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Demand for food in Ondo state, Nigeria: Using quadratic almost ideal demand system

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There has been great emphasis, on how to reduce the consequences of food insecurity on the people of Ondo State, Nigeria, as a result of which there is a lot of research into demand for food. Estimation of demand for food has ignored required connection between theory and empirical analysis and concentrated on the estimation of single linear demand equation. Even where non linear models such as Almost Ideal Demand System (AIDS) models were used; there was no allowance for a non-monotonic relationship between the marginal budget share and total expenditure. Thus, this study examined demand for food in Ondo State using standard Quadratic Almost Ideal Demand System (QUAIDS) and the specific objectives are: (i) to examine the expenditure pattern, (ii) to determine how household demography affects household expenditure for food, and (iii) to analyse the difference in expenditure purchase among the households in the three senatorial districts of the State. Data collected from 1,200 heads of households, through multistage sampling methods were analyzed. Result shows that the QUAIDS test is more reliable, as the Wald test{Chi2(9)=340.71; Prob≥Chi2=0.0000} indicates that lambda coefficients are jointly significantly different from zero and that the quadratic income terms are important, showing the superiority of QUAIDS model over the AIDS model. The estimated expenditure elasticities for all Ondo State are all positive and statistically significant at the 5%, indicating that all the food items are normal goods and that rice, beans, yam-flour, meat and vegetable and fruits are luxury goods since the coefficients are 1.419, 1.017, 1.385, 1.183 and 1.618 respectively which are greater than 1. However, garri, yam, bread and plantain are all necessity goods. The study conclude that policy-makers should consider consumer behavior at different income and price levels, as this will affect the rate at which people have access to food.

Key words: AIDS, QUAIDS, Elasticity, Expenditure, Food Demand and Household.

INTRODUCTION

The poverty situation in Nigeria is quite disturbing. Most quantitative measurements attest to the growing incidence and depth of poverty in the country (Okunmadewa, *1996*). This situation however, presents a paradox considering the vast human and physical resources that the country is endowed with. It is even more disturbing that despite the huge human and material resources that have been devoted to poverty reduction by successive governments, no significant success has been achieved. Although, predicted poverty reduction scenarios vary greatly depending upon the rate and nature of poverty related policies, actual evidence suggests that the depth and severity of poverty is still at its worst in Nigeria, Sub-Saharan Africa and South Asia (Hanmer and Nasehold, 2000; Barbier, 2000; Okunmadewa, *1996*). According to Yemi (2012), 112.519 million Nigerians live in relative poverty conditions, which represents 69% of the country's total population.

This is staggering when compared with the country's estimated 163 million population.

Yemi (2012) estimates that this trend may increase further into the future if the potential impacts of several anti-poverty programmes, such as food security intervention programme, are not taken into account.

Food is a basic necessity of life. Its importance, at the household level, is obvious since it is a basic means of sustenance. In view of the importance of food in man's life, food is rated as the most basic of all human needs. Man needs food for life's sustenance, prevention of sickness and in providing energy for the normal psychological activities of the body including the normal state of mind. Hence, the need for food security becomes pertinent as it eventually affects a nation's productivity and growth. Food security exists when all people at all times have access to safe nutritious food to maintain a healthy and active life (FAO, 2002). The main goal of food security is for individuals to be able to obtain adequate food needed at all times, and to be able to utilize the food to meet the body's needs.

Food security requires access to food both in terms of availability which is described as the ability of people to access food of adequate nutritional quality and quantity and be able to afford it. There is adequate access when there is adequate food availability to the household and, at the same time, the household has adequate capacity for effective demand for available food.

In the recent years, attention has been focused on the means to eliminate food insecurity and hunger worldwide. The International Conference on Nutrition, 1992 and the World Food Summit 1996, both emphasized the critical need to decrease food insecurity and hunger globally.

According to Sen (1981), Maxwell and Frankenberger (1992), Bentley and Pelto (1991) and USAID (1999), food security includes the related concepts of physical access to food, economic access to food and food utilization.

According to USAID (1999), food access, otherwise referred to as food demand or economic access to food is ensured when households and individuals within them have adequate resources to obtain appropriate foods for a nutritious diet. Access depends on income available to the household, the distribution of income within the household, and the price of food. In Nigeria, food prices continue to soar up day by day, and, ultimately going out of the reach of the common man while household incomes in the country are significantly debased by the staggering inflation rate. The retail price index for food in 1970, was 12.5% but this has risen outrageously to 548.2% in 2005. This underscores the fact that households' income can hardly cope with soaring food prices, which has compelled increased food spending out of households' income of between 60 percent and 80 percent coupled with poor income per capita, in Nigeria.

With increased emphasis on how to achieve food access so as to reduce consequences of food insecurity on the people in Nigeria, there is the urgent need to carry out more research on food demand. The compelling reason being that the country's population has grown to 167million with the growth rate of 3.75 per cent per annum (James, 2011) which causes a heavy pressure on demand for food. More research evidence on food demand is necessary, particularly at the State level, as national surveys may not be appropriate for prodding possible solutions. Ondo State is one of the States with a growing population rate and this should make the government and the policy makers to be interested in food access (demand) by the people. The objectives of the study therefore, are as follows: i) to examine the expenditure pattern for food in Ondo State. ii) to determine how household's demography affect household's expenditure for food. iii) to analyse the differences in expenditure purchases among the households in the three senatorial districts of the State. The sequence of the study is clear. The literature review is discussed in Section 2 while Section 3 deals with the methodology. Section 4 presents and discusses the empirical results and Section 5 deals with the study's conclusion.

Literature Review

Estimation of demand functions consistent with economic theory has been highly researched in the last four decades. Estimation of demand for goods and services has also attracted the attention of both theoreticians and empiricists, and a very dense literature is now available. Some of these studies such as Blundell (1998) have ignored required connections between theory and empirical analysis, while concentrating on the estimation of single linear demand equations. Given the doubts about the results of such an approach, empirical work such as Poi (2002) and Poi (forthcoming) has been directed towards the estimation of complete demand systems. Estimation of demand functions is very useful as it provides information on income and price elasticities. The measurement of income and price elasticities is required for the design of many different policies. For example, intelligent policy designs for indirect taxation and subsidies that require knowledge of these elasticities for taxable commodities and services.

The goal of demand analysis is to model households' expenditure patterns on a group of related items in order to obtain estimates of price and income elasticities and to estimate consumer welfare. As emphasized by Blundell (1988), there are few aspects of political economy that do not require some knowledge about consumers' household behavior. Empirical evidence on consumer's behavior is increasingly important in the formulation and analysis of economic policies. Consumption affects economic activity in several dimensions. For instance, one of the most often used practices to measure the effect of price changes on consumption is to estimate demand functions.

The analysis of consumer behavior is indispensable since there are few aspects of economic policy that do not require some knowledge of household behavior. To be able to estimate demand function, many functional forms are available, economic theory does not answer the question of which specification is the best to choose in estimating it.

Different approaches for comparison have been proposed in the literature. An elementary approach consists of estimating different specifications of demand functions with a given data set and selecting the one that has the best goodness of fit statistics (Berndt et al., 1977; Fisher et al, 2001). A second approach uses the fact that the properties of demand functions, derived from neo-classical preferences are known only in the region within which the functions satisfy theoretical regularity conditions. Knowing the location and size of the regular region can help support the choice of one functional form over another (Caves and Christensen, 1980; Barnett and Lee, 1985). A third approach uses a Monte Carlo study to explore accuracy of the demand model, when the true elasticities of substitutions are known (Barnett and Choi, 1989).

There has been widespread interest in choosing an estimate system of equation to represent household demand for various goods. These include the Linear Expenditure System (LES) of Stone (1954) which has been the pioneer in this area. However, LES has some limitations such as proportional income and price elasticities, and the ruling out of complementary relationships among goods. These limitation opened doors to the development of other models. Rotterdam model (Theil, 1965) and Translog model (Christensen, *et al*. 1975) can be listed among these more flexible models. However, Deaton and Muellbauer (1980) proposed an alternative modelling which they called Almost Ideal Demand System (AIDS).

AIDS gives an arbitrary first-order approximation to any demand system; it satisfies exactly the axioms of choice; it perfectly over aggregates consumers' choices without invoking parallel linear Engel curves; it has a functional form which is consistent with known household-budget data; it is simple to estimate, largely avoiding the need for non-linear estimation; and, it can be used to test the restrictions of homogeneity and symmetry through linear restrictions on fixed parameters. Although many of these desirable properties are possessed by one or the other of the Rotterdam or translog models, neither possesses all of them simultaneously.

Thus AIDS modelling has attracted a great deal of attention; and, it has been used extensively in empirical studies. Though AIDS has been widely used in analyzing consumption in developing countries, there is now evidence to suggest that the linearity of budget shares in the logarithm of household expenditure makes it a very restrictive model (Meenakshi and Ray, 1999). The AIDS model is locally flexible, in the sense that it does not put *a priori* restrictions on the possible elasticities at any one point. The model thus possesses enough parameters to approximate any elasticities at a given point. But, its locally flexible functional form often exhibits small regular region consistent with microeconomic theory. As a result, a number of alternative flexible functional forms with larger regular regions have been developed. Examples include the Quadratic AIDS model (QUAIDS) (Banks *et al*, 1997). This extension of AIDS is developed to make the model as rich as possible.

