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Sample Selection Analysis of Household Food Consumption in Southwestern Nigeria

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Abstract: The objective of the study is to analyze food consumption pattern in Southwestern Nigeria. Data collected from 300 heads of household through a multi-stage random sampling technique were analyzed. Sample selection models that allow to take into account and correct the possible bias due to zero consumption were used. Also various single equation models were applied. Demand function was estimated by Ordinary Least Squares (OLS); Heckman two-steps sample selection estimator and the maximum likelihood estimator. Result shows that the t statistics test on the sample selection coefficient indicates absence of sample selection bias. It is found out that the mean percentage expenditure share for carbohydrate (rice, yam and gari) foodstuffs in the three states was 51.7% while 28.6% was spent on proteinous foodstuff. The expenditure elasticities results indicate that gari and rice are normal goods in the region. Result shows that rice and gari are strong substitute. Also that beans is a substitute for rice and plantain.

Key words: Analyis, household food, consumption, pattern, techniq

INTRODUCTION

The Structure of Nigerian Food Consumption has been undergoing dramatic change for some years now. There was decrease in the Dietary energy consumption (kcal per caput per day) for the periods 1990-1992, 1995-1997 and 2001-2003 that was put at 2540, 2750 and 2700, respectively. Also there is decrease in dietary protein consumption (gm per caput per day) for the period 1995-1997 and 2001-2003. The per caput protein intake was 62 between 1995-1997 but dropped to 61 between 2001-2003[1].

It is clear that many factors have influenced the Nigeria food consumption pattern and the understanding of these factors will be pertinent to know for proper assessment of the agricultural product market in Nigeria. As Nigeria, with a population of about 120 million, is Africa's most populous country and the continent's third largest economy NCEMA[2], changes to its food consumption pattern will directly affect world agricultural trade. The desire to know which of the staple foods in Nigeria is normal or inferior good is important for evaluating the significance of Nigerian domestic food consumption policy.

The objective of this study is to analyse food consumption pattern in southwestern Nigeria. The study is relatively unusual because it is based on household data, while most literature on the analysis of food demand in Nigeria used aggregate data at the national level. In this paper we present a sample selection model that allows taking into account and correct the possible bias due to zero consumption which was major shortcomings in previous studies.

Food is a basic necessity of life. Its importance at the household level is indicated by the fact that it is a basic means of sustenance Ajibola[3]. The adequacy of which in quantity and quality is a key requirement for healthy and productive life. Food strategies must not merely be directed at ensuring food security for all but must also achieve the consumption of adequate quantities of safe foods for healthy life Olayemi[4,5].

There is a large amount of literature available in the measurement of food consumption. These include econometric models such as single equations and systems of demand equations Chern *et al.*[6].

These include the Working Leser demand model (Intriligator *et al.*[7]. In some of the study available the Ordinary Least Square (OLS) was applied to the demand equation. This was however argued against by different economists and econometricians that OLS is not suited to analyse data that are developed under a sample selection process[8-18].

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According to them when there is selection problem, the result is that OLS regression gives bias estimates. Heckman[8] argued that there is need for the introduction of an inverse mill ratio into the equation of interest and that a standard t test on the coefficient of the inverse Mills ratio (λ) is a valid test of the null hypothesis of no selection bias.

Chern *et al.*[6] therefore argued that whenever there is problem of zero consumption in the demand analysis for household data that a sample selection model should be used.

MATERIALS AND METHODS

The data for this study were obtained from Southwestern Nigeria from which the selected states were Ondo, Osun and Ekiti states. Data were collected from 300 heads of households through a multi-stage random sampling technique and interviewed at intervals of two weeks for three months. The multi-stage random sampling employed involved 4 stages. At the first stage, Osun, Ondo and Ekiti states were randomly selected out of the 6 states in Southwestern Nigeria. At the second stage, 5 local governments and 3 towns were randomly selected. At the third stage, the number of households from each state was selected using proportionality, such that the number of respondent households from each state is proportional to the number of local government areas in each state. While the number of households from each town/village was selected at the fourth stage. Data collected included household food expenditure, quantities and types of food consumed.

Theoretical framework and model specification: In a standard microeconomic theory the quantity of food demand can be expressed as a function of own price, price of related commodities that is substitutes or compliments, consumption expenditures and other shifters to account for dynamics and time trend. This demand function can be structured as

$$Q_k^d = f'(P_k, P_s, X, Z_d | \Theta_d) \qquad (1)$$

Where Q is the quantity demanded, P_k is the own price, X is a vector of prices of related commodities, X is real expenditure or income, Z is a vector of other shifters in the demand equation such as lagged regressand and trend use to measure the dynamic adjustment of consumers, Θ is a vector of demand coefficients; and d is the superscript and subscript for demand. To determine the elasticties the log transformation of equation 1 was taken.

