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A double hurdle analysis of determinants of protein consumption pattern among rural households in Egbeda local government area, Oyo state

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Abstract: This study was carried out in selected rural areas in Egbeda LGA of Ibadan, to investigate the protein consumption pattern of rural households as well as the factors responsible for households' decision to consume protein. A double hurdle model was specified for this purpose. Findings from the research show that for animal protein consumption, all the specified exogenous variables had statistically significant relationship with the household's decision to consume animal protein, albeit at different levels. Also, for actual rural household animal protein expenditure, all the specified exogenous variables, with the exception of household monthly expenditure on food supplement, had significant relationships. All the specified variables in the model had significant marginal effects on household's decision to consume animal protein. For both plant and animal protein sources, a unit increase in household size decreased the probability of households decision to consume each of the protein sources, albeit the more so for plant protein sources (by 9.1% for plant protein against 3.5% for animal protein sources). Increase in expenditure on substitutes for both sources decreased the probability of household's decision to consume protein sources, albeit the more for plant protein sources (10%) than for animal protein sources (1.4%). However, this influence translated to an increase in household actual expenditure on protein sources but both with inelastic coefficients.

Increase in food supplement expenditure increased the probability of household's decision to consume protein sources by close to 10% (7.8% for animal protein and 6.5% for plant protein sources). The elasticity coefficient was not significant though inelastic for animal protein but was significant and elastic for plant protein sources. It can be concluded that plant protein expenditure among these rural dwellers is very responsive and sensitive to household's expenditure on food supplements, while increase in expenditure on plant protein substitutes also increases household expenditure on plant protein. However, the significant variables with respect to actual animal protein consumption had inelastic coefficients. It is therefore recommended that among rural households there is the need for massive campaigns to educate them on the need to plan parenthood and the productive capacities of rural dwellers (the larger percentage of who are farmers) should be enhanced. Also, it is recommended that efforts should be made intensify nutrition campaigns to rural areas that would help in raising the level of awareness of rural dwellers with respect to the importance of proteinous food.

Keywords: Animal protein, plant protein, protein energy, malnutrition, kwashiorkor

INTRODUCTION

Research over the years has shown that many people in Nigeria are given to diets characterised by high starch content and low protein value (a fall out of the harsh economic condition). Excessive feeding on starchy food has been found to cause malnutrition conditions. Adequate nutrition has been defined as a nutritional condition which has a regular quantity and quality of food intake that meets some nutritional need (Ojo, 1991). A major component and important part of an adequate nutrition is protein. Scientifically, protein consists of many amino acids of which only 20 are used by the body in various combinations for body tissue synthesis. Protein in human nutrition can be of two types, animal sources and plant sources. The animal sources of protein however have an edge over the plant sources in that they all contain the 20 amino acids required for body tissue synthesis while no one plant protein source contains all the 20 amino acids (Cattlemen's Beef Board and National Cattlemen's Beef Association, 2009). The issue lies in the fact that in the absence of one of the amino acids in ones' daily diet, body tissue synthesis cannot be done hence a waste of otherwise useful other amino acids (Wolfe, 2006)

It has been discovered that protein malnutrition causes kwashiorkor, a disease condition resulting from protein deficiency. Prolonged cases of protein malnutrition could cause marasmus or even retarded growth. Rarely an isolated condition, protein deficiency usually accompanies a deficiency of dietary energy and other nutrients resulting from insufficient food intake (Elamin, undated). In fact, Elamin (undated) pointed out that in developing areas of the world, people often have diets low in energy and an attendant shortage of protein. People who consume too little protein and food energy can go on to develop protein-energy malnutrition (PEM).

Children suffer from the effects of starvation more quickly than adults. According to the United Nations Children's Fund (UNICEF), malnutrition contributes to the deaths of more than 6 million children under age five each year. Typically, starving children develop a condition called protein-energy malnutrition (PEM). The two most common forms of PEM, marasmus and kwashiorkor, occur in all developing countries and are life-threatening conditions (Microsoft Encarta, 2007). In fact, the Nigerian 2015 Millennium Development Goal (MDG) target of reducing by two-thirds, the proportion of under-five mortality rate per a thousand live births, in line with the Millennium Development Goals, is worsening (as depicted in Table 1). This owes in some to malnutrition (National Planning Commission, 2005). This situation is particularly worse off in rural areas, hence the focus of the study. Marasmus occurs when a child is weaned earlier than normal and receives foods low in nutrients. The child may also suffer repeated infections, such as gastroenteritis, due to poor hygiene. A child with marasmus is very underweight, with no body fat and wasted muscles. Kwashiorkor occurs when a child is weaned later than normal and receives starchy foods low in protein. In this disease, the child's abnormally low body weight is often masked by water retention, which makes the face

moon-shaped and the belly swollen (Elamin, undated).

