Household demand for food commodities in Zambia: An empirical assessment in the context of food insecurity

By

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A dissertation submitted to the University of Zambia in partial fulfilment of the requirements of Masters of Art degree in Economics

The University of Zambia
2009

I, JUSTIN KAPENDA, declare that this dissertation:

a) Represents my own work;

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Approval

This dissertation of JUSTIN KAPENDA is approved as partial fulfilling the requirements for the award of the Masters of Art degree in Economics by the University of Zambia.

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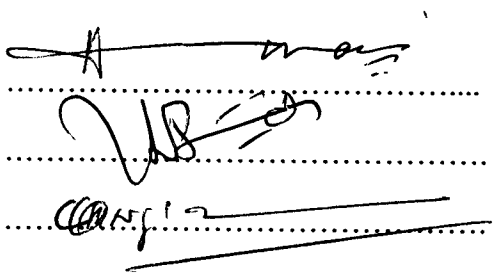

27 - July 2009

27 July 2009

15 - July 2009

It is known that Zambia's population has high food poverty and about 82% of the population in most parts of the country are said to be vulnerable to food insecurity (MoFNP, 2006). The extent of food poverty is particularly more prevalent in rural areas and among the poor people. The high food poverty levels should be a great concern to the policy makers and the government seeking to improve the economy. Addressing this problem requires understanding of the dynamics of this food poverty such as the locality and expenditure pattern on food of the affected people. Little, however, is known on these factors and about how food demand differs across different income groups and across different regions and this household food demand is affected as food prices change. With organized information about responsiveness of heterogeneous consumer households to changes in prices and income, policy makers seeking a mechanism for improving the welfare of households will have relevant information that facilitates the choice between policies that aim at increasing food production or reducing retail food prices and policies that focus directly on affected households. The objective of this research was to investigate the pattern of household food expenditure and examine how the price, income and demographic factors influence demand for food in Zambia using data on 5 food groups. The dissertation address four research questions: First, how do household food expenditure patterns in Zambia differ across different income groups and across different geographical regions? Second, to what extents do demographic factors in Zambia influence consumption decisions and expenditure pattern of household food? Third, how effective are income and price changes in influencing household food demand? And fourth, do households in Zambia diversify in food consumption when income or prices of food change? We used latest Central Statistic Office (CSO) cross sectional data of household expenditure survey of 2006 with a sample of 18,628 households designed to be nationally representative of all Zambian households. We applied Deaton and Muellbauer's (1980) Linear Approximation of the Almost Ideal System (LA/AIDS) model to estimate the demand systems. The demand system was estimated by nonlinear Iterated Seemingly Unrelated Regression (ITSUR) technique using EVIEWS econometric package. The results showed that maize meal, fish/kapenta, fruit/vegetables were inelastic and meat was elastic. The result also showered that meat was a luxury commodity. The main policy implication of the results includes a substantial price decline associated with increased production of maize and fish/kapenta and would benefit the majority of households since the two commodities have high budget shares and low own price elasticities of demand.

Dedicated to my dad Mr. Peter Kapenda and mum Mrs. Getrude Mwandwe Kapenda

Acknowledgement

I wish to express my profound gratitude to Prof V. Seshamani, my supervisor of this research, for his guidance and useful suggestions throughout the period of this research. Without his effective guidance, this project would not have been possible. I'm grateful for the constructive criticism and comments rendered to this dissertation from lecturers of Economics department, in particular, Dr. F. Masiye, Dr. S. Bwalya and Prof. D. Johnson. Sincere recognition is extended to my fellow postgraduate students in Economics for their constructive critique and recommendations for this study.

Grateful acknowledgement is also expressed to the Head of department of Economics Prof. M. Ndulo for allowing me to use the computer room for the department any time during the day. An earnest thanks is extended to the department secretary Ms. S. Nsana for being so helpful whenever I asked to use department facilities. I'm indeed grateful for her assistance. To the postgraduate co-ordinator Dr. C. Ng'andwe, I'm thankful for those constant reminders and updates on the progress of proposals and dissertations. Those relentless reminders in my e-mail box compelled me to submit my research work within the academic calendar. I wish also to thank the staff in dissemination and price section of Central Statistic Office (CSO) in for their assistance and hospitality during my data collection at CSO.

Special thanks go to my much-loved friend and relative Mr. H. Chalenga for being supportive of my studies. His unconditional encouragement is beyond repayment. I wish also to thank Elvis Besa, an undergraduate student at University of Zambia as well as Michael and Mr H. Chalenga for helping me to enter the huge CSO data on the spreadsheet. Without their commitment and resilience, this project could have taken long period to be completed. To my very good and old friend Mr. M. Chirwa, a tutor in the Department of Social Development Studies, Social Work Division, I'm very thankful for all the countless good things he contributed to this work. Without his presence at campus it would have been extremely difficult to accomplish the research. I wish to extend my thanks to my sponsor, Ministry of Health, for making the funds readily available, and for funding the research. I wish also to acknowledge Dr. F. Bwalya, Director of Mansa General Hospital, for being supportive and for making transport funds available during academic recess.

Finally, I would like to thank my family, in particular, my beloved mum and dad for their love to me and support to my study. Their love and understanding shall always be cherished.

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List of abbreviations and acronyms

AIDS	Almost Ideal Demand System Model
CSA	Census Supervisory Areas
CSO	Central Statistics Office
EVIEWS	Econometric Statistical Package
FSP	Fertiliser Support Programme
IMR	Inverse Mills Ratio
ITSUR	Iterated seemingly Unrelated Regression
LA/AIDS	Linear Approximation of the Almost Ideal Demand System Model
MDGs	Millennium Development Goals
MoFnP	Ministry of Finance and National Planning
PSP	Poverty Reduction Programs
QUAIDS	Quadratic Almost Ideal Demand System Model
SUR	Seemingly Unrelated Regression
SAS	Statistical package
SEAs	Standard Enumeration Areas
UN	United Nations

CHAPTER 1

INTRODUCTION

Household food security in terms of access, availability and stability of supply as well as food quality and safety has become a typical issue of discussion both locally and globally in recent times. This is especially in the context of the Millennium Development Goals (MDGs) on poverty reduction and health indicators such as infant malnutrition, mortality and morbidity. The incidences of food insecurity and poverty are particularly devastating in the developing countries. On his address to UN summit in Rome on 3rd June 2008, UN Secretary General Ban Ki-moon urged heads of states to improve vulnerable people's access to food and take immediate steps to increase food availability in their communities and contribute to global food security. In Zambia, about 82 percent of the population in most parts of the country are said to be vulnerable to food insecurity, 47 percent of children are stunted, and 28% are underweight while 5 percent are wasted (MoFNP, 2006; CSO, 1998). With the recent high food price increases, the effect of food insecurity is likely to have worsened. At continental level, it is estimated that 27.4 percent of people in Africa are still chronically undernourished and the figure is expected to increase to 30 percent by 2010.

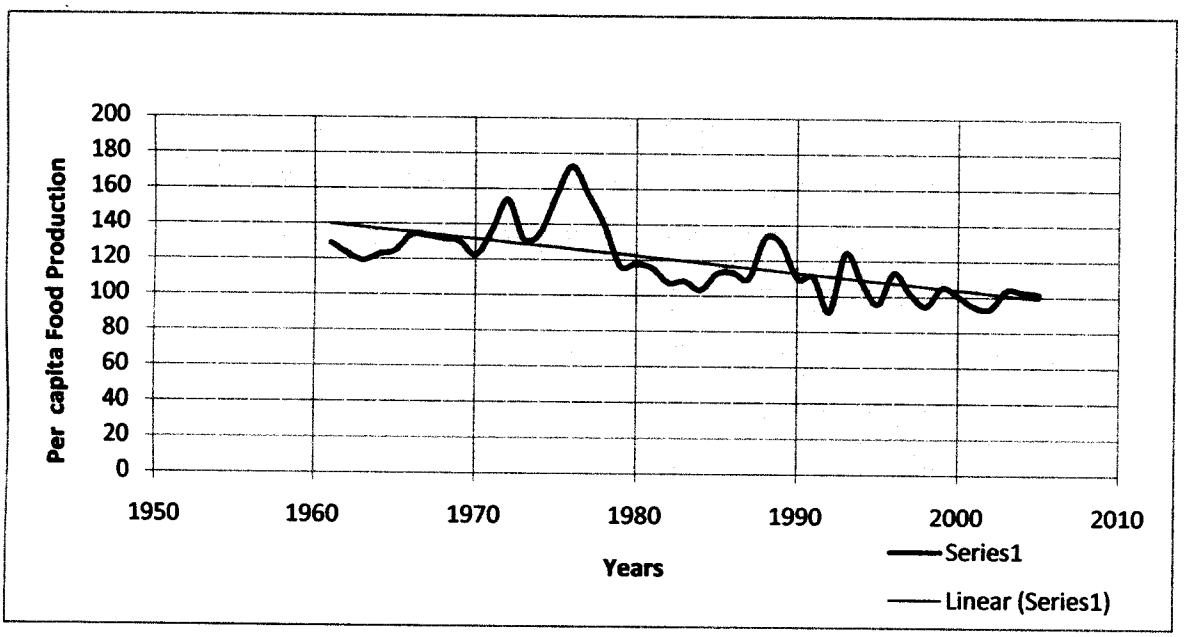
While the level of food insecurity varies from household to household, it is most pronounced in rural areas and among the poor households. Many households in rural areas of Zambia generally receive low incomes with about 92 percent of households receiving K600, 000 (US$150) or less (CSO, 2004). The low income households often spend more on staple food that is usually starch with low quality, and switch to consume more of non staple food as income increases (Duong, 2000). They are also likely to shift to non staple food as the prices of food commodities fall due to the increase in the purchasing power. However, due to the continued low income, rural households continue to be vulnerable to inadequate and low quality food stuff leading to chronic poverty, infant malnutrition and poor health for majority of the people. With about 65 percent of total population being in rural areas but constituting only 41 percent of the total income, the rural households are most likely hit by food insecurity and should be the priority of MDGs.