In order to correct for the sample bias problem in food consumption, Heckman's two-step estimation (Heckit) procedure can be applied, as suggested by[8,9]. In the first stage, a probit regression is computed in order to estimate the probability that a given household consumes the food item in question. This regression is used to estimate the inverse Mills ratio (λ) for each household, which is used as an instrument in the second regression. The first and second regression equations are given as Eq. 2 and 3:

$$Z_i = \gamma' w_i + u_i \qquad (2)$$

Where i = index for each survey household,
z = Boolean variable indicating membership into a plan,
γ = Vector of variable coefficients to be estimated,
w = vector of independent variables in equation 1
u = error term ~ N (0,1).

$$y_i = \beta' x_i + \epsilon_i \qquad (3)$$

Where y = Satisfaction levels as measured by survey questions,
β = vector of variable coefficients to be estimated,
x = vector of independent variables used in the probit model i.e., Eq. 2 plus the Inverse Mills ratio,
ϵ = error term ~ N (0, σ^2)

The sample rule is that y_i is observed only when z_i is greater than zero.

$$E[y_i | y_i \text{ is observed}] = E[y_i | z_i^* > 0]$$
$$= E[y_i | u_i > -w`y_i]$$
$$= x`_i\beta + E[\epsilon_i | u_i > -w`\gamma_i]$$
$$= x`_i\beta + p\sigma_\epsilon \lambda_i(\alpha_u)$$
$$= x`_i\beta + \beta_\lambda \lambda_i(\alpha_u) \qquad (4)$$

$$\text{Where } \alpha_u = -w_i'/\sigma_u \text{ and } \lambda(\alpha_u) = \phi(w_i'/\sigma_u) \Big/ \Phi\left(w_i'/\sigma_u\right) \qquad (5)$$

Equation 5 is the Inverse Mills ratio for every household. For notational convenience this is put as

$$\frac{\phi_i\left(\hat{\gamma}_0 + \hat{\gamma}_1 w_i\right)}{\Phi_i\left(\hat{\gamma}_0 + \hat{\gamma}_1 w_i\right)} \qquad (6)$$

Where ϕ_i is the density probability function and Φ_i is the cumulative probability function. β and β_λ can be estimated by the following equation:

$$y_i | z_i^* > 0 = E[y_i | z_i^* > 0] + v_i$$
$$= x`_i\beta + \beta_\lambda \lambda_i(\alpha_u) + v_i \qquad (7)$$

Were v_i is heteroscedastic:

$$\text{var}\left[v_i \middle| z_i = 1, x_i, w_i\right] = \sigma_\epsilon^2\left(1 - p^2\delta_i\right) \tag{8}$$

Least squares regressions using incidentally truncated data produces inconsistent estimates of β. However, the least squares regression of y on x and λ produces consistent estimators. Omitting λ would produce the specification error of an omitted variable. Unless $\beta\lambda = p\sigma_\epsilon = 0$. The hypothesis therefore is to test H_0: P = 0 using t statistic on λ_i.

For maximum likelihood, recall from Eq. 2 and 3 that, for the sample selection model, there are two types of observation:

Those where y_i is observed and we know that $z_i > 0$. For these observations, the likelihood function is the probability of the joint event y_i and $z_i > 0$. We can write this probability for the ith observation as the following (using Bayes Rule):

$$\Pr\left(y_i, z_i > 0 \middle| x, w\right) = f\left(y_i\right)\Pr\left(z_i > 0 \middle| y_i, x, w\right) = f\left(\in_i\right)\Pr\left(u_i > -w_i y \middle| \in_i, x, w\right)$$

$$\frac{1}{\sigma_1}\phi\left(\frac{y_i - x_i\beta}{\sigma_1}\right)\cdot\int_{-w_i\gamma}^{\infty} f\left(u_i \Leftrightarrow \in_i\right)du_i$$

$$\frac{1}{\sigma_1}\phi\left(\frac{y_i - x_i\beta}{\sigma_1}\right)\cdot\int_{-w_i\gamma}^{\infty}\phi\left(\frac{u_i - \frac{p}{\sigma_1}\left(y_i - x_i\beta\right)}{\sqrt{1-p^2}}\right)du_i$$

$$\frac{1}{\sigma_1}\phi\left(\frac{y_i - x_i\beta}{\sigma_1}\right)\cdot\left[1 - \Phi\left(\frac{-w_i\gamma - \frac{p}{\sigma_1}\left(y_i - x_i\beta\right)}{\sqrt{1-p^2}}\right)\right]$$

$$\frac{1}{\sigma_1}\phi\left(\frac{y_i - x_i\beta}{\sigma_1}\right)\cdot\Phi\left(\frac{w_i\gamma + \frac{p}{\sigma_1}\left(y_i - x_i\beta\right)}{\sqrt{1-p^2}}\right) \tag{9}$$

Thus the probability of an observation for which we see the data is the density function at the point y_i multiplied by the conditional probability distribution for Z_i given the value of y_i that was observed.

