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An Econometric Analysis of Engel's Curve: Household Commodity Groups in Jordan

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Abstract: This study uses five functional forms and OLS to estimate models of Engel curves for Jordanian household commodity groups. The obtained results indicate that the estimated elasticities concerning family size are significantly different from zero for food, durables, services, and miscellaneous commodity groups, and the elasticity estimates concerning family size for tobacco, clothing, housing, and transportation commodity groups are not significantly different from zero. in other words, family size does not affect the demand for these commodity groups. It has also found diseconomies of scale for food, durables, and miscellaneous commodity groups. Nevertheless, it is worth mentioning that for food, there is a constant return of scale for the food commodity group. Finally, the consumption pattern for urban areas does not differ from the consumption pattern of rural areas for food, tobacco, transportation, and services. But it has been found that the consumption patterns for the other commodity groups are not the same in urban and rural areas.

Keywords: Engel curve, Commodity Groups, Economies of Scale, Jordan.

1. Introduction

Since Engel's work in 1987, the estimation of Engel elasticity has taken center stage in the majority of budget studies. The Engel curve shows the relationship between a household's expenditure on a specific good and its total expenditure or income. Due to their significance in models of income distribution, these relationships have garnered a lot of attention (Bewley, 1986). The angle elasticity of good measures the percentage change in a household expenditure on that good relative to a total percentage change in a household income or total expenditure. This measure may be very useful for a variety of reasons, including:

1- The government wants to gauge how changing the tax system will affect consumer demand.
2- The government intends to provide subsidies to specific population segments.

3- The government is interested in predicting long-term changes in the economic structure of the country.

Objectives of the Study

The main objectives of the present study are:

1- To examine some of the popular forms of Engel curves.
2- To analyze the patterns of consumption in Jordan using data from the household survey of 2017.
3- To estimate the elasticity of different community groups concerning income.
4- To compare the estimated results of different functional forms.

Hypotheses

H_1 Family size does not affect the demand for commodity groups in Jordan.

H_2 There aren'teconomies of scale for the commodity groups in Jordan.

H_3 Consumption patterns in urban areas are similar to those in rural areas.

2. Previous Studies

Many studies have been undertaken to estimate the Engel curves from cross-sectional data. so that, it is impossible to quote all the studies that have been done over the last six decades. But there have been a large number of excellent surveys of household studies concerning Engel curves, notably by the Brown and Deaton (1972), Deaton and Muellbauer (1980), Bewley (1986), Deaton (1986), Caclayan and Aster (2012), Rajapakse (2011), Beneito (2003), and Nsabimana et al. (2020).

Several functional forms of Engel curves have been formulated and applied to cross-sectional data. Several studies have compared different functional forms using the goodness of fit as the criterion for determining the appropriate functional form. Examples are those of Paris and Houthakker (1955) and kakwani (1977).

This approach has resulted in specifications, that are inconsistent with the budget constraint, according to Bewley (1982). On the other hand, Leser (1963) examined five functional forms of Engel curves, all of which obey the adding-up criterion. He compared the model's performance using the Irish data and concluded that the Working-Lesser model was superior to other models.

Recent Studies have emphasized the utility-based approach, which not only fulfills the adding-up criterion but also assures that the predicted expenditures are nonnegative and do not preclude saturation, examples are those of Bewley (1982 and 1986), Aasness and Rodseth(1983) and Giles and Hampton (1985).

Other studies attempted to model demographic effects into cross-sectional studies. This is because it is known that in cross-sectional studies, households vary, not only in their total expenditure but also on age and sex composition, which varies from household to household. Examples are those of Kakwani (1977), Ketkar and Ketkar (1987), Binh and Whiteford (1990).

More recently, different approaches have been taken to estimate a system of Engel curves. Examples are those Rajabakse (2011), Beueito (2003), and Caglayan and Aster (2012).

3. The Data and Methodology

3.1 The data

The grouped data from Jordan's 2017 Household Expenditure and Income Survey (HEIS) were used to estimate demand parameters. The Hashemite Kingdom of Jordan Department of Statistics conducted the HEIS, and its main findings have been reported and published. Based on a wide range of commodities and a national sample of households, the survey was conducted. The Department of Statistics deemed the sample size to be representative because it was drawn from various social classes and geographic regions of Jordan. The sample survey aimed at gathering data related to household income, household expenditure on goods and services, age of the head of household, number of members of the family, job status of each member of the family, marital status, and highest education of the head of household. All of these data were classified tabulated, grouped, and presented in tables according to the size of the family, highest education of the head of the family, income, and the like.

The present article will consider the grouped data for eight community groups distributed according to household income. Two locations of the household have been considered rural and urban location.

In this study, all expenditure is grouped into eight major commodity groups. Data has been classified according to the total income per annum of each household. Sixteen income categories have been considered. Tables (1), (2) and (3) highlight Per-capita expenditure on each community group classified according to the total income per annum for each household in the country as a whole, the urban sector and the rural sector respectively.

Table (1) demonstrates per capita total expenditure on each commodity group classified according to family's income per annum. The data indicate that the largest proportion of expenditure consumption is spent on food for all classified categories except for the category whose per capita income is greater than JD 26,000.

