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Heckman Modeling of Factors Explaining Livestock Products' Expenditures among Households in Nigeria

Abayomi Samuel Oyekale
Department of Agricultural Economics and Extension,
North-West University Mafikeng Campus, 2735 Mmabatho, South Africa

Abstract: Consumption of animal products is essential for supplying protein in man's diet. However, inadequate protein intake is a major nutritional hurdle in many Nigerian households. This study analyzed the factors influencing livestock products' consumption expenditures in Nigeria. The data were the 2009/10 Harmonized Nigeria Living Standard Survey (HNLSS). Heckman selection model was used for parameter estimation given that the selection bias parameter (mill lambda) was statistically significant ($p<0.01$). The results showed that southern geopolitical zones had higher average expenditures on all categories of livestock products. The Heckman's Model showed statistical significance ($p<0.01$) with rho (the error correlation parameter) being perfectly correlated. The parameters of North-Central zone (-1566.51), South East (2472.84), South South (10382.92), rural sector (-2835.92), household size (2469.50) and per capita food expenditure (proxy for income) (0.29) were statistically significant ($p<0.05$). It was concluded that poverty often makes households to deemphasize the importance of livestock products in their daily diets and that efforts to enhance people's income would assist in improving their animal protein intakes.

Key words: Livestock products, consumption expenditure, Heckman, household, Nigeria

INTRODUCTION

Livestock products are sumptuous components of food commodity bundle in some Nigerian households. This is as a result of widespread poverty which often limits expenditures to cheap starchy foods which are often the basic necessities of poor households. The situation can be more pathetic in some rural areas where consumption of certain livestock products are directly associated with rich households. The nostalgic desires of some households to consume some livestock products are always tainted with inability to pay which more often than not reflects the generally low standard of living in the country. Therefore, minimum nutritional requirements of some households are rarely met, especially with regards to protein and other essential minerals. The impact of such nutritionally deficient diet is more pronounced among children where diseases such as marasmus, kwashiorkor, growth retardation and poor brain development can be significantly symptomatic against any factual denunciation or deliberate camouflage (Ahmed *et al*., 2009).

For some obvious political reasons, Nigerian policy makers have always shown concerns about nation's progress in meeting people's food needs. This is critically deductive because a nation's developmental progress is largely gauged internationally by ability to provide the citizens with adequate food in required quality and quantity. Whichever way the die is cast, however, recent assessment of households' welfare in Nigeria presents a perfect discordance with politicians' electoral promises. Specifically, recent poverty assessment revealed that poverty increased from 54.4% in 2004 to 69.9% in 2010. The implication is that with estimated population of 163 million, there were 112.47 million people wallowing below the poverty line (NBS, 2012). Unacceptability of Nigerian poverty situation can be aptly decoded from several wasteful spending of political office holders and absolute insincerity in addressing critical issues that border on lifting the people beyond the precarious poverty line. More important also is the fact that poverty is concentrated in rural areas and among those in agriculture-related businesses.

Although, poor performance of the agricultural sector is often blamed for deficiency in food consumption in developing countries, the horror of misplaced policy priorities can often transcend any imaginable ecstasy of presumptuous political pretence. In Nigeria, the dilemma of developing the rural sector often resurfaces as strong pillar upon which any people-oriented development foundation must be tactically laid. This epitomizes a perfect framework for achieving the much needed pro-poor growth which promises to deliver proportionately more benefits of economic growth into

the hands of the poorest segment of the population (Dollar and Kraay, 2002; Bibi *et al*., 2012). However, in some instances, rural development agendas are often parsimoniously conceived without adequate consideration of the fundamental rights that people have to basic needs of nutritious food and adequate shelters. This has often made rural dwellers to be at the receiving end of the grievous consequences of political instability, policy failure and economic stagnation and recession. The oblivious outcomes often include economic destitution, malnutrition and spiteful deprivation in human development.

