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The Effects of Food Price Increases on Urban Household Food Commodities Expenditures in Ghana

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Abstract

The paper analyses the elasticities of urban food demand using household survey data. Expenditure endogeneity and truncated expenditures were controlled in the estimation process using the "Augmented Regression Approach" and Heckman two-stage procedure respectively. Household demographic characteristics such as household size, education, sex, and age of household head have significant influences on food expenditures by urban households. The marginal expenditure shares show that cereals and bread, roots and tubers, fish and vegetables will continue to constitute important share of Ghanaian urban food expenditure as they collectively constitute about 78% of future food expenditure. The study finds that urbanisation generally presents market opportunities for Ghana's local economy, and this potential can fully be exploited if appropriate agricultural policy is focused on increasing food production rather than guaranteed prices.

Key words: Ghana, Urban, LAIDS, Demand, Food, Elasticities

1. Introduction

Ghana's urban[1] population has been increasing rapidly since 1970's. According to the Ghana Statistical Service (GSS, 2012) report, 50.9 percent of Ghanaians live in urban areas as at 2010 and this proportion has been projected to reach 63 percent by 2025.Urbanisation may pose a threat to household food security and demand if the rate of increase in urban population does not correspond to increases in food supply by the largely rural producers. Urban food demand outstripping food supply may result in food price increases. Evidence of this phenomenon is the contribution of the increase in population of India and China to rising global food prices in China (Zezza *et al*. 2009).On the other hand, rising urban population also expands the market for rural food products and thus an opportunity for thriving agribusinesses.

The average annual growth rate of Ghana's urban population within the last decade has been 3.4 percent (GSS, 2012) and GDP growth rate recorded 13.6 percent in 2011 (GoG, 2012).Population and economic growth spurs up urbanisation which results in increase in demand for food. Ghana recently attained middle-income status likely due to rising incomes. It is expected that expenditure patterns particularly on food items will also change. Urban households generally have higher income than rural households and hence are likely to consume more high valued foods than low valued foods.

Urban households are mainly net buyers of food. An average of 40.4 percent of household income is spent on food in Ghana (GSS, 2008). Ghanaian urban households involved in agriculture are estimated to be 28.2 percent of urban households (GSS, 2008).There is limited information on urban food demand in Ghana. This paper attempts to bridge the knowledge gap in urban food demand in Ghana. Several studies cite urban households as more vulnerable to food price increases(Ackah & Appleton, 2007; Haq *et al.*,2008;Sadoulet &

[1]Urban area is defined to be a settlement of at least 5000 inhabitants**.**

Janvry, 2009; Muhammed *et al.*, *2010*; and Alem & Soderbom, 2012). As Ghana's urban population increases, what will be the future trend of urban food demand? How do increases in food prices affect urban household food demand? The paper assesses the effects of increase in food prices on urban household food consumption in Ghana. Specifically, the study estimates price and income elasticities of demand for eleven food groups in Ghana using household data from the Ghana Living Standard Survey Fifth round (GLSS5).

The estimated elasticities of demand obtained in the study will be relevant in analysing the impacts of domestic trade by urban households in the Ghanaian economy. A thorough understanding of the nature of food expenditure patterns and how these patterns change over time has the potential of influencing the design of appropriate policies that will improve food security in urban Ghana. The knowledge of the pattern of urban food consumption should direct food policy in terms of providing adequate market for food products in Ghana. The demand parameters help to understand the food demand structure of Ghana. Furthermore, the estimated parameters can provide a useful framework for analysing the impacts of food policies on households in general. It is therefore imperative to examine how urban consumers react to changes in food prices. The rest of the paper is structured as follows: section 2 outlines the Linear Almost Ideal Demand Systems (LAIDS) model specification. In section 3, the description of the data is presented whilst section 4 presents and discusses the results of the LAIDS model. Section 5 presents the conclusions of the paper.