Expenditure on food items differs from category to other; it ranges nearly 43% of the total expenditure of the low-income group to 20% of the high-income group. Expenditure on housing, services, and transportation commodity groups are also high. These expenditures accounted for about 52% for the low-income group and about 65% for the high-income group.

Finally, regarding tables (2) and (3); it is observed there are marked differences in the distribution of expenditure on some commodity groups between rural and urban populations. Out of a given expenditure, rural people spend higher proportions on food and clothing than urban people. On the other hand, urban people devote higher of their total expenditure to housing services and other community groups.

3.2 Methodology

Although there are an infinite number of functional forms available, only a small number have been applied in studies on household budgets. Here are a few of the most common functional forms:

(1) The linear form which can be written as

$$V_i = P_i q_i = \alpha_i + \beta_i m + \upsilon_i \ldots . (1)$$

WhereV_i is the expenditure on the ithcommodity group, P_i is the price of ithcommodity, $q_i$the quantity of ithcommunity, m is a total expenditure and $\upsilon_i$is the disturbance term, and α_i and β_i are parameters needing to be estimated.Equation (1) satisfies the theory of demand in the sense that the adding-up criterion is satisfied.That is if aset of linear Engelcurves are fitted to an additive data set, then the ordinary least square (OLS) regression estimates will automatically satisfy the following restrictions$\sum_i a_i = 0 \quad \sum_i \beta_i = 1 \quad \sum_i m_i = 0$.

On the other hand, in the cross-sectional data on household demand, all the restrictions in terms of price derivatives, including homogeneity, symmetry, and the negative own-substitution effect, disappear given that prices are constant, according to Prais and Houtherskeker (1955). The only property or restriction that remains is the adding-up condition, which follows from the budget constraint equation (2).

$$\sum P_i q_i = m \ldots . (2)$$

This condition implies that some of the budget shares have to be equal (1) at all expenditure levels. Moreover, this condition also suggests that the sum of the marginal budget share has to be equal (1) at all expenditure levels, that is:

$$\sum_i \frac{\partial P_i q_i}{\partial m} = 1 \qquad \ldots . . (3)$$

2) The double-log form which is the most widely used functional form for estimating the Engel curve, because it is easy to estimate, has constant income elasticity, and can be expressed as

$$lnV_i = A_i + \beta_i lnm + \upsilon_i \ldots . (4)$$

The double log form proved to be satisfactory for luxury commodities for non-food items. But, unfortunately, the functional violates the adding-up condition.

3) Thesemi-log form which can be written in the following form

$$V_i = \alpha_i + \beta_i lnm + \upsilon_i \ldots . (5)$$

The more criticalproblem with the semi-log is that it fails to satisfy the adding-up condition.That is, if all Engelcurves for all commoditygroups are of this form, then the sum of the estimated expenditure on all community groups would not be equal total expenditure, Thomas (1987).

4) Working-Leser form which has the following written form

$$w_i = \alpha_i + \beta_i lnm + \upsilon_i \ldots . (6)$$

Where w_i is the budget share of commodity i and the other notations are as defined above.

Equation 6 satisfies the adding-up condition provided that $\sum_i a_i = 1 \quad \sum_i \beta_i = \sum_i \upsilon_i = 0$and these will be automatically satisfied when OLS fits the model.

5) Other functional forms such as the hyperbolic form can be written as:

$$V_i = \alpha_i + \frac{\beta_i}{m} + \upsilon_i \ldots . (7)$$

and the reciprocal form which can be written as:

$$logV_i = \alpha_i - \frac{\beta_i}{m} + \upsilon_i \ldots . (8)$$

Engel CurvesAnalysis

The most popular functional forms of Engel curves were briefly discussed in the previous section. These functional will be applied to the Jordanian data which is presented in tables (1), (2), and (3). Determining the independent variable, however, is one of the main issues that must be covered at this point.

When estimating the Engel elasticity of demand for a community, it is standard practice in econometric family budget studies to use total expenditure rather than total family income as the independent variable. Various arguments have been offered to justify this. Podder (1971) argued that net family income rather than gross family income is relevant for estimating demand relations, and since people tend to forget the exact figure of refunds on income tax, they can't give the exact income.

Furthermore, they also deliberately avoid mentioning subsidiary incomes from the property and other sources. Friedman (1957) proposed that permanent income, rather than actual measured income, determines expenditure patterns. The better explanatory variable in household budget studies is total expenditure because the income level recorded in a given period of time may be distorted by cyclical components. This was also suggested by Currie (1972) who believed that total expenditure is likely to reflect permanent income more accurately than actual measured income.

In addition, it may be argued that actual income figures may be a better indicator of permanent income than total expenditure because total expenditure figures are also likely to be distorted by transitory components. This is because they will depend on the actual timing of purchases of durable goods. Despite this argument in the present paper, total expenditure will be used as the explanatory variable, because most of the previous and current studies do that.

Finally, it has been found by Al-tayeb et al (1990) that Jordanian household deliberately tends to underestimate their income.

Table (1): Per Capita Expenditure on Group of Commodities and Services for the Country as a Whole Class of Annual Housing Income.

