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REGULAR ARTICLE

FOOD DEMAND PATTERNS IN GHANAIAN URBAN HOUSEHOLDS

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ABSTRACT

This paper analysed food consumption patterns in Ghanaian urban households by comparing food commodity budget shares and estimating price and expenditure elasticities for eleven food commodity groups across different income groups. The Linear Approximation Almost Ideal Demand System (LA/AIDS) was applied to the data. Demand for most of the food commodity groups was found to be elastic. The study concluded that generally, across income groups, food commodities respond negatively to changes in food prices and that cereals/bread, roots/tubers, vegetables, meat and fish will remain an important component of urban household food expenditure. Generally, household demographic characteristics such as age, gender and household size had significant effects on urban food demand patterns.

Keywords: Almost Ideal Demand System, Budget Shares, Demand, Elasticities, Food Consumption
JEL: D12, Q12

INTRODUCTION

According to the 2010 census report by the Ghana Statistical Service, the proportion of the Ghanaian population living in urban areas is 50.9 percent and this urban population is growing at a rate of 3.5 percent annually. This implies that the urban population of Ghana will double in about twenty years. Food commodity prices the world over have risen since 2002 with a dramatic surge between 2005 and 2007. Most forecasts suggest a further rise in the prices of food commodities (**Ivanic and Martin, 2008**).

The situation in Ghana is no different from the other parts of the world as rising inflation levels indicate that commodity prices will keep rising, with urban areas experiencing a greater effect since most urban dwellers are net food buyers. That is, they buy more of the food they consume than they produce themselves. The impact of rising food prices on urban food security is therefore a concern for many.

Despite the obvious importance in studying urban household expenditure patterns, available literature suggests that there is limited information on food demand patterns across income groups in Ghana even though food prices continue to increase. The proportions of urban household incomes allocated to food commodities and the responsiveness of urban households to price and income changes are not known.

Previous studies by **Kaneda and Johnson (1961), Ord (1965), Haessel (1976), Meng *et al.* (2012), Eghan (2012)** and **Asante (2013)** are but a few empirical studies on food demand patterns that have been carried out in Ghana.
However, **Kaneda and Johnson (1961), Ord (1965) and Haessel (1976)** ignored the effect of demographic factors on food demand. This study employs the LA/AIDS to examine the effect of demographic variables on food demand. **Meng *et al.* (2012),** examined the food expenditure patterns in rural households in the Northern region of Ghana. His study covered only one out of the ten administrative regions of Ghana. This study fills this gap by covering all ten administrative regions of Ghana.

Eghan (2012) examined the effects of food price changes on household food consumption in Ghana. Their analysis on food expenditure patterns was also based on all households in Ghana irrespective of their levels of income but food expenditure patterns for urban households have been described and examined in this study based on three different income groups.

DATA AND METHODS

Model Specification

The AIDS model is highly popular in demand analysis. Due to its obvious advantages over other models, **Alem (2011)** rated it as the most popular empirical tool in a number of countries for over twenty years. This assertion is further confirmed by **Buse (1994)** in his examination of about 207 citations in which he concluded that over 76 percent of empirical applications used the Linear Approximation Almost Ideal Demand System to estimate demand functions.

Following **Deaton and Muellbauer (1980)**, the AIDS model is expressed as in Eq. (1).

$$w_i = \alpha_i + \sum_j^n \gamma_{ij} ln\, p_j + \beta_i ln\left(\frac{x}{P}\right) + u_i \qquad (1)$$

Where: w_i is the budget share of commodity i in the commodity groups; p_j is the nominal price of commodity *j; x* is total expenditure on household food commodities; P is a trans log price index; α, γ and β are all parameters to be estimated.

The translog price index P is defined by Eq. (2).

$$ln\,P = a_0 + \sum a_i\, ln\, p_i + \frac{1}{2}\sum\sum \gamma_{ij}^{*}\, lnp_i\, lnp_j \qquad (2)$$

However, specifying the price index (Eq. 2) makes the estimation procedure of the AIDS model complicated, making it a non-linear econometric model. **Deaton and Muellbauer (1999)** and **Hahn (1994)** experienced this difficulty and attempted to solve this convergence problem by making use of the Stone's price index rather. Following **Deaton and Muellbauer (1980a)**, the Stone's price index is expressed by Eq. (3)

$$\ln P = \sum_{i=1}^{n} w_i lnp_i \qquad (3)$$

Where: w_i and p_i are the ith budget share and price respectively. However, the Stone's price index is criticized for its unit measurement error.

It causes a simultaneity problem in the model since the Stone's price index which is used as an explanatory variable in the AIDS model, contains the budget share which is the dependent variable in the AIDS model **(Moschini, 1995).** This study therefore follows from **Moschini (1995)** and makes use of the Laspeyres price index (Eq. 4).

$$ln(P^L) = \sum_{i=1}^{n} \bar{w}_i ln(P_i) \qquad (4)$$

Where: $\bar{w}_i$is the geometric mean budget share of the ith commodity.

Equation (4) is therefore substituted into the AIDS model and gives the Linear Approximation Almost Ideal Demand System (LA/AIDS) (Eq.5).

$$w_i = a_i^* + \sum_j^n \gamma_{ij} lnp_j + \beta_i\left[\ln(x) - \sum_{j=1}^n \bar{w}_j lnp_j\right] + u_i^* \qquad (5)$$

Where:

$$a^* = a_i - \beta_i\left(a_i - \sum_{j=1}^n \bar{w}_j ln\bar{p}_j\right) \qquad (6)$$

and $\bar{p}_j$ is the mean price of the *j*th commodity, with all other variables being interpreted as before.

For consistency with demand theory, some restrictions are placed on the AIDS model. These include Adding Up, Homogeneity and Symmetry.

$$\sum_i^n a_i = 1$$

$$\sum_{j=1}^n \gamma_{ij} \qquad (7)$$

$$\sum_{i=1}^n \beta = 0$$

The need to account for differences in household preferences is resolved through the incorporation of demographic variables into the budget share equations through a linear demographic translator **(Pollak and Wales, 1978)**. This linear demographic translator is expressed as Eq. 8.

$$D(Z) = \sum_{r=1}^k \delta_r Z_r \qquad (8)$$

Where: Z_r is a vector of demographic household characteristics and δ_r is a parameter estimate.

