DEMAND FOR ENERGY AMONG HOUSEHOLDS IN IJEBU DIVISION, OGUN STATE, NIGERIA

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Abstract

This study examines the influence of households' socio-economic characteristics on household demand for electricity, petrol, diesel, kerosene, firewood, domestic gas, and transport in commercial vehicles. Primary data obtained in a cross-section survey of 90 households selected across six communities in Ijebu-Division of Ogun State, Nigeria was used in estimating a system of energy demand equations and elasticities. The study reveals that an average household in the sample had about five members, headed by a 52 year old male that had about nine years of formal education. The mean monthly household consumption expenditure was ₦ 15,458.63, of which about 25% was expended on the seven commodities. While the influence of education and household size on household energy use were insignificant; income (budget size), household ownership of electrical/electronic appliances and automobiles, as well as age of household heads exercised significant influence on the relative shares of some/all of the seven energy commodities in household budgets in the study area. The income effects were positive for all the energy commodities, except firewood. Demand for petrol, diesel and domestic gas were income elastic. Thus, the study concludes that improvement in income would cause increase in demand for electricity and petroleum products in the study area, but worsening real income would place greater demand on biomass fuel.

1. INTRODUCTION

Nigeria's economy has, for over two decades now, been plagued by perennial energy crises, which manifest in at least four ways: erratic electric power supply, acute shortages of petroleum products on several occasions, sharp increases in prices of energy commodities, and frequent conflicts between the populace, led by the labour movements, and the Federal Government on what should constitute appropriate prices of petroleum and other energy supplying commodities. These lingering crises have dealt several devastating blows on the nation's fragile economy, slowing down growth and socio-economic

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development. Perhaps one major pointer to this is a steady decline in the nation's industrial capacity utilisations, which dropped from 78.7% in 1977 to 40.4% in 1987 and 30.4% in 1997, CBN (2000).

A number of previous studies had attempted estimating the cost of Nigeria's energy crises. Ukpong (1973), estimated the costs of power outages to the nation's industrial sector as early as the years 1965 and 1966 at about ₦ 1.68 million and ₦ 2.75 million respectively: these figures were, respectively, equivalent to about US$ 57.79 million and US$ 94.60 million, in 1993 US Dollars[3]). With respect to households, Iyanda (1982) estimated an average electricity outage cost of about ₦ l.19 (US$ 40.18, in 1993 US Dollars) per hour among high-income households in Lagos. A more comprehensive estimate was provided by World Bank (1993), which estimated the adaptive costs of electricity failure on Nigeria's economy as a whole at about US$ 390 million (in 1993 US Dollars). This was divided between consumer back-up capacity (US$ 250 million), operating and maintenance costs of diesel auto-generators (US$ 90 million), and fuel and lubrication (US$ 50 million).

The World Bank (1993), attributed Nigeria's energy crises to (a) energy supply and distribution inadequacies, (b) inappropriate energy pricing policies, (c) inconsistent planning system, and (d) inadequate manpower and manpower training, among others. These findings point to the need for an urgent review of energy policies in Nigeria; more so, that recent efforts by the Federal government were aimed at encouraging inflow of foreign capital and private investment into Nigeria's energy sector. As an input into policy and private investment decisions, there exists an urgent need for reliable estimates of demand for energy-supplying commodities in Nigeria. Thus, against the background that households remain the largest consumers of energy in the nation's economy, this study analyses the patterns of household energy consumption in Nigeria. It examines the influence of household socio-economic characteristics on demand for such energy commodities as electricity, petroleum products and biomass fuel. The empirical setting is the Ijebu-Division of Ogun State in the Southwest rainforest zone of Nigeria. The remaining part of the paper is organised as follows. The second section describes the methodology adopted in the study. The third section presents the results and their discussion, while the fourth presents the summary and conclusions.