Besides rural areas, food insecurity is very eminent among the poor households. About 68 percent of Zambia's population lives below poverty line while 50 percent of the population are living in extreme poverty (CSO, 2004). As food becomes more scarce, market prices of food stuff are expected to increase leading to either expenditures on food to increase or

induce substitution across food items. In the presence of food substitutes, low income households substitute poor dietary food, usually food stuffs that are starch in nature. This makes the poor households vulnerable to infant malnutrition and poor health. In the absence of the substitutes, however, (usually the case for low income household) there is increased expenditure share on food thereby constraining the budget and increasing further risks to malnourishment, morbidity and mortality for affected households. This is particularly the case with staple goods that are noticed to be highly inelastic. In periods of food crisis such commodities significantly reduce budget share of the low-income household by taking away a large expenditure share.

There are several factors that have been attributed to food problem in Zambia. The main ones are policy change in agriculture such as withdrawal from the highly subsidised marketing of maize and farm inputs, credit reduction, livestock diseases and climate change leading to droughts and floods. These factors are found to have negative implication on per capita food production in the country. As shown in figure 1 below, per capita food production in index has declined from 130 recorded in 1961 to 100 in 2005, and has been more severe in the last decade.

Figure 1: Per capita Food Production for the year 1961-2005



Source: FAO, 2006

In order to cope with poverty and food insecurity, households resort to coping strategies such as doing piece work on farm and other piece work, working on Food-for-work programs,

accessing relief food, eating wild food only, substituting ordinary meals, reducing the number of meals, reducing other household items, informal and formal borrowing, accessing church and NGO charity, sale of assets, petty vending, asking from friends, relatives, etc and begging from streets (CSO, 2005).

1.1 Statement of the problem

Zambia's population has high food poverty and about 82 percent of the population in most parts of the country are said to be vulnerable to food insecurity (MoFNP, 2006). The question is why food insecurity has remained high in Zambia despite numerous interventions that include Fertilizer Support Programs (FSP) and Poverty Reduction Programs (PRS). Addressing this question is critical in reducing food poverty and malnutrition as well as improving food security among the majority of households. The high level of food insecurity should be a source of great concern to policy makers and the government where the number of children suffering from malnutrition is high and increasing, and the level of food poverty, morbidity and mortality is relatively very high.

The extent of food poverty is particularly more prevalent in rural areas and among the poor people. Moreover, the problems of children malnutrition, morbidity and mortality are more common in rural households and among the poor. Many households in rural areas generally receive low incomes with the average monthly income for rural households almost one-third that of urban households (CSO, 2004). The lower income households suffer from higher share of food expenditure on the total outlays. This generally implies that rural and poor households have a higher expenditure pattern on food and that their budget is constrained to such an extent that they hardly meet adequate nutritious food. Latest official statistics show that at national level, the proportion of household food expenditure is higher in rural areas (73.6 percent) than in urban areas (56.6 percent). And also the expenditure on food by the poor is higher (71.8 percent) than for the non poor (59.3 percent). Besides, there is also a marked difference in food expenditure patterns within rural and urban regions of Zambia and between the urban poor and rural poor. Food policies, therefore, need to address these aspects of food expenditure across regions and income groups.

Little, however, is known about the characteristics of the demand side of the food market in Zambia. In particular, little is known about how food demand differs across different income groups and across different regions, and how this demand would change as income and prices

changes. Equally, not adequate is known about the extent of influence of households' characteristics and demographic factors on consumption decisions of food at household level. Without a thorough understanding of these behavioural patterns in food expenditures, and how these patterns are changing, it will continue to be difficult to design policies that improve food security over a broad range of heterogeneous food-insecurity-prone households. It is thus essential to gain thorough knowledge of the determinants of food demand in order to design comprehensive food and social policy options that improve access to food for majority of Zambians. Predictions of changes in consumer expenditure caused by changes in income and prices are key information for this purpose, and econometric analyses are needed to estimate them empirically.

Hence, this dissertation addressed four research questions on food expenditure pattern by households. First, how do household food expenditure patterns in Zambia differ across different income groups and across different geographical regions? Second, to what extents do demographic factors in Zambia influence consumption decisions and expenditure patterns of household food? Third, how effective are income and price changes in influencing household food demand. And fourth, do households in Zambia diversify in food consumption when income or prices of food change?

1.2 General objective

To investigate the pattern of household food expenditure and examine how the price, income and demographic factors influence demand for food in Zambia using data on 5 food groups. This objective was addressed by the following specific objectives:

1.2.1 Specific objectives

1. To analyse the pattern of household food expenditures and the dynamics of household demand for food;
2. To analyse the determinants of food demand across households;
3. To recommend the policies that would help to stabilise household food consumption patterns, increase nutrition and reduce poverty, infant morbidity and mortality.

1.3 Hypotheses

1. Household demand for food is unlikely to differ across different income groups and regions;
2. The staple food such as mealie meal or maize grain, unlikely to be inelastic to price changes.

1.4 Justification and significance of the study

Zambia faces enormous challenge of attaining the Millennium Development Goals (MDGs) by the year 2015 particularly in the area of eradicating extreme hunger and poverty, reducing child mortality and improving maternal health. Organized information about consumer behaviour, such as elasticities, can help in designing effective policy instruments that can influence consumer behaviour and good diet, improve food security and reduce food poverty thereby improving maternal health and reducing child mortality.

Equipped with detail information about responsiveness of heterogeneous consumer households to changes in prices and income, policy makers seeking a mechanism for improving the welfare of households will have relevant information that facilitates the choice between policies that aim at increasing food production or reducing retail food prices and policies that focus directly on affected households. Policies such as those involving subsidising on input prices for food producers and cutting tax for food are price policies that aim to increase food production and reduce retail prices, respectively. The decision to use price policies begins with knowing the responsiveness of food demand by the household to price changes. Such policies when applied can reduce food poverty and improve nutrition for affected households by having access to adequate food and through substitution to better food. Policy makers may as well propose income policies such as income transfers or in-kind transfers like food relief (or food stamps) to the affected households. Such transfers on food consumed have favourable income effect on the household budget and make the households better off in real terms, and that reduces food poverty, malnutrition and child mortality for many low income households. In a similar way, for the income policy to be effective, knowledge on how food demand responds to income changes should be known. In the long run, the knowledge of food consumption elasticities and the derived elasticities of demand for agricultural commodities may help for forecasting and simulating the impact of policy instruments and their effect on nutrition.

One of the major outputs from this paper is a set of price and expenditure elasticities for a group of food commodities including Maize, the source of the staple food for majority Zambian households. However, due to climate change experienced in recent years that has led to recurrent floods and droughts, there has been crop failure reported in main parts of Zambia with Maize crop production immensely affected. Knowledge of elasticities would then be a critical factor to help recognize and promote production of substitutes that have similar or same tastes, and are nutritious to maximise utility and prevent diseases and

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malnutrition. The elasticities also would reveal how much for instance the price of other food substitutes would increase if maize is scarce due to crop failure. Demographic characteristics would reveal the tastes of food stuff for different regions, and whether or not households can easily shift to cheaper food types.

Knowledge of elasticities would also be useful for better targeting of policies and expenditures by distinguishing between food commodities that are necessities and luxuries as well as those that are inelastic or elastic. Knowledge in this area would facilitate which policy to recommend in order to have greater impact on food poverty. For instance if many food stuff are found to be more response to income changes than price changes, this would mean that income oriented policies can have a relatively greater effect on promoting food expenditure than price related policies.

How a household responds to changes in price and income for particular food commodities reveals how important the household considers those food commodities. The household for instance would still consume highly inelastic food commodities such as staple foods even in times of price escalation and this is a source of food poverty. Because low income households cannot cope with price rise, they resort to reducing on the number of meals. It is thus important for policy makers and NGOs seeking to improve food security to identify the food that are elastic and those that inelastic across different income groups and localities. Estimation of food demand caused by changes in prices and income and varying demographic characteristics are thus key information for policy analysts and model builders in Zambia who may have been relying upon subjective judgement or past elasticity estimates.

CHAPTER 2

LITERATURE REVIEW

Household demand for food has been an intensive subject of study in western countries and Asia. The food demand studies done in western countries particularly focus on the quality of food, and are usually conducted to enhance food marketing decisions. Food demand studies in Asian countries, on the other hand, are concerned more about the availability and accessibility of food stuff for majority households. In African countries, there are very few studies done on food demand, and we did not find any published study on Zambia.

The review of prior research will assist in proper placement of this study in the literature. We shall therefore review literature on cross sectional data studies only because these relate to our study. The literatures reviewed have also determined, to a great extent, the research design proposed in this study. The literatures considered are those by Bopape, and Myers (2007), Weliwita et al (2003), Meenakshi and Ray (1990), Park and Rodney (1996), Raper et al., (2002), Yen et al., (2002; 2003), Gao and Spreen (1994), Nayga (1995) and Dong et al., (2004)

Bopape, and Myers (2007) estimated price and income elasticities and demographic effects on household demand for food in South Africa using KwaZulu-Natal Income Dynamics (KIDS) panel dataset of 1993, 1998 and 2004 survey. Demographic factors included were household size, education of the head, and age of household head. Maximum likelihood was used to estimate a Quadratic Almost Ideal Demand System (QUAIDS) model with theoretical restrictions of adding-up, homogeneity and symmetry imposed during estimation. They found that meat and fish are luxuries across all household groups. Expenditures on meat and fish are more elastic among rural and low income households than among urban and high income households. Grains that are part of staple food for many households are price elastic among high income households.

Weliwita (2003) applied the linearised Almost Ideal Demand System (LA/AIDS) to the 1991/92 household budget survey data of Tanzania to estimate price and food expenditure elasticities of demand for twelve food groups. The results indicate that maize, rice, other cereals, pulses, sugar, edible oils, fish, starch, fruits and other foods are price inelastic while milk and dairy products have unitary elasticity of demand. The results also show that household income and family size have significant effects on food demand pattern.

