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Econometric modeling of household consumption in Algeria using Engel functions

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Abstract

This study aimed to test the consumption spending behavior of Algerian families toward commodity totals, using Engel's linear and double logarithmic models and relying on the least squares estimation method based on the results of the two household surveys,1988 and 2011.

We concluded through the study that the behavior of Algerian families towards commodity groups has changed. The purchasing power improved during the period (1988-2011). Hence, food commodities were luxury goods in 1988, while clothes and shoes, health and physical hygiene, as well as various materials and other expenses, are luxury goods. The rest of the other commodities were essential in 2011.

Keywords: Total consumption expenditures, Engel's functions, Aggregated data, Marginal propensity to consume, Income elasticity.

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1. INTRODUCTION

Building partial consumption models receives excellent attention in several areas, the most important of which are consumption planning and fair income distribution.

The ENGEL functions are the first and essential step in building these models. As "ENGEL ERNEST" is the first to prove the relationship between consumption and the standard of living and to study consumer behavior through consumer spending allocations. He concluded from the comparisons that he made that food expenditure related to families' standard of living. The poorer societies have a higher share allocated to food expenditures among the total consumption expenditures, and the higher purchasing power means the lower food expenditures of the community. No matter how much the income changes, the percentage allocated to clothing, housing, and heating consumption remains constant. In contrast, the part allocated to other consumptions rises more than the percentage of income.

Studies on household consumption models are considered the mainstay of economic studies in countries with developing economies, such as Algeria, in which the low-income consumer directly bears the consequences of changes in the consumption pattern, so the problem of our study is as follows: What are the most critical standard models explaining the phenomenon of family consumption? What is the consumer spending behavior of Algerian families?

As an answer to the problem, we put forward the following hypotheses:

- The application of Engel models is considered the essential step for studying the phenomenon of family consumption, and it has a great ability to explain the behavior of consumer spending in general and the consumption spending of Algerian families in particular;

- Algerian families acquire goods and services according to the priority and nature of the required commodity;

- Algerian families' behavior towards commodity aggregates changed in 2011 compared to 1988.

To achieve the goal of the research and test the validity and verification of its hypotheses, we decided to divide it into:

1- Concepts about consumption and income;

2- Standard Form Analysis of Engel functions;

3- Building standard models of household consumption in Algeria using Engel's functions.

2. Concepts about consumption and household income

The issue of consumption has recently become part of the sensitive economic issues that economists address, as most of their studies in this field focus on household consumption spending based on their budgets.

2.1. Definition of household consumption

Several definitions of household consumption differ according to the purpose for which this consumption is estimated and analysed and the different sources from which the data are derived, where consumption is defined as the use of goods and services with the intent to obtain benefits, whether this is done by decreasing their value or going away, which causes the loss of the actual value of the thing consumed, which leads to a change in its overall characteristics (Muwaffaq, 2002, p. 33).

It is also defined as the sum of the goods and services consumed by the family, in addition to the goods and services provided by the state and institutions, and included

in the family's consumption free of charge or at low prices; also, the sum of the goods that it produces and consumes by itself. As for microeconomic theory, the consumption of a commodityfor an individual or family is the satisfaction of this commodity well out of the economic circle (Rottier & Mazodie, 1969, p. 165).

One of the most basic definitions of household consumption is used in household budget surveys, including final household consumption. It includes the following (Amory & Al-Moallem, 2001, p. 9):

- Goods and services are purchased by the household with cash for consumption;

- Goods that are produced and consumed by the same household, including the rental value of the dwellings occupied by the families that own them;

- Goods and services obtained by the family as in-kind income.

2.2. Definition of family income

Many economic theories deal with the importance of the income factor as one of the factors influencing the increase in spending. Keynes said: "Total income is the main variable on which the consumption component of the aggregate demand function will depend" (Keynes, 1936, p. 96). Hence, we see the importance of disposable income (i.e. disposable income), as it is the main factor determining consumer spending.

It is also defined as the primary income families obtain after deducting taxes and adding transfers, which expresses purchasing power (khenniche, 2011, p. 66).

While the National Office of Statistics (ONS) in Algeria defines it as the sum of in-kind resources (real income) or cash (cash income) obtained by the family over some time (the year is usually taken as a unit or period for study, family income is the sum of cash resources obtained in addition to any in-kind acquisition, whatever its source by the administration, institutions, or other families (Technical Directorate in charge

of Social Statistics and Income, National Survey on Household Consumption Expenditures "2000": Brief Instructions for Female Researchers, National Statistics Office, Algeria, January 2000, p. 18).

The best source for consumption and income data is the family budget, in which both aspects of household consumption and income are covered, in addition to some data related to these two aspects, such as data on family members in terms of age, gender, educational attainment and employment status, and data on family ownership of some commodities and the availability of some services for her and so on (Amory & Al-Moallem, 2001, p. 25).