2. Model Specification and Estimation

2.1. *Almost Ideal Demand System (AIDS)*

The AIDS model has been widely applied in empirical demand studies since its conception in 1980. According to Buse (1994), a closer examination of 207 accessible citations revealed that 68 of the 89 empirical applications used the Linear Approximate version of the AIDS model and that 23 of the 25 papers used the LA/AIDS model for estimating demand functions. Following Deaton and Muellbauer (1980), the AIDS model is specified as:

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

Where w_i is the budget share devoted to commodity i in the commodity groups, p_j is the nominal price of commodity j,x is total expenditure of the household on food commodities, α, γ *and* $\beta$are all parameters to be estimated with u as the error term of the model. P is a translog price index defined by:

$$\log \mathrm{P} = a_0 + \sum a_i \log p_i + \frac{1}{2} \sum \sum \gamma_{ij}^* \log p_i \log p_j \qquad (2)$$

The use of the price index in (2) raises estimation difficulties caused by the non-linearity of parameters. Originally, Deaton and Muellbauer (1980) suggested the use of Stone's price index defined by:

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

but the use of stone's price index causes a problem of simultaneity in the model because, the budget share (w_i) serves as both dependent and independent variable in the model (Eales and Unnevehr, 1988; and Moschini, 1995). Following Moschini (1995), a Laspeyres price index is used to substitute for the Stone's Price index in (3). According to Moschini (1995) the Laspeyres price index is specified as:

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

Where $\overline{w}_i$ is the geometric mean budget share of the i^{th} commodity.

Substituting equation (4) into the AIDS model (1) gives the Linearised Almost Ideal Demand System (LAIDS) as :

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

where $a_i^* = a_i - \beta_i\left(a_i - \sum_{j=1}^{n} \overline{w}_j \ln \overline{p_j}\right)$ and $\overline{p_j}$ is the mean price of the j^th^ commodity, all other variables retain their previous interpretation.

For AIDS model to be consistent with demand theory, the following restrictions are imposed on the AIDS model:

Adding Up

$$\sum_{i=1}^{n} a_i = 1 \sum_{i=1}^{n} \gamma_{ij} = 0 \sum_{i=1}^{n} \beta_i = 0 \quad (6)$$

Homogeneity

$$\sum_j \gamma_{ij} = 0 \quad (7)$$

Symmetry

$$\gamma_{ij} = \gamma_{ji} \quad (8)$$

Eleven (11) food groups are considered in this paper and the data recorded zero expenditure for some food commodities. To account for selection bias, Heckman (1979) suggested a two-stage estimation procedure to correct the potential selection bias. The Heckman procedure is estimated in two stages. The first stage involves estimation of a dichotomous-choice probit model to calculate for the Inverse Mills Ratio (IMR) for each household. The probit model gives the probability that a given household will consume a particular food commodity. The second stage involves the use of the calculated IMR as an instrument in the food commodity demand model. Following Osei-Asare (2004), the probit model is specified as:

$$Y_i = \beta_0 + \beta_i Z + \varepsilon_i \quad \text{and} \quad (9)$$

$$Y_i = \begin{cases} 1 \text{ if commodity } i \text{ is consumed} \\ \quad 0 \text{ otherwise} \end{cases}$$

Where Y_i denotes the decision to consume commodity group i by a household, Z a vector of household socio-demographic characteristics and prices with $\varepsilon_i \sim N(0,1)$. $\emptyset(Z,\beta)$, a univariate standard normal probability function and an associated cumulative distribution function $\theta(Z,\beta)$ are formed using the estimated parameters from the probit model in (9). The IMR (λ) is derived by:

$$\lambda = \frac{\emptyset(Z,\beta)}{\theta(Z,\beta)} \quad (10)$$

From (5), the system of eleven demand equations to be estimated are specified as:

$$w_i = a_i + D(Z) + \gamma_{i1} \ln p_1 + \gamma_{i2} \ln p_2 + \gamma_{i3} \ln p_3 + \gamma_{i4} \ln p_4 + \gamma_{i5} \ln p_5 + \gamma_{i6} \ln p_6 + \gamma_{i7} \ln p_7 + \gamma_{i8} \ln p_8 + \gamma_{i9} \ln p_9 + \gamma_{i10} \ln p_{10} + \gamma_{i11} \ln p_{11} + \beta_i[\ln(x/P^L)] + \lambda_i IMR + \varphi_i\, err + u_i \quad (11)$$

where w_i denotes budget share for i^th^ commodity group (1= Bread and Cereals; 2=Meat; 3= Fish; 4= Dairy; 5 = Oils and Fat; 6= Fruits; 7= Vegetables; 8= Pulse and Nuts; 9= Roots and Tubers; 10= Food away from home (FAFH); and 11= Others), Z denotes vector of socio-economic variables for the i^th^ equation, α, γ, φ and λ denote parameters to be estimated, err denotes error term instrument used to correct expenditure endogeneity, IMR denotes Inverse Mills Ratio, $\ln p_i$ denotes logarithm of price for the i^th^ commodity group, x denotes total food expenditure, P^L denotes Laspeyres price index, a_i denotes a constant for the i^th^ food commodity group.

