma j)} - \beta_i\right] \quad \ldots. (5)$$

3.2. Price Elasticities of Demand:

There are two important price elasticities of demand are:

A- Own-price elasticity of demand (η_{ii}):

We can get the own-price elasticity of demand (η_{ii}) through the following formula:

$$\eta_{ii} = \frac{\partial q_i}{\partial p_i} * \frac{p_i}{q_i} \qquad \ldots. (6)$$

And by conduct the partial differentiation on the relationship (1) according to price (p_i), and simplification we get the following formula:

$$\frac{\partial q_i}{\partial p_i} = -\frac{\beta_i}{P_i^{\wedge}2}(m - \Sigma_{i \neq j} P_j \gamma_j) - 2\left[\frac{(E_i - Pj\,\gamma j)}{(m - \Sigma j\, Pj\,\gamma j)} - \beta_i\right]\frac{[Pi\gamma_i + \beta i\,(m - \Sigma j\, Pj\,\gamma j))]}{P_i^{\wedge}2} +$$

$$+ \frac{[\beta i\, \Sigma i \neq j\ Pj\theta j][m - \Sigma j\, Pj\,\gamma j]^{\wedge}2}{P_i^{\wedge}2\ \Pi j\ P_i^{\wedge}2\beta j} \qquad \ldots. (7)$$

And by compensation a result of the relationship (7) in the formula (6), and simplification we get the own-price elasticity of demand (n_{ii}) of the Quadratic Expenditure System (QES), as follows:

$$\eta_{ii} = -\frac{1}{E_i}[\beta_i(m - \Sigma_{i \neq j} P_j \gamma_j) + 2[\frac{E_i - Pj\,\gamma j}{(m - \Sigma j\, Pj\,\gamma j)} - \beta_i]\,[Pi\gamma_i + \beta_i\,(m - \Sigma j\, Pj\,\gamma j))] -$$

$$\frac{[\beta i\, \Sigma i \neq j\ Pj\theta j][m - \Sigma j\, Pj\,\gamma j]^{\wedge}2}{\Pi j\ P_i^{\wedge}2\beta j} \qquad \ldots. (8)$$

B- Cross-price elasticity of demand η_{ij}

We can get the cross-price elasticity of demand (n_{ij}) through the following formula:

$$\eta_{ij} = \frac{\partial q_i}{\partial Pj} * \frac{Pj}{q_i} \qquad \ldots. (9)$$

And by conduct the partial differentiation on the relationship (1) according to price (p_j), and simplification we get the following formula:

$$\frac{\partial q_i}{\partial Pj} = -\frac{\beta_i\,\gamma j}{P_i} - 2\left[\frac{E_i - Pi\,\gamma i}{(m - \Sigma j\, Pj\,\gamma j)} - \beta_i\right]\left[\frac{[Pj\,\gamma j + \beta j(m - \Sigma j\, Pj\,\gamma j))]}{P_i\,Pj}\right] - \frac{[\beta i\,\theta j][m - \Sigma j\, Pj\,\gamma j]^{\wedge}2}{P_i\ \Pi j\ Pj^{\wedge}2\beta j}$$

$$\ldots. (10)$$

And by compensation a result of the relationship (10) in the formula (9), and simplification we get the cross -price elasticity of demand (η_{ij})of the Quadratic Expenditure System (QES), as follows:

$$\eta_{ij} = -\frac{1}{E_i}[\beta_i\, P_j\, \gamma_j + 2[\frac{E_i - Pi\gamma i}{(m - \Sigma j\, Pj\,\gamma j)} - \beta_i]\,[Pj\,\gamma j + \beta j\,(m - \Sigma j\, Pj\,\gamma j)]$$

$$+ \frac{\beta i\, Pj\theta j[m - \Sigma j\, Pj\,\gamma j]^{\wedge}2}{\Pi j\ Pj^{\wedge}2\beta j} \qquad \ldots. (11)$$

RESULTS & DISCUSSION

1. Estimation of Quadratic Expenditure System (QES) Parameters

The study is mainly depending on the secondary data related to the expenditure data on the animal products in Jordan selected from the annual reports of public of statistics department - Jordan. To achieve the study objects, the researcher select the expenditure data during the period (2000-2015), as shown in the following Table No. (1).