The presence of malnutrition before 6 months of age is known to leave a permanent scar in the child's intelligence. Apart from infants and children alike, protein energy malnutrition (PEM) or protein calorie malnutrition (PCM) as it is sometimes called, is known to affect the physical development of individuals and job performance of the workforce in a nation, which in turn has a negative impact on the nation's growth and development. It is also known to reduce adult capacities by reducing work attendance and output and even when work is done, it makes for a slow pace of work as a result of fatigued muscle (Elamin, undated)

The aggregation of all these implications affects the economic growth of the nation in a negative way. Thus there is the need to investigate into the factors which determine the demand for protein based components of household food. This demand component can further be decomposed into two, namely, the decision to consume these protein based food and the actual consumption of these food types, given the factors influencing the two components.

The study therefore aims to

i) Determine the factors that significantly influence rural households' decision to consume protein based food and the direction of the influence
ii) Determine the factors that significantly influence rural households' actual consumption of protein based food and the direction of the influence

LITERATURE REVIEW

The double hurdle model has been applied widely in household consumption. The model was formulated by Cragg(1971) and assumes that households make two decisions with regards to purchasing an item, which in turn is determined by a different set of explanatory variable. In order to observe a positive level of expenditure, two separate hurdles must be passed. In double hurdles model, two hurdles must be overcome to observe a positive value. The first is that a positive amount must be desired and the second is that favourable conditions must be in place for the positive expenditure to be achieved.

The double-hurdle model, assumes that households make two decisions with regard to purchasing an item, each of which is determined by a different set of explanatory variables. In order to observe a positive level of expenditure, two separate hurdles must be passed. A different latent variable is used to model each decision process, with a probit model to determine participation and a Tobit model to determine the expenditure level.

$Y^* = W_i + V_i$ (1) Participation decision

$Y^{**} = X_i\beta + U_i$ (2) Expenditure decision

$Y_i = X_i\beta + U_i$

If Y_i^* □ 0

and

Y_i^{**} □ 0

Otherwise, $Y_i = 0$

The double hurdle model is a parametric generalization of the tobit model in which two separate stochastic processes determine the decision of household to consume and the eventual consumption level.

The Tobit model was widely used in early studies for this purpose, which treats all the zero observations as corner solutions and assumes all households consume the product (Gao, Wailes and Cramer, 1995). In more recent studies, various improvements of the Tobit model have been developed, modified, and applied for different problems (e.g. Cragg, 1971). These bivariate decision models have also gained widespread applications in the food demand literature. A basic property of these models, according to Gao et al (1995), is that they model a consumer's zero value of purchase as a decision result, the Tobit assumption of equivalence between zero demand and a comer solution is relaxed. The double-hurdle model and the infrequency purchase model are the most frequently used models with this property. When these bivariate models are applied in demand analysis, the decision to buy and the decisions of how much to buy depend on different sets of exogenous variables. These decisions can be modelled jointly, if consumers decide whether and how much to buy simultaneously. They can also be modelled sequentially, where the decision on whether to purchase will affect how much to purchase, but not vice versa (in some circumstances, the decision sequence can also be turned around when the second decision affects the first).