Those where y_i is not observed and we know that $z_i \le 0$. For these observations, the likelihood function is just the marginal probability that $z_i \le 0$. We have no independent information on y_i. This probability is written

$$\Pr\left(z_i \le o\right) = \Pr\left(u_i \le -w_i\gamma\right)\Phi\left(-w_i\gamma\right) = 1 - \Phi\left(w_i\gamma\right) \tag{10}$$

Therefore the log likelihood for the complete sample of observations is the following:

$$\log L\left(\beta,\gamma,p,\sigma;\text{thedata}\right) = \sum_{i=1}^{N_0}\log\left[1 - \Phi\left(w_i\gamma\right)\right] + \sum_{i=N_0+1}^{N}\left[-\log\sigma_1 + \log\phi\left(\frac{y_i - x_i\beta}{\sigma_1}\right) + \log\Phi\left(\frac{w_i\gamma + \frac{p}{\sigma_1}\left(y_i - x_i\beta\right)}{\sqrt{1-p^2}}\right)\right] \tag{11}$$

Where there are No observations where we don't see y_i and N_1 observations where we do ($N_0 + N_1 = N$). The parameter estimates for the sample selection model can be obtained by maximizing this likelihood function with respect to its arguments. These estimates will be consistent and asymptotically efficient, under the assumption of normality and homoskedasticity of the uncensored disturbances.

DATA PRESENTATION AND DISCUSSION

The estimates of expenditure and income elasticities from the whole sample Ordinary Least Square (OLS) are shown in Table 1. The food items surveyed are rice, gari, beans, yam, milk, bournvita, meat, fruit and vegetable and plantain. The results indicate gari and rice to be normal goods in this estimation.

Table 1: Pooled sample elasticities for major food consumption (OLS)

Food	Mean budget share%	% of zero consumption	Own-price elasticity	Expenditure elasticity
Rice	29.17	0.00	-1.2017 (1.115)	1.16 (10.10)
Gari	8.26	0.00	-1.121 (3.12)	1.012 (12.71)
Beans	11.66	4.20	-0.0137 (2.71)	0.014 (34.16)
Yam	14.31	8.40	-0.007 (0.85)	0.10 (41.97)
Milk	5.22	21.80	-0.0028 (1.64)	0.02 (10.06)
Bournvita	5.12	26.40	-0.0259 (2.131)	0.018 (17.14)
Meat	16.93	5.40	-0.00138 (0.978)	0.054 (0.38)
Fruits and vegetable	4.89	16.90	-0.0063 (2.73)	0.0072 (17.11)
Plantain	4.45	44.10	-0.0028 (3.06)	0.032 (0.40)

Note: The numbers in parentheses following the elasticities estimates are t statistics, Source: Computed from data obtained from Field Survey, 2005

The expenditure elasticity of both is above one. Other commodities are also relatively expenditure inelastic with yam having the highest expenditure elasticity followed by meat and plantain respectively. It is noteworthy that the own-price elasticities for gari and rice are very elastic.

Southwestern Nigerian consumers are sensitive to price changes in gari and rice. If this estimate represents southwestern consumer behaviour correctly, gari export-which should lead to an increase in price-might be much felt by consumers but it will also boost the effort of the farmers to produce more. From this estimation, gari is found to be a normal good. If this is so, gari consumption would increase as per capita GDP grows. If this is the case, it would be possible to project higher gari demand in the future as the income of Nigerians increase. From this estimation, it could further be seen that the expenditure elasticities for all other foods are less than 1 and they are staple foods and that the consumption of each of these will decline as per capita income increases. This result is further complimented when the mean budget share is considered. In all the states pooled together, the highest percentage of budget for food went for rice 29.17% followed by meat 16.93% yam 14.31% and beans 11.66% gari had 8.26% while plantain had 4.45%. Overall the highest percentage of budget for food went for carbohydrate food (i.e., yam, gari and rice), which was 51.74%. This result accorded Olarinde and Kuponiyi[19].

In order to have a consistent result, OLS, Heckman's two-step and maximum likelihood estimators are compared and the results are shown on Table 2. Result shows that the t statistic test on the sample selection coefficient indicates absence of sample selection bias. The Table shows the estimated own-price, cross-price and expenditure elasticities of the nine food items. The adequacy of the estimated model is reflected by a number of statistics. The estimated model displays all the theoretical demand properties since this were imposed in the estimation. The sign of elasticities checks whether the minimum requirement of a downward sloping demand are met. The models have correct signs as shown in the elasticities derived from them. That is own-price elasticities are negative and expenditure elasticities are all positive. Many of these have coefficients estimates that are significant. Also differenced regressors and trend are significant suggesting dynamic adjustment of consumers. Moreover, the absolute values of the elasticities are within the range reported for these commodities in other studies. It is surprising that the own-price elasticity for all staple foods except rice and gari are below 1 in absolute terms in the OLS, Heckit, MLE, Heckit with no restriction and MLE with no restriction. If the absolute value is considered, the lowest estimates of own-price elasticity for all the staple food are found in the Heckman's two-step with no restriction where the inverse Mill ratio was used. The own price elasticity of gari and rice were -1.121