3. Analysis of standard forms of Engel functions

Engel functions are considered the essential step for building standard models of consumption. They have several uses in evaluating consumer behavior, interpreting the dynamics of the welfare of societies, and how the goods purchased by the consumer change...etc. These functions differ according to the field of study and the types of commodities studied.

3.1. A look at the Engel functions

The German statistician, "Engel ERNST" studied the relationship between income and demand for some types of commodities, as he used data on a portion of the family budget allocated for food as an indicator of the standard of living in 1857, which was supplemented in 1895 in 153 Belgian families. The families' incomes were weak; the part allocated for food was significant; on the contrary, whenever that share decreased, we noticed that the living conditions of those families were better. Thus, food expenditures tie the share of thepercentage allocated to food to the consumer's purchasing power (Emilie & coudin, 2010, p. 78).

Engel's functions are of great importance in estimating the poverty line, according to Rowntree's studies (1901), to cover the costs of basic needs. Many studies took advantage of some of the characteristics developed by some of the reformers of Engel's functions that depend on demographicvariables and other consumer characteristics (Abbi & Girma, 2004, p. 2).

3.2. Types of Engel functions

We distinguish between two types of Engel functions; these functions may be linear or nonlinear.

a. Linear Engel functions

The family budget research is carried out over a relatively short period, as it is assumed that there will be no changes in the prices of commodities during the research period. Thus, the simple relationship between consumption and income is given in the following form (Amory & Al-Moallem, 2001, p. 84):

$$q_i = f_i(R, Z)$$

An Engel curve or function thatrepresents this relationship:

q_i: It is the consumed quantity of the commodity.

R :Income, or total expenditure on goods and services.

Z :ray represents other characteristics that characterize the consumer.

The most widely used linear model is the model known as the Working-Laser model (1943), which proposed linear characteristics of the budget share.

$$w_i = a_i + b_i \log(y)$$

This model was used to estimate the expansion area of the price system. Working and Laser determined the Piglog (Price-Independent Generalized Logarithmic) form in which they considered that the part of the budget for each commodity is a linear logarithm function of total income. Pig log models were developed by Deaton and Muelbauer (1980) to study the overall behavior of consumers as a result of consumer behavior at the micro level. This system provides a first-order approximation, so the AIDS (Integrable Quadratic Almost Ideal Demand System) model was proposed, which is the best model for estimating the linear consumption function and the best estimate for elasticity, and it also allows us to test hypotheses of homogeneity and symmetry, using linear constraints on parameters (Annabi & Cockburn, 2003, p. 18). The econometric linear model of the specific relationship between food consumption expenditures and total consumption expenditures is built by studying the Engel functions as follows (Rottier, 1975, p. 27):

$$W_i = \alpha + \beta\ Dt_i + \varepsilon_i$$

So, it represents the consumption expenditures for commodities andthe total expenditures for consumption butis the random limit. The marginal propensity to consume can be calculated as follows:

$$mpc = \frac{\partial W_i}{\partial Dt_i} = \beta$$

We notice that the marginal propensity to consume is constant. This means that spending on the commodity continues to increase or decrease whenever the total expenditures for consumption change at the same rate of increase or decrease. This characteristic is not suitable for people with high incomes, just as it is not suitable for people with low incomes; it is practicallyapplicable to people with middle incomes. Income elasticity (When we use data on total spending, it is called spending

flexibility) can also be used as an indicator to express the effect of fluctuations in income (total expenditures) on consumption, which measures the ratio of the infinitesimal relative change rather than the absolute change and is therefore considered as the ratio of the partial derivative.

$$E_{Dt_i}^{W_i} = \frac{Dt_i}{W_i} * \frac{\partial W_i}{\partial Dt_i} = \beta * \frac{Dt_i}{W_i}$$

As income increases, the income elasticity approaches one.

b. Nonlinear Engel functions

There are several reports of nonlinear Engel functions, such as the works of Hausman, Newey, Powelle (1955), Banques, Bundell, and Lewbel (1997), who suggested that the Working-Laser model approaches the linear model for some commodities and explains the convexity of some items, so the system of quadratic functions was developed Second-order IQAIDS (Integrable Quadratic Almost Ideal Demand System). This model is extracted from the AIDS system, which setsa model for estimating the consumption function (Lewbel, 2006, pp. 2-3).

Nonlinear Engel functions take many forms, and we will suffice with presenting the double logarithmic paper (Amory & Al-Moallem, 2001, p. 88):

$$LogW_i = \alpha + \beta\ Log\left(Dt_i\right) + \varepsilon_i$$

The marginal propensity to consume is:

$$mpc = \beta * \frac{w_i}{Dt_i}$$

The income elasticity is:

$$E_{Dt_i}^{W_i} = \beta$$

3. Building econometric models of household consumption in Algeria using Engel's functions:

The econometric models of household consumption in Algeria are built using the Engel mentioned above functions, where we will rely on the linear and double logarithmic models.