Meenakshi and Ray (1990) found that non-economic variables such as demographic and cultural variables are also important factors that explain expenditure pattern in developing countries. The research was an attempt to explain the regional variations in expenditure patterns of household. The study was conducted on Indian households by applying both Almost Ideal Demand System (AIDS) and QUAIDS models on nine constituted various household commodities with six of these being food categories. Maltsoglou, (2007) compared the household expenditure on food of animal origin among three countries; Uganda, Vietnam and Peru. She used 1999-2000 data, data for 2002 and household survey data for 2003, respectively to estimate a linear regression model. The result indicates that in Uganda, as income increases, the expenditure on livestock products increases and the difference between urban and rural households reduces. Households consume more fish compared to meat but spend a smaller part of their budget on fish. As income increases the share of fish expenditure level reduces. In Peru, the estimation reveals that as income increases the discrepancies in expenditure levels between urban and rural areas increases while the budget shares reduce. In urban areas across income quintiles, expenditures for fish increase, shares reduce and the quantities per capita slightly reduce. As for Peru, the result suggests that, as income increases, household expenditure increases and the discrepancies between urban and rural expenditure levels also increases.

Park et al., (1996) employed a Heckman two-step procedure for a system of equations to explain the bias introduced from zero expenditure on given commodities by a household. The second step of estimation involved the use of the linear expenditure system. They applied the estimation procedures on twelve food commodity groups according to household poverty status using the 1987-88 US Nationwide Food Consumption Survey data. Parameter estimates were used to obtain subsistence expenditures, own-price elasticities, expenditure elasticities, and income elasticities. Own-price elasticities were similar between the income groups for most commodities. However, income elasticities were consistently higher for the lower-income group. The study by Raper et al., (2002) also suggested that elasticity estimates and subsistence quantity estimates differ across income groups. Their study was conducted on food expenditures and subsistence quantities of poverty status and non-poverty status of U.S. households within a linear expenditure system that postulates subsistence quantities to be linear combinations of demographic variables. Using the 1992 US data, Raper et al. (2002) employed the Heckman (1979) two-step procedure to estimate the demand system across nine broadly aggregated food commodity groups. Another similar study by Yen et al., (2003)

found that demand was price elastic for pork and fish but price inelastic for all other food products. The result also suggested that the cross-price effects were less pronounced than own-price and total food expenditure effects. Yen et al. (2003) came up with these findings when they analysed food consumption by food stamp receiving households in the United States using data from the National Food Stamp Program Survey (NFSPS). They employed a quasi-maximum-likelihood estimator and applied it to a censored translog demand system for foods.

Gao and Spreen (1994) using the 1987-88 US household food consumption survey data, estimated price and expenditure elasticities and the effect of household demographic variables on U.S. meat demand. A demand system, which combines a modified generalized addilog system and a level version Rotterdam demand system, was developed and used as a framework. The results reviewed that region, ethnic background, household size, urbanization, health information, female household head employment status, and proportion of food expenditure on away-from-home consumption were the significant household characteristics and socio-economic variables.

Nayga (1995) adopted a sample selection approach to estimate the demand system by applying the 1992 data to estimate the U.S. meat demand system. He found that age is significantly related to expenditures on a range of meat products, and expenditure on beef initially increases with age, and then declines. He also found that beef and pork expenditures are positively related to household size.

Dong et al., (2004) found significant impacts of household size on demand elasticities after they estimated twelve commodity demand models using simulated maximum likelihood procedures. The estimation procedure is an extension of the Amemiya-Tobin approach to demand system estimation using an AIDS specification. According to Wales & Woodland, (1983), Amemiya-Tobin derived demand (share) equations from a nonstochastic utility function and claimed that latent expenditures (shares) do differ from observed expenditures due to errors of maximization by the consumer, errors of measurement of the observed shares, or random disturbances that influence the consumer's decisions. To account for these differences, error terms were added to the deterministic shares. The technique was applied to the 1998 expenditure survey data on Mexican households. Demographic characteristics such as household size, location, age, and number of children were also included in the model. Yen et al., (2002) estimated censored systems of household fat and oil demand equations with

a two-step procedure, using cross-sectional data from the 1987-1988 U.S. Nationwide Food Consumption Survey. The study used a translog demand model and did not include the demographic characteristics. They found that own-price and total expenditure elasticities were close to unity, and compensated elasticities indicated net substitution among the products.

CHAPTER 3

METHODOLOGY

3.1 Theoretical framework

The theoretical framework of consumer demand is derived from the neo-classical microeconomic theory of consumer choice based on consumer utility. The theory of consumer choice aim to explain choices made by consumers, given the condition of the market environment, incomes and prices, they have to face.

In the theory, consumers are assumed to make the choice in a rational way. Consumers will choose to buy the bundle of commodities that maximize the utility they can achieve, given the limited budget available to them. To determine the quantities that will be bought, it is assumed that the consumer has certain preferences, which can be represented by a utility function. The consumer will then allocate his limited income among goods in order to maximize utility. The utility function measures the level of satisfaction an individual experiences as a result of consuming a particular bundle of commodities that can be either goods or services.

Under the neo-classical utility maximisation framework, the quantity demanded can be expressed as a function of price and income (Chern and Ernest, 2001). Demand equations can be generated by maximizing the utility function subject to the consumer's budget constraint. The utility framework includes the measurements of real income, the measurement of the effects of distortions such as commodity taxation and the division of goods into groups that are closely related. In addition, the utility function generates the three major predictions of demand analysis: 1) the demand equations are homogeneous and adding-up; 2) the substitution effects are symmetric; and 3) the substitution matrix is negative semi definite. Demand functions being homogeneous indicate that the demand functions are of homogeneity degree Zero on price and income. This is based on the assumption that a proportional change in all prices and expenditure does not affect the quantities purchased. In other words, the consumer does not exhibit money illusion. By Young's theorem (Chiang, 2005, p. 296), the symmetry states that the order of differentiation of the demand function with respect to any two arguments does not change the value of the derivative. The substitution effects being symmetric thus imply that compensated across-price effects between any two goods are equal. Symmetry restriction then guarantees consistency of

consumer choice. The adding-up prediction requires that the household doesn't spend more than its total budget. Hence, this prediction allows the budget shares to sum up to unit.

3.2 Empirical model

The Almost Ideal Demand System (AIDS) model was employed to analyse the demand for food. The AIDS model is relatively easy to estimate, and its popularity allows for comparisons with other studies. According to Deaton and Meulbauer (1980), Alston and Chalfant (1993) and Eales and Unnevehr (1994), the AIDS model is as flexible as other locally flexible functional forms but has the added advantage of being compatible with aggregation over consumers. It can thus be interpreted in terms of economic models of consumer behaviour when estimated with aggregated (macroeconomic) or disaggregated (household survey) data. The model is derived from a specific cost function and therefore corresponds with a well defined preference structure, which is convenient for welfare analysis. Homogeneity and symmetry restrictions depend only on the estimated parameters and are therefore easily tested and/or imposed. In addition the AIDS model gives an arbitrary first-order approximation to any demand system and has a functional form which is consistent with known household-budget data. Perhaps the most desirable feature according to Sadoulet and Janry (1995) when compared to previous demand estimating techniques is that the method assumes that there are no price variations within clusters, hence that unit value variations across households in the same cluster are only due to quality differentials and measurement errors. This allows using within-cluster variations in demand to estimate the impact of income and consumer characteristics on demand, including the quality effect. This relation can then be used to remove the predicted effect of income and households characteristics on demand and explain the residual cross-cluster variation in demand by price.

The AIDS model is specified as:

$$W_i = \alpha_i + \sum_j \gamma_{ij}\, lnP_j + \beta_i ln\left(\frac{X}{P}\right) \qquad (1)$$

Where

W_i= The budget share for i^{th} food group

α_i= The intercept

P_j= Price of commodity

γ_{ij}= Price coefficients

β_i= The expenditure coefficient

X= The total expenditure on all commodities

P= The price index given by,

$$lnP = \alpha_0 + \sum_j \alpha_j \, lnP_j + \frac{1}{2}\sum_i \sum_j \gamma_{ij} \, lnP_i lnP \dots \dots (2)$$

The α parameters are the average budget shares when all prices and real expenditure are equal to one. The β parameters measure the change in the i^{th} budget share with respect to a change in real income, all else held constant, and indicate whether goods are necessities or luxuries. If $\beta_i < 0$, W_i decreases when X increases so that good i is a necessity. Conversely, if $\beta_i > 0, W_i$ increases with W_i so that good i is a luxury. The γ_{ij} parameter measures the change in the i^{th} budget share for a unit change in P_i with real income held constant.

The demand for food is influenced by various demographic variables. To capture the effects of these variables on food demand patterns, the intercept of equation (1) is modified by the translating method just like many other studies (Heien and Wessells, 1990). According to the translating method,

$$\alpha_i = \rho_{i0} + \sum_{k=1}^{s} \rho_{ik} \, d_k \dots \dots (3)$$

Incorporating (3) into (1) will yield,

$$W_i = \rho_{i0} + \sum_{k=1}^{s} \rho_{ik} \, d_k + \sum_j \gamma_{ij} \, lnP_j + \beta_i ln\left(\frac{X}{P*}\right) \dots \dots (4)$$

Where P^* is a Stone price index defined as,

$$lnP^* = \sum_i W_i \, lnP_i \dots \dots (5)$$

Hence,

$$W_i = \rho_{i0} + \sum_{k=1}^{s} \rho_{ik} \, d_k + \sum_j \gamma_{ij} \, lnP_j + \beta_i ln\left(\frac{X}{P*}\right) + \varepsilon_i \dots \dots (6)$$

Where ε_i is an error term

The model (6) is linear approximation (LAIDS) to the AIDS model (1) which is intrinsically nonlinear. To be consisted with the demand theory, the following restriction were imposed on equation (6)

i. $\sum_j \gamma_{ij} = 0$ (homogeneity)
ii. $\gamma_{ij} = \gamma_{ji}$ (symmetry)
iii. $\sum_i \alpha_i = 1, \sum_i \gamma_{ij} = 0, \sum_i \beta_i = 0$ (adding up)

The adding-up restriction allows the budget shares to sum up to unit. Homogeneity restriction indicates that the demand functions are homogeneous of degree Zero on price and expenditures. Symmetry restriction guarantees consistency of consumer choice.

