

Disaggregated Engel Function Analysis of Income and Expenditure among Nigerian Small Scale Farmers

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Abstract. This study examined the relationship between income and expenditure among the Nigerian small scale farmers using the Disaggregated Engel function analysis. The study showed that increase in total income would lead to a corresponding increase in each of the disaggregated expenditure groups. Households had high marginal propensity to consume more food for every naira increase in household income. As household income rises, spending on necessities rises, but the proportion of income spent on them falls. The study showed that increase in total income would lead to a corresponding increase in the expenditure on basic needs of the small scale farmers in Nigeria thereby improving the level of their welfare.

Keywords: Analysis, Disaggregated Engel function, Income, Expenditure, small scale farmers

1. Introduction

According to Delgado *et al.* (1998), the consumption patterns and direct increase in agricultural income are a major determinant of the strength of agricultural growth linkage. The multiplier effect is most significant when the incremental income is spent in labour-intensive, locally produced goods and services.

Consumption patterns have been found to change across the income spectrum. It was reported that poor people in both Africa and Asia tend to spend a large share of their incomes and increments to incomes on starchy staples, while higher income rural households spend a greater portion of their income on manufactured goods and preferred foods such as dairy products, meat and fruits (Delgado *et al.*, 1998). In another study, Agbola *et al.* (2004) used total expenditure as proxy to income in a food security analysis in Osun State, Nigeria and obtained a regression coefficient of -0.00002392 . The negative and significant effect of the household income indicates that for every naira increase in income, the level of food insecurity will reduce by 0.00002392 . This is so because an increase in the level of household income increases the capacity of farming households to consume more, especially of foods that are not produced by the household. Erubami and Young (2003) reported that the poorest 40% of Nigerians derived one hundred percent of their income from home consumption: "real subsistence farmers, suggesting that they had little or no surplus output for sale as a source of extra income". They also discovered that between the fifth and seventh income deciles, income from agricultural output rose to 50%, while for the wealthiest 30%, wage income constituted six to eight percent of the total. With regard to spatial distribution, the southern (geopolitical) zones experienced an improvement in low income incidence in the 1990s, while the northern zones experienced deterioration, particularly in the rural areas, suggesting that one parameter along which income inequality is rising is the south-north longitudinal axis and that poverty interventions should vary accordingly.

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Having a particular level of income and expenditure is not a sufficient indicator of the level of welfare to define the poverty line. More important is how that amount is spent in determining the level of welfare and ability to undertake economic activity (Aigbokhan, 2000). It is, therefore, important to understand the relationship between income and consumption expenditure of the farming households especially the small scale farmers in Nigeria as this has some implications for poverty alleviation policy.

The broad objective of the study is to analyse the relationship between income and expenditure among the Nigerian small scale farmers. The specific objectives of the study are to:

- i. determine the response of disaggregated expenditure groups to total income among the small scale farmers in Nigeria; and
- ii. analyse the households budget shares and expenditure elasticity of the expenditure groups among the small scale farmers in Nigeria.

The following hypothesis was stated and tested:

- iii. There is no significant relationship between the income and consumption expenditure among the small scale farmers in Nigeria.

2. Methodology

For this study, farm level data were collected from smallholder farmers in Benue State, Nigeria. Benue State is located between Longitudes 6° 35'E and 10°E and between Latitudes 6° 30'N and 8° 10'N. Arable land in the State is estimated to be 3.8 million hectares. This State is predominantly rural with an estimated 75 percent of the population engaged in rain-fed subsistence agriculture.

Benue State is divided into three (3) agricultural zones viz: Zone A, Zone B and Zone C. Zone A and Zone B are made up of seven Local Government Areas each while Zone C is made up of nine Local Government Areas. Using a constant sampling fraction of 45%, three Local Government Areas were randomly selected from Zone A and Zone B while four Local Government Areas were randomly selected from zone C. From each of the selected Local Government Areas, one farming community was randomly selected. Finally, from each community, households were randomly selected on the basis of the community's population size using a constant sampling fraction of 1% in order to make the sampling design to be self-weighting thereby avoiding sampling bias (Eboh, 2009). Based on the foregoing, 224 small scale farmers were randomly selected for the study.

Data were collected mainly from primary sources. The primary data were obtained through the use of structured questionnaires that were administered to the selected 224 small scale farmers in Benue State.

The disaggregated Engel function was used for the analysis of the specific objectives. The Wald tests for joint significance of parameters and linear restrictions of parameters were used to test the null hypothesis.

In this study, the disaggregated Engel function is assumed to be the appropriate model for the analysis of the relationship between the income and consumption expenditure of the small scale farmers in Nigeria. A number of empirical studies have provided insight on the relationship between household income and expenditure. Behrman and Deolalikar (1987) reported a weak linkage between income and consumption while Bouis and Hadad (1990) reported a strong and positive but non-linear relationship between food calorie consumption and household income.

