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Food Expenditures in Rural Households in the Northern Region of Ghana

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Abstracts:

The objective of the paper is to identify farmer and farm characteristics that determine the food expenditure in rural households in the Northern Region of Ghana. The results indicate income, implicit wealth, age, family structure, cultivation staple or cash crop, and buying dry goods in bulks are the major determinants.

Key words: *Northern Ghana, Farm characteristics, Food expenditure.*

1 Introduction

The food systems in African countries are quite distinct from those we observe in developed countries because in many parts of the continent poverty is pervasive (Fielda, Masakureb and Henson, 2010). Ghana is ranked 152nd of 177 countries on the Human Development Index, and 53% of its population is estimated to be living on less than 2 dollars per day (United Nations Development Program, 2009). However, the Ghanaian economy has registered a strong growth in recent years. The average GDP growth rate of Ghana was 5.8% between 2001 and 2010, and PPP GNI per capita (in current international \$)¹ was \$1,600 in 2010². The World Bank has projected that Ghana will be the fastest growing economy in Sub-Saharan Africa, with the growth rate of 13.4 percent in 2011, declining to 10 percent in 2012³.

There is a growing pool of literature on the increasing prevalence of modern supermarkets in low-income countries and African countries in particular. This phenomenon has received considerable attention in development economics literature over the past few years. Growing disposable incomes have attracted foreign investment illustrated by the entrance of international supermarket chains, which see revenue potential due to growing food demand. The demand growth for rice provides an insightful illustration. Rice is the second most important food staple after maize in Ghana and demand for rice has been fuelled by population growth, gains in incomes, urbanization, and changes in consumer preferences (Fielda, Masakureb and Henson, 2010). Although the demand for foods like rice is increasing, the local supply lags demand (Kula and Dormon, 2009). The local rice production has varied due to bottlenecks in rainfall, irrigation, infrastructure, input supply, seed development, post-harvest processing, marketing, research and

development and land tenure, among other (Kula and Dormon, 2009; Ministry of Food and Agriculture, 2009). The time between stock depletion and the next harvest is defined as months of inadequate household food provisioning, and in particular, the Northern and Upper West regions recorded five months food inadequacy (Quaye, 2008). It seems even the farmer households, which cultivate some kinds of staple themselves, still need to purchase food during months of inadequate household food provisioning.

However, the past growth and development have been accompanied by increased income inequality and poverty, especially in Northern Ghana, due to uneven development (Al-Hassan and Diao, 2007). Actually, much of the economic activity is concentrated in the metropolitan area of Accra, the capital, and several urban centers located in the coastal and central parts of the country, while in contrast, the North recorded slower growth and poverty reduction⁴. Research focused on Northern Ghana is very limited.

The objective of the paper is to identify farmer and farm characteristics including the socio-demographic characteristics that determine the purchase of food in Dagomba villages located in the vicinity of Tamale, the capital of the Northern Region in Ghana. Knowledge of the farmer and farm household characteristics provide insights that allow the concentration of efforts in areas that strengthen the local economy and result in increased earnings of all groups of the regional society.

The structure of this paper is following. Firstly, we derive the theoretical and empirical model of food expenditure and farmer/farm characteristics. The next section presents, results of the descriptive analysis on the used data. The third section reports the results of the estimated

empirical model and compares results from three approaches applied to deal with the confirmed heteroskedasticity problem. The final section states the remark conclusions and future work.

2 Theoretical framework and Empirical Model

2.1 Theoretical framework

The demand for food represents the amount of food that consumer is willing and able to purchase and determined by own price, all other prices (including prices of substitute and complementary goods), income, tastes and preferences. Equation 1 shows, the demand for food **F** is a function of its own price of food **Pf**, all other prices **Pm**, income **I**, the tastes and preferences **T**.

$$F = f(Pf, Pm, I, T) \quad (1)$$

The food expenditure is the product of the food demand and the price of food. In Equation 2, the food expenditure is a function of the price of food, all other prices, income, tastes and preferences. For cross-section data, it is reasonable to assume all prices are stable within the time period under consideration. Then, the expenditure on food is only determined by the consumer's income level **I**, and tastes and preferences **T**.

$$EXP_F = Pf * F = Pf * f(Pf, Pm, I, T) = g(Pf, Pm, I, T) = h(I, T | Pf, Pm) \quad (2)$$

2.2 Empirical Model

According to the theoretical model above, the expenditure on food is affected by the consumer's income level, tastes and preferences. In our empirical model, the dependent variable is weekly food expenditure (including fish and meat), while the explanatory variables include income, socioeconomic and demographic factors of rural families, and selected farm features. The log-linear functional form is applied. There are two main advantages of using log-linear model.