To obtain elasticities, Hayes et al, (1990) have shown that elasticities in LAIDS model can be expressed as:

Expenditure elasticity: $\eta_i = 1 + \frac{\beta_i}{w_i}$

Compensated elasticity: $\eta_{ii}^* = -1 + W_j + \frac{\gamma_{ij}}{w_i}, \eta_{ij}^* = +W_j + \frac{\gamma_{ij}}{w_i}$

Uncompensated elasticities: $\eta_{ii} = -1 - \beta_i + \frac{\gamma_{ii}}{w_i}$ and $\eta_{ij} = \frac{\gamma_{ij}}{w_i} - \frac{\beta_i W_j}{w_i}$

3.3 Data and variable descriptions

3.3.1 Data

We used the Central Statistics Office (CSO) household expenditure survey data for 2006. It is the most recent nationally representative household survey, for which the stratified multi-stage systematic cluster sampling method was used. The survey covered both rural and urban areas in all the nine provinces, and was designed to provide data for every district in Zambia. A sample of 18,628 households was drawn and covered all the 72 districts. The districts were subdivided into 155 constituencies, which were further broken down into wards. The wards consisted of Census Supervisory Areas (CSA) and these were subdivided into standard Enumeration Areas (SEAs). The Living condition monitoring survey employed a two-stage stratified cluster sample design whereby during the first stage a number of SEAs were selected. During the second stage, households were systematically selected from an enumeration area listing. The selection of households from various strata was preceded by assigning fully responding households sampling serial numbers. The circular systematic sampling method was then used to select households. The detailed demographic characteristics collected in this survey permitted us to investigate heterogeneity in

preferences. In addition, we used the large sample size because this allowed us to conduct the estimation of a large demand system.

Thirty-six food commodities were grouped into 5 food groups; (i) Maize meal (ii) Meat (viii) Fish and Kapenta (iv) Vegetables and Fruits and (v) other foods. The 'other food' group included beans, dairy and dairy product, edible oil, rice and sugar. It also included salt, sorghum, millet, non alcoholic, baby food and other minor foods. The demand was modelled for these food groups, assuming weak separability between foods and all other goods. Besides quantities, the database also included the prices, expenditures and demographic characteristic.

3.3.2 Variable description

Since prices of commodities were not collected in the household survey, market prices for 2006 collected by CSO were used. To control for demographic effect, the following demographic variables were incorporated into the AIDS model: age of the head of the household, sex and marital status of the head of the household, maximum educational level of the head of the household, household size, number of children, income, availability of own produce food, regions and residence (urban/rural). The age of the head of the household is an indicator of the stage of the household life cycle, and education indicates the level of understanding of nutritional importance by the head of household. Region and residence are captured by dummies, respectively. According to the household production model, a variable indicating the availability of own food produce controlled for the absence of home production in the data. Studies have shown that home production tend to exhibit a socially differentiated pattern. For examples, studies by Blaylock and Gallo, 1983; Caillavet, Nichele, and Robin, 1998 have reported a negative income effect on vegetable home production.

We split total expenditure into quintiles in order to classify households' income into income groups: low income, low-middle income, middle income, middle-high income and high income. The expenditure quintiles (income groups) had been included in the model to control for differences in nominal income of households. Many studies (such as those by Chern, 2003; Weliwita etal, 2003; Bopape and Myers, 2007) have shown that expenditure pattern and consumption decisions are affected by income differences of households as well as real income. The expenditure quintiles is, therefore, considered separately from the continuous expenditure variable that control for the real income. Age of the head of the household was categorised into three: $\leq 28\ years, 29-38\ years\ and\ \geq 39\ years$. This is because there

were very few households less than 28 years and above 39 years in the data. To control for education, two dummies were used; Basic School Education and High School Education. The dummy variable to measure Basic School education level of the head of the household was put at grade 9 and High School level education was at grade 12. The Basic School Education level also measured literacy for the head of the household. The dummies for regions measured the effect on expenditure share of being in different regions of Zambia, hence control for geographical regional differences. Southern Province and Western Province had been merged into one region since these provinces appeared to share the same geographical area, culture and consumption pattern which is not the case if any of the two provinces are merged. For instance, though Luapula and Northern Province share the same geographical area and has same culture in almost all aspects, Luapula Province has conspicuously high consumption of fish and cassava meal than Northern Province. The dummy for residence measured the effect on expenditure of being in urban Zambia.

The prices for commodities groups were calculated by summing the unit prices of individual food items which were weighted by the corresponding budget shares. Since, in the 2006 household survey, the expenditure on mealie meal and maize grain was not captured separately, an average market price was used for maize meal.

Table 1 below provides the descriptive statistics of monthly data used in this study. The statistics indicate that among all food groups, other foods accounts for the highest mean expenditure share of more than 41percent followed by maize meal, meat, fish/kapenta, fruits/vegetables with 23.1 percent, 17.8 percent, 10.3 percent and 7.6 percent expenditure shares, respectively.

The high mean expenditure shares on other food are not surprising considering that this group contains much food stuff that constitutes major meals for an average household in Zambia. The expenditure on maize meal being second to other food groups confirms that it is a staple food for the majority of Zambians. The relatively high mean expenditure share on meat explains its importance on household expenditure decision.

Fish/kapenta meal has the highest price unit among all food groups, followed by meat and other food. Maize meal has lowest unit price of 1,170.67 measured in Kwacha. The high cost of meat and fish/kapenta are mainly due to high transportation costs and low domestic output. The standard deviation measure for prices indicates that meat, fish/kapenta and other foods

followed by housing (25.6 percent), medicals (19.9 percent), cloth (18.1 percent), personal (16.7 percent), transport (14.6 percent), remittance (12.8 percent) and education (10.2 percent). The survey results (in Table 2) also showed that, average household size in Zambia was about 5.24 with a range from 1 to 32 members. About 62 percent of the households had children younger than five years with some households having up to 9 children. The average age of the household was 45 years and about 77 percent of the households are male headed. 18 percent of the household heads were 28 years and less, 32 percent were aged between 29-38 years of age and about 50 percent were 39 years of age and more. About 67 percent of the total head of households were married.

The descriptive statistics of dummies for education showed that about 49 percent of the head of households had acquired basic education (Grade 9) and about 28 percent had reached high school level education and beyond.[1] Regarding the income levels, 17 percent of the household heads fall in the low income groups and 22 percent in the low-middle income. About 22 percent of the household heads were in the middle income, 20 percent in the middle-high income and 19 percent in the high income group. The households in the low and low-middle income groups when put together formed 39 percent of the total households which made up the largest number of households with relatively very low income. The survey also showed that about 46 percent of households produce their own food which is particularly maize grain and cassava that are staple food for majority of Zambians. Whilst Maize grains are grown across Zambia, Cassava tubers are particularly grown in Luapula and Northern Province of Zambia and are a source of major meal for Luapula households. Demographically, the survey indicated that about 51 percent of households are located in urban areas of Zambia, 16.9 percent in Copperbelt Province, 8.6 percent in Central province, and 11.1 percent Eastern Province. About 12.7 percent of households are based in Lusaka province, 8.1 percent in Luapula, 13.7 percent in Northern Province and 9.4 percent in North-western Province. Western and Southern region had a largest number of households of about 19.5 percent. Dummies: 29 – 38 year age of the head of the household, Basic Education level of the head of household, Middle-High income group of the head of household and Copperbelt Province were used as reference point (base) and hence were dropped from the model.

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1. Zambian education system define basic education at grade 9 and high school level at grade 12

Table 2:

Descriptive statistics of demographic variables for Zambia used in LA/AID model, 2006

No.	Variable	Variable notation	mean	St dev
1	Size of the household	d_1	5.24 (1-32)	2.75
2	Number of under five children in the household	d_2	0.62 (0-9)	0.82
3	Dummy for Sex of the head of the household	d_3	0.77	0.42
5	Dummy for $\leq$ 28 year age of the head of household	d_{41}	0.18	0.38
6	Dummy for 29 – 38 year age of the head of the household**	d_{42}	0.32	0.47
7	Dummy for $\geq$ 39 years age of the head of household	d_{43}	0.50	0.50
8	Dummy for marital status	d_5	0.67	0.52
	Dummy for basic education level of the head of household**	d_{61}	0.49	50
9	Dummy for high school education level of the head of household	d_{62}	0.28	0.45
10	Dummy for low income group of the head of household	d_{71}	0.17	0.41
11	Dummy for low-to-middle income group of the head of household	d_{72}	0.22	0.41
12	Dummy for middle income group of the head of household	d_{73}	0.22	0.41
13	Dummy for middle-high income group of the head of household**	d_{74}	0.20	0.40
15	Dummy for high income group of the head of household	d_{75}	0.19	0.39
16	Dummy for urban residence	d_8	51	0.50

17	Dummy for own-food produce	d_9	0.46	0.50
18	Dummy for copperbelt province**	d_{101}	0.168	0.375
19	Dummy for Central province	d_{102}	0.086	0.28
20	Dummy for Eastern province	d_{103}	0.111	0.341
21	Dummy for Luapula province	d_{104}	0.081	0.273
22	Dummy for Lusaka province	d_{105}	0.127	0.333
23	Dummy for Northern province	d_{106}	0.137	0.344
24	Dummy for North-western province	d_{107}	0.094	0.292
25	Dummy for Western and Southern province	d_{108}	0.195	0.396

Where ** indicates the dummy variable used as the base, and thus omitted in the estimation

3.4 Estimation method

To estimate demand systems, we used Central Statistic Office (CSO) cross sectional data of household expenditure survey for the year 2006. We applied the linear approximation of the almost ideal system (LA/AIDS) model developed by Deaton and Muellbauer (1980) because of its known theoretical properties and popularity, which allows for comparisons with other studies. However, the estimation of demand systems using household-level data is more challenging than the conventional time-series data approach, for two reasons. First, household data are usually highly disaggregated across products, and it is difficult to estimate a completely disaggregated system because of the large number of products involved. Therefore, product aggregation is inevitable and is evident in previous work. Second, for any given household, many of the goods have zero consumption, implying a censored dependent variable. Techniques which do not take this censored dependent variable into account yield biased and inconsistent results. The zero expenditure indicates nonpurchases due to nonpreference, sufficient household inventory, or responses to market prices (Cheng and Capps, 1988).