Table 2: Parameter estimates of food demand

Variable	OLS		Heckman 2 STEP (Heckit)		Maximum Likelihood Estimator (MLE)		Heckit with no restriction		MLE with no restriction	
Dependent										
Share of rice										
Independent										
Constant	0.745	(7.07)	1.07	(9.16)	2.45	(6.16)	2.11	(5.21)	1.86	(8.17)
Price of rice	-1.2017	(1.116)	-1.640	(1.48)	-1.415	(0.08)	-1.012	(0.016)	-1.712	(1.95)
Price of gari	1.611	(7.96)	1.745	(6.52	1.212	(12.61)	1.117	(4.10)	1.817	(13.64)
Price of beans	0.705	(9.48)	1.210	(8.96)	0.978	(7.32)	0.614	(11.02)	1.226	(7.11)
Price of yam	0.448	(18.13)	0.336	(21.25)	0.311	(26.62)	0.279	(30.17)	0.973	(10.14)
Price of milk	0.460	(0.35)	0.401	(0.51)	0.381	(0.72)	0.322	(9.68)	0.816	(10.41)
Bournvita price	0.519	(0.17)	0.507	(0.14)	0.467	(0.09)	3.416	(16.77)	1.101	(11.12)
Price of meat	0.895	(0.72)	0.717	(0.58	0.6141	(0.41)	0.476	(10.35)	1.621	(9.41)
Price of fruit	0.905	(0.97)	0.8821	(0.87)	0.714	(0.63)	0.5311	(0.32)	7.706	(0.52)
Price of plant	0.636	(8.21)	0.512	(11.41)	0.501	(12.31)	0.476	(15.17)	0.934	(0.23)
Real expenditure	1.160	(0.10)	1.042	(12.06)	1.004	(15.64)	1.010	(0.331)	1.778	(5.82)
First difference of rice share	0.352	(5.75)	0.514	(6.88)	0.212	(3.26)	0.111	(3.11)	0.517	(7.24)
Trend	0.34	(17.7)	0.71	(22.11)	0.24	(10.10)	0.17	(9.11)	1.07	(21.07)
Diagnostics										
Mills: Lambda		2.621 (3.14)**								
R^2	0.51									
Wald			1.232*							
Dependent										
Share of gari										
Independent										
Constant	0.554	(22.14)	1.572	(25.02)	0.682	(19.07)	3.105	(16.14)	7.108	(26.04)
Price of rice	0.944	(3.71)	1.011	(3.99)	0.422	(2.66)	0.117	(2.41)	1.214	(2.31)
Price of gari	-1.121	(3.12)	-1.604	(3.16)	-1.062	(2.07)	-1.0009	(1.009)	-1.6271	(3.76)
Price of beans	0.4284	(18.56)	0.4716	(15.31)	0.4017	(24.06)	0.3112	(31.27)	0.7634	(9.18)
Price of yam	0.3713	(29.64)	0.6431	(13.76)	0.3210	(31.66)	0.2874	(41.11)	0.6461	(12.21)
Price of milk	0.4986	(2.46)	0.6617	(4.15)	0.4410	(2.12)	0.3874	(16.41)	0.7141	(10.11)
Bournvita price	0.4614	(19.17)	0.700	(16.32)	0.3910	(26.14)	0.3274	(28.13)	0.6130	(17.01)
Price of meat	0.6173	(91.22)	0.6576	(10.13)	0.5130	(14.37)	0.4137	(0.22)	0.9817	(1.36)