3.1. Presentation of study data and estimation in the case of collected data:

The data we have are data collected in 10 layers called deciles about the total annual consumption expenditure of Algerian households on various commodity aggregates, and we will depend on the division of the National Bureau of Statistics into commodity totals, which are shown in the following table:

Table 1. The division of the National Statistical Office in Algeria for commodity aggregates

Commodity group	Group icon	Group name (its contents)
First group	G1	Food and beverages (nutrition in general)
Second group	G2	Clothes and shoes
The third group	G3	housing and itsburdens
Fourth group	G4	Furniture and furnishing (home furnishing)
Fifth group	G5	Health and hygiene
Sixth group	G6	Education, culture, and entertainment
Seventh group	G7	Transportation
Eighth group	G8	Various materials and other expenses

Source: National Bureau of Statistics, Algeria 1988/2004

The number of individuals (family size) is the number of family members per decimal.

Number of Families: It is the number of families represented per decimal.

This type of estimation is used in the event of ignorance of the actual data on individuals, and the availability of data on the average of a group of individuals in the form of layers (Class expresses decimal) from D1 to DG for each layer with a sample size of $n_i (i = 1 \cdots 10)$ with G = 10, where:

$$\overline{DT}^{i} = \frac{1}{n_i}\sum_{j=1}^{n_i} X_j \qquad \overline{DL}^{i} = \frac{1}{n_i}\sum_{j=1}^{n_i} Y_j \qquad \overline{DR}^{i} = \frac{1}{n_i}\sum_{j=1}^{n_i} Y_j$$

$$\overline{DA}^{i} = \frac{1}{n_i}\sum_{j=1}^{n_i} Y_j \qquad \overline{DM}^{i} = \frac{1}{n_i}\sum_{j=1}^{n_i} Y_j \qquad \overline{DU}^{i} = \frac{1}{n_i}\sum_{j=1}^{n_i} Y_j$$

$$\overline{DH}^{i} = \frac{1}{n_i}\sum_{j=1}^{n_i} Y_j \qquad \overline{DS}^{i} = \frac{1}{n_i}\sum_{j=1}^{n_i} Y_j$$

$$\overline{DE}^{i} = \frac{1}{n_i}\sum_{j=1}^{n_i} Y_j$$

Where (DA, DH, DL, DM, DS, DE, DR, DU) in this order represent the commodity groups shown in Table 1.

For the first commodity group, the relationship is written as follows (Faroukhi, 1992, pp. 42-43):

$$\overline{DA}^{n}_{n} = \alpha + \beta \overline{DT}^{n}_{n} + \overline{\varepsilon}^{n}_{n}$$

The same is true for other groups, where the relationship is always linear, so if we estimate this model using the ordinary least squares method, we will get biased estimators. This is due to the non-fulfillment of one of the classic hypotheses, which is the instability of variance, as we become in a state of dispersion of errors which:

$$E\left(\overline{\varepsilon}^{i\,2}\right) = \sigma^{2} \diagup n_i$$

Therefore, before estimation, we try to achieve the hypothesis of stability of variance, so we multiply the variance of errors by the root of the sample size, i.e. the number of families in each stratum, through this the variance of error becomes:

$$E\left(\sqrt{n_i}\,\overline{\varepsilon}^{i}\right)^2 = \sigma^2$$

Thus, we have achieved the hypothesis of stability of variance, and we can apply the ordinary least squares method to the following new models (What is noticed through this model is that it does not contain a fixed limit, that is, αZ_i^* not a fixed limit for our linear model because it is related to the number of families for each layer, and this number is different from one layer to another, so this limit becomes variable and not fixed, in this case, we cannot focus our analysis on two statistics R^2 and $\bar{R}^2$ because they are related to the fixed limit):

$$\left(\sqrt{n_i}\,\overline{DA}^{i}\right) = \alpha\sqrt{n_i} + \beta\left(\sqrt{n_i}\,\overline{DT}^{i}\right) + \left(\sqrt{n_i}\,\overline{\varepsilon}^{i}\right)$$

$$DA_i^* = \alpha\, Z_i^* + \beta\, DT_i^* + \varepsilon_i^* \qquad ,i = 1,2,\dots,G.$$

$DH_i^* = \alpha Z_i^* + \beta DT_i^* + \varepsilon_i^*$

$DL_i^* = \alpha Z_i^* + \beta DT_i^* + \varepsilon_i^*$

$DM_i^* = \alpha Z_i^* + \beta DT_i^* + \varepsilon_i^*$

$DS_i^* = \alpha Z_i^* + \beta DT_i^* + \varepsilon_i^*$

$DE_i^* = \alpha Z_i^* + \beta DT_i^* + \varepsilon_i^*$

$DR_i^* = \alpha Z_i^* + \beta DT_i^* + \varepsilon_i^*$

$DU_i^* = \alpha Z_i^* + \beta DT_i^* + \varepsilon_i^*$

3.2. Estimate and test models

We estimated the data we collected using the least squares method, then analysed the results statistically and economically during two years of the survey: 1988 and 2011.

a. Analysis of the results of estimating the linear model of Engel for the year 1988

The table below shows the parameters estimated by the OLS method for the linear form of the Engel functions for the results of the investigations of the National Bureau of Statistics on Algerian families for the year 1988 (For more details, see Appendix 1).