Table 1. Average Annual Expenditure of the Individual on Animal Products in Jordan during the Period (2000-2015), and Per Capita of Disposable Income (dinars)

Years	Red Meats	Fish	Milk	Poultry Meats	Eggs	Per capita of disposable income
2000	19.211	3.701	4.217	20.136	6.071	998.137
2001	20.317	2.989	4.354	19.977	6.121	1059.006
2002	21.545	3.096	4.761	21.214	6.851	1102.416
2003	21.982	3.175	4.951	20.851	7.191	1298.731
2004	22.031	3.863	4.662	20.976	7.862	1210.212
2005	23.702	4.004	5.119	21.212	8.179	1312.456
2006	22.834	4.112	5.242	22.034	8.313	1320.541
2007	24.002	4.621	5.014	23.119	8.401	1331.669
2008	24.242	4.533	5.841	24.076	7.908	1342.019
2009	25.647	5.119	6.217	24.129	8.412	1345.217
2020	27.037	6.024	6.359	25.313	8.764	1299.821
2011	28.192	6.172	6.496	27.811	9.152.	1317.054
2012	29.761	6.871	6.845	28.217	9.041	1340.317
2013	31.097	6.827	7.117	29.115	9.007	1359.822
2014	30.852	5.831	7.533	29.419	8.885	1381.614
2015	32.367	6.944	6.772	33.125	9.017	1401.769

Source: *Annual reports of public of statistics department – Jordan & http://alrai.com/article/10402187.*

In order to estimate the parameters of Quadratic Expenditure System (QES), we used the following relation No. (3):

$$E_{it} = p_{it}\,\gamma_i + \beta_i\,(m_t - \Sigma_j\, P_{jt}\,\gamma_j) + \frac{[Pit\,\theta_i - \beta i\,\Sigma j\,Pjt\,\theta j][m - \Sigma j\,Pjt\,\gamma j]^2}{\Pi j\,Pit^2\beta j}$$

$$i, j = 1,2,3,\ldots,n \quad , \quad \beta_i > 0 \quad , \quad \Sigma_i\,\beta_i = 1 \quad , \quad t = 1,2,3,\ldots,16$$

And by depending on the expenditure data on the Animal products in Jordan during the period (2000-2015) listed in Table No. (1), and using the Modified Steepest Decent Method, the estimating process involving the initial values for all parameters of the system $(\gamma_i\ ,\ \beta_i\ ,\ \theta_i)$ based on the prior information about these parameters, where the prior information about the parameters $(\gamma_i\ ,\ \beta_i)$ are represent the stable estimates which obtained through using the traditional estimation methods (OLS) for the expenditure data of the most important animal products after we assume that $(\theta_i = 0,\ \forall\, i)$ for all products. As shown in Column (2) of Table (2).

Table 2. Estimation Results of the Quadratic Expenditure System (QES) Parameters using Modified Steepest Decent Method

(1)	(2)			(3)			(4)		
Animal product name	Initial Values of parameters			Initial estimates of parameters (The 1st iteration)			Final estimates of parameters Stability stage (convergence) (The 7th iteration)		
	γ_{i0}	β_{i0}	θ_{i0}	γ_{i1}	β_{i1}	θ_{i1}	γ_{i7}	β_{i7}	θ_{i7}
Red Meats	0.041	0.062	0	0.04094	0.06194	0.00079	0.04141	0.06178	- 0.00157
Fish	0.037	0.056	0	0.03721	0.05702	0.00094	0.03787	0.05684	- 0.00254
Milk	0.021	0.038	0	0.02131	0.03842	0.00086	0.02148	0.03889	- 0.00102
Poultry Meats	0.029	0.045	0	0.03113	0.04517	- 0.00017	0.03015	0.04476	- 0.00011
Eggs	0.048	0.029	0	0.04901	0.01006	- 0.00013	0.04926	0.01018	- 0.00014

2. Estimation the Elasticities of Quadratic Expenditure System (QES)

2.1. Estimation the Income Elasticity (η_{i0}) of (QES)

In order to estimate the income elasticity of demand (η_{i0}) of Quadratic Expenditure System (QES) for all animal products, we used the relation No. (5), as shown in the following Table No. (3) , and the results of this Table indicate to some economical and statistical indicators obtained through the application of (QES) to some household food consumption data of the individual expenditure on the animal products in Jordan for the period (2000 – 2015):

Table 3. Estimation Results of Income Elasticities (η_{i0}) and (D.W.) Values of (QES)

Animal products / Indicators	Red Meat	Fish	Milk	Poultry Meats	Eggs
η_{i0}	0.508	0.914	0.971	0.992	0.712
D.W.	2.01	1.98	1.95	1.89	2.02
F-test = 16.224 , p-value = 0.000 , R^2 = 0.899 , S.E. of (QES) = 8.667					

The results presented in Table No. (3), show the following:

1. The value of determination coefficient (R^2) amounting to (0.899), indicates that Quadratic Expenditure System (QES) is able to interpret (89.9%) of the total variations value, making the system is very good in interpreting the Jordanian consumer spending.

2. It shows that the value of (S.E. of estimate) amounting to (8.667) is relatively small, which makes Quadratic Expenditure System (SEQ) high quality to analyze the data under the study.

3. The values of (D.W.) for all animal products under the study indicate that the time series data related to the individual expenditure on the most important animal products do not suffer from the problem of Autocorrelation.