The differences in household's characteristics will result in different expenditure patterns of households. Therefore, the need to include demographic characteristics of households in demand models cannot be over emphasised. To account for socio-demographic effects on urban food expenditures, this paper follows the approach by Osei-Asare (2004) by applying the linearised demographic translation. This approach preserves the linearity of the LAIDS model.

The demographic translation ($D(Z)$) is expressed as:

$$D(Z) = \delta_1 AGE + \delta_2 HHSIZE + \delta_3 SEX + \delta_4 EDU \quad (12)$$

where, AGE denotes age of household head, HHSIZE denotes household size, SEX denotes biological description of household head (1=male, 0=otherwise), EDU denotes educational level of household head (0= no formal education, 1= primary, 2= J.S.S/M.S.L.C, 3= S.S.S/vocational, 4= technical/training colleges and 5= tertiary).

Expenditure endogeneity is controlled using the Augmented Regression Approach proposed by Blundell and Robin (1999).To avoid singular matrix during estimation due to the use of budget share equations, the demand equation of "other food" is dropped from the system of demand equations. The parameters of the omitted budget share equation are retrieved by using the property of adding-up.The demand model for the remaining ten food aggregates are estimated simultaneously by using the Zellner's Seemingly Unrelated Regressions (SUR) procedure with STATA version 11.

Following Ackah and Appleton (2007), the elasticities are computed at sample means as follows:

(i) Expenditure Elasticity

$$\eta_i = \frac{\partial \log q_i}{\partial \log x} = 1 + \left(\frac{1}{w_i}\right)\left(\frac{\partial w_i}{\partial \log x}\right) = 1 + \left(\frac{\beta_i}{w_i}\right) \quad (12)$$

(ii) Marshallian (Uncompensated) Elasticity

$$e_{ij} = \frac{\partial \log q_i}{\partial \log p_j} = -\delta_{ij} + \left(\frac{1}{w_i}\right)\left(\frac{\partial w_i}{\partial \log p_j}\right) = -\delta_{ij} + \left(\frac{\gamma_{ij}}{\overline{w}_i}\right) - \left(\frac{\beta_i}{\overline{w}_i}\right)\overline{w}_j \quad (13)$$

(iii) Hicksian (Compensated) price elasticity as estimated from the Slutsky equation:

$$\varepsilon_{ij}^* = e_{ij} + \eta_i w_j \quad (14)$$

(iv) Marginal Expenditure shares (Abdulai *et al.*,1999):

$$m_i = \eta_i w_i \quad (15)$$

whereδ_{ij} is the Kronecker delta defined by:

$$\delta_{ij} = \begin{cases} 1 & \text{for } i = j \\ 0 & \text{0therwise} \end{cases}$$

3. Data

The Ghana Living Standard Survey Round Five (GLSS5) developed by the Ghana Statistical Service (GSS) is the main expenditure data set utilised. The GLSS is a multi-purpose survey of households in Ghana that collects information on different dimensions of living conditions of Ghanaians. The GLSS has enough information to estimate total food consumption of each household in the form of expenditure on the commodities consumed. The GLSS5 sampled 8,687 households that were interviewed between September 2005 and September 2006:3618 (41.65%) of households lived in urban areas. Exactly 2935 urban households were used for the analysis after data management processes. The regional distribution of the sample is presented in Table 1.

Individual food commodities were aggregated into eleven (11) food groups: Bread & Cereals, Tubers & Roots, Fish, Meat, Oils & Fats, Nuts & Pulse, Dairy, Vegetables, Fruits, Food away from home (FAFH) and "Others". The "Others" food group is used to represent all other food commodities that do not fall under any of these aggregates. The price data from GSS was collected separately since the GLSS5 did not capture commodity prices at the local markets. Hence, the regional average retail prices of fifty-eight (58) food commodities were used to substitute for community prices. These individual prices were later weighted by the respective geometric mean of that food commodity to compute the aggregate commodity prices using the Laspeyres price index. The prices for these commodities for the years 2005 and 2006 were used for the analysis.

4. Results and Discussions

4.1 Description of Socio-Demographic Variables

The socio-demographic characteristics of the sample are summarised in Table 2.The majority (72%) of the sample were males. The majority of the sampled household heads were aged between 25 and 54 years collectively constituting about 76.5% of the sample. The age distribution of the sample shows that the majority of household heads are in the active labour force. Majority of the households had 1 to 3 persons per household and about 45.1% of the sample had household size greater or equal to the national average of 4 persons per household.