Table 2. Engel linear model estimation results for the year 1988

t-Statistic	$\hat{\beta}$	**t-Statistic**	$\hat{\alpha}$	**Estimation results commodity group**
4.723634	0.301095	8.946383	2.23E+15	Food and beverages
10.07163	0.061813	2.370468	2.04E+14	Clothes and shoes
26.51655	0.084240	-1.623761	-7.23E+13	housing and itsburdens
19.15386	0.079567	-6.225630	-3.63E+14	Furniture and furnishing
12.10318	0.017783	4.503836	9.28E+13	Health and hygiene
10.22296	0.260385	-4.103613	-1.47E+15	Education, culture, and entertainment
12.23037	0.089832	-4.486832	-4.62E+14	Transportation
58.21939	0.105285	-6.439012	-1.63E+14	Various materials and other expenses

Source: Composite table of linear model estimation results using EVIEWS10

From the table, we conclude that the parameter $\hat{\alpha}$is significant for all commodity groups except for the third group, represented by housing and its burdens. In contrast, the parameter is morally different from zero for all commodity groups. Thus, the model is statistically acceptable. This model produces an estimator that represents the marginal propensity to use and. Therefore, an analysis of the results of this propensity to consume various commodity groups is summarized as follows:

Food and beverages:

We note the direct proportion between food expenditures and the number of families. This is consistent with the study carried out by Engel, whereby the more prominent the family in a decimal, the higher the food consumption expenditures in the same decimal. As for the marginal propensity to consume $\hat{\beta}$, in economic theory, it is $0 < \hat{\beta} < 1$. This is confirmed, $\hat{\beta} = 0.30$ which means that an increase in income (total expenditure) by one unit increases food expenditures by 0.30 units. Food expenditures represent 30% of the total expenditures.

Clothing and shoes:

We note from the marginal propensity to consumethat whenever income increases by one unit, this increases expenditure on clothing and shoes by 0.60 units. Thus, 6% of total fees are directed to clothing and shoes.

Housing and its burdens:

Through the marginal propensity to consume $\hat{\beta} = 0.08$, we note that an increase in income by one unit leads to a rise in expenditures on housing and its burdens by 0.80 units. That is, 8% of the total costs are directed to spending on housing and its burdens.

Furniture and furnishing:

The marginal propensity to consume $\hat{\beta} = 0.07$, indicates an increase in expenditures on furniture and furnishing by 0.70 units, whenever income increases by one unit. That is, expenses on furniture and furnishing represent 7% of the total expenses.

Health and physical hygiene:

We notice through the marginal propensity to consume $\hat{\beta} = 0.01$, that the higher the income by one unit, the higher the expenditures on health and physical hygiene by 0.01 units. Therefore, only 1% of the costs are related to health and physical hygiene.

Education, culture, and entertainment:

Through the marginal propensity to consume $\hat{\beta} = 0.26$, an increase in income by one unit increases expenditures on education, culture, and entertainment by 0.26 units. This means 26% of total costs are directed to education and entertainment.

Transportation and communications:

We see through the marginal propensity to consume $\hat{\beta} = 0.08$, that an increase in income by one unit leads to an increase in transportation expenses by 0.80 units. Thus, expenditures on transportation and communications represent 8% of total expenditures.

Various materials and other expenses:

We notice through the marginal propensity to consume $\hat{\beta} = 0.10$, that an increase in income by one unit leads to an increase in expenditures on various materials and other expenses by 0.10 units, of which 10% of the total costs are directed to spending on multiple materials and other fees.

b. Analysis of the results of estimating the double logarithmic model of Engel for the year 1988

The table below shows the parameters estimated by the OLS method for the double logarithmic form of the Engel functions for the results of the investigations of the National Bureau of Statistics on Algerian families for the year 1988 (For more details, see Appendix 2).

Table 3. Engel's double logarithmic model estimation results for the year 1988

t-Statistic	$\hat{\beta}$	**t-Statistic**	$\hat{\alpha}$	**Estimation results commodity group**
81.24382	1.042086	-4.254204	-0.004130	Food and beverages
40.34747	0.922068	0.870785	0.001506	Clothes and shoes
54.25818	0.942428	-0.108784	-0.000143	housing and its burdens
29.64880	0.698782	9.161212	0.016341	Furniture and furnishing
79.80606	0.938807	-1.772381	-0.001578	Health and hygiene
25.70284	0.746111	6.479082	0.014234	Education, culture, and entertainment
34.45077	0.738017	8.257141	0.013387	Transportation
143.5093	0.888664	8.559917	0.004012	Various materials and other expenses

Source: Composite table of linear model estimation results using EVIEWS10

From the table, we conclude that the parameter $\hat{\alpha}$ is significant for all commodity groups except (clothes and shoes, housing and its burdens, health, and physical hygiene). In contrast, the parameter $\hat{\beta}$ is essential for all commodity groups. Thus, the model is statistically acceptable.