When Eq. (8) is substituted into Eq. (5), the translated LA/AIDS model is now specified as Eq. 9.

$$w_i = a_i^{**} + D(Z) + \sum_j^n \gamma_{ij} lnp_j + \beta_i\left[ln(x) - \sum_{j=1}^n \bar{w}_j lnp_j\right] + u_i^{**} \qquad (9)$$

Where: $a_i^{**} = a_i^* - D(Z)$

Adding up and homogeneity restrictions are maintained by imposing the following restrictions on Eq. (9)

$$\sum a_i^{**} = 1 \quad \text{and} \quad \sum \delta_r = 0$$

In order not to obtain biased estimates, the zero expenditure problem is resolved by the Heckman two-step approach. Following **Blundell and Robin (1999)**, the Augmented Regression Approach is used to control expenditure endogeneity. To avoid obtaining a singular matrix for the variance-covariance matrix of error terms, the complete n equation demand system cannot be estimated. This is due to the adding up restriction **(Heien and Wessel, 1990)**.

To resolve this problem and following from **Heien and Wessel (1990)**, one of the equations is deleted and the model estimated for ten commodity groups. The parameters for the deleted equation are estimated using the adding up property **(Ackah and Appleton, 2007)**.

Therefore, Seemingly Unrelated Regression (SUR) procedure is used to estimate the demand model for ten commodity groups. The "Other Food" group is deleted from the system and its parameters are estimated by the adding up property. Homogeneity and symmetry conditions are easily imposed by the use of the Seemingly Unrelated Regression procedure.

The demand model for the ten food commodities is estimated simultaneously using Zellner's Seemingly Unrelated Regression and STATA 14.

Following **Chalfant (1987)** and **Abdulai *et al*. (1999)** elasticities are computed in Eq. (10), (11), (12) and (13)

Expenditure Elasticity

$$(\eta_i) = 1 + {}^{\beta_i}/_{w_i} \qquad (10)$$

Marginal Expenditure Shares

$$m_i = \eta_i w_i \qquad (11)$$

Uncompensated (Marshallian) Price Elasticity

$$\left(e_{ij}^{m}\right) = \frac{\gamma_{ij}}{w_i} - \frac{\beta_i w_j}{w_i} - \delta_{ij} \qquad (12)$$

Where: the Kronecker delta
$\delta_{ij} = \{1\ for\ i = j, 0\ otherwise\}$

Compensated (Hicksian) Price Elasticity,
$$e_{ij}^{h} = e_{ij}^{m} + w_j e_i \quad (13)$$

Data

The Ghana Living Standards Survey-Round Five (GLSS 5) was developed by the Ghana Statistical Service and this is the main data set used for the study. The data was collected through the entire nation and covered a period of 12 months from September 2005 to September 2006. The GLSS 5 collected detailed information on topics, including demographic characteristics of the population, education, health, employment and time use, migration, housing conditions and household agriculture. A total of 8687 households were sampled during the survey. This included 3618 urban households and 5069 rural households. The GLSS 5 did not capture data on actual market prices hence the price data (for the same year as the GLSS was collected), was collected separately from the Ghana Statistical Service. The Laspeyres price index was used to compute the aggregate commodity prices from the individual commodity prices. The food commodities were aggregated as Bread/Cereals, Roots/Tubers, Meat, Pulses/Nuts, Fats/Oils, Fish, Dairy, Fruits, Vegetables, Cooked Meal and "Others". Any food group that did not fall under the ten main groups was put under the "others" group.

RESULTS

Food Expenditure Elasticities and Marginal Expenditure Shares

Table 1 shows the expenditure elasticities and the marginal expenditure shares for each food group. The first, second and third columns under the expenditure elasticities represent values for the low income (first quintile, Q1), middle income (third quintile, Q3) and high income (fifth quintile, Q5) households respectively. The "National" column represents expenditure elasticity values for the entire country. This also applies to the column for marginal expenditure shares. Expenditure elasticities describe the effect of an increase in income on the household's expenditure for each food commodity whiles the marginal expenditure shares give the percentage of a future increase in income that will be allocated to each food group.

All expenditure elasticities are positive and range from 0.0204 to 3.3150. The positive values of the expenditure elasticities indicate that all the commodity groups are normal goods and as such their consumption increases with an increase in income. Commodity groups with expenditure elasticities greater than unity (>1) are theoretically referred to as luxuries whiles commodity groups with values less than unity (<1) are referred to as necessities. This implies that for a luxury good, demand increases more than proportionate with an increase in income whiles demand for a necessity increases less than proportionate with an increase in income.

Figures for the first quintile (Table 1) indicate that, with an increase in income, urban households in this quintile will consume more cereals/bread, dairy, fats/oils, fruits, roots/tubers and "other" foods. This is because their expenditure elasticities are greater than 1(1.08, 1.17, 1.73, 2.05, 1.10 and 1.53 respectively).

These commodity groups are therefore luxuries (income elastic) in these households. However, households in quintile 1 will consume relatively less meat, fish, vegetables, pulses, and cooked food since their expenditure elasticities are less than 1 (0.34,0.93,0.82,0.85 and 0.89 respectively) making them necessities (income inelastic) for the households. This shows the growing importance of meat, fish, vegetables and pulses in low income urban households.