Studies across the world have emerged that confirm the appropriateness of QUAIDS in modelling preferences. Examples using developed countries data, include Abdulai (2002) who applies QUAIDS to the food expenditure data from Switzerland, Moro and Sckokai (2000) who use Italian food expenditure data; Gould and Villarreal (2006) using food expenditure data from urban China.

Banks *et al*. (1977) and Blundell and Robin (1999) who both use expenditure data on broad consumption goods from the U.K., and Fisher *et al*. (2001) who apply QUAIDS to the U.S. aggregate consumption data. A number of studies in developing countries are also emerging that support QUAIDS. However, these studies are fewer compared to those from developed countries. Examples include Abdulai and Aubert (2004) using Tanzanian food expenditure data, Meenkashi and Ray (1999) using Indian food expenditure data, and Molina and Gil (2005) using aggregate consumption data from Peru. Most of these studies, however, did not take into consideration demographic variables. In Africa, studies had also been carried out on food demand analysis using AIDS and a few studies using QUAIDS. These include Taljaard *et al* (2004), Ahmad *et al* (1993), and Robert (2009). Some of the studies, in South Africa, have typically been based on highly aggregate data and have either been limited to examining only one commodity (e.g. Taljaard, 2003; Nieuwoudt, 1998) or ignored any impact of demographic factors on food demand (Bowmaker and Nieuwoudt, 1990). The exception is the study by Agboola (2003) which is based on micro data and incorporates household demographics. However, he used cross–sectional data collected in 1993, one year prior to the major reforms introduced by the democratic government. Furthermore,Agboola's study is based on a

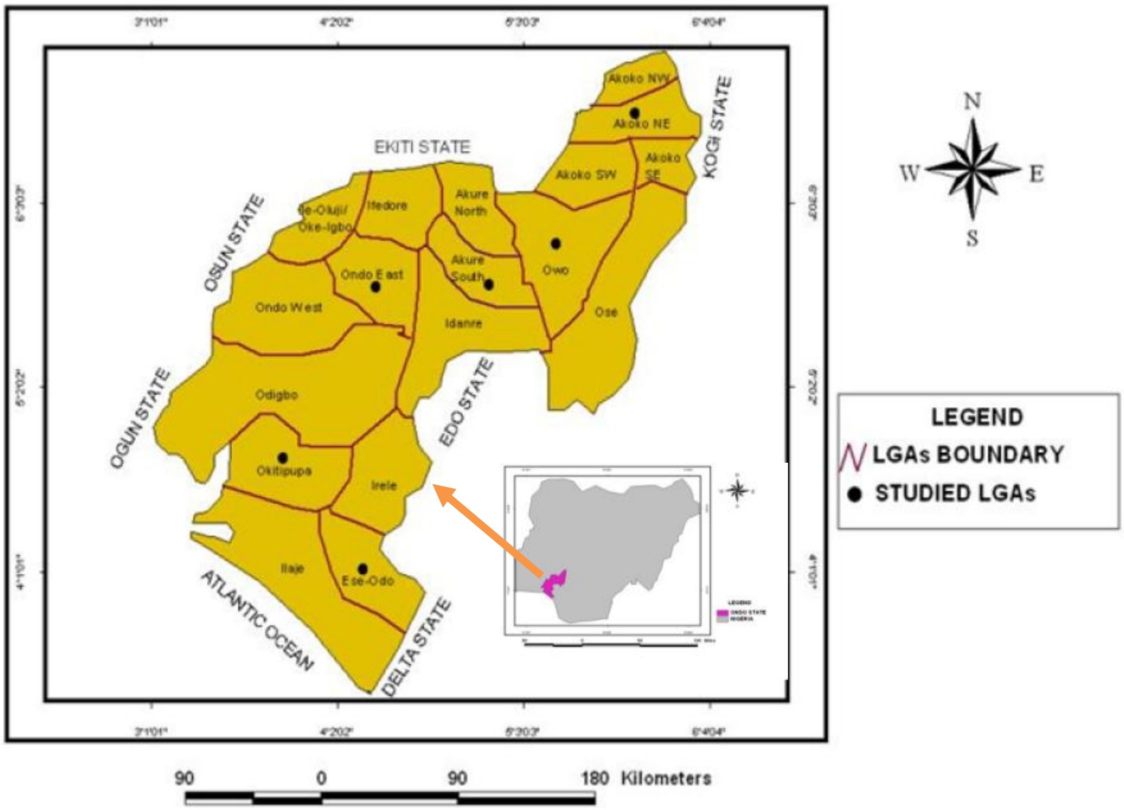

Figure 1: Map of the Study Area (inset: Nigeria showing Ondo) Source: Ondo State Ministry of Lands and Housing, Akure

restrictive linearized Almost Ideal Demand System (LA/AIDS) model, which does not allow for adequate curvature in the Engel curves. In a related study, using the KIDS data-set, Bopape and Myers (2000) explicitly tested for whether the demand model should be specified with a quadratic (QUAIDS) or a linear AIDS expenditure term and found evidence against AIDS. This study also tests for expenditure endogeneity and control for it where necessary.

In Nigeria, there are few literatures on food demand, majority of which centered on the demand for individual food items. Such studies include the study on the demand for rice by Odusina (2008) using AIDS model. In addition, scanty empirical studies have looked closely at the demand for food using QUAIDS model in Nigeria. For example, Abiodun *et al* (2009) looked at the impact of socio-economic variables on households' food demand. This did not consider the demographic factors. Also, it was a research considered for the North Central Nigeria. This present study deviated from the previous study as it looked at the pattern of food demand in Ondo State using QUAIDS model. The effect of the demographical factors was also taken into consideration.

METHODOLOGY

Study Area

Ondo state covers a land area of 14,793 square kilometres with its administrative capital at Akure. The population of the State in the 1991 Census, was 2,249,548 while the 2006 census put the population at 3,441,024. The State is made up of 18 Local Government Areas (LGAs); and, it is bounded in the North by Ekiti and Kogi States and in the South by the Atlantic Ocean. Ondo State is located entirely within the Tropics (see Figure 1).

The tropical climate of the State is broadly of two seasons: rainy season (April-October) and dry season (November – March). The temperature throughout the year ranges between 21^{oC} to 29^{oC} and humidity is relatively high. The annual rainfall varies from 2,000mm in the Southern areas to 1,150mm in the northern areas. The State enjoys luxuriant vegetation with high forest zone (rain forest) in the south and sub-savannah forest in the northern fringe.

There is a maze of numerous rivers, creeks and lakes in and around Ondo State with very prominent rivers like

Owena, Ala, Oluwa, Oni, Awara, Ogbese and Ose. Generally, the land rises from the coastal part of Ilaje, Ese-Odo and Okitipupa areas to highlands and inselbergs to the northern parts of the state.

The State's economy is basically agrarian with large scale production of cocoa, palm produce, timber and rubber. Other crops like maize, yam and cassava are produced in large quantities for both consumption and commerce.

Nature and Sources of Data

Both primary and secondary data were used for this study. The Questionnaire schedule was administered to generate necessary (primary) information. Data collected from 1,200 heads of households, through a multistage sampling method were analyzed. The eighteen LGAs in the state were the first stage sampling units. From these, six LGAs were selected, to reflect differences along senatorial districts. The selected LGAs are Akoko North East, Akure South, Ese Odo, Owo, Okitipupa and Ondo East (see Figure 1). Data were collected on some household characteristics such as income, expenditure, quantities of food commodities consumed etc. Data on important demographic variables were also collected, such as age and household sizes.

The secondary data such as population growth and price index etc were obtained from various issues of the Central Bank of Nigeria (CBN) publications.

Data Description

Data used were from a collection of households' budgets which have been opportunely organized in a data-set in order to give them a common structure and make room for comparison. By household budgets, data were collected on one or more families in relation to the following:

I. its demographic structure;
II. its expenditures on food items; and
III. its income.

Model Specification

Consideration was given for a consumer's demand for a set of k goods, for which the consumer has budgeted *y* sums of currency. For example, the *k* goods could represent different categories of food and the amount to be spent on food y , was chosen based on a two-stage budgeting process. Alternatively, the *k* goods could represent broad categories like rice, beans, garri, yam and yam flour and m is household income. Demand systems are typically specified with expenditure shares as the dependent variables. According to Poi (2002), the household's expenditure share for good *i* is defined as

$$w_i = \frac{p_i q_i}{y}$$

where pi is the price paid for good i, qi is the quantity of good i purchased or consumed, and y is the total expenditure on all goods in the demand system. With this definition of y,

$$\sum_{i=1}^{k} w_i = 1$$

where K is the total number of goods in the system. The QUAIDS model assumes that household preferences belong to the following quadratic logarithmic family of expenditure functions:

$$In(u, p) = Ina(p) + \frac{ub(p)}{1 - \text{ª}(p)b(p)u}$$

Where u is utility, p is a vector of prices, a(p) is a function that is homogeneous of degree one in prices, b(p) and (p) are functions that are homogeneous of degree zero in prices.