This model produces an estimator, and it represents the elasticity of total expenditures or what is known as the income elasticity, where we note that the total spending elasticityof food expenditures, through the economic theory of the consumer, when the elasticity of expenditure is greater than 1 means that the consumer raises the share or part of the expenditures the total allocated to food commodities when his income rises, and this is, of course, assuming that other things remain constant. Thus, food commodities are considered luxury commodities. As for the rest of the other commodities, they are essential commodities for Algerian society during the year 1988. We can arrange the commodity totals according to their importance to Algerian families. We find nutrition in the first place, then housing and its burdens in the second place. Health and physical hygiene, clothing, shoes, various materials, other expenses, education, and culture. And we finally find furniture and furnishing and entertainment, transportation, and communications**.**

c. Analysis of the results of estimating the linear model of Engel for the year 2011

The table below shows the parameters estimated by the OLS method for the linear form of the Engel functions for the results of the investigations of the National Bureau of Statistics on Algerian families for the year 2011(For more details, see Appendix 3).

Table 4. Results of Engel linear model estimation for the year 2011

t-Statistic	$\hat{\beta}$	t-Statistic	$\hat{\alpha}$	Estimation results commodity group
2.623846	0.446255	13.85065	10804370	Food and beverages
26.17439	0.111578	-5.124832	-2792082	Clothes and shoes
48.49283	0.084919	4.805498	1075510	housing and itsburdens
24.84129	0.019979	3.919685	402898.4	Furniture and furnishing
9.983474	0.108527	-2.820698	-3918851	Health and hygiene
6.593375	0.053404	-1.357551	-1405300	Education, culture, and entertainment
11.75420	0.112243	-2.065133	-2520358	Transportation
44.61292	0.063096	-9.107307	-1646186	Various materials and other expenses

Source: Composite table of linear model estimation results using EVIEWS10

The table shows that the parameter $\hat{\alpha}$ is significant for all commodity groups except for the sixth and seventh groups, represented in education, culture, entertainment, transportation, and communications. As for the parameter $\hat{\beta}$, it differs morally from zero in all commodity groups. So, the model is statistically acceptable. The following is an analysis of the results for the various commodity groups.

Food and beverages:

The marginal propensity to consume $\hat{\beta} = 0.44$ indicates that a change in income by one unit will result in a change in food expenditure by 0.44 units.

Clothing and shoes:

We note that the marginal propensity to consume $\hat{\beta} = 0.11$ means that an increase in income by one unit will increase expenditures on clothing and shoes by 0.11 units. Thus, 11% of total expenditures are directed to clothing and shoes.

Housing and its burdens:
The marginal propensity to consume $\hat{\beta} = 0.08$ indicates that an increase in income by one unit leads to increased expenditures on housing and its burdens by 0.80 units, or 8% of total expenditures directed to spending on housing and its burdens.

Furniture and furnishing:
Through the marginal propensity to consume $\hat{\beta} = 0.01$, we note that an increase in income by one unit leads to increased expenditures on furniture and furnishing by 0.01 units. That is, expenses on furniture and furnishing represent 1% of the total expenses.

Health and physical hygiene:
It is clear from the marginal propensity to consume $\hat{\beta} = 0.10$ that the higher the income by one unit, the higher the expenditure on health and physical hygiene by 0.10 units. Thus, 10% of the expenditures are on health and physical hygiene.

Education, culture, and entertainment:
The marginal propensity to consume $\hat{\beta} = 0.05$ shows that an increase in income by one unit leads to an increase in expenditures on education, culture, and entertainment by 0.50 units. This means that 5% of total expenditures are directed to education, culture, and entertainment.

Transportation and communications:
It appears through the marginal propensity to consume $\hat{\beta} = 0.11$ that an increase in income by one unit leads to increased expenditures on transportation and communications by 0.11 units. Thus, 11% of total expenditures are spent on transportation and communications.

Various materials and other expenses:
Through the marginal propensity to consume $\hat{\beta} = 0.06$, we note that an increase in income by one unit will lead toincreased expenditures on various materials and other expenses by 0.06 units, of which 6% of the total expenditures are directed to spending on various materials other expenses.

d. Analysis of the results of estimating the double logarithmic model of Engel for the year 2011

The table below shows the parameters estimated by the OLS method for the double logarithmic form of the Engel functions for the results of the investigations of the National Bureau of Statistics on Algerian families for the year 2011 (For more details, see Appendix 4).