The double hurdle model has an adoption equation given as

Di = 1 if Di* □0 and = 0 if D* 0

Where Di = αZi + Vi

Where D* is a latent variable that takes a value of 1 if household consumes and zero if otherwise, and Z is a vector of household characteristics and α is a vector of parameters. In our case for protein consumption as measured by protein food expenditure (Y) would be given as

Yi= yi* if yi* □0 and Di*□0

And yi* =0 if otherwise

yi*= βiXi + Vi

The log-likelihood function for the double hurdle model can be specified as follows

Log L= (1-Φ(αZi))+ (Φ(αZi) Φ) ---------- (1)

Under the assumption of independency between the error terms Vi and Ui, the model is equivalent to a combination of a truncated regression model and a univariate Probit model. The Tobit model as presented above arises if

ʎ = and X=Z

A simple test for the double hurdle model against the tobit model can be used. It can be showed that the tobit log-likelihood is the sum of the truncated and the probit models. Therefore, one can simply estimate the truncated regression model, the tobit model and the probit models separately and use a likelihood ratio test.

Ґ= -2(ln Lt – (ln Lp + ln Ltr)) ˜χ2k

Where Lt is the likelihood for the tobit model, Lp is the likelihood for the probit model, Ltr is the likelihood for the truncated regression model, k is the number of independent variables in the equations.

Burton, Tomlinson and Young (1994) using the double hurdle analysis, carried out their work in consumption-expenditure with the view of increasing the number of consumers who choose to eat meat against the backdrop of those who chose not to eat, bearing in mind the implication of this decision for livestock farmers and the obvious implications of this trend on livestock farmers and the industry. Results from

the study indicated that employment class and adult gender were significant determinants of meat consumption. Income was also found to affect the decision to buy or not to buy in opposite direction. Expenditure was found to affect expenditure alone and not the decision to buy or not to buy.

Burton and Young (1991) also carried out a non-parametric test for changes in consumer preferences for meat. The objective of the study was to investigate if the changing pattern of meat and fish purchases was due to the structure of consumer preferences or attributable to conventional economic factors such as changes in relative prices and total expenditure. The work analysed data based on two non-parametric tests derived from the revealed preference theory. Results showed that observed changes in meat consumption was as a result of conventional economic factors.

Gao et al (1995) observed that per capita rice consumption in the U.S. has doubled over a period of a decade. The effects of social and demographic variables on the household's rice consumption decisions was analyzed along with income and price variables. A double-hurdle model was used to solve simultaneously the consumer decisions whether to purchase rice and how much. The joint decision hypothesis was tested and accepted. They posited that the non-normal distribution of error terms may be responsible for possible bias in the empirical test of the joint decision hypothesis. The hyperbolic sine transformation was also used to correct the problem in this study prior to testing the joint decision hypothesis.

Newman, Henchion and Matthews (undated), in their study on Irish households' expenditure on prepared meals for home consumption, analysed consumption using the 1987 and 1994 Irish Household Budget Survey datasets. The aim of the paper was to analyse the factors influencing Irish households' decisions to purchase prepared meals and how much to spend on these food items. This was done using the double-hurdle methodology adjusted for the problems of heteroscedasticity and non-normality. Income elasticities was estimated for household expenditure on prepared meals in both years and significant socio-economic influences identified. These socio-economic factors were assumed to underpin the tastes and preferences of Irish households, with convenience identified as a significant preference of many household groups.

METHODOLOGY

Sampling Procedure:

The study area is Egbeda local government area in Ibadan metropolis of Oyo state. Ibadan is the largest city in West Africa and the second largest in Africa, with the land size of 240 km2. The metropolis is made up of 11local government areas of which Egbeda local government is one. Egbeda local government area has an area of 191km2 and a population of 281,573 as at the 2006 census, with its capital at egbeda town. The target population consisted of selected rural areas within egbeda local government in Ibadan. The sample was obtained through a multi-stage sampling technique. From a list of villages, 5 villages were randomly selected, namely Molade, Ayegbami, Opeyemi,

Orisunmibare and Adogba villages. From each of these villages, twenty households were then randomly selected. Thereafter, a structured questionnaire was administered to both the household head and the member of the household most directly involved with the household food pot and purchase. In order to capture household food behaviour, the researcher relied on a 7-day memory recall by the respondents.

Empirical Model Specification and Estimation

For the purpose of determining factors determining household's decision to consume protein based food and those affecting actual consumption, the double hurdle model was used.

Like Newman et al (undated) rightly identified, theory provides no guidance as to which explanatory variables to include in the first and second hurdles of the double-hurdle model. Including the same set of regressors in each hurdle makes it difficult to identify the parameters of the model correctly and so exclusion restrictions must be imposed (Jones, 1992). An underlying assumption of the double-hurdle model is that the first hurdle is a function of non-economic factors determining household's decisions to participate.