Rural households are habitually confined to source main protein intakes from cheaply available plants and associated products. Their consumption patterns often depend on households' food demand habit which is directly related to preferences and food utilization information. However, proteins from animal products contain more essential amino acid and are considered to be superior for adequate body's metabolic activities and growth (Oloyede, 2005). Specifically, although FAO recommended between 65-75 g per capita daily protein intake, estimated intake in Nigeria is 45.4 g. However, about 40% (36 g) of these is expected to come from animal protein. It should be noted that there may be significant spatial differences in consumption of animal products in Nigeria because of agro-ecological (Evbuomwan, 2013). Specifically, residents in northern part of the country may consume enough animal products but lacking in basic carbohydrate containing foods like yam, maize, cassava, etc. which are largely cultivated in the south. This is as a result of involvement of many of them in animal husbandry.

The socio-economic determinants of households' nutritional status have been explored in literature. However, the supply-side of the equation is always more intricately and dynamically linked with every other variable. With respect to livestock products, several attempts had been made to explore the critical factors influencing demand. This often trickles down to the common hypotheses in relation to elasticity and marginal propensity to consume. In some instances, households' composition, household size, occupation, tribe, gender and age had been explored.

Specifically, Muhammad-Lawal and Balogun (2007) specified different functional form to model the determinants of daily per capita protein intakes of some households in Kwara State. The result showed that household size negatively influenced animal protein intakes. The finding pointed at the likelihood of poor households not meeting their animal protein requirements because they are always ironically with large family sizes.

Adetunji and Adepoju (2011) analyzed the determinants of protein consumption in Oyo State using Ordinary Least Square (OLS) regression. Their results showed that household size negatively influenced protein intakes while income, age, education and marital status had positive impact. The study also noted that although, the households were aware of the nutritional benefits of proteinous food, their consumption was quite low due to serious income constraint. However, Bamiro (2011) found that consumption of animal protein food in Remo Division of Ogun State was positively influenced by household size, income and years of schooling.

This study explored the determinants of livestock products' consumption in Nigeria using the most recent nationally representative survey data of 2010. The policy relevance of studies on animal products' consumption cannot be over emphasized. Such studies critically explore the socio-economic correlates of protein consumption with utmost goal of identifying what should be government policy actions and reactions. The implications of government's macroeconomic policies on food prices, households' incomes and demographic structure can be keenly monitored from such analyses. These can serve as a way to safeguard some sudden perils in an economy by understanding the nutritional consequences of government's policies. The findings can also trigger government's actions in specific interventions which may border on awareness creation, promotion of food utilization education and other form of marginal reforms that would be deemed adequate.

MATERIALS AND METHODS

Sampling method: The 2009/10 Harmonized Nigeria Living Standard Survey (HNLSS) had an expanded scope from what used to be the National Consumer Surveys and Nigeria Living Standard Survey (NLSS). The survey was carried out in the Nigeria's 36 states and the Federal Capital Territory (FCT). Part A of the survey was called welfare approach which was administered to 100 households per Local Government area while Part B obtained information on consumption expenditures from 50 households per Local Government area. In all the 774 LGAs where data were collected, sampling frames were based on the 2006 Housing and Population Census Enumeration Areas as identified by the National Population Commission (NPopC). Two-stage sample design was used. At the first stage, Enumeration Areas (EAs) were selected while at the second stage, respondent Households (HHs) were selected. In the Part B of the survey which was used for this study, 37,800 were targeted nationally. However, 33,012 households completed the survey of which 24,941 were from rural areas.

Analytical approach: The modeling of households' expenditure patterns in economic literature had been approached from different econometric perspectives. Conventional demand estimation methods had focused on practical applications of consumer utility function, Engel function and system of demand equations. The starting point in all these cases is to examine the nature of data and gauge its analytical method vis a vis some basic econometric estimation assumptions. For the study at hand, presence of missing expenditures compels specification of Heckman selection model, in order to correct for likelihood of estimator inefficiency if Ordinary Least Square (OLS) Method is used. Selection bias becomes a critical problem in this study due to the nature of issue addressed. For instance, beyond income constraints, there are a lot of reasons why some households may not consume livestock products. These may include religious obligations, health reasons as recommended by doctor, or simply a chosen lifestyle like the case of vegetarians. These issues are not captured in the questionnaire and may therefore raise serious question of selection bias.