First, after log transformation of the original dependent data, the relationship between the explanatory variables and the logarithm of dependent variable is linear. Therefore, the use of the common linear regression technology (i.e. OLS to analysis data) is straightforward. Second, the slope coefficients of log-linear model are interpreted as semi-elasticities, which measure the constant proportional or relative change in dependent variables (weekly food expenditure in this paper) for a given absolute change in the value of the regressors. By multiplying the relative change in dependent variables by 100, the product will then give the percentage change or the growth rate in the dependent variable (Gujarati, 2009). The specified empirical model is:

$$\text{Log}(EXP_F) = \beta_0 + X_{income}\beta_{income} + X_{soc-demo}\beta_{soc-demo} + X_{farm}\beta_{farm} + \varepsilon \quad (3)$$

Where EXP_F is the expenditure on food; β 's are coefficients to be estimated; ε is the stochastic error term; X_{income} is a n by 2 matrix which refers to income variables; $X_{soc-demo}$ is a n by 9 matrix refers to the group of socioeconomic and demographic variables; X_{farm} is a n by 4 matrix which indicates the farm characteristics variables; and, n is the sample size. Income and tractor ownership are included in the income variables set. Age, gender, married status, education and family structure are soci-demographic characteristics. Farm characteristics variables group include the total number of acres under groundnut cultivation, cultivation of plant staple or cash crop, and buying dry goods in bulks. Price is not available in the survey data set in this study. But, the price is assumed to be constant across all selected distinct for the study.

2.3 Variables Selection

The objective of this paper is to identify the factors that determine the purchase of food in Dagomba villages. According to the classical economic theory of the good demand, the income

or wealth are important variables to explain the food demand. W. C. Hopper (2011) showed the close relationship between the income of the household and the quantities of milk, cream, cheese, eggs, meat, fish, and fresh fruits and vegetables purchased. Income is found to be one of the most prominent measures of food consumption behavior (Muhammad, Seale, Meade and Regmi, 2011). In our model, households' income and tractor ownership are used to capture the income level of the respondent household.

The socio-demographic characteristics of the consumers (i.e. age, gender, married status, education, family structure) are also found closely affecting the food expenditure. The age and education influence the frequency of groundnut consumed; and the total revenue and gender affect the product form of groundnut consumed including fresh boiled, dry shelled boiled, shelled roasted, roasted, ground, fried, and etc (Jolly, Awuah, Fialor, Agyemang, Kagochi and Binns, 2008). Socio-cultural factors affect consumers' preference: eating habits, indigenous knowledge about the method of preparation, cooking time or convenience, nutritional and medicinal values, taste and slipperiness (Quaye, W., Gyasi, O., Larweh, P., Johnson, P-N. T. and Obeng-Aseidu, P. 2009). The presence of children in the households is expected to have a positive relationship with the expenditure on fresh vegetables that is supported by Han and Wahl (1998).

In the paper, we are interested in analyzing the food expenditure of particular consumer group-the groundnut farmer households, so besides socio-demographic characteristics illustrated above, farm characteristics (i.e. the total number of acres under groundnut cultivation, the indicator variable of planting staple or cash crop, the indicator variables of buying dry goods in

bulks) are also considered to be explanatory variables of the food expenditure. Farm characteristics are directly determine consumers' income, and further affect the expenditure of food. The income of farm family can divided into two parts - the farm income and the nonfarm income. The farm income as the main source for farm family income comes from selling their staple crops and cash crops. The related literature concerning about farm family is limited. Clark and LeBovit (1955) analyzed food consumption of farm families in Minnesota and found higher income farm families drank more milk than those with lower incomes. Pitt and Rosenzweig (1985) utilized existing household survey data from Indonesia to analyze the effects of food price changes and health program interventions on the health, nutritional status and profits of farm households. Despite the well-recognized potential importance of farm characteristics affecting the food expenditure, there is little empirical analysis on the linkages between farm characteristics and food expenditure. In this paper, we extend the conventional model of the household food expenditure model by incorporating farm characteristics.

3 Data and Descriptive Analysis

The study uses the survey data collected between July 27 and August 2, 2010. A total of 251 respondents participated in the survey. The survey was conducted in four distincts (including SND, savelugu Nanton, Tamale metropolis and Tolon Kumbungu) and 18 towns (including Kogni, Lungbun Gundaa, Wantugu and etc) in the vicinity of Tamale, the capital of the Northern Region. Agriculture dominates the regional economy and Tamale is a center of trade in regionally grown commodities including peanuts, beans, and millet. The survey was conducted in local language, Dabani, with the help of trained enumerators from the Ghana's National

Statistical Service. The selection of surveyed households was aided by local leaders and procedures applied by the enumerators used collection of data for the national service.