Table 2: Continued

Variable	OLS		Heckman 2 STEP (Heckit)		Maximum Likelihood Estimator (MLE)		Heckit with no restriction		MLE with no restriction	
Price of fruit	0.3195	(0.46)	0.5043	(0.72)	0.2817	(0.04)	0.2233	(35.56)	0.3112	(17.91)
Price of plantain	0.4750	(9.17)	0.5551	(8.61)	0.4104	(5.97)	0.3142	-(0.09)	0.7178	(3.27)
Real expenditure	1.012	(12.71)	1.202	(9.26)	1.3074	(7.14)	0.7982	(0.231)	1.4144	(6.56)
First difference of gari share	0.352	(1.10)	0.511	(1.21)	0.244	(0.79)	0.212	(0.65)	0.717	(2.11)
Trend	0.012	(3.25)	0.002	(3.41)	0.074	(2.79)	0.005	(2.65)	0.091	(3.70)
Diagnostics										
Mills: Lambda		2.158 (6.771)**								
R^2	0.48									
Wald			4.110**							
Dependent										
Share of beans										
Independent										
Constant	6.27	(20.14)	4.07	(27.31)	3.13	(17.61)	7.110	(14.02)	13.4	(27.01)
Price of rice	1.3678	(11.41)	1.421	(10.29)	0.9144	(11.09)	0.6411	(0.77)	1.7141	(0.32)
Price of gari	0.7127	(10.21)	0.8612	(8.14)	0.4136	(29.15)	0.332	(37.47)	0.9714	(7.41)
Price of beans	-0.0137	(2.071)	-0.2104	(2.074)	-0.0101	(0.056)	-0.003	(0.013)	0.4131	(3.097)
Price of yam	1.0959	(14.66)	1.1412	(21.17)	0.776	(10.12)	0.5551	(18.33)	1.6122	(7.17)
Price of milk	0.0452	(0.03)	0.4234	(0.21)	0.0181	(0.021)	0.0121	(44.02)	0.6112	(0.081)
Bournvita price	0.7171	(0.14)	0.9125	(0.32)	0.5310	(0.24)	0.3141	(31.92)	1.0671	(12.07)
Price of meat	0.5111	(30.01)	0.7121	(25.14)	0.4001	(40.32)	0.2410	(0.09)	0.9887	(0.31)
Price of fruit	0.5217	(26.01)	0.6161	(21.48)	0.2307	(41.27)	0.037	(0.04)	0.7177	(0.21)
Price of plantain	0.8265	(10.11)	1.4060	(7.06)	0.6743	(14.11)	0.4171	(0.04)	1.6332	(0.62)
Real expenditure	0.034	(34.16)	0.046	(10.17)	0.017	(12.22)	0.012	(13.21)	0.4160	(16.61)
First difference of beans share	1.412	(6.01)	2.300	(6.71)	1.212	(4.17)	0.971	(3.06)	2.751	(7.18)
Trend	0.512	(4.61)	0.711	(4.88)	0.210	(3.14)	0.092	(2.76)	0.910	(5.11)
Diagnostics										
Mills: Lambda		3.337 (5.326)**								
R^2	0.71									
Wald			4.01*							
Dependent										
Share of yam										
Independent										
Constant	1.871	(29.17)	2.313	(36.04)	1.606	(20.11)	1.234	(15.16)	6.771	(31.17)
Price of rice	1.022	(11.10)	1.304	(7.96)	0.9451	(10.52)	0.6451	(13.16)	1.5430	(7.17)
Price of gari	0.671	(15.11)	0.911	(17.11)	0.72	(13.40)	0.41	(11.01)	1.23	(17.32)
Price of beans	0.4565	(15.07)	0.55171	(12.11)	0.2810	(22.15)	0.1773	(37.44)	0.6711	(11.13)
Price of yam	-0.007	(0.85)	-0.014	(0.012)	-0.0027	(0.011)	-0.001	(0.003)	-0.103	(1.07)
Price of milk	0.4998	(25.14)	0.5714	(14.22)	0.2174	(40.11)	0.1183	(42.70)	0.7174	(10.68)
Bournvita price	0.0844	(37.16)	0.0914	(39.11)	0.03971	(41.07)	0.0161	(47.11)	0.2131	(21.03)
Price of meat	0.306	(40.47)	0.0401	(38.12)	0.0170	(43.11)	0.0113	(46.11)	0.1114	(21.14)
Price of fruit	0.335	(38.14)	0.0617	(33.45)	0.0121	(45.07)	0.0075	(80.66)	0.2731	(0.14)
Price of plantain	0.0042	(51.06)	0.0081	(47.60)	0.0018	(49.00)	0.0006	(33.05)	0.4117	(27.08)
Real expenditure	0.10	(41.97)	0.171	(45.16)	0.047	(27.12)	0.032	(28.11)	0.530	(12.36)
First difference of yam share	0.121	(10.06)	0.337	(13.14)	0.097	(11.44)	0.041	(9.01)	0.670	(13.41)
Trend	0.007	(4.77)	0.037	(5.16)	0.005	(4.15)	0.0012	(3.05)	0.102	(5.12)
Diagnostics										
Mills: Lambda		2.146 (7.718)**								
R^2	0.58									
Wald			6.715*							
Dependent										
Share of milk										
Independent										
Constant	-0.271	(3.88)	-4.11	(4.75)	-9.75	(2.28)	-0.675	(2.14)	-4.70	(4.71)
Price of rice	1.122	(12.91)	1.3301	(10.74)	1.1071	(9.07)	0.8774	(7.99)	1.544	(6.72)
Price of gari	0.898	(7.41)	0.9177	(8.42)	0.7970	(10.14)	0.5630	(12.14)	1.122	(12.14)
Price of beans	0.1301	(28.13)	0.2370	(31.03)	0.1122	(40.11)	0.0760	(40.81)	0.4432	(28.34)
Price of yam	0.4016	(16.62)	0.5166	(14.12)	0.3170	(16.26)	0.0240	(53.06)	0.7221	(39.0)
Price of milk	-0.0028	(1.64)	-0.0111	(2.06)	-0.0100	(0.06)	-0.0015	(0.003)	-0.0117	(2.14)
Bournvita price	0.5516	(13.74)	0.7124	(16.28)	0.4137	(18.93)	0.2246	(18.44)	0.9416	(6.33)
Price of meat	0.3721	(19.21)	0.5175	(13.16)	0.3111	(21.44)	0.1217	(31.17)	0.6516	(11.18)
Price of fruit	0.2971	(24.16)	0.3166	(17.46)	0.2107	(15.37)	0.1100	(39.66)	0.4132	(16.77)
Price of plantain	0.0609	(11.11)	0.0817	(21.13)	0.0417	(20.11)	0.021	(25.01)	0.1717	(28.43)
Real expenditure	0.040	(10.04)	0.1030	(18.68)	0.024	(16.72)	0.012	(0.470)	0.1121	(39.41)
First difference of milk share	0.276	(14.11)	0.573	(16.02)	0.311	(11.10)	0.023	(9.73)	1.211	(16.02)
Trend	-0.071	(0.91)	-0.122	(1.02)	-0.055	(0.811)	-0.033	(0.641)	-0.911	(2.10)

