The Impact of Rising Food Prices on Household Welfare in Zambia

Miniva Chibuye

Summary

Given the global food price spike experienced in 2007/8, the core question of this research is, ‘what was the impact of the rising food prices on household welfare in Zambia’? Taking an empirical approach and using micro-economic methods, four welfare outcomes are assessed: consumption, equality of income distribution, poverty and nutrition. The 2006 and 2010 cross-section household surveys - Living Conditions Monitoring Surveys (LCMS) - are primarily used to answer the question. The thesis first assesses the changes in consumption patterns across time, geographical locations and quintiles. The short-term distribution of income from the rise in prices is then analysed using non-parametric methods to show the likely winners and losers from the price spike and the subsequent impact on poverty. These results are supplemented by a supply response as an attempt to understand longer-term poverty effects. The final empirical exercise focuses on nutrition outcomes. The thesis confirms the hypothesis that on average, urban households may suffer a welfare loss but rural households may gain. In the case of maize grain, the results suggest that the highest gain may accrue to rural households clustered around the poverty line. Furthermore, the findings suggest that, while overall poverty may increase in the short-run, the long-run impacts of rising food prices (once supply response are accounted for) may lead to a marginal decline in poverty. Finally, we observe that the slight increase in income, from selling maize, among some rural households may not necessarily lead to an improvement in nutrition outcomes. In particular, while rural households exhibit a small net rise in income from an increase in maize prices, the impact on stunting levels among children below five years appears to be regressive in both urban and rural areas. The overall results of this research strengthen the case for contextual impact analysis of covariate shocks and also highlight the policy challenges arising from such conflicting results.

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List of abbreviations and acronyms

AE	Adult Equivalent
BOZ	Bank of Zambia
CDC	Centre for Disease Control and Prevention
CGE	Computable General Equilibrium
CPI	Consumer Price Index
CSO	Central Statistical Office
DALY	Disability Adjusted Life Years
EU	European Union
GRZ	Government of the Republic of Zambia
FAO	Food and Agriculture Organisation
FGT	Foster Greer and Thorbecke
FISP	Farmer Input Support Programme
FOB	Freight on Board
FRA	Food Reserve Agency
FSP	Fertiliser Support Programme
FSRP	Food Security Research Project
HAZ	Height for Age Z-score
HDI	Human Development Index
IAPRI	Indaba Agriculture Policy Research Institute
IDS	Institute of Development Studies
IFAD	International Fund for Agricultural Development
IFPRI	International Food Policy Research Institute
IMF	International Monetary Fund
LCMS	Living Conditions Monitoring Survey
JCTR	Jesuit Centre for Theological Reflection
LFS	Labour Force Survey
MAZ	Millers Association of Zambia
MDG	Millennium Development Goals
MIRAGE	Modelling International Relations under Applied General Equilibrium
NAMBOARD	National Agricultural Marketing Boards
NBR	Net benefit Ratio
NCHS	National Centre for Health Statistics
NFNC	National Food and Nutrition Commission
UNDP	United Nations Development Programme
UNICEF	United Nations Children’s fund
SAFEX	South African Futures Exchange
SNDP	Sixth National Development Plan
SSR	Starchy Staple Ratio
WFP	World Food Programme
ZDA	Zambia Development Agency
ZMK	Zambian Kwacha
ZNFU	Zambia National Farmers Union

Chapter 1: Introduction

"*73 per cent of an additional dollar of expenditure devoted to food... highlights the critical role of food in the budget decisions of very poorest households*", Cranfield, et al., (2007 p.9).

1.1. Background

The impact of high food prices on household welfare is ambiguous as it depends on whether a household is a net buyer or net seller of the product facing a price spike. It has long been recognised by many authors (see for example, Deaton, 1997, Cranfield et al., 2007, Lipton and Waddington, 2004) that high food prices are of significant concern in poor countries because the poorest have been shown to usually spend three-quarters or more of their budgets on foods. As suggested in Cranfield, et al., (2007), this issue is especially important to households in developing countries, where the majority of the poor live.

In the wake of the 2007/8 food crisis for example, Ivanic and Martin (2008) estimated that as a result of the price spike, the poverty headcount in low income countries increased by 105 million people (out of the low-income population of 2.3 billion). Global estimates by the FAO (2008b) indicated that the number of chronically hungry people in the world would rise by 75 million in 2007 to reach 923 million. A more recent joint publication by FAO, IFAD and WFP (2011) showed however that between 2007 and 2008, the number of undernourished people was essentially constant in Asia (an increase of 0.1 percentage points), while it increased by 8 percentage points in Africa[1]. The impact was more modest than was initially anticipated.

Nevertheless, the recorded unrests in various countries, particularly among urban consumers, was testimony of the effect of rising food prices. In Mexico City, there were mass protests about the cost of tortillas. In West Bengal in India, disputes over food-rationing arose. In Dakar (Senegal), Mogadishu (Somalia), Maputo

[1] In absolute terms, the number of undernourished people was 867 million globally (FAO, IFAD and WFP 2012).

(Mozambique) and other parts of Africa, riots occurred over staple food prices, while in Yemen children marched in public to call attention to child hunger (Camillo, 2010, World Bank, 2008a). This chain of events was in stark contrast to the falling food prices that consumers have come to expect over previous decades (Mitchell, 2008, Food and Agriculture Organisation, 2008, Evenson and Gollin, 2003)[2]. The FAO (2008b) argued that riots and civil disturbances, which took place in many low- and middle-income developing countries, was a signal of the desperation caused by soaring food and fuel prices for millions of poor and also middle-class households.

The FAO warned that the 2007-2008 food price spike could have detrimental long-term effects on human development as households, in their effort to deal with rising food bills, either reduced the quantity and quality of food consumed (substituting protein-rich for energy-rich food), divested their productive assets or reduced expenditure on health and education. They cautioned that children, pregnant women and lactating mothers were at highest risk (Food and Agriculture Organisation, 2008). Similar arguments on high food prices having a negative effect on children were made by nutritionists such as Campbell, et al., (2010).

Following the neoclassical economic theory on the effects of price changes, an increase in prices of food is expected to have two consequences; first, it would lead to a reduction in purchasing power of poor households and second, it would induce households to substitute away from expensive foods. As argued by Perloff (2011; p.111), "a doubling of the price of all goods the consumer buys is equivalent to a drop in the consumer's income to half its original level. Even a rise in the price of only one good reduces a consumer's ability to buy the same amount of all goods previously purchased." This is especially so when the commodity in question is a staple.

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[2] According to the combined report by FAO, IFAD and WFP (2011), prices of food commodities on world markets, adjusted for inflation, declined substantially from the early 1960s to the early 2000s, when they reached a historic low affecting most farmers negatively. Dorward (2011) discusses this issue from a global perspective and argues that the perception of historically low real food prices is an artefact of the widespread use of the US consumer price index as the real price deflator.

Consumer theory does not take into account the production side. Singh, Squire and Strauss (1986) argue that traditional economic theory had dealt with household consumption and production as separate units while their interdependence is of crucial importance in developing economies where most households depend on agriculture. As such, it is possible that in the long term, food producing households could benefit from a rise in food prices. In his discussion on economics in general, Chang (2014; p.451) makes the following point, which resonates with our research:

> "When faced with an economic argument, you must ask the age-old question '*Cui bono?*' (Who benefits?), first made famous by the Roman statesman and orator Marcu Tullius Cicero".

In relation to food prices and similar to Singh, Squire and Strauss, Vu and Glewwe (2011) argued that the initial fears that the poor in developing countries could fall deeper into poverty and experience increased malnutrition often overlooked the fact that most poor households in these countries live in rural areas and are producers and not only consumers of food. These authors suggested that the impact of rising food prices on poor households in developing countries was dependent on the net selling position of the household and as such, varied across countries and across households within each country. This observation of rural households being both producers and consumers had been made earlier by others such as Deaton (1989).

Therefore, given the nature of economic activities in developing countries, the impact largely depends on whether a household is a net producer or net consumer of the commodity facing a price spike. Robles and Keefe (2011) and McCulloch and Grover (2010) found significant negative effects on urban households. This suggests that urban households are on average net food consumers and hence would suffer a welfare loss while rural households are net food producers and would gain from a rise in food prices. On the other hand, Ivanic and Martin (2012) argued that if price spikes are short lived, even the poor producers are negatively affected as they do not have time to increase their output in response to a price change. As summarised by Minot and Goletti (2000), it is almost always certain that urban households would suffer a welfare loss from rising food prices but the impact on rural households is uncertain. We provide a more detailed review of empirical evidence on the effects of rising food prices on households in *chapter 2*.

Considering the ambiguous impacts associated with rising food prices, it is critical that developing countries closely monitor the effects of changing food prices on household welfare. Given this context, the central question in the present research is, what was the impact of the 2007/8 global food price spike on household welfare in Zambia? This question is relevant given the rapid increase in global food prices, which saw the FAO food price index rise by 73 points (36.5 per cent) between 2006 and 2008 as depicted in *figure 1.1* in the next section.

We contribute to the literature related to these issues by empirically assessing the welfare impacts of rising food prices on Zambian households. While welfare can be interpreted using various functionings (c.f. Sen, 1999), in this research, we estimate welfare using variables such as consumption, distribution of income, poverty[3] and nutrition.

We have selected Zambia as the country of focus for various reasons. First and as further elaborated in *section 1.3*, Zambia was severely affected by the 2007/8 food crisis, with an average food inflation rate of about 21.5 between December 2006 and January 2009 (Government of the Republic of Zambia, 2010a). There is however little empirical evidence about the effects of this steep rise on household welfare in Zambia. Virtually no comprehensive assessment by the government was conducted during the crisis period, hence limiting the possibility of evidence-based policy making and budgeting. The 2006 Living Conditions Monitoring Survey (LCMS), the main source of information on household wellbeing in Zambia, was published in the same year (2011) as the 2010 LCMS, creating a delay of several years before relevant household welfare information was available. As such, no synchronization seems to exist with key policy decisions. For instance, at the time the Sixth National Development Plan (SNDP) for the period 2011 to 2016 was being published, both the 2006 and 2010 LCMSs were still not available. Essentially, major development plans for the country were made without taking into account the potential changes in household wellbeing.

[3] Defined as the fraction of people living in households where per capita total consumption falls below a defined poverty line (Deaton and Tarozzi 2000). *Section 5.4* provides a further description of the concept.

Nevertheless, a few multi-country studies, some of which included Zambia, were conducted after the food crisis by the World Bank and other international agencies. These studies were however, for their majority, limited to staple food items and old data (for example Ivanic and Martin (2008) who used the 1998 LCMS data, or a limited number of commodities as in the case of Aksoy and Isik-Dikmelik (2008)). In a rather unique multi-country panel study, Heltberg, Hossain and Reva (2012) used qualitative methods to assess the impact of the food crisis and the coping mechanisms. Specific to Zambia, the authors followed a limited number of households in urban Lusaka and in Mpika district on an annual basis between 2009 and 2012.

In-country studies on Zambia covering a high number of households are sparse. McCulloch and Grover (2010) studied the impact of the food, fuel and financial crisis on Zambian households, but their study only used the LCMS household data before the crisis (2006). Similarly, a recent study by Caracciolo, Depalo and Macias (2014) used the 2004/5 household data to estimate a demand system after simulating price changes. Another study was conducted by Mason, et al., (2011) who utilised IAPRI[4] data to examine trends in per capita incomes relative to staple food prices in urban Zambia between 1994 and 2009. Although the data by IAPRI followed the same households twice (August 2007 and February 2008), it is limited to a relatively small sample of households in a minority of districts (Lusaka, Kitwe, Kasama and Mansa). Considering the covariate nature of the 2007/8 food crisis, the IAPRI data cannot speak to the breadth of the crisis or the income distribution across the Zambian geography.

To address this gap in research and evidence, a wide range of food commodities, rather than only staple crops are used in this research. This decision was informed by the food price index calculated by the FAO (2011a), which reported that the price increases were recorded in all food groups (elaborated in *section 1.2*). Furthermore, we use the 2006 and 2010 cross-section data collected through the LCMS. The

[4] IAPRI stands for Indaba Agriculture Policy Research Institute. It was formerly known as the Food Security Research Project (FSRP).

advantage of the data we use is that they cover the period before (2006) and after (2010) the unprecedented 2007/8 global food crisis.

Second, Zambia lacks lengthy panel data to estimate household welfare given a covariate shock such as food prices. When assessing the welfare effect of a covariate shock on households, it is widely accepted that the ideal dataset to use is a lengthy panel covering the period before and after the shock. For many developing countries however, lengthy panel data are not available and cross-sectional surveys (or panels with two or three waves) with either income or consumption data, are still very rare (Christiaensen and Subbarao, 2005, Günther and Harttgen, 2009, Glewwe and Hall, 1998). Our research is therefore conducted using less than ideal datasets (cross section survey), hence, contributing towards the provision of methodological insights best suited in countries where data limitations are the norm, such as Zambia.

Third, unlike most studies that just focus on the effects of food price spikes on either poverty or nutrition, the research questions in this thesis are centered on the following welfare outcomes: consumption, equality of income distribution, poverty and nutrition status. This will provide a much needed broader understanding of the food price effects on Zambian households.

Fourth, the results could also be relevant for policy makers in identifying the households most vulnerable and most likely to suffer or gain during future covariate shocks. Finally, the analysis of Zambia may also shed light on countries in sub-Saharan Africa with similar characteristics.

The rest of the thesis is structured as follows: the following sections in *chapter 1*, the evidence of the global food crisis and some causes are reviewed. This is followed by a graphical presentation of food price trends in Zambia and some of the strategies (such as the maize export ban put in place in January 2008) implemented by the government during the crisis to mitigate the impact of high food prices. The chapter ends by highlighting research questions and hypotheses guiding this research.

Chapter 2 provides a review of the relevant empirical literature on the impact of rising food prices on household welfare in various contexts while pointing out the identified gaps. The second part of this chapter discusses the context and the broad history of food price policy in Zambia. As maize is Zambia's staple crop and is also one of the commodities that faced the steepest increase in prices, popular government strategies such as the producer and consumer maize price subsidies are highlighted. *Chapter 3* summarises the conceptual framework guiding the analysis. It further details the various data sets and sources used in this research.

Chapter 4, the first empirical chapter, begins by estimating the Zambian household food consumption. This is meant to investigate whether households adjusted their consumption patterns across and between food groups as a response to the rising food prices. We then discuss the theory of various price indexes and estimate the results based on the selected index. The rationale for the sub-section on price indexes is to estimate the spatial and inter-temporal price differences. In general, this chapter uses simple but very data intensive methods.

In *chapter 5*, we first address the impact of rising food prices on distribution of income following Deaton's non-parametric techniques. In this empirical chapter, we estimate the likely winners (net sellers) and losers (net buyers) of the food price spike. As a contribution to the growing literature on the impact of food price shock being dependent on the net producing/selling position of the household, we estimate the net effect on households by using both producer and consumer prices. Unlike consumer prices, producer prices are not available in many developing countries, making it difficult for researchers to conduct reasonable estimates of the effects on households. In Deaton's paper, he assumed that the change in producer prices and the change in consumer prices is equal to unity. This is unlikely to happen in many developing countries where subsidies may be introduced at either the consumer or producer level (Vu and Glewwe, 2011). We then estimate poverty effects using headcount, poverty gap and severity of poverty measures. In these poverty estimates, we also incorporate the compensating variation method. Finally, we assess the first-order effects of rising food prices on household welfare and attempt to estimate the second-order effects by integrating elasticity of supply factors.

Chapter 6, the last empirical chapter, assesses the impact of rising prices on nutrition. The objective of the first section in this chapter is to strengthen the discussion initiated in *chapter 4* on the substitution patterns. We then assess the possible effects of such household choices. Finally, we estimate the impact of rising food prices on child health outcomes. We do this by assessing the impact of rising prices of individual food commodities on the levels of stunting[5] (one of the main manifestations of malnutrition) for children under five. The final chapter (*chapter 7*) links back the findings from our empirical research to the theoretical framework and background information. We also discuss the policy implications and present ideas for future research.