In this study, total consumption expenditure was used as proxy to total income (Agbola *et al.* 2004). Assuming that all households differ only in their total consumption expenditure, a linear function would be too restrictive for this purpose.

3. The Linear Engel Curve

$$E_i = \alpha_i + \beta_i E, \quad (1)$$

where, E_i is expenditure on good i , E is total consumption expenditure, and α is a constant, which does not permit the marginal budget share (β_i) to vary at all. Thus, redistribution is implicitly assumed to have effect on the aggregate expenditure of good i .

A non-linear function is clearly required; therefore a modified form of the Working-Lesser model was chosen as specified below (Delgado *et al.*, (1998):

$$S_i = \beta_i + \alpha_i/E + \gamma_i \log E + \varepsilon \quad (2)$$

Where $S_i = E_i/E$ is the share of good in total expenditure, ε as error term and γ_i is a constant.

The Engel function is then:

$$E_i = \alpha_i + \beta_i E + \gamma_i E \log E + \varepsilon \quad (3)$$

In comparing the expenditure of households with different incomes, allowance must be made for differences in their socio-economic characteristics like household size, farm size or differences in education and age. This is because such variables have effect on household expenditure. Therefore, a number of household characteristics variables were included in the Engel function, in a way that allows them to shift both the intercept and the slope of the Engel functions.

Let Z_j denote the j th household characteristic variable and let μ_{ij} and λ_{ij} be constants. The complete model is then:

$$E_i = \alpha_i + \beta_i E + \gamma_i E \log E + \sum_j (\mu_{ij} Z_j + \lambda_{ij} E Z_j) + \varepsilon \quad (4)$$

In expenditure share form, this is equivalent to:

$$S_i = \beta_i + \alpha_i/E + \gamma_i \log E + \sum_j (\mu_{ij} Z_j/E + \lambda_{ij} Z_j) + \varepsilon \quad (5)$$

Given the chosen Engel function, the marginal budget share (MBS), the average budget share (ABS) and expenditure elasticity (C_i) for the i th commodity are as follows:

$$MBS_i = dE_i/dE = \beta_i + \gamma_i (1 + \log E) + \sum_j \lambda_{ij} Z_j \quad (6)$$

$$ABS_i = S_i \quad (7)$$

$$C_i = MBS_i/ABS_i \quad (8)$$

The average budget share (ABS) measures the percentage of total household expenditure going to a group of goods. A high percentage suggests that response to income for that group is relatively important. ABS is derived directly from the expenditure data for each sub-sample of interest.

The marginal budget share (MBS) measures the percentage of additions to income that are allocated to the goods in question. Being the practical equivalent of the marginal propensity to consume a given group of goods, it measures the direct impact of income changes on the consumption of the goods in question.

An MBS that is lower for a given group of goods than the ABS for the same group of goods implies that the relative importance of that commodity in the consumption basket decreases as income (that is total consumption) increases. In such cases, demand is income inelastic.

The expenditure elasticity (C_i) measures change in expenditure/consumption associated with a proportionate change in income.

4. Results and Discussion

The result in Table 1 shows that at 5% level of significance, the hypothesis that there is no significant relationship between total income and the respective disaggregated expenditure group is rejected by Wald test of linear parameter restrictions, suggesting that there is a significant impact between each of the disaggregated expenditure groups and total income. The model (regression line) fits the data fairly reasonably. For example, the (maximum likelihood) estimates maximize the log likelihood functions. This implies that among all the possible regression lines, the coefficients (b 's) of this regression line maximizes the joint (total) probability (likelihood) of observing the n sample values of the disaggregated expenditure groups. This indicates that variation in the respective disaggregated expenditure group is each explained by the (maximum likelihood) estimates of the total income, suggesting that the model has some explanatory power on the changes in each of the disaggregated expenditure groups among the respondents. The calculated Wald test (statistics) values are greater than the critical values (at 5% level of significance), implying that there is a significant cause-effect relationship between each of the disaggregated expenditure groups and total income.

Table 1: Wald Tests of Hypotheses Involving Linear Parameter Restrictions

Expenditure Group	Test for Joint Significance of Parameters			Test for Linear Restrictions of Parameters		
	Wald test	*Critical value	Conclusion	Wald test	*Critical value	Conclusion
Food	192958.91	22.36	Reject	140.41	3.84	Reject
Durables	32564.36	22.36	Reject	5951.57	3.84	Reject
Consumables	55212.39	22.36	Reject	501.56	3.84	Reject
Education	126755.75	22.36	Reject	1366.03	3.84	Reject
Health	121151.21	22.36	Reject	2361.55	3.84	Reject
Farming	598614.19	22.36	Reject	2350.05	3.84	Reject

Source: Field Survey, 2010.

*Critical value is significant at 5% level of significance.