Table (1): Per Capita Expenditure on Group of Commodities and Services for the Country as a Whole

Class of Annual Housing Income	Commodity Groups							
	Food	Tobacco	Cloth	Housing	Durables	Services	Transportation	Miscellaneou
2000>	2086.5	412.3	228.6	1811.9	131.7	871.3	685.1	222.7
4000>-2000	2287.8	379.4	252.7	1861.5	124.1	843.5	444.8	253.8
6000>-4000	2639.2	441.4	343.6	2080.2	201.5	972.8	956.4	336.0
8000>-6000	3014.5	466.3	411.8	2350.9	259.8	1186.3	1469.9	418.1
10000>-8000	3353.3	494.7	455.3	2603.4	266.0	1530.6	1747.5	421.0
12000>-10000	3681.3	514.6	528.1	2876.0	312.0	1886.9	2126.8	507.8
14000>-12000	3793.0	593.6	537.0	2953.1	298.3	1995.1	2165.2	504.6
16000>-14000	4086.2	662.9	641.6	3379.7	410.2	2515.5	2785.2	599.0
18000>-16000	4311.9	727.1	695.3	3629.3	353.5	2638.9	2815.3	669.7
20000>18000	4461.0	820.7	662.1	3714.1	404.5	3243.9	3126.4	658.9
22000>20000	4511.8	733.3	707.5	4067.0	403.4	3454.4	3494.2	799.0
24000>22000	4725.1	864.9	857.5	4181.3	498.6	3962.9	4868.3	802.1
26000>-24000	5212.1	727.3	883.2	4573.7	510.5	4274.6	3671.0	818.8
28000>26000	4663.6	671.5	735.4	4615.3	459.8	6131.7	5179.9	799.6
30000>28000	4856.3	778.3	1195.8	5665.5	314.4	5172.0	3982.2	817.2
30000 +	6379.0	754.2	1219.2	7794.2	681.1	9150.6	6695.3	1289.5

Table (2): Per Capita Expenditure on Group of Commodities and Services for the rural

Class of Annual Housing Income	Commodity Groups							
	Food	Tobacco	Cloth	Housing	Durables	Services	Transportation	Miscellaneou
2000>	2371.6	393.7	227.3	1344.3	259.8	603.7	856.1	231.
4000>-2000	2156.2	297.7	224.8	1457.2	197.8	422.2	662	187.
6000>-4000	2825.9	415.9	390.6	1616.6	349.8	691.2	1056.6	374.
8000>-6000	2996	440.4	413.9	1820.2	380.8	808	1631.5	400.
10000>-8000	3420.4	500.7	463.1	2102	414.2	994	1424.9	451
12000>-10000	3613.9	486.3	566.3	2097.9	434.5	1160.9	2822.4	426.
14000>-12000	3719.2	677.5	518.5	2223.2	458.2	1221.5	2237.5	384
16000>-14000	4520.2	706.7	579.1	2615.4	507.3	1599.5	2447.4	536.
18000>-16000	4278.6	658	684.2	2546.7	548.3	1361.8	2916.5	512.
20000>18000	4369.7	783.9	677	2447.7	573.4	1626.3	2660.5	642.

22000>20000	4547.7	1083.1	605.5	2320.3	376.7	1943.6	3491.8	571.
24000>22000	4554.9	1072.1	550.1	2603.8	636.5	2725.6	3827.8	867.
26000>-24000	5579.4	1073.1	1027.7	2575	588.5	2396.3	5463.6	1085
28000>26000	5591.9	911.4	994.8	2999.6	1903.3	3624.2	5926.2	718.
30000>28000	5064.8	1311.1	1071.9	2734.2	821.4	2987.6	5920.2	1023
30000 +	6319.5	721.6	1313.7	4531	1413.9	13099.4	7592.5	968.

Table (3): Per Capita Expenditure on Groups of Commodities and Services for the Urban

Class of Annual Housing Income	Commodity Groups							
	Food	Tobacco	Cloth	Housing	Durables	Services	Transportation	Miscellaneou
2000>	2048.4	414.8	228.8	1874.4	215.4	806.2	662.2	221.
4000>-2000	2306.1	390.8	256.5	1917.9	224.4	791.5	642.4	263.
6000>-4000	2615.1	444.7	337.6	2139.9	315.6	875.8	943.6	331.
8000>-6000	3017.2	470.1	411.5	2430.1	399.9	1084.6	1476.8	420.
10000>-8000	3344.9	493.9	454.3	2666.5	413.5	1432	1788.1	417.
12000>-10000	3690.8	518.6	522.7	2985.7	479.6	1804.4	2028.7	519.
14000>-12000	3802.9	582.4	539.4	3051	468.6	1907.1	2155.6	520.
16000>-14000	4034.7	657.7	649	3470.2	598.5	2424.3	2825.2	606.
18000>-16000	4315.9	735.5	696.7	3761.3	543.3	2581	2803	688.
20000>18000	4472.6	825.3	660.2	3874.1	601.4	3230.2	3185.3	660.
22000>20000	4508.2	697.6	717.9	4245.3	628.1	3386.6	3494.5	822.
24000>22000	4738.5	848.6	881.7	4305.2	759.5	3788.3	4950	797
26000>-24000	5168.5	686.3	866.1	4810.9	759.4	4239.5	3458.3	787.
28000>26000	4609.5	657.6	720.3	4709.4	586.9	6066.6	5136.4	804.
30000>28000	4839.5	735.2	1205.8	5253.9	493.6	5128.2	3825.6	800.
30000 +	6381.6	755.7	1214.9	7940.7	936.3	8685.2	6655	1303

4. Analyzes of the Household Expenditure in Jordan

Grouping household data would result in heteroscedasticity in the disturbance term unless the same numbers of households are presented in each group. Prais and Aitchison (1954) have shown that the variance of the disturbance term is inversely proportional to the number of households within each group and this form of heteroscedasticity can be corrected by using weighted least Squares (WLS). Therefore, an attempt has been made to test for the presence of heteroscedasticity in each equation of the estimated linear model using Spearman's rank correlation test, it has been found that heteroscedasticity has been rejected at the 5% level of significance for All equations on the system. Similar results have been obtained by Goldfield and Quandt test. Accordingly, OLS methods have been used to estimate the models discussed above.