Table 1 Expenditure Elasticities and Marginal Expenditure Shares

	Expenditure Elasticities				Marginal Expenditure Shares			
	Q1	Q3	Q5	National	Q1	Q3	Q5	National
Cereals	1.0814	1.3222	1.2280	1.3141	0.1514	0.238	0.2456	0.2234
Meat	0.3460	0.4060	1.4693	1.2122	0.0173	0.0406	0.2057	0.1091
Fish	0.9283	0.4206	0.5211	0.8869	0.1114	0.0715	0.0938	0.1419
Dairy	1.1750	0.1940	1.6417	0.6520	0.0705	0.0097	0.0985	0.0326
Fats	1.7300	1.1433	0.0350	0.8250	0.0346	0.0343	0.0007	0.0165
Fruits	2.0500	0.6233	0.8833	0.6567	0.082	0.0187	0.0265	0.0197
Vegetables	0.8270	1.1257	1.3931	1.0217	0.0827	0.1576	0.1811	0.1226
Pulses	0.8550	1.2200	1.0020	0.9000	0.0171	0.0244	0.0200	0.0180
Roots	1.1071	1.4142	0.7715	1.3200	0.0775	0.1697	0.1003	0.1452
Cooked	0.8905	1.1093	0.4525	0.4458	0.3295	0.1664	0.0362	0.0847
Others	1.5333	3.9550	0.0780	3.3150	0.0460	0.0791	0.0020	0.0663

Households in quintile 3 have expenditure elasticities of less than one for meat, fish, dairy and fruits whereas cereals/bread, fats/oils, vegetables, pulses and roots have values greater than 1. Therefore, meat, fish, dairy and fruits are seen as necessities for middle income urban households whiles cereals and roots are seen as luxuries. Similar results are obtained in quintile 5 where cereals/bread, dairy and vegetables are luxury goods and fish, fruits, roots and cooked food are necessities.

On the national level, cereals/bread, meat, vegetables, roots/tubers and "others" all have expenditure elasticities greater than 1 and as such are luxuries.

As earlier stated, the marginal expenditure shares depict future allocations of an increase in income to each commodity group. The figures indicate that for any increase in future expenditure, households will allocate 22% of that increase to cereals/bread, 10.91% to meat, 14.19% to fish, 3.2% to dairy, 1.65% to fats, 1.97% to fruits, 12.26% to vegetables, 1.8% to pulses, 14.51 % to roots and tubers, 8.47 % to cooked food and 6.6 % to "others".

Across income groups the marginal expenditure shares for cereals, meat and vegetables increase from quintile 1 to quintile 5. This implies that future expenditure allocations to these commodity groups will continue to increase with increasing incomes. However, budget shares of fruits and cooked food decline steadily across income groups indicating a steady decline in future expenditure allocations to these commodity groups. The marginal expenditure share of cooked food decreases from 32.95% for quintile 1 to 3.6% for quintile 5. This implies that high income households will continue to allocate a less percentage of a future expenditure increase to cooked food as opposed to low income households.

Price Elasticities

Uncompensated (Marshallian) Price Elasticities

To investigate the effects of price changes on the demand for each food group, uncompensated or Marshallian price elasticities are computed from the parameters of the LA/AIDS model. The uncompensated elasticity measures the percentage change in demand due to a 1% change in the price of the good or another good. It includes both the income and substitution effects.

Table 2 depicts the uncompensated price elasticity matrix for urban households in Ghana. However, Tables 3, 4 and 5 also give the uncompensated elasticities for each income group; Q1, Q3 and Q5 respectively. Own and cross price elasticities are represented in the matrices. From Table 2, the values across the diagonal are the own-price uncompensated elasticities. In conformity with demand theory, all own-price elasticities are negative. These are shown in bold figures. The negative own price elasticities indicate that an increase in the price of a commodity will cause demand for that commodity to decrease by a certain percentage. A good is said to be price-elastic if the absolute value of its own-price elasticity is greater than unity and price inelastic if the absolute value of its own-price elasticity is less than unity.

Cereals/bread, meat, fish, fats, fruits and vegetables are all price elastic with own-price elasticities of -1.0922, -1.2458, -1.2069, -1.0815, -1.0197, and -1.0134 respectively (Table 2). An own price elasticity of -1.0922 for cereals and bread indicate that a 10% increase in the price of cereals and bread will lead to a 10.92% decrease in the demand for cereals and bread. Meat and fish are seen to be highly elastic with a 10% increase in their respective prices leading to a 12.45% and a 12.06% decrease in their respective demand. This price increase which leads to a lowered consumption of meat compensated by an increase in the demand for fish as shown by the positive value of their cross price elasticity.

Similarly, lowered fish consumption as a result of high prices is compensated marginally by the increase in the consumption of meat. This is shown by the positive cross price elasticity of fish and meat. Dairy products, pulses, roots and tubers, cooked food and "others" are all price inelastic since the absolute values of their own-price elasticities are less than unity. The own price elasticity of dairy is -0.3846, pulse (-0.5630), roots (-0.6236) and -0.4413 for "others". These values imply that an increase of say 10% in their respective prices will lead to a 3.8% decrease in the demand for dairy, a 5.6% decrease in the demand for pulse, a 6.2% decrease in the demand for roots and a 4.4 % decrease in the demand for "others". The average own-price elasticity is -0.87 and this indicates that generally, food commodities are responsive to own price changes.

The cross price elasticities also indicate whether the food commodities are substitutes or complements. Goods which are substitutes will have a positive cross price elasticity whiles goods which are complements will have a negative cross-price elasticity. With the exception of the "others-cereal", "others-meat" and "others-dairy" cross price elasticities, all other cross price elasticities have absolute values which are less than unity and are therefore inelastic. This indicates that commodity groups show little response to changes in other groups. There is therefore little substitutability and complementarity between different food groups. However, substitutability and complementarity exist within food groups. Across income groups, the uncompensated own and cross price elasticities show little or no variation to the national values.

Own-price uncompensated elasticities for household in quintile 1 are all negative as expected and the values are shown across the diagonal in Table 3. Cereals and bread, meat, fish, fruits and "others" are all price elastic with absolute own price elasticities greater than unity. Cereals, meat and fish are highly elastic with values -1.3350, -1.5593 and -1.2681 respectively. This indicates that for low income urban households, a 10% increase in the price of cereals, meat and fish will lead to a 13.35 %, 15.59% and a 12.68% decrease in their respective consumption. Again the lowered consumption, of meat is probably compensated for by an increase in the consumption of fish and vice versa. Dairy, fats, vegetables, pulses, roots and cooked food are all price inelastic. An average own price elasticity of -0.94 indicate food commodities are generally responsive to own price changes. This value is above the national value of -0.87. Almost all cross price elasticities are inelastic indicating less substitutability or complementarity between food groups.

