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**The Determinants of Food Expenditures in the Urban Households of Ghana: A  
Quantile Regression Approach**

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## **The Determinants of Food Expenditures in the Urban Households of Ghana: A Quantile Regression Approach**

**Abstracts:** The study applies quantile regression to identify determinants of the entire distribution of food expenditure, and quantify their effects among Ghana's urban household subgroups. The results indicate that among the significant factors the largest effect in descending order have location, marital status, education, household composition, age, and income.

**Key words:** *Food Expenditure, Ghana, Quantile Regression, Urban Households.*

## **1 Introduction**

Several developing countries experience a substantial economic growth in recent years. For instance, in 2011, the annual percentage growth rate of GDP is 9.3% in China, 6.7% in Bangladesh, 5.9% in Vietnam, 6.7% in Uganda, and 7.3% in Ethiopia.<sup>1</sup> Food consumption in these countries has also been stimulated by the increasing disposal income. And a large number of economists focus their research on the food consumption and its determinants in developing countries. For example, Campbell et al. (2010), Yu and Abler (2009) and Ayo et al. (2012) examine food consumption in Bangladesh, China, and Uganda respectively. Among these countries, it is notable that Ghana experienced and sustained a considerable economic improvement in the past several years. According to the data released by the World Bank, Ghana achieved a 14.3% annual growth rate of GDP in 2011, and about 8% average annual growth rate of GDP in the last five years from 2007 to 2011.<sup>2</sup> Also, in 2011, gross national income per capita (GNI per capital in current US dollar) of Ghana is 1,410 dollar with a 10% annual growth rate, while GNI per capital in Sub-Saharan Africa (all income levels) is 1,269 dollar with a 1% annual growth rate.<sup>3</sup>

Ghana is the world's second largest cocoa producer behind Ivory Coast, and Africa's biggest gold miner after South Africa.<sup>4</sup> It is inhabited by 52 ethnic groups, and the native and largest ethnic group is Akan taking up 45% of the population.<sup>5</sup> In addition, as other developing countries, recently, Ghana has an increasing urbanization population that takes 53% of total population in 2012.<sup>6</sup> However, the economic growth in Ghana is still uneven, the development of urban areas in Southern and Coastal Region is considerably faster than rural areas in Northern Ghana. The objective of this study is to

explore the entire distribution of food consumption and its determinants in urban households in Ghana using the data collected in 2011 in the three large cities – Accra and Takoradi located in the Southern Region, and Tamale located in Northern Region. The study applies quantile regression approach to examine how the socioeconomic and demographic characteristics have different effects on food consumption among several population subgroups in Ghana’s urban households, and to generate useful knowledge for both food producers/marketers and public organizations concerned about food inadequacy.

## **2 Conceptual Framework**

Food consumption is an important part of social behavior which is affected by culture, geography, and it differs across individuals and households and varies with incomes, preferences, cultural traditions, and local prices (Pinstrup-Andersen & Watson II, 2011). In classical consumer demand theory, a household chooses its optimal food consumption to maximize the household utility within the budget constraint. By solving the first order condition, namely, marginal rate of substitution is equal to price ratio, the optimal household consumption is mainly determined by factors such as the price level, household income, and household preferences. In particular, price has a negative effect on food consumption since food is usually regarded as an ordinary good, while income is positively related to household consumption, which is captured by Engel curve for a normal good. Because household preference can determine the specific form of utility function and the shape of indifference curve, food consumption is also affected by household preference. Capturing the household preference, however, is not necessarily easy. A substantial number of studies indicate that the household preference is

determined by socioeconomic factors such as occupation and education, as well as demographic factors such as age, race, and household composition. In this study, assuming the stable food price within the period under consideration, household food expenditure, amount of money being spent on household food purchase, is influenced by socioeconomic and demographic characteristics.

In spite of the remarkable economic growth, food inadequacy is still a big challenge faced by the developing countries. And the risk of food inadequacy or excess is generally greater at the tails of the food consumption distribution than at the mean, the Ordinary Least Square (OLS) may be of limited value in capturing these distributions (Variyam et al., 2002), and quantile regression approach is preferred in this situation. Actually, quantile regression approach is first introduced by Koenker and Bassett Jr (1978), and later, a number of studies develop this method and apply it to enormous fields including Econometrics (Variyam et al., 2002 and Stewart et al., 2003) According to Koenker and Hallock's study in 2001, the tendency of the dispersion of food expenditure increases as household income increases. And other characteristics such as age and education may also have a closed relation with the dispersion of food expenditure. Because the socio-demographic factors might have different effects along various quantiles of the distribution of food expenditure, quantile regression approach is more appropriate in this study.

