Indian Journal of Economics and Business
Vol. 20 No. 1 (January-June, 2021)

http://www.ashwinanokha.com/IJEB.php

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

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Received: 01st May 2021
Revised: 04th June 2021
Accepted: 15th June 2021

Abstract: This paper estimates models of Engel curves for household commodity groups in Jordan using five functional forms along side OLS. Obtain results indicate that the estimated elasticities with respect to family size are significantly different from zero for food, durable, services and miscellaneous commodity groups, and the elasticity estimates with respect to 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 there are diseconomies of scale for food, durable and miscellaneous commodity groups. Nevertheless, it is worth mentioning for food there is constant return of scale for the food commodity group. Finally, the consumption pattern for urban areas does not differ from consumption pattern of rural areas for food, tobacco, transportation and services. But it has found that the consumption pattern for the other commodity groups are not the same in urban and in rural areas.

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

1. Introduction

The estimation of Engel elasticity has occupied the central position in most budget studies since the work of Engel in 1987. The Engel curve illustrate the relationship ~~a~~ between household's expenditure among particular good and total household expenditure or income. These relationships have attracted a considerable amount of attention because they play an important role in models of income distribution (Bewley, 1986). The angle elasticity of a good measure 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 can be of great interest for many purposes, such as:

1- The government wants to estimate reactions in consumer demand when it plays change in tax system.

2- The government plans to subsidize certain subgroups of population
3- The government is interested in forecasting long-term changes in the economic structure of the country.

Objectives of the Study

The main objectives of the present paper 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 with respect to 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't economies of scale for the commodity groups in Jordan.

H_3 consumption patterns in urban aren't differ from the consumption patterns of rural areas.

1. Previous Studies

Many studies have been undertaken which is estimate the Engel curves from cross-sectional data. so that, it is impossible to quote all the studies which have been over for 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. a number all studies have compared different functional forms using the goodness of fit as the criterion in determining the appropriate functional form. Examples are those of Paris and Houthakker (1955) and kakwani (1977).

This approach has resulted in specifications, which are inconsistent with the budget constraint, 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 models performance using the Irish data and concluded that the Working- Lesser model was superior to other models.

Recent Studies have been emphasized the utility-based approach, which not only fulfils the adding-up criterion but also assures that the predicted expenditures are nonnegative and does 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, household 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 in order to estimate a system of Engel curves. Examples are those, Rajabakse (2011), Beueito (2003) and Caglayan and Aster (2012).

2. The Data and Methodology

3.1 The data

To estimate demand parameters, the grouped data of Household Expenditure and Income Survey(HEIS) of Jordan for the year 2017. The HEIS was conducted by the Hashemite kingdom of Jordan Department of Statistics and its main results have been reported and published. The survey was based on the national sample covered households and a comprehensive list of commodities. The sample size was considered by the Department of Statistics to be a representative, because it was selected from different social classes and from different location in Jordan. The sample survey aimed at gathering data related to household's income, household's expenditure on goods and services, age of the head of household, number of the 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 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's income. Two locations of the household have been considered rural and urban location.

In this paper 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 indicates that the largest proportion of expenditure consumption is spent on food for all classified categories except for the category which their per capita income greater than JD 26,000.

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

Finally, in the regard of tables (2) and (3); it is observed there are marked differences the distribution of expenditure on some commodity groups between rural and urban population. 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 to the other community groups.

3.2 Methodology

There are an infinite number of functional forms to choose from, but in practice few have actual been used in household budget studies. Some of the popular functional forms are as follows:

(1) The linear form which can be written as

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

Which V_i is the expenditure on the ithcommodity group, P_i is 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 other hand, the cross-sectional data on household demand all the restrictions in terms of price derivatives, such as homogeneity, symmetry and negativity of the own-substitution effect disappear given that prices are constant, Prais and Houtherskeker (1955). The only property or restriction that remains is the adding-up condition which follows from the budget constraint equation (2).

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

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

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

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

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

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

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

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

The more critical problem with the semi-log is that it fails to satisfy the adding-up condition. That is, if all Engel curves for all commodity groups 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 can be written in the following form

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

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 to the model.

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

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

and the reciprocal form which can be written as:

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

Engel Curves Analysis

Some of the popular functional form of Engel curves has been presented in the previous section. These functional will be applied to the Jordanian data which is presented in tables (1), (2) and (3). However, one of the main issues which must be discussed at this stage is to determine the independent variable.

It is usually practice in the econometric family budget studies to use total expenditure rather than total family income as the independent variable in the estimation of the Engel elasticity of demand for a community. Various arguments have been put forward to justify this. Podder (1971) argued that net family income not gross family income is relevant for estimating demand relation: 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 property and other sources. Friedman (1957) suggested that expenditure patterns are determined by permanent income rather than by actual measured income. Since the income level recorded in a particular time period may be will distorted by transitory components, so that the better explanatory variable in household budget studies is total expenditure. This 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 better indicator of the permanent income than total expenditure, due to the fact that 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	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 Group 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

3. Analyzes of the Household Expenditure in Jordan

Grouping household data would result in heteroscedasticity in the disturbance term unless the same numbers of the 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 the 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 both urban and rural sectors, as well as for pooled data equation (1)has been estimated for each of the eight community groups within each sector.

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.

The estimated results for the pooled data (the country as whole) seem to be plausible from a statistical of view, since all the coefficient parameters are significantly different from zero as the 5% level of significance. 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 relatively high for most of the equation estimates within the system i.e the value of R^2exceed 86% in seven equations out of the eight equations.

The estimated 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 result, however, satisfy the additivity condition or Engel aggregation, which implied by the Utility Theory.