Middle income households in quintile 3 also have all own-price elasticities being negative and an average own-price elasticity of -0.91 as shown in Table 4. This figure though greater than the national average in absolute terms, is less than the average for the low income households. This implies that low income households are more responsive to own price changes than middle income households. Cereals, meat, fish, fats, fruits and vegetables are all price elastic whereas dairy, pulses, roots, cooked food and "others" are all price inelastic. Cereals and bread are highly price elastic with an own price elasticity of -1.2119.

Table 5 illustrates the uncompensated price elasticity matrix for the high income urban households. Commodity groups that were inelastic in the low and middle income groups are found to be elastic in the high income group. These include pulses, roots and "others" with values -1.0950, -1.1341 and -1.1666. This indicates that a 10% increase in the respective prices of all these commodity groups will result in a 10.9% decrease in the consumption of pulses, an 11.34% decrease in the consumption of roots and an 11.66 % decrease in that of "others". Meat and fish however remain elastic as well as fruits, vegetables and dairy. Cereals/bread however is seen to be inelastic and has a value of -0.8216. An average own price elasticity of -1.01 indicates that very high income households are highly responsive to changes in own prices.

Compensated (Hicksian) Price Elasticities

To assess the net price effect of price changes on demand, it is necessary to compute the compensated or Hicksian price elasticities. This enables the strength of the substitution effect to be known. The matrix for the compensated price elasticities for the entire nation is shown in Table 6. However, Tables 7, 8 and 9 illustrate these elasticities across the different income groups. This implies that all own-price compensated elasticities must be negative. This condition is satisfied as all the own-price elasticities are negative. The dynamics of these elasticities are the same as the uncompensated ones with an increase in price causing a change in the demand of the commodity.

Meat, fish and fats are price elastic whereas cereals, dairy, vegetables, pulses, roots, cooked food and others are price inelastic (Table 6). Another characteristic of the compensated own-price elasticity is that it is expected to be less in absolute values than the corresponding uncompensated elasticities due to the absence of income effect. This condition is also satisfied as all the own-price compensated elasticities are less in absolute values than their corresponding uncompensated ones. Most cross price elasticities are also inelastic. These characteristics of the compensated own price elasticities are similar for each income group.

For quintile 1, cereals/bread, meat, fish and "others" are elastic whiles the other food groups are inelastic. Fish, fats, fruits and vegetables are all elastic in quintile 3 while fish, dairy, fruits, vegetables, pulses, roots and "others" are also elastic in quintile 5. It is not uncommon for some cross-price elasticities to alternate signs between their uncompensated and compensated forms **(Tsegai *et al*., 2002).**

Table 10 shows a summary of the compensated and uncompensated own price elasticities for each income group as well as for the entire country.

Determinants of Food Demand

Table 11 illustrates the results obtained from the Linear Approximation Almost Ideal Demand System on a national basis. The figures in parentheses are standard errors. The household characteristics used were household size, age of the household head, gender of the household head and the level of education of the household head.

Household size and gender had a positive effect on the budget share of cereals and bread. This means that an increase in the household size will increase the households' consumption of cereals and bread. This positive effect applies to all other food groups with the exception of dairy, fruits and cooked food. This is expected as an increase in the size of the household will mean that the household would have to shift consumption from fruits to food groups that are considered to be more important. A negative effect of household size on cooked food also shows that an increase in the size of the household will decrease its expenditure on cooked food since it will be more expensive to purchase cooked food for more members of the household.

The positive effect of gender on the budget shares of cereals and bread, meat, fish, dairy, vegetables and root and tuber crops indicate that expenditure on these food groups by female headed households are less than that of their male counterparts by 2.3%, 1.2%, 2.1%, 0.25%, 1.9% and 2.3% respectively.

Education had a negative effect on the budget shares of cereals and bread, fats and oils and root and tuber crops. This indicates that an increase in the level of education of the household head will decrease expenditure on these food groups. This could be due to the fact that as people get more educated, they become more aware of the health implications of too much carbohydrates and fats in their diets and hence reduce their consumption of these commodities. The results indicate that the consumption of proteins like meat and fish rather increase with an increase in the level of education. Another reason could be that more educated people stand the chance of earning more income and as such can afford the relatively expensive food commodities like meat and fish. Education also had a negative effect on the consumption of cooked food. This can be explained by the fact that as people get more educated, they become aware of the dangers involved in consuming cooked food outside the home and hence may prefer to rather cook themselves

The age of the household head had a negative effect on the consumption of cereals and cooked food as older people tend to be more comfortable eating at home than purchasing cooked food from outside the home. There was also a positive relationship with fish and vegetables. This is probably because people tend to be more conscious of their health as they grow and as such might prefer fish and vegetables to meat. A summary of the parameter estimates for each income group is given in Table 12.