The estimated model of food expenditures uses 208 observations after deleting incomplete records and two records where households reported unusually high income. The results are considered to adequately represent the rural population of the Northern Region. Table 1 shows descriptive statistics, definitions of the variables and units of measurements. Overall, the average respondent was 38 years old and among the respondents 17 percent were females, 92.3 percent were married and 14.9 percent of all respondents had not received any formal education. The average family size was 15 with the family structure averaging 2.5 family members below 3 years old, 2.9 between 4 and 12 years old, 2.4 between 13 and 18 years old, 5.1 between 19 and 60 years old and only 0.3 61 years old or older. Only 4.3 percent of the families reported to own a tractor and the average household income in the month preceding the survey was 130.69 new cedis, while the reported weekly food expenditure was 13.25 new cedis (1 Ghanaian Cedi = \$ 0.6772)⁵. The reported farm characteristics data revealed 93.8 percent of the farm families were planting staple crops including rice, maize, yam, cassava, sorghum and millet, while 73.1 percent were cultivating cash crops like pepper, garden eggs, okra, tomato, cotton, or tobacco. Among all the surveyed households 50.5 percent reported to buy dry goods such as rice, corn and beans in bulk. In addition, on average, a surveyed family cultivated 3.95 acres of peanuts.

4 Estimation Results

Equation 4 shows the specified empirical model in this paper that includes all the selected variables. Two variables (i.e., Income and Tractor) measure the income and wealth of the

surveyed families. Other variables including gender, age, marital status, education and the structure of family reflect socioeconomic situation of a respondent and her household and demographic characteristics. Then, four other variables (i.e. Staple crop, Cash crop, the total number of acre under groundnut and buying dry goods in bulk) capture the farm characteristics.

The empirical equation with the dependent variable expressed in the logarithmic form is:

$$\begin{aligned} \text{Log}(EXP_F) = & \beta_0 + [\beta_1 \text{Income} + \beta_2 \text{Tractor}] \\ & + [\beta_3 \text{Gender} + \beta_4 \text{Age} + \beta_5 \text{Married} + \beta_6 \text{Age3} + \beta_7 \text{Age12} + \beta_8 \text{Age18} + \beta_9 \text{Age60} + \beta_{10} \text{Age61} + \beta_{11} \text{Educ}] \\ & + [\beta_{12} \text{Staplec} + \beta_{13} \text{Cashc} + \beta_{14} \text{Gutacre} + \beta_{15} \text{Drygood}] + \varepsilon \quad (4) \end{aligned}$$

Where ε is the error term.

4.1 The Methods

Ordinary Least Squares (OLS) was applied to estimate the empirical model (Equation 4). Two tests, i.e., White test and Breusch-Pagan test, were used to examine the constant variance hypothesis. However, the results of these two tests are not consistent. The result of the White test with the p-value 18.7% suggests the model does not suffer from heteroskedasticity problem, while the Breusch-Pagan test with the p-value 7.7% indicates that the constant variance hypothesis does not hold in at 10% significance level and requires correction. Usually, OLS with robust standard errors and Weighted Least Squares (WLS) are two main methods used to correct heteroskedasticity problem. Table 2 shows the estimation results of these two methods along with OLS.

The three sets of estimation results are very similar suggesting the model only has minor heteroskedasticity problem. Results of the three sets of estimation indicate that the same variables (such as Income, Tractor, Age, Age3, Age61, Cashc and Drygoods) are statistically

significant to explain and predict the value of logarithm of food expenditure. However, OLS and WLS results show that the variables staple crop is statistically significant, while OLS with robust standard errors does not confirm such relationship. Also, among the three methods, only WLS indicates the statistical significance of the variable Age60, Gnutacre and Education.

In the plot of the residuals obtained using OLS, which is the plot of residuals against the OLS fitted values, the points are randomly dispersed around the horizontal axis and do not show a non-random pattern suggesting the model fits the data set. Furthermore, the White test supports the constant variance hypothesis. But according to Breusch-Pagan test that suggests the constant variables hypothesis is violated, OLS with robust standard errors and WLS should be applied to fix the heteroskedasticity problem. The mixed results obtained by the application of the three estimation techniques complicate the choice of the final method. However, because both the residuals plot and White's test support the constant variance hypothesis in case of OLS, and OLS is easy to implement and yields unbiased coefficients, it is preferred over the OLS with robust errors or WLS.