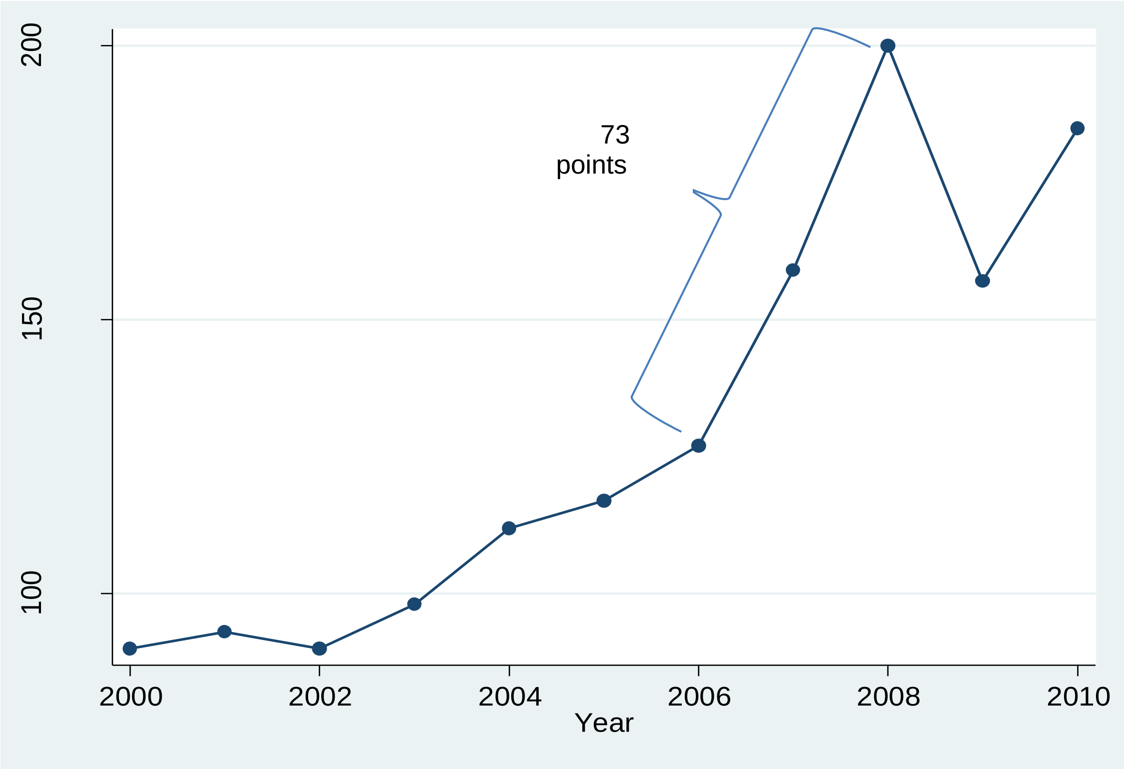
1.2. The global food price crisis

The 2007/8 food crisis was severe and unprecedented in a number of ways: first, with the exception of the early 1970s, historical periods of rapidly rising prices were followed by a retreat back to their pre-spike level (Trostle, 2008). In contrast, this was not the case for the recent crisis. As depicted in *figure 1.1,* food prices declined slightly in early 2009 but not to the level prior to the crisis. In fact, prices further depict an upward trend from mid-2009.

Second and perhaps more worryingly, the 2007/8 global food price rise was driven by unprecedented increases across all food groups between 2006 and 2008, as opposed to previous food crises where price spikes were observed in staples. The FAO data (2011a) shows that with the exception of sugar, all the main food products increased almost simultaneously: meat products (beef, pork and sheep) increased by 22.2 percentage points; the index for dairy products (for example, butter and cheese) was 41.8 percentage points higher in 2008 than in 2006; cereal price index increased by 49.2 percentage points; and the price index for oil and fats was higher by 50.2 percentage points in the same time period.

[5] The WHO (1995) defines stunting as having a height (or length)-for-age more than two standard deviations below the median of the NCHS/WHO growth reference.

Figure 1.1: FAO global food price index (points)



note: 2002-2004 = 100

Source: own calculations from FAO database (2011a)

The 2007/8 food crisis was said to have been caused by both supply and demand factors. Though not exhaustive, the following are the principal demand factors that contributed to the price spike: sustained economic growth in China and India (9 per cent a year between 2005 and 2007) led to increased demand for meat, dairy products and vegetable oils; increased demand for biofuels leading to shifts in usage in land from food to biofuel production; depreciation of the dollar between 2002 and June 2008; import policies such as removing import barriers or lowering tariffs added to the upward pressure on prices (Trostle, 2008, Mitchell, 2008, Von Braun and Torero, 2009, FAO, 2008a, World Bank, 2008, Robles and Torero, 2010).

Supply factors include the decline in growth of agricultural production; higher energy prices ($120 a barrel of crude oil in May 2008); an increase in the general cost of production arising from higher prices of agriculture inputs such as fertiliser and chemicals; long term structural factors such as the decline in investment in agricultural productivity; and adverse weather conditions in large-grain producing countries such as Australia, Ukraine and the European Union (EU) prompting a reduction in grain exports[6]. Export bans to maintain countries' internal consumption in the aftermath of the food crisis exacerbated the crisis symptoms (Trostle, 2008, Mitchell, 2008, Von Braun and Torero, 2009, World Bank, 2008). This is because the bans restricted access to supplies internationally. As of April 2008, fifteen countries, including Argentina, China, Russia and Zambia[7], imposed export restrictions on agricultural commodities. FAO (2008) suggest that export bans and price controls are the most disruptive to markets and are likely to suppress incentives to producers to increase production. Simulations by the International Food Policy Research Institute (IFPRI) using the MIRAGE[8] model found that in the first half of 2008, trade restrictions explained as much as 30 per cent of the increase in prices. This is despite the fact that the estimates were modest as their model did not factor in speculation (Robles and Torero, 2010).

The impact of speculative and investor activities have however been indeterminate. In theory, speculation exerts upward pressure on commodity prices as traders bulk buy in anticipation of future higher prices. von Braun and Torero (2009) statistically tested whether speculative activity in the futures market could have contributed to the price rise in 2007/8. They found that speculation affected prices, with significant impacts in the soybean market. Rapsomanikis (2009) however argued that speculative 'bubbles' in food prices were short-lived during the global food crisis and mostly added to price variability rather than determining the food price levels.

1.3. From global to local: food price crisis in Zambia

Despite the price spike in food commodities globally, it is not obvious that the global prices would translate into an immediate and proportionate rise in local consumer prices. De hoyos and Medvedev (2009) argued that, in a world where as little as 7 per cent of total food consumption is being traded internationally, the

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[6] The impact of the adverse weather conditions in the main grain exporting countries has been disputed. For example, the World Bank (2008) argues that the reduction in production among the exporting countries were largely offset by good crops and increased exports in other countries and would not, on their own, have had a significant impact on prices.

[7] The full list of countries that imposed export restrictions on agricultural commodities are: Argentina, Bangladesh, Bolivia, Cambodia, China, Egypt, Ethiopia, India, Kazakhstan, Malaysia, Pakistan, Russia, Tanzania, Vietnam and Zambia (von Braun and Torero 2009).

[8] MIRAGE stands for Modeling International Relations under Applied General Equilibrium.

international and domestic food consumer price indices are only marginally related. According to the FAO (2011), in most cases, the surges in prices on international markets led to substantial increases in domestic prices, although domestic prices did not increase in some countries. In China, India and Indonesia, domestic prices of rice and wheat were very stable due to government controls on exports of these crops.

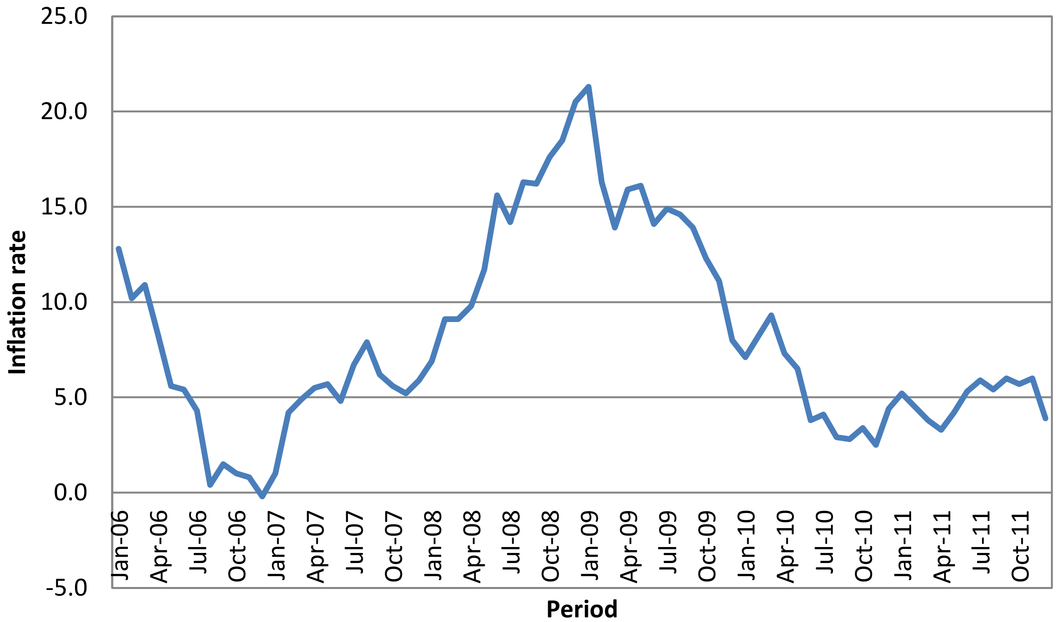
The degree of price transmission therefore depends on factors such as currency exchange rates, quality of local infrastructure, government policies for price stabilisation and trade openness (FAO, 2008b, World Bank, 2008, Winters, McCulloch and McKay, 2004). As regards trade openness, Robles and Torero (2010) suggest that a higher price transmission is expected in countries that are more integrated with international markets and that have no or minimum barriers to trade.

In relation to the case of Zambia, Chapoto (2012) conducted an empirical test on the level of integration between Zambia and the international market for the main staple, maize. He found that there was no statistically significant long-run relationship between local maize prices and the United States Gulf freight on board (FOB) maize prices or the South African Futures Exchange (SAFEX) maize prices. This is partly because Zambia has been self-sufficient in maize, except during periods of drought (for example, 2001, 2002 and 2005). The link to the South African market is relevant here as during deficit periods, Zambia primarily imports maize from South Africa (Dorosh, Dradri and Haggblade, 2009).

Focusing on the South African market to assess transmission of white maize prices to the Zambian market, Rapsomanikis (2009) found that this transmission was dependent on the geographical location. The author assessed 6 Zambian local markets: the capital city Lusaka, Chipata (Eastern province), Kabwe (Central province), Choma (Southern province), Kasama (Northern province) and Ndola (Copperbelt province). He found that it took between 3.1 months (Ndola) to 8.3 months (Chipata) before full adjustment to South African prices was observed. For the other towns, the months to full adjustment were 5.3 for Kabwe, 6.7 for Choma, 7.6 for Lusaka and 7.7 months for Kasama. Therefore, aside for Ndola, the integration for other markets with the South African market was from moderate to weak.

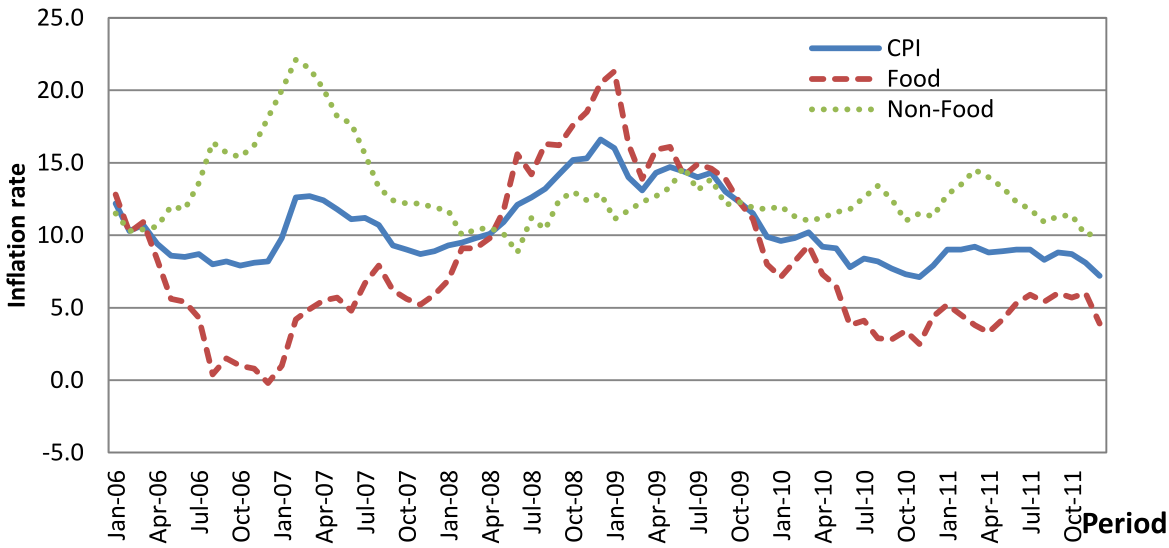
Despite these results, Zambia experienced a price spike, with its peak recorded in mid-2008 (*Figure 1.2)*. The index was highest in December 2008 and January 2009. In general, Zambian households spend about half of their total budget on food. According to the estimates by the Central Statistics Office (CSO) of Zambia, households spent 42 per cent of their income on food in 2006, in comparison to 49.2 per cent in 2010. Once disaggregated by rural and urban areas, a higher share of household expenditure in rural areas is spent on food than non-food while the reverse is observed in urban areas (Government of the Republic of Zambia, 2011d; p. 163). The report specifically finds that food expenditure in rural areas accounted for 58.7 per cent of overall expenditure in 2006 and increased to 64.6 per cent in 2010. On the other hand, the share of household expenditure on food in urban areas was only 32.4 per cent in 2006 and 39.1 per cent in 2010. *Figure 1.3* shows that the overall consumer price index during the 2007/8 food crisis period was driven by food prices as the non-food price index remained relatively stable.

Figure 1.2: Consumer food price index: Zambia



note: inflation rate is relative to previous year (annual inflation rate)
Source: own calculations from CSO's Consumer Price Index (Government of the Republic of Zambia, 2010a)

Figure 1.3: Consumer price indexes: Zambia

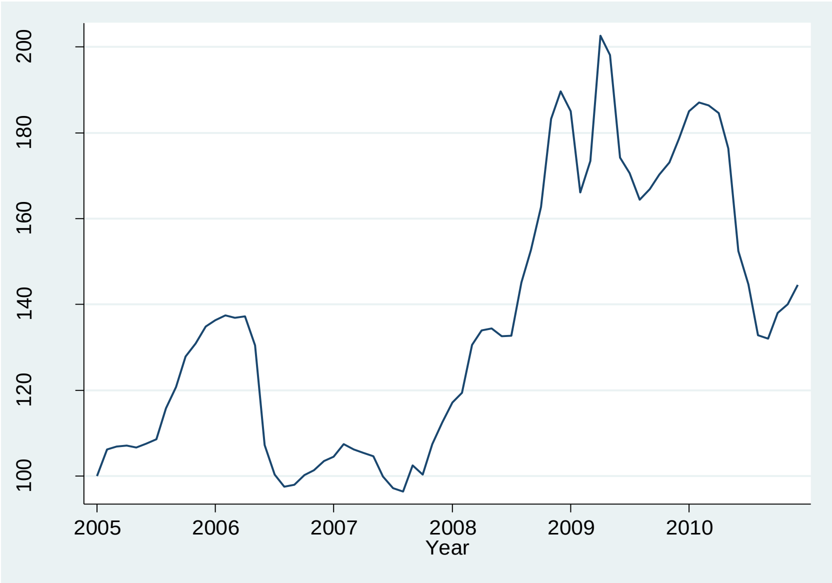


Source: own calculations from CSO's Consumer Price Index (Government of the Republic of Zambia, 2010a)

Analogous to global trends, food spikes were observed in all food commodities in Zambia. *Figures 1.4 to 1.6* plot the price trend of the refined maize flour (locally known as breakfast mealiemeal), less-refined maize flour (locally known as rollermeal)[9] and rice. Evidently, there was a price spike in 2008. Following the global trend, prices eased off slightly from January 2009 but by January 2010, prices were still much higher than before the food price shock. *Table 1.1* shows that the highest price spikes between 2006 and 2010 were observed in kapenta[10] and rice, which doubled in price. In nominal terms, the price of refined maize flour increased by 46.3 per cent between 2006 and 2010[11] while the price of less-refined maize flour increased by 40.6 per cent.

[9] Zambia's most common meal is *nshima* made from maize flour (this can either be refined, less-refined or hammer-milled flour). It is prepared as a thick porridge. Other more liquid porridges are mainly given to children as complementary foods. *Nshima* is usually eaten with different types of relishes made with vegetables (such as rape plant, cabbage, pumpkin leaves), pulses (e.g. beans), meat (poultry, goat meat, beef, pork) or fish (FAO 2009).
[10] Kapenta is a small sardine-like fresh water fish, normally traded dry. It is mainly found in Lake Tanganyika in the Northern Province (bordering with Tanzania) and has also been introduced in Lake Kariba in the Southern Province (bordering with Zimbabwe).
[11] Calculated by author using monthly retail price data collected by the Zambian Government's Central Statistics.