Table 5. Engel's double logarithmic model estimation results for the year 2011

t-Statistic	$\hat{\beta}$	t-Statistic	$\hat{\alpha}$	Estimation results commodity group
13.60705	0.963570	0.123724	0.008476	**Food and beverages**
15.00571	1.191782	-3.884142	-0.298438	**Clothes and shoes**
31.88982	0.878847	0.460201	0.012270	**housing and itsburdens**
28.77437	0.890781	-2.057819	-0.061630	**Furniture and furnishing**
9.283978	1.130329	-2.098333	-0.247152	**Health and hygiene**
4.324176	0.852733	-0.016464	-0.003141	**Education, culture, and entertainment**
8.025972	0.991467	-0.850796	-0.101678	**Transportation**
32.15334	1.300278	-11.00215	-0.430434	**Various materials and other expenses**

Source: Composite table of linear model estimation results using 10 EVIEWS

We note that each elasticity of total expenditures on clothing and shoes, health and physical hygiene,and various materials and other expenditures aremore significant than one, indicating that they were luxury goods for Algerian consumers in 2011. As for the rest of the other commodities, they are essential commodities and commodity groups can be arranged According to their importance to Algerian families as follows:

We find the various materials and other expenses in the first place, then clothes and shoes in the second place, health and physical hygiene, transportation and communication, nutrition, furniture and furnishing, housing and its burdens, and in the last, we find education, culture, and entertainment.

4. Conclusion

The application of Engel models is the primary step in studying the phenomenon of household consumption. It can explain consumer spending behavior. It takes several formulas to express the relationship between total expenditures and spending on various expenditure commodity aggregates, through which several estimates can be obtained, including marginal propensities for consumption and elasticities. We have relied on the linear and double logarithmic models, as the study showed a high marginal propensity for food consumption during the year 1988, which is a luxury commodity group for Algerian society, so it occupies the first place. Housing and its burdens in the second place, health and physical hygiene, clothing and shoes, various materials and other expenses, education, culture and entertainment, transport and communications, and last, we find furniture and furnishing. Whereas in the year 2011, we find various materials and other expenses in the first place, then clothes and

shoes in the second place, health and physical hygiene, transportation and communications, nutrition, furniture and furnishing, housing and its burdens, and the last, we find education, culture, and entertainment, and thus through the flexibility of total expenditures is evident clothes and shoes, health and physical hygiene, as well as various materials and other expenses are luxury goods for the Algerian consumer, while the rest of the other commodities are necessary commodities, which explains the change in the behavior of Algerian families, as well as the improvement in purchasing power.

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6. Appendices

Appendix 1. Estimation of Engel's linear model for the year 1988

Food and beverages

DependentVariable: DA88
Method: Least Squares
Date: 10/13/22 Time: 21:09
Sample: 1 10
Includedobservations: 10

Variable	Coefficient	Std. Error	t-Statistic	Prob.
NM88	2.23E+15	4.72E+14	4.723634	0.0015
DT88	0.301095	0.033656	8.946383	0.0000

Clothes and shoes

DependentVariable: DH88
Method: Least Squares
Date: 10/13/22 Time: 21:20
Sample: 1 10
Includedobservations: 10

Variable	Coefficient	Std. Error	t-Statistic	Prob.
NM88	2.04E+14	8.61E+13	2.370468	0.0452
DT88	0.061813	0.006137	10.07163	0.0000

housing and itsburdens

DependentVariable: DL88
Method: Least Squares
Date: 10/13/22 Time: 21:27
Sample: 1 10
Includedobservations: 10

Variable	Coefficient	Std. Error	t-Statistic	Prob.
NM88	-7.23E+13	4.46E+13	-1.623761	0.1431
DT88	0.084240	0.003177	26.51655	0.0000

Furniture and furnishing

DependentVariable: DM88
Method: Least Squares
Date: 10/13/22 Time: 21:34
Sample: 1 10
Includedobservations: 10

Variable	Coefficient	Std. Error	t-Statistic	Prob.
NM88	-3.63E+14	5.83E+13	-6.225630	0.0003
DT88	0.079567	0.004154	19.15386	0.0000

Health and hygiene

DependentVariable: DS88
Method: Least Squares
Date: 10/13/22 Time: 21:43
Sample: 1 10
Includedobservations: 10

Variable	Coefficient	Std. Error	t-Statistic	Prob.
NM88	9.28E+13	2.06E+13	4.503836	0.0020
DT88	0.017783	0.001469	12.10318	0.0000

Education, culture, and entertainment

DependentVariable: DE88
Method: Least Squares
Date: 10/13/22 Time: 21:50
Sample: 1 10
Includedobservations: 10

Variable	Coefficient	Std. Error	t-Statistic	Prob.
NM88	-1.47E+15	3.57E+14	-4.103613	0.0034
DT88	0.260385	0.025471	10.22296	0.0000