The participation rate, which is defined as the proportion of the total sample that has nonzero consumption of a particular commodity, was unfavourable for most variables. As shown in Table 1 above, with the exception of other food, all commodity groups had low participation rate of less than 90 percent. The low participation rates mean the presence of a large number

of zeros for the budget shares which cause the disturbances associated with those variables to have non zero mean. Hence, the use of standard estimation methods will result in biased and inconsistent parameter estimates because such methods do not take into account the nonzero mean of the disturbances (Maddala, 1992). To deal with zero expenditure we employed the approach by Heien and Wessells (1990) and Weliwita et al (2003). The method involved a model in which the dependent variables were censored. The modelling process took two stages; in the first stage, households decided whether to purchase some amount of a particular food item or not and in the second stage they decided on the amount they buy. The estimation procedure then involves two steps. First, a probit regression for each of the 4 food groups except the other food group, which are deleted from the system, is estimated that determines the probability that a given household will consume the good in question. This regression is then used to compute the inverse Mills ratio (Φ) for each household. The inverse Mills ratio is then used as an instrument that incorporates the censoring latent variables in the second stage estimation of the demand relations. However, as observed by Dale and Wessels (1990), little, if any, theoretical work has been done regarding the specification of probit for demand equations. Nevertheless, prices and demographic effects should play roles similar to those expected in traditional demand analysis. However, in this study we applied the probit similar to the one used in the estimation of demand model with a deflated expenditure.

CHAPTER 4

ANALYSIS OF EMPIRICAL RESULTS

The decision to buy or not to buy in the first stage was expressed as a dummy variable. The dependent variables (budget shares) took the value zero when consumer expenditure on a particular good is zero and one when the expenditure is nonzero.

The probit regressions take the form

$P_{ih} = f(P_1, \ldots, P_j, Xd_1, \ldots, d_1)$ ..... (7)

Where P_{ih} is 1 if the h^{th} household buys the i^{th} food item and 0 if it does not. The maximum likelihood estimates from equation (7) are then used to construct the inverse Mill's ratio for each household for each food group.

Table 2 below shows probit result for of 4 food groups

Table3:
Parameter estimates of probit regression

Variables	Maize meal		Meat		Fish and Kapenta		Fruits and Vegetables	
Intercept	γ_{ij} -1.088	p-value 0.002	γ_{ij} -0.396	p-value 0.129	γ_{ij} -1.216	p-value 0.000	γ_{ij} -0.481	p-value 0.076
Household characteristics								
Sex of the head of the household (d_1)	0.003	0.765	-0.004	0.451	-0.006	0.274	-0.019	0.002
Household size	0.013	0.000*	-0.005	0.000*	-0.0008	0.388	-0.003	0.011
Age of the head of the household								
28 years and less	-0.024	0.011	0.012	0.095	0.012	0.070	0.018	0.016
39 years and above	0.030	0.000*	-0.027	0.000*	-0.012	0.026	-0.022	0.000*
Education level of head of household								
High school	-0.106	0.000*	-0.024	0.000*	0.002	0.695	0.014	0.033
Income of the head of household								
Low (d_{71})	-0.175	0.000*	-0.133	0.000*	-0.111	0.000*	-0.247	0.000*
Low-middle (d_{72})								

	0.008	0.534	-0.017	0.098	0.007	0.435	-0.062	0.000*
Middle (d_{73})	0.019	0.184	0.016	0.12	0.015	0.123	-0.019	0.079
Number of under five children	0.009	0.033	0.002	0.652	0.005	0.112	0.003	0.463
Demographic characteristics								
Urban residence (d_8)	-0.176	0.000*	0.070	0.000*	0.020	0.014	0.098	0.000*
Regions								
Luapula	-0.206	0.000*	-0.063	0.000*	0.117	0.000*	0.093	0.000*
Northern	-0.112	0.000*	0.009	0.341	0.091	0.000*	0.076	0.000*
North western	-0.015	0.234	-0.051	0.000*	-0.153	0.000*	-0.169	0.000*
Western and Southern	0.028	0.003	-0.022	0.002	-0.053	0.000*	-0.088	0.000*
Lusaka (d_{105})	-0.130	0.000*	0.018	0.061	-0.063	0.000*	-0.120	0.000
Eastern	0.071	0.000*	0.038	0.000*	-0.083	0.000*	-0.016	0.139
Interaction terms								
$d_{71} * d_{105}$	0.313	0.000*	-0.145	0.000*	-0.061	0.051	-0.049	0.171
$d_{71} * d_8$	0.117	0.000*	-0.214	0.000*	-0.003	0.875	0.030	0.171
$d_{73} * d_8$	0.004	0.815	0.010	0.451	0.017	0.15	0.043	0.002
$d_1 * d_8 * d_{72}$	-0.010*	0.602	-0.031	0.029	0.007	0.588	0.066	0.000*
Own-food produce	0.002	0.796	0.094	0.000	0.007	0.167	-0.035	0.000*
Price								
Maize meal	0.313	0.000*	-0.112	0.000*	-0.036	0.196	-0.159	0.000*
Meat	-0.043	0.000*	0.09	0.000*	0.024	0.001	-0.042	0.000*
Fish and Kapenta	0.041	0.000*	0.013	0.121	0.113	0.000*	0.080	0.000*
Fruits and Vegetables	-0.110	0.000*	-0.042	0.000*	0.056	0.000*	0.186	0.000*
Other foods	-0.001	0.819	0.024	0.000*	0.009	0.007	0.024	0.000*

Expenditure	0.057	0.000*	0.115	0.000*	0.056	0.000*	0.044	0.000*

Where the asterisk * indicates extremely low p-values; prices and expenditure on food are in natural logarithm

The highly significant variables in all of the probit regressions were deflated total expenditures, the household size, the dummy variable for 39 age and above of household, dummy variable for the low income group of for the head of the household. The dummy for residence as well as for most of the regions were also significant. Many of the price variables were found to be significant. For the total of 20 variables of prices, 14 variables were significant at p-value> 0.05 of the observed t-statistics.

The h^{th} household that consumes the i^{th} item, the inverse Mills's ratio is,

$$\Phi_{ih} = \frac{\theta(P_1, \dots, P_j, X_1 d_1, \dots, d_s)}{\Theta(P_1, \dots P_j, X d_1, \dots, d_s)} \dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots (8)$$

Where θ and Φ are the standard normal density and the cumulative probability functions, respectively. The P_j is a vector of prices for the h^{th} household, $d_s$is a vector of the demographic variables for the h^{th} household.

The inverse Mill's ratio for a household that does not consume the i^{th} item is derived from;

$$\Phi_{ih} = \frac{\theta(P_1, \dots, P_j, X_1 d_1, \dots, d_s)}{1 - \Theta(P_1, \dots P_j, X d_1, \dots, d_s)} \dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots (9)$$

The inverse Mill's ratio for each household for each item is then used as an instrument in equation (10), of estimating model of the second stage regression:

$$W_i = \rho_{i0} + \sum_{k=1}^{s} \rho_{ik}\, d_k + \sum_{j} \gamma_{ij}\, lnP_j + \beta_i ln\left(\frac{X}{P^*}\right) + \delta_i \Phi_{ih} + \epsilon_i \dots\dots\dots (10)$$

Where ϵ_i is an error term

However, the variance-covariance matrix of error terms for the complete equation demand system would be singular due to adding-up conditions. The normal procedure, according to Dale and Wessels, (1990), is to delete one of the equations since the parameters for that relation can be can be computed residually from the others. The estimates are invariant to which good is dropped. As Heien and Wessels (1990) have pointed out, if all n equations

were specified according to (10), adding up conditions would require that $\delta_i \Phi_{ih} = 0$. Since Φ_{ih} can assume any value, this restriction is not possible. To preserve the adding-up condition, Heien and Wessels (1990) indicate that the adding up condition can be preserved by specifying the deleted equation as:

$$W_i = \rho_{i0} + \sum_{k=1}^{s} \rho_{ik}\, d_k + \sum_j \gamma_{ij}\, lnP_j + \beta_i ln\left(\frac{X}{P^*}\right) + \delta_i \Phi_{ih} - \sum_{j=1}^{n-1} \delta_i \Phi_{ih} + \epsilon_i \ldots . (11)$$

A Seemingly Unrelated Regression (SUR) technique was employed to estimate the demand system with homogeneity and symmetric restrictions imposed using Econometric EVIEWS version 3.1 software. This was thus done by estimating a demand (10) of $n-1$ with the following economic restrictions imposed:

$$\text{homogeneity:} \sum_j \gamma_{ij} = 0 \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots . (12)$$

$$Symmetry: \gamma_{ij} = \gamma_{ji} \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots . (13)$$

$$Adding\ up: \sum_i \alpha_i = 1, \sum_i \gamma_{ij} = 0, \sum_i \beta_i = 0 \ldots \ldots . (14)$$

Where;

$$\sum_i \alpha_i = \rho_{i0} + \sum_{k=1}^{s} \rho_{ik}\, d_k = 1$$

$$\sum_i \rho_{i0} = 1$$

$$\sum_{k=1}^{s} \rho_{ik}\, d_k = 0$$

In a demand system with 5 commodity groups, symmetry required imposing 10 restrictions of the estimated coefficients.[2]

2. In a 5×5 matrix, there are 10 pairs of off-diagonal elements that are forced to be equal. These were calculated as $(5 \times 5 - 5)/2$

The SUR method applies to demand system of equations since they appear to be unrelated, since none of the endogenous quantities or budget shares appear on the right-hand side of the equations. Yet this is not the case, however, since error terms across equations are correlated by the fact that the dependent variables needs to satisfy the budget constraints. While an OLS estimate of these equations would be consistent and unbiased, the estimation method developed by Zell (1962) for SUR provides estimates that are more efficient. SUR estimation is a two-stage technique in which the residuals are calculated from OLS regression in the first stage and then generalised least squares is applied in the second stage. The parameters in the omitted equation were obtained indirectly from the above restrictions (12)-(14) while the estimates of the standard errors (for the t-statistics) were calculated from the standard expression for variances of linear combinations of random variances.[3]

Some research works done on demand have empirically tested for the validity of the restrictions. In this study, we have not tested for their validity. Instead, we directly imposed them on the system because they are implied by demand theory. The estimates of this food demand system are presented in table 4 below.