### **3 Data and Descriptive Analysis**

The study applies survey data collected in 2011 in Ghana's three big cities (i.e., Accra, Tamale, and Takoradi). Accra, the capital and largest city of Ghana, serves as the nation economic and administrative center; Takoradi together with another twin city

Sekondi, is the capital city of the Western Region of Ghana, fourth largest city, industrial and commercial center in Ghana; Tamale is the capital city of the Northern Region of Ghana mostly inhabited by the Mole-Dagomba linguistic group, serving as convergence zone as well as the commercial capital of the three northern regions.<sup>7</sup> In the survey, the respondents were probed about their food shopping and preparation habits, total food spending, and some personal information such as household income and household composition.

Table 1 shows the summary of descriptive statistics such as mean and standard deviation. Among the surveyed households, 60.7 percent are from Accra, 20.8 percent from Takoradi, and the remaining 18.5 percent from Tamale. The respondent's age is from 17 to 80 years old, and the mean is 39.2 years old. More than 98 percent of respondents are females, and 75.3 percent are married. The average household has 0.94 children (4-12 years old), 0.98 teenagers (13-18 years old) and 2.2 adults (above 18 years old). Moreover, 64.2 percent of respondents are self-employed, 24.2 percent work in government or civil department, and the remaining 11.6 percent are retired, students, or unemployed. About 51.6 percent of respondents have secondary or higher education. In the month preceding the survey, the recorded income ranges from 5 Ghanaian cedi (1 US Dollar = 1.49989 Ghanaian Cedi on January 1<sup>st</sup>, 2011<sup>8</sup>) to 8500 Ghanaian cedi with the mean of 646.6 Ghanaian cedi, while the average weekly household food expenditure is 58.3 Ghanaian cedi, or 36.1% of the household income.

#### **4 Empirical Model**

In the empirical model, Weekly household food expenditure is the dependent variable, while socioeconomic and demographic characteristics (i.e., household income,

education, occupation, age, age squared, marital status, household composition etc.) are serving as explanatory variables. The quantile regression at 25th, 50th, 75th, and 90th quantiles is applied to examine how socio-demographic factors affect the food expenditure distribution in urban households in Ghana. In fact, a large number of studies has explored the theory background and application of quantile regression, and also made a clear comparison about Ordinary Least Squares regression (OLS) and quantile regression. Introduced by Koenker and Bassett Jr in 1978, Quantile regression approach seeks to model quantiles of the conditional distribution of the response variable as functions of observed covariates. Koenker and Hallock (2001) state that quantile regression can be applied to a number of fields such as biomedicine and economics, and provide an example about how to use quantile regression to explore Engel's curve. Later, Variyam et al. (2002) use the quantile regression to characterize the distribution of macronutrient intake among U.S. adults. And Stewart et al. (2003) analyze the income effect on vegetable and fruit spending among low-income households also by quantile regression approach. It is crucial to note that the Ordinary Least Squares regression models the relationship between the set of explanatory variables and the conditional mean of the response variable, while the quantile regression extends the regression model to conditional quantiles of a response variable, such as the 10<sup>th</sup>, or 90<sup>th</sup> quantile. Just as the mean gives an incomplete picture of a single distribution, the regression curve of the OLS also gives a corresponding incomplete picture for a set of distributions, thus we could compute several different regression curves corresponding to the various percentage points of the distributions to get a comprehensive understanding (Koenker & Hallock, 2001). Quantile regression is regarded to be particularly useful when the rate of change in



the conditional quantile, expressed by the regression coefficients, depends on the quantile, and furthermore, the main advantage of quantile regression over least squares regression is its flexibility for modeling data with heterogeneous conditional distributions.<sup>9</sup> Since this study does not enforce the assumption that socio-demographic factors have exactly the same effects on every point of the food expenditure distribution, thus, quantile regression approach is more suitable. The simultaneous-quantile regression at 25th, 50th, 75th, and 90th quantiles is employed to this study and the paired bootstrap procedure (500 replications) is used to obtain standard errors for the estimators. Also, the F test is used to check whether the explanatory variables have statistically significant differential effect at various quantiles.