The quadratic AIDS model of Banks, Blundell, and Lewbel (1997) is based on the indirect utility function.

$$\ln V(p, y) = \left[\left\{ \frac{\ln y - \ln a(p)}{b(p)} \right\}^{-1} + \text{ª}(p) \right]^{-1}$$

where y is total expenditure. The specific functional form is

$$\text{ª}(p) = \sum_{i=1}^{k} \text{ª}_i InP_{i,} \quad \text{where} \quad \sum_{i=1}^{k} \text{ª}_i = 0$$

and where i = 1, ,k denote the number of goods entering the demand model. And where In a(p) is the transcendental logarithm function

$$\ln a(p) = \sim_0 + \sum_{i=1}^{k} \sim_i \ln p_i + \frac{1}{2} \sum_{i=1}^{k} \sum_{j=1}^{k} \text{¥}_{ij} \ln p_i \ln p_k$$

Pi is the price of good i for i = l ……. k, b(p) is the Cobb-Douglas price aggregator

$$b(p) = \prod_{i=1}^{k} p_i^{\quad i}$$

and

$$\text{ª}(p) = \sum_{i=1}^{k} \text{ª}_i \ln p_i$$

The fact that $\sum_i w_i = 1$ is often called the adding-up condition and this condition is satisfied if the following hold, that is if:

$$\sum_{i=1}^{k} \sim_i = 1 \quad \sum_{i=1}^{k} {}_i = 0 \quad \sum_{i=1}^{k} ª_i = 0 \text{ and } \sum_{i=1}^{k} ¥_{ii} = 0 \quad \forall i$$

The adding-up restrictions are not testable, and are imposed by dropping one of the share equations and estimating the remaining equations.

Moreover, since demand functions are homogeneous of degree zero in (p,y),

$$\sum_{i=1}^{k} ¥_{ii} = 0 \quad \forall i$$

Slutsky symmetry implies that

$$¥_{ii} = ¥_{ii}$$

Usually, $\sim_0$ is difficult to estimate directly and so is set equal to the minimum level of expenditure that would be needed for subsistence if all prices were equal to one.

To be able to specify the expenditure model if q_i denote the quantity of good *i* consumed by a household, and define the expenditure share for good I as $w_i = \frac{p_i q_i}{y}$.

Applying Roy's Identity as used in Poi (2012) to equation (1),

$$w_i = \sim_i + \sum_{j=1}^{k} ¥_{ij} \ln p_j + {}_i \ln\left\{\frac{y}{a(p)}\right\} + \frac{ª_i}{b(p)}\left[\ln\left\{\frac{y}{a(p)}\right\}\right]^2, i = 1.....k$$

When $ª_i$ for all I, the quadratic term in each expenditure share equation drops out, and we are left with Deaton and Muellbauer's (1980a) original AIDS model.

Consider the original AIDS model without the quadratic term:

$$w_i = \sim_i + \sum_{j=1}^{k} ¥_{ij} \ln p_j + {}_i \ln\left\{\frac{y}{a(p)}\right\}, i = 1.....k$$

This set of expenditure share equations requires nonlinear estimation techniques because of the price index $\ln a(p)$. Deaton and Muellbauer (1980) suggests replacing that price index with the approximation $\ln a(p) \approx \sum_j w_j \ln p_j$, resulting in a set of equations that can be fit by linear estimation techniques.

If a demographic variable is introduced, using the scaling technique by Poi (2012) and extended to the quadratic AIDS model . We use x to represent a vector of s characteristics. In the simplest case, x could be a scalar representing the number of people in a household. Let $e^R(p,u)$ denote the expenditure function of a reference household, where a reference household might be one that contains just a single adult.

Ray's method uses for each household an expenditure function of the form

$$e(p,x,u) = y_0(p,x,u).e^R(p,u)$$

The function $y_0(p,x,u)$ scales the expenditure function to account for the household characteristics. Ray further decomposes the scaling function as

$$m_0(p,x,u) = \tilde{y}_0(z).¤(p,x,u)$$

The first term measures the increase in a household's expenditures as a function of z, not controlling for any changes in consumption patterns.

Following Poi (2012) QUAIDS parameterizes $\bar{y}_0(x)$ as

$$\bar{y}_0(x) = 1 + p'x$$

Where p is a vector of parameters to be estimated. As in Poi (2002) QUAIDS parameterizes $¤(p,x,u)$ as

$$\ln ¤(p,x,u) = \frac{\prod_j^k p_j^{\;j}\left(\prod_{j=1}^k p_j^{n_j^{§x}} - 1\right)}{\frac{1}{u} - \sum_{j=1}^k ª_j \ln p_j}$$

The expenditure share equations take the form

$$w_i = \sim_i + \sum_{j=1}^{k} ¥_{ij} \ln p_j + ({}_i + ¦_i' x)\ln\left\{\frac{y}{\bar{y}(x)a(p)}\right\} + \frac{ª_i}{b(p)c(p,x)}\left[\ln\left\{\frac{y}{\bar{y}_0(x)a(p)}\right\}\right]^2$$

$¦_j$ represents the jth column of s x k parameter $¦$.

Where $\quad c(p,x) = \prod_{j=1}^{k} p_j^{n_j'x}$ i

The adding-up condition requires that $\sum_{j=1}^{k} ¦_{rj} = 0$ for r=1….s, if we set $ª_i$ for all i, we are left with the AIDS model with demographics used by Poi (2012).

According to Poi, the formulas for elasticities for the standard AIDS model and models without demographics are nested within the more general variants and that the uncompensated price elasticity of good i with respect to changes in the price of good j is

$$\in_{ij} = -¢_{ij} + \frac{1}{wi}\left[¥_{ij} - \left[{}_i + ¦_i' x + \frac{2ª_i}{b(p)c(p,x)}\ln\left\{\frac{y}{\bar{y}_0(x)a(p)}\right\}\right]\right] \text{ x}$$

Table1: Descriptive Statistics for Important Variables

Variable |	Obs	Mean	Std. Dev.	Min	Max
p1 |	506	710.2391	1564.553	0	10000
p2 |	509	355.389	629.7846	0	5200
p3 |	509	331.2711	579.184	0	10000
p4 |	508	371.998	560.8679	0	6500
p5 |	508	299.0768	877.5562	0	15000
p6 |	509	168.9391	194.1741	0	2000
p7 |	507	664.0828	657.4763	0	8500
p8 |	506	841.9368	1785.45	0	25000
p9 |	509	260.2299	680.2813	0	10000
p10 |	502	813.8446	2707.545	0	21200
expfd |	509	13889.93	10258.12	.1	72600
w1 |	509	.2175226	.1696917	0	2.19
w2 |	508	.1087008	.1002555	0	.59
w3 |	509	.10778	.0777462	0	.8
w4 |	508	.112185	.0974778	0	.72
w5 |	509	1.621947	35.45729	0	800
w6 |	508	.0654114	.0608009	0	.65
w7 |	509	.0839587	.0806232	0	.8
w8 |	508	.1792421	.1114229	0	.9
w9 |	509	.0566601	.0729927	0	.82
w10 |	504	.0400972	.0515709	0	.46
lnp1 |	509	2.531906	.4331065	0	4
lnp2 |	507	2.219941	.5831523	0	3.72
lnp3 |	509	2.373811	.438068	0	4
lnp4 |	507	2.15503	.8415275	0	3.81
lnp5 |	509	1.316562	1.294029	0	4.18
lnp6 |	509	1.896346	.7904257	0	3.3
lnp7 |	506	2.402628	1.008549	0	3.93
lnp8 |	509	2.588271	.5825799	0	4.4
lnp9 |	509	1.893733	.6809924	0	4
lnp10 |	508	1.586949	1.321028	0	4.33
lnexp |	509	3.750334	1.212449	-1	4.86
age |	507	32.1144	13.54639	0	79
hhsize |	484	4.721074	2.740444	1	26

$$\left(\sim_j + \sum_l \text{¥}_{jl} \ln pl\right) - \frac{\left(_j + \text{¦}'_j x\right)\text{a}_i}{b(p)c(p,x)}\left[\ln\left\{\frac{y}{\bar{y}(x)a(p)}\right\}^2\right]$$

The expenditure (income) elasticity for good i is

$$\text{«}_i = 1 + \frac{1}{w_i}\left[\ _i + \text{¦}'_i x + \frac{2\text{a}_i}{b(p)c(p,x)}\ln\left\{\frac{y}{\bar{y}_0(x)a(p)}\right\}\right]$$

Compensated price elasticities are obtained from the Slutsky equation as

$$\in^c_{ij} = \in_{ij} + \text{«}_i w_j$$

Estimation Methods

The use of the quadratic model is justified by the quadratic relationship between the budget shares and the logarithm of total expenditures. The inclusion of demographic variables is meant to study whether the diet of the family members depends on the age of the individual. Variables related to household's demography are expected to affect the allocation of household expenditures among goods mainly because of economies of scale and because families of different sizes and composition have different needs (Blow, 2003).