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[3] *In 1973, the official Naira (₦) exchange rate for a US$ was about ₦ 0.66 = $1. The corresponding figures in 1982 and 1993 were, ₦ 0.67 = $1 and ₦ 22.63 = $1 respectively. Today (2003), about ₦ 135 exchange for $1 at the Autonomous Foreign Exchange Market. The official exchange rate was abolished in December 1998.*

2. METHODOLOGY

2.1 The study data and data collection method

The data used in this study was obtained in a multiple visit, cross section survey of 90 households, conducted between January and March 2002. A three-stage sampling process was used in selecting the respondents. In the first stage, the enumeration areas (EA) mapped out and used by the National Population Commission (NPC) during the 1991 census were stratified into three – those in the relatively urban, sub-urban and rural communities; and one EA was randomly selected from each of these strata in each of Ijebu-North and the old Ijebu-Ode local government areas of the state. By NPC designs, each EA consists of 30-50 contiguous residential buildings, each of which accommodates as many households as its capacity can contain. Thus, in the second stage of the sampling process, 15 residential buildings were selected by systematic random sampling from each of the six communities (EA), and one willing household per residential building was included in the sample at the final stage. A total of 90 households were therefore included in this study.

Each household in the sample was visited once in a month, over a three-month period (January-March 2002), during which the survey data were collected using a personally administered questionnaire. During the first set of visits, data were obtained on the socio-economic characteristics of the households; their electrical/electronic appliances, automobiles and other assets owned; electricity bills received and/or paid (and where available, electric meter readings) within the last six months; expenditure on clothing, education, and household durables over the last one year; rent payments (or imputed values), cost of healthcare services and body care (pomade, tooth paste, soap, etc) utilised over the last one month; and cost of food, petroleum products, firewood/charcoal, and paid transport services enjoyed within the last one week, among others. In subsequent visits, supplementary expenditure data on these items were obtained to cover the period from the time of last visit to date, or within the last one week, as applicable. Data obtained from 11 of the respondents was however discarded for observed inconsistency/incompleteness.

2.2 Analytical framework

To begin with, demand for an energy-supplying commodity (as well as other commodities) by a household was hypothesised to be a function of the household's income, size, wealth, other socio-economic variables, and prices. While noting the existence of a wide range of household consumption models in literature, the analytical framework of the linear logit model of Tyrrel &

Mount (1982) was preferred in this case for at least two reasons. Firstly, the linear logit model allows for the incorporation of household socio-economic variables into a typical logarithmic demand function. Secondly, the model displays "adding up" property derived from budget constraint, which is not sacrificed by the introduction of household socio-economic variables. In addition, a-priori economic principles of homogeneity and symmetry can be imposed and tested.

The linear logit model, as presented by Tyrrel & Mount (1982), is based on a logistic budget share equation that satisfies the budget constraint and therefore the adding up property, given as:

$$wi = \frac{e^{f_i(M, P_1..P_N, Z_1...Z_R)}}{\sum_{i=1}^{N} e^{f_i(M, P_1..P_N, Z_1...Z_R)}} \quad (1)$$

where:

I = 1, 2 ..... N, refers to an item (or category) of household commodity

w_i = budget share allocated to the i^{th} commodity $\left(\frac{P_i Q_i}{M}\right)$

M = income (or total expenditure on all commodities in the budget)

Pi = price of the i^{th} commodity

Z_r = the r^{th} household characteristic

$f_i(\,)$ = general notation for an unspecified function of argument that is linear in an unknown parameter.

If each f_i is allowed to include stochastic residuals, and is assumed to take the specific form given as:

$$f_i = B_{0i} + B_{11}\ln M + \ldots\ldots\ldots\ldots\ldots\ldots.. + ei \quad (2)$$

where:

I = 1, 2, …., N; M is income, and e_i is a stochastic residual.

Then, the logarithm of the ratio of two budget shares would be given as:

$$\ln(w_i/w_N) = (B_{0i} - B_{0N}) + (B_{1i}\text{-}B_{1N})\ln M + \ldots.+ (e_i\text{-}e_N) \quad (3)$$

where:

i = 1, 2, …., N-1; and w_N is the budget share of the base commodity

The system of equations (3) can be estimated by linear regression. Note however, that such set of N-1 seemingly unrelated regression equations in (3) is better estimated jointly by generalised least squares (GLS) techniques, which Zellner (1962) observes is more efficient than an equation by equation application of least-squares.