Very few (0.2%) of the sampled household heads had no formal education whilst the majority (51.3%) of the sample had Junior Secondary School or Middle School education. The sample showed that only 12.5% of the household heads had attained tertiary level of education. In general, about 88% of the household heads in the sample had attained at least basic education.

4.2 Demographic Effects of LAIDS Model

The parameter estimates for the LAIDS model are presented in Table 3. The chi-squares for all the ten estimated equations were significant at 1 percent significance level. The magnitudes of the coefficients of the demographic characteristics have no direct economic interpretations. However, the signs of the coefficient tell the direction of the relationship between the variables and the budget shares. The discussions will therefore be focused on the relationships.

For cereals and bread equation, all the socio-demographic characteristics were significant at 1 percent significant levelfor age, sex and household size, and at 10 percent significant level for educational level of household head. Sex of the household head is the most influential factor as it recorded a higher coefficient value of -0.023 implying that male household heads have a lower budget share on cereals food group in Ghana. Apart from household size, all the other factors had a negative relationship with budget share on cereals and bread food group. Household size having positive relationship with budget share on cereal is not surprising. This is because, cereals is a major staple food group of Ghanaian households and as expected, household size increases results in increases in household budget for cereals.

The meat equation also recorded significant levels of socio-demographic influences on household meat expenditures. All the socio-demographic characteristics were significant at 1 percent significance level except age of household head which was significant at 10 percent significance level. Again, apart from sex of household head, all other variables had positive relationship with budget shares on meat. Female-headed households tend to have more budget shares allocated to meat than male-headed households. As household size increases, budget shares on meat also increases, this result was not expected because meat is a high valued food commodity and as such, as household size increases, ceteris paribus, the percapita expenditure within a particular household is expected to fall and hence budget share on meat will also fall. As expected, educational level of household head had positive relationship with meat food group. Ceteris paribus, higher education should be commensurable with good jobs and thus leading to higher incomes, and meat being a high valued food commodity, it should be expected that higher educated household heads would spend more on meat.

Fish, one of the important sources of protein in Ghanaian diet, has all the household socio-demographic characteristics influencing the allocation of budget shares to it except educational level of household head that had no significant influence on fish budget shares. As household size increases, budget share on fish also increases. Similarly, as the age of household head increases, the budget shares on fish commodities also increases. For dairy equation, only sex and educational level of household heads influence budget shares on dairy significantly. Female-headed households tend to have higher budget shares on dairy than male-headed households. Educational level is positively related to budget shares on dairy.

All other demographic variables influence budget shares of fruits and vegetables at 5 percent significant levels except age of household head. More educated household heads spend higher budget shares on fruits than household heads with lower education whiles larger households spend less budget on fruits. With regards to vegetable consumption, increases in both household size and age of household head results in increases of expenditure allocation on with vegetable consumption whiles educational level has negative effect on vegetable consumption. Male-headed households consume less vegetables than female headed households whilst they rather expend more on fruit consumption.

Roots and tubers, another staple food group in Ghanaian diet is significantly influenced by all the demographic variables at 1 percent significance levels. Larger households and female headed households allocate more budget to roots and tubers whiles household heads with higher education have less budget shares allocated to roots and tubers. The budget share equation for FAFH food group had household size, sex and age of household head influencing demand at 1 percent significant level with all of them having negative effects on budget shares for FAFH.

4.3 Expenditure Elasticities and Marginal Budget Shares

The parameter estimates from the LAIDS model are used to derive the expenditure elasticities of demand for the food groups as well as the marginal budget shares using the formulae outlined in (13) and (16). The calculated expenditure elasticities and the marginal budget shares are presented in Table 4. The first and second columns give the expenditure elasticities and marginal budget shares respectively. The expenditure elasticity measures the responsiveness of demand to a percentage change in expenditure.

All expenditure elasticities are positive. The positive expenditure elasticities imply that all the food commodities under consideration are normal goods, meaning that expenditures on these food items rise with increase in income. This is consistent with consumer demand theory. The most expenditure elastic food group is the “others” food group (2.613) followed, by cereals (1.3578), meat (1.3361), and roots and tubers (1.3261) with FAFH having the least expenditure elasticity.

The study finds that, as income grows in urban Ghana, expenditures on cereals, meat, vegetables and roots and tubers are going to rise more than proportionate to income growth. As income grows as evident in consistent growth GDP, the market potential for cereals, meat, roots and tubers and vegetables will also increase. This is a positive signal for supply response of these food groups. With 6 out of 11 food groups registering elastic expenditure elasticities of demand, urbanisation coupled with income growth presents a huge market for the food subsector in the Ghanaian economy.