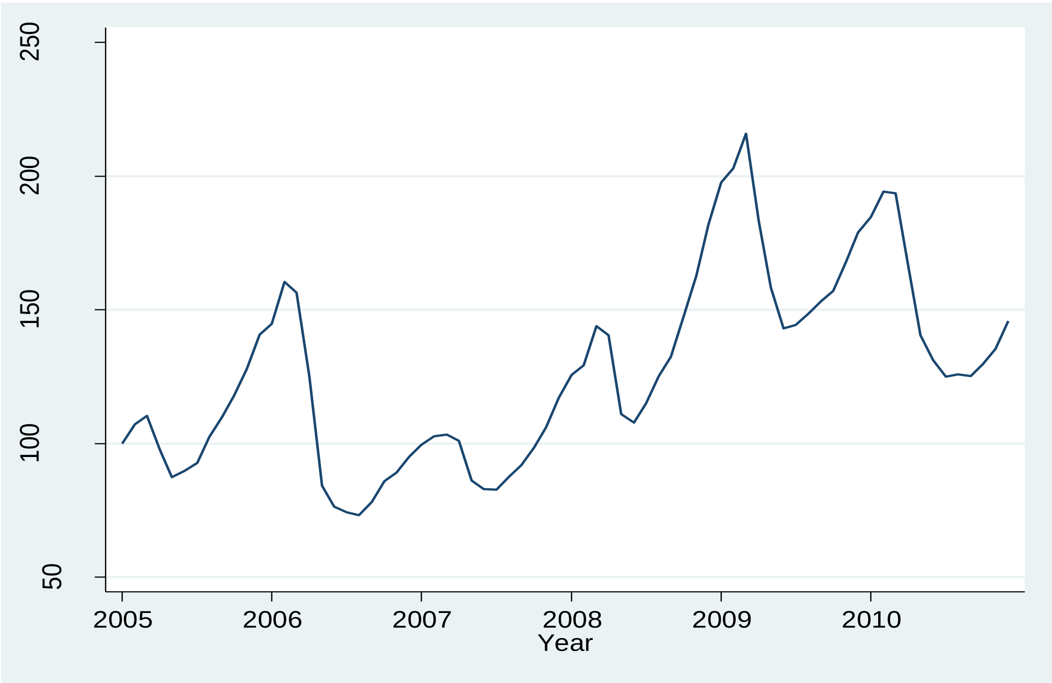
Figure 1.4: Refined maize flour price



note: 2005=100

Source: own calculations from CSO's monthly price data

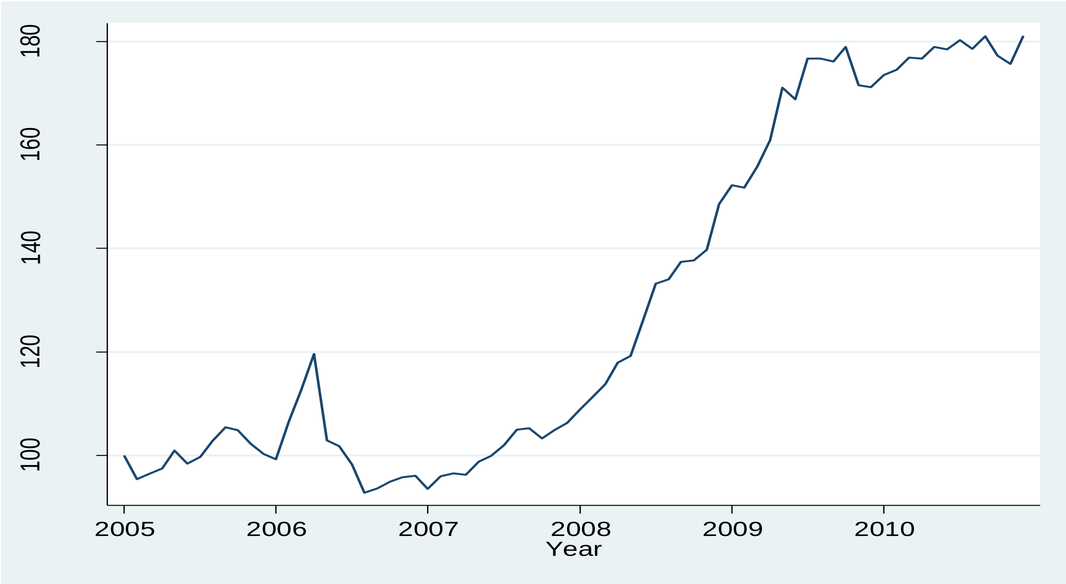
Figure 1.5: Less-refined maize flour price



note: 2005=100

Source: own calculations from CSO's monthly price data

Figure 1.6: Rice prices



note: 2005=100

Source: own calculations from CSO's monthly price data

Table 1.1: Nominal prices

District Prices (in Kwacha '000)	2006 Mean	SD	2010 Mean	SD	Price increase (%)
Maize grain	13.57	2.4	20.85	3.9	53.6
Refined maize flour	37.12	4.52	54.30	4.99	46.3
Less-refined maize flour	27.57	4.94	38.76	4.14	40.6
Kapenta	29.56	7.35	59.74	18.64	102.1
Bream fish	11.77	3.35	15.53	4.29	31.9
Milk	2.47	1.07	3.78	0.76	53.2
Eggs	5.61	0.56	8.64	0.86	54.0
Rice	3.75	0.53	7.60	1.37	102.7
Bread	2.86	0.52	4.31	0.61	50.7
Groundnuts	5.53	2.62	7.41	2.95	34.0
Cooking oil	17.66	1.71	28.73	1.57	62.7
Onions	4.05	1.77	5.57	2.93	37.5
Tomatoes	2.26	0.85	3.66	1.20	62.0
Vegetables	1.68	0.62	2.77	1.28	64.9
Chicken	12.85	2.49	17.75	3.61	38.1
Beef	13.99	5.43	20.81	4.51	48.8
Beans	5.75	2.68	9.45	4.19	64.4
Sugar	8.59	0.49	12.64	0.60	47.2

note: SD= standard deviation.

Refined and less-refined maize flour are measured in 25kg each, maize grain is per 20kg while the rest of the products are measured in 1kg each.

Source: authors' calculations based on 2006 and 2010 LCMS raw data and Central Statistical Office district price data

1.3.1. Causes of the rise in food prices in Zambia and governments' response

Between 2000 and 2010, Zambia experienced four episodes of food crises: in 2001/2, 2002/3, 2005/6 and 2008/9 marketing seasons. Unlike the most recent food crisis in 2008/9 that happened during the global financial and food crisis, the first three episodes were caused by severe drought conditions in the country that resulted in food balance shortfalls (Chapoto, 2012). As highlighted by Wroblewski et al., (2009), during drought years in Zambia, maize production fell considerably. In years when maize production has fallen, domestic prices have risen, sometimes surpassing import parity prices.

In relation to the 2007/8 crisis, McCulloch and Grover (2010) suggest that the poor harvest, in part due to flooding in some key provinces caused a strain on prices. As a result, the decline in prices usually observed after the main harvest in May/June did not transpire and shortages of stock, combined with large increases in world food prices led to local price spikes.

Chapoto (2012) argues that another reason for the upward trend of food prices in Zambia were the speculative maize purchases by the traders and millers and general bidding up of prices by both government and private sector over the limited maize surplus at the beginning of the marketing season. He also suggests that the rise in prices was linked to other international factors such as the increase in fuel prices, which occurred around the same time. The links between fuel and food prices have been made by others. Robles and Torero (2010) argue that increases in oil prices directly affect transportation costs and indirectly affect the price of fertiliser. In their study on global oil price pass-through to maize prices in East Africa, Dillon and Barrett (2013) found that global oil prices strongly affect maize prices at sub-national markets through their impacts on transport fuel prices.

A similar observation has frequently been made by the Jesuit Centre for Theological Reflection (JCTR), through their monthly cost of living surveys in Zambia. For example, after a 15 per cent increase in the pump price for fuel in December 2009, JCTR warned that this had a potential to deteriorate the living conditions of Zambian households. The reason given was that the high fuel cost would be passed on to consumers through increased transportation costs translating to an upward adjustment of the prices of goods and services (Jesuit Centre for Theological Reflection, 2010).

In addition, fertiliser prices doubled during the 2008-9 input preparation period. Some small-scale farmers were reported to hold out on selling maize grain in the hope of obtaining a higher price in order to offset rising fertiliser costs. This point is linked to the speculative activities referenced earlier. Maize grain retail prices on the Zambian market, as of December 2008, were in the range of US$500 per tonne in comparison to October when retail maize prices were in the range of US$340 per tonne (Fewsnet, 2008).

Jayne et al., (2008) provides a list of other factors that could have led to a price spike in Zambia. These are: (a) an increase in income, for example, real GDP per capita increased by almost 30 per cent between 2000 and 2008; (b) growing livestock consumption and feed demand, and higher per capita incomes arising from the booming mining industry led to more meat and maize consumption, directly by consumers and indirectly in the form of feedstock; (c) demand for Zambian maize from neighbouring countries such as the Democratic Republic of Congo (DRC) due to similar boost in the mining sector; and (d) high bread prices, which increased the demand for relatively less expensive maize meal.

However, it is imperative to note that maize production and pricing in Zambia has historically been a political issue (details in *section 2.2*). Therefore, government intervention is expected to ensure there are adequate supplies of maize and these prices are affordable for consumers. This assertion is evidenced during the 2007/8 food crisis. As highlighted by Mitchell (2008), Zambia was one of the countries during the 2007/8 food crisis that banned exports in an effort to stabilise prices.

The government estimated the 2007/8 maize harvest to be slightly below that of the previous year *(see Table 2.2)*. As such, the Food Reserve Agency (FRA) announced a buying price of 45,000 kwacha per 50 kg bag and banned private exports. The maize floor price for the previous agricultural season was K38,000. In anticipation of a rise in prices and shortages of maize, private millers and traders started the 2008 season by aggressively buying maize at prices higher than the FRA floor price. The FRA countered by raising its buying price to 55,000 kwacha in an attempt to procure its target supplies. This subsequently raised prices after the harvest. The government started issuing licenses for maize importation in December 2008, which enabled importation of maize as a pre-emptive measure (IRIN, 2008).

At the beginning of January 2009, the Zambian government through the FRA further intervened in an attempt to quell any socio-economic or political instability. The FRA procured maize from small-scale farmers at a higher price (K65,000) and sold to millers at K60,000[12]. This resulted in the government losing K5,000[13] for every 50kg bag of maize or K100,000 per metric tonne (Ministerial-Statement, 2013, Zambia Institute of Banking and Financial Services, 2012).[14] Despite the governments' intervention through export bans and provision of consumer and producer subsidies, a food price spike was observed (see figures 1.2 to 1.6). It is possible therefore that the price of the staple crop would have been much higher without these interventions. Furthermore, the decline in maize harvests and the bulk buying, particularly among maize millers, contributed to the rise in maize prices during the global food crisis.

[12] The purpose of this strategy was to enable millers sale subsidised maize flour to consumers.
[13] In the original documents, the values are in Kwacha rebased. On 22 August, the Bank of Zambia announced that the Kwacha would be rebased starting on 01 January 2013. This consequently resulted in the removal of three zero's from the denominations of the K1000 kwacha notes and above. The intention according to the Minister of Finance was to address the costs associated with an accumulated loss in the value of the kwacha experienced during episodes of high inflation that undermined the kwacha's basic function as a store of value, medium of exchange and standard of value (ZIBFS 2012).
[14] This cost estimate was contested. The World Bank had earlier argued that once the additional costs associated with handling, transport and storage are incorporated; the government loses much more than K5,000 per bag. In their estimates, the Bank found that the FRA loses about US$140 on every tonne sold to the milling industry (World Bank 2010).

1.4. Research questions and hypotheses

Given the importance of the food budget to household income, particularly among the poor, a number of questions can be raised in relation to the effect of food price peaks on household welfare. As highlighted earlier, a relevant research question in this overall context is: What has been the impact of rising food prices on household welfare in Zambia between 2006 and 2010? To answer this question, we further ask the following sub-questions and develop the following corresponding hypothesis[15]:

I. **What were the differentiated impacts of the rising food prices on household distribution of income and poverty across rural and urban Zambia?**

Hypothesis: urban poverty would increase while the change in rural poverty will depend on whether the benefit to net sellers would outweigh the negative effects to net buyers.

Testing this hypothesis will require investigating who the net buyers and net sellers are across the entire income distribution disaggregated by rural and urban locations. Based on this information, we will estimate poverty (extreme and overall) taking into consideration the change in the price of select commodities.

II. **Did households change their food consumption patterns within and across major nutrition groups, and if so, how?**

Hypothesis: Households, predominantly those in urban areas would reduce consumption of protein as they substitute protein-rich food for energy-rich foods such as maize.

This hypothesis assumes that households will change their consumption behaviour by protecting consumption of calorie-rich foods while sacrificing protein-rich foods. We are further assuming that this behaviour will be more evident among urban than rural households. To test this hypothesis, we will particularly be interested in the

[15] Note that despite the hypotheses appearing in this section, we formulated them after reviewing the relevant literature on the impact of food price increases on household welfare.

change in consumption of main staples crops, such as maize grain, as well as animal-source proteins. This interest is rooted in the importance of macro-nutrients for enhanced human functioning and quality of nutrients, particularly in the case of animal-source proteins.

III. Given these possible changes in food consumption patterns, what were the effects on height for age z-scores for children below five years old?

Hypothesis: if it happened, the adjustment in household consumption patterns could have a negative effect on health outcomes of children under five years old. Specifically, a rise in food prices may have important impacts on height-for-age z-scores (HAZ) [16] for children under the age of five.

Unlike the previous questions and hypotheses, the focus here will be on long term effects measured by HAZ for children. The choice of using child height, conditional on age and gender, instead of low weight for age or low weight for height z-scores as a measure of child nutrition outcomes has been made in this research as HAZ is a good predictor of long run cognitive and other human capital deficits when children are below -2 Standard deviations (SD) in their first two years of life (Thomas et al., 1990, Barrera, 1990, Government of the Republic of Zambia, 2009d). Waterlow, et al., (1977) recommended that for the assessment of nutritional status in cross-sectional studies, primary reliance should be placed on weight-for-height as an indicator of the present state of nutrition and on height-for-age as an indicator of past nutrition. Furthermore, Victora et al., (2008) argues that height-for-age at 2 years is more closely related to outcomes for human capital than birthweight, weight-for-age, or body-mass-index-for-age.

In the present research, we use consumption as an indicator of welfare instead of income. In support of using consumption rather than income as a welfare measure, Thomas, Strauss and Henriques (1990; p. 200) make the following argument, “to the extent that households smooth consumption, total household expenditure is a better

[16] Z-scores are standard deviation scores. The Z-score system expresses the anthropometric value as a number of standard deviations or Z-scores below or above the reference mean or median value. These scores are widely recognized as the best system for analysis and presentation of anthropometric data. They are calculated as follows: *(observed value minus median value of the reference population)/ standard deviation value of reference population* (de Onis and Blössner 1997).

measure of long-run resource availability than income, which tends to have a larger transitory component". Furthermore, Coudouel, Hentschel and Wodon (2002) argue that consumption is a good measure of welfare for the following reasons: (a) it is more closely related to a persons' well-being, in the sense of having enough food to meet current basic needs, (b) it fluctuates less than income hence, it may be better measured, and (c) it may better reflect a household's actual standard of living and ability to meet basic needs.

Chapter 2: Literature review and country context

The first part of the present chapter provides a review of the relevant empirical literature on the impact of rising food prices on household welfare in various contexts while pointing out the identified gaps in the literature[17]. The second part discusses the context and the broad history of food price policy in Zambia with a particular focus on consumer and producer subsidies.

2.1. The impact of food prices on household welfare: existing evidence

Whether higher food prices improve or worsen the situation of particular households is dependent on the products involved (Ivanic and Martin, 2008). One of the considerations is that the effect is much larger if the commodity affected by a price spike is a staple crop or main cash crop. The intuition here is that if a commodity is not especially important in either expenditure as compared with a revenue terms, then uncertainty surrounding its prices is unlikely to concern a household greatly. But if a crop is a households' main source of nourishment and/or income, then variable prices will seriously impinge a households' well-being (Barrett and Dorosh, 1996). As suggested by Bauer and Paish (1952), when a small farmer is mainly dependent on the production and sale of a single crop, violent fluctuations in prices may involve changes in real incomes. According to these authors, changes in real incomes can be so drastic that they may imperil not only the health of the economy but also the social and the political stability of the territories affected. Others further argue that even temporary increases in food prices can worsen malnutrition levels, potentially leading to irreversible health and productivity impacts (Alderman, et al., 2006; Wodon and Zaman 2009).

It is therefore predictable that many authors focussed their analysis on a limited number of food commodities, normally staple crops (Ivanic and Martin, 2008, Jensen and Miller, 2008, Vu and Glewwe, 2011, Barrett and Dorosh, 1996) or else differentiate by food groups (Robles and Torero, 2010). However, conducting an

[17] Note that we will present more specific review of literature in some empirical chapters. For example, the section on the impact of rising food prices on child health outcomes.

assessment on one crop or by food groups only could be a limitation when assessing the impact of the 2007/8 food crisis, as price spikes were observed in almost all food commodities.

A paper by Ivanic, Martin and Zaman, (2012) summarised the factors determining the extent to which food prices affect household welfare as being dependent on: a) the distribution of net buyers (whose welfare would decline given the rise in food prices) and net sellers (who would experience a welfare gain in case of price rises) of staple foods; b) the specific commodity for which the price increased; c) the ability for consumers to substitute to other less expensive food items; d) the coping strategies available to households; and e) the specific policy responses by governments.

The rest of this section summarises the discussion from empirical studies based on three strands of evidence. These are:

i. Households who benefit (winners) and those who suffer a welfare loss (losers) from a rise in food prices: these outcomes are defined by geographical location of the household (rural or urban households) and the net selling position (that is, whether a household is a net buyer or net seller of commodities experiencing a price spike). Vu and Glewwe (2011) argue that the most important variable for assessing changes in welfare is households’ net food sales, defined as food sales minus food purchases.

ii. Short term (first-order) and long term (second-order) effects: unlike in the first-order approximation, the second-order analysis allows for assessing whether the negative effects of rising food prices are compensated by quantities demanded and supplied, as well as the change in wages. In discussing this category, we will also include the studies that used the Computable General Equilibrium (CGE) models.

iii. Nutrition effects: these effects mainly focus on the impact of rising prices on the quantity and quality of household food consumption. Based on the immediate changes in diet, the health outcomes can also be examined.