Table 2: Continued

Variable	OLS		Heckman 2 STEP (Heckit)		Maximum Likelihood Estimator (MLE)		Heckit with No restriction		MLE with no restriction	
Diagnostics										
Mills: Lambda			4.822 (7.55)**							
R^2	0.61									
Wald					1.206**					
Dependent										
Share of bournvita										
Independent										
Constant	-0.877	(18.11)	-1.214	(22.01)	-0.613	(14.07)	-0.444	(11.06)	-2.117	(21.34)
Price of rice	1.221	(8.87)	1.3420	(7.88	1.1040	(16.08)	0.8630	(11.21)	1.5501	(6.09)
Price of gari	1.008	(11.76)	1.1142	(12.91)	0.9487	(6.14)	0.5711	(2.41)	1.4171	(15.66)
Price of beans	0.8412	(6.14)	0.9621	(6.47)	0.6711	(5.15)	0.4316	(3.41)	1.1124	(10.11)
Price of yam	0.3313	(11.05)	0.4141	(13.07)	0.2314	(10.04)	0.0947	(8.11)	0.7714	(12.77)
Price of milk	0.7414	(9.16)	0.8153	(9.14)	0.6123	(8.14)	0.2776	(6.61)	1.4177	(11.51)
Bournvita price	-0.0259	(2.13)	-0.0320	(2.004)	-0.0041	(2.003)	-0.0045	(0.003)	-0.1043	(3.06)
Price of meat	0.0283	(31.04)	0.03122	(28.14)	0.0171	(31.01)	0.0066	(33.04)	0.4117	(12.06)
Price of fruit	0.0486	(21.00)	0.0120	(17.11)	0.0246	(19.04)	0.0057	(0.04)	-0.2161	(0.34)
Price of plantain	0.0321	(24.00)	0.0720	(20.16)	0.0271	(21.30)	0.0189	(30.31)	0.1764	(15.14)
Real expenditure	0.018	(17.14)	0.0210	(18.16)	0.0127	(16.14)	0.011	(19.01)	0.6620	(20.14)
First difference of bournvita share	0.222	(0.911)	0.317	(1.11)	0.121	(0.67)	0.070	(0.41)	1.062	(1.69)
Trend	0.580	(6.70)	1.120	(6.88)	0.412	(4.47)	0.221	(3.04)	2.110	(7.13)
Diagnostics										
Mills: Lambda		0.051 (0.14)**								
R^2	0.75									
Wald			3.377*							
Dependent										
Share of Meat										
Independent										
Constant	0.961	(10.70)	2.77	(13.81)	0.573	(9.02)	0.338	(7.28)	4.177	(15.60)
Price of rice	1.4102	(12.03)	1.5122	(11.07)	1.1041	(16.14)	0.8140	(17.01)	1.766	(9.03)
Price of gari	1.6110	(14.48)	1.6717	(12.05)	1.243	(16.17)	0.9201	(10.04)	1.8140	(11.06)
Price of beans	0.612	(10.14)	0.7320	(11.10)	0.550	(9.80)	0.3111	(5.07)	0.8177	(12.14)
Price of yam	0.779	(9.16)	0.8142	(12.14)	0.479	(6.11)	0.2861	(4.76)	1.0141	(11.96)
Price of milk	0.417	(6.41)	0.6100	(7.72)	0.321	(4.11)	0.3011	(4.00)	0.7175	(10.16)
Bournvita price	0.0612	(0.67)	0.0744	(0.87)	0.0417	(0.56)	0.0261	(0.37)	0.0944	(0.10)
Price of meat	-0.00138	(0.97)	-0.0017	(3.11)	-0.00104	(2.48)	-0.011	(0.029)	-0.2104	(0.10)
Price of fruit	0.0123	(0.48)	0.3410	(2.48)	0.0078	(1.07)	0.0010	(3.14)	0.4222	(5.08)
Price of plantain	0.178	(2.14)	0.1914	(2.48)	0.1310	(2.10)	0.0730	(0.69)	0.5162	(4.17)
Real expenditure	0.054	(0.38)	0.1871	(0.51)	0.0240	(0.21)	0.031	(0.621)	0.4176	(4.66)
First difference of meat share	0.019	(0.811)	0.027	(0.978)	0.011	(0.622)	0.009	(0.471)	0.101	(2.02)
Trend	0.023	(12.41)	0.068	(12.78)	0.002	(10.15)	0.017	(8.17)	0.113	(14.70)
Diagnostics										
Mills: Lambda		4.711(11.317)**								
R^2	0.59									
Wald			2.881**							
Dependent										
Share of fruit										
Independent										
Constant	0.614	(15.61)	0.974	(15.88)	3.071	(12.03)	5.470	(10.71)	2.330	(17.11)
Price of rice	1.403	(7.28)	1.5002	(6.71)	1.037	(10.42)	0.8891	(9.46)	1.6771	(5.47)
Price of gari	0.917	(11.13)	0.9781	(12.71)	0.7114	(8.31)	0.5117	(7.10)	1.0084	(8.98)
Price of beans	0.545	(8.10)	0.6734	(8.93)	0.3224	(6.34)	0.1281	(3.18)	0.7761	(9.13)
Price of yam	0.141	(2.04)	0.2123	(3.74)	0.0789	(0.85)	0.0119	(0.30)	0.3222	(5.21)
Price of milk	0.214	(3.72)	0.4917	(6.18)	0.1778	(2.16)	0.1004	(2.07)	1.5103	(6.22)
Bournvita price	0.106	(2.58)	0.2104	(3.11)	0.0861	(7.15)	0.0421	(5.22)	0.3130	(4.13)
Price of meat	0.08	(0.96)	0.1204	(3.06)	0.055	(0.68)	0.0110	(0.32)	0.1670	(2.36)
Price of fruit	-0.0063	(2.73)	-0.0121	(3.72)	-0.0043	(6.12)	-0.0013	(2.14)	-0.0170	(3.14)
Price of plantain	0.814	(10.24)	0.847	(10.49)	0.6241	(8.17)	0.0189	(30.31)	0.1764	(15.14)
Real expenditure	0.018	(17.11)	0.0210	(18.16)	0.0127	(16.14)	0.2891	(4.41)	0.9177	(13.06)
First difference of fruit share	0.458	(0.60)	0.517	(0.88)	0.238	(0.41)	0.117	(0.23)	0.979	(1.071)
Trend	-0.004	(5.71)	-0.018	(6.24)	-0.012	(3.70)	-0.011	(3.17)	-0.006	(6.98)
Diagnostics										
Mills: Lambda		3.157 (8.55)**								
R^2	0.46									
Wald			2.732**							
Dependent										
Share of plantain										
Independent										