The marginal budget shares measures the future allocation of any increases in income. From the estimates of the marginal budget shares, if household income should increase, on the average, the Ghanaian urban consumer is expected to spend out of the income increase, about 24 percent on cereals and bread, 15 percent on roots and tubers, 14 percent on fish and 13 percent on vegetables.

4.4. Price Elasticities

The marshallian (uncompensated) price elasticity matrix is presented in Table 5. Both own and cross price elasticities are presented. Price elasticity of demand measures the degree of responsiveness of demand to a percentage change in the price of a commodity. As expected, all own price elasticities are negative, which is consistent with consumer demand theory. Negative own price elasticity means that an increase in the price of the food group results in a decrease in demand for that food group. The own price elasticities are shown in bold figures along the major diagonal in Table 5. Cereals and bread, meat, fish, oils and vegetables are relatively own price elastic whiles the rest of the food commodities are own price inelastic. Meat is highly elastic with own price elasticity of -1.28 suggesting that when the price of meat increases by 1 percent, demand for meat will reduce by 1.28 percent and vice versa.

All cross price elasticities are inelastic as they are all less than 1 in absolute terms. This indicates that there is weak response of one food group to changes in the price of other food groups. This result is expected because there is less substitutability between food groups; substitutability easily occurs within food groups. Positive cross price elasticity implies that the commodities are substitutes while negative cross price elasticities indicate that the commodities are compliments. The cross price elasticities are generally low in absolute values suggesting that the degree of responsiveness of demand for one food group to the price of another food group is low.

The compensated price elasticities as presented in Table 6**,** measures the strength of the pure substitution effects in affecting consumption of the food groups under consideration. Again, as expected, all compensated own price elasticities are negative, implying that the necessary condition of concavity of the cost function used to derive the AIDS model is fulfilled (Osei-Asare, 2004).

The compensated price elasticity assumes that the consumer has been compensated with income to keep the household utility constant. The compensated price elasticities of demand are generally smaller in absolute values than the uncompensated price elasticities. The dynamics of the compensated price elasticities are similar to the uncompensated elasticities; the only difference is that the absence of income effect in the compensated price elasticities makes it smaller in absolute values. With income compensation, only demand for cereals and bread, and oils,are own price elastic. A change in the price of any of them will result in more than proportionate change in quantity demanded of that food commodity group.

5. Conclusions and Policy Implications

The study sought to model urban food demand in Ghana using household consumption expenditure data by estimating a complete demand system for eleven food groups using the LAIDS model. Household demographic characteristics such as household size, education, sex and age of household head have significant influences on food expenditures by urban households. Changes in these socio-demographic factors can have effects on the overall food demand in Ghana. The most significant demographic variables are household size and sex of household head. The results of the study indicate that larger household sizes have higher budget shares for all the food groups except fruits and dairy. This implies that increase in urban population will result in demand increases for various food groups and this has a huge potential of expansion in urban markets for food crops. Agriculture policy in Ghana should focus much on food production to meet the bigger market that awaits it.

All the food groups used in this paper were normal goods (positive expenditure elasticities and negative own price elasticities). The marginal expenditure shares show that cereals and bread, roots and tubers, fish and vegetables will continue to constitute important share of Ghanaian urban food expenditure as they collectively constitute about 78% of future food expenditure. Expenditure elasticities for cereals and bread, meat, oils and fats, vegetables and roots and tubers are elastic. This implies that increasing incomes of urban households likely to result from economic growth presents huge market for rural farmers. The own price elasticities were elastic for most food groups, implying that urban consumers are very sensitive to changes in food prices. The recent increases in food prices are likely to affect nutritional status of urban households. The study finds that urbanisation generally presents market opportunities for Ghana's local economy and this potential can fully be exploited if appropriate agricultural policy is focused on increasing food production rather than guaranteed prices.