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3. Capps et al (1985) indicates that due to the adding-up constraint, the parameters in the omitted equation are linear combinations of parameters from the remaining equations. Given that the estimated coefficients are asymptotically normally distributed and given that linear combinations of normally distributed random variables are also normally distributed, the estimates of the parameters in the omitted equation are normally distributed. The estimates of the standard errors associated with the estimates of the parameters in the omitted equations can thus be calculated from standard expressions for variances of linear combinations of random variables.

Table 4:

Parameter estimates of food demand system for Zambia using Censored-Regression Method

Variables	Maize meal		Meat		Fish and kapenta		Fruits and vegetables		Other foods	
	γ_{11}	t-ratio	γ_{11}	t-ratio	γ_{11}	t-ratio	γ_{11}	t-ratio	γ_{11}	t-ratio
Intercept	0.156*	5.583	-0.206*	-9.944	0.264*	16.13	0.219*	18.88	0.567*	3.180
Household characteristics										
Household size	0.003*	5.606	-0.002*	-5.188	0.0005	1.805	0.0006	0.282	-0.002	-2.199
Number of under-five children	0.006*	3.360	-0.006*	-4.664	-0.0006	-0.627	-0.0001	-0.178	0.0007	0.415
Sex of the head of the household (d_1)	-0.003	-1.108	0.005	2.204	0.005*	2.969	-0.005*	-3.666	-0.002	-0.990
Age of the head of the household										
≤ 28 *years*	-0.015*	-4.262	-0.001	-0.279	0.003	1.306	0.0007	0.465	0.012*	3.236
≥ 39 *years*	0.019*	6.465	-0.011*	-5.116	0.0004	0.022	-0.001	-0.811	-0.0074	-2.188
Education level of head of household										
High school	-0.053*	-17.20	0.031*	13.35	-0.003	-1.514	-0.003	-1.981	0.028*	8.136
Income of the head of household										
Low (d_{71})	0.091*	14.90	-0.035*	-7.746	-0.011*	-3.145	0.031*	12.30	-0.098*	-14.32
Low-middle (d_{72})	0.023*	4.589	-0.019*	-4.900	0.002	0.776	0.008*	3.763	0.010	1.676
Middle(d_{73})	0.013*	2.412	-0.013*	-3.345	0.005	1.751	0.003	1.259	-0.002	-0.571
Demographic characteristics										
Urban residence (d_8)	-0.151*	-33.77	0.034*	10.11	-0.002	-0.942	0.045*	23.95	0.074*	15.00
Regions										
Luapula	-0.092*	-16.56	-0.056*	-14.29	0.043*	13.29	0.004	1.578	0.101*	17.79
Northern	-0.062*	-13.09	-0.012*	-3.764	0.012*	4.418	0.001	0.529	0.061*	12.42
North-western	0.085*	18.13	-0.016*	-4.682	-0.009*	-3.164	-0.027*	-13.79	-0.033*	-6.562
Eastern	0.060*	12.99	0.027*	7.874	-0.035*	-13.09	-0.015*	-7.859	-0.037*	-6.774
Western and Southern	0.046*	12.80	-0.005	-1.848	-0.009*	-4.579	-0.019*	-12.22	-0.013*	-3.148
Lusaka (d_{105})	-0.005	-1.232	0.005	1.706	-0.019*	-7.708	-0.005*	-2.390	0.024*	5.622
Interaction variables										
$d_{71} * d_8$	0.136*	14.76	-0.087*	-12.46	0.009	1.644	0.014*	3.743	-0.072*	-7.027

$d_{73} * d_8$										
	0.019*	2.813	-0.021*	-4.286	0.003	0.855	0.015*	5.561*	-0.016	-2.247
$d_{71} * d_{105}$										
	0.162*	9.451	-0.037*	-2.831	0.022	2.131	0.012	1.753	-0.159*	-8.378
$d_1 * d_8 * d_{72}$										
	0.043*	6.004	-0.024*	-4.451	0.008	1.924	0.013*	4.280	-0.04*	-5.010
Own-produce										
	-0.047*	-15.85	0.040*	17.83	-0.012*	-6.707	-0.024*	-19.77	0.043*	13.23
Economic variables										
Prices										
Maize meal										
	0.117*	17.54	-0.350*	-12.61	0.026	0.945	-0.381*	-14.68	0.588*	15.37
Meat										
	-0.350*	-12.61	0.421*	19.16	-0.047*	-3.200	-0.133*	-10.57	0.109	0.144
Fish and Kapenta										
	0.026	0.945	-0.047*	-3.200	-0.090*	-4.701	0.162*	12.82	-0.051*	-2.713
Fruit and vegetables										
	-0.381*	-14.68	-0.133*	-10.57	0.162*	12.82	0.339*	18.18	0.013*	5.349
Other food										
	0.588*	15.37	0.109	0.144	-0.051*	-2.713	0.013*	5.349	0.659	2.500
Expenditure										
	-0.010*	-4.365	0.036*	21.80	-0.017*	-12.80	-0.016*	-17.66	0.007*	2.601
Mills ratio										
	0.033*	69.65	0.019*	70.72	0.011*	57.97	0.009*	53.76	-0.072*	26.39
R^2										
	0.392		0.399		0.224		0.374		--	
Adj. R^2										
	0.391		0.348		0.223		0.373		--	
Standard error										
	0.161		0.121		0.095		0.067		--	
Mean dependent variable										
	0.166		0.187		0.109		0.084		0.453	
Durbin-watson stat										
	1.596		1.789		1.672		1.690		1.656	

The asterisk * indicate statistical significance at 99% level; All prices and expenditure are in natural logarithms.

The results indicate that R^2 *and adjusted* R^2 of the system demand equations ranged 0.224 to 0.399 and 0.223 to 0.391. The poor fit in demand models of cross sectional data is, however, not unusual as can be observed in many cross sectional studies.[4] The Durbin-watson of more than 1.5 in all the equations suggested the absence of serial correlations. A total of 145 parameters were estimated in the model. Of these parameters, 113 were found to be statistically significant at 95 percent confidence interval. The number of these significant parameters represents more than 77 percent of total parameters. Inverse mills ratio coefficients are highly significant at 99 percent confidence interval. The high significant of

inverse mills ratio shows that estimating the demand system without considering the presence of zero expenditures would result in biased and inconsistent parameter estimates.

Expenditure parameter estimates of all the food groups are significant at 99% confidence interval. The parameters for maize meal, fish/Kapenta and fruits/vegetables are negative that implies that they are necessity foods. On the other hand, expenditure parameters on meat and other foods are positive, and thus they are a luxury food. Meat and other foods being a luxury commodity, and maize meal, fish/kapenta and fruits/vegetable being necessity for Zambian household, means that as the income of people improves their mean expenditure on meat and other foods increases as well. People, however, reduce expenditure on maize meal, fish/kapenta and fruit/vegetables when income increases.

With the exception of household's size parameter on fish/kapenta and fruits/vegetable, all parameters of demographic characteristics were found to be significant at 5 percent level significant. An addition of one person on the household size, increases the mean expenditure share on maize meal by 0.3 percent. However, mean expenditure shares on meat and other foods of a household reduce both by the same amount of 0.2 percent per every addition of one person. This might mean that households on average reallocate the expenditures away from luxury food towards necessity foods as household size increases. Only mean expenditure shares on maize meal and meat are significant for a variable on the number of under-five children. The results indicates that expenditure shares on maize meal increases by 0.6 percent and meat expenditure shares reduces by same amount per increase in the number of under five children.

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4. These values of adj. R^2 and R^2 obtained in this study are realistic when compared to other cross-section demand studies. For example Heien and Wessells, 1990 had estimated R^2 that ranged 0.159-0.568 while Weliwita, Nyange and Tsujii, and 2003 had adj. R^2 that ranged 0.05-0.21. Other studies found 0.06–0.15 (Huang and Lin, 2000), 0.13–0.39 (Abdulai and Aubert, 2004), 0.10– .33 (Park et al., 1996) and 0.08–0.43 (Saha et al., 1997; Chern, eta al, 2007).

It is interesting to note that per every addition of an under-five child in the household, consumption of maize meal increases three times more than the increase in the household size (caused by an addition of person of any age). This consumption behaviour may mean that the households with the presence (or addition) of under-five children make available mealiemeal all the time in a month in order not to starve the children by providing porridge or nshima. A male-headed household consumes more of meat and fish/kapenta and less of fruit/vegetables. However, a households headed by 28 years old and below, regardless of income and location consume less maize meal and more of other foods while households headed by 39 years old and above consume more maize meal but less meat and other foods. These results may suggest that the households headed by old age in Zambia may be failing to meet the cost of buying meat and may be more likely to be vulnerable to food poverty.