4.1 The Linear Form Results

For each of the eight community groups within each sector, equation (1) has been estimated for both the urban and rural sectors as well as for pooled data.

Table (4) contains estimates of the marginal budget shares β_i the α_i estimates and the coefficient of determination$R^2$for Jordanian budget expenditure,urban and rural sectors.

From a statistical perspective, the estimated results for the pooled data (the country as a whole) appear plausible because all of the coefficient parameters are statistically significantly different from zero at the 5% significance level. This is also true for five of eight of the intercept estimates, α_i, overall fit it relatively high since the values of the coefficients of the determination $R^2$are relatively high for most of the equation estimates within the system i.ethe value of R^2exceed 86% in seven equations out of the eight equations.

Theestimated marginal budget shares β_i satisfy*a priori knowledge*, since the value of each $\beta_i$estimates is greater than zero and less than unity for all commodity groups. Furthermore, the sum of β_i estimates is equal to unity, and the sum of $\alpha_i$is equal to zero.These results, however, satisfy the additivity condition or Engel aggregation that the Utility Theory implies.

From a statistical and economic perspective, the results for the urban sector appear to be plausible. The coefficient of determination R^2 suggests that the overall fit is high for all equations of the system. T-ratios indicate that all the marginal budget shares β_i are significantly different from zero at the 5% significance level. This is also true for 5 out of 8 of the intercept terms, α_i. Again, the estimated marginal budget shares satisfy a priori reasoning since each β_i estimate is greater than zero and less than unity for all Community groups.Furthermore, the sum of $\beta_i$estimates is equal to unity and the sum of the $\alpha_i$estimate is equal to zero.

On the other side, the estimated results for the rural sector are plausible for all community groups except for the tobacco equation which$R^2$is very low.

Table (4): Linear Model Results of Household Expenditure in Jordan

	Pooled Data			Urban Data			Rural Data		
	α_i	β_i	R^2	α_i	β_i	R^2	α_i	β_i	R^2
Food	1615.4 (8.594)	0.1506 (13.91)	0.933	1574.4 (8.502)	0.151 (14.272)	0.936	1999.585 (7.776)	0.1455 (9.242)	0.859
Tobacco	356.97 (5.921)	0.0171 (4.014)	0.633	359.77 (6.287)	0.0162 (4.962)	0.638	382.053 (2.773)	0.0232 (2.755)	0.352
Cloth	51.575 (0.786)	0.038 (9.931)	0.876	45.284 (0.662)	0.038 (9.626)	0.869	83.684 (1.433)	0.038 (10.755)	0.892
Housing	341.48 (2.366)	0.205 (24.695)	0.978	349.57 (2.24)	0.2101 (23.562)	0.975	997.398 (9.207)	0.095 (14.271)	0.936
Durables	57.414 (1.637)	0.0186 (9.188)	0.858	137.48 (2.609)	0.024 (8.066)	0.823	-66.347 (-0.441)	0.047 (5.083)	0.659
Services	-1703.99 (-6.246)	0.304 (19.364)	0.964	-1711.72 (-6.055)	0.2951 (18.265)	0.96	-2924.855 (-4.071)	0.360 (8.194)	0.827
Transportation	-754.68 (-3.766)	0.231 (19.973)	0.966	-787.18 (-3.492)	0.2288 (17.756)	0.957	-619.303 (-1.917)	0.261 (13.193)	0.926
Miscellaneous	35.796 (1.34)	0.037 (23.934)	0.976	32.42 (1.094)	0.0369 (21.762)	0.971	147.784 (1.669)	0.030 (5.548)	0.687

4.2 The Double Form Results

Table (5) presents the estimated results of equation (4) for the total, urban and rural samples. The coefficients of determination R^2, for the whole country estimates suggest that the overall fit is very high for all equations on the system. The R^2range from 82% for the tobacco equation to 98.5% the for services equation. The t-ratios indicate that all the coefficient estimates (elasticities) are significantly different from zero at the 5% of significance. this is also true for 5 out of 8 of the intercept estimates α_i.

In addition, the estimated total expenditure elasticities, which are estimated directly from equation (4) i. e $\beta_i$show the demand for food, tobacco, and housing are inelastic, which implies these community groups are necessities. on the other hand,thet-tests indicate that the elasticity estimates for clothing, durables, and miscellaneous commodity groups are not different from unity at 5% significant level. And the expenditure elasticities for services, clothing, and transportation commodity groups are elastic, which means that these commodity groups are luxuries.