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Appendices

List of Tables

Table 1: Regionaldistribution of the sample

Region	Frequency	Percentage
Ashanti	674	22.96
Brong Ahafo	212	7.22
Central	212	7.22
Eastern	272	9.27
Greater Accra	997	33.97
Northern	92	3.13
Upper East	44	1.50
Upper West	29	0.99
Volta	154	5.25
Western	249	8.48
Total	**2,935**	**100.00**

Table 2: Summary of Socio-Demographic Variables used

Variable	Frequency	Percentage

Age (years)		
15 – 24	221	7.5
25 – 34	851	29.0
35 – 44	796	27.1
45 – 54	599	20.4
55 – 64	288	9.8
> 64	180	6.1
Total	**2935**	**100.0**
Sex		
Female	833	28.4
Male	2102	71.6
Total	**2935**	**100.0**
Level of Education		
None	5	0.2
Primary	361	12.3
J.S.S./ Middle School	1507	51.3
S.S.S./Training Colleges	695	23.7
Tertiary	367	12.5
Total	**2935**	**100.0**
Household Size		
1 – 3	1611	54.9
4 – 6	1018	34.7
7 – 9	265	9.0
> 9	41	1.4
Total	**2935**	**100.0**

Source: Author's calculations from GLSS5, 2012

Table 3: Parameter Estimates for the LA/AIDS Model

Explanatory Variable	Dependent Variable (Budget shares)										
	Cereal	**Meat**	**Fish**	**Dairy**	**Oil**	**Fruits**	**Vegetables**	**Pulse**	**Roots**	**FAFH**	**Others**
Constant	-0.2201***	-0.0565	0.1801***	0.2***	0.0459*	0.1026***	0.1007**	0.0303	-0.0853*	1.0272***	-0.3249
	0.0544	*0.0477*	*0.0442*	*0.0383*	*0.0257*	*0.0288*	*0.0317*	*0.0409*	*0.0495*	*0.0652*	-
Real Expenditure	0.0627***	0.0301***	-0.017***	-0.0221***	0.0002	-0.0156***	0.0051	-0.0019	0.0362***	-0.1182***	0.0405
	0.0078	*0.0074*	*0.0063*	*0.0058*	*0.0028*	*0.0043*	*0.0042*	*0.0048*	*0.0070*	*0.0098*	-
Socio demographic parameters											
Household size	0.0091***	0.0028***	0.0069***	-0.0004	0.0011***	-0.002***	0.0051***	0.0008***	0.0038***	-0.0266***	-0.0006
	0.0011	*0.0009*	*0.0010*	*0.0007*	*0.0003*	*0.0006*	*0.0007*	*0.0003*	*0.0008*	*0.0021*	-
Sex	-0.0234***	-0.0163***	-0.0172***	-0.0042*	0.0003	0.0072***	-0.0193***	0.0005	-0.0225***	0.1083***	-0.0134
	0.0044	*0.0037*	*0.0045*	*0.0023*	*0.0013*	*0.0017*	*0.0031*	*0.0013*	*0.0036*	*0.0086*	-
Age	-0.0007***	0.0002*	0.0011***	-0.0001	0	0	0.0006***	0.0001*	0.0007***	-0.0016***	-0.0003
	0.0002	*0.0001*	*0.0001*	*0.0001*	*0.0000*	*0.0001*	*0.0001*	*0.0000*	*0.0001*	*0.0003*	-
Education	-0.0036**	0.0049***	0	0.0065***	-0.0012**	0.0018***	-0.0028**	-0.0006	-0.0047***	-0.0001	-0.0002
	0.0017	*0.0014*	*0.0016*	*0.0009*	*0.0005*	*0.0007*	*0.0011*	*0.0005*	*0.0012*	*0.0034*	-
Price Parameters											
Cereal	-0.0116	-0.0085	0.0229***	-0.0037	0.005	-0.0185***	0.0148***	-0.0052	0.0273***	-0.0416***	0.019***
	0.0109	*0.0052*	*0.0061*	*0.0056*	*0.0032*	*0.0032*	*0.0053*	*0.0033*	*0.0056*	*0.0057*	*0.0058*
Meat	-0.0085	-0.0221***	0.012***	0.0051	-0.0062***	0.0137***	-0.0085***	-0.0007	-0.0065*	0.0078*	0.0138***
	0.0052	*0.0050*	*0.0040*	*0.0033*	*0.0021*	*0.0021*	*0.0033*	*0.0020*	*0.0036*	*0.0044*	*0.0039*
Fish	0.0229***	0.012***	-0.0222***	-0.0061	0.0073***	-0.0039	0.016***	-0.0001	-0.0173***	0.0199***	-0.0285***
	0.0061	*0.0040*	*0.0067*	*0.0044*	*0.0025*	*0.0025*	*0.0040*	*0.0024*	*0.0042*	*0.0051*	*0.0052*
Dairy	-0.0037	0.0051	-0.0061	0.0285***	0.0025	0.0078***	-0.0097**	-0.0011	-0.0082*	0.0054	-0.0205***
	0.0056	*0.0033*	*0.0044*	*0.0056*	*0.0026*	*0.0022*	*0.0040*	*0.0034*	*0.0044*	*0.0035*	*0.0044*
Oils and Fat	0.005	-0.0062***	0.0073***	0.0025	-0.0034	-0.0016	0.0064**	0.01***	0.0004	-0.0181***	-0.0023
	0.0032	*0.0021*	*0.0025*	*0.0026*	*0.0031*	*0.0015*	*0.0026*	*0.0024*	*0.0026*	*0.0018*	*0.0027*