Furthermore, the findings shows that households whose heads have education level going up to grade 12 and beyond, consume more of meat and other food but less maize meal and fruit/vegetables. This is expected considering that income level increases with education level, and that starch food such as maize meal are low quality food that a rational consumer would like to replace with improved income. The dummy variables for income show that households in low, low-middle and middle income bracket consume more maize meal and less meat than high income group. However, low income households consume more fruits/vegetable and less fish/kapenta and other foods than those in high income group. The low-middle income households consume more fruits and vegetables than high income group while the consumptions on fish/kapenta and other foods were not significant.

Most of the estimated coefficients on demographic characteristics are statistically significant. Out of the 35 demographic factor coefficients, 31 of them are significantly different from zero. The coefficients on residence, a proxy of urbanisation, are highly significant for all food groups except fish/kapenta implying that there are significant differences in the patterns of food consumption between rural and urban areas of Zambia. Relative to households in rural, urban households allocate more of their food budget to meat, fish/kapenta and other foods, and less to maize meal. It's difficult to explain why the urban households appear to allocate less budget shares to maize meal than the rural considering that this maize meal is a staple food to Zambia. This may be due to emerging diversification of consumption of food by households caused by readily availability of variety of food stuff in urban areas. The estimated coefficients of most regional variables, about more than 83 percent, are statistically

different from zero at 5 percent significance level or less, which suggests that regional characteristics influence households' food consumption pattern. The result, further, suggest that the food demand structure may be different among varying demographic groups in Zambia. Copperbelt province was taken as a base, and was thus omitted in the model while the majority of coefficients of food on Central Province were insignificant; therefore Central Province was dropped from the model. The results review that Luapula province consumes less maize meal and meat, and more fish/kapenta and other foods. The results are expected as the province is relatively dominated by high consumption of cassava food than maize meal. Cassava is widely grown in this region, and for majority of households, cassava is taken as staple food in place of maize meal. The high consumption of fish/kapenta in Luapula province, too, is not surprising considering that this region has abundant fishing areas (Luapula River, Lake Mweru, Lake Bangueulu) than any other region in Zambia. This provide cheaper source of food and protein for the people of this region. Like Luapula province, Northern Province consumes more fish/kapenta and other food, and less maize meal and meat while consumption on fruit/vegetables is insignificant. The similarity in the consumption pattern in Northern and luapula is largely because these regions share the same geographic areas, land formation, climatic condition and culture. However, relative to households in Luapula Province, households in Northern consume more of maize meal and meat, and less fish/kapenta and other food. The less widely availability of fish/kapenta and cassava in Northern Province may contribute to this mean consumption differences between the two regions.

The estimated coefficients of food groups on North-Western province are all statistically significant. The result indicates that households in this region consume more maize meal, and less meat, fish/kapenta, fruits/vegetables and other foods. The low consumption of meat, fish/kapenta, fruits/vegetables and other foods may be due to remoteness and low economic activities in many of the districts in this region. The results also suggest high food poverty levels on average households. Households in Eastern Province consume more maize meal and meat, and less fish/kapenta, fruits/vegetables and other foods. The results are expected since there are active pastoral activities in cattle in this region and there is relatively absence of main lakes or rivers for fishing. Western and Southern province region consumes more maize meal, and less fish/kapenta, fruit/vegetables and other foods. At 10 percent level of significance, the result shows that Western and Southern Province consume less meat, and this should be of great concern to policy markers since this region is characterised by

traditional cattle rearing. This may suggest that cattle rearing in this region are either meant for cultural purposes or for sale, particularly, for those outside the region, and this may have severe nutritional consequences on average households since there is less consumption of fish/kapenta and other foods that should have been substitutes. Lusaka Province consumes more other foods and less fish/kapenta and fruit/vegetables while coefficient on consumption on maize meal and meat are not significant.

The results on interaction variables show that households located in urban areas consume more maize meal and fruits/vegetables and less meat and other foods. The urban middle income households have similar consumption behaviour as urban low income households. However, unlike their counterpart, the urban middle income consumes relatively less maize meal, and more meat, other foods and more fruits/vegetable. This may mean that middle income may be relocating from poor starch food to more quality protein food and variety. Low income households living in urban towns of Lusaka, exhibits a positive effect on maize meal consumption and fish/kapenta, and a negative effect on the consumption of meat and other foods. This is possibly because meat and other foods are luxury food whose prices are too high for Lusaka low income households to afford. The coefficients for the interaction terms among sex, residence and low-middle income indicate that being a male headed household and living in urban with low-middle income have a positive effect on consumption of maize meal and fruit/vegetables, and a negative effect on consumption of meat and other foods. The results also indicate that households producing their own food consume less on maize meal, fish/kapenta and fruit/vegetables and consume more of meat food and other foods. The results are expected since many average households producing their own are applied mainly to maize grain growers and fishermen. Maize growers produce a great deal of maize grain and this assist them to be food secured in terms of staple food and relocate food expenditure towards quality food such as meat and other foods.

The effect of price effects on for food is analysed in terms of own demand price elasticities and cross price demand elasticities. Table 5 below shows the results on own price elasticity for both Marshallian and Hicksian.

Table 5:
Own-price and expenditure elasticities for food in Zambia

Type of food demand	Marshallian elasticity	Absolute t-ratio	Hicksian elasticity	Absolute t-ratio
Maize meal demand				
Maize meal	-0.484	2.231	-0.263	2.521
Expenditure	0.957	3.326		
Marginal expenditure share	0.221			
Meat demand				
Meat	-1.323	2.653	-1.538	2.007
Expenditure	1.202	2.964		
Marginal expenditure share	0.214			
Fish and kapenta demand				
Fish and kapenta	-1.859	3.512	0.680	3.427
Expenditure	0.834	2.932		
Marginal expenditure share	0.086			
Fruit and vegetables demand				
Fruit and vegetables	-5.971	5.432	-3.513	4.725
Expenditure	0.791	3.887		
Marginal expenditure share	0.060			
Other foods demand				
Other foods	0.596	3.224	-1.014	2.995
Expenditure	1.017	5.332		
Marginal expenditure share	0.418			

All the estimated expenditure elasticities for all food groups are positive implying that all food groups are normal goods. This entails that an increase in income will on average lead to increased consumption. The expenditure elasticity estimates for maize meal, fish/kapenta and fruit/ vegetables are less than one. The result also shows that meat and other food expenditure elasticity estimates are more than one. This shows that the increase in any future expenditure on food will result in less than proportionate increase in the expenditure on maize meal, fish/kapenta and fruit/ vegetable and a proportionate increase in the expenditure of meat and other foods. The marginal expenditure share, which is defined as the product of the expenditure elasticity and the budget share, for each food category is also presented above in table 5. The marginal expenditure share reflects the absolute change in consumption per change in total expenditure. The results indicate that there would not be a substantial change in food demand patterns following an increase in future total expenditure on food. However, a slight increase in the consumption is expected in all food.

The uncompensated (Marshallian) own price elasticities of demand for all food groups are negative. The amount of these elasticities for all commodity groups are well below unity and consistent with the demand theory, and their elasticity estimates ranged from -5.971 for fruit/vegetables to 0.596 for other food. Maize meal and other food are found to be inelastic with maize having an elasticity estimate of -0.484 and other foods recording an elasticity estimate of 0.596. Meat, fruit/vegetables and fish/kapenta are elastic with estimated elasticity of -1.323, -5.971 and -1.859, respectively. Hence, households respond more than proportionately to changes in the price of these foods. However, when the substitution effects are considered, fish/kapenta and other foods become price inelastic and elastic, respectively while maize meal remains inelastic with compensated own-price elasticity estimates of less than unity. It is only in the case of meat and fruit/vegetables where both uncompensated and compensated elasticity estimates remain price elastic.

Maize meal being inelastic in both elasticity estimation methods confirms that maize meal is a staple food for majority of the households. Meat being elastic in both cases is also expected considering that it is relatively expensive for many households particularly the low income households. Its high market price is mainly attributed to transport cost, lack of refrigeration and low output of meat in Zambia. The compensated price elasticity is a better measure of substitutability between two goods because it measures only the substitution effect leaving the income effect out. As predicted by demand theory, the compensated own-price elasticities are negative for all commodities. Maize meal, fish/kapenta and fruit/vegetables are lower in absolute terms than the uncompensated ones while meat and other foods are higher in absolute terms, suggesting that a rise or fall in the price of the respective commodities would have considerable real expenditure effects (a proxy of income effect) on maize meal, fish/kapenta and fruits/vegetables, and a substitution effect on meat and other foods. The other foods group are elastic possibly because the large percentage of food commodities contained is not easily affordable and accessible to majority of the people. Other food is made up mainly of sugar (10.7 percent), edible oil (11.5 percent), milk and daily product (11.1 percent), beans (6.5 percent), bread and buns (12.7 percent), Rice (7 percent) and cassava (6.7 percent). Other cereals, potatoes and minor food such as salt, onion, tea/coffee, baby food constitute about 34 percent of the food group.

Meat being elastic in both compensated and uncompensated elasticity indicates the greater substitution possibilities that households have in responding to changes in the prices of meat compared to other food groups.