Furthermore, from a statistical and economic perspective, the results for the urban data appear to be as expected. All the elasticity estimates β_i are significantly different from zero. Furthermore, $R^2$is relatively very high for all equations on the system. The estimated total expenditure elasticities (income) show again the demand for food, tobacco, housing, and durable community groups with respect to total expenditure are inelastic. These results confirm with a priori knowledge that these community groups are necessities, noting that tobacco is necessary for those people who smoke.

Finally, the estimated results for the rural sector seem also to be plausible for all equations Banda system. The t-values for all elasticity estimates are significant and the estimated results fit the data very well since R^2exceeds 80% for all equations except for tobacco, which is about

65% of that total variation on the dependent variable that has been explained by the estimated equation.

Table (5): Double-logModel Results of Household Expenditure in Jordan

	Pooled Data			Urban Data			Rural Data		
	α_i	β_i	R^2	α_i	β_i	R^2	α_i	β_i	R^2
Food	2.171 (7.238)	0.636 (20.305)	0.967	2.114 (6.913)	0.640 (20.085)	0.966	2.433 (6.768)	0.617 (16.289)	0.95
Tobacco	1.578 (2.578)	0.505 (7.906)	0.817	1.819 (3.086)	0.478 (7.78)	0.812	-0.23 (-0.175)	0.710 (5.13)	0.653
Cloth	-3.195 (-5.051)	0.999 (15.137)	0.942	-3.242 (-4.996)	1.003 (14.826)	0.94	-3.022 (-4.136)	0.99 (12.85)	0.921
Housing	0.1832 (0.626)	0.829 (27.133)	0.981	0.187 (0.610)	0.831 (25.944)	0.98	2.209 (5.612)	0.583 (14.052)	0.934
Durables	-3.08 (-3.554)	0.925 (10.224)	0.882	-1.611 (-2.047)	0.815 (9.931)	0.876	-3.653 (-2.887)	1.046 (7.839)	0.814
Services	-6.614 (-13.803)	1.507 (30.132)	0.985	-7.164 (-13.048)	1.558 (27.219)	0.981	-8.3 (-9.35)	1.653 (17.656)	0.957
Transportation	-6.124 (-9.816)	1.452 (22.306)	0.973	-6.235 (-9.362)	1.461 (21.046)	0.969	-5.784 (-7.097)	1.439 (16.744)	0.952
Miscellaneous	-3.089 (-8.055)	0.984 (24.6)	0.977	-3.073 (-7.499)	0.982 (22.993)	0.974	-2.737 (-2.687)	0.95 (8.844)	0.848

4.3 Working Leser Results

The estimated outcomes of equation (6) for the pooled data, the urban, and the rural sector are displayed in Table (6). The overall fit for the pooled data appears to be unsatisfactory for the commodity groups of clothing, durables, and miscellaneous commodity groups as indicated by R^2. On the other hand, the overall fit for food, tobacco, housing, services, and transportation commodity groups are relatively high.

The t-ratios indicate that 5 out of 8 of the coefficient estimates, β_i are significantly different from zero at 5% significant level.This is also true for seven out of eight of the intercept term α_i. As it has been expected, the sum of $\alpha_i$is unity, and the sum of β_i is zero.

With a few minor exceptions, the estimated results for the urban and rural sectors are nearly identical to those for the total estimates.

4.4 Other Functional Forms Results

The estimated results for the semi-log, hyperbolic, and reciprocal forms are shown in tables (7) to (9) respectively. the estimated results of the semi-log for the pooled data and the urban sector fit the data very well for all the commodity group equations.

The goodness of fit R^2 is relatively very high for all commodities ranging from 77% to 97.2%.T-tests indicate that all the coefficientsβ_i are significantly different from zero at 5% significance level.On the other hand, the estimated results for the rural sector indicate that $R^2$is relatively very high for food, clothing, housing, transportation, and miscellaneous equations but it is unsatisfactory for tobacco and durable equations.

The coefficient of the determination R^2 indicates that equations (7) and (8) also fit the data for most of the equations of the system for pooled data,urban and rural sectors.

Table (6): Working-Leser Model Results of Household Expenditure in Jordan

	Pooled Data			Urban Data			Rural Data		
	α_i	β_i	R^2	α_i	β_i	R^2	α_i	β_i	R^2
Food	1.194 (18.127)	-0.096 (-14.013)	0.933	1.1698 (17.112)	-0.094 (-13.203)	0.926	1.334 (17.39)	-0.108 (-13.39)	0.928
Tobacco	0.238 (11.302)	-0.02 (-9.241)	0.859	0.248 (11.939)	-0.21 (-9.883)	0.875	0.145 (2.57)	-0.01 (-1.64)	0.161
Cloth	0.038 (1.44)	0.0003 (0.121)	0.001	0.0355 (1.326)	0.0005 (0.1887)	0.002	0.047 (1.517)	-0.0002 (-0.078)	0.0004
Housing	0.631 (9.172)	-0.041 (-5.78)	0.704	0.64 (8.736	-0.0419 (-5.481)	0.682	0.873 (12.41)	-0.073 (-9.874)	0.874
Durables	0.0373 (2.094)	-0.002 (-0.824)	0.046	0.089 (3.673)	-0.006 (-2.268)	0.269	0.0012 (0.019)	0.004 (0.632)	0.028
Services	-0.694 (-6.775)	0.091 (8.514)	0.838	-0.734 (-6.686)	0.094 (8.232)	0.829	-0.881 (-4.036)	0.107 (4.637)	0.606
Transportation	-0.49 (-5.063)	0.069 (6.832)	0.769	-0.495 (-4.751)	0.069 (6.364)	0.743	-0.569 (-3.496)	0.0815 (4.746)	0.617
Miscellaneous	0.046 (3.045)	-0.0006 (-0.416)	0.012	0.046 (2.878)	-0.0007 (-0.43)	0.013	0.05 (-0.001)	1.222 (-0.222)	0.004