4.2 Estimation Results

The first two columns of Table 2 show OLS estimation results of the log-linear model to predict expenditure on food. Eight out of fifteen explanatory variables are found to be statistically significant at the preselected levels.

Two variables that indicate the income and wealth level of the surveyed families are both found to be significant, while the sign of the coefficients are opposite. An increase in the household income is found to decrease the weekly food expenditures. The result is less unexpected than it appears

due to the specification of income and food expenditure. Because the survey focused on farm households and the income was reported as the income earned in the month preceding the survey, the link between the earned income and food expenditure is less obvious. Farms do not necessarily earn income every month, but only in months when they decide to sell any farm production for cash. High income earned in a particular month must suffice until the next sale of the farm output generates cash income. An increase in the household wealth index represented by a dummy variable indicating whether the household owned a tractor increases the weekly food expenditure. It means the families that own a tractor are found to spend more on food compared to their counterpart, and it reinforces the positive relationship between income and expenditure. Only 4.3 percent of the families reported to own a tractor, so the families who own it feel they can afford to spend more on food.

Among the socio-demographic factors, age and family structure variables are found to be statistically significant. Age of a respondent has a positive influence suggesting that as the age increase, a respondent spends more on food. Compared to young people, older people are more concern about health and further care more about the food nutrition, so the expenditure on food will obviously increase. The results also illustrate that the age structure of family members is closely related to the household food expenditure. Households with a large number of children (3 years or younger) have higher weekly food expenditure, while those with a large number of family members 60 years old or older spent less on food. The families with children spend more on food since the nutritional needs of growing children increase as they advance in age, while families with old family members may need less food because the caloric needs tend to decrease

with age, so their presence in a household leads to declining food expenditure.

The results also indicate some farm features clearly affect the food expenditure. Households reporting in the cultivation of staple crops (such as rice or corn) or cash crops (such as vegetables or tobacco) spent more on weekly food purchase. In fact, most of the farm-income for farm family comes from selling their staple crops and cash crops. So the families reporting the cultivation of staple or cash crops are believed to have income that can be spent on additional food purchase as compared to those who do not cultivate either crop type. Furthermore, households reported to buy dry goods (rice, corn, beans, etc) in bulk spend more on food because buying dry goods in bulk is another indicator suggesting income available for purchase of foods not likely grown on family farm.

5 Conclusions

This paper focuses on identifying farmer and farm characteristics that affect the food expenditure of rural households in the Northern Region of Ghana. Overall, the results of estimation are consistent with the results of previous studies and expectations. In addition, results from the current study enriched the literature on food expenditure research specific to farmer households and Northern Region of Ghana. The study fills the gap analyzing the situation at a rural household level in an area that is characterized by lower than the average aggregate income level. Moreover, the analysis of the determinants of the food expenditure also provides insights for food manufacturers, food marketers and selected government agencies.

Results of the study indicate selected socio-economic characteristics such as household income and wealth effect play an important rule in determining the expenditure on food. The

household income had a negative and counterintuitive effect on the weekly food expenditures. The result is likely due to the formulation of the question and the specificity of way generating farm household income among Ghana's rural households. The reported income was earned in the month preceding the survey, while the food expenditure was reported for the average week making the link between earned income and food expenditure less obvious. While an increase in the household wealth index captured by the tractor ownership increases the weekly food expenditure. In farm households the importance of the accumulated wealth effect cannot be underestimated in sustaining food purchases because income appears at irregular intervals.

Demographic characteristics, i.e., age, family structure, were found to be major factors influencing household food expenditure. Age has a positive effect on the food expenditures. An average family reported 2.5 children three years old or younger. Results of the study suggest the number of children in the family has a significant positive influence on the weekly expenditure on food. Because the nutritional needs of growing children increase as they advance in age, the expenditure on food is likely to increase. Because age of a respondent also has the positive effect, food distributors and retailers need to recognize the potential need for foods eaten by two distinct age groups with different nutritional needs. For example, an efficient promotion of food marketers might involve developing material and related food products targeting families with small children because buying food for children may supersede buying food for adult consumers. Such promotion has been taking place, but not through commercial food distribution channels, but NGOs working on public health issues.

The findings also suggest farm features have a meaningful influence on the food expenditure

in farm households. The cultivation of both staple and cash crops increase weekly food expenditure. This result is expected because many farm households earn income by selling their staple or cash crops. The earned income permits to increase food expenditure. The link between the cultivation of staple or cash crops and higher food expenditures play an important role in farm households' capability of purchasing food not likely grown on family farm and, therefore, stimulating the commercial food sector. Furthermore, food purchase behavior such as buying dry goods in bulks also has been positively associated with the farm household food expenditure. Food marketers aware of such information could anticipate changes in purchase behavior with an increase in food expenditure.