In order to model livestock product demand using Heckman Model, the outcome and selection models were specified. What is unique in Heckman Model is the ability to generate data by applying some moments of the incidentally truncated bivariate normal distribution. Following Heckman (1979), the selection model can be specified as:

$$z_i^* = a + \varphi_i \sum_{i=1}^{k} X_i + k_i \quad (1)$$

Where:

$$z_i = \begin{cases} 1 & \text{if } z_i^* > 0 \\ 0 & \text{if } z_i^* \le 0 \end{cases} \quad (2)$$

The outcome equation can be specified as:

$$y_i = \begin{cases} \pi + \mu_i \sum_{i=1}^{k} X_i + s_i & \text{if } z_i^* > 0 \\ - & \text{if } z_i^* \le 0 \end{cases} \quad (3)$$

Fundamental problem arises when estimating μ_i if v_i and s_i are correlated. However, this type of data can be modeled with Tobit Model which obviously is a special condition where $y_i = z_i$. The error terms in the selection and outcome models also exhibit the following properties:

$$k_i \sim N(0, 1) \quad (4)$$

$$s_i \sim N(0, \sigma^2) \quad (5)$$

$$\text{corr}\, k_i, s_i = \rho \quad (6)$$

If the correlation coefficient in Eq. 6 is zero, analysis of Eq. 3 with OLS yields consistent parameters. However, if the correlation is not zero, the parameter will be inconsistent. It is therefore important that the selection bias be taken adequate account of. In this study, Heckman regression was first carried out with outcome and selection equations jointly specified using STATA Software. The analysis generated some diagnostic parameters which are rho (correlation coefficient between the two error terms in the two equations), athrho (inverse hyperbolic tangent of rho), sigma (standard deviation estimation of the error term in outcome equation) and lambda (estimated coefficient of the Inverse Mill's ratio or product of sigma and rho). Statistical significance of lambda indicates presence of selection bias.

The alternative method of correcting selection bias was also explored. This was done by calculating inverse mill ratio as a variable in Eq. 3 after estimating the selection model with Probit regression (Greene, 2003). This is computed as:

$$\left[\frac{\phi(w_i\gamma)}{\Phi(w_i Y)}\right]$$

which is the probability density function, divided by the cumulative distribution function of the distribution. In STATA, the inverse mill ratio can be generated as a variable after estimating the Probit Model by invoking some other commands. The inverse mill ratio was then included in a regression model for estimating outcome model while respondents with zero expenditure were deleted. The model is specified as:

$$y_i = \begin{cases} \pi + \mu_i \sum_{i=1}^{k} X_i + \gamma\lambda + s_i & \text{if } z_i^* > 0 \\ - & \text{if } z_i^* \le 0 \end{cases} \quad (7)$$

Where:

y_i = The sum of expenditures and value of home produced but consumed livestock products for households (₦)
λ = The inverse mill ratio
μ_i = The estimated parameters
π = The constant term (autonomous consumption)

Statistical significance of γ implies the presence of selection bias. It thus reveals that estimation of the regression coefficients using OLS Method would yield inconsistent parameters. The X_is are the explanatory variables specified as North central zone (yes = 1, 0

otherwise), North East zone (yes = 1, 0 otherwise), North West zone (yes = 1, 0 otherwise), South East zone (yes = 1, 0 otherwise), South South zone (yes = 1, 0 otherwise), age of household head (years), household size, per capita food expenditure (N), sex of household head (male = 1, 0 otherwise) and rural sector (yes = 1, 0 otherwise).

RESULTS AND DISCUSSION

Households' expenditures across different livestock products: Table 1 shows households' expenditure profiles across different livestock products in the states and geopolitical zones in Nigeria. It reveals that across the zones, southern geopolitical zones had higher average expenditures on all categories of livestock products. Specifically, in the group of poultry products, South West zone had the highest average expenditure (₦1468.45), followed by South South and South East with ₦1468.45 and ₦1269.34, respectively. These figures can be compared to those from northern zones with average expenditure of ₦636.91, ₦518.58 and ₦234.91 for the North Central, North East and North West, respectively. It should also be noted that variability indices across the zones differed with northern zones having quite higher values. North West in particular had the highest variability index of 1633.70%. The findings are therefore pointing to the fact that northern zones did not only have lowest average expenditures on poultry products, their variability indices were also high. In the state results, Lagos, Rivers and Edo had highest average poultry expenditures with ₦4973.20, ₦2622.75 and ₦2068.72, respectively. However, Katsina and Jigawa states had the lowest average expenditures of ₦39.35 and ₦95.34, respectively. The state-level variability indices results showed that Lagos had the lowest value (178.04%) while Sokoto had the highest (2472.05%).