Table (7): Semi-log Model Results of Household Expenditure in Jordan

	Pooled Data			Urban Data			Rural Data		
	α_i	β_i	R^2	α_i	β_i	R^2	α_i	β_i	R^2
Food	-18584.7 (-18.029)	2360.25 (21.938)	0.972	-18673.9 (-17.373)	2365.82 (21.113)	0.969	-18650.9 (-18.198)	2403.79 (22.247)	0.972
Tobacco	-2158.6 (-5.476)	291.13 (7.076)	0.781	-2009.43 (-5.224)	274.4 (6.843)	0.77	-3.57065 (-3.465)	453.01 (4.169)	0.554
Cloth	-4881.1 (-8.894)	577.64 (10.084)	0.879	-4900.4 (-8.524)	579.07 (9.661)	0.87	-5046.71 (-10.097)	600.75 (11.4)	0.903
Housing	-2.4843.5 (-8.411)	2971.7 (9.64)	0.869	-25553.3 (-8.468)	3054.75 (9.71)	0.871	-11095.2 (-8.18)	1422.16 (9.945)	0.876
Durables	-2388.2 (-8.265)	286.30 (9.493)	0.866	-3.122.4 (-7.747)	380.84 (9.064)	0.854	-5993.61 (-4.122)	697.77 (4.552)	0.597
Services	-38293.4 (-7.622)	4326.64 (8.252)	0.829	-37516.7 (-7.725)	4230.29 (8.356)	0.833	-42131.5 (-4.178)	4693.3 (4.414)	0.582
Transportation	-30326.8 (-12.36)	3472.1 (13.559)	0.929	-30129 (-11.33)	3444.8 (12.426)	0.917	-35175.7 (-121.014)	4049.25 (13.118)	0.925
Miscellaneous	-4683.4 (-12.77)	554.13 (14.507)	0.938	-4688.5 (-11.813)	554.354 (13.398)	0.928	-4163.89 (-6.398)	501.43 (7.308)	0.792

Table (8): Hyperbolic Model Results of Household Expenditure in Jordan

	Pooled Data			Urban Data			Rural Data		
	α_i	β_i	R^2	α_i	β_i	R^2	α_i	β_i	R^2
Food	6199.21 (29.888)	- 28272182 (-11.73)	0.908	6183.94 (29.468)	- 28528851 (-11.569)	0.905	6466.09 (30.206)	- 27342536 (-12.112)	0.913
Tobacco	911.61 (21.86)	-3656933 (-7.546)	0.803	884.96 (21.434)	-3454934 (-7.121)	0.784	1202.148 (10.72)	-5611047 (-4.745)	0.617
Cloth	1172.2	-6761654	0.784	1171.98	-6827823	0.776	1202.18	-6503767	0.768

	(14.363)	(-7.129)		(14.059)	(-6.97)		(13.257)	(-6.801)	
Housing	6166.9 (12.423)	-33092491 (-5.737)	0.702	6353.42 (12.644)	-34364715 (-5.82)	0.708	3676.5 (15.397)	-15147791 (-6.015)	0.721
Durables	615.73 (15.462)	-3398521 (-7.344)	0.794	880.68 (17.048)	-4612743 (-7.599)	0.805	1228.79 (6.182)	-7137553 (-3.405)	0.453
Services	6771.04 (8.33)	-47091662 (-4.985)	0.64	6591.97 (8.456)	-46592184 (-5.086)	0.649	6002.88 (4.072)	-42827153 (-2.755)	0.352
Transportation	5997.67 (12.974)	-39860855 (-7.42)	0.797	5936.03 (12.61)	-39840856 (-7.202)	0.787	6884.85 (11.259)	-43147613 (-6.691)	0.762
Miscellaneous	1116.84 (15.889)	-6400389 (-7.836)	0.814	1118.1 (15.556)	-6450111 (-7.637)	0.806	1072.29 (12.406)	-5666330 (-6.216)	0.715