The empirical evidence on these strands will be treated in turn.

2.1.1. Winners and losers from food price spikes

One of the biggest debates on the impact of rising food prices on household welfare relates to the question of who are the winners and losers from the price spike. As highlighted in *chapter 1*, the effect of an increase in food prices, particularly staple crops such as maize, is dependent on whether a household is a net producer or a net consumer of the commodity. Since most rural households are agricultural producers, they would be expected to gain from a rise in food prices. Conversely, urban households who are predominantly net consumers of food would be expected to lose. Using a compensating variation method, Friedman and Levinsohn (2002) investigated the impact of large price spikes during the 1997 Indonesian crisis and found that virtually every household was severely affected, although the urban poor fared the worst. This was because the ability of poor rural households to produce food mitigated the worst consequences of the high inflation.

The results from the existing empirical literature related to the recent food crisis are mixed. While many authors confirm that urban households are more disadvantaged than rural areas when faced with a food crisis, others provide a more nuanced picture. In Guatemala, Robles and Keefe (2011) used simulations to understand potential effects of changing food prices on welfare on different populations. They found differentiated impacts depending on the location. In rural areas, they found that more households (6.8 per cent) were better off than in urban areas, where less than 1 per cent of households benefitted from a rise in food prices. Working with the hypothesis that the impact of rising food prices on household welfare was dependent on whether a household is a net producer or net consumer, the authors attributed the finding to the fact that most food producers are located in rural areas.

Similarly, D'Souza and Jolliffe (2010) in Afghanistan found that urban areas suffered a higher welfare loss than rural areas. They observed that the percentage decline in real monthly per capita food consumption in urban areas was about double the decline in rural areas. The authors came to this conclusion after estimating the relationship between several measures of household wellbeing and food prices using province-level fixed effects. Haq, Nazli and Meilke (2008) who used the linear approximation of the almost-ideal demand system to simulate welfare changes in Pakistan found that the unexpected food price changes resulting from the food crisis severely affected urban households where poverty doubled. More generally, Ivanic and Martin (2008) conducted a multi-country analysis and established that urban areas suffered a higher welfare loss than rural areas, after simulating price increases.

One implication of the findings above is that higher food prices are pro-poor as rural households may gain. This should especially be true in developing countries where the majority of the poor people live in rural areas and are mainly engaged in agricultural activities. This line of thought was advanced by authors such as Aksoy and Isik-Dikmelik (2008) who focussed on net buyers and net sellers (the distinction between '*net buyers and sellers*' as opposed to '*net consumers and producers*' is briefly discussed below). The authors questioned the common perception that most of the poor in developing countries are net food buyers and food price increases were bad for the poor. In their paper, they questioned the common perception that lower food prices could be pro-poor by estimating net food sellers and buyers in nine low income countries. They found that only three (Ethiopia, Bangladesh and Zambia[18]) of the nine countries examined exhibited a substantial proportion of vulnerable households that would be significantly affected by high prices of staple food (e.g. maize and wheat). They therefore concluded that higher food prices could be pro-poor as income would be transferred from richer urban areas to poorer rural areas.

On the other hand, some studies show a high proportion of net food buyers among rural households in developing countries. For example, much earlier work by Weber

[18] Using the 1998 LCMS, Aksoy and Isik-Dikmelik found that 12.5 per cent were vulnerable food buyers in Zambia.

et al., (1988) questioned the assumption that the vast majority of rural Africans are net sellers of food and would benefit from a rise in food prices. After estimating net buyers and net sellers in five sub-Saharan African countries (Mali, Senegal, Somalia, Rwanda and Zimbabwe), the authors found that in major food producing areas, 15 to 73 per cent of the households were net buyers, depending on the crop and the country. In fact, aside from Zimbabwe, which had net buyers ranging between 15 to 25 per cent, the rest of the countries had net buyers above 30 per cent. Barrett and Dorosh (1996) who used nonparametric density estimation and kernel smoothing techniques found that up to one-third of poor rural rice farmers were net buyers of rice in Madagascar. Therefore, these results suggest that higher food prices may also hurt rural areas and therefore would not be pro-poor.

An extension to this argument is that while higher food prices would in theory almost always have negative effects on urban households, the impact on rural households are indeterminate (Vu and Glewwe, 2011, Minot and Goletti, 2000). This is because the majority of households are both consumers and producers of staple foods. The effect would therefore depend on the net selling position of the household. Using data from Vietnam, McKay and Tarp (2014) assessed the distributional impact of changes in the rice price in 2008 on consumers and producers. The authors found that while not many rice producers are net consumers, those that are tend to be very poor and hence would suffer a welfare loss. These results are similar to a study by Trairatvorakul (1984) in Thailand, which found that one-fourth of the small scale farmers, mostly based in rural areas, were net purchasers of rice and hence would be negatively affected by a rise in prices. Using descriptive statistics, the author also found that most of the net gains would accrue to large commercial farms.

Similarly, Robles and Torero (2010) who analysed the food price effects on four Latin American countries (Guatemala, Honduras, Nicaragua and Peru) by applying a quadratic almost-ideal demand system and price rise simulation found that while almost all urban households were more affected than rural households, losing households in rural areas suffer more than their urban counterparts in all four countries. Furthermore, a study by Wodon and Zaman (2009), which conducted a multi-country assessment of the impact of higher prices of staples on poverty established that in Cambodia, Madagascar and Vietnam, the poor were net producers. However, the authors also found that in Bolivia, Ethiopia, Bangladesh and Zambia, the poor were net consumers. In making these assessments, the authors mainly followed Deaton's Net Benefit Ratio methodology. In some instances, hardly any effect was recorded. Minot and Goletti (2000) who also incorporated Deaton's Net Benefit Ratio in their study on Vietnam found after hypothesising a ten per cent increase in rice prices that higher food prices had no effect on the incidence of overall poverty despite one-third of Vietnamese households being net sellers.

In general, the above studies suggest that not all rural households are directly engaged in farming and that not every household engaged in agricultural activities benefits when prices rise. However, it is clear that a rise in food prices would lead to some households benefiting while others would lose. The results further suggest that there is a difference between food production and food sales and between food consumption and food purchases.

In well known work by Singh, Squire and Strauss (1986a), most households in agricultural areas play a dual role of producing for sale (role of a firm or business) and for own consumption (role of a household). It is important to note here that '*food production*' is different from '*food sales*' as '*food consumption*' is different from '*food purchases*'. This is because not every product that is produced is sold just as not every item that is consumed is purchased. Vu and Glewwe (2011) argue that producing food for own-consumption constitutes a significant part of what is produced and what is consumed. For example, households may not purchase everything they consume as some of it is own-produced. This is especially true for most staple crops like maize and rice, which are both produced and consumed. In the present research, we will use *'food sales'* and *'food purchases'* to assess welfare effects on households.

2.1.2. Short vs long term effects

Ferreira, et al., (2013) suggest that applying basic consumer theory to analyse the impact of food prices on household welfare gives rise to a first-order approximation. The first-order (or short-term) welfare effects of changing food prices is equivalent to the elasticity of real income with respect to price. In the context of the food prices, first-order analysis considers only the direct impacts of changes in prices of food on household expenditure (Ivanic and Martin, 2008, Valero-Gil and Valero, 2008). But, as conceptually argued by Singh, Squire and Strauss (1986), households play a dual role of being producers and consumers. The first-order approximation therefore has two major short comings as recognised by many authors including Deaton (1997):

i. It neglects the partial equilibrium consequences of food prices on consumption and production. On the consumer side, households may substitute from the more expensive food commodity to a less expensive commodity (as will be illustrated in *chapter 4*). On the producer side, a supply response can occur where production levels increase for the item facing a higher rise in prices. Furthermore, it is possible that both the demand and supply for labour would change in response to price change. Therefore, the household welfare effects will depend not only on production and consumption values, but also the second-order effects such as substitution and labour effects.
ii. It ignores general equilibrium effects of the price changes such as those that operate through labour markets, technological innovation and many other determinants of welfare.

The significance of ignoring the above effects has been widely discussed. For example, Robles and Keefe (2011) argue that substitution effects on both the production and consumption side must be taken into account in order to fully understand the impact of rising food prices on poor people as households can mitigate risks by adjusting consumption and production. Ivanic and Martin (2014) further argue that poverty impacts of food price changes might be reversed if supply responses are sufficient and/ or wage rates for unskilled labour change substantially. Furthermore, Headey (2014) notes that standard microeconomic methods consistently suggest that, in the short run, higher food prices increase poverty in developing countries. In contrast, macroeconomic models that allow for an agricultural supply response and consequent wage adjustments (long run—poverty episodes of one to five years in duration) suggest that the poor ultimately benefit from higher food prices.

However, the two highlighted effects can only be observed in the long-run, that is, once households have had a chance to respond to prices. Furthermore, detailed data on wages, or variables such as prices of other commodities like fertiliser are required to estimate the supply response. Due to data limitations, the first-order approximation based on the net purchases of each commodity by a farm household remains the central analytical tool for the welfare impact of price changes in developing countries (Ferreira et al., 2013). While first-order effects may provide a less accurate measure of welfare, one argument in favour of this type of analysis is that in the short run, they may offer better indicators than those generated from more inclusive and structured models such as Computable General Equilibrium models (Barrett and Dorosh, 1996; p.657). Barrett and Dorosh further suggest that there are uncertainties surrounding model parameters (in the case of general equilibrium approaches) and possible distortions caused by imposing a substantial modelling structure on the problem.

In separating the short from long run effects, this sub-section groups the empirical studies into three categories: (i) those studies that purely estimated the short-term effects, (ii) the studies that incorporated some long run effects, for example, an adjustment in wages or consumption/ production response[19] and (iii) the studies that used the general equilibrium approach.

Among authors that used short-term effects, the studies can broadly be divided into two. First, there are those that only focus on who benefits and who loses. For example, Barrett and Dorosh (1996) examined the instantaneous distributional implications of rice price changes in Madagascar by applying nonparametric density estimation and kernel smoothing techniques. They found that the first order gains from an increase in rice prices were highly concentrated among the largest rice farmers and particular regions in Madagascar. Others such as Budd (1993) in Cote d'Ivoire and Deaton (1989) in Thailand, both utilising non-parametric net benefit

[19] Short-term effects and partial equilibrium effects will therefore be used interchangeably in this thesis.

ratio methods, found that rural middle income households benefitted the most. In the second category are studies that estimated actual poverty effects. For instance, Wodon et al., (2008) applied simulations to estimate the impact of higher food prices on the Foster, Greer and Thorbecke (FGT) class of poverty measures in West and Central African countries. They found that on average, levels of poverty increased. Using Deaton's Net Benefit Ratio model, Simler (2010) in Uganda found that the incidence and depth of poverty increased by 2.6 percentage points as a result of higher food prices in 2008.

Among authors that incorporated aspects of the second-order effects, Friedman and Levinsohn (2002) in Indonesia found negligible results after incorporating the substitution effect into their compensating variation methodology. A study by Caracciolo, Depalo and Macias (2014) also found negligible substitution effects in Zambia. Using the Hicksian demand system, they found that the cross-price elasticities were small (between 0.05 and 0.2)[20]. These results were based on a simulated 50 per cent rise in maize prices. Interestingly, a 50 per cent rise in maize prices would lead to a 0.17 percentage point corresponding increase in consumption of meat and fish[21]. Mainly following Deaton's Net Benefit Ratio model, Vu and Glewwe (2011) allowed for production responses to investigate the price effect on welfare in Vietnam. These authors' simulation results revealed that, allowing for a supply response led to slightly higher levels of welfare increases for the country as a whole.

Other authors explored whether in the medium or long term, the rise in food prices could be compensated by a rise in wages. For example, Christiaensen and Demery (2007) argue that this depends on the extent to which wages are affected by price spikes and also on whether a household is a net buyer or net seller. Using simulations, Ivanic and Martin (2008) started by estimating short run impacts using household surveys containing at least one thousand households in each of the nine low-income countries (Bolivia, Cambodia, Madagascar, Malawi, Nicaragua,

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[20] Note that these elasticities have been calculated by the current author based on the demand system parameter estimations provided by Caracciolo, Depalo and Macias (2014) in their paper.

[21] Other cross-price elasticities using a 50 per cent rise in maize prices would lead to the following substitution effects: 0.05 percentage points increase in cassava, 0.21 in cereals, 0.2 in fruit and vegetables, 0.07 in eggs and milk and 0.12 in beans.

Pakistan, Peru, Vietnam and Zambia). For Malawi and Zambia, the most important commodity was maize, for which both urban and rural households are net buyers. As a consequence, increasing the price of maize by 10 per cent would raise average poverty in Malawi and Zambia by 0.5 and 0.8 per cent respectively. After including wage effects of unskilled workers, the rise in poverty would only be 0.2 per cent in Malawi and 0.6 per cent in Zambia. Therefore, for Zambia, the variation between the wage and no wage scenario was modest.

Similarly, McCulloch and Grover (2010) studied the impact of the food, fuel and financial crisis on Zambian households. These authors mainly used a first-order approximation of the impact of the triple (food, fuel and financial) crises on households. However, they also induced changes in the wages. They acknowledged that it would be better to take into account wage changes but the poor quality of data on wages and non-farm business income in Zambia made it impossible to provide a definitive account of these welfare changes. The authors therefore estimated the welfare changes by simulating two scenarios on wages. The first scenario was that wages did not rise (pessimistic scenario). The second scenario was that wages increased commensurate to inflation (optimistic-scenario considering the rapid inflation in 2008/09). They found that non-agricultural rural households fared better than urban households in the static wage scenario, since they depended less on wage income than urban households. However, when wages are adjusted for inflation, low and medium income urban households were better off compared to rural non-agricultural households. These findings differ from the earlier claim by Headey (2014) that the poor benefit from high food prices in the long run.

In contrast, Ferreira, et al., (2013) who also estimated second-order effects found that if agricultural wages rose in the same proportion as food prices, this would lead to falling poverty in Brazil’s rural areas. For the country as a whole, they found that the net effect was U-shaped, with actual welfare gains for the bottom 5-6 per cent of the population, and the largest losses (roughly of the order of 5 per cent) accruing to the three middle quintiles. The authors’ methodology was influenced by Singh, Squire and Strauss theory and Deaton’s methodology of incorporating the production response in assessing welfare effects.

Based on these studies, allowing for increases in wage rates generally reduces the adverse impact of rising food prices on poverty. The effect is however not homogenous across income groups.

The final category is comprised of those authors that apply general equilibrium models. Minot and Goletti (2000) found that a 10 per cent rise in prices would benefit farmers in general and average income in Vietnam would rise by 0.3 per cent in the long-run. Paradoxically, in spite of the rise in income, the authors found that the poverty rate would rise slightly by 0.2 per cent. Using data for 25 high income and 22 developing countries, De Hoyos and Medvedev (2009) found that extreme poverty headcount at the global level would increase by 1.7 percentage points. These authors further found that while the poverty consequences of higher food prices were substantial, the total poverty elasticity of high food prices in the long term (taking indirect effects into account) is much lower than the first-order, or direct, elasticity.

Using a CGE model for Mozambique, Arndt et al., (2008) estimated that the medium to larger farmers in the north and the centre of the country would benefit from higher food prices while households in urban areas and in the food deficit rural south areas would lose. A recent study by Ivanic and Martin (2014), which also used a CGE model of the world economy found that in general, higher food prices in the short run tend to hurt the poor while the long-run adjustments in wages and agricultural profits outweigh these losses and hence generate reductions in poverty. Specific to Zambia, these authors utilised the 2010 LCMS data and found that in the short run, poverty increased by 6 percentage points after simulating a 50 per cent rise in food prices. However, after adjusting for wages in the long run, average poverty in the country declined by 1.1 percentage points and by 3.2 percentage points once the supply response was incorporated.

In general, studies incorporating second-order effects suggest that consumption and production responses, including wages, offset a rise in poverty only in a limited way. In relation to the overall literature on the impact of rising food prices on household welfare, the most consistent results suggest that urban households in general suffer a welfare loss while rural households gain. Furthermore, the rural results are more nuanced in that the effect is largely dependent on net selling position of the household given that most of the households depend on agriculture.

2.1.3. Nutrition effects

Most empirical studies on the impact of rising food prices on household welfare mainly focus on the effect on consumption and subsequently poverty levels. Fewer studies estimate nutrition effects. As suggested earlier, during a price spike, households may decide to substitute to cheaper food commodities. This switch may have implications on household nutrition outcomes. For example, based on regression analysis using Ordinary Least Squares, Brinkman et al., (2010; p.158) postulate that the decreased purchase of more expensive foods typically equates to consumption of fewer nutrient-dense foods.

On the other hand, in their study on two Chinese provinces, Hunan and Gansu, Jensen and Miller (2008) used panel data of 1,300 urban-poor[22] households from 2006 to examine the impact of experimentally induced food price subsidy for grains on the consumption and nutrition of poor households. They found that the overall nutritional impact of the price increase was small because households were able to substitute to cheaper foods and because the domestic prices of staple foods remained low due to government intervention in domestic grain markets. This finding suggests that cheaper commodities do not necessarily lead to poor nutrition. In Hunan, the largest observed change was the increase in cereal consumption (largely rice) and a decrease in the consumption of meat, dairy products and fats. For Gansu, the pattern was different. Consumption of cereals decreased while consumption of pulses and fruits and vegetables increased.