Furthermore, results on average meat expenditure in the zones revealed that South South zone had the highest value (₦7991.41), with South East and South West having ₦6586.67 and ₦6498.69, respectively. Variability indices for Northern zone were also highest with North-West having 209.73%. Across the states, Rivers and Abuja had the highest average meat expenditures with ₦11694.80 and ₦10602.45, respectively. However, Jigawa and Yobe states had lowest average meat expenditures with ₦2237.51 and ₦2883.05, respectively. Also, results of variability indices at state-level indicated that Jigawa and Oyo states had highest values with 299.99 and 268.40%, respectively. The lowest variability indices were recorded for Abia (99.80%), Lagos (114.50%) and Taraba (126.60%).

Average fish expenditures were highest in South South and South East with ₦14498.82 and ₦10866.20, respectively. The lowest values were reported in North West and North East with ₦1588.62 and ₦3713.03, respectively. Variability indices across the zones revealed that North Central and North West had the highest values with 251.50 and 249.89%, respectively. At the state-level, Rivers and Bayelsa states had highest average fish expenditures with ₦23080.98 and ₦23030.92, respectively. The lowest were from Sokoto and Katsina States with ₦275.52 and ₦538.55, respectively. Sokoto State, Katsina State and Kogi State had the highest variability indices with 579.91, 382.58 and 309.17%, respectively. Also, Ekiti States, Ogun State, Anambra State and Edo State had the lowest variability indices of 72.91, 81.36, 86.03 and 89.18%, respectively.

Table 1 also shows the average expenditures for dairy products. Average fish expenditures in South East and South South were highest with ₦1642.27 and ₦1416.22, respectively. North East and North Central zones had the lowest values of 521.67 and 601.00, respectively. Variability indices were lowest South West and South South with 263.36 and 297.72%, respectively while North East had the highest value (435.63%). At state level, Lagos State, Imo State and Zamfara State had the highest average dairy expenditures with ₦3004.85, ₦2271.15 and ₦2148.33, respectively. Dairy expenditure variability indices were highest Taraba, Enugu, Gombe and Borno states with 738.25, 607.09, 517.04 and 512.45%, respectively.

Total average expenditures on livestock products were highest in South South and South East zones with ₦25374.91 and ₦20364.47, respectively. Lowest values were reported in North West and North East with ₦7401.80 and ₦9800.82, respectively. The variability indices of average total expenditure on livestock products were however highest in North West and North East with 183.03 and 167.56%. The state-level results showed that Rivers State, Bayelsa State and Lagos State had the highest average total livestock products expenditures with ₦39370.25, ₦33414.69 and ₦25845.12, respectively. The variability indices of average total livestock products expenditures at state-level revealed that Sokoto, Kogi and Enugu had the highest values with 245.62%, 238.71 and 231.93, respectively.

The results have shown great disparities between the northern parts of Nigeria and the southern. They have generally pointed at the fact that livestock products expenditures were not only low in the north, their variability were also sometimes high. Large livestock like cow, ram, sheep and goats are best reared in the north due to availability of pasture land. However, these products

Table 1: Average expenditures on livestock products in the states and geopolitical zones in Nigeria