When the N-1 equations in (3) are fitted, Tyrrel and Mount (1982) suggest that one can estimate the budget share of the base commodity as:

$$\hat{w}_N = 1 \Big/ 1 + \sum_{j=1}^{N-1} e^{\ln(w_j \hat{/} w_N)} \qquad (4)$$

where:

$\ln(w_j \hat{/} w_N)$ is the predicted value of the j[th] commodity for a specific set of the regressors.

And, that the shares of other commodities can then be computed as:

$$\hat{w}_i = \hat{w}_N e^{\ln(w_i \hat{/} w_N)} \qquad i = 1, 2, \ldots, N\text{-}1 \qquad (5)$$

The corresponding share's elasticity for the base (N[th]) commodity with respect to any one of the explanatory variables, say X, can be computed as:

$$\frac{d \ln \hat{w}_N}{d \ln X} = \sum_{j=1}^{N-1} \hat{w}_j \frac{d \ln(w_j / w_N)}{d \ln X} \qquad (6)$$

where:

$d \ln(w_i / w_N) / d \ln X$ is the partial derivative of the j[th] estimated equation with respect to X (where X could be income, own price, education, etc.), evaluated at the same point used to predict $w_1, w_2, \ldots w_N$.

The corresponding demand elasticities can be written as:

$$E_{NX} = \frac{d \ln \hat{w}_N}{d \ln X} + \begin{cases} 1 & if \;\; X = M \\ -1 & if \;\; X = P_N \\ 0 & if \;\; otherwise \end{cases} \qquad (7)$$

$$E_{iX} = \frac{d \ln \hat{w}_N}{d \ln X} + \frac{d \ln(w_i / w_N)}{d \ln X} + \begin{cases} 1 & if \;\; X = M \\ -1 & if \;\; X = P_i \\ 0 & if \;\; otherwise \end{cases}$$

where:

i =1, 2, …, N-1

2.3 Model specification and estimation

In this applied study, a system of linear logit household energy demand equations was specified and estimated. For this purpose, average monthly household consumption expenditure was decomposed into eight categories, seven of which are expenditure on the seven energy commodities - electricity, petrol, diesel, domestic gas, kerosene, firewood and transport in commercial vehicles, while the eighth category was expenditure on all other consumption items including food, clothing, healthcare, body care, accommodation, education, etc. Expenditure on such regularly consumed items as food and petroleum products obtained on weekly basis were averaged over the three visits, and converted to monthly expenditure. Expenditure on such occasionally paid for items as electricity, clothing, healthcare, housing, etc. were averaged over the relevant number of months on which data were obtained. Expenditure on such durable items as building construction, furniture and purchase of electrical/electronic appliances whose useful lives extend over several years, and investment in stock, farming, trades, etc. as well as expenditure on ceremonies were however excluded.

The share (w_i) of each of the eight categories of items in each household's average monthly consumption expenditure was computed, having replaced all zero expenditures by 0.01, and the share of "all other commodities" (w_8) was chosen as that of the base commodity. Because all households pay the same set of prices for electricity and petroleum products[4], whose supplies are under the control of government's monopolies in Nigeria, prices were excluded as explanatory variables in this study. Also, households' wealth could not be included directly as explanatory variable, partly because most respondents were reluctant in providing this piece of information, and because of difficulty encountered in aggregating this wide range of items into a common denominator that has some relevance to energy consumption. Note for example, that an amount invested in such assets as landed property,