Other researchers such as Torlesse et al., (2003) argue that households spend more on non-staple foods when staple prices decrease and less when staple prices increase. Using a three round household panel data in urban Ethiopia, Alem and Söderbom (2012) found that households adjusted food consumption by cutting down on the quantity of food consumed. The authors used ordered probit to analyse their

[22] Households falling below a locally defined poverty threshold.

data. On the other hand, D'Souza and Jolliffe (2010) who utilised province-level fixed effects on Afghanistan household data found that prior to and during the large increase in food prices from August 2007 to September 2008, there was a decline in the real food consumption of approximately 33 percent. Their regression analysis indicated much smaller price elasticities with respect to calories than with respect to food consumption, which according to the authors suggested that households traded off quality for quantity of calories consumed. In particular their estimates showed that the price increases were associated with changes in the composition of food consumption, mainly decreases in dietary diversity and a movement towards staple foods.

Friedman, Hong and Hou (2011) estimated the reduction in caloric availability at household level after the 2008 food price spike in Pakistan using compensating variation methods and regression analysis. They found that average household caloric availability fell by almost 8 percent between 2006 and first half of 2008. They also found that urban households were disproportionately affected in comparison to rural households.

While many authors (such as the ones referenced above) have studied the effect of rising food prices on nutrition in general, there is a smaller body of literature linking food prices to child health outcomes. Applying separate multivariate models, Campbell, et al., (2010; p.192) found that households with higher expenditure on rice (staple) in Bangladesh have an increased incidence of child stunting in comparison with households with higher non-rice expenditure. This is because a rise in the staple crop would lead them to spend less money on non-rice foods such as animal-source foods, fruits, vegetables and oils. Thomas and Strauss (1992) and Christiaensen and Alderman (2004) have studied the effect of rising food prices on child nutrition outcomes using regression analysis. Both papers find the effects of rising prices on nutrition outcomes of children as measured by height for age z-scores are not uniform, but depend on the specific food item affected by the price increase, and other factors such as age and geographical location (rural or urban).

A focus on child health outcomes is important as inadequate intake of food can lead to deficits in cognitive development, psycho-social development and physical growth among children below the age of five. There is a strong association between undernutrition in children and shorter adult height, less schooling, reduced economic productivity, and—for women—lower off spring birth weight (see for example, Victora et al., 2008, Alderman and Behrman, 2006, Behrman and Hoddinott, 2005, Thomas et al., 1990). Furthermore, Victora et al., (2008) argue that inadequate nutrition in utero and in the first 2 years of life has long term consequences. Considering maternal and child undernutrition is the underlying cause for 35 per cent of the disease burden in children younger than 5 years and 11 per cent of total global Disability Adjusted Life Years --DALYs-- (Black et al., 2008), the importance of the effects of food price spikes on child health outcomes cannot be overemphasised. Using the assessment by WHO (1995), stunting reflects a process of failure to reach linear growth potential as a result of suboptimal health and/or nutritional conditions.

In sum, an increase in the price of food harms poor households, especially net food buyers in urban areas. However, the indeterminate effects arising from possible benefits by rural households who are mainly food producers' and the variation of effects across time (short vs long-run effects) makes the policy response challenging.

In terms of methodology, it appears from the summarised literature that Deaton's Net Benefit Ratio methodology has been the workhorse for many studies that aimed to assess the impact of rising food prices on household welfare. Another observation is that most studies on the effects of food prices on household welfare applied simulations. The justification for simulating welfare effects is usually driven by a lack of comparable pre- and post-crisis data (D'Souza and Jolliffe 2010). As highlighted in section 1.1, while lengthy panel data are the best in assessing the effects of a shock on households, very few developing countries have such data set and can only rely on cross section data or at best very short panels, with only two waves. The use of simulations has been critiqued however by various authors asbeing somewhat arbitrary given that they are not based on measured differences in consumption behaviour among households.

2.2. Country context and the politics of maize prices in Zambia: a historical account

2.2.1. Country context

Zambia is a landlocked country located in Southern Africa and is surrounded by eight countries[23]. Formerly a British colony, it gained independence in 1964 and remained a one party state until 1991 when it transitioned to multi-party democracy. The country is divided into the following administrative units: province, district, constituency and ward. The ward is the smallest and lowest administrative unit in the country.

Prior to 2011, the country was divided into nine provinces for administrative purposes. These provinces were the capital city Lusaka, Copperbelt, Central, Eastern, Northern, Southern, Western, North-Western and Luapula. A new province, Muchinga, was created in October 2011 by the newly elected president, Mr. Michael Chilufya Sata. Muchinga originally belonged to the Northern Province. In 2013, the President further created 17 new districts increasing the total number of districts from 72 to 89. Therefore, there are currently 10 provinces and 89 districts in Zambia.

For the purposes of this research however, only the original nine provinces and 72 districts will be referenced. This is because we mainly utilise data from the 2006 and 2010 Living Conditions Monitoring Survey (described in the data section of *chapter 3*). This data was collected before the administrative boundaries were re-organised.

Zambia is endowed with vast natural resources. The country is Africa's biggest producer of copper (African Economic Outlook, 2012). While it has had a diversification agenda for decades, the economy continues to be heavily dependent on copper production. Copper accounts for three quarters of the country's exports, whereas agricultural exports make up only 7 per cent of total exports despite the

[23] Zambia's neighbours are Angola, Botswana, Democratic Republic of Congo, Malawi, Mozambique, Namibia, Tanzania and Zimbabwe.

majority of the Zambian population working in the agriculture sector (Government of the Republic of Zambia, 2011g, FAO, 2011b).

Map of Zambia

The dependence on copper and limited diversification of the country's exports makes the economy susceptible to the booms and busts of the international copper market. The precipitous fall in copper prices during the 2008/9 global economic crisis sparked job losses and ultimately lower income tax revenue, limiting fiscal space for the government (Ndulo et al., 2009, Fundanga, 2009, Government of the Republic of Zambia, 2009b).

Despite this recent slump, the Zambian economy has generally managed to benefit from the favourable development of global commodity prices and copper in particular in the last decade. Economic growth between the period 2006-2009 averaged 6.1 per cent per annum, compared with an average of 4.8 per cent between 2002 and 2005 (Bank of Zambia, 2011).

As a result of steady growth, in 2011, the country was reclassified to lower middle income status by the World Bank (World Bank, 2011, Zambia Development Agency, 2011). Additionally, on 2 March 2011, Fitch Ratings, a globally recognised independent credit rating organisation, assigned Zambia a sovereign credit rating of B+ with a stable outlook. This rating, the first ever for the country, was a further indication of the country's creditworthiness and ability to repay its creditors (Bank of Zambia, 2011).

Despite this positive economic outlook and in spite of its rich resource endowment, Zambia performs very poorly on various human development indicators and continues to have a high poverty rate. On the occasion of the 20th anniversary of the Human Development Report, the United Nations Development Programme (UNDP) reported that in 2010, of the 135 countries surveyed between 1970 and 2010, only three countries -- the Democratic Republic of Congo, Zambia and Zimbabwe -- had a lower Human Development Index (HDI) in 2010 than in 1970 (United Nations Development Programme, 2010; p.3). In the same report, Zambia was ranked within the low human development category, as 150th out of 169 countries. The decline in the country's HDI was attributed to the collapse of copper prices in 1980, which had adverse effects on the economy, and the emergence of health problems such as HIV and AIDS in the same period. Furthermore, the country is lagging behind on efforts to meet the Millennium Development Goals (MDGs), to be met by 2015. For example MDG 1 on eradicating extreme poverty and hunger and MDG 4 aimed at reducing child mortality in Zambia will not be met (United Nations Development Programme, 2013).

2.2.2. Agriculture activities (2006 - 2010)

As mentioned above, the Zambian economy is highly dependent on the copper industry, but as *Table 2.1* shows, a significant proportion of households in Zambia are engaged in agricultural activities (68.1 per cent in 2006 and 65.5 in 2010). As expected, the proportion is higher in rural areas (93.6 and 90.5 in 2006 and 2010 respectively) than in urban areas (20.5 per cent in both years).

Furthermore, the provinces with the lowest proportion of households engaged in agricultural activities are Lusaka and Copperbelt. This is to be expected as they are the most urbanised of the nine provinces, with 83 and 80 per cent of the population living in urban areas respectively (United Nations, 2011, Government of the Republic of Zambia, 2009e, Government of the Republic of Zambia, 2011d). However, the Copperbelt province has higher maize production levels than largely rural provinces such as Luapula, North Western and Western province.

Another notable fact in *Table 2.1* is that in general, the number of households engaged in agricultural activities reduced slightly between 2006 and 2010. The exception is Southern and Northern Province, which remained about the same. This is surprising as the expectation would be that more households would engage in the more lucrative agriculture sector due to high food prices. Overall, there was an increase in maize production across the two time periods[24].

Table 2.1: Summary of agriculture activities in Zambia (Per cent) between 2006 and 2010

Provinces	**Share of Agricultural Households**		**Maize yield (metric tonnes 000s)**	
	2006	**2010**	**2006**	**2010**
Central	78.3	74.1	409	411
Copperbelt	37.2	34.7	206	161
Eastern	93.5	90.7	436	456
Luapula	92	89.1	61	58
Lusaka	17.6	17.1	92	74
Northern	87	86.4	198	269
North Western	85.9	77.2	97	100
Southern	72.6	72.7	343	402
Western	87	81.3	101	100
Rural	93.6	90.5	1,711	1,813
Urban	20.5	20.5	231	219
All Zambia	**68.1**	**65.5**	**1,942**	**2,032**

Source: GRZ (2011d; p 130)

The main crops produced and consumed in Zambia include maize, cassava, millet, sorghum and rice. However, maize is by far the most important staple crop in the country as it accounts for over half of all calories consumed in Zambia (Dorosh et al., 2009) and also serves as the main source of income for the majority of households in the country (Government of the Republic of Zambia, 2004a). As such, a higher proportion of agricultural households produce maize in comparison to other crops. Taking 2010 as an example, 83.3 per cent of agricultural households grew maize while only 29.7 per cent grew cassava, 7 per cent millet, 3.7 per cent rice paddy and 2.4 per cent sorghum (Government of the Republic of Zambia, 2011d).

[24] Personal communication with a researcher in Zambia revealed that in most cases, the increase in maize production is not as a result of efficient production but rather, more land being tilled. Hence, productivity is still low (field interviews, 2012). Our own analysis of the LCMS revealed that the mean land size (in hectares) devoted to maize was 1.23 and 1.44 in 2006 and 2010, respectively. Furthermore, households grew less local maize in favour of hybrid maize.

Between 2006 and 2010, Zambia produced sufficient maize for both human consumption and industrial use. This is evident in *Table 2.2*, which shows the national food balance information based on the post-harvest surveys conducted by the government. The table displays information on total maize available for the reference agriculture season. This is aggregated by human consumption, strategic reserves, industrial requirements (stock feed, breweries and seed) and crop losses. The aggregated amount is estimated using stocks expected to be held by commodity traders, millers, the Food Reserve Agency (FRA), commercial farmers and small-scale farmers in rural areas.

Of the total crop stock available, human consumption constitutes the majority of use. The required stock for human consumption is estimated on assumption that staple foods represent 70 per cent (1,421 kilo calories per person per day) of the total daily requirement (2,030 kilocalories per person per day). This is then converted to metric tonnes by multiplying the total population with the daily requirements per person.

Table 2.2: National food balance for Zambia for the 2011/2012 agricultural marketing season (metric tonnes)

Agricultural Season	Crop Status	Crop					
		Maize	Rice	Wheat	Sorghum and Millet	Sweet and Irish potatoes	Cassava flour
2006/07	Available	1,799,188	19,248	115,843	39,192	75,664	1,190,059
	Required	1,549,188	31,248	140,000	39,192	75,664	727,104
	Surplus	250,000	-12,000	-24,157	0	0	462,956
	Planned net exports	-	-12,000	-24,157			
2007/08	Available	1,601,916	26,822	205,848	46,199	116,719	1,163,029
	Required	1,458,916	37,249	195,000	46,199	116,719	694,134
	Surplus	143,000	-10,427	10,848	0	0	468,895
	Planned net exports	-	-10,427	10,848			
2008/09	Available	1,950,808	42,107	260,516	72,281	221,735	1,151,700
	Required	1,747,537	54,107	210,000	72,281	221,735	687,067
	Surplus	203,271	-12,000	50,516	0	0	464,632
	Planned net exports	203,271	-12,000	50,516	0	0	0
2009/10	Available	3,094,164	54,088	225,352	78,339	275,807	1,179,657
	Required	2,008,455	63,328	215,000	78,339	275,807	673,559
	Surplus	1,085,709	-9,240	10,352	0	0	506,098
	Planned net exports	1,085,709	-9,240	10,352	0	0	0

Source: Records from Ministry of Agriculture and cooperatives (Government of the Republic of Zambia, 2007a, Government of the Republic of Zambia, 2008, Government of the Republic of Zambia, 2009c, Government of the Republic of Zambia, 2010b)

The majority of maize is produced by small and medium scale farmers. Commercial farmers focus on other cash crops such as wheat and soybeans (Government of the Republic of Zambia, 2011b, Chapoto, 2012). In a good harvest year, the smallholder sector produces more than 90 per cent of the total maize production and 80 to 85 per cent of the total maize sales in the country. Only about 15 to 20 per cent comes from the large-scale commercial sector (Chapoto, 2012). In terms of proportion, small scale farmers in Zambia make up 59 per cent of the total population while medium scale farmers and large scale farmers make up only 3 per cent of the total population (Government of the Republic of Zambia, 2011)[25].

Clearly, the period between 2006 and 2010 marketing seasons were surplus years for maize production *(Table 2.2)*. However, despite recording a surplus, the missing values on planned net exports both for the 2006/7 and 2007/8 agricultural periods suggest that the government did not encourage exports. In fact, during this time, the government banned exports as highlighted in *section 1.3*. This may indicate that the government was not sure about whether this surplus could be sustained in the subsequent agricultural seasons. This might especially be the case for the 2007/8 agricultural season when the available supplies of maize were less than in the previous agricultural season. An extraordinary surplus was recorded in 2009/10. As stated in the 2010 budget speech by the Minister of Finance, this was the largest harvest Zambia had recorded in over a decade and the increase in production was attributed to the fertiliser support program (Government of the Republic of Zambia, 2009a). However, an empirical study by Burke, Jayne and Chapoto (2010) found that favourable weather conditions explained 61 per cent of the increase followed by increased fertiliser use (responsible for 32 per cent of the yield increase) and finally, increased hybrid use was attributed with another 5 per cent.

As suggested earlier, maize production in Zambia has historically been a political issue. As such, understanding the pricing of the staple crop, maize, requires exploring the politics and policies of maize production and marketing in the country. More specifically, the government's priority has been to ensure that the farmers have adequate income from the crop sales while the price faced by consumers is expected to be affordable. The next section therefore provides a brief historical account of the consumer and producer subsidies implemented by the government.

[25] A small-scale farmer is defined as a household cultivating 4.99 hectares of crops or less. Households cultivating between 5 and 19.99 hectares of crops are classified as medium scale farmers. All households cultivating 20 hectares or more are classified as large scale farmers (GRZ, 2011b).

2.2.3. Consumer and producer subsidies: a historical perspective

Consumer subsidies

Due to the neglect of smallholder agriculture and infrastructural development during the former colonial period, maize became the implicit and sometimes explicit "social contract" that the post-independence government made with the Zambian farmers (Jayne and Jones, 1997). After Zambia gained independence from British rule in 1964, one of the areas of focus was to ensure food security within the country, particularly for the side-lined indigenous population[26]. As part of this campaign, the government formed National Agricultural Marketing Boards (NAMBOARD) in 1969 to service both large and small-scale farmers. One of the key objectives of NAMBOARD was to create crop-buying depots. It was in charge of all importation, distribution and pricing of maize. In addition, the government nationalised businesses, including the milling industry (Beveridge, 1974).

Through these actions, the government subsidised maize consumption, and to a smaller degree, production in the rural areas. Öjermark and Chabala (1993) and Dorosh, Dradri and Haggblade (2009) argue that the highest priority for the government was to reduce the price of maize meal to urban consumers, and that this was done by introducing a consumer subsidy. The subsidies took the form of direct payments of crop marketing and input distribution costs by the government on behalf of consumers. Furthermore, the government bought maize from farmers at prices higher than the market price and sold to consumers at a lower rate than the market price.

To meet the cost of subsidies, NAMBOARD accounted for 15% of government budget in the late 1980s (Tembo et al., 2010). However, soon after formation, NAMBOARD attracted criticism due to high costs and poor performance. For example, farmers were not receiving inputs on time and payments to farmers for the crops purchased were delayed. Furthermore, producer and consumer prices were set with little regard for the eventual cost (Kydd, 1986).

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[26] Before independence, Africans were not allowed to engage in trade except in certain areas such as, the separate African locations and shanty towns (Beveridge 1974).

The subsidies were not sustainable in an economy shaken by the increase in oil prices in the 1970s and the collapse of copper prices in the 1980s. These caused insurmountable economic problems for Zambia. To keep the economy running during the crisis, Zambia borrowed money from the international community. Between 1970 and 1980 Zambia's debt rose from US$800 million to US$3.2 billion and by 1985, the countrys' debt stood at well over 300 per cent of national income (Jubilee Debt Campaign), making it one of the most indebted countries in the world.