		Poultry		Meat		Fish		Dairy		Total exp	
State/Zone	Freq.	Mean	CV	Mean	CV	Mean	CV	Mean	CV	Mean	CV
North West	7,919	234.91	1,633.70	4,366.64	209.73	1,588.62	249.89	1,211.63	235.33	7,401.80	183.03
Jigawa	1,155	95.34	1289.95	2237.51	273.97	844.22	299.99	749.91	284.35	3926.98	199.40
Kaduna	1,003	333.70	823.08	4881.79	246.60	2700.48	140.75	1215.77	344.63	9131.74	191.44
Kano	1,828	381.88	929.79	3611.89	194.06	1549.74	173.88	650.24	409.40	6193.75	171.44
Katsina	1,413	39.35	1803.95	3698.39	175.16	538.55	382.58	1327.87	178.12	5604.16	139.38
Kebbi	889	147.40	1484.64	5929.75	185.10	3564.45	214.54	1402.27	177.28	11043.87	150.07
Sokoto	1,066	343.20	2472.05	5046.79	223.77	275.52	579.91	1861.16	148.62	7526.67	245.62
Zamfara	565	291.78	723.02	8175.00	132.01	3257.11	176.64	2148.33	141.84	13872.23	103.65
North East	4,784	518.58	608.97	5,047.54	191.65	3,713.03	231.88	521.67	435.63	9,800.82	167.56
Adamawa	890	399.07	871.61	6874.34	220.66	4682.12	179.82	705.67	314.88	12661.19	180.67
Bauchi	922	898.92	442.34	3521.87	192.96	1596.51	163.08	449.98	350.19	6467.28	146.65
Borno	1,104	194.73	1044.06	5044.36	144.37	4685.43	161.39	671.51	512.45	10596.04	143.95
Gombe	479	1412.38	301.00	3767.09	237.33	1436.63	247.10	335.54	517.04	6951.64	168.56
Taraba	688	464.56	689.28	7830.93	126.60	6961.01	238.04	224.02	738.25	15480.53	136.38
Yobe	701	122.36	1149.58	2883.05	193.42	2102.75	179.82	565.71	259.44	5673.87	159.40
North Central	5,256	636.91	541.57	5,183.68	197.35	6,409.95	251.50	601.00	359.04	12,831.54	166.51
Benue	1,032	928.20	503.60	4267.72	232.36	6373.14	132.44	53.17	1070.87	11622.22	122.70
Kogi	742	591.69	648.53	3384.69	185.57	12278.69	309.17	662.87	298.27	16917.95	238.71
Kwara	750	814.81	504.39	6012.28	168.71	5072.12	98.99	867.56	230.72	12766.78	100.85
Nasarawa	627	228.78	814.26	5700.03	164.76	6621.36	101.98	399.71	451.85	12949.89	103.02
Niger	1,112	417.74	518.57	6169.68	186.51	4874.85	141.02	550.03	243.79	12012.28	130.99
Plateau	728	527.43	472.54	3538.77	245.99	2113.96	166.54	785.00	401.13	6965.15	167.41
Abuja	265	1311.72	301.54	10602.45	153.67	11650.46	134.91	1991.43	240.54	25556.06	129.37
South West	5,866	1562.84	369.91	6,498.69	208.99	7,308.73	110.88	1,277.93	263.36	16,648.19	121.40
Ekiti	746	1048.36	541.95	4101.70	188.75	6918.17	72.91	552.77	327.22	12620.99	106.98
Lagos	804	4973.20	178.04	8668.02	114.50	9199.04	100.35	3004.85	193.34	25845.12	90.10
Ogun	940	680.69	595.39	3635.76	153.46	7754.46	81.36	368.43	491.18	12439.34	85.49
Ondo	789	1077.65	474.95	7182.19	143.59	8854.26	143.54	448.81	342.72	17562.91	109.65
Osun	1,132	840.33	572.05	6045.07	148.76	6904.62	113.54	1525.69	195.62	15315.71	107.81
Oyo	1,455	1337.28	370.40	8360.80	268.40	5652.78	108.17	1539.92	225.93	16890.77	156.67
South South	4,782	1468.45	475.95	7,991.41	154.11	14,498.82	150.16	1,416.22	297.72	25,374.91	128.06
Akwalbom	1,370	627.80	383.10	7030.53	145.63	14404.86	118.60	1496.66	287.30	23559.86	108.66
Bayelsa	327	1056.86	327.26	7357.34	137.59	23080.98	92.85	1919.51	185.58	33414.69	86.60
Cross River	694	798.69	604.46	5431.23	167.54	8361.51	130.21	404.80	360.69	14996.24	132.63
Delta	733	1797.45	462.30	6642.16	205.09	11873.32	168.17	1270.94	385.95	21583.88	143.42
Edo	729	2068.72	325.45	9156.13	128.18	8435.48	89.18	1376.57	213.06	21036.90	95.53
Rivers	929	2622.75	431.97	11694.80	135.71	23030.92	152.98	2021.78	276.66	39370.25	126.51
South East	4,405	1269.34	512.09	6,586.67	167.06	10,866.20	109.13	1,642.27	332.21	20,364.47	127.86
Abia	792	1317.83	429.70	7917.18	99.80	12908.80	96.74	2033.77	168.21	24177.59	88.02
Anambra	918	1393.45	534.04	7398.61	132.30	10884.84	86.03	1472.46	199.95	21149.36	97.80
Ebonyi	614	866.09	425.89	3291.88	291.21	6028.54	113.91	210.44	396.73	10396.95	132.62
Enugu	802	958.20	695.79	4172.92	329.75	8672.13	156.61	1543.29	607.09	15346.54	231.93
Imo	1,279	1538.90	465.93	8275.25	139.79	13286.15	96.44	2271.15	250.06	25371.45	109.06
Total	33,012	892.70	569.01	5,795.55	191.15	6,788.63	194.16	1,113.30	313.07	14,590.19	154.78