Table 2 Uncompensated (Marshallian) Price Elasticity Matrix (National)

Commodity group	With respect to the price of										
	Cereals	Meat	Fish	Dairy	Fats	Fruits	Vegetables	Pulses	Roots	Cooked	Others
Cereals	**-1.0922**	-0.0853	0.0809	-0.0498	0.0390	-0.0918	0.0617	-0.0269	-0.1881	-0.3250	0.0631
Meat	-0.1439	**-1.2458**	0.0938	0.0472	-0.1120	0.1047	-0.0888	-0.0342	-0.0633	0.0275	0.2058
Fish	0.1586	0.0821	**-1.2069**	-0.0150	0.0604	-0.0204	0.1205	0.0048	-0.0957	0.1146	-0.1296
Dairy	-0.0568	0.1353	-0.0103	**-0.3846**	0.1330	0.1904	-0.2242	0.0076	-0.2337	0.2621	-0.4830
Fats	0.4148	-0.4693	0.4930	0.3238	**-1.0815**	-0.0648	0.2060	0.3485	0.0743	-0.8768	-0.2015
Fruits	-0.4083	0.3642	-0.0717	0.3172	-0.0398	**-1.0197**	-0.0055	-0.0731	0.0978	0.2952	-0.1198
Vegetables	0.1372	-0.0495	0.1390	-0.1119	0.0304	-0.0123	**-1.0134**	0.0229	0.0426	-0.1658	-0.0396
Pulse	-0.1580	-0.1260	0.0360	0.0065	0.3470	-0.1170	0.1520	**-0.5630**	-0.2590	-0.2460	0.0270
Roots	0.1829	-0.0615	-0.2085	0.1076	0.0036	0.0068	0.0107	-0.0555	**-0.9279**	-0.1635	0.0391
Cooked	-0.1432	0.0820	0.1671	0.0793	-0.0847	0.0529	-0.0356	-0.0168	0.0015	**-0.6236**	0.6003
Others	1.4801	0.7417	-1.1254	-2.6873	-0.2463	-0.2595	-0.5178	-0.0228	2.6054	0.0651	**-0.4413**

Source: Calculated from GLSS 5

Table 3 Uncompensated (Marshallian) Price Elasticity Matrix for Quintile 1

Commodity group	With respect to the price of										
	Cereals	Meat	Fish	Dairy	Fats	Fruits	Vegetables	Pulses	Roots	Cooked	Others
Cereals	**-1.3350**	-0.0005	0.0667	0.0365	-0.0816	-0.2240	0.2269	-0.1302	0.4036	-0.4001	0.3540
Meat	0.1016	**-1.5593**	0.2785	0.2552	0.4171	0.4962	-0.2686	0.0211	-0.0122	-0.1100	0.0456
Fish	0.0992	0.0869	**-1.2681**	-0.0115	-0.0536	-0.0988	0.4413	-0.0136	-0.1383	0.1190	-0.0887
Dairy	0.0722	0.1713	-0.0527	**-0.1705**	-0.2552	-0.0553	-0.6492	-0.2002	-0.2839	0.1936	0.0548
Fats	-0.6572	0.9735	-0.4176	-0.7988	**-0.9596**	0.1258	0.3870	1.0804	-0.0611	-1.0751	-0.3369
Fruits	-0.9195	0.5350	-0.4310	-0.1380	0.0565	**-1.1495**	-0.2400	0.1265	-0.2160	-0.0160	0.3210
Vegetables	0.3532	-0.1584	0.5418	-0.3686	0.0955	-0.0471	**-0.7287**	0.0115	0.1971	-0.4950	-0.2238
Pulses	-0.8797	0.0273	-0.0726	-0.5813	1.0979	0.3008	0.0545	**-0.3671**	0.0302	0.1537	-0.6007
Roots	0.8036	-0.0468	-0.2586	-0.2393	-0.0050	-0.0857	0.2536	0.0036	**-0.9618**	-0.1896	-0.3832
Cooked	-0.1247	-0.0421	0.0431	0.0485	-0.0413	0.0446	-0.1401	0.0076	-0.0207	**-0.7014**	0.0379
Others	1.8523	0.0200	-0.4307	0.0847	-0.2207	0.4453	-0.8200	-0.4207	-0.9240	0.2327	**-1.1127**

Source: Calculated from GLSS 5

Table 4 Uncompensated (Marshallian) Price Elasticity Matrix for Quintile 3

Commodity group	With respect to the price of										
	Cereals	Meat	Fish	Dairy	Fats	Fruits	Vegetables	Pulses	Roots	Cooked	Others
Cereals	**-1.2119**	-0.0533	0.1058	0.0872	0.0131	-0.0908	-0.1362	-0.0437	0.0436	-0.0828	0.0441
Meat	0.0689	**-1.0086**	0.3130	-0.0003	-0.0202	0.0918	0.1762	0.0109	-0.0337	-0.0669	0.0689
Fish	0.2743	0.1826	**-1.1856**	0.0996	0.0456	-0.0314	0.1617	0.0222	0.0401	0.0316	-0.1025
Dairy	0.5171	0.0206	0.3770	**-0.7597**	0.0302	0.1502	-0.0012	-0.1199	-0.2353	0.1629	-0.4879
Fats	0.1109	-0.1410	0.1356	0.0028	**-1.1143**	-0.1410	0.3766	0.3738	-0.3272	-0.2715	-0.1495
Fruits	-0.4189	0.2843	-0.2293	0.2288	-0.1254	**-1.1354**	0.2727	-0.1191	-0.0315	0.3798	0.2575
Vegetables	-0.1398	0.0539	0.0765	-0.0470	0.0812	0.0434	**-1.2262**	0.0575	0.0013	0.0404	0.0575
Pulses	-0.3746	-0.0270	0.0526	-0.3510	0.5584	-0.1966	0.3892	**-0.2294**	-0.7214	-0.1580	-0.1644
Roots	0.0488	-0.1289	-0.1121	-0.1590	-0.0899	-0.0316	-0.0388	-0.1241	**-0.6697**	-0.2546	0.1434
Cooked	-0.0610	-0.1149	-0.0813	0.0085	-0.0533	0.0614	-0.0773	-0.0189	-0.1671	**-0.5964**	-0.0089
Others	0.3024	-0.0105	-1.0474	-1.0078	-0.3087	0.2864	0.0063	-0.2191	0.5454	-1.3833	**-0.8441**