Table (9): Reciprocal Model Results of Household Expenditure in Jordan

	Pooled Data			Urban Data			Rural Data		
	α_i	β_i	R^2	α_i	β_i	R^2	α_i	β_i	R^2
Food	8.868 (303.78)	-7908.88 (23.315)	0.975	8.867 (295.99)	-8022.27 (-22.791)	0.974	8.9098 (282.7)	-7331.4 (-22.06)	0.972
Tobacco	6.908 (115.23)	-6414.4 (-9.207)	0.858	6.868 (115.77)	-6086.28 (-8.731)	0.844	7.265 (56.1)	-8963.16 (-6.563)	0.755
Cloth	7.33 (103.91)	-12383.7 (15.107)	0.942	7.329 (100.04)	-12502.5 (-14.523)	0.938	7.3509 (84.688)	-11608.55 (-12.682)	0.92
Housing	8.871 (111.44)	-9771.1 (-10.56)	0.889	8.903 (112.2)	-9874.05 (-10.59)	0.889	8.299 (128.61)	-6610.08 (-9.714)	0.87
Durables	6.678 (81.989)	-11681.07 (-12.341)	0.916	6.991 (96.249)	-10382.4 (-12.165)	0.914	7.253 (40.845)	-11659.7 (-6.226)	0.735
Services	9.194 (67.307)	-17858.08 (-11.25)	0.90	9.194 (65.461)	-18629.2 (-11.287)	0.90	8.892 (41.21)	-17913.1 (-7.873)	0.816
Transportation	9.178 (150.22)	-18058.02 (-25.436)	0.979	9.17 (137.95)	-18289.7 (-23.414)	0.975	9.291 (94.02)	-16862.2 (-16.18)	0.949
Miscellaneous	7.273 (133.08)	-12110.01 (-19.069)	0.963	7.272 (128.39)	-12165.8 (-18.28)	0.96	7.234 (96.347)	-11387.7 (-10.345)	0.884

5. Engel Elasticity Estimates

Based on the estimated results illustrated presented in Table (10), Engel's elasticities of demand with respect to total expenditure for each commodity group are assessed at the mean values.

Table (10)Engel Elasticity Estimates

Commodity group	Linear	Double log	Working Lesser	Semi log	Hyperbolic	Reciprocal
Food	0.63	0.64	0.68	0.59	0.42	0.65
Tobacco	0.45	0.51	0.45	0.46	0.35	0.41
Cloth	0.98	1.00	0.99	0.89	0.83	0.92
Housing	0.95	0.83	0.96	0.83	0.85	0.93
Durables	0.88	0.93	0.96	0.81	0.88	0.79
Services	1.63	1.51	1.94	1.39	1.14	1.82
Transportation	1.84	1.45	1.98	1.2	1.82	1.98
Miscellaneous	1.00	0.98	1.17	0.89	1.36	1.12

These data show that demand for food, housing, and durable goods is inelastic concerning total

expenditure, proving that these goods are necessities. While all functional forms estimate that demand for transportation and services is elastic, indicating that these commodity groups are luxuries. On the other hand, the estimated elasticity for clothing estimated by the linear, logarithmic, and Working Lesser forms seems to have an approximately unity elasticity of demand concerning the total expenditure, for goods with low elasticity, like the food and tobacco commodity groups, the elasticity estimates based on various functional forms do not differ significantly. But even for these commodity groups with high elasticities, there are significant differences.

6. Testing the Hypotheses

6.1 Effect of Family Composition on Engle Curve

It is believed that the size of the family affects the various needs of the household.If there is any correlation between family composition and family total expenditure, Currie (1972) contends that the omission of family composition from a household budget study and the relegation of its effect to a disturbance term will lead to biased estimates of the total expenditure coefficients.To test the idea that the family composition has an impact on the Engel curve, the family composition as measured by the number of people will be added into the logarithmic form for each commodity group.

The followingform will be applied for each of the groups in the system.

$$\log v_i = \alpha_i + \beta_i logm + \gamma_i logn + v_i \ldots . (9)$$

Where n is the number of persons in the household and the other notations are as identified above.

The estimated results of equation (9) are presented in Table (11).

Table (11). Elasticity Estimate with Respect to Total Expenditure and concerningFamily Size

	α_i	β_i	γ_i	R^2
Food	1.336 (2.9)	0.688 (19.1)	0.04 (2.3)	0.97
Tobacco	2.343 (2.2)	0.457 (6.4)	-0.036 (-0.9)	0.83
Cloth	-3.337 (-2.9)	1.008 (11.2)	0.007 (0.15)	0.94
Housing	0.285 (0.54)	0.822 (19.8)	-0.005 (-0.24)	0.98
Durables	-5.864 (-4.786)	1.1 (11.3)	0.133 (2.8)	0.93
Services	-4.807 (-8.1)	1.393 (29.5)	-0.087 (-3.72)	0.99
Transportation	-6.967 (-6.5)	1.505 (17.6)	0.04 (0.96)	0.97
Miscellaneous	-4.259 (-7.6)	1.058 (23.9)	0.056 (2.6)	0.99

The estimated elasticities with respect to total expenditure for all commodity groups are significant. The estimated elasticities for food, tobacco, and housing are less than unity indicating that these commodity groups are inelastic and are necessities which confirms Engel's

law. On the other hand, the elasticities estimated for clothing, durables, services, transportation, and miscellaneous are greater than one implying that these commodity groups are luxuries.

The estimated elasticities concerning family size are significantly different from zero for food, durable, services, and miscellaneous commodity groups. The elasticity estimates for the commodity groups related to tobacco, clothing, housing, and transportation are not statistically different from zero, according to the t-tests. This implies that demand for these commodity groups is unaffected by family size.