are largely sold in the southern parts. The implication is that although northern farmers were keeping livestock, the need for cash to meet other household expenses often hinders consumption of these products in large quantities. The results however showed that in Southern parts where fish is usually abundant due to presence of Atlantic ocean and other rivers where fishing can be carried out. The results also more importantly indicated some cultural dimensions of diets in South South and South East where fish is used more often. This also reflects in their expenditures. However, a bit of involvement in livestock husbandry is reflected in average dairy expenditure where Zamfara had one of the highest values. Specifically, households in the northern parts of the country, especially those in the rural areas consumed dairy products in the form of fresh milk and their products while residents in Southern Nigeria depend so much on industrial processed dairy products.

Table 2: Results of Heckman's selection parameters

Variables	Coefficient	SE	z-value	p>|z|
North Central	-0.5830	0.05	-12.70	0.0000
North East	-0.8821	0.05	-19.35	0.0000
North West	-1.0898	0.04	-25.53	0.0000
South East	-0.1380	0.05	-2.58	0.0100
South South	-0.2539	0.05	-5.17	0.0000
Rural sector	-0.2362	0.03	-8.00	0.0000
Household size	0.0532	0.00	11.24	0.0000
House head sex	0.0305	0.04	0.86	0.3890
Household head age	0.0012	0.00	1.82	0.0690
Percapita foodexpenditure	0.0000	0.00	20.34	0.0000
Constant	1.4904	0.06	24.13	0.0000

Number of observations = 33012; Log likelihood = -9810.51; LR χ^2 = 2668.68; Pseudo R^2 = 0.1197

Determinants of livestock selection and expenditures: Table 2 shows the Probit regression results that were estimated to determine the factors influencing probability of consuming livestock products. The model produced a good fit as shown by statistical significance of the computed Likelihood Ratio Chi-square (2668.68) ($p<0.01$).

Table 3: Results of Heckman's outcome parameters

	Heckman (Outcome model)				OLS with inverse mill ratio			
Variables	Coefficient	SE	z-value	p>|z|	Coefficient	SE	z-value	p>|z|
North Central	-1566.51	635.85	-2.46	0.0140	-1566.51	481.73	-3.25	0.0010
North East	-662.24	874.20	-0.76	0.4490	-662.24	674.13	-0.98	0.3260
North West	46.35	1070.80	0.04	0.9650	46.34	830.69	0.06	0.9560
South East	2472.84	570.44	4.33	0.0000	2472.84	424.16	5.83	0.0000
South South	10382.29	564.56	18.39	0.0000	10382.29	421.82	24.61	0.0000
Rural sector	-2835.92	424.27	-6.68	0.0000	-2835.92	320.45	-8.85	0.0000
Household size	2469.50	74.61	33.10	0.0000	2469.50	56.84	43.45	0.0000
House head sex	3220.89	453.91	7.10	0.0000	3220.89	340.67	9.45	0.0000
Household head age	-4.08	9.85	-0.41	0.6780	-4.08	7.48	-0.55	0.5850
Per capita food exp	0.29	0.01	47.22	0.0000	0.29	0.00	63.17	0.0000
Mill lambda	-26709.21	3264.39	-8.18	0.0000	-26709.21	2566.82	-10.41	0.0000
Constant	1.76	863.04	0.00	0.9980	1.76	652.61	0.00	0.9980
Rho	-1.00				Number of obs.	29520		
Sigma	26709.21				F(11, 29508)	1105.03***		
Lambda	-26709.21	3264.387***			Adj. R^2	0.2915		