## 5 Results

Table 2 displays the estimation results of the simultaneous quantile regression (SQR) at 25th, 50th, 75th, and 90th quantiles, and as well as the results of ordinary least square (OLS). The first four columns show the SQR results, and as a comparison, the last column is the OLS results.

**Income** has a positive effect on weekly household food expenditure at any quantile and as well as at mean. A hundred cedi increase in household monthly income adds to the weekly food expenditure 1.36 cedi, 2.4 cedi, 3.8 cedi and 4.5 cedi, respectively at the 25th, 50th, 75th and 90th quantiles. This finding reaffirms the role of income in affecting food expenditure. Higher income allows households to afford a larger quantity or higher quality food.

The attained **education** is also found to be a significant factor. At the 25th and 50th quantile, households with a secondary or higher education spend more on food

weekly than their counterparts. Education brings an increase in weekly food expenditure by 3.8 cedi and 4.7 cedi, respectively at the 25th and 50th quantile. The result is consistent with the argument that education has a closed correlation with the awareness of the importance of healthy diets (Stewart et al., 2003).

**Occupation** has a significant effect on household food expenditure but only at the 90th quantile. In the survey, respondent are grouped in the following job categories: government employee, self-employed, student, retired, or unemployed. The results indicate that the self-employed have higher food expenditure than households in other job categories. It might be due to the self-employed have a more flexible work schedule, therefore, they usually have adequate time to purchase food.

Besides the socioeconomic characteristics illustrated above, several demographic factors such as location, marital status, age, and household composition are also significantly correlated with weekly food expenditure. In this study, the sampled households are from three big cities-Accra, Takoradi, and Tamale. The results clearly indicate that households in **Tamale** spend less on food than in Accra in any quantile, and also at the mean. Tamale is the capital city of Northern Region of Ghana, which is still the least developed area in Ghana, therefore, it is not a surprise to find that households in Tamale have significant lower food expenditure than the capital households. Moreover, the gap of weekly food expenditure between Accra and Tamale households is bigger in the upper quantile than in the lower quantile. Compared with Accra households, **Takoradi** households spend less on weekly food purchase at median and higher quantiles. Takoradi is in the south coastal area with a relatively fast economic growth in

recent years, which can explain that the gap of food expenditure between Takoradi and Accra households is not significant below the 50<sup>th</sup> quantile.

**Marrital status** has a significantly positive effect on weekly household food expenditure at the 50th and 70th quantile, and also at mean level. This finding is consistent with the study that married households are inclined to have more balance diets than the households of single consumers.

Both **age and its square** are included in the empirical model. Age is positively correlated with weekly food expenditure at any quantile, and also at mean level. While the square form of age has a significant negative coefficient at the 25th and 50th quantile (i.e., two lowest quantiles). This finding stresses that the household spending on food increases with age, but at a significantly decreasing rate for households with the median or lower food expenditure. As age increases, people tend to pursue healthy diets, and therefore, have higher food expenditure.

**Household composition** also has a significant influence in determining food consumption. At the 75th and 90th quantile, a household with a large number of children (between 4 and 12 years old) has a higher weekly food expenditure. Because children usually have special food needs for their growth. In addition, the number of adult household members is found to have a significant positive influence on food expenditure at a decreasing rate at any quantile, and also at mean level of the distribution. The number of adults is usually used to represent the household size, and in general, a large household spends more on weekly food purchase than a small household. Since it is very hard to support a large household size, food expenditure tends to increase with the household size at a decreasing rate.

## **6 Conclusions and Implication**

Because of the substantial economic growth of Ghana in recent years, household consumption has attracted enormous interests from both public and private agencies. Public sectors need to capture the entire distribution of food consumption to formulate new or adjust current policy to reduce the risk of food inadequacy. Moreover, private organizations such as domestic and international food producer/marketer need comprehensive information to make decisions regarding investment, marketing, and promotion. Using the survey data collected in three big cities of Ghana in 2011, simultaneous quantile regression approach was applied in the study to identify the underlying determinants of food expenditure, and further quantify their relative different effects among population subgroups in urban households of Ghana.