Transportation

DependentVariable: DR88
Method: Least Squares
Date: 10/13/22 Time: 21:55
Sample: 1 10
Includedobservations: 10

Variable	Coefficient	Std. Error	t-Statistic	Prob.
NM88	-4.62E+14	1.03E+14	-4.486832	0.0020
DT88	0.089832	0.007345	12.23037	0.0000

Various materials and other expenses

DependentVariable: DU88
Method: Least Squares
Date: 10/13/22 Time: 22:01
Sample: 1 10
Includedobservations: 10

Variable	Coefficient	Std. Error	t-Statistic	Prob.
NM88	-1.63E+14	2.54E+13	-6.439012	0.0002
DT88	0.105285	0.001808	58.21939	0.0000

Appendix 2. Engel's 1988 double logarithmic model estimation

Food and beverages

DependentVariable: LDA88
Method: Least Squares
Date: 10/13/22 Time: 21:15
Sample: 1 10
Includedobservations: 10

Variable	Coefficient	Std. Error	t-Statistic	Prob.
NM88	-0.004130	0.000971	-4.254204	0.0028
LDT88	1.042086	0.012827	81.24382	0.0000

Clothes and shoes

DependentVariable: LDH88
Method: Least Squares
Date: 10/13/22 Time: 21:23
Sample: 1 10
Includedobservations: 10

Variable	Coefficient	Std. Error	t-Statistic	Prob.
NM88	0.001506	0.001730	0.870785	0.4092
LDT88	0.922068	0.022853	40.34747	0.0000

Housing and itsburdens

DependentVariable: LDL88
Method: Least Squares
Date: 10/13/22 Time: 21:29
Sample: 1 10
Includedobservations: 10

Variable	Coefficient	Std. Error	t-Statistic	Prob.
NM88	-0.000143	0.001315	-0.108784	0.9161
LDT88	0.942428	0.017369	54.25818	0.0000

Furniture and furnishing

DependentVariable: LDM88
Method: Least Squares
Date: 10/13/22 Time: 21:36
Sample: 1 10
Includedobservations: 10

Variable	Coefficient	Std. Error	t-Statistic	Prob.
NM88	0.016341	0.001784	9.161212	0.0000
LDT88	0.698782	0.023569	29.64880	0.0000

Health and hygiene

DependentVariable: LDS88
Method: Least Squares
Date: 10/13/22 Time: 21:47
Sample: 1 10
Includedobservations: 10

Variable	Coefficient	Std. Error	t-Statistic	Prob.
NM88	-0.001578	0.000890	-1.772381	0.1143
LDT88	0.938807	0.011764	79.80606	0.0000

Education, culture, and entertainment

DependentVariable: LDE88
Method: Least Squares
Date: 10/13/22 Time: 21:52
Sample: 1 10
Includedobservations: 10

Variable	Coefficient	Std. Error	t-Statistic	Prob.
NM88	0.014234	0.002197	6.479082	0.0002
LDT88	0.746111	0.029028	25.70284	0.0000

Transportation

DependentVariable: LDR88
Method: Least Squares
Date: 10/13/22 Time: 21:57
Sample: 1 10
Includedobservations: 10

Variable	Coefficient	Std. Error	t-Statistic	Prob.
NM88	0.013387	0.001621	8.257141	0.0000
LDT88	0.738017	0.021422	34.45077	0.0000

Various materials and other expenses

DependentVariable: LDU88
Method: Least Squares
Date: 10/13/22 Time: 22:03
Sample: 1 10
Includedobservations: 10

Variable	Coefficient	Std. Error	t-Statistic	Prob.
NM88	0.004012	0.000469	8.559917	0.0000
LDT88	0.888664	0.006192	143.5093	0.0000

Appendix 3. Estimation of Engel's linear model for the year 2011

Food and beverages

DependentVariable: DA11
Method: Least Squares
Date: 10/19/22 Time: 14:37
Sample: 1 10
Includedobservations: 10

Variable	Coefficient	Std. Error	t-Statistic	Prob.
NM11	10804370	4117761.	2.623846	0.0305
DT11	0.446255	0.032219	13.85065	0.0000

Clothes and shoes

DependentVariable: DH11
Method: Least Squares
Date: 10/19/22 Time: 14:52
Sample: 1 10
Includedobservations: 10

Variable	Coefficient	Std. Error	t-Statistic	Prob.
NM11	-2792082.	544814.4	-5.124832	0.0009
DT11	0.111578	0.004263	26.17439	0.0000

Housing and itsburdens

DependentVariable: DL11
Method: Least Squares
Date: 10/19/22 Time: 15:03
Sample: 1 10
Includedobservations: 10

Variable	Coefficient	Std. Error	t-Statistic	Prob.
NM11	1075510.	223808.2	4.805498	0.0013
DT11	0.084919	0.001751	48.49283	0.0000