6.2 Economies of Scale

Deaton (1986) suggested the following functional form for testing the hypothesis of economies of scale.

$$\log q_i = \alpha_i + \beta_i logm + \gamma_i logn + \upsilon_i \ldots . (10)$$

Whereq_i is the quantity demanded and the other notations are defined above.Tests are conducted for the sum of $(\beta_i + \gamma_i)$ is less than unity (economies of scale), is equal unity (no economies or diseconomies), is equal than unity (diseconomies of scale). But since the available data is in per-capita expenditure for each community group not in the quantity demanded. So that to obtain the quantity index for each community group,divide the expenditure on each category by the corresponding price index in 2017.Then equation (10) for each community group fitted to the data and calculate thesum value of $(\beta_i + \gamma_i)$, I and its standard error which can be obtained as follow:

$$Var(\beta_i + \gamma_i) = Var(\beta_i) + Var(\gamma_i) + 2cov(\beta_i, \gamma_i) \qquad \ldots . (12)$$

Hence t-ratio can be used to test whether$(\beta_i + \gamma_i)$is significantly less than one, greater than one, or not significantly different from one.

Equation 10 has been fitted to the Jordanian data for all each commodity groups. The t-tests indicate that $\gamma_i$is not significantly different from zero for tobacco, clothing, housing, and transportation, implying that family size does not affect the per-capita consumption of these commodity groups. Hence, these commodity groups will be excluded from tests regarding possible economies of scale. According to t-tests, it has been found that there are economies of scale only for the services commodity group. This implies that per-capita service consumption declines as family size increases. It has also found there are diseconomies of scale for food, durable, and miscellaneous commodity groups. This shows that as family size increases, the per-capita consumption of these commodity groups increases. But it is worth mentioning that the sum of β_i and γ_i for food is not different from unity at the 5% significant level, this suggests that there is constant return of scale for the food commodity group.

6.3 Effect of Location of the Householdon Per-Consumption for Each community group

The Chow (1960) test will be used to test the hypothesis that the location of the household has an effecton per-consumption for each community group.That is,first, we pool

together the two samples(urban and rural data) and form a sample of (16+16, 32) observations.From this, the pooled function in the following form will be fitted to be the data

$$v_i = \alpha_i + \beta_i m + v_i \ldots . (13)$$

From (13) the residual sum of square ($RSS(H_0)$) will be estimated.Then equation (13) will be fitted to the urban and rural sectors separately. The residual sum of squares($RSS(H_1)$) for urban and the residual sum of squares for Rural ($RSS(H_2)$) will be estimated.

The F^* ratio will be calculated as

$$F^* = \frac{\left[RSS(H_0) - [RSS(H_1) + RSS(H_2)]\right]/K}{[RSS(H_1) + RSS(H_2)]/[n_1 + n_2 - 2k]} \ldots . (14)$$

where $n_1$and $n_2$are the sample size of the urban and rural sectors respectively and k is the number of parameters in each equation.

Finally, the F^*calculated by equation (14) will be compared with the critical value of $F_{0.05}$with$v_1 = k$ and v_2=$(n_1 + n_2 - 2k)$ degrees of freedom. If $F^* > F_{0.05}$then the hypothesis that the pattern of consumption of the urban areasdiffers from the consumption pattern of rural areas would be accepted. But if $F^* < F_{0.05}$ then the hypothesis would be accepted.

The theoretical value of F at the 95 percent level of significance with v1=2 and v2=28 degrees of freedom is 3.3

Since $F^* < F_{0.05}$ for food, tobacco, transportation, and services, the hypothesis that the consumption pattern for urban areas does not differ from the consumption pattern of rural areas for these commodity groups would be accepted. On the other, it has been found that the consumption patterns for the other commodity groups are not the same in urban and in rural areas.

Conclusions

According to the estimated results for the linear form, the estimated marginal budget shares $\beta_i$for all commodity groups are greater than zero and less than unity.

Furthermore, the sum of β_i estimates is equal to unity and the sum of α_i is equal to zero. However, the Utility Theory's implied Engel aggregation or additivity condition is satisfied by these results.According to the Double form's estimated results, the demand for food, tobacco, housing, and long-lasting community groups is inelastic with respect to total expenditure. These community groups are necessities.With a few minor exceptions, the estimated results for the Working Leser form's urban and rural sectors are nearly identical to those for the total estimates. The estimated results of the semi-log for the pooled data and the urban sector fit the data very well for all the commodity group equations.

According to Engel's theory of demand elasticity, the demand for food, housing, and durable goods is inelastic with respect to total expenditure, indicating that these commodity groups are necessities. The demand for services and transportation, however, are luxuries.

On the other hand, it appears that the estimated elasticity for clothing using the linear, logarithmic, and Working Lesser forms has an elasticity of demand with respect to total expenditure that is close to unity. For goods with low elasticity, like the food and tobacco commodity groups, the elasticity estimates based on various functional forms do not differ significantly. But even for these commodity groups with high elasticities, there are significant differences.

The estimated elasticities concerning family size indicate that family size does not affect the demand for tobacco, clothing, housing, and transportation commodity groups.

The resultsimply that family size does not affect per-capita consumption of tobacco, clothing, housing, and transportation. Resultshave been found that there are economies of scale only for the services commodity group. It has also found there are diseconomies of scale for food, durable, and miscellaneous commodity groups. But there is a constant return of scale for the food commodity group.

The hypothesis that the consumption pattern for urban areas does not differ from the consumption pattern of rural areas for food, tobacco, transportation, and services would be accepted. On the other, it has been found that the consumption patterns for the other commodity groups are not the same in urban and in rural areas.

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