The result in Table 2 shows that at 5% level of significance, expenditure on food, expenditure on durables, expenditure on consumables, expenditure on education, expenditure on health and expenditure on farming all have positive and significant relationship with total income, indicating a direct relationship between total income and the respective disaggregated expenditure group. This implies that with increase in total income aggregate expenditure would increase and hence increase in the respective disaggregated expenditure group. This means that increase in total income would lead to a corresponding increase in each of the disaggregated expenditure groups.

Table 2: Regression Results of the Response of Expenditure Groups to Total Income among the Respondents

Expenditure Group	Coefficient	t-ratio
Food	0.000834	322.35**
Durables	0.000259	93.02**
Consumables	0.000417	138.86**
Education	0.000688	225.46**
Health	0.000664	237.85**
Farming	0.000276	330.47**

Source: Field Survey, 2010.

** t-ratio is significant at 1%.

Food expenditure is seen to generate the highest degree of response to total income, suggesting that food expenditure takes the greatest share of total income and incremental income among the respondents. The implication of this result is that any increase in total income among the households tends to make them invest more towards meeting their food needs (both in quality and quantity). This is consistent with the evidence from earlier studies that suggests that poor households tend to spend a large share of their incomes and increments to incomes on food (Hopkins *et al.*, 1994; Delgado *et al.*, 1998; Okoruwa, 2000; Agbola *et al.*, 2004).

The average budget shares, marginal budget shares and expenditure elasticity for the selected disaggregated expenditure groups (disaggregates) for the rural and peri-urban communities are presented in Table 3. The average budget share (ABS), which measures the percentage of total expenditure going to a group of goods, shows that farming (66.8%) and food (8.57%) are the highest, indicating their relative importance among the respondents.

The marginal budget share (MBS), which measures the percentage of additions to total income that are allocated to the disaggregates indicates that among the households, for every 1 naira increase in income 0.1729 kobo will be spent on food, 0.1496 kobo on education, 0.1457 kobo on health and 0.0799 kobo on farming.

Table 3: Households Budget Shares (ABS and MBS) and Expenditure Elasticity of the Expenditure Groups among the Respondents

Expenditure Group	ABS	MBS	C_i
Food	0.0857	0.00172	0.0201
Durables	0.0598	0.00061	0.0101
Consumables	0.0607	0.00097	0.01595
Education	0.0582	0.00015	0.00259
Health	0.0686	0.00146	0.02128
Farming	0.6680	0.00055	0.00077

Source: Field Survey, 2010.

The implication is that the households are highly prone to spend additional income on food, suggesting that they have high marginal propensity to consume more food for every naira increase in household income. This finding is in consonance with the observation of Agbola *et al.* (2004) that for every naira increase in income, the level of food insecurity will reduce. This is so because an increase in the level of household income increases the capacity of farming households to consume more especially of foods that are not produced by the household.

The expenditure elasticity (c), which measures the change in consumption associated with a proportionate change in income shows that among the households, the expenditure elasticity for food, durables, consumables, education, health and farming are all less than unity. The implication is that a proportionate change in income would lead to a less than proportionate change in expenditures on food, durables, consumables, education, health and farming.

The study showed that the MBS is lower than the ABS for all the groups of goods, suggesting that the relative importance of these commodities in the consumption basket decreases as income (that is total consumption) increases, indicating that demand for these commodities are income inelastic among the respondents. The implication of this finding is that as poor households they spend large share of their incomes on necessities. However, as their household income rises, spending on these necessities rises, but the proportion of income spent on them falls. This is because they would prefer to spend the increments to income on higher qualitative necessity products. Todaro and Smith (2009) observed that in addition to financial savings, the poor tend to spend additional income on improved nutrition, education for their children, improvements in housing conditions, and other expenditures that, especially at poverty levels, represent investments rather than consumption.

This is consistent with evidence from earlier studies: Agbola *et al.* (2004) who found that increase in the level of households income increases the capacity of farming households to consume more, especially of foods that are not produced by the household; Okoruwa (2000) in southwestern Nigeria who found that estimates of expenditure elasticity for food and non-food categories suggested that there was increased expenditure on higher qualitative foods (protein based diet) and basic necessities of household (clothing and education) as household income rose; Delgado *et al.* (1998) who observed that poor people in both Africa and Asia tend to spend a large share of their incomes and increments to incomes on starchy staples, while higher income rural households spend a greater portion of their income on manufactured goods and preferred foods such as dairy products, meat and fruits.

5. Conclusion

Wald tests reject the hypothesis of no significant relationship between total income and the respective disaggregated expenditure group, suggesting that changes in household income has significant effect on expenditure on basic needs of the small scale farmers in Nigeria. The study showed a direct relationship between total income and the respective disaggregated expenditure group, indicating that increase in total income would lead to increase in aggregate expenditure and hence increase in the respective disaggregated expenditure group. This implies that increase in total income would lead to a corresponding increase in the expenditure on basic needs of the small scale farmers in Nigeria thereby improving the level of their welfare.

6. References

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