RESULTS

Descriptive Result

In an attempt to look at the expenditure pattern for food demand, in Ondo State, this section begins by examining the descriptive statistics of the data used in the study. These include: descriptive statistics for prices, expenditure shares, and total expenditure for each household age and household size for the period covered in the study. All these are in Table 1.

Table 1 shows that P8 has the largest mean followed by P10. While P10 has the largest standard deviation, P6 has the smallest standard deviation. The mean and standard deviation for the total expenditure are 13889.93 and 10258.12. The mean value for age and household size are 32.11 and 4.72 respectively.

Figure 2a shows the head of household by age group. The Figure shows that those above the age of 60 years are more in the South Senatorial District of the State followed by the Central Senatorial District. Those between the ages of 30 - 44 years are less in the Central Senatorial district. Figure 2b shows the head of household by sex and local government.

The mean number of males who are heads of household are more in each of the LGAs in the study area. Figure 2c shows that the mean household size for rural area is high in both the Ondo Central Senatorial and Southern Senatorial districts. While the average household size for rural and urban in Central and South Senatorial was 3 and 4 respectively, but for the urban, it was 2 and 3 respectively. At the North Senatorial area, the average household size was 5 each for both rural and urban areas. Figure 2d shows the scatterplot matrices

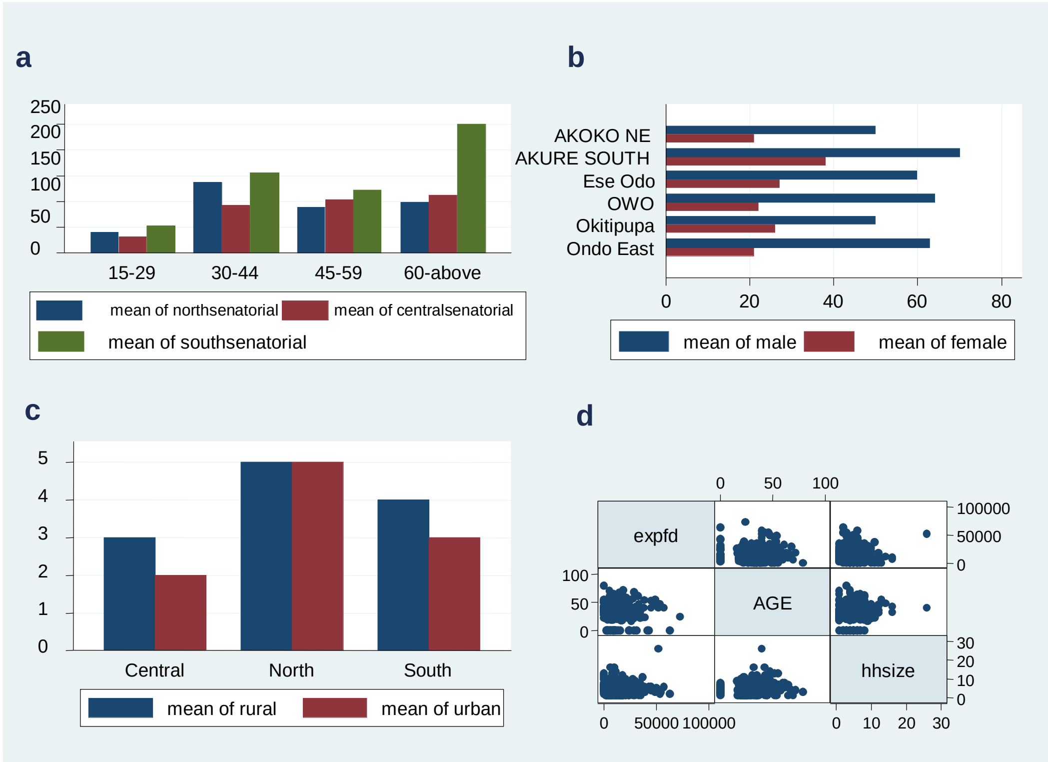

Figure 2. (a) Head of household by age group; **(b)** Head of household by sex and local government; **(c)** Household size; **(d)** Scatterplot correlation matrix among age, household size and expenditure

between total expenditure for food, age and household size. This is used to look at the relationship between all these variables. In each plot, the variable to the side of the graph is used as the Y variable and the variable above or below the graph is used as the X Variable (Ulrich *et al*, 2008). In the first line of the Figure 2d are scatter plots of expenditure for food against age and household size. This shows that there is positive relationship between expenditure and age and between expenditure and household size.

Table 2 shows the results of the estimated parameters of the AIDS model with demographic variables (age and household size). The third column reports parameter estimates of the AIDS model while the fourth column reports the value of the standard error.

Most of the 55 price effect are significantly different from zero at the 5% significance level, suggesting that there is much quantity response to movement in relative prices, that is, a change in price leads to systemic change in the expenditure share for each of the commodities. The coefficient of the household size is positively related to the expenditure share indicating that as the household size increases, the expenditure share for food also increases. This result is in line with Horowitz (2002). However, most of the coefficients of age are negative, indicating that at a younger age, the rate of consumption tend to be high.

Table 3 shows the estimated parameters of the QUAIDS model with demographic variables (age and household size) using data on all of Ondo State. Most of the prices effects are significantly different from zero at the 5% significance level, suggesting that there is much quantity response to movement in relative prices. The expenditure squared term on food is significant for all the food captured in the model. This contrasts with similar studies like Surabhi (2008) that the squared terms of expenditure on food are significant only for two of the food item captured in his study. The result of the QUAIDS model also show that the demand for food depends on the age and household composition of the household.

We interprete result only for the QUAIDS model. This is so because the finding shows that the QUAIDS test is more reliable, as the Wald test{Chi2(9)=340.71; Prob≥Chi2=0.0000} indicates that lambda coefficients are jointly significantly different from zero and that the quadratic income terms are important showing the

Table 2: Estimated Parameters of the AIDS Food Demand System with Demographic Variables Using Data on Ondo State

Variable	Eq	Coefficient	Std. Error
Constant	α1	0.153	0.025
	α2	0.096	0.180
	α3	0.115	0.014
	α4	0.094	0.017
	α5	0.048	0.012
	α6	0.056	0.011
	α7	0.002	0.012
	α8	0.216	0.021
	α9	0.081	0.013
	α10	0.138	0.010
Expenditure	β1	0.000	0.004
	β2	0.004	0.003
	β3	0.001	0.002
	β4	0.002	0.003
	β5	0.004	0.002
	β6	0.003	0.002
	β7	0.011	0.002
	β8	0.006	0.003
	β9	0.001	0.002
	β10	0.011	0.001
Prices	[illegible]	0.089	0.012
	[illegible]	0.009	0.006
	[illegible]	0.022	0.006
	[illegible]	0.002	0.006
	[illegible]	0.002	0.004
	[illegible]	0.002	0.004
	[illegible]	0.004	0.004
	[illegible]	0.028	0.007
	[illegible]	0.028	0.005
	[illegible]	0.012	0.003
	[illegible]	0.054	0.006
	[illegible]	0.008	0.004
	[illegible]	0.004	0.004
	[illegible]	0.011	0.002
	[illegible]	0.016	0.002
	[illegible]	0.011	0.002
	[illegible]	0.024	0.005
	[illegible]	0.006	0.003
	[illegible]	0.001	0.002
	[illegible]	0.051	0.006
	[illegible]	0.007	0.003
	[illegible]	0.008	0.002
	[illegible]	0.000	0.002
	[illegible]	0.006	0.002
	[illegible]	0.008	0.004
	[illegible]	0.004	0.003
	[illegible]	0.003	0.002
	[illegible]	0.054	0.005
	[illegible]	0.000	0.002
	[illegible]	0.006	0.002
	[illegible]	0.003	0.002
	[illegible]	0.012	0.004
	[illegible]	0.011	0.003
	[illegible]	0.004	0.002
	[illegible]	0.032	0.002
	[illegible]	0.001	0.001
	[illegible]	0.002	0.001
	[illegible]	0.003	0.002
	[illegible]	0.004	0.001
	[illegible]	0.002	0.001
	[illegible]	0.036	0.002
	[illegible]	0.004	0.001
	[illegible]	0.003	0.003
	[illegible]	0.000	0.002
	[illegible]	0.001	0.001
	[illegible]	0.040	0.002
	[illegible]	0.006	0.003
	[illegible]	0.000	0.002
	[illegible]	0.002	0.001
	[illegible]	0.081	0.007
	[illegible]	0.005	0.004
	[illegible]	0.000	0.002
	[illegible]	0.051	0.004
	[illegible]	0.001	0.001
	[illegible]	0.026	0.001
Age	Age 1	0.035	0.021
	Age 2	0.091	0.050
	Age 3	1.070	0.001
	Age 4	0.609	0.031
	Age 5	3.111	0.000
	Age 6	5.217	0.000
	Age 7	1.006	0.011
	Age 8	0.817	0.026
	Age 9	1.002	0.001
	Age 10	0.220	0.111
Household Size	hhsize 1	1,012	0.000
	hhsize 2	2.011	0.001
	hhsize 3	4.014	0.003
	hhsize 4	0.290	0.000
	hhsize 5	0.011	0.000
	hhsize 6	0.023	0.000
	hhsize 7	2.007	0.050
	hhsize 8	1.024	0.031
	hhsize 9	0.201	0.000
	hhsize 10	1.015	0.001