$yi^* = \beta iXi + Vi$

where Xi ranges from X1 to X6 for both animal and plant protein sources

X1= household size

X2= monthly income of household head

X3= awareness of nutritional importance of protein (either plant or animal protein); if household head is aware = 1, if not aware = 0

X4= relative affordability of protein source ; if affordable relative to its substitute =1, if not affordable relative to its substitutes= 0

X5= monthly expenditure on substitutes (if plant protein, then substitutes would be animal protein and vice versa)

X6= monthly expenditure on food supplements.

RESULT AND DISCUSSION

Table 2 shows the socio-economic characteristics of households interviewed in the five villages. Majority of the households were headed by men (94.0%) while a minority (6.0%) were headed by women. Out of the households interviewed, 63.0% were involved in farming as a profession either on a full time basis or on a part time basis, while just about 37% were not involved in any form of farming at a professional level. This means that majority of the respondents were farmers. A few of the population interviewed had over 10 household members (5%), while majority of the respondents (71.0%) had between 6 and 10 members. Much of the household head (34.0%) were between the ages of 51 and 60 years i.e. close to retirement and becoming economically unproductive, while just 2.0% were above the productive years, over 60 years of age. Another 33.0% of the household heads were between the ages of 21 and 30 years.

Table 3 shows that for animal protein consumption, all the specified exogenous variables had statistically significant relationship with the household's decision to consume animal protein, albeit at different levels. Also, for actual rural household animal protein expenditure, all the specified exogenous variables, with the

exception of household monthly expenditure on food supplement, had significant relationships. Rural household size and household monthly expenditure on animal protein substitutes were found to decrease the likelihood of household's decision to consume animal protein. By implication, this means that households with large members tended to decide against consumption of animal protein based food while households with lesser members tended to decide in the favour of animal protein food. In the same vein, the higher a household's expenditure on animal protein substitutes the less likely would the house be in deciding for animal protein sources of food. Other variables such as monthly income of household head, relative affordability of animal protein, awareness of nutritional importance of protein and monthly expenditure on food supplements, were found to increase the likelihood of household spending on animal protein. Hence, households with more monthly income tended to spend more on animal protein, just as the perception of the household head with respect to affordability of animal protein relative to plant protein, tended to also increase household's spending on animal protein.

Table 4 shows that for plant protein consumption, household size and household monthly expenditure on plant protein substitutes significantly decreased the odds in favour of household decision to consume plant protein. This is similar to the result obtained for animal proteins. Monthly income of household head and increase the households' monthly expenditure on food supplements was found to significantly increase the odds in favour of household decision to consume plant protein. Household size was found to decrease the likelihood of household's spending on plant protein, while household expenditure on plant protein substitutes as well as expenditure on food supplements was found to increase the likelihood of household spending on plant protein.

Table 5 presents the marginal effects on the decision to consume protein sources (animal and plant alike) of the explanatory variables. It also presents elasticity(s) of household expenditure on animal and plant protein sources relative to the explanatory variables calculated at sample means and were computed using the SHAZAM 10.0 software. The marginal effects are used to calculate percentage changes in the dependent variable when variables shift from zero to one.

For animal protein sources, all the explanatory variables were statistically significant in their influence of household's decision to consume. The percentage ranged from 0.6% to 7.8% for the explanatory variables. The result showed that a unit increase in household size would decrease the probability of household's decision to consume animal protein consumption by 3.5%. Another variable decreasing the probability of a household's decision to consume animal protein was household expenditure on animal protein substitutes (decreasing the probability by 1.4%). Also, a naira increase in the monthly income of household head was found to increase the probability of household's decision to consume animal protein by 0.6%. An increase in the level of awareness of household of nutritional importance of protein was found to increase the probability of decision by 1.5% and household's

perception of relative affordability of the protein source relative to its substitutes also increased the probability by 1.8%. Finally, for animal protein sources, a unit increase in the expenditure of households on food supplements was found to increase the probability by 7.8%.