Results of the study indicate that household income has a significantly positive effect on the weekly food expenditure at any quantile, and the effect is larger at higher quantiles of food expenditure than at lower quantiles. Increasing income can generally improve the food consumption in Ghana's urban households, however income has a smaller effect in those households with low food expenditure. It suggests that the increased income in those relatively poor households might be spent on other goods besides food such as medication or education. Therefore, for low-food-expenditure households, although food aid might be a direct way to enhance food consumption, other complemented programs such as education and medical assistant are also of crucial importance.

The secondary or higher education of a respondent leads to a higher food expenditure at the 25th and 50th quantile. It clearly suggests that to stimulate food

consumption in urban households, it is essential to provide more education and training opportunities to the households with median or lower food expenditure. Since education could provide consumers helpful knowledge about what foods to purchase to prepare healthy diets.

Comparing with Accra households, Tamale households spend less on food at any quantiles, while Takoradi households spend less at the median and higher quantiles. For public sectors and nongovernment organizations concerned about food inadequacy, related food interventions such as food assistant need to focus on less developed areas such Northern Region of Ghana, since households in these areas have significantly low food expenditure. While food producers and marketers are suggested to target their food marketing and promotion at relatively developed areas like Southern and Coastal Region.

Furthermore, the study also provides a comprehensive profile of food consumers' demographic characteristics, food retailers need to more focus on high-income and well-educated married households with a large household size, and also consider the special food needs of elders and children. In general, elder consumers prefer foods with low fat and sugar, while households with a large number of children tend to purchase high-nutrition foods with attractive taste and package.

In a nutshell, the study provides a comprehensive picture of food expenditure in urban households in Ghana, which is remarkably useful to forecast the future trends in food consumption. The results also suggest that food marketers need to focus promotion on the high-income and well-educated households in relatively developed areas and recognize nutrient needs of children and food preference of elder consumers. To reduce the risk of food inadequacy and improve local development, it is essentially necessary to

provide education opportunities, distribute food aid, as well as enhance complemented programs to low-food expenditure households in less developed areas like Northern Region of Ghana.

## Footnotes

<sup>1</sup> The World Bank. Data. GDP growth (annual %). Available online <http://data.worldbank.org/indicator/NY.GDP.MKTP.KD.ZG> [Accessed on January 3rd, 2013]

<sup>2</sup> The World Bank. Data. GDP growth (annual %). Available online <http://data.worldbank.org/indicator/NY.GDP.MKTP.KD.ZG> [Accessed on January 3rd, 2013]

<sup>3</sup> The World Bank. Data. GNI per capita, Atlas method (current US\$). Available online <http://databank.worldbank.org> [Accessed on January 3rd, 2013]

<sup>4</sup> UNDP In Ghana. Available online <http://www.undp-gha.org/design/countryinfo/> [Accessed on December 31th, 2012]

<sup>5</sup> Jamaica National launches new Ghana money transfer brand. Available online [http://www.jamaicaobserver.com/business/Jamaica-National-launches-new-Ghana-money-transfer-brand\\_9719123](http://www.jamaicaobserver.com/business/Jamaica-National-launches-new-Ghana-money-transfer-brand_9719123) [Accessed on January 3rd, 2013]

<sup>6</sup> World DataBank. Urban population (% of total). Available online <http://data.worldbank.org/indicator/SP.URB.TOTL.IN.ZS> [Accessed on January 1st, 2013]

<sup>7</sup> Ghana Web. Tamale. Available online <http://www.ghanaweb.com/GhanaHomePage/geography/tamale.php> [Accessed on January 1st, 2013]

<sup>8</sup> Ghana Web. Foreign Exchange Rates. Available online <http://www.ghanaweb.com/GhanaHomePage/economy/forex.php> [Accessed on January 1st, 2013]

<sup>9</sup> SAS software. QUANTREG Procedure. Available online <http://support.sas.com/rnd/app/da/quantreg.html> [Accessed on January 5th, 2013]

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**Table 1. Descriptive statistics of variables**