Table 2: Continued

Variable	OLS		Heckman 2 STEP (Heckit)		Maximum likelihood estimator (MLE)		Heckit with no restriction		MLE with no Restriction	
Constant	0.799	(13.41)	2.155	(15.21)	3.406	(11.17)	0.697	(7.97)	4.116	(17.03)
Price of rice	1.4712	(7.49)	1.5170	(6.61)	1.1174	(8.21)	0.7144	(9.32)	1.7141	(4.78)
Price of gari	1.0410	(12.80)	1.1040	(11.81)	0.9710	(10.11)	0.4711	(6.14)	1.220	(8.17)
Price of beans	0.3640	(4.51)	0.4331	(6.78)	0.3010	(4.27)	0.2745	(3.11)	0.5541	(3.81)
Price of yam	0.6791	(8.31)	0.6911	(8.82)	0.4211	(5.17)	0.3117	(4.92)	0.8174	(11.35)
Price of milk	0.2177	(3.11)	0.2814	(3.62)	0.1111	(2.41)	0.0760	(2.17)	0.3330	(4.21)
Bournvita price	0.3270	(4.58)	0.4177	(6.12)	0.3006	(4.21)	0.2148	(3.19)	0.6517	(7.73)
Price of meat	0.1371	(2.14)	0.1910	(3.02)	0.0736	(0.88)	0.0434	(0.69)	0.2141	(4.14)
Price of fruit	0.3270	(5.12)	0.3894	(4.79)	0.1476	(2.84)	0.0718	(8.11)	0.4162	(6.22)
Price of plantain	-0.028	(3.06)	-0.1214	(2.74)	-0.018	(3.11)	-0.0011	(2.04)	-0.1566	(0.09)
Real expenditure	0.032	(0.40)	0.0517	(0.49)	0.021	(0.31)	0.013	(0.22)	0.074	(0.94)
First difference of plantain share	0.053	(3.31)	0.091	(4.07)	0.011	(2.69)	0.007	(2.47)	02.107	(6.09)
Trend	0.171	(7.70)	0.206	(9.01)	0.0180	(6.41)	0.009	(4.63)	0.506	(10.11)
Diagnostics										
Mills: Lambda		3.141 (4.171)**								
R^2	0.65									
Wald			3.75*							

Note: The t statistics are in parentheses under the estimates. * Significant at 5%, ** Significant at 1%, Source: Computed from data obtained from Field Survey, 2005

and-1.2017 under OLS model but-1.604 and-1.640 under Heckit model; but for MLE it was-1.062 and-1.415 and it was-1.0009 and-1.012 for Heckit with no restriction.