For the plant protein sources, a fewer variables were statistically significant in determining the probability of decision for consumption. The percentage decrease in the probability of decision of the households to consume plant protein arising from a unit increase in the household size was higher in this case than in the animal protein case (9.1%). Following the same trend as in the animal protein case, expenditure on plant protein sources also decreased the probability of household's decision to consume animal protein by 10%, again a higher figure compared to that for the animal protein sources. A unit increase in household's expenditure on plant protein sources increased the probability of household's decision to consume plant protein by almost twice (6.5%) the increase in the probability of such decision arising from a unit in the income of household head (3.4%).

From table 5, it was also discovered that more of the elasticities of the estimates for animal protein were significant determinants of household's level of protein consumption than for the plant protein sources arguably based on the significance levels of their underlying marginal effects. Whereas the relative affordability of animal protein sources and household's expenditure on food supplements were significant determinants of the probability of households decision to consume animal protein, they were however not significant in the determination of households actual level of consumption. Household size was the only variable with negative elasticity for actual consumption level of animal protein with elasticity coefficient of -0.45. This implies that as household size increases, expenditure on animal protein sources decreases but at a less than proportionate rate. The same pattern was observed for plant protein sources but with as much unitary elasticity (-0.95). This implies that plant protein consumption is more responsive to changes in household sizes than animal protein. Household head's monthly income, nutritional awareness level of importance of animal protein as well as household's expenditure on substitutes were all positively significant determinants of animal protein consumption but with inelastic coefficients (between 0.17 and 0.61). For plant protein sources however, the other two positively significant determinants of plant protein consumption were household's expenditure on substitutes and household's expenditure on food supplements, with elasticity coefficients of 0.58 and 1.17 respectively. This implies that increases in household's expenditure on plant protein substitutes increased in a less than proportionate increase in plant protein sources, while increases in household's expenditure on food supplements increased more than proportionate the household expenditure on plant protein.

SUMMARY, CONCLUSION AND RECOMMENDATION

With the exception of nutritional awareness of the importance of protein and relative affordability of plant protein variables

for plant protein consumption, all the other variables had significant marginal effects on household's decision to consume plant protein.

All the specified variables in the model had significant marginal effects on household's decision to consume animal protein.

For both plant and animal protein sources, a unit increase in household size decreased the probability of households decision to consume each of the protein sources, albeit the more so for plant protein sources (by 9.1% for plant protein against 3.5% for animal protein sources).

Increase in expenditure on substitutes for both sources decreased the probability of household's decision to consume protein sources, albeit the more for plant protein sources (10%) than for animal protein sources (1.4%). However, this influence translated to an increase in household actual expenditure on protein sources but both with inelastic coefficients.

Increase in food supplement expenditure increased the probability of household's decision to consume protein sources by close to 10% (7.8% for animal protein and 6.5% for plant protein sources). The elasticity coefficient was not significant though inelastic for animal protein but was significant and elastic for plant protein sources.

It can be concluded that plant protein expenditure among these rural dwellers is very responsive and sensitive to household's expenditure on food supplements, while increase in expenditure on plant protein substitutes also increases household expenditure on plant protein. This may be so maybe as a result of the fact that what households consider substitutes may actually be complements, or may be necessary part of the household food basket or bundle.

It can also be concluded that for animal protein sources in these rural areas, unlike for plant protein sources, expenditure on food supplements were not significant determinant of actual expenditure on animal protein. However, the significant variables with respect to actual animal protein consumption had inelastic coefficients.

It is therefore recommended that among rural households there is the need for massive campaigns to educate them on the need to plan parenthood and manage small family sizes as this impact negatively on their ability to consume protein sources of food.

Also, since the results show that monthly income of household head increased both the probability of decision to consume plant and animal protein sources as well as the actual consumption level of the preferred animal protein sources, it would be of help if the productive capacities of rural dwellers (the larger percentage of who are farmers) are enhanced. This can be done by injection of credit and capital into these rural areas in order to break the vicious cycle of poverty which so predominantly characterise them.

Since, nutritional awareness of the importance of protein as a variable increased the probability of household's decision to consume the more preferred animal protein as well increased the actual consumption level of animal protein, it is recommended that government and non-governmental organisations alike intensify nutrition campaigns to rural areas that would

help in raising the level of awareness of rural dwellers with respect to the importance of proteinous food.

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