Sources: Author's Computation using Stata 11

Table 3: Estimated Parameters of the QUAIDs Food Demand System with Demographic Variables Using Data on All of Ondo State

Variable	Eq.	Coefficient	Std. Error
Constant	α_1	0.298	0.039
	α_2	0.049	0.029
	α_3	0.106	0.021
	α_4	0.084	0.026
	α_5	0.091	0.019
	α_6	0.036	0.016
	α_7	0.040	0.020
	α_8	0.215	0.033
	α_9	0.122	0.019
	α_{10}	0.034	0.013
Expenditure Squared	β_1	0.053	0.015
	β_2	1.010	0.011
	β_3	0.201	0.008
	β_4	0.018	0.010
	β_5	0.106	0.007
	β_6	0.014	0.006
	β_7	0.043	0.007
	β_8	0.115	0.012
	β_9	0.014	0.007
	β_{10}	0.013	0.005
Prices	[illegible]	0.099	0.013
	[illegible]	0.007	0.006
	[illegible]	0.020	0.006
	[illegible]	0.003	0.005
	[illegible]	0.001	0.003
	[illegible]	0.005	0.004
	[illegible]	0.012	0.004
	[illegible]	0.025	0.007
	[illegible]	0.025	0.005
	[illegible]	0.015	0.003
	[illegible]	0.055	0.006
	[illegible]	0.007	0.004
	[illegible]	0.004	0.004
	[illegible]	0.011	0.002
	[illegible]	0.015	0.003
	[illegible]	0.009	0.003
	[illegible]	0.025	0.005
	[illegible]	0.006	0.003
	[illegible]	0.002	0.002
	[illegible]	0.051	0.006
	[illegible]	0.008	0.003
	[illegible]	0.007	0.002
	[illegible]	0.000	0.002
	[illegible]	0.006	0.002
	[illegible]	0.008	0.004
	[illegible]	0.003	0.003

Table 3. Cont.

	γ_{103}	0.003	0.002
	γ_{44}	0.054	0.005
	γ_{54}	0.000	0.002
	γ_{64}	0.006	0.002
	γ_{74}	0.003	0.002
	γ_{84}	0.012	0.004
	γ_{94}	0.011	0.003
	γ_{104}	0.004	0.001
	γ_{55}	0.032	0.002
	γ_{65}	0.001	0.001
	γ_{75}	0.002	0.001
	γ_{85}	0.003	0.002
	γ_{95}	0.005	0.001
	γ_{105}	0.002	0.001
	γ_{66}	0.037	0.002
	γ_{76}	0.001	0.002
	γ_{86}	0.004	0.003
	γ_{96}	0.001	0.002
	γ_{106}	0.000	0.001
	γ_{77}	0.045	0.003
	γ_{87}	0.007	0.003
	γ_{97}	0.001	0.002
	γ_{107}	0.000	0.001
	γ_{88}	0.082	0.007
	γ_{98}	0.006	0.004
	γ_{108}	0.001	0.002
	γ_{99}	0.052	0.004
	γ_{109}	0.002	0.001
	γ_{1010}	0.027	0.001
Expenditure	λ_1	0.003	0.000
	λ_2	0.001	0.000
	λ_3	0.000	0.000
	λ_4	0.000	0.001
	λ_5	0.010	0.014
	λ_6	1.005	0.002
	λ_7	0.202	0.000
	λ_8	0.300	0.000
	λ_9	0.001	0.000
	λ_{10}	0.001	0.000
Age	Age 1	0.301	0.000
	Age 2	2.004	0.001
	Age 3	3.011	0.002
	Age 4	0.001	0.000
	Age 5	0.023	0.051

Table 3. Cont.

	Age 6	3.020	0.022
	Age 7	0.041	0.000
	Age 8	0.007	0.000
	Age 9	2.150	0.000
	Age 10	0.061	0.002
Household size	hhsize 1	2.011	0.003
	hhsize 2	0.924	0.001
	hhsize 3	0.001	0.000
	hhsize 4	2.701	0.006
	hhsize 5	0.001	0.000
	hhsize 6	1.014	0.005
	hhsize 7	3.061	0.012
	hhsize 8	0.371	0.003
	hhsize 9	0.021	0.001
	hhsize 10	0.007	0.000

Sources: Author's Computation using Stata 11

superiority of QUAIDS model over the AIDS model. That is the quadratic model rather than the AIDS model is good because of the quadratic relationship between the budget shares and the logarithm of the total expenditure. This finding accords with that of Luca (2007).

Compensated Elasticities

Compensated or Hicksian elasticities are reduced to contain only price effects, and are thus compensated for the effect of a change in the relative income on demand. By using the parameter estimates in Table 4 for both AIDS and QUAIDS model in all of Ondo State, the compensated own and cross-price elasticities, were calculated at their sample means and are shown in Table 4.

The compensated own and cross-price elasticities for both AIDS and QUAIDS model was shown on Tables 5 to 7 for Ondo South, Ondo North and Ondo Central Senatorial Districts.

Compensated own price elasticities of all ten foods are fairly relatively inelastic (see Table 4). For QUAIDS model, most of the food items carry negative signs in accordance with the *a priori* expectation and are statistically significant at the 5% level. The compensated own price elasticity in all of Ondo State for beverages (-0.508) is the most elastic, followed by the own price elasticity for beans (-0.4020), rice (-0.399), and garri (-0.397). Except for the cross-price elasticity for few of the foods that are compliments, such as, yam flour and gari, yam and gari, rice and plantain, and vice versa all other cross-price elasticities carry positive signs as expected for substitute products. Similar to the own price elasticities, the cross-price elasticities are all statistically significant at the 5% level. Regarding the cross-price elasticities for all the state put together using the QUAIDS model, the consumption of rice shows the strongest substitution response for the price of gari (0.347), whereas the consumption of gari isn't as responsive to the price of rice (0.04). The second strongest substitute response is the consumption of rice for the price of beverage (0.217), followed by rice for yam (0.207). This scenario is also similar to what obtained in each of the senatorial districts of the state.

Uncompensated Elasticities

Uncompensated or Marshallian price elasticities contain both the income and price effects. Similar to the compensated own and cross-price elasticities, the uncompensated own and cross-price elasticities were calculated at their sample means and results are shown in panel 4 of Table 4. As for the case of the compensated own price elasticities, the uncompensated own price elasticities possess the expected negative signs and are statistically significant at the 5% level. The uncompensated own price elasticities of rice (-0.70), yam (-0.468), beans (-0.509) and yam (-0.483) are all significant. The consumption of beverages shows the strongest substitution response for the price of fruit and vegetable (0.256), followed by meat for plantain (0.208).

Table 8 shows the expenditure elasticity of demand for major food groups in Ondo State and each of the Senatorial areas as estimated using the QUAIDS model. The elasticities are presented at the mean level. The expenditure elasticities are computed for the food, which are rice, garri, beans, yam, yam flour, bread, beverages, meat, fruit and vegetable and plantain.

The estimated expenditure elasticities for all Ondo State are all positive and statistically significant at the 5% level, indicating that all the food items are normal goods. And that rice, beans, yam flour, meat, and vegetables and fruits are luxury goods since the coefficient 1.419, 1.017, 1.385, 1.183 and 1.618, respectively which are all greater than l. However, garri, yam, bread, beverages and plantain are all necessity goods. From this result, it can be inferred that for the people to be able to get the required protein sources from meat and enough vitamin from beans, the government must encourage the consumption of each of these food items so that people can afford it.