4. The results of the income elasticities (η_{i0}), show the following:

a. The red meat group came in the top of animal products under study in terms of the importance degree of this product in life of the Jordanian consumer compared to the other products due to decline of the income elasticity (η_{i0}) for this product amounting to (0.508), making it a necessary product for the Jordanian consumer.

b. The table eggs got on the second ranked of its importance as a necessary product from the perspective of Jordanian consumer, where the income elasticity value of this product was (0.712).

c. The products of (fish, raw milk, and poultry meat) got on the ranked (3, 4 and 5) respectively in terms of their importance in the daily life of the Jordanian consumer, where the income elasticity values for these products were (0.914, 0.971 and 0.992), respectively.

2.2. Estimation the Own (η_{ii}) & Cross ($\cdot_{ij}$) Price Elasticities of (QES)

In order to estimate the own (η_{ii}) and cross (η_{ii}) price elasticities of Quadratic Expenditure System (QES) for animal products, we used the relations (8 and 11). Therefore, the results listed in Table No. (4), refer to the own (η_{ii}) and cross (η_{ii}) price elasticities matrix of Quadratic Expenditure System (QES), which applied on some of the family food consumption data of the individual spending on the animal products in Jordan for the period (2000-2015):

TABLE 4. Estimation Results of the Own (η_{ii}) and Cross (η_{ij}) price Elasticities Matrix of (QES)

Product whose price Changes / Product whose Demand changes	Red meat	Fish	Milk	Poultry meats	Eggs
Red meats	**-0.768**	0.026	0.075	0.186	0.039
Fish	0.174	**-1.014**	0.009	0.029	-0.011
Milk	0.384	0.011	**-1.021**	0.128	0.015
Poultry meats	0.176	-0.007	0.006	**-1.052**	-0.012
Eggs	0.112	-0.009	0.004	0.013	**-0.689**

The results presented in Table No. (4), show the following:

1. The absolute values of the own price elasticities (η_{ii}) listed in Table No. (4), refer to the following:

a. The table eggs are of the most products important for the Jordanian consumer, which is not affected high by increasing the prices compared to other products, so the increase in the prices of table eggs by (100%) will lead to an increase in the demand by (68.9%), making it product a necessary from the consumer's perspective and therefore the demand for its product is inflexible price.

b. The red meat group came in the second ranked in terms of importance to the Jordanian consumer; so the increase in the red meat prices by (100%) will lead to decrease the demand on it by (76.8%), making it group a necessary from the consumer's perspective and therefore the demand for its group is inflexible price.

c. While the other products are considered goods perfectionism from the perspective of Jordanian consumer, as shown by the results of the analysis, which makes the demand for it's a flexible price.

2. Through the cross price elasticities ($\cdot_{ij}$) values, shows the following:

a. The table eggs came in the top of products under study in terms of the effects degree its prices in the demand (spending) on other products, so the increasing the prices of this product by (100%) will lead to a decrease the demand on the products (fish and poultry meat) at varying rates ranged between (1.1-1.2%), which makes the relation of table eggs with these products is a relation (integration), while its relation with other products (red meat and raw milk) is a relation (exchange), so the increasing the prices of table eggs will lead to increase the demand on other products at varying rates ranged between (1.5-3.9%).

b. The fish group came in the second ranked in terms of the effects degree its prices, as the increase in prices of this product by (100%) will lead to a decrease in consumer spending on the products (poultry meat and table eggs) at varying rates ranged between (0.7-0.9%), which makes the relation of the fish with the mention products is a relation (integration), as for his relation with products (red meat, raw milk) is a relation (exchange), as the increase in the fish prices will lead to an increase the demand on other products at varying rates ranged (1.1-2.6%).

c. While the relation of other products with each other is a relation (exchange), as the increase in prices of one of these products will lead to increase the demand on other products at varying rates, as shown by the results of the analysis.

CONCLUSIONS

1. The results indicates that, the red meat group came in the (first) ranked of animal products, the table eggs got on the (second) ranked of its importance, and the products of (fish, raw milk, and poultry meat) got on the ranked (3, 4 and 5) respectively in terms of their importance in the daily life of the Jordanian consumer. The results supported by the income elasticities (η_{i0}) of the animal products.

2. The results of the absolute values of the own price elasticities (η_{ii}) refer to the table eggs are of the most products important for the Jordanian consumer, and the red

meat group came in the second ranked in terms of importance to the Jordanian consumer.

3. The results of the cross price elasticities (n_{ij}) indicates that, the table eggs came in the top of products under study in terms of the effects degree its prices in the demand (spending) on other products, and the fish group came in the second ranked in terms of the effects degree its prices.

4. The results of the cross price elasticities (n_{ij}), explained that the relation of other products with each other is a relation (exchange), as the increase in prices of one of these products will lead to increase the demand on other products at varying rates, as shown by the results of the analysis.

5. The results of the analysis showed that the (exchange) relations that resulted among some of the animal products under study, conflict with the economic logic which considered as a relation between all the products under among them is a relation (integration), since that existence of such a conflict is the reason of cross price elasticities values for some products in positive signs, while these values should in negative signs.

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