<b>Variable name/type</b>	<b>Variable description / units of measurement</b>	<b>Mean</b>	<b>Std dev</b>
<b>Dependent variable:</b>			
<b>Food_Exp</b>	Weekly food spending (including fish and meat) in Ghanaian cedis	58.3291	41.3654
<b>Independent variables:</b>			
<b>Demographic factors</b>			
<b>Tamale</b>	=1 if a household is in Tamale	0.1845	0.3881
<b>Takoradi</b>	=1 if a household is in Takoradi	0.2083	0.4063
<b>Married</b>	=1 if a respondent is married	0.7530	0.4315
<b>Age</b>	Actual age in year	39.2361	10.6610
<b>Agesq</b>	Square of the actual age	1653.016	934.2486
<b>Age_12</b>	Number of household members between 4-12 years old	0.9425	1.0634
<b>Age_18</b>	Number of household members between 13-18 years old	0.9772	1.1910
<b>Adult(&gt;18)</b>	Number of household members older than 18 years old	2.2341	1.8714
<b>Adultsq</b>	Square of the number of household members older than 18 years old	8.4900	15.6150
<b>Socioeconomic factors</b>			
<b>Income</b>	Household income in the month preceding the survey in Ghanaian cedis	646.6074	785.7604
<b>Employ_self</b>	=1 if a respondent is self employed	0.6419	0.4797
<b>Employ_gov</b>	=1 if a respondent is gov/civil employee	0.2421	0.4285
<b>Educ</b>	=1 if a respondent has a secondary or higher education (including Senior high/GCE O-A level Vocational school, Technical school, Teacher training, University, Postgraduate)	0.5159	0.5000

**Table 2. Estimation results for the Expenditure on food**

Methods Variable name/Coef (std err.)	Quantile Regression				OLS
	0.25	0.5	0.75	0.9	
<b>Intercept</b>	-5.695 (8.602)	-8.206 (12.919)	1.225 (15.685)	4.570 (19.491)	-9.101 (10.591)
<b>Demographic factors</b>					
<b>Tamale</b>	-14.097*** (2.421)	-22.202*** (2.603)	-28.950*** (3.296)	-32.563*** (6.225)	-24.246*** (2.641)
<b>Takoradi</b>	-1.322 (2.970)	-6.518** (2.845)	-8.197*** (3.101)	-11.390* (6.096)	-6.268** (2.582)
<b>Married</b>	3.437 (2.114)	5.374** (2.160)	6.044** (2.792)	4.065 (4.542)	5.516** (2.194)
<b>Age</b>	1.136*** (0.429)	1.473** (.643)	1.395* (0.809)	1.789* (1.038)	1.401*** (0.526)
<b>Agesq</b>	-0.010** (0.005)	-0.013* (.007)	-.010 (0.009)	-.014 (.012)	-0.011* (0.006)
<b>Age_12</b>	0.690 (0.933)	2.108 (1.340)	3.763*** (1.340)	5.346*** (1.847)	2.546** (1.097)
<b>Age_18</b>	0.551 (0.815)	0.612 (1.154)	1.565 (1.411)	-.752 (1.792)	0.447 (1.045)
<b>Adult(&gt;18)</b>	3.264** (1.378)	3.638*** (1.347)	4.327** (1.722)	7.791*** (2.675)	6.480*** (1.384)
<b>Adultsq</b>	-0.272* (0.151)	-0.331** (0.157)	-.437*** (0.170)	-.721*** (.256)	-.589*** (.133)
<b>Socioeconomic factors</b>					
<b>Income</b>	0.0136*** (0.004)	0.024*** (0.005)	0.038*** (0.004)	0.045*** (.010)	0.023*** (.004)
<b>Employ_self</b>	-0.548 (2.625)	3.139 (3.393)	1.998 (4.387)	8.536* (5.059)	4.753* (2.804)
<b>Employ_gov</b>	-1.585 (3.213)	0.636 (3.702)	-5.484 (5.087)	-9.255 (5.753)	-2.531 (3.546501)
<b>Educ</b>	3.826* (2.321)	4.676* (2.484)	4.518 (3.170)	4.635 (4.558)	6.154** (2.424)

Note: \*, \*\* and \*\*\* denote significant at 10%, 5%, and 1% levels, respectively. Standard errors (in parentheses) are bootstrap estimates based on 500 replications of the design matrix.