The calculated expenditure elasticities for each of the Senatorial District, differ. The elasticities are all positive and significant at 5% level for Ondo North, indicating normal goods for some of the foods with the exception of garri, yam, bread and beverages which are necessity

Table 4: Price Elasticity of the AIDs and QUAIDS Food Demand System using Data on All of Ondo State. Compensated or Hicksian Elasticity (AIDS model)

	RICE	GARI	BEANS	YAM	YAM FLOUR	BREAD	BEVERAGES	MEAT	FRUITS AND VEGETABLES	PLANTAIN
RICE	-0.367	0.152	0.001	0.097	0.055	0.054	0.609	0.043	-0.078	-0.018
GARI	0.303	-0.38	0.186	0.068	-0.066	-0.088	-0.022	-0.05	-0.003	0.051
BEANS	0.002	0.188	-0.406	0.04	-0.029	0.062	0.026	0.094	0.014	0.008
YAM	0.189	0.067	0.039	-0.387	0.04	0.001	0.046	0.063	-0.054	-0.005
YAM FLOUR	0.252	-0.149	-0.065	0.093	-0.253	0.038	0.034	0.111	-0.048	-0.013
BREAD	0.178	-0.145	0.1	0.002	0.027	-0.372	0.018	0.125	0.051	0.016
BEVERAGES	0.157	-0.028	0.033	0.061	0.019	0.014	-0.441	0.112	0.057	0.016
MEAT	0.052	-0.03	0.056	0.038	0.029	0.046	0.052	-0.369	0.089	0.039
FRUITS & VEGETABLES	-0.299	-0.006	0.027	-0.106	-0.04	0.059	0.085	0.284	-0.017	0.012
PLANTAIN	-0.101	0.141	0.02	-0.014	-0.015	0.027	0.034	0.18	0.017	-0.289
Uncompensated or Marshallian Elasticity (AIDS Model)										
	RICE	**GARI**	**BEANS**	**YAM**	**YAM FLOUR**	**BREAD**	**BEVERAGES**	**MEAT**	**FRUITS AND VEGETABLES**	**PLANTAIN**
RICE	-0.576	0.047	-0.102	-0.01	0.01	-0.009	-0.02	-0.132	-0.133	-0.057
GARI	0.09	0.486	0.081	-0.399	-0.112	-0.153	-0.104	-0.228	-0.059	0.013
BEANS	-0.214	0.795	-0.513	-0.071	-0.077	-0.004	-0.058	-0.088	-0.042	-0.032
YAM	-0.019	-0.037	-0.064	0.493	-0.006	-0.062	-0.035	-0.112	-0.109	-0.432
YAM FLOUR	0.054	-0.248	-0.163	-0.008	-0.296	-0.023	-0.043	-0.056	-0.1	-0.049
BREAD	-0.027	-0.247	-0.002	-0.102	-0.018	-0.435	-0.062	-0.466	-0.003	-0.021
BEVERAGES	-0.032	-0.122	-0.06	-0.036	-0.023	-0.044	-0.515	-0.047	0.008	-0.018
MEAT	-0.17	-0.141	-0.054	-0.075	-0.02	-0.022	-0.034	-0.555	0.031	-0.001
FRUITS & VEGETABLES	-0.514	-0.114	-0.08	-0.216	-0.088	-0.007	0.001	0.104	-0.073	-0.027
PLANTAIN	-0.369	0.007	-0.112	-0.151	-0.074	-0.054	-0.07	-0.045	-0.053	-0.338
Compensated or Hicksian Elasticity (QUAIDS Model)										
	RICE	**GARI**	**BEANS**	**YAM**	**YAM FLOUR**	**BREAD**	**BEVERAGES**	**MEAT**	**FRUITS AND VEGETABLES**	**PLANTAIN**
RICE	-0.399	0.174	0.003	0.11	0.041	0.066	0.01	0.018	-0.099	-0.015
GARI	0.347	-0.397	0.18	0.055	-0.049	-0.101	-0.067	-0.028	0.018	0.043
BEANS	0.015	0.178	-0.402	0.032	-0.025	0.06	0.018	0.095	0.025	0.004
YAM	0.207	0.057	0.032	-0.39	0.046	-0.005	0.029	0.074	-0.039	-0.009
YAM FLOUR	0.167	-0.104	-0.01	0.113	-0.28	0.062	0.11	0.073	-0.093	0.013
BREAD	0.197	-0.158	0.01	-0.009	0.037	-0.377	-0.008	0.14	0.061	0.017
BEVERAGES	0.212	-0.068	0.03	0.038	0.044	-0.006	-0.508	0.157	0.095	0.007
MEAT	0.035	-0.022	0.055	0.044	0.024	0.501	0.07	-0.375	0.078	0.04
FRUITS & VEGETABLES	-0.367	0.031	0.041	-0.073	-0.07	0.077	0.159	0.238	-0.056	0.018
PLANTAIN	-0.006	0.087	0.022	-0.045	0.021	-0.001	-0.078	0.235	0.597	-0.292

Tabl 4. Cont.

	Uncompensated or Marshallian Elasticity (QUAIDS Model)									
	RICE	**GARI**	**BEANS**	**YAM**	**YAM FLOUR**	**BREAD**	**BEVERAGES**	**MEAT**	**FRUITS AND VEGETABLES**	**PLANTAIN**
RICE	-0.7	0.023	-0.146	-0.444	-0.025	-0.027	-0.018	-0.235	-0.178	-0.07
GARI	0.206	-0.468	0.11	-0.017	-0.08	-0.144	-0.122	-0.146	-0.019	0.017
BEANS	-0.201	0.07	-0.509	-0.079	-0.073	-0.006	-0.086	-0.032	-0.035	0.004
YAM	0.025	-0.035	-0.058	-0.483	0.006	0.061	-0.042	-0.08	-0.087	-0.423
YAM FLOUR	-0.128	-0.251	-0.207	-0.037	-0.345	-0.028	-0.005	-0.174	-0.17	-0.041
BREAD	0.059	-0.228	0.031	-0.08	0.007	-0.419	-0.062	0.024	0.025	-0.009
BEVERAGES	0.178	-0.857	0.013	0.2	0.367	-0.016	-0.522	0.128	0.086	0
MEAT	-0.217	-0.148	-0.07	-0.084	-0.032	-0.027	-0.028	-0.586	0.013	-0.006
FRUITS & VEGETABLES	-0.711	-0.141	-0.129	-0.249	-0.145	-0.029	0.256	-0.05	-0.146	-0.045
PLANTAIN	-0.038	0.071	0.006	-0.062	0.014	-0.011	-0.09	0.208	0.051	-0.298

Sources: Author's Computation

Table 5: Price Elasticity of the AIDs and QUAIDS Food Demand System using Data on Ondo South. Compensated or Hicksian Elasticity (AIDS model)

	RICE	**GARI**	**BEANS**	**YAM**	**YAM FLOUR**	**BREAD**	**BEVERAGES**	**MEAT**	**FRUITS AND VEGETABLES**	**PLANTAIN**
RICE	-0.374	0.092	0.092	0.141	0.052	0.027	0.016	-0.0004	-0.05	0.005
GARI	0.272	-0.487	0.141	0.134	-0.019	-0.079	-0.044	0.108	-0.059	0.035
BEANS	0.218	0.113	-0.372	0.046	0.002	0.021	0.006	-0.052	0.037	-0.018
YAM	0.313	0.101	0.043	-0.47	0.081	-0.007	0.005	-0.035	0.019	-0.051
YAM FLOUR	0.245	-0.032	0.005	0.174	-0.4	-0.027	0.017	0.072	-0.045	-0.009
BREAD	0.127	-0.123	0.039	-0.014	-0.026	-0.504	0.108	0.375	0.005	0.011
BEVERAGES	0.062	-0.053	0.009	0.008	0.013	0.087	-0.406	0.177	0.099	0.004
MEAT	-0.003	0.069	-0.041	-0.031	0.028	0.155	0.093	-0.349	0.037	0.042
FRUITS & VEGETABLES	-0.306	-0.122	0.093	0.052	-0.057	0.007	0.167	0.118	4.812	0.046
PLANTAIN	0.057	0.125	-0.081	-0.238	-0.021	0.025	0.013	0.229	0.079	-0.189
	Uncompensated or Marsallian Easticity (AIDS Model)									
	RICE	**GARI**	**EANS**	**YAM**	**YAM FLOUR**	**BREAD**	**BEVERAGES**	**MEAT**	**FRUITS AND VEGETABLES**	**PLANTAIN**
RICE	-0.695	-0.017	-0.043	-0.003	-0.016	0.043	-0.072	-0.171	-0.103	-0.025
GARI	0.057	-0.559	-0.05	0.037	-0.065	-0.127	-0.103	-0.007	-0.096	0.015
BEANS	-0.045	0.025	-0.483	-0.072	-0.053	-0.037	-0.066	-0.192	-0.007	-0.044
YAM	-0.019	-0.012	-0.097	-0.619	0.012	-0.079	-0.086	-0.212	-0.035	-0.083
YAM FLOUR	-0.057	-0.134	-0.122	0.039	-0.463	-0.093	-0.065	-0.089	-0.094	-0.038

Table 5. Cont.