Source: Calculated from GLSS 5

Table 5 Uncompensated (Marshallian) Price Elasticity Matrix for Quintile 5

Commodity group	With respect to the price of										
	Cereals	Meat	Fish	Dairy	Fats	Fruits	Vegetables	Pulses	Roots	Cooked	Others
Cereals	**-0.8216**	-0.2484	0.0955	-0.0987	0.0799	-0.1488	-0.0851	-0.0731	0.1594	-0.2972	0.2079
Meat	-0.4031	**-1.1078**	0.0691	-0.0710	-0.0830	0.0295	-0.0410	-0.0165	-0.0732	0.1432	0.0792
Fish	0.2480	0.1865	**-1.2277**	-0.0240	0.0951	-0.0101	0.0823	-0.0282	0.0778	0.0905	-0.0060
Dairy	-0.4117	-0.1898	-0.2738	**-1.1285**	0.2072	0.3874	-0.3068	0.1388	0.3783	0.0287	-0.4745
Fats	1.0380	-0.3699	0.9437	0.7179	**-0.7507**	-0.0461	0.3605	0.7543	-0.5896	-1.0828	-1.0007
Fruits	-0.9233	0.2197	-0.1257	0.8103	-0.0477	**-1.0765**	-0.0548	-0.0777	0.2485	0.2527	-0.1110
Vegetables	-0.1648	-0.0335	-0.0431	-0.1259	0.0283	-0.0279	**-1.2442**	0.0129	0.0558	0.0278	0.1175
Pulses	-0.6854	-0.0453	-0.3404	0.4549	0.7350	-0.1201	0.1347	**-1.0950**	-0.1403	-0.3752	0.4700
Roots	0.3365	0.0189	0.0627	0.2268	-0.1054	0.0599	0.1366	-0.0170	**-1.1341**	-0.1333	-0.2216
Cooked	-0.5880	0.3929	0.2161	0.0929	-0.2791	0.1077	0.1674	-0.0828	-0.1751	**-0.3962**	0.0960
Others	2.5630	0.7391	0.0260	-1.3297	-0.9916	-0.1473	0.9299	0.4984	-1.3501	0.4188	**-1.1666**

Table 6 Compensated (Hicksian) Price Elasticity Matrix (National)

Commodity group	With respect to the price of										
	Cereals	Meat	Fish	Dairy	Fats	Fruits	Vegetables	Pulses	Roots	Cooked	Others
Cereals	**-0.8688**	0.0329	0.2912	0.0159	0.0653	-0.0524	0.2194	-0.0006	-0.0435	-0.0753	0.0894
Meat	0.0622	**-1.1367**	0.2878	0.1078	-0.0878	0.1411	0.0567	-0.0100	0.0700	0.2578	0.2300
Fish	0.3094	0.1619	**-1.0650**	0.0294	0.0781	0.0063	0.2269	0.0225	0.0019	0.2831	-0.1119
Dairy	0.0540	0.1940	0.0940	**-0.3520**	0.1460	0.2100	-0.1460	0.0206	-0.1620	0.3860	-0.4700
Fats	0.5550	-0.3950	0.6250	0.3650	**-1.0650**	-0.0400	0.3050	0.3650	0.1650	-0.7200	-0.1850
Fruits	-0.2967	0.4233	0.0333	0.3500	-0.0267	**-1.0000**	0.0733	-0.0600	0.1700	0.4200	-0.1067
Vegetables	0.3108	0.0425	0.3025	-0.0608	0.0508	0.0183	**-0.8908**	0.0433	0.1550	0.0283	-0.0192
Pulses	0.0157	-0.0341	0.1800	0.0515	0.3650	-0.0900	0.2600	**-0.5450**	-0.1600	-0.0750	0.0450
Roots	0.3359	0.0195	0.0027	0.1736	0.0300	0.0464	0.1691	-0.0291	**-0.7827**	0.0873	0.0655
Cooked	0.0812	0.2008	0.3783	0.1016	-0.0758	0.0663	0.0179	-0.0079	0.0505	**-0.5389**	0.6092
Others	1.5558	0.7818	-1.0541	-2.5215	-0.1800	-0.1600	-0.1200	0.0435	2.9700	0.6950	**-0.3750**

Table 7 Compensated (Hicksian) Price Elasticity Matrix (Quintile 1)

Commodity group	With respect to the price of										
	Cereals	Meat	Fish	Dairy	Fats	Fruits	Vegetables	Pulses	Roots	Cooked	Others
Cereals	**-1.1836**	0.0536	0.1964	0.1014	-0.0600	-0.1807	0.3350	-0.1086	0.4793	-0.0108	0.3864
Meat	0.1500	**-1.5420**	0.3200	0.2760	0.4240	0.5100	-0.2340	0.0280	0.0120	0.0180	0.0560
Fish	0.2292	0.1333	**-1.1567**	0.0442	-0.0350	-0.0617	0.5342	0.0050	-0.0733	0.4625	-0.0608
Dairy	0.2367	0.2300	0.0883	**-0.1000**	-0.2317	-0.0083	-0.5317	-0.1767	-0.2017	0.6283	0.0900
Fats	-0.4150	1.0600	-0.2100	-0.6950	**-0.9250**	0.1950	0.5600	1.1150	0.0600	-0.4350	-0.2850
Fruits	-0.6325	0.6375	-0.1850	-0.0150	0.0975	**-1.0675**	-0.0350	0.1675	-0.0725	0.7425	0.3825
Vegetables	0.4690	-0.1170	0.6410	-0.3190	0.1120	-0.0140	**-0.6460**	0.0280	0.2550	-0.1890	-0.1990
Pulses	-0.7639	0.0686	0.0300	-0.5300	1.1150	0.3350	0.1400	**-0.3500**	0.0900	0.4700	-0.5750
Roots	0.9233	-0.0040	-0.1257	-0.1729	0.0171	-0.0414	0.3643	0.0257	**-0.8843**	0.2200	-0.3500
Cooked	0.0303	0.0133	0.1760	0.1019	-0.0235	0.0803	-0.0511	0.0254	0.0416	**-0.3719**	0.0646
Others	1.9770	0.0645	-0.3238	0.1767	-0.1900	0.5067	-0.6667	-0.3900	-0.8167	0.8000	**-1.0667**

Table 8 Compensated (Hicksian) Price Elasticity Matrix (Quintile 3)