[4] *As at the time of this survey, petrol and diesel are sold at ₦ 26 per litre, kerosene is sold at ₦ 24 per litre, while electricity consumed by households is billed at about ₦ 4 per kilowatt.*

annuities, stock, etc. may not have the same influence on demand for energy as a similar amount invested on electrical/electronic appliances, automobiles, and power generating sets. These considerations, motivated the classification of sampled households into three on the basis of their ownership and use of electrical/electronic appliances and automobiles. The three household categories are: "the poor households" consisting of those that owned no more than a radio set/an electric fan with at best a black and white television set; "the average households" consisting of those that owned a wider range of electrical/electronic devices (radio, television, refrigerators, electric/gas cooker, etc.) and sometimes motorcycle; and "the wealthy households" that consists of those that, in addition to owning a wide range of electrical/electronic appliances, also owned at least one motor vehicle and/or a power generating set. It was decided that these differences should be reflected in the model as asset related dummy variables[5].

The ensuing estimating equations of the linear logit model is specified as:

$$(\ln(w_i/w_8) = (B_{0i} - B_{08}) + (B_{1i}-B_{18})\ln M + (B_{2i}-B_{28})\ln S + (B_{3i}-B_{38})\ln E + (B_{4i}-B_{48})\ln A + (B_{5ij}-B_{58j})D_j + (e_i-e_8) \quad (8)$$

i = electricity, diesel, petrol, kerosene, domestic gas, firewood and transport services

where:

w_i = budget share of the i^{th} energy commodity;

M = Budget size (₦), obtained as the sum of the average monthly expenditures of the household on all commodities;

S = Household size;

E = Educational attainment of the household head, measured in terms of years of formal schooling;

A = Age of the household head (years);

D_j = The j^{th} binary variable (j=1, 2) depicting the wealth related category that the household belongs to, 1 if it belongs and 0 if otherwise. The dummy variable for "the average households" was however, excluded.

B_{ki} = Parameter of the k^{th} variable in the i^{th} equation.

[5] *A reviewer suggested that the use of dummy variables in place of actual value/quantity of assets and exclusion of other sources of wealth reduced the "wealth" dummy into a "technology" dummy.*

Given that the same set of explanatory variables appears in each of the seven equations of the system, and that no restriction is required across equations, parameters of the model were estimated by applying OLS to each of the equations separately. This position is supported by Zellner (1962) and Intriligator (1978:172-3), who posited that if the same set of regressors appears in each of the equations of the system and no restriction is imposed across equations, OLS and GLS estimators would be computationally identical. The estimated shares and demand elasticities implicit in the estimating equations in (8) were computed as laid down in equations (4) to (7).

3. RESULTS AND DISCUSSION

3.1 Socio-economic characteristics of respondents

Table 1 presents the socio-economic characteristics of the sampled households, and the structure of their ownership of electrical/ electronic appliances and automobiles. The mean income of the entire sample was ₦ 19,984.81 while the mean total monthly household expenditure was ₦ 15,458.63. An average household in the sample had about five members, whose heads had mean age of about 52 years and mean years of formal schooling of about nine years, which is equivalent to about a Junior Secondary School education.

As much as 31.65% of the sampled households owned no electrical/electronic appliances or automobiles other than a radio, an electric fan and/or a black and white television set, thus belonging to "the poor household" category. About 22.78%, in addition to owning most electrical/electronic appliances itemised on table 1, also own at least a car and/or an electric power generating set, and therefore belongs to "the wealthy household" category. The rest of the sampled household were in "the average household" category: All of these had one or more radio, TV set and electric iron; the majority had in addition, one or more pressing iron and electric/gas cooker; about 42% had one or more video player as well as refrigerators, while about 32% own at least one motorcycle.

A close look at Table 1 reveals that about 84% of the relatively poor households had heads that had no more than primary school education, while as much as 76% of the relatively wealthy households were headed by individuals with at least a Senior Secondary School Certificate. This suggests that education plays some roles in asset accumulation by households in the study area, most especially, on ownership of electrical/electronic appliances and automobiles.