Parameter Estimates for the LA/AIDS Model Continued

Price Parameters	Dependent Variable (Budget shares)										
	Cereal	**Meat**	**Fish**	**Dairy**	**Oil**	**Fruits**	**Vegetables**	**Pulse**	**Roots**	**FAFH**	**Others**
Fruits	-0.0185***	0.0137***	-0.0039	0.0078***	-0.0016	0.0009	-0.001	-0.0007	0.0025	0.0059**	-0.0052*
	0.0032	*0.0021*	*0.0025*	*0.0022*	*0.0015*	*0.0021*	*0.0022*	*0.0015*	*0.0023*	*0.0024*	*0.0028*
Vegetables	0.0148***	-0.0085***	0.016***	-0.0097**	0.0064**	-0.001	-0.002	0.002	0.006	-0.0204***	-0.0036
	0.0053	*0.0033*	*0.0040*	*0.0040*	*0.0026*	*0.0022*	*0.0051*	*0.0025*	*0.0037*	*0.0038*	*0.0041*
Pulse	-0.0052	-0.0007	-0.0001	-0.0011	0.01***	-0.0007	0.002	0.0103***	-0.0087***	-0.0034*	-0.0024
	0.0033	*0.0020*	*0.0024*	*0.0034*	*0.0024*	*0.0015*	*0.0025*	*0.0035*	*0.0025*	*0.0018*	*0.0029*
Roots	0.0273***	-0.0065*	-0.0173***	-0.0082*	0.0004	0.0025	0.006	-0.0087***	0.0124**	-0.0125***	0.0048
	0.0056	*0.0036*	*0.0042*	*0.0044*	*0.0026*	*0.0023*	*0.0037*	*0.0025*	*0.0059*	*0.0044*	*0.0043*
FAFH	-0.0416***	0.0078*	0.0199***	0.0054	-0.0181***	0.0059**	-0.0204***	-0.0034*	-0.0125***	0.0448***	0.0123***
	0.0057	*0.0044*	*0.0051*	*0.0035*	*0.0018*	*0.0024*	*0.0038*	*0.0018*	*0.0044*	*0.0097*	*0.0045*
Others	0.019***	0.0138***	-0.0285***	-0.0205***	-0.0023	-0.0052*	-0.0036	-0.0024	0.0048	0.0123***	0.0126
	0.0058	*0.0039*	*0.0052*	*0.0044*	*0.0027*	*0.0028*	*0.0041*	*0.0029*	*0.0043*	*0.0045*	-
Instruments											
Errors	0.0000***	0.0000**	0.0000	0.0000***	0.0000***	0.0000***	0.0000***	0.0000	0.0000***	0.0000***	-
	0.0000	*0.0000*	*0.0000*	*0.0000*	*0.0000*	*0.0000*	*0.0000*	*0.0000*	*0.0000*	*0.0000*	-
IMR	0.1567***	0.0049	-0.1185***	-0.0516***	-0.0123*	-0.0358***	-0.0447***	-0.0089	0.0151	-0.1121***	-
	0.0201	*0.0096*	*0.0130*	*0.0112*	*0.0071*	*0.0100*	*0.0070*	*0.0108*	*0.0142*	*0.0173*	
Model diagnostics											
R^2	0.1227	0.1654	0.1825	0.0735	0.1049	0.0736	0.18	0.0568	0.151	0.314	-
χ^2	465.4	569.68	671.63	259.11	368.01	308.05	601.9	162.17	566.57	1592.94	-
p-value	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	-
N	2935	2935	2935	2935	2935	2935	2935	2935	2935	2935	2935

Figures in *italics* are standard errors.