Commodity group	With respect to the price of										
	Cereals	Meat	Fish	Dairy	Fats	Fruits	Vegetables	Pulses	Roots	Cooked	Others
Cereals	**-0.9739**	0.0789	0.3306	0.1533	0.0528	-0.0511	0.0489	-0.0172	0.2022	0.1156	0.0706
Meat	0.1420	**-0.9680**	0.3820	0.0200	-0.0080	0.1040	0.2330	0.0190	0.0150	-0.0060	0.0770
Fish	0.3500	0.2247	**-1.1141**	0.1206	0.0582	-0.0188	0.2206	0.0306	0.0906	0.0947	-0.0941
Dairy	0.5520	0.0400	0.4100	**-0.7500**	0.0360	0.1560	0.0260	-0.1160	-0.2120	0.1920	-0.4840
Fats	0.3167	-0.0267	0.3300	0.0600	**-1.0800**	-0.1067	0.5367	0.3967	-0.1900	-0.1000	-0.1267
Fruits	-0.3067	0.3467	-0.1233	0.2600	-0.1067	**-1.1167**	0.3600	-0.1067	0.0433	0.4733	0.2700
Vegetables	0.0629	0.1664	0.2679	0.0093	0.1150	0.0771	**-1.0686**	0.0800	0.1364	0.2093	0.0800
Pulses	-0.1720	0.0856	0.2600	-0.2900	0.5950	-0.1600	0.5600	**-0.2050**	-0.5750	0.0250	-0.1400
Roots	0.2684	-0.0069	0.1283	-0.0883	-0.0475	0.0108	0.1592	-0.0958	**-0.5000**	-0.0425	0.1717
Cooked	0.1935	0.0265	0.1592	0.0640	-0.0200	0.0947	0.0780	0.0033	-0.0340	**-0.4300**	0.0133
Others	0.5021	0.1004	-0.8588	-0.8100	-0.1900	0.4050	0.5600	-0.1400	1.0200	-0.7900	**-0.7650**

Table 9 Compensated (Hicksian) Price Elasticity Matrix (Quintile 5)

Commodity group	With respect to the price of										
	Cereals	Meat	Fish	Dairy	Fats	Fruits	Vegetables	Pulses	Roots	Cooked	Others
Cereals	**-0.5760**	-0.0765	0.3165	-0.0250	0.1045	-0.1120	0.0745	-0.0485	0.3190	-0.1990	0.2325
Meat	-0.1093	**-0.9021**	0.3336	0.0171	-0.0536	0.0736	0.1500	0.0129	0.1179	0.2607	0.1086
Fish	0.3522	0.2594	**-1.1339**	0.0072	0.1056	0.0056	0.1500	-0.0178	0.1456	0.1322	0.0044
Dairy	-0.0833	0.0400	0.0217	**-1.0300**	0.2400	0.4367	-0.0933	0.1717	0.5917	0.1600	-0.4417
Fats	1.0450	-0.3650	0.9500	0.7200	**-0.7500**	-0.0450	0.3650	0.7550	-0.5850	-1.0800	-1.0000
Fruits	-0.7467	0.3433	0.0333	0.8633	-0.0300	**-1.0500**	0.0600	-0.0600	0.3633	0.3233	-0.0933
Vegetables	0.1138	0.1615	0.2077	-0.0423	0.0562	0.0138	**-1.0631**	0.0408	0.2369	0.1392	0.1454
Pulses	-0.4068	0.1498	-0.1600	0.5150	0.7550	-0.0900	0.2650	**-1.0750**	-0.0100	-0.2950	0.4900
Roots	0.5369	0.1592	0.2015	0.2731	-0.0900	0.0831	0.2369	-0.0015	**-1.0338**	-0.0715	-0.2062
Cooked	-0.4337	0.5009	0.3549	0.1200	-0.2700	0.1213	0.2263	-0.0738	-0.1163	**-0.3600**	0.1050
Others	2.6535	0.8024	0.1074	-1.3250	-0.9900	-0.1450	0.9400	0.5000	-1.3400	0.4250	**-1.1650**

Table 10 Summary of Own Price Elasticities

Commodity	Uncompensated				Compensated			
Group	Q1	Q3	Q5	National	Q1	Q3	Q5	National
Cereals	-1.3350	-1.2119	-0.8216	-1.0922	-1.1836	-0.9739	-0.5760	-0.8688
Meat	-1.5593	-1.0086	-1.1078	-1.2458	-1.5420	-0.9680	-0.9021	-1.1367
Fish	-1.2681	-1.1856	-1.2277	-1.2069	-1.1567	-1.1141	-1.1339	-1.0650
Dairy	-0.1705	-0.7597	-1.1285	-0.3846	-0.1000	-0.7500	-1.0300	-0.3520
Fats /Oils	-0.9596	-1.1143	-0.7507	-1.0815	-0.9250	-1.0800	-0.7500	-1.0650
Fruits	-1.1495	-1.1354	-1.0765	-1.0197	-1.0675	-1.1167	-1.0500	-1.0000
Vegetables	-0.7287	-1.2262	-1.2442	-1.0134	-0.6460	-1.0686	-1.0631	-0.8908
Pulses	-0.3671	-0.2294	-1.0950	-0.5630	-0.3500	-0.2050	-1.0750	-0.5450
Roots/Tubers	-0.9618	-0.6697	-1.1341	-0.9279	-0.8843	-0.5000	-1.0338	-0.7827
Cooked	-0.7014	-0.5964	-0.3962	-0.6236	-0.3719	-0.4300	-0.3600	-0.5389
Others	-1.1127	-0.8441	-1.1666	-0.4413	-1.0667	-0.7650	-1.1650	-0.3750

CONCLUSIONS AND POLICY IMPLICATIONS

The study analysed food expenditure patterns in Ghanaian urban households. Expenditure and price elasticities were estimated across different income groups. The “Augmented Regression Approach” was used to control for expenditure endogeneity. The Heckman’s two step procedure was also used to control zero expenditure.