BREAD	-0.077	-0.193	-0.046	-0.105	-0.069	-0.548	0.052	0.267	-0.029	-0.009
BEVERAGES	-0.018	-0.08	-0.025	-0.027	-0.004	0.069	-0.428	0.135	0.087	-0.003
MEAT	-0.276	-0.023	-0.157	-0.153	-0.029	0.095	0.018	-0.495	-0.009	0.016
FRUITS & VEGETABLES	-0.631	-0.232	-0.044	-0.094	-0.125	-0.064	0.078	-0.054	-0.054	0.015
PLANTAIN	-0.128	0.062	-0.159	-0.321	-0.059	-0.015	-0.038	0.131	0.049	-0.207
					Compensated or Hicksian Easticity (QUAIDS Model)					
	RICE	**GARI**	**EANS**	**YAM**	**YAM FLOUR**	**BREAD**	**BEVERAGES**	**MEAT**	**FRUITS AND VEGETABLES**	**PLANTAIN**
RICE	-0.736	0.106	0.25	0.27	0.237	0.169	0.161	-0.359	0.156	0.055
GARI	-0.089	-0.474	0.314	0.277	0.173	0.066	0.116	-0.294	-0.182	0.089
BEANS	0.852	0.103	-0.668	-0.201	-0.324	-0.221	-0.247	0.579	0.227	-0.096
YAM	1.288	0.079	-0.402	-0.856	-0.427	-0.387	-0.378	0.959	0.314	-0.182
YAM FLOUR	2.432	-0.079	-0.967	-0.664	-1.529	-0.881	-0.834	2.265	0.592	-0.315
BREAD	1.113	-0.145	-0.384	-0.379	0.535	-0.889	-0.288	1.345	0.295	-0.124
BEVERAGES	-0.275	-0.031	0.161	0.148	0.19	0.211	-0.259	-0.189	-0.015	0.56
MEAT	-1.365	0.083	0.562	0.497	0.733	0.681	0.615	-1.68	-0.358	0.221
FRUITS & VEGETABLES	-1.235	-0.131	0.521	0.431	0.426	0.375	0.501	-0.807	-0.255	0.166
PLANTAIN	0.835	0.114	-0.383	-0.513	-0.432	-0.279	-0.282	0.964	0.294	-0.309
					Uncompensated or Marsallian Easticity (QUAIDS Model)					
	RICE	**GARI**	**EANS**	**YAM**	**YAM FLOUR**	**BREAD**	**BEVERAGES**	**MEAT**	**FRUITS AND VEGETABLES**	**PLANTAIN**
RICE	-1.261	-0.072	0.029	0.034	0.126	0.054	0.017	-0.639	-0.243	0.004
GARI	-0.526	-0.622	0.13	0.082	0.082	-0.029	-0.004	-0.525	-0.255	0.047
BEANS	0.972	0.143	-0.618	-0.148	-0.299	-0.194	-0.214	0.643	0.247	-0.084
YAM	1.549	0.167	-0.292	-0.739	-0.372	-0.329	-0.306	-1.098	0.357	-0.157
YAM FLOUR	3.379	0.242	-0.569	-0.239	-1.33	-0.674	-0.574	2.768	0.749	-0.224
BREAD	1.453	-0.03	-0.241	-0.226	-0.463	-0.815	-0.195	1.525	0.351	-0.092
BEVERAGES	-0.575	-0.133	0.034	0.014	0.128	0.145	-0.342	-0.348	-0.064	0.027
MEAT	-2.428	-0.278	0.115	0.019	0.509	0.448	0.322	-2.245	-0.534	0.119
FRUITS & VEGETABLES	-2.082	-0.418	0.164	0.051	0.248	0.189	0.268	-1.258	-0.396	0.085
PLANTAIN	1.053	0.188	-0.292	-0.415	-0.386	-0.231	-0.222	1.08	0.33	-0.289

Sources: Author's Computation

Table 6: Price Elasticity of the AIDs and QUAIDS Food Demand System using Data on Ondo North. Compensated or Hicksian Elasticity (AIDS model)

	RICE	GARI	EANS	YAM	YAM FLOUR	BREAD	BEVERAGES	MEAT	FRUITS AND VEGETABLES	PLANTAIN
RICE	-0.587	0.369	0.029	0.096	0.015	-0.029	0.151	0.145	0.192	0.003
GARI	0.432	-0.315	0.134	-0.033	-0.069	-0.033	-0.011	-0.149	0.031	0.041
BEANS	0.051	0.197	-0.733	-0.029	-0.079	0.1	0.026	0.281	0.178	0.007
YAM	0.187	-0.056	-0.034	-0.264	0.017	-0.023	0.05	0.141	0.014	-0.034
YAM FLOUR	0.083	-0.334	-0.258	0.049	0.115	0.069	0.094	0.199	-0.101	0.085
BREAD	-0.085	-0.082	0.171	-0.034	0.036	-0.259	-0.04	0.145	0.067	0.082
BEVERAGES	0.33	-0.019	0.033	0.056	0.036	-0.029	-0.457	0.008	0.041	0.0007
MEAT	0.166	-0.146	0.186	0.083	0.04	0.056	0.004	-0.515	0.076	0.05
FRUITS & VEGETABLES	-0.714	0.097	0.383	0.027	-0.067	0.085	0.069	0.249	-0.078	-0.052
PLANTAIN	0.012	0.044	0.016	-0.066	0.057	0.107	0.0008	0.168	-0.054	-0.285

Uncompensated or Marshallian Elasticity (AIDS model)

	RICE	GARI	EANS	YAM	YAM FLOUR	BREAD	BEVERAGES	MEAT	FRUITS AND VEGETABLES	PLANTAIN
RICE	-0.763	0.219	-0.073	0.005	-0.016	-0.089	0.07	-0.009	0.239	-0.043
GARI	0.237	-0.482	0.021	-0.133	-0.104	-0.099	-0.099	-0.32	-0.022	-0.037
BEANS	-0.139	0.035	-0.843	-0.127	-0.113	0.036	-0.06	0.114	0.127	-0.043
YAM	0.009	-0.208	-0.137	-0.355	-0.015	-0.083	-0.031	-0.015	-0.08	-0.08
YAM FLOUR	-0.092	-0.484	-0.359	-0.041	0.084	0.009	0.014	0.045	-0.148	0.039
BREAD	-0.27	-0.239	0.064	-0.129	0.003	-0.323	0.124	-0.017	0.018	0.034
BEVERAGES	0.158	-0.167	-0.066	-0.032	0.006	-0.88	-0.535	-0.143	-0.005	-0.044
MEAT	-0.03	-0.313	0.072	-0.018	0.005	-0.01	-0.085	-0.687	0.024	-0.001
FRUITS & VEGETABLES	-0.897	-0.059	0.277	-0.066	-0.099	0.023	-0.014	0.089	-0.128	-0.099
PLANTAIN	0.225	-0.158	-0.122	-0.187	0.015	0.026	-0.107	-0.04	-0.118	-0.347

Compensated or Hicksian Elasticity (QUAIDS model)

	RICE	GARI	EANS	YAM	YAM FLOUR	BREAD	BEVERAGES	MEAT	FRUITS AND VEGETABLES	PLANTAIN
RICE	-0.575	0.348	0.335	0.097	0.018	-0.037	0.158	0.136	-0.178	-0.002
GARI	0.386	-0.309	0.148	-0.043	-0.054	-0.019	-0.034	-0.126	0.014	0.04
BEANS	0.07	0.207	-0.75	-0.035	-0.087	0.109	0.027	0.28	0.175	0.003
YAM	0.182	-0.053	-0.044	-0.261	0.023	-0.025	0.05	0.142	0.018	-0.032
YAM FLOUR	0.137	-0.264	-0.296	0.085	0.065	0.082	0.111	0.185	-0.157	0.048
BREAD	-0.124	-0.036	0.186	-0.044	0.394	-0.272	-0.034	0.149	0.039	0.097
BEVERAGES	0.331	-0.033	0.028	0.055	0.034	-0.02	-0.459	0.008	0.045	0.012
MEAT	0.162	-0.139	0.189	0.084	0.043	0.055	0.003	-0.515	0.072	0.045
FRUITS & VEGETABLES	-0.616	0.029	0.369	0.056	-0.099	0.054	0.103	0.207	0.002	-0.106
PLANTAIN	0.009	0.442	0.334	-0.072	0.061	0.104	0.0007	0.167	-0.059	-0.286

Table 6. Cont.

	Uncompensated or Marshallian Elasticity (QUAIDS model)									
	RICE	**GARI**	**EANS**	**YAM**	**YAM FLOUR**	**BREAD**	**BEVERAGES**	**MEAT**	**FRUITS AND VEGETABLES**	**PLANTAIN**
RICE	-0.771	0.181	-0.08	-0.004	-0.017	-0.103	0.068	-0.036	-0.23	
GARI	0.284	-0.397	0.089	-0.095	-0.072	-0.054	-0.08	-0.215	-0.013	0.014
BEANS	-0.161	0.009	-0.884	-0.153	-0.128	0.03	-0.078	0.078	0.113	-0.058
YAM	0.014	-0.196	-0.141	-0.346	-0.006	-0.082	-0.026	-0.004	-0.027	-0.076
YAM FLOUR	-0.186	-0.539	-0.483	-0.079	0.008	-0.027	-0.036	-0.098	-0.244	-0.037
BREAD	-0.255	-0.148	0.11	-0.111	0.016	-0.316	-0.094	0.035	0.004	0.062
BEVERAGES	0.189	-0.154	-0.054	-0.018	0.008	-0.068	-0.524	-0.117	0.007	-0.025
MEAT	-0.046	-0.317	0.069	-0.023	0.006	-0.016	-0.091	-0.697	0.016	-0.009
FRUITS & VEGETABLES	-0.964	-0.268	0.167	-0.124	-0.161	-0.064	-0.055	-0.097	-0.092	-0.197
PLANTAIN	-0.2	-0.134	-0.088	-0.179	0.023	0.033	-0.095	-0.016	-0.116	-0.341

Sources: Author's Computation

Table 7: Price Elasticity of the AIDs and QUAIDS Food Demand System using Data on Ondo Central. Compensated or Hicksian Elasticity (AIDS model)