The estimated results for the urban sector seem to be plausible from a statistical and an economical point of views. The coefficient of determination R^2 suggests that the overall fit is high for all equations of the system. T-ratios indicate the 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 rural sector are plausible for all community groups except for tobacco equation where, $R^2$is very low.

Table (4): Linier 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

First of all, the estimated results of equation (4) for the total, the urban and the rural samples are presented in table (5). The coefficients of determination,R^2, for the whole country estimates suggests that the overall fit is very high for all equations on the system. The R^2range from 82% for tobacco equation to 98.5% 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 not different from unity at 5% significant level. And the expenditure elasticity for services, clothing and transportation commodity groups are elastic, which means that these commodity groups are luxuries.

Furthermore, the estimated results for the urban data seem to be satisfactory from statistical and economical point of views. 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 smokes.

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^2 exceed 80% for all equations except for tobacco, which is about 65% of that total variation on the dependent variable have been explained by the estimated equation.

Table (5): Double-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	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

Table (6) shows the estimated results of equation (6) for the pooled data, the urban and the rural sectors. Overall fit for the Pooled data seem to be unsatisfactory for clothing, durables and miscellaneous commodity groups as indicated by R^2. On the other hand, 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.

The estimated results for the urban and the rural sector nearly the same as those for the total estimates for most of the equations with minor exceptions.

4.4 Other Functional Forms Results

Table (7) to table (9) show the estimated results for the semi-log, the hyperbolic and the reciprocal forms 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 a relatively very high for all commodities range from 77% to 97.2%.T-tests indicate that all the coefficient β_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^2indicate 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 (14.363)	-6761654 (-7.129)	0.784	1171.98 (14.059)	-6827823 (-6.97)	0.776	1202.18 (13.257)	-6503767 (-6.801)	0.768
Housing	6166.9 (12.423)	-33092491	0.702	6353.42 (12.644)	-34364715	0.708	3676.5 (15.397)	-15147791	0.721

		(-5.737)			(-5.82)			(-6.015)	
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

4. Engel Elasticity Estimates

Based on the estimated results illustrated above, Engel elasticities of demand with respect to total expenditure for each commodity group are evaluated at the mean values and presented in table (10).

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 indicate the demand for food, housing and durable commodity group is clearly inelastic with respect to total expenditure, indicating that these commodity groups are necessities. Whereas the demand for services, transportation as estimated by all functional forms to be

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 with respect to total expenditure. The elasticity estimates based on different functional forms don't differ considerably for goods which have low elasticity such as food and tobacco commodity groups. But their are considerable differences for these commodity groups which have large elasticities.

5. 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 household. According to Currie (1972) the omission of family composition from a household budget study and the relegation of its effect to disturbance term will result in biased estimates of the total expenditure coefficients if there is any correlation between family composition and family total expenditure. So that, family composition as measured by the number of persons will be introduced into the logarithmic form for each commodity group in order to test the hypothesis that the family composition has an affect on Engel curve.

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

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

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 with Respect to Family 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 other hand, the elasticity estimated for clothing, durables, services, transportation and miscellaneous are greater than one implying that these commodity groups are luxuries.

The estimated elasticities with respect to family size are significantly different from zero for food, durable, services and miscellaneous commodity groups. The t-tests indicate that the elasticity estimates with respect to family size for tobacco, clothing, housing and transportation commodity groups are not significantly different from zero. This suggests that family size does not affect the demand for these commodity groups.

6.2 Economies of Scale

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

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

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 a quantity demanded. So that in order to obtain the quantity index for each community group, dividing 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 the sum value of $(\beta_i + \gamma_i)$, I and its standard error which can be obtained as follow:

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

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 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 is economies of scale only for services commodity group. This suggests that as the size of the family increases per-capita consumption of services decrease. It has also found there are diseconomies of scale for food, durable and miscellaneous commodity groups. This indicates that as the size of family increases, per-capita consumption of these commodity groups increases. But it is worth mentioning that 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 House hold on Per-Consumption for Each community group

In order to test the hypothesis that the location of household has an affect on per-consumption for each community group, Chow (1960) test will be used. That is, first we pool together the two samples(urban and rural data) and forming a sample of (16+16, 32) observations. From this the pooled function in the following form will be fitted to be the data

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

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 square ($RSS(H_1)$) for urban and the residual sum of squares for Rural ($RSS(H_2)$) will be estimated.

The F^* ratio will be calculated as

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

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 the 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 areas differ 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, so that the hypothesis that the consumption pattern for urban areas does not differ from consumption pattern of rural areas for theses commodity groups would be accepted. On the other it has found that the consumption patterns for the other commodity groups are not the same in urban and in rural areas.

Conclusions

The estimated results for the linear form indicates that the marginal budget shares β_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 α_i is equal to zero. These result, however, satisfy the additivity condition or Engel aggregation, which implied by the Utility Theory.The estimated results for the Double form indicate that the demand for food, tobacco, housing and durable community groups with respect to total expenditure are inelastic. These community groups are necessities. The estimated results for the urban and the rural sector of the Working Leser form nearly the same as those for the total estimates for most of the equations with minor exceptions. 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

Engel elasticities of demand indicate that the demand for food, housing and durable commodity group is clearly inelastic with respect to total expenditure, indicating that these commodity groups are necessities. Whereas the demand for services, transportation 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 with respect to total expenditure. The elasticity estimates based on different functional forms don't differ considerably for goods which have low elasticity such as food and tobacco

commodity groups. But their are considerable differences for these commodity groups which have large elasticities.

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

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

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

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