With pressure from the International Monetary Fund (IMF) to stabilise and restructure the economy, government spending was cut back sharply, particularly on capital spending which fell by 70 per cent between 1975 and 1983. Furthermore, the government removed subsidies on food, including maize and fertiliser, which led to widespread public protests in urban areas and the reinstatement of these subsidies.

In 1986, NAMBOARD's monopoly was removed in order to enable cooperatives, millers, and other traders to participate in maize marketing. However, this policy shift had the opposite effect as private traders who were allowed to participate in agricultural marketing demanded adequate compensation for their handling costs, and as a result there was an upward push in the price of maize meal, which culminated in serious food riots in 1986 (Öjermark and Chabala, 1993). Nevertheless, NAMBOARD remained the buyer of last resort and a government tool for intervening in the market. Producer prices of all controlled agricultural commodities, except maize for which a fixed price was determined, were set as floor prices. This meant that any price above the floor price was determined by supply and demand, and producers and buyers had the freedom to bargain.

On May 1, 1987, the IMF program was suspended, and in its place the government announced its own 'self-help' program under the theme: 'Growth from Our Own Resources'. The continued high public sector spending without a commensurate rise in government revenue led to among others, high inflation, shortages of basic household commodities, difficulties in servicing external debt and the rise in inflation from about 35 per cent in 1986 to about 64 per cent in 1988 and then to 154 per cent in 1989 (Kalinda and Floro, 1992).

In 1989, the government reintroduced IMF and World Bank-type stabilisation policies. Prices of all consumer products, except maize, were decontrolled. Furthermore, NAMBOARD was abolished and marketing functions transferred to cooperatives (Jayne and Jones, 1997). Kydd (1986) suggests that NAMBOARDs' closure was necessary as it was no longer financially viable. The author further argues that, even the 50 per cent increase in the consumer price of maize in mid-1985 (the maximum increase judged politically tolerable) was insufficient to meet NAMBOARDs' requirement for additional funding.

In 1990, the government withdrew the consumer maize flour subsidies, leading to a rise in the price of the commodity. This prompted an attempted coup in July 1990. The doubling of maize prices was cited as one of the reasons for military action (Perlez, 1990). While the coup was unsuccessful, these challenges saw an increase in calls for the reintroduction of multi-party democracy and subsequently the amendment of the constitution and the formation of the Movement for Multi-Party Democracy (MMD) led by Frederick Chiluba. Chiluba won the presidential elections in 1991 and Kaunda handed over power peacefully after ruling for 27 years.

The MMD government immediately liberalised the economy and privatised most nationally owned companies, including the mines. These free market principles were implemented following the proposed reforms from the IMF and the World Bank. As part of the reforms, by 1993, the government stopped subsidizing production (fertiliser subsidy) and consumption of maize (maize flour subsidies). Furthermore, marketing board depots were closed, causing the prices of basic food commodities including maize to sharply increase. This, once again, led to riots prompting the MMD government to revert back to some government controls on the food market (Chapoto, 2012). Therefore, the sensitivity of maize subsidies transcended political regimes.

Ndulo and Mudenda (2004) found that the liberalisation of trade impacted negatively on the labour markets of the country. Formal employment as a percentage of the labour force declined from 23.3 percent in 1980 to 8.1 per cent in 2003. In absolute terms, between 1985 and 1997, total formal employment fell sharply from 521 900 to 475 100, or by 10 percent (GRZ, 2007). This was despite the increase in the size of the labour force. The experiences in Zambia were in line with broader perceptions of the impacts of liberalisation. As suggested by Cornia, Jolly and Stewart (1987), liberalising markets led to adverse effects on the poor through job losses particularly in formerly state-owned institutions, higher food prices and the erosion of social safety net programs.

In 1995, the government established the Food Reserve Agency (FRA) through an Act of Parliament. One of the functions of FRA according to the Food Reserve Act, Cap 225 (1995) was to administer the national strategic reserve. The main role therefore was to ensure the country was food secure by keeping enough stock in case of an emergency. Furthermore, it operated in about 10 of the 72 districts and mainly benefitted commercial farmers and small scale farmers (Ministerial-Statement, 2013).

As highlighted by Tembo et al., (2010), up until the 2000/2001 marketing season, FRA involvement in the buying and selling of grain was very limited, and all purchases and sales were done using a tender process. With an increase in budgetary support from the government and the looming drought of 2001/2002, the FRA found itself becoming one of the major actors in the maize market.

In 2005, the Food Reserve Act was amended to include the responsibility of crop marketing. Following the amendment, the Agency expanded operations and opened several depots in almost all districts. The rationale was to reduce the transaction cost for small-scale farmers (Ministerial-Statement, 2013). The FRA started announcing maize floor prices and was seen as synonymous to the ‘buyer of last resort’, similar to NAMBOARD. The agency increased its buying activities and has continued to buy a large portion of local production. Over the years, FRA has arguably become the dominant player in the maize market, in some years purchasing more than 70 per cent of the marketed surplus from small holder farmers at above-market prices (Chapoto, 2012).

Similar to the post-independence period and as highlighted in *section 1.3.1,* in early 2009, the FRA bought maize at prices higher than the market rate and sold to millers at prices lower than the market rate. This was meant to mitigate the effects of the high 2007/8 food prices on consumers without disadvantaging farmers. As highlighted earlier, a price spike was observed despite government's intervention. Furthermore, the effectiveness and efficiency of these subsidies was questioned by other actors including researchers (see for example Mason, Jayne and Mofya-Mukuka, 2013 and Jayne et al., 2013).

As in the post-independence period, the intervention was not fiscally sustainable. On 27 June 2013, the Minister of Agriculture announced that due to the high level of loss at which the FRA operates, the programme would face some reforms, including removal of miller/ consumer subsidies[27] (Ministerial Statement, 2013). These reforms coincided with the removal of fuel subsidies. As expected, price spikes in maize prices were recorded in 2013, which led to sharp reactions from stakeholders. *Appendix B* provides some reactions based on media reports.

In this research however, we only focus on the period between 2006 and 2010, which covers the 2007/8 food crisis. The current food price crisis arising from the removal of the governments' consumer subsidy programme is therefore outside the scope of our research. Empirical findings gathered here could however be applied to the current and future food crises that may occur.

Producer subsidies

The major producer subsidy in Zambia is the input support programme. Government formed the Fertiliser Support Programme (FSP) in 2002 to subsidise production. In a Ministerial Statement, the Minister of Agriculture stated that the intention of the programme was to increase production of the staple food commodity, maize, and reduce poverty. This was deemed necessary following a succession of weather-related stresses such as droughts and floods, which led to reduced maize production. The programme was designed to improve the food security situation in the country (Government of the Republic of Zambia, 2013).

The FSP was designed to distribute 1 hectare worth of maize input packs to qualifying farmers at subsidized prices. Each FSP pack was meant to consist of 20kg

[27] As supporting evidence for these measures, the minister cited the miller/consumer subsidy as normally exceeding the budgeted amount and often requiring a supplementary budget to fund the excess. For example, in 2009, the amount exceeding the budget was 216.6 per cent, 2,632 per cent in 2010, 2,114 per cent in 2011 and 732.7 per cent in 2012.

hybrid maize seed plus four 50kg bags of Compound D basal fertilizer and four 50kg bags of Urea top dressing fertilizer (World Bank, 2010). The original implementation plan was to follow a graduation plan with a three-year span. In the first year, the farmer would contribute 40 per cent and government subsidy would equal 60 per cent. In the second year, the farmer and the government would contribute equally (50 per cent each), and in the final year, the farmer would pay 60 per cent and the government 40 per cent (Ministerial Statement, 2013).

But, as argued by Bauer and Paish (1952; p. 766), “small producers are unlikely to have the self-restraint and foresight to set aside in good times sufficient reserves to cushion the effects of worse ones, or, even if they have, may be debarred from doing so by social customs and obligations”[28]. Indeed, the FSP was so popular that while it was intended as a short term measure for the farmers at its inception, it turned out to be permanent. The program’s operations significantly increased with large additions to the numbers of farmers targeted in some years. Little attention was paid to the intended graduation requirements, leading to a significant escalation of total costs and cost per beneficiary. The budgeted amount for 2007/8 for example was ZMK 150 billion (World Bank, 2010).

Despite this level of investment, the performance of the agriculture sector was below par. In the 2009 budget speech to the National Assembly, the honourable Minister of Finance cited weaknesses in the FSP as one of the reasons for an average contraction of about 1.2 per cent in the agricultural sector. He further acknowledged that the Programme has had limited impact on increasing agricultural productivity. As a result, government initiated a comprehensive review of the Programme in order to improve its efficiency and effectiveness, especially with regard to distribution at district and constituency level (Government of the Republic of Zambia, 2009b).

During the 2010 budget address[29], the Minister of Finance announced that following the review of FSP, the government had revised the Programme (and renamed it to

[28] The continuation of the program could also have been for political reasons. For example, rural households could use their electoral votes as political leverage hence, forcing the government to continue with the programme.
[29] Note that there was a delay in announcing the budget for 2009. Normally, the budget for the subsequent year is announced, debated and adopted before the end of the year. The 2009 budget

Farmer Input Support Programme (FISP)). Under this revision, the number of small-scale farmers that would benefit from FISP would double to 534,000 eligible farmers. Unlike under FSP, FISP would cater for 0.5 hectare maize production per beneficiary. As such, government reduced the pack size to four 50kg bags of fertiliser (two Compound D basal fertilizer and two 50kg bags of Urea top dressing fertilizer) and one 10kg bag of seed, instead of eight 50kg bags of fertiliser and two 10kg bags of seed. According to the Minister, this was meant to ensure optimal utilisation and increase the coverage of the programme (Government of the Republic of Zambia, 2009a).

Theoretically, subsidising the cost of production should lead to reduced prices. In relation to input subsidies, Dorward, Chirwa and Jayne (2010) suggest that incremental use of fertiliser should lead to higher maize production, increased households' incomes and lower maize prices, among other effects. Empirically however, authors such as Ricker-Gilbert et al., (2013) find that fertilizer subsidies in Zambia have either no statistically significant effect on retail maize prices or, more commonly, a statistically significant but very small negative effect on those prices. According to the authors, the results suggest that the welfare benefits of the programs are limited almost exclusively to farmers who receive the subsidy. Other farmers and urban consumers are not affected in a major way. This could explain why historically, protests are directly related to removal of consumer subsidies rather than producer subsidies.

This section has shown that in Zambia, food prices, particularly for the main staple (maize), are highly influenced by the political economy. An absence of consumer subsidies in the country has historically led to riots and a reversal of such policies. In general, the findings in this chapter are a reflection of the prominence of food prices in household budgets and subsequently household welfare. Therefore, a threat to affordability of maize prices is often synonymous with political instability in Zambia.

speech should have been addressed in the last quarter of 2008 and not January 2009. This is because the fiscal year for Zambia runs from January to December. For 2010 however, the normal budget cycle was followed and the budget was announced in October 2009. Therefore, both the 2009 and 2010 national budgets were announced in 2009.

Having outlined the changes in food prices globally and nationally, the impact in various countries as established by other authors and a broad overview of the Zambian context, *chapters 4 through 6* will attempt to provide empirical answers to the research questions. However, before establishing the changes in consumption, income distribution, poverty and nutrition effects on Zambian households, the next chapter outlines the framework used to analyse this empirical work and also describes the data.

Chapter 3: Theoretical framework and data

Having provided a background to the food price spike and a review of literature, the present chapter mainly focuses on the theory guiding the understanding of the impact of food prices on household welfare and the data used in this research.

3.1.The effects of price changes: Theory

This research draws upon the standard micro-economic theory of consumer behaviour under adjusting market prices[30]. In consumer theory, individuals make choices to purchase goods and services that will maximise their utility given the varying prices and limited income. Each consumer/ household has a preference system upon which a set of commodities that maximise their welfare are selected.

The consumer behaviour theory also postulates that an increase in the price of a commodity leads to both a substitution and income effect. With a normal good, the substitution effect arises from the reduction of the food item purchased and subsequently consumed. In return, consumption of a competitive item is increased[31]. The income effect on the other hand occurs because a rise in the price of a commodity would lead to a decline in real income and subsequently the welfare of an individual or in this case, a household (see for example Varian, 1987).

Intuitively therefore and as emphasised by authors such as Dorward (2012), the relative balance between the substitution and income effects depends on the expenditure share of the item facing a price rise and the marginal utilities of different goods and services. As highlighted in *chapter 1*, poorer households allocate a higher proportion of their budget towards food costs, implying a higher marginal

[30] See Dorward (2012) for a theoretical description of the meaning of 'price' in relation to food prices, based on standard micro-economic theory.

[31] However, it could also happen that consumption of a particular commodity increases with the rise in food prices. In economics, this is called a Giffen good. Jensen and Miller (2008) found strong evidence of Giffen behaviour for rice among the poor urban households in Hunan, China during the 2007/08 food crisis.

utility. These households therefore suffer a higher decline in wellbeing if food prices increase.

In principle, this approach is conducive for the analysis of the impact of price changes of all kinds of commodities on household behaviour and welfare. For example, following the standard economic theory, Deaton illustrates this economic interpretation of welfare in a preference ordering or utility function $[u(q_f, q_n)]$, where q_f is the quantity of food, q_n is the quantity of non-food, and u is the utility[32] that people derive from consuming these quantities of goods (Deaton, 1997; p.207). This framework can also be used to assess the level of utility that a household gets from consuming food $\left[u\left(q_f\right)\right]$ alone. As suggested by D'Souza and Jolliffe (2010), total food consumption is an informative measure of wellbeing in itself, but is also important because it is a core component of poverty indicators.

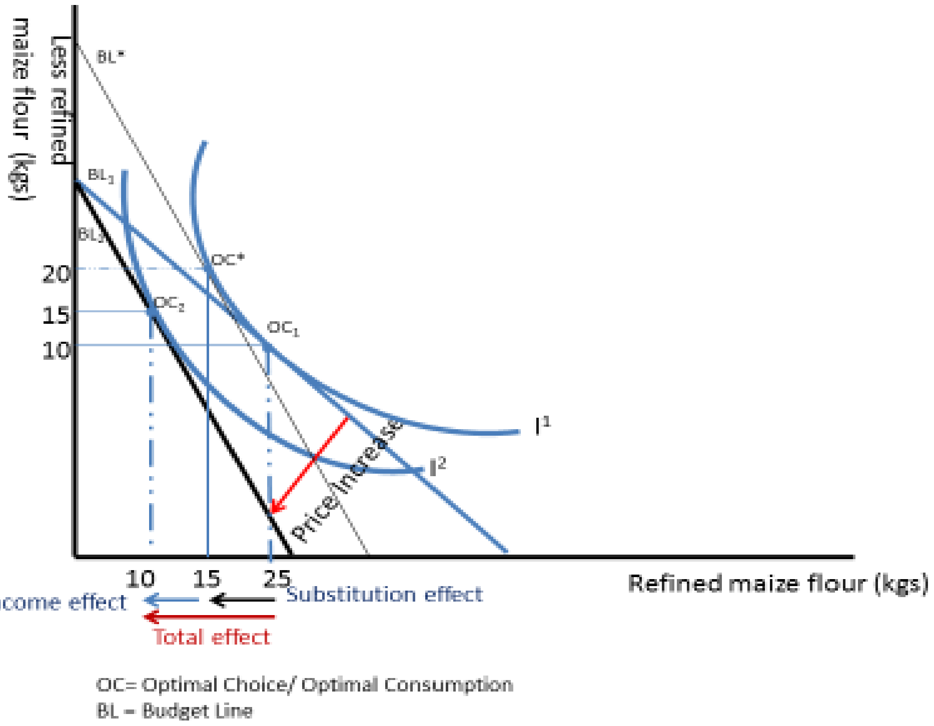
Figure 3.1 illustrates the indifference curves of a household choosing how much to consume of the staple food (let's say refined maize flour) and a substitute, less-refined maize flour, given the price increments. The less-refined maize flour has higher calories while the more refined maize flour is more tasty and preferred but has less-nutritive properties. The diagram shows that an increase in the price of refined maize flour causes the household budget line to change its slope from BL_1 to BL_2. [33] As a result, the household reduces consumption from 25kg of refined maize flour and 10kg of less-refined maize flour (OC_1) to 10kg of refined maize flour and 15kg of less-refined maize flour (OC_2). The shift in demand from BL_1 to BL_2 is the total effect of the price change. In other words, *ceteris paribus* and on average, households are expected to reduce consumption of food commodities that become more expensive. If the household was compensated to offset the rise in prices, the budget line would be BL*. The difference between where the budget line BL* and BL_1 hit the vertical axis is called the compensating variation. The compensating variation is therefore the value that would have to be given to a household/ consumer in order to bring them back to the level of welfare as before the price spike (see for example Perloff 2011).

[32] The intuitive meaning of utility is simply the level of satisfaction a consumer receives from the consumption of a particular bundle of goods.
[33] Any lower indifference curve yields less satisfaction for the consumer/ household.