Furthermore, results of this study are also helpful for the concentration of efforts in areas that encourage food expenditure and strengthen the local economy in rural areas of Northern Ghana. Through foreign direct investment, the discovery of mineral deposits and plans to expand the infrastructure in Northern Ghana will offer job opportunities contributing to an increase in incomes and, likely, reflected in an increase of expenditure.

In the current study, income was reported as the income earned in the month preceding the survey, and the paper assumes price stability within the time period under consideration, i.e., in the cross-section data set. Future efforts may include collecting additional relevant information such as annual income and price of food products, and the development of panel database to capture changing factors that determine food expenditure.

Footnotes

1 <http://data.worldbank.org/indicator/NY.GNP.PCAP.PP.CD>

2 <http://databank.worldbank.org/ddp/home.do?Step=3&id=4>

3 http://ghana.gov.gh/index.php?option=com_content&view=article&id=4452:world-bank-on-ghanas-economic-growth-&catid=28:general-news&Itemid=162

4 http://www-wds.worldbank.org/external/default/WDSPContentServer/WDSP/IB/2011/06/23/000333038_20110623231121/Rendered/PDF/578980PAD0Box30ly00GEF0R20110002001.pdf

5 <http://www.exchange-rates.org/Rate/GHS/USD/8-1-2010>

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Table 1. Descriptive statistics of variables

Variable name	Units of measurement/variable description	Mean	Std dev
Dependent variable:			
Exp	Weekly food spending (including fish and meat)	13.2500	18.3172
Independent variables:			
Income factors			
Income	Household income in the month preceding the survey	130.6923	206.3241
Tractors	own tractors=1;other=0	0.0433	0.2040
Socio-Demographic factors			
Gender	Male=1; Female=0	0.8269	0.3792
Age	Age	38.1298	11.6274
Marital status	Married=1; other=0	0.9231	0.2671
Age3	How many household members are 3 years or younger?	2.5096	2.0024
Age12	How many household members are 4-12 years old?	2.9279	2.1758
Age18	How many household members are 13-18 years old?	2.3654	2.4576
Age60	How many household members are 19-60 years old?	5.0865	3.8601
Age61	How many household members are 61 years old and older?	0.3317	0.8168
Education	Formal Education=1; otherwise=0	0.8510	0.3570
Farm characteristics factors			
Staplec	Cultivate Staple crops=1; otherwise=0 (including rice, maize, yam, cassava, sorghum, millet)	0.9375	0.2426
Cashc	Cultivate Cash crops=1; otherwise=0 (including pepper, garden eggs, okra, tomato, cotton, tobacco)	0.7308	0.4446
Groundnut	Total number of acres under groundnut cultivation	3.9543	2.9990
Drygoods	Do you buy dry goods in bulks (rice, corn, bean, etc.)? Yes=1;No=0	0.5048	0.5012

Table 2. Estimation results for the Expenditure on food

Methods	OLS		OLS(Robust Std. Err)		WLS	
Variable name	Coef.	Std. Err.	Coef.	Std. Err.	Coef.	Std. Err.
Intercept	1.072***	0.349	1.072***	0.334	0.906***	0.307
Income factors						
Income	-0.001***	0.000	-0.001***	0.000	-0.001***	0.000
Tractor	0.460*	0.255	0.460**	0.179	0.483***	0.179
Socio-Demographic factors						
Gender	-0.219	0.166	-0.219	0.201	-0.241	0.153
Age	0.008*	0.005	0.008*	0.004	0.008**	0.004
Married	-0.259	0.208	-0.259	0.174	-0.237	0.173
Age3	0.123***	0.033	0.123***	0.035	0.100***	0.029
Age12	-0.006	0.027	-0.006	0.027	0.011	0.025
Age18	-0.022	0.027	-0.022	0.025	-0.014	0.023
Age60	0.018	0.016	0.018	0.020	0.026*	0.014
Age61	-0.212***	0.070	-0.212***	0.062	-0.228***	0.062
Education	0.178	0.155	0.178	0.122	0.209*	0.122
Farm characteristics factors						
Staplec	0.424*	0.253	0.424	0.291	0.422*	0.247
Cashc	0.299**	0.126	0.299**	0.121	0.272***	0.104
Gnutacre	0.016	0.020	0.016	0.027	0.452***	0.089
Drygoods	0.421***	0.106	0.421***	0.102	0.906***	0.307

Note: *, ** and *** denote significant at 10%, 5%, and 1% levels, respectively