	RICE	**GARI**	**BEANS**	**YAM**	**YAM FLOUR**	**BREAD**	**BEVERAGES**	**MEAT**	**FRUITS AND VEGETABLES**	**PLANTAIN**
RICE	-0.241	0.046	-0.024	0.094	0.027	0.058	0.026	0.14	-0.071	-0.004
GARI	0.117	-0.452	0.138	0.029	0.064	-0.021	0.033	0.075	-0.023	0.047
BEANS	-0.045	0.109	-0.318	0.077	0.028	0.056	0.019	0.073	0.026	0.013
YAM	0.163	0.016	0.069	-0.371	0	0.009	0.064	0.097	-0.101	0.053
YAM FLOUR	0.099	0.093	0.053	0.001	-0.31	0.018	0.124	-0.119	-0.005	0.044
BREAD	0.154	-0.023	0.077	0.016	0.011	-0.398	0.026	0.096	0.049	-0.007
BEVERAGES	-0.058	0.03	-0.019	0.082	0.069	0.02	-0.418	0.212	0.047	0.036
MEAT	0.122	0.026	0.032	0.049	-0.027	0.031	0.085	-0.415	0.111	-0.014
FRUITS & VEGETABLES	-0.196	-0.025	0.037	-0.163	-0.003	0.051	0.059	0.352	-0.125	0.013
PLANTAIN	-0.02	0.09	0.031	0.142	0.053	-0.013	0.075	-0.075	0.021	-0.304
	Uncompensated or Marshallian Elasticity (AIDS model)									
	RICE	**GARI**	**EANS**	**YAM**	**YAM FLOUR**	**BREAD**	**BEVERAGES**	**MEAT**	**FRUITS AND VEGETABLES**	**PLANTAIN**
RICE	-0.467	-0.044	-0.139	-0.037	-0.033	-0.027	0.13	-0.12	-0.152	-0.053
GARI	-0.132	-0.551	0.011	-0.122	-0.002	-0.115	0.081	-0.21	-0.113	-0.006
BEANS	-0.251	0.026	-0.423	-0.042	-0.027	-0.021	-0.114	-0.163	-0.048	-0.031
YAM	0.013	-0.044	-0.007	-0.458	-0.04	-0.047	0.005	-0.075	-0.155	0.021
YAM FLOUR	-0.093	0.016	-0.045	-0.109	-0.361	-0.055	0.035	-0.34	-0.074	0.003

Table 7. Cont.

BREAD	0.001	-0.084	-0.001	-0.072	-0.029	-0.455	-0.044	-0.078	-0.006	-0.04
BEVERAGES	-0.157	-0.01	-0.07	0.025	0.043	-0.017	0.463	0.099	0.012	0.014
MEAT	-0.075	-0.053	-0.069	-0.065	-0.08	-0.043	-0.006	-0.641	0.04	-0.056
FRUITS & VEGETABLES	-0.39	-0.103	-0.062	-0.275	-0.055	-0.022	-0.03	0.13	-0.195	-0.029
PLANTAIN	-0.171	0.029	-0.046	0.054	0.013	-0.07	0.005	-0.249	-0.033	-0.337
Compensated or Hicksian Elasticity (QUAIDS model)										
	RICE	**GARI**	**EANS**	**YAM**	**YAM FLOUR**	**BREAD**	**BEVERAGES**	**MEAT**	**FRUITS AND VEGETABLES**	**PLANTAIN**
RICE	-0.252	0.049	-0.02	0.109	0.036	0.053	-0.029	0.142	-0.081	-0.008
GARI	-0.045	-0.658	0.033	0.001	0.011	0.027	0.193	0.135	0.226	0.073
BEANS	-0.067	0.069	-0.328	0.058	0.021	0.063	0.002	0.083	0.089	0.01
YAM	0.058	-0.163	-0.026	-0.148	-0.053	0.047	0.202	0.126	0.15	0.071
YAM FLOUR	0.077	0.014	0.021	-0.033	-0.328	0.022	0.176	-0.115	0.121	0.043
BREAD	0.056	-0.127	0.024	0.019	-0.021	-0.362	0.122	0.118	0.158	0.009
BEVERAGES	-0.113	-0.059	-0.063	0.071	0.048	0.035	-0.348	0.2	0.182	0.044
MEAT	0.175	0.113	0.068	0.066	-0.011	0.026	0.024	-0.418	-0.024	-0.017
FRUITS & VEGETABLES	0.317	0.635	0.385	-0.089	0.175	-0.121	-0.475	0.198	-0.943	-0.064
PLANTAIN	-0.153	-0.064	-0.057	0.133	0.007	0.022	0.208	-0.049	0.23	-0.281
Uncompensated or Marshallian Elasticity (QUAIDS model)										
	RICE	**GARI**	**EANS**	**YAM**	**YAM FLOUR**	**BREAD**	**BEVERAGES**	**MEAT**	**FRUITS AND VEGETABLES**	**PLANTAIN**
RICE	-0.458	-0.033	-0.124	-0.01	-0.018	-0.024	-0.124	-0.093	-0.154	-0.052
GARI	-0.492	-0.837	-0.195	-0.257	-0.107	-0.141	-0.012	-0.376	0.065	-0.023
BEANS	-0.31	-0.029	-0.452	-0.082	-0.043	-0.082	-0.11	-0.195	0.001	-0.042
YAM	-0.288	-0.301	-0.203	-0.618	-0.145	-0.083	0.043	-0.271	0.026	-0.003
YAM FLOUR	-0.204	-0.098	-0.123	-0.195	-0.402	-0.083	0.047	-0.436	0.02	-0.017
BREAD	-0.225	-0.239	-0.119	-0.143	-0.095	-0.468	-0.006	-0.203	0.057	-0.051
BEVERAGES	-0.32	-0.141	-0.169	-0.049	-0.007	-0.043	-0.443	-0.037	0.108	0
MEAT	0.048	0.062	0.003	-0.008	-0.045	-0.022	-0.034	-0.563	-0.07	-0.044
FRUITS & VEGETABLES	0.863	0.853	0.663	0.226	0.32	0.084	-0.224	0.803	-0.747	0.053
PLANTAIN	-0.47	-0.19	-0.219	-0.049	-0.077	-0.097	0.062	-0.411	0.117	-0.348

Sources: Author's Computation

Table 8: Expenditure and Own Price Elasticity from QUAIDS Models

Commodity	Expenditure Elasticity				Own Price Elasticity			
	Ondo South	Ondo North	Ondo Central	All-Ondo	Ondo South	Ondo North	Ondo Central	All-Ondo
Rice	1.947	1.043	1.089	1.419	-0.736	-0.575	-0.252	-0.399
Garri	1.617	0.540	2.371	0.664	-0.474	-0.309	-0.658	-0.397
Beans	-0.441	1.231	1.288	1.017	-0.668	-0.750	-0.328	-0.402
Yam	-0.966	0.891	1.838	0.859	-0.856	-0.261	-0.418	-0.390
Yam Flour	-3.508	1.719	1.489	1.385	-1.529	0.065	-0.328	-0.280
Bread	-1.257	0.697	1.489	0.653	-0.889	-0.272	-0.362	-0.377
Beverages	1.111	0.757	1.097	0.162	-0.259	-0.459	-0.348	-0.508
Meat	3.939	1.109	0.675	1.183	-1.680	-0.515	-0.418	-0.375
Fruit & Vegetable	3.140	1.850	-2.896	1.618	-0.255	0.002	-0.943	-0.056
Plantain	-0.808	1.113	1.678	0.151	-0.309	-0.286	-0.281	-0.092

Sources: Author's Computation

goods, since their coefficient are less than 1. The result of the Ondo Central is similar but for the expenditure elasticity for fruit and vegetable that is now negative indicating it to be an inferior good. For Ondo South, beans, yam, yam flour, bread and plantain are all inferior goods with the coefficient of -0.441, -0.966, -3.508, -1.257 and -0.808, respectively that are all less than 1.

Policy Implications and Conclusion

This study looked at food demand in Ondo State, Nigeria. The major food consumed in the area were selected which include rice, garri, beans, yam, yam flour, bread, beverages, meat, fruit and vegetables and plantain. The finding shows some important revelations, some of which are listed below:

I. The QUAIDS model seems to be more appropriate for the data used in the study as a result of the coefficient of the quadratic term of the estimate.
II. The expenditure elasticity has the predicted sign for all the food items captured in the study for all Ondo State put together. Garri, yam, bread, beverages and plantain are necessities. While rice, beans, yam flour, meat and fruit and vegetables are luxury goods, since the expenditure elasticity for them are greater than 1. This implies that as expenditure increases or income levels increase the proportion of expenditure on these products is much higher than all other food items. The demand for high value food is more income elastic as compared to that for staple food.
III. Expenditure share for food increases with household size and decreases with age. This is against the study of Luca (2007) that food share does not increase with family size enlargement.
IV. The own price elasticity is lowest for fruit and vegetable, and yam while highest for beverages in all Ondo State put together. Thus even a marginal increase in the price of beverages and its products can lead to a substantial decline in its consumption. This is, however, not true when looked at each of the senatorial districts. For instance, in Ondo South, meat has the highest own price elasticity.

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