If income were to increase commensurate to the rise in prices of refined maize flour, the consumer would stay on the same indifference curve (same utility as in OC_1). Yet, despite consuming comparable total quantities to OC_1, the household is now consuming less of refined maize flour (15kg) but more of less-refined maize flour (20kg), revealing the substitution effect. To reiterate, according to this theory, a rise in food prices will have two effects on consumers. The first is that consumers will purchase less items due to the loss in real income and second, even if they were compensated for the real income loss, consumers would buy less of the commodity facing a price rise. In reality of course, households are usually not compensated, and the lower purchasing power of their income causes further reductions in consumption of both goods. The total change in the quantity purchased is the sum of the income and substitution effects. As highlighted in *chapter 1,* Perloff argues that even a rise in the price of only one good reduces a consumer's ability to buy the same amount of all the goods previously purchased. Furthermore, the effect on households is likely to be different depending on the initial level of welfare.

While *Figure 3.1* was drawn assuming strong substitution effects, this might not be an accurate depiction of reality as households may be able to smooth consumption by borrowing, selling their assets or by tapping into financial assets accumulated in the past (Alem and Söderbom, 2012). Furthermore, poor households may not be in a position to make such decisions due to, for instance, an already lean diet and very limited income. Price changes and the resulting consumption choices and substitution decisions may lead them to switch from protein rich (and usually relatively expensive) foods to energy-rich (and relatively cheaper) foods such as cereals.

Figure 3.1: Substitution and income effects with normal goods



Adapted from Perloff (2011)

As already indicated, the theory assumes that consumers always make rational decisions and consume items that maximise their utility. Price elasticities for basic foods vary by income and each household has a different utility curve[34]. In his seminal work, Engel states that the food share can be used as an inverse indicator of welfare, as the share of expenditure on food in the household budget declines as income or total outlay increases. This assertion is called Engel's law (cited in Deaton, 1997; p. 254 - 255).

Another important aspect related to the income effect is that there is an adjustment in the composition of the basket. This is called Bennett's Law, which states that the "starchy staple ratio" declines as household incomes increase. That is, the proportion of calories that an individual derives from the basic starchy staples (mostly grains and root crops) --the starchy staple ratio-- falls with rising income as the consumer

[34] Timmer, Falcon and Pearson (1983) postulate that the food policy analyst should expect great diversity in how different individuals will respond to changes in the income and price variables that drive the consumer theory framework.

diversifies the food consumption bundle to include higher priced calories (Timmer, Falcon and Pearson, 1983). Empirically, a number of authors have confirmed that as their incomes rise, consumers may choose food that is better tasting, but that has lower nutritional value. For example, Banerjee and Duflo (2011) found that, as India has gotten richer over the past 25 years, people have not increased their caloric intake. According to these authors, households buy better-tasting, more expensive food and also spend more on entertainment.

Similarly, Cirera and Masset (2010) argue that food purchases are rarely dictated by nutritional requirements. People do not necessarily buy the food that is recommended by health providers as healthier or more nutritious. Rather, these authors suggest that food demand is dominated by tastes, which vary across countries and over time. Following micro-economic theory, Jensen and Miller (2011) argue that since consumers' choices maximise their utility, if they make choices that reduce their nutrition, then it must be that they gain more from the increased taste or variety than they lose in calories or long-term health status.

Despite its limitations, this micro-economic theory offers analytical insights for the welfare outcomes considered in this research: consumption, equality of distribution, poverty and nutrition status. In the poverty chapter of the thesis (*chapter 5*), the research aims at empirically estimating the price effect on income distribution and levels of poverty. In the nutrition *chapter (6)*, the research assesses the loss/gain in nutrients arising from change in consumption patterns within and across food groups. Unlike economists, nutritionists see high substitution elasticities as a cause for concern, at least among the poor, since nutritional status is threatened by price increases (Deaton, 1997). Using this framework, we translate the change in consumption patterns into nutrients to assess whether households gain or lose nutrients by substituting across and within food groups when prices increase.

Another important aspect to conceptualising the impact of rising food prices on household welfare derives from the work by Singh, Squire and Strauss (1986) on agricultural households models. As described in *chapter 2,* these authors showed that agricultural household economic theory combines two fundamental units of micro-economic analysis: the household and the firm. They argued that traditional economic theory had dealt with these units separately, yet their interdependence is of crucial importance in developing economies where most households depend on agriculture.

While in the short term a rise in food prices will impact household welfare through quantity responses from the consumer side by reducing consumption of those items that became more expensive (see for example Vu and Glewwe 2011), in the medium term, there can also be positive effects from rising food prices where food producing households increase their production of food (Robles and Keefe, 2011).

Timmer, Falcon and Pearson (1983) argue that food consumers and food producers react to food prices in opposite ways. For consumers, higher food prices restrict the range of foods and other commodities and services that can be purchased, while lower food prices permit greater food intake, a wider variety of foodstuffs, and a higher quality diet. Food producers on the other hand see food prices as a major factor determining their incomes. These authors further suggest that the dual role of food prices determining food consumption levels, especially among poor people, and the adequacy of food supplies through incentives to farmers, raises an obvious dilemma for food policy analysts.

As summarised by Deaton (1997; p 184-185), producers benefit from a price change in proportion to the amount of their production, and consumers lose in proportion to the amount of their consumption. For households that are both producers and consumers (farm-households), the gain or loss is in proportion to the difference between production and consumption. This can be estimated as $P_{hi} - q_{hi}$ where P_{hi} is the production of commodity (i) by household (h) and q_{hi} is the amount that a household consumes of the commodity.

Therefore, when assessing the impact of rising food prices on welfare, it may be better to extend the assessment to both the consumption and profit[35] function of the household. Using the work by Singh, Squire and Strauss (1986); Deaton (1989) and Ivanic and Martin (2008), the expenditure function can be expressed as $e(p, w, u)$

[35] In the context of food prices, profit (π) is the difference between what a household earns from selling the commodity they produced and the cost of production (e.g. inputs, labour etc).

where p is a vector of prices of all the commodities consumed by the household, w represents the prices of supplied factors and u is the households' level of utility. On the other hand, the profit function $\pi(p, w, v)$ is defined over the prices of commodities produced or purchased as inputs, w is the prices of variable factors purchased and v represents fixed factors such as land.

In his seminal work on the distributional effects of price changes, Deaton (1989) proposed a non-parametric methodology for understanding the net production (selling) position of a household. As already described, for net sellers, a rise in prices should lead to an increase in real incomes and therefore, higher expenditure on goods and services that would maximise household utility. Given the above explanation, for each household, the net welfare effect of an increase in food prices will depend on the combination of a loss in purchasing power, the substitution effect and the net selling position of a household.

3.2. Data and descriptive statistics

To answer the research questions posed in this research, we use four main data sources: (i) the LCMS; (ii) the district retail price data (iii) qualitative data, which we collected from October to November 2012 and (iv) qualitative data collected by the Institute of Development Studies (IDS) and OXFAM Great Britain (GB) between 2008 and 2013.

3.2.1. The Living Conditions Monitoring Survey (LCMS)

The LCMS is the main dataset used in the present research. It evolved from the Priority Surveys, which the Central Statistics Office (CSO) of Zambia had been collecting since 1991. The main objective of the Priority Surveys was to monitor the social dimensions of adjustment programmes and its impact on the country's population. Among other data, the survey collected information on health, education, household consumption, household amenities and facilities.

The objectives of the LCMS are broader than the original priority surveys, and are as follows:

i. Monitor the impact of government policies on the wellbeing of the Zambian population
ii. Monitor the level of poverty and its distribution in Zambia
iii. Provide various users with a set of reliable indicators against which to monitor development
iv. Identify vulnerable groups in society and enhance targeting in policy implementation

(Government of the Republic of Zambia, 2011d; p.4)

The LCMS is a cross-section survey and is currently the major source of household social-economic information in Zambia. The household data is collected from the entire geographic range of the country on a sample basis. These surveys tend to be large (data was collected from about 18,000 and 20,000 households in 2006 and 2010 respectively) but they are not panels[36]. Assessing the impact of a covariate shock on welfare in most developing countries is challenging due to the lack of panel data sets encompassing the period before and after the crisis. One of the contributing factors to the dearth in repeated panels might be because their collection is costly, time-consuming, and logistically more complicated than cross-section data collection. This is because the same households have to be tracked over time and some households may have migrated to a different location.

To date, five LCMS reports have been published in Zambia, for 1996, 1998, 2002/3, 2004 and 2006/2010. Based on the LCMS objectives, it would be best if the wellbeing indicators (e.g. poverty) could be compared over time. However, only the following rounds of surveys are comparable: 1991 is only comparable to 1993, the second comparable set is 1996, 1998 and 2004. Finally, 2006 is comparable to only 2010. The interruption in comparability is a result of differences in survey design, and in some instances adjustments in methodologies for estimating poverty. This research draws mainly from the 2006 and 2010 LCMSs, which were published in one report due to the delayed release of the 2006 results.

[36] Unlike a cross-section survey, a panel survey is where the same households are surveyed over time.

The two cross section surveys (2006 and 2010 LCMSs) have been selected for a number of reasons. First, they are the latest available household surveys. Second, the surveys just precede (2006 LCMS) and follow (2010 LCMS) the 2007/8 global food crisis. Furthermore, the expectation is that households would have adapted to high prices by 2010 and the effects on poverty, substitution and child health outcomes would be observable by then. Third, the survey has appropriate modules to estimate welfare effects. These include household characteristics, consumption, agriculture production, education and anthropometric measures such as height and weight, which are relevant for estimating child health outcomes.

Fourth, each of these surveys was conducted around the same calendar month, December for the 2006 survey and December and January for the 2010 survey. Therefore, observed differences are unlikely to be influenced by seasonal variations. Arguably, given that for a typical year in Zambia, these survey months fall within the main planting season and are characterised as the peak hunger season (see figure F.1 in Appendix F, which depicts FEWSNETs' seasonal calendar for Zambia), the results may be regressive even for households that are net sellers in other seasons. Conversely, net sellers may have a higher positive effect during the period when cereal prices peak (February to April) while net buyers would suffer a welfare loss. Therefore, had the survey been conducted in February to April, the overall positive effect could have been higher. In short, the effects of food prices on household welfare could be dependent on when the survey is conducted. Such an effect may be stronger among poorer households. In Nigeria for instance, Lipton (1983) found no relationship of calories per consumption unit to seasonal instability among non-poor households. However, the relationship was stronger among low income households.

Ideally, it would be best to assess the net effect across the seasons. However and borrowing from the argument put forward by Ivanic and Martin (2008), it is likely that the overall impact of rising food prices on household welfare in poor countries depends on whether the gains to poor net sellers outweigh the adverse impacts on net buyers.

In relation to consumption (one of the main modules we use in this research), detailed information was collected on various food and non-food commodities. For food items, the LCMS records consumption based on three sources of enquiry: purchased, own-produced and gifts. Specifically, the questionnaire was designed as follows: a respondent was asked whether they had purchased a specific item (for example maize grain) during a specified reference period (two weeks or one month) [37]. If it was the case, the respondent was then requested to provide information on the total value purchased. The subsequent question was about whether the respondent had consumed maize grain from own-produce. If so, information on the unit consumed, quantity consumed and estimated market value was collected. The final question was about whether the respondent had consumed maize received as a gift or other sources such as food for work. If yes, then information on units consumed, quantity and the value was sourced. The respondent was then asked about the next food commodity until all the items on the list were exhausted.

The production data is sourced from the agriculture module where households were asked questions, among others, on crops grown and quantities sold. Analogous to the consumption data, households were asked whether any member of the household grew a particular crop (for example, maize) during the last agriculture season. From what was planted, the households were asked the quantities harvested. A subsequent question was on the quantities sold and the total value (in Kwacha) realised from the sale.

Assessing the impact of food prices on household welfare using cross-section household surveys has various sources of "noise". One major source, which has also been widely discussed, is that of reporting error, which may be caused by recall error due to faulty memory. Deaton (1997: p.25) argues that household recall capacities deteriorates with time hence, recall periods of even two weeks will result in downward-biased estimates of consumption. It is possible that there may be such

[37] For almost all the food products, the questionnaire asked questions using two reference periods, "last four weeks" and "two weeks". Therefore, there was a choice to use either one of these references. Following the recommendation in Deaton and Grosh (2000), whenever available, we used the one month recall of consumption, which is a better welfare measure than what actually happened in the last two weeks, which could have been unusual for any number of reasons. Otherwise, all the food sub-aggregates were converted to a uniform reference period, a month.

recall errors in the data. Deaton and Grosh (2000) suggest that ideally, many visits may be required to ensure that accurate data are collected on high-frequency consumption but that such visits can be prohibitively costly. They further argue that the diary method was designed to minimise reliance on respondents' memories but this method poses special problems when a substantial fraction of the population is illiterate.

Given the choice we made in the present research of using monthly data, it is possible that the welfare deterioration in the present research may be less adverse than estimated as households may have consumed more than what they reported. Since the recall period is the same for both survey periods (2006 and 2010), the bias is likely to be consistent. Reporting error may also be caused by telescoping where a household compresses actual consumption that occurred over a longer period of time into the reference period asked, hence, in such an instance, the reported consumption is greater than the actual value (see for example, Beegle, et al., 2010).

Part of the initial exercises for our research was to match the consumption to the price data, which entailed making the data consistent between the two survey periods (2006 and 2010). A challenge we encountered with the LCMS survey was that the list of food commodities was not consistent across the two surveys. More specifically, the 2010 LCMS survey questionnaire featured more food items (112) in comparison to only 39 food items in 2006. One reason why the food items in 2006 seem fewer is that some products such as different types of vegetables, fruits and non-alcoholic drinks were combined in the questionnaire. In 2010 however, the products were more disaggregated as each type of vegetable, fruit and non-alcoholic drink was asked in turn. Due to the importance of these items in the Zambian diet, particularly vegetables, we amalgamated the relevant food items from the 2010 data to make the list of food items comparable to that of 2006. The alternative would have been to drop the commodities. This procedure reduced the initial list from 112 to 51 commodities. Some items from the 2010 LCMS were excluded because they were not part of the 2006 LCMS. These included: alcoholic beverages; confectioneries such as sweets and cocoa; foods labelled as "other", such as "other meat", "other cereal" and "other poultry". The final list was made up of 36 food commodities[38]. In a study on Indonesia, Friedman and Levinsohn (2002) conducted a similar exercise.

3.2.2. Price data

Price data are critical for answering the questions raised in this thesis. However, the LCMS does not contain any data on consumer prices. With such surveys, it is usually possible to compute unit values calculated by dividing the total expenditure of a particular good by the quantity consumed (Friedman and Levinsohn, 2002, Deaton, 1997)[39]. One issue however that emerged with the 2006 LCMS questionnaire was that under the ‘purchased’ category, the questions on units and quantity consumed were omitted. Instead, households were only asked to provide information on the total amount spent. This omission was rectified in the 2010 questionnaire. Following authors such as Attanasio, et al., (2013; p.140), computing a unit value requires both the expenditure and the quantity of a given item purchased. As we could not directly estimate quantities from the consumption section, calculating prices using this data was impossible.

In the absence of adequate food price data, the procedure adopted here, as suggested originally by Deaton (1997; p.283), consisted of merging regional price data with the household survey data. This line of thinking was extended in Deaton and Zaidi (2002; p.40), where they argued that ancillary data sources such as government price surveys are typically a last resort, but that it was better to use such data than make no price correction at all. As such, the estimations in this research associated each household with the respective district prices in the actual month and year the survey was conducted. We therefore merged the monthly consumer price data collected by the Central Statistical Office in various districts with the LCMS household consumption data. According to the Central Statistics Office (CPI methodology, n.y)[40], the consumer price data is collected for a set of individual products from various markets and small outlets in specific districts in each province. This was

[38] Three items were excluded from both the 2006 and 2010 list: alcoholic beverages, cigarettes and processed baby foods.
[39] See Deaton (1997; p.284) for a discussion on unit values and challenges arising from estimating them.
[40] This is an internal document, which was shared with us by the Price Statistics Department at the Central Statistics Office of Zambia. n.y stands for ‘No Year’.

meant to ensure a better representation of the prevailing price of commodities. The prices for an individual product are then averaged to district level and subsequently national level for purposes of estimating the CPI.

In the present research, district level prices will be utilised. The disadvantage of using district price data is that prices are prone to poor granularity as they are not as localised as community price data or prices estimated from household level data. However, utilising district level price data frees us from dealing with the challenges arising from the large numbers of missing values for price data associated with household surveys or prices collected at community level (see the discussion on the problems of missing values for prices in Frankenberg, 2000).

Since actual prices and not unit values are used in the current research, the analysis is free from the risks arising from utilising unit values. Examples of the risks include: the effect of choice of quality of product on prices; errors arising from inconsistent use of units and; challenges of converting from units to a standard measure (e.g. kilogramme). For a further discussion on unit values and its' weaknesses, see Deaton (1997: p.284).

We then estimated the quantities of individual food commodities in 2006 and 2010 by dividing the total household monthly consumption value on a particular commodity with the monthly district price of the same commodity.

This exercise revealed that of the 36 common food items in the 2006 and 2010 LCMS consumption section, only 29 had price observations (*Table 3.1*). These were the final food items included in our estimation for quantities consumed and price indexes for example. The advantage of this list is that it features all the commodities included in the list for estimating the official poverty line for Zambia (*Table F.2* in *Appendix F*). Furthermore, the items include some of the most consumed food items in the country as will be shown in *chapter 4* on household food consummption shares.