Household demographic factors are relevant in explaining changes in food demand patterns in Ghanaian urban households. All food commodities are normal goods as evidenced from their positive expenditure elasticities and their negative own-price elasticities. The marginal expenditure shares indicate that cereals and bread, roots and tubers, vegetables, meat and fish will remain an important component of urban household food expenditure since they jointly constitute 74% of future expenditure on food. Household food expenditure on fish is expected to decline in the future whiles that of all other commodities rise.

Generally, food demand responds to changes in prices and income (expenditure). This is because the average own price elasticity is -0.87 and cross price elasticities range from -0.0100 to -2.5215. Also expenditure elasticities ranged from 0.4458 to 1.3141. Low income urban households are more responsive to changes in prices than middle income households. However very high income households show high responsiveness to price changes as well. Dairy was the least responsive to changes in own price. Meat was the most responsive food commodity to changes in own price.

Since food demand is quite responsive to changes in own prices and income, policy makers must pay particular attention to these factors when designing policies to reduce poverty and malnutrition levels in urban Ghana. Education on the need for households to balance their diet should intensify since the study revealed an increase in future expenditure on carbohydrate but a decrease in future expenditure on protein (fish) and fruits. This education should be focused more in Northern Ghana since households in these regions are the most vulnerable. The effects of demographic factors in food demand analysis need to be properly understood by policy makers in order to make better predictions and forecasts concerning food expenditure. Cereals and bread and fish food commodity groups have high budget shares and as such a price decline on these commodities will be beneficial to more urban households. Increased production can result in this price decline. Food commodity groups like cereals and bread, meat, vegetables and root and tuber crops have very high income elasticities and as such an increase in income will increase expenditure on these commodities. Hence a policy mix that will aim at increasing household incomes as well as stabilizing prices are recommended to policy makers. Demand elasticities should be used to identify beneficiaries of government social intervention programs like the Livelihood Empowerment against Poverty (LEAP) in order to achieve the desired impacts. An expansion in the Ghana Buffer Stock to include more food items is encouraged in order to ensure that prices are regulated.

Table 11 Parameter Estimates of the LA/AIDS Model (National)

Explanatory Variable	Dependent Variables(Budget Shares)									
	Cereals and Bread	Meat	Fish	Dairy	Fats and Oils	Fruits	Vegetables	Pulses and Nuts	Roots and Tubers	Cooked Food
Constant	-0.2021	-0.0063	0.1516	0.1260	0.0903	0.0918	0.0668	0.0408	-0.1399	1.1613
	(-0.0478)	(0.0509)	(-0.0422)	(0.0348)	(0.0233)	(0.031)	(0.0293)	(0.0305)	(0.0394)	(0.0599)
Real Expenditure	0.0534***	0.0191**	-0.0181***	-0.0174***	-0.0035	-0.0103**	0.0026	-0.0020	0.0352***	-0.1053***
	(0.0068)	(0.0074)	(0.0058)	(0.0054)	(0.0023)	(0.0045)	(0.0038)	(0.0031)	(0.0051)	(0.0094)
Household size	0.0096***	0.0031***	0.0073***	-0.0008	0.0005	-0.0024***	0.0041***	0.0007**	0.0039***	-0.0261***
	(0.0011)	(0.0009)	(0.0011)	(0.0007)	(0.0004)	(0.0007)	(0.0008)	(0.0003)	(0.0008)	(0.0022)
Gender	0.0236***	0.0123***	0.0216***	0.0025	-0.0013	-0.0069***	0.0190***	-0.0003	0.0239***	-0.1091***
	(0.0043)	(0.0038)	(0.0043)	(0.0023)	(0.0013)	(0.0016)	(0.003)	(0.0012)	(0.0035)	(0.0087)
Age	-0.0006***	0.0002*	0.0013***	-0.0002*	0.0000	-0.0001	0.0005***	0.0001	0.0007***	-0.0018***
	(0.0002)	(0.0001)	(0.0001)	(0.00009)	(0.00004)	(0.00007)	(0.0001)	(0.00005)	(0.0001)	(0.0003)
Education	-0.0003*	0.0004***	0.0001	0.0007***	-0.0001	0.0002***	-0.0002**	0.0000	-0.0005***	-0.0002
	(0.0002)	(0.0001)	(0.00016)	(0.00009)	(0.00005)*	(0.00006)	(0.0001)	(0.00005)	(0.0001)	(0.0003)

Notes: Standard errors in parentheses: *** p<0.01, ** p<0.05, * p<0.1 indicate level of significance at 1%.5% &10% respectively.

Table 12 Summary of the Effects of Demographic Variables on Food Budget Shares for each Quintile

Household Size											
	Cereals	Meat	Fish	Dairy	Fats /Oils	Fruits	Vegetables	Pulses	Roots/Tubers	Cooked	Others
Quintile 1	+	+	+	-	+	-	+	-	+	-	+
Quintile 3	+	+	+	+	+	-	-	+	+	-	+
Quintile 5	+	-	+	-	+	-	-	+	-	-	+
Gender											
	Cereals	Meat	Fish	Dairy	Fats /Oils	Fruits	Vegetables	Pulses	Roots/Tubers	Cooked	Others
Quintile 1	+	+	+	+	+	-	+	-	+	-	+
Quintile 3	+	-	+	-	+	-	+	+	+	-	+
Quintile 5	+	-	+	+	-	-	-	-	-	-	+
Age											
	Cereals	Meat	Fish	Dairy	Fats /Oils	Fruits	Vegetables	Pulses	Roots/Tubers	Cooked	Others
Quintile 1	-	+	+	-	+	-	+	-	+	-	+
Quintile 3	-	+	+	-	+	-	+	+	+	-	-
Quintile 5	-	+	+	-	+	-	+	+	+	-	+
Education											
	Cereals	Meat	Fish	Dairy	Fats /Oils	Fruits	Vegetables	Pulses	Roots/Tubers	Cooked	Others
Quintile 1	-	+	+	+	-	-	+	-	+	-	+
Quintile 3	+	+	+	+	+	+	-	+	-	-	-
Quintile 5	-	-	+	+	+	+	-	-	-	-	+

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