Table 4: Expenditure Elasticities and Marginal Expenditure Shares

	Expenditure elasticity	Marginal expenditure shares
Cereals and Bread	1.3578	0.2379
Meat	1.3361	0.1196
Fish	0.8948	0.1443
Dairy	0.5554	0.0276
Oils and Fats	1.0087	0.0263
Fruits	0.5004	0.0156
Vegetables	1.0398	0.1341
Pulse and Nuts	0.907	0.0186
Roots and Tubers	1.3261	0.1471
FAFH	0.3485	0.0633
Others	2.6131	0.0656

Source: Author's calculations from GLSS5, 2012

Table 5: Marshallian (Uncompensated) Price Elasticity Matrix

	with respect to the price of										
Commodity Group	Cereal	Meat	Fish	Dairy	Oil	fruits	vegetables	pulse	roots	FAFH	Others
Cereals and Bread	**-1.129**	-0.0803	0.0732	-0.0386	0.0192	-0.1167	0.0383	-0.0369	0.116	-0.3026	0.0994
Meat	-0.1533	**-1.2768**	0.08	0.04	-0.0777	0.143	-0.1388	-0.0147	-0.1104	0.0263	0.1463
Fish	0.1607	0.0839	**-1.1207**	-0.0328	0.0483	-0.021	0.1127	0.0013	-0.0955	0.1423	-0.1739
Dairy	0.0043	0.1421	-0.0518	**-0.4026**	0.0629	0.1712	-0.1383	-0.0134	-0.1167	0.1889	-0.402
Oil	0.1906	-0.2375	0.2806	0.0973	**-1.1322**	-0.0628	0.2432	0.3839	0.0148	-0.698	-0.0885
Fruits	-0.5043	0.4847	-0.0449	0.2747	-0.0392	**-0.9541**	0.0334	-0.0119	0.1344	0.2808	-0.154
Vegetables	0.1078	-0.0698	0.1176	-0.0773	0.0483	-0.0088	**-1.0207**	0.015	0.0424	-0.1652	-0.0292
Pulse	-0.2357	-0.0256	0.0079	-0.0498	0.4895	-0.0308	0.1111	**-0.4959**	-0.414	-0.151	-0.1127
Roots	0.1888	-0.0882	-0.2085	-0.0904	-0.0048	0.0121	0.0124	-0.0853	**-0.9247**	-0.1723	0.035
FAFH	-0.1153	0.1014	0.2146	0.0619	-0.083	0.0531	-0.0283	-0.0056	0.0032	**-0.6347**	0.0843
Others	0.474	0.4073	-1.3951	-0.8967	-0.1337	-0.2576	-0.3527	-0.1273	0.0117	0.1982	**-0.5412**

Source: Author's calculations from GLSS5, 2012

Table 6: Compensated (Hicksian) Price Elasticity Matrix

	with respect to the price of										
Commodity Group	cereal	Meat	fish	dairy	Oil	fruits	vegetables	pulse	roots	FAFH	Others
Cereals and Bread	**-0.8911**	0.0413	0.2923	0.0288	0.0546	-0.0742	0.2134	-0.009	0.2666	-0.0561	0.1335
Meat	0.0808	**-1.1572**	0.2955	0.1063	-0.0428	0.1847	0.0335	0.0128	0.0378	0.2688	0.1798
Fish	0.3175	0.164	**-0.9763**	0.0116	0.0716	0.0069	0.2281	0.0196	0.0037	0.3047	-0.1515
Dairy	0.1016	0.1918	0.0378	**-0.375**	0.0774	0.1885	-0.0667	-0.002	-0.0551	0.2897	-0.388
Oil	0.3674	-0.1472	0.4433	0.1474	**-1.106**	-0.0313	0.3733	0.4047	0.1266	-0.515	-0.0632
Fruits	-0.4166	0.5295	0.0359	0.2995	-0.0261	**-0.9384**	0.0979	-0.0016	0.1899	0.3716	-0.1415
Vegetables	0.29	0.0233	0.2853	-0.0257	0.0754	0.0237	**-0.8866**	0.0363	0.1577	0.0235	-0.0031
Pulse	-0.0767	0.0556	0.1542	-0.0048	0.5132	-0.0025	0.228	**-0.4773**	-0.3134	0.0136	-0.0899
Roots	0.4212	0.0305	0.0054	-0.0247	0.0297	0.0535	0.1834	-0.0581	**-0.7776**	0.0684	0.0682
FAFH	-0.0542	0.1326	0.2708	0.0792	-0.0739	0.0639	0.0167	0.0015	0.0418	**-0.5714**	0.093
Others	0.9319	0.6412	-0.9735	-0.7671	-0.0656	-0.176	-0.0157	-0.0736	0.3016	0.6725	**-0.4757**

Source: Author's calculations from GLSS5, 2012