Furniture and furnishing

DependentVariable: DM11
Method: Least Squares
Date: 10/19/22 Time: 15:13
Sample: 1 10
Includedobservations: 10

Variable	Coefficient	Std. Error	t-Statistic	Prob.
NM11	402898.4	102788.5	3.919685	0.0044
DT11	0.019979	0.000804	24.84129	0.0000

Health and hygiene

DependentVariable: DS11
Method: Least Squares
Date: 10/19/22 Time: 15:22
Sample: 1 10
Includedobservations: 10

Variable	Coefficient	Std. Error	t-Statistic	Prob.
NM11	-3918851.	1389320.	-2.820698	0.0225
DT11	0.108527	0.010871	9.983474	0.0000

Education, culture, and entertainment

DependentVariable: DE11
Method: Least Squares
Date: 10/19/22 Time: 15:30
Sample: 1 10
Includedobservations: 10

Variable	Coefficient	Std. Error	t-Statistic	Prob.
NM11	-1405300.	1035173.	-1.357551	0.2117
DT11	0.053404	0.008100	6.593375	0.0002

Transportation

DependentVariable: DR11
Method: Least Squares
Date: 10/19/22 Time: 15:39
Sample: 1 10
Includedobservations: 10

Variable	Coefficient	Std. Error	t-Statistic	Prob.
NM11	-2520358.	1220434.	-2.065133	0.0728
DT11	0.112243	0.009549	11.75420	0.0000

Various materials and other expenses

DependentVariable: DU11
Method: Least Squares
Date: 10/19/22 Time: 15:58
Sample: 1 10
Includedobservations: 10

Variable	Coefficient	Std. Error	t-Statistic	Prob.
NM11	-1646186.	180754.4	-9.107307	0.0000
DT11	0.063096	0.001414	44.61292	0.0000

Appendix 4.Engel's 2011 pairedlogarithmic model estimation

Food and beverages

DependentVariable: LDA11
Method: Least Squares
Date: 10/19/22 Time: 14:39
Sample: 1 10
Includedobservations: 10

Variable	Coefficient	Std. Error	t-Statistic	Prob.
NM11	0.008476	0.068508	0.123724	0.9046
LDT11	0.963570	0.070814	13.60705	0.0000

Clothes and shoes

DependentVariable: LDH11
Method: Least Squares
Date: 10/19/22 Time: 14:56
Sample: 1 10
Includedobservations: 10

Variable	Coefficient	Std. Error	t-Statistic	Prob.
NM11	-0.298438	0.076835	-3.884142	0.0046
LDT11	1.191782	0.079422	15.00571	0.0000

Housing and itsburdens

DependentVariable: LDL11
Method: Least Squares
Date: 10/19/22 Time: 15:08
Sample: 1 10
Includedobservations: 10

Variable	Coefficient	Std. Error	t-Statistic	Prob.
NM11	0.012270	0.026661	0.460201	0.6576
LDT11	0.878847	0.027559	31.88982	0.0000

Furniture and furnishing

DependentVariable: LDM11
Method: Least Squares
Date: 10/19/22 Time: 15:16
Sample: 1 10
Includedobservations: 10

Variable	Coefficient	Std. Error	t-Statistic	Prob.
NM11	-0.061630	0.029949	-2.057819	0.0736
LDT11	0.890781	0.030957	28.77437	0.0000

Health and hygiene

DependentVariable: LDS11
Method: Least Squares
Date: 10/19/22 Time: 15:26
Sample: 1 10
Includedobservations: 10

Variable	Coefficient	Std. Error	t-Statistic	Prob.
NM11	-0.247152	0.117785	-2.098333	0.0691
LDT11	1.130329	0.121750	9.283978	0.0000

Education, culture, and entertainment

DependentVariable: LDE11
Method: Least Squares
Date: 10/19/22 Time: 15:34
Sample: 1 10
Includedobservations: 10

Variable	Coefficient	Std. Error	t-Statistic	Prob.
NM11	-0.003141	0.190778	-0.016464	0.9873
LDT11	0.852733	0.197201	4.324176	0.0025

Transportation

DependentVariable: LDR11
Method: Least Squares
Date: 10/19/22 Time: 15:44
Sample: 1 10
Includedobservations: 10

Variable	Coefficient	Std. Error	t-Statistic	Prob.
NM11	-0.101678	0.119509	-0.850796	0.4196
LDT11	0.991467	0.123532	8.025972	0.0000

Various materials and other expenses

DependentVariable: LDU11
Method: Least Squares
Date: 10/19/22 Time: 16:02
Sample: 1 10
Includedobservations: 10

Variable	Coefficient	Std. Error	t-Statistic	Prob.
NM11	-0.430434	0.039123	-11.00215	0.0000
LDT11	1.300278	0.040440	32.15334	0.0000