From Table 2, meat has the most inelastic own-price elasticity among other foods considered on the study. This indicates that households in southwestern Nigeria are insensitive to changes in the price of meat. That is if the price of meat comes down or there is increase in the per capita income of household, consumption will not be much affected.

Gari and rice have higher own-price elasticity than every other staple in the models. The result also shows that rice and gari are strong substitute. Also that beans is a substitute for rice and plantain.

CONCLUSION

This study empirically analyzed food consumption in Southwestern Nigeria. The followings are the findings and possible areas of intervention:

- The total percentage of expenditure share for rice, yam and gari (carbohydrate food) is highest for all the states pooled together. There is need to encourage households to improve their intake through a reallocation of food expenditure so that more of proteinous food could be taken. This is important to avoid serious ailments such as kwashiorkor and marasmus arising from acute protein deficiency in consumption.
- The expenditure elasticity results indicate that gari and rice are normal goods in Southwestern Nigeria. High expenditure elasticity for gari and rice means that the consumption of these two food items will not decrease dramatically as long as the households in that region maintain their present per capita income.
- One set of results is related to the estimated low own-price elasticity for most of the staple foods. This means that the households are insensitive to price change. Since this elasticity has important implications for the impacts of Southwestern Nigeria agricultural and trade policies, it needs to be assessed carefully. The reliability of the estimates can be seen from the fact that the range is relatively robust across different estimators.
- It was found out that rice and gari are strong substitute. Also beans has strong substitute for rice and plantain. Meaning that government must ensure the availability of any of these at all times.

In conclusion, all these issues and challenges need to be addressed in a pragmatic manner. The level of food consumption of household is an important yardstick for measuring the quality of a nation's labour force and diet to cope with the burgeoning epidemic of non-communicable diseases.

REFERENCES

1. FAO., 2006. FAOSTAT food security statistics-Nigeria. http://Fao.org/Faostat/Foodsecurity/countries/EN/Nigeria._e.pdf
2. NCEMA, 2006. Structural adjustment programme in Nigeria. Causes process and outcomes. Revised technical paper submitted to global development network. Website:www.gdnet.org
3. Ajibola, O., 2000. Institutional analysis of the national food storage programme. J. Development Policy. Development Policy Centre, Ibadan, Nigeria, Research Report No. 23: 1-30.

4. Olayemi, J.K., 1998. Food security in Nigeria. J. Development Policy, Development Policy Centre Research Report, pp: 17- 2.
5. Obamiro, E.O., W. Doppler and P.M. Kormawa, 2005. Pillars of food security in rural areas of Nigeria. Website: htt://foodafrica.nri.org/security: internetpaper/obamiro Unice pdf
6. Chern, W.S., K. Ishibashi, L. Taniguchi and Y. Tokoyoma, 2003. Analysis of the food consumption of Japanese households. FAO Economic and Socil Development, pp: 152.
7. Intriligator, M., R. Bodkin and C. Hsiao, 1996. Application to household, demand analysis. In Econometric Model, Techniques and Applications. New Jersey, USA, Prentice-Hall.
8. Heckman, J.J., 1976. The common structure of statistical models of truncation sample selection and limited dependent variables and a simple estimator for such models. Annals of Economic Social Measurement, 5: 475-492.
9. Heckman, J.J., 1979. Sample selection bias as a specification bias. Econometrica, 47: 53-161.
10. Golan, A., G. Judge and D. Miller, 1996. Maximum entropy econometrics robust estimation with limited data, New York, John Wiley and Son.
11. Ahn, H. and J.L. Powell, 1993. Semi parametric estimation of censored selection models with a non parametric selection mechanism. J. Econometric, 58: 3-29.
12. Golan, A., G. Judge and J.M. Perloff, 1997. Recovering information from censored and ordered multinormal response data. J. Econometrics, 79: 23-51.
13. Hay, J., R. Leu and Rohrer, 1987. Ordinary least square and sample selection models of health care demand. J. Bus. Economic Statistics, 5: 499-506.
14. Nawata, K. and N. Nagase, 1996. Estimation of sample selection bias models. Econometric Rev., 15: 387-400.
15. Powell, J.L. and T.M. Stoker, 1996. Optimal bandwith choice for choice for density-weighted Average. J. Econometrics, 75: 291-316.
16. Bronwyn, H. Hall, 2002. Notes on sample selection models. Web-site: elsa.Berkeley.edu.
17. Puhan, P.A., 2000. The heckman correction for sample selection and its critique. J. Economic Survey, 1491: 53-68.
18. Wooldridge, J.M., 2002. Econometric analysis of cross section and panel data. MIT Press.
19. Olarinde, I.O. and F.F. Kuponiyi, 2005. Rural livelihood and food consumption pattern among households in Oyo State, Nigeria; Implications for Food Security and Poverty Eradication in a Deregulated Economy. Jo. Social Sci., 11: 127-132.