Table 1: Descriptive statistics of household characteristics and asset ownership

	Very Poor Households	Average Households	Wealthy Households
Number of respondents	25	36	18
Per cent of respondents	31.65	45.57	22.78
Mean age of Household Head	56	52	51
Mean monthly expenditure (N)	8,105.74	12,900.84	24,435.94
Household size			
▪ 1-4	27.00	41.67	48.00
▪ 5-6	52.00	38.89	36.00
▪ 7-8	21.00	19.44	16.00
Mean household size	5	5	5
Education of Household Head			
▪ No Formal	56.00	22.22	8.00
▪ Primary	28.00	16.67	16.00
▪ Secondary	16.00	27.78	36.00
▪ Tertiary	0.00	33.33	40.00
Mean years of schooling by household heads	5.4	9.0	11.4
Percentage of the households that own at least one unit of:			
▪ Air conditioner	0.00	0.00	22.22
▪ Electric fan	28.00	100	100
▪ Electric/Gas cooker	0.00	75.00	88.89
▪ Motorcycle	0.00	30.56	11.11
▪ Power generator	0.00	0.00	22.22
▪ Pressing iron	24.00	92.67	100
▪ Radio	84.00	100	100
▪ Refrigerator	0.00	41.67	94.44
▪ Television set	0.00	66.67	100
▪ Vehicle/car	0.00	0.00	94.44
▪ Video/CD player	0.00	41.67	88.89

Source: Field survey, 2002.

3.2 Shares of energy commodities in sampled households' budget

Table 2 presents the composition of the average monthly consumption expenditures of an average household in each of the three wealth related categories in the sample. Based on results of analysis of variance with Duncan multiple range tests, sufficient evidence exists to suggest that the mean budgetary shares of the energy commodities vary significantly across the three categories of households. While the budgetary allocations of the relatively poor households differ significantly from those of the average households in terms of their higher budgetary allocations to kerosene and firewood, and lower allocations to petrol, the relatively wealthy households' budgetary allocations to all the energy commodities except kerosene, were significantly different from those of the other two categories. On the average, households in the average and relatively poor categories expended about 25% of their average monthly consumption expenditure on the seven energy commodities combined. But, households in the relatively wealthy category expended as much as about 36% of their average monthly consumption expenditures on the seven energy commodities, and about two-third of this goes to fuel (petrol and diesel) for the households' automobiles and generating sets.

Table 2: Average shares of energy commodities in household consumption budget

Items	Households' Wealth-based category			
	Poor	Average	Wealthy	F-Statistics
Budget size (~~N~~)	**8,105.74 (542.60)**	**12,900.84 (762.58)**	**24,435.94 (1,357.71)**	
Budget share allocated to:				
1. Diesel	0.0000[a]	0.0101[a]	0.0597[b]	3.690*
2. Electricity	0.0330[a]	0.0288[a]	0.0434[b]	5.326*
3. Domestic gas	0.0029[a]	0.0113[a]	0.0207[b]	7.334*
4. Kerosene	0.0721[b]	0.0459[a]	0.0282[a]	9.390*
5. Petrol	0.0000[a]	0.0514[b]	0.1831[c]	32.915*
6. Wood	0.0313[c]	0.0114[b]	0.0000[a]	15.647*
7. Transport in commercial vehicles	0.1083[b]	0.0895[b]	0.0247[a]	17.081*

Notes: 1. Figures in parentheses are standard errors of the respective mean budget sizes.
2. An asterisk indicates that the difference is statistically significant ($p<0.05$).
3. Mean shares (fractions) in the same row having same superscript belongs to the same homogeneous subset.

Source: Computed from survey data, 2002.

3.3 Effects of socio-economic variables on household demand for energy

The results of regression analyses aimed at assessing the influence of households' socio-economic characteristics on the size of their budgetary allocations to the various energy commodities are summarized on Table 3, while Table 4 presents the income effects implicit in the estimated demand equations obtained for an average household that earned the mean income in each of the three wealth-based categories.