Table 6:
Cross-price elasticities for food in Zambia

Type of food demand	Marshallian elasticity	Absolute t-ratio	Hicksian elasticity	Absolute t-ratio
Maize meal demand				
Meat	-1.505	3.445	-1.334	4.654
Fish and Kapenta	-0.117	3.221	-0.215	3.665
Fruits and vegetables	-1.644	4.437	-1.571	3.865
Other food	2.544	3.226	2.953	4.905
Meat demand				
Maize	-2.008	2.998	-1.730	4.445
Fish and Kapenta	-0.284	5.943	-0.161	5.070
Fruits and vegetables	-0.761	4.552	-0.669	2.880
Other food	0.528	2.774	1.022	4.005
Fish and Kapenta demand				
Maize	-0.291	6.005	-0.485	4.432
Meat	-0.428	5.774	-0.279	6.994
Fruits and vegetables	1.590	3.975	1.654	2.998
Other food	-0.429	4.972	-0.086	3.976
Fruit and Vegetables demand				
Maize	-4.938	6.443	-4.755	4.991
Meat	-1.703	3.860	-1.562	3.995
Fish and Kapenta	2.142	3.092	2.222	6.095
Other food	0.256	4.925	0.581	4.997
other food demand				
Maize	1.428	3.664	1.547	5.995
Meat	0.271	5.883	-0.085	4.650
Fish and Kapenta	-0.124	7.004	-0.098	4.642
Fruits and vegetables	0.038	3.994	-0.349	2.759

The Marshallian (uncompensated) and Hicksian (compensated) elasticity estimates are presented in the table 6. The estimates for the uncompensated cross-price elasticity are positive and negative indicating that some food groups are gross substitutes while others are gross complements. The estimates for these uncompensated cross-price elasticities range from -4.938 to 2.142. In cross price elasticities, substitutable commodities have a positive elasticity while complementable commodities have negative elasticity. Uncompensated cross

price elasticity indicates that other foods are substitutes of meat and maize meal, while fruits/vegetables are substitutes of fish/kapenta. The estimates also indicate that fruit/vegetables are substitutes of other foods. The compensated cross price elasticity for food range -4.755 to 2.953. Like uncompensated cross-price elasticity estimates, the compensated cross price elasticity estimates indicate that with exception of meat and fruts/vegetables, all the other food groups have substitutable relationships with each other. For cross-price elasticity of meat and fruits/vegetables, while the Marshallian estimates for these foods are positive, the Hicksian estimates are negative. However, the income effect on fruits/vegetables outweighs the substitution effect while substitution effect on meat has a considerable influence.

CHAPTER 5

CONCLUSION AND POLICY IMPLICATION

This research work analyses the expenditure pattern of Zambian households in the context of food insecurity, using a demand system framework with incorporated household and demographic factors. The demand system is estimated by applying Linear Approximation of Almost Ideal Demand (LA/AID) model using censored regression on the most recent CSO household cross-sectional survey data of 2006. The research confirms that inclusion of zero consumption in the demand system removes the biasness as shown by highly significant inverse Mills ratio (IMR) and improves the estimation results and goodness of fit. The results show important outcome for food policy analysis and model building. The result indicate that expenditure pattern of Zambian households cannot be entirely explained by price and income. The findings suggest that households and demographic factors are as important as economic variables in explaining food expenditure pattern. The results indicate that the household size, number of under-five children, age of the head of household, education level and income of the head of the household, residence and geographical regional differences are important determinants of the expenditure allocation among food commodities. The results are similar to many studies that have found demographic factors to be important determinants of household's expenditure decision such as those by Weliwita etal (2003), Mwenakshi and Ray (1990), Raper et al (2002), park et al 1996) and Gao and Spreen (1994). For instance Weliwita (2003) found that households income and family size have a significant effects on foods demand pattern while Gao and Spreen (1994) found region, ethinic background, female household head employment status and many other demographic characteristics to be significant.

The increase in household size or number of under-five children leads to increases in the expenditures of the foods kwacha to basic foods and to decreases in the expenditure of the food kwacha to luxury foods. For example we found that expenditure share increases on maize by 0.3 percent and expenditure share on meat reduces by 0.2 percent for every addition of an extra person in the households. This result shows that as the household's size increases, there is reallocation of food from luxury food such as meat and other foods towards most basic food such as maize meal. This imply that, on an average, households with relatively large family size are made worse off in terms of accessibility to quality food, and thus anti-

food poverty programmes and measures should take into account the household size and number of under-five children in the household. The results also suggest that the households headed by people aged 39 years and older in Zambia spends less on meat and other foods, and more on maize meal. This, too, mean that the old aged may be failing to meet the prices of quality foods, and may be more likely to be vulnerable to food poverty. Thus, for any food policy to be effective in alleviating the problems of food insecurity and malnutrition programmes, attention should be paid to increase food accessibility to old-age headed households.

Furthermore, the findings shows that households whose heads have education level went up to grade 12 and beyond, consumes more of meat and other food but less on maize meal and fruit/vegetables. This result is important because it appears to show that education tends to have influence on expenditure by directing financial resources away from starch food to better and nutritious food. It also confirms that income level increases with education level, and that starch food such as maize meal are low quality food that households would like to replace with improved income. The finding also reviews that households in low, low-middle and middle income bracket consumes more on maize meal and less on meat than high income group. This shows that it may not only be the low income households but even to those in middle income bracket are vulnerable to food insecurity. This is very worrying since these groups cover a total of about 61 percent of the population (based on own calculation of the quintiles for 2006 CSO living condition monitoring survey data). Hence, there is need to develop holistic anti-poverty measures that are income biased and should address even households in middle income group.

Beside difference in expenditure of food between the households in low income and high income groups, the results, further, indicate that there are substantial differences in expenditure patterns of rural and urban as well as across households in different regional areas of Zambia. This suggests that the food demand structure may be different among varying demographic groups in Zambia. The policy implication of these differences is that the design of anti-poverty and nutrient enhancement programs needs to be region-specific and take into account these behavioural differences in food expenditures. The results also show that Luapula Province and Northern Province consume less maize meal and meat, and more fish/kapenta and other foods. Cassava is widely grown in this region, and for majority of households, cassava is taken as staple food in place of maize meal. The more diversified to

growing of cassava in other regions is important as cassava tubers are resistant to harsh conditions such as dry weather. Households in North-western Province are characterised with low expenditure on meat, fish/kapenta, fruits/vegetables and other foods than any other region, and this may be due to remoteness and low economic activities in many of the districts in this region. The results also suggest low accessibility, and signify high food poverty levels on average households in this region. This result is consistent with CSO report findings that have shown North Western Province time and again to be one of the poorest regions in Zambia. Hence future anti-poverty programmes that are regional specific should give North-western province a first priority.

Eastern Province consumes more maize meal and meat, and less fish/kapenta, fruits/vegetables and other foods. The high expenditure of on meat confirms that the active cattle pastoral activities in this region is the important source of meat for households and is considered as a substitute for fish/kapenta that is scarcely obtainable in this region. At 10% level of significance, the result shows that Western and Southern Province consume less meat, and this should be of great concern to policy markers since this region is characterised by traditional cattle rearing. This may suggest that cattle rearing in this region are either meant for cultural purposes or for sale, particularly, for those outside the region, and this may have severe nutritional consequences on average households since there is less consumption of fish/kapenta and other foods that should have been substitutes. Thus, measures aimed to alleviate poverty and malnutrition should begin to put high priority on promoting not only production of beef but also consumption of locally nurture cattle. Households in Lusaka Province consume more other foods and less fish/kapenta and fruit/vegetables. The results also indicate that households producing their own food consume less on maize meal, fish/kapenta and fruit/vegetables, and consume more of meat food and other foods. This mean that maize growers produce a great deal of maize grain and this assist them to be food secured for the staple food and relocate food expenditure towards quality food such as meat and other foods. Hence, anti-poverty strategy should focus on supporting households to produce their own food especially households in the low income, low-middle and middle income bracket as this is observed to increase purchasing power of households to access good nutritious food.

Empirical estimates of price and income elasticities of food are essential for decisive food policy analysis and model building in Zambia. Major findings of the study and policy

implications drawn from these findings are as follows: Some food commodities, under marshallian, are inelastic with respect to the own price but elastic to the expenditure on food and others elastic to the own price but inelastic to the expenditure on food. Food such as maize meal though less elastic to own price, it is relatively more elastic with respect to expenditure. This means income oriented policies will have a relatively greater effect on promoting food expenditure than price related policies. However, a substantial price decline coupled with increased production of maize meal would benefit the majority of households since it is staple food and has the high budget shares with low own price elasticities of demand. Foods such as fish/kapenta, fruits/vegetables and other foods are more elastic to own price and less elastic with respect to expenditure. This suggests that, in general price oriented policies will have a greater effect in promoting food expenditure than income related policies. However, meat is elastic both with respect to own price and food expenditure, and this imply that both price and income policies will have a great affect on consumption of beef.

Zambia is one of the countries in the sub-Saharan worst hit with the problem of malnutrition. In Zambia, malnutrition is a largely a problem of lack of nutritious food such as protein caused by monotonous food consumption of maize meal or cassava meal. The finding in this study show that the demand for protein decreases significantly with the number of under-five children in the household. The fact that meat is elastic with respect to own price and food expenditure indicates that consumers of meat are responsive to both income and price. A form of subsidy in this beef sector would substantially promote consumption of meat by many households with under five children.

5.1 Limitations, gaps and future studies

The analysis of elasticities is done at national level only, and does not give a scenario at geographical regions or between rural and urban. A detailed study need to be done to examine how price and expenditure elasticity on food differs across regions and income groups. This requires exploring the difference in terms of elasticities between rural and urban areas, and between high and low income groups. This shall need to use more flexible model such as Quadratic Almost Ideal Demand (QUIDS) or modified LA/AID model by Chern (2007). The LA/AID model used in this study does not permit interaction of prices and expenditure variables with socio-demographic factors, thus elasticities for different regions, residence and income groups could not be obtained. Thus future studies need to focus on

further disaggregation of findings and examine elasticity for rural, urban and income groups since this study has shown that there is substantial difference in consumption between regions, residence (rural/urban) and income groups (low and high income).

Unit values were not available in Central Statistics Office's (CSO) Living condition monitoring survey and thus market prices of food commodities for districts were used instead. These prices were obtained from CSO, and were meant to estimate food inflation. The problem with this data is that it is likely to overestimate or underestimate actual prices faced by some consumers. By using these prices, this study made an assumption that all prices of food in the district are invariant. However, there are likely to be a substantial difference between places in the same districts especially between rural areas and urban areas of the same district because of mobility differences. However, huge differences in prices are not expected because of improved transport and mobile communication in recent years across the country. Nonetheless, there is need to use unit values as proxy for prices in future study that use the actual prices faced by the household.

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