Statistically significant (p<0.01); Number of obs. = 33012; Censored obs. = 3492; Uncensored obs. = 29520; Wald χ^2 (20) = 6195.39

Out of the included parameters, only the parameters of sex of household heads and age did not show statistical significance (p>0.05). The parameters of zone dummy variables are all with negative sign, implying that when compared to those from South West (reference group), residence in those zones reduced the probability of consuming livestock products. Also, residence in rural areas reduced the probability of consuming livestock products. Household size increased the probability of consuming livestock products while increasing per capita expenditure of food will also increase livestock products.

Table 3 further shows the results of the jointly estimated Heckman (1979)'s Model using STATA Software and that obtained separately after computing the Inverse Mill Ratio after the Probit regression results. As expected, the parameters of the variables are the same in both the Heckman's and OLS Regression Model. However, there are some differences in the estimated standard errors, thereby making results from OLS to have higher statistical significance. The Heckman's results are going to be used for interpretation. The model produced a good fit of the data as shown by statistical significance of the Wald Chi-square (p<0.01). The rho is the parameter of correlation between the error terms of the selection and outcome models. This parameter indicated a perfect negative correlation. The computed sigma parameter is 26709.21 with its multiplication with rho giving mill lambda that shows statistical significance (p<0.01). This implies that there is presence of selection bias in the model and estimating it without due consideration would produce inconsistent parameters.

The parameter of North Central zone is statistically significant (p<0.05). It implies that the autonomous livestock products' expenditure of the respondents from North Central zone is lower from those from South West zone by ₦1566.51. The parameter of North East and North West are statistically insignificant (p>0.05) but those of South East and South South were statistically significant (p<0.01). The result implies that the autonomous consumption expenditure of the households that were resident in South East was higher than those from South West by ₦2472.84. However, autonomous livestock products' expenditure of those households that were in South South was higher than those in South West by ₦10382.29. High autonomous livestock products' consumption expenditures of those is South East and South South geopolitical zone are due to the fact that some of them were catching the fish consumed due to presence of rivers for fishing as required of states like Bayelsa that is largely riverrine.

Furthermore, compared to those resident in urban areas, rural households had autonomous livestock products expenditure that was lower by ₦2835.92. This is expected because rural people are mostly poor with priority given to starchy food products. If household size increases by one person, livestock consumption expenditure will increase by ₦2469.50. This is expected because of expected higher demand. Similar findings had been reported Bamiro (2011) while contrary were found by Muhammad-Lawal and Balogun (2007) and Adetunji and Adepoju (2011). Also, the households that were headed by males had autonomous livestock products' expenditure which is higher by ₦3220.89. No gender difference in milk products consumption expenditure was found by Oni and Fashogbon (2012). If per capita food expenditure of households increases by ₦1.00, livestock expenditure will increase by ₦0.29k. The per capita food expenditure is a proxy for households' income which had been found to positively influence animal protein consumption by Adetunji and Adepoju (2011), Bamiro (2011) and Muhammad-Lawal and Balogun (2007).

CONCLUSION

Livestock products constitute vital components of households' food commodity bundle due to high component of protein. They are veritable sources of other critical nutrients that are essential for study body functioning. The results presented in this study have shown disparity between consumption expenditures of households resident in the southern part and those in the north. Though livestock products essentially cattle, goats, sheep are kept by farmers in the North, the results have pointed at critically low expenditures and large variability among northern residents. It also shows the importance of place residence and gender of household heads with rural households and female headed spending lesser amount of money. It is important to conclude that poverty often makes households to deemphasize the importance of livestock products in their daily diets. It is obviously revealed that taste and preferences for livestock products as evident in cultural diets have shown significant impacts on demand for livestock product with South East and South South resident having highest livestock consumption expenditures. The major platform for ensuring higher households' expenditures on livestock products is ensuring higher income by providing better livelihood opportunities for the people.

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