Initial sets of results obtained reveal that inclusion of the poor household dummy variable caused some of the equations to have very low and insignificant F-statistics, suggesting that such equation will have no predictive power. When this variable was excluded, substantial improvement was recorded as all the F-statistics became significant at at-least $p<0.10$ in all the equations of the system. In the later specification however, parameters associated with household size and education level of household heads were not significant in all the seven equations of the system. When these variables were also excluded, and the model was re-estimated, the adjusted R^2 values and the computed F-statistics were higher in all the equations, and the level of significance of some of the remaining variables as well as the number of significant variables improved. These suggest some degree of multicollinearity exists among the variables. Increase in education for instance, may positively influence income while budget size may rise as household size increases. Thus, the revised form of the model was adopted (see Koutsoyiannis, 1973:233-57 for a range of other methods for handling problems of multicollinearity), and effects of socio-economic variables were evaluated within this framework.

Table 3: OLS estimates of the linear logit energy expenditures model

Nat. log of variables	Diesel	Electricity	Domestic Gas	Kerosene	Petrol	Wood	Transport
FULL MODEL							
Constant	-22.19* (-1.88)	-0.07 (-0.03)	-34.99* (-1.76)	6.54* (2.105)	-51.13** (-2.46)	26.55 (1.55)	3.05 (1.02)
Budget size	0.67 (0.75)	-0.46*** (-3.15)	4.04** (2.67)	-0.89*** (-3.78)	4.40** (2.79)	-5.68*** (-4.41)	-0.68*** (-3.00)
Household size	1.73 (1.30)	0.18 (0.80)	0.15 (0.07)	0.26 (0.75)	0.26 (0.11)	-1.74 (-0.91)	0.16 (0.49)
Age of household head	0.56 (0.26)	0.18 (0.51)	-3.98 (-1.11)	-0.41 (-0.72)	-0.51 (-0.14)	5.30* (1.73)	0.16 (0.30)
Education of household head	0.04 (0.11)	0.02 (0.29)	0.42 (0.75)	0.01 (0.11)	0.16 (0.27)	-0.31 (-0.65)	0.06 (0.65)
Wealthy household dummy	0.98 (0.96)	0.93*** (5.64)	2.47 (1.44)	0.30 (1.10)	6.23*** (3.48)	-1.64 (-1.12)	-0.65** (-2.52)
$\overline{R}^2$	0.05	0.30	0.31	0.16	0.47	0.46	0.40
F-Value	1.80	7.54	8.14	4.06	14.71	14.35	11.25
REVISED MODEL							
Constant	-28.20** (-2.62)	-0.65 (-0.37)	-34.63* (-1.92)	5.63* (2.00)	-51.72** (-2.76)	31.70* (2.06)	2.58 (0.95)
Budget size	0.79 (0.89)	-0.44*** (-3.10)	4.19** (2.83)	-0.87*** (-3.77)	4.46*** (2.90)	-5.88*** (-4.65)	-0.65*** (-2.93)
Age of household head	2.51* (1.74)	0.36 (1.57)	-4.19* (-1.73)	-0.11 (-0.30)	-0.35 (-0.14)	3.59* (1.74)	0.30 (0.84)
Wealthy household dummy	0.84 (0.83)	0.92*** (5.69)	2.59 (1.54)	0.28 (1.05)	6.26*** (3.58)	-1.59 (-1.10)	-0.65** (-2.57)
$\overline{R}^2$	0.05	0.31	0.33	0.18	0.48	0.47	0.41
F-Value	2.45	12.53	13.63	6.70	25.13	23.70	18.85

Notes: 1. Figures in parentheses are t – values of estimates.
2. ***, **, and * imply that the associated coefficients are significant.
3. at p < 0.01, 0.05 and 0.10 respectively.

The results reveal that households that, in addition to owning a wide range of electrical/electronic devices, also owned at least a car and/or an electric power generating set allocated significantly more fraction of their average monthly consumption expenditure to electricity and petrol consumption relative to "other household expenditure" than an average household in the sample. Their budgetary allocation to transportation in commercial vehicles was also significantly lower. Increase in income (budget size) caused an average household in the sample to significantly raise the relative shares of domestic gas and petrol in the household budget, and significantly lower the relative shares of electricity, kerosene and transport in commercial vehicles. Households with older heads were indicated as having significantly higher budgetary allocation to firewood and diesel, and significantly lower budgetary allocations to domestic gas than an average household in the sample.

A clearer picture of the direct effects of the socio-economic variables on demand for the various energy commodities are better appreciated by looking at demand elasticities. These elasticities, with respect to income, for a typical household that earned the mean income under each of the three wealth related household categories are summarized on Table 4. The results reveal that income has positive effects on all the eight categories of commodities except firewood. Meanwhile, demand for petrol, diesel and domestic gas are revealed to be income elastic, while demand for kerosene, transport in commercial vehicles, and electricity (except for wealthy households) are indicated to be income inelastic.

Table 4: Income elasticity estimates based on linear logit model (revised form)

Items	Households' Wealth-based category		
	Poor	Average	Wealthy
1. Diesel	1.65	1.73	2.36
2. Electricity	0.42	0.50	3.48
3. Domestic gas	5.06	5.14	5.76
4. Kerosene	0.00	0.08	0.70
5. Petrol	5.34	5.42	6.04
6. Wood	-5.02	-4.94	-4.31
7. Transport in commercial vehicles	0.21	0.29	0.91
8. Other commodities	0.87	0.94	1.57

4. SUMMARY AND CONCLUSIONS

Against a background of a lingering energy crisis in Nigeria, the resolution of which the governments have hinged on increased private initiatives and inflow of foreign capital into the nation's energy sector, this study sought to provide policy information on the influence of households' socio-economic characteristics on patterns of energy use/demand among households in Nigeria. The case of households in the Ijebu-Division of Ogun State, Southwest rainforest zone of Nigeria was presented. Based on primary data obtained in a multiple visit cross-section survey of 90 randomly selected households in the study area, a system of household energy demand equations was estimated by ordinary least square regression techniques; and effects of household socio-economic characteristics on demand for electricity, petrol, diesel, kerosene, firewood, domestic gas and transport in commercial vehicles were appraised.

The study reveals that an average household in the sample had about five members, and is headed by a 52 year old male that had about nine years of formal education. The mean monthly household income in the sample was ₦ 19,984.81 while the mean monthly household consumption expenditure was ₦ 15,458.63. On the average, the relatively poor as well as the average households in the sample allocated about 25% of their monthly consumption expenditure to the seven energy commodities, while the relatively wealthy households devoted as much as 36% of their budget to energy consumption. About two-third of the relatively wealthy households' energy related expenditures goes to fuel (petrol/diesel) used by their automobiles/power generating sets, while expenditure on transport services followed by cooking fuel (kerosene and firewood/domestic gas) took the lion share of the energy expenditures of the relatively poor and average households.

The study found no sufficient evidence to suggest that education of household head as well as household size had any significant influence on the relative budget shares of the seven energy commodities. However, income (budget size), ownership of motor vehicles/generating sets and age of household heads exercised significant influence on the relative budget shares of the seven energy commodities. Increase in age of household heads was found to be associated with significant increase in relative budget shares of firewood and diesel, but lower budgetary allocations to domestic gas. Ownership of motor vehicles and/or power generating sets as well as more electrical/electronic appliances significantly raised relative budget shares of petrol and electricity, but significantly lowered relative budget share of transport services. Income effects on demand for all the energy commodities, except firewood, were positive. Demand for petrol, diesel and domestic gas were income elastic, while demand for electricity, kerosene, and transport services were income inelastic.

The study concludes that increase in income would be accompanied by increase in demand for electricity and petroleum products, with the increase in demand for diesel, petrol and domestic gas being more than the proportionate increase in income among households in the study area. However, worsening economic conditions, most especially decline in real income, would encourage increase use of biomass fuel (firewood, coal, etc). Thus policy measures aimed at discouraging deforestation and burning of biomass fuel must seek improvement in household income among others measures.

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