Table 3.1: List of commodities

Maize grain	Fruits	Groundnuts
Refined maize flour	Kapenta (small dried fish)	Cooking Oil
Less-refined maize flour	Bream fish (tilapia)	Vegetables
Millet	Chicken	Tomatoes
Sorghum	Beef	Onions
Rice	Pork	Salt
Bread/ Bread rolls	Beans	Tea leaves/ tea bags
Sweet potatoes	Eggs	Butter
Irish potatoes	Milk (fresh)	Sugar
Cassava	Milk (powdered excluding baby milk)	

Source of Data: LCMS raw data

Another challenge with the CSO price data is that prices were collected by the government from only 38 of the 72 districts where household surveys were conducted. Each of the 9 provinces was represented by at least 3 districts in the price data. To match households from the LCMS data to as local a price observation as possible, we followed a similar process proposed by Ferreira, et al., (2013) by assigning commodity prices to other districts on the basis of geographic proximity. This was done as follows: for 3 (Ndola, Kabwe and Lusaka) of the 38 districts, two sets of price data existed, rural prices and urban prices. This is an anomaly in the labelling of districts by CSO as for Lusaka province for example, there are three districts: Lusaka, Chongwe and Kafue. Of the three, only Lusaka is an urban district and the rest are rural districts. Therefore, Lusaka rural should have been recorded as either Chongwe or Kafue district. The same situation applies to Ndola and Kabwe as these are also predominantly urban districts. We reallocated these 'rural prices' to neighbouring (and predominantly rural districts) but within the same province. Therefore, prices collected in Ndola Rural were reallocated to Mpongwe district, Kabwe Rural was reallocated to Chibombo district, and Lusaka Rural was reallocated to Chongwe district. This increased the number of districts with price data to 41. For the rest of the districts (31), reallocations were also primarily based on geographical proximity (see *Table C.1* in *appendix C* for the assignment rules). A major weakness arising from this process is that prices faced by households were not accurately reflected due to the variation in transportation and transaction costs across districts. The direction of the bias is not obvious and depends on the district.

For the specific research questions posed in *chapter 5*, we also use district producer prices to make the source of price data (consumer and producer prices) consistent. The source of the producer prices is the 2005/6 agriculture year (2006/7 marketing year) of the Zambia Post-Harvest Survey conducted by the CSO in conjunction with the Ministry of Agriculture[41]. The CSO estimates the district crop prices based on smallholder households' total value of cash sales for a specific crop divided by the quantity sold during that period. Analogous to the process for estimating district consumer prices, the prices of an individual crop are then averaged to district level[42].

One overarching challenge of big household datasets is that the data processing requirements are high and time-consuming. Prior to performing any analytical work, we conducted consistency checks to ensure the data was ready for analysis. As suggested by Deaton and Zaidi (2002; p.123), every analytical exercise with household surveys reveals new problems with data and is very data intensive. Therefore, data cleaning and setting up relevant datasets before analysis formed a significant aspect of our research.

The data was rigorously checked for coding errors. In relation to consumption values for food, outlier identification and adjustment were performed only over the positive observations for the variable. As argued by Ackland et al., (1996), one reason for using only positive values is that many households record zero values meaning that the mean for such variables would be so low that too many observations would be identified as outliers. Instead outliers in the present research were defined as consumption aggregates per variable that deviated by more than 2 standard deviations from the mean of a specific district, which we disaggregated by rural and urban location. These outliers were replaced by the median of the region (rural or urban) and district that a household is located. We used the median, rather than mean, as it is less sensitive to outliers. Similarly, in instances where households were consuming non-zero quantities of a particular item, but where data on the total

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[41] Unlike the consumer price index, the producer prices are not readily available. Maize prices are disaggregated to district level but the producer price information for other crops is very limited. Therefore, the net effect of maize products on household welfare is better estimated due to producer prices being recorded at district level. The prices of other crops were recorded at national level only.

[42] The data were collected in mid-2007. Unlike in the case of consumer prices, the producer prices are collected in 70 of the 72 districts. Similarly, we assigned the price data for the 2 districts with missing price information using geographical proximity.

value of consumption were missing, we followed the standard practice discussed in Deaton and Zaidi (2002) of imputing median values for other households in the same region and district.

3.2.3. Qualitative data

This research also uses two sets of qualitative data. The first set is based on information we collected in October and November 2012 in three sites: two urban (Lusaka and Ndola) and one rural (Masaiti)[43]. The rationale for conducting the primary research was to better understand households' experiences during the crisis period. Interviews were conducted with households, traders, government officials and representatives of non-state actors. A breakdown of respondents interviewed is shown in *Table 3.2*. In total, 20 households, 15 traders and 7 representatives from state and non-state actors were interviewed.

Initially, we planned to only interview households in Kabwata (medium density area in Lusaka)[44] and Masaiti (rural area). However, most households in Kabwata were not willing to participate in the research. We therefore decided to supplement the household interviews with Chainda, a high density area in Lusaka. As such, 6 households were interviewed in Chainda while only 3 households were interviewed in Kabwata.

In the rural site, households were asked questions related to agriculture activities, markets for their produce, whether higher food prices induced them to increase agriculture production and coping strategies employed when faced with a covariate shock. For urban households, we focussed the interviews on their experience of higher food prices and coping strategies. Interviews with traders focussed on sources of product(s) being sold, who the product is sold to and at what price. State and non-state actors were mainly asked policy related questions and about the governments' response to the 2007/8 food crisis.

[43] Masaiti is a district located on the Copperbelt Province of Zambia.
[44] Most middle-class families live in medium-density areas in Zambia.

The research further draws upon a unique panel of qualitative information collected in Zambia between 2009 and 2012 through the food price volatility project by the Institute of Development Studies (IDS) and Oxfam UK[45]. We were given access to the raw data i.e. field interviews and field notes, which enabled us to make our own interpretation of the experiences[46]. The qualitative information however is only used to a limited extent as this research is mainly quantitative in nature.

Table 3.2: List of respondents

Stakeholder	**Location**	**Number of respondents**
Households	Masaiti	7 farmers
	Twapia* (Ndola)	4 non-farmers
	Kabwata** (Lusaka)	3 non-farmers
	Chainda*** (Lusaka)	6 non-farmers
Traders	Soweto market (Lusaka)	8
	Masala market (Ndola)	5
	Kabwata market (Lusaka)	2
Government	**Name of Organisation**	
	Central Statistical Office (CSO)	Interviewed one respondent in each of these offices
	Ministry of Agriculture and Livestock	
Non-state actors	Common Market for Eastern and Southern Africa (COMESA)	
	Famine Early Warning Systems Network (FEWSNET)	
	Food Security Research Project (FSRP)	
	Indaba Agricultural Policy Research Institute (IAPRI)	
	Zambia Institute of Policy Analysis and Research (ZIPAR)	

Source: Authors tabulation based on field interviews

*Twapia is a high density residential area in Ndola; ** Kabwata is a medium density area; *** Chainda is a high density area in Lusaka

[45] The Zambian research is part of a six-country community-level qualitative research under the IDS/ Oxfam project called, 'Life in a Time of Food Price Volatility'. The collection of the data involved at least two visits to the selected household per year. In Zambia, the research was conducted in Chief Chikwanda's area in Mpika (Northern Province) and Kabwata (Lusaka Province). As described by Hossain and McGregor (2011), the communities in this project were selected to offer insights into how the shocks were experienced by people with a range of different relationships to the global economy and who were living with poverty and vulnerability prior to the shock.

[46] We were able to access this information due to our formal engagement with the IDS/ OXFAM food price volatility project as a research consultant on the social impacts of food price volatility.

3.3. Summary

This chapter put forward microeconomic consumer theory, highlighting the impact of food prices on household welfare. The guiding theory for this work is the consumer behaviour supplemented with the theory by Singh, Squire and Strauss (1986) on the dual role of households. The chapter also discussed the notion of a household as both a consumer and producer. In the second part, details of the data that is used in this research was provided. We also discussed the weaknesses of the data we are using and how we have resolved these weaknesses for purposes of our research. The subsequent chapters will present the empirical evidence of the impact of rising food prices on household welfare in Zambia. Note however that the empirical chapters will provide a brief description of the specific data to be used.

Chapter 4: Food consumption across households and price indexes

4.1. Introduction

The current chapter, which provides the first empirical results for this thesis, investigates whether households adjusted their food consumption patterns within and across major nutrition groups. The results presented in this chapter are not only important for understanding the initial household behaviour given the rise in food prices but will also be useful in the subsequent analysis in this research (*chapters 5 and 6*). As argued by Minot and Goletti (2000), information on food consumption is important as the impact of a price spike on welfare depends on the importance of a commodity in a households' budget.

The motivating hypothesis for the current chapter therefore is that when faced with a rise in food prices, households, predominantly those in urban areas, will reduce consumption of protein-rich foods and other micro-nutrients in favour of energy-rich foods. By implication therefore, the pattern of value of consumption shares has important effects on nutrition, particularly if the share of animal products, fruit and vegetables is sub-optimal (Attanasio et al., 2013)[47].

Prior to commencing the analysis in this chapter, we first describe the specific data and methods used. We then show in *section 4.2* the evolution of household consumption using the share of the food budget allocated to a particular commodity before and after the 2007/8 food crisis in Zambia. While this is not the formal way of assessing substitution within and across groups[48], the results presented in this chapter provide an indication of how households may have adjusted their preferences post-crisis. In an attempt to highlight the heterogeneity in consumption patterns, the household budget shares are shown not only for the entire sample but also disaggregated by geographical location and by quintile. This analysis is followed by a discussion on price indexes in *section 4.3*. We limit the discussion to

[47] This point will be returned to in *chapter 6*.

[48] Assessing these substitution possibilities requires estimating a demand system. However, demand system estimation is beyond the scope of this research (see for example, Attanasio et al., 2013).

three indexes, the Laspeyres, Paasche and Fisher index. Based on the index-related literature and the empirical evidence on Zambia, we will argue that the Fisher index provides better spatial and intertemporal estimates. This information is therefore informative for predicting the locations to be more affected by price effects. Having provided evidence on household consumption choices and how prices evolved over time and space, the chapter will be concluded in *section 4.4*.

4.1.1. Data and methods

To assess the effect of rising food prices on household welfare in Zambia, we start the analysis by estimating the changes in the share of the food budget that households spent on individual food commodities. This is calculated from the consumption module of the LCMS, which provides details of household consumption during a defined recall period. As indicated in *chapter 3*, the LCMS collected food consumption data by asking households on the basis of three sources: purchased, own-produce and gifts. Using a straight forward aggregation exercise, we combine food items from the three sources to construct a food consumption sub-aggregate. Deaton and Zaidi (2002) advise that when computing a measure of total food consumption to include as part of the aggregate welfare measure, it is important to incorporate food consumed by the households from all possible sources. District price data is also used to estimate the indexes.

Equation (i) shows the budget share, which is calculated as household consumption (x) of commodity i in year $t \epsilon (2006, 2010)$ divided by the total household food consumption (X_{tf}^{h}).

$$w_{it}^{h} = x_{it}/X_{tf}^{h} \qquad \text{(i)}$$

4.2. Household food consumption shares

Food share is often singled out as a measure of household welfare (Hentschel and Lanjouw, 1996). As shown in *section 1.3*, the share of food in the total budget for household in Zambia increased in 2010 relative to 2006. Furthermore, rural households allocated a higher share of their income towards food in comparison to urban households. Following Engel's argument, this implies that Zambian households in 2010 were worse off in comparison to 2006. The results also imply that rural households are poorer as they devote a higher proportion of their budget towards food needs than do urban households.

Evolution of consumption shares (2006-2010)

The results in *Table 4.1* indicate that the share of the household budget allocated to some individual items evolved between 2006 and 2010. The changes include a 3 percentage points reduction in the share of the budget devoted to refined maize flour while there was a commensurate increase (3 percentage points) in consumption of less-refined maize flour. Significant variations in consumption patterns are observed in vegetables where the share doubled during the reference period. Furthermore, households allocated a much lower share of their food consumption towards some items such as chicken, bream fish[49] and cooking oil in 2010 than in 2006. In all these instances, the consumption shares are statistically different from zero at 1 per cent level.

On average, the results on budget shares suggest that the change in consumption is from more expensive cereals (e.g. refined maize flour and rice) to less expensive cereals (less-refined maize flour and maize grain). *Table 4.1* further shows that households in 2010 significantly increased the consumption of vegetables while the share of the consumption budget allocated towards animal-source foods such as beef, chicken and fish declined slightly. Among the animal-source foods, the highest decline was observed in bream fish at about 2.3 percentage points. The most significant changes in the budget share were however observed between refined and less-refined maize flour. This is a classic case of the substitution and income effect. The substitution effect, in our case, arises from the increase in consumption of less-refined maize flour whose price is relatively cheaper and a decline in the consumption of the more expensive refined maize flour. The income effect from the rise in the price of maize products also leads to a decline in real income, which subsequently results in a decrease in consumption of normal goods. Furthermore, and as highlighted in the theoretical framework, Dorward (2012) elaborates that

[49] Bream fish is similar in appearance to tilapia fish and is normally sold in large sizes.

since poorer consumers spend a greater proportion of their income on basic food which give them higher marginal utilities, increases in the price of food then lead to larger proportionate decline in real income and in welfare for poorer consumers.

The finding in the present research on the observed change in consumption from refined to less-refined maize flour is similar to observations made by authors such as Ruel, et al., (2010) that to minimize the impacts of rising food prices on welfare, households may among others decide to switch to cheaper, often less preferred or lower quality staples to protect energy intake.

One key parameter, which we do not explore in the present research, is that of cross-price elasticity. This may have implications for our overall results. Dorosh et al., (2009) argued that farmers and consumers in northern Zambia produce and grow both cassava and maize, and in drought years, households may benefit from the spike in maize prices by selling more maize and consuming more cassava. The cross-price elasticity of demand would therefore project the resulting responsiveness of cassava consumption to changes in the maize price. Based on this argument, excluding cross-price elasticities may underestimate the observed welfare effects for some households. However, and as highlighted in the literature review section, after empirically conducting a cross-price elasticity analysis using Zambian data, Caracciolo, Depalo and Macias (2014) showed that the substitution effects were negligible (between 0.05 and 0.2). The authors took into consideration various food items including cassava, cereals and animal products.

Table 4.1: Consumption share of food items between 2006 and 2010

Commodity	2006	2010	Difference
Maize grain	0.090(0.157)	0.099(0.157)	-0.009***
Refined maize flour	0.053(0.115)	0.022(0.077)	0.031***
Less-refined maize flour	0.021(0.089)	0.054(0.094)	-0.033***
Hammermill maize flour	0.016(0.076)	0.026(0.083)	-0.010***
Rice	0.031(0.050)	0.027(0.055)	0.004***
Cassava	0.035(0.107)	0.041(0.120)	-0.006***
Millet	0.005(0.039)	0.005(0.036)	-0.000
Sorghum	0.004(0.034)	0.002(0.025)	0.002***
Bread	0.052(0.068)	0.057(0.078)	-0.005***
Sweet Potatoes	0.002(0.016)	0.011(0.035)	-0.009***
Irish Potatoes	0.010 (0.024)	0.009(0.027)	0.001***
Chicken	0.080(0.088)	0.065(0.086)	0.015***
Other poultry	0.002(0.014)	0.001(0.015)	-0.001
Beef	0.043(0.065)	0.032(0.061)	0.010***
Pork	0.012(0.043)	0.008(0.030)	0.004***
Goat meat	0.013(0.046)	0.009(0.039)	0.004***
Mutton	0.001(0.012)	0.000(0.000)	0.001
Game meat	0.008(0.038)	0.007(0.034)	0.001***
Bream fish	0.068(0.086)	0.045(0.070)	0.023***
Kapenta	0.053(0.064)	0.039(0.056)	0.014***
Vegetables	0.047(0.062)	0.103(0.100)	-0.056***
Beans	0.035(0.048)	0.031(0.048)	0.004***
Onion	0.017(0.025)	0.018(0.025)	-0.001*
Tomatoes	0.040(0.437)	0.033(0.032)	0.007***
Eggs	0.019(0.032)	0.020(0.035)	-0.001*
Cooking Oil	0.078(0.073)	0.047(0.048)	0.031***
Groundnuts	0.021(0.049)	0.015(0.036)	0.006***
Butter	0.007(0.016)	0.006(0.017)	0.001***
Sugar	0.062(0.062)	0.045(0.051)	0.017***
Honey	0.002(0.021)	0.001(0.015)	0.001***
Tea/ coffee	0.008(0.017)	0.006(0.018)	0.002***
Fresh milk	0.016(0.035)	0.015(0.036)	0.001***
Powdered milk	0.003(0.014)	0.002(0.013)	0.001***
Salt	0.029(0.055)	0.013(0.013)	0.016***
Fruits	0.006(0.019)	0.030(0.049)	-0.024***
Non alcoholic drink	0.012(0.031)	0.008(0.032)	0.004***
Total	1.00	1.00	

Source of Data: Estimated from LCMS raw data

*Notes: Standard deviations in parenthesis. Significance of the difference in means based on a t-test for continuous variables. ***p<0.01, **p<0.05, *p<0.1*

4.2.1. Evolution of consumption shares by geographical location and year

The following analysis disaggregates the household budget shares by geographical location and by quintiles. It is clear from *Table 4.1* that the average results obscure important spatial, temporal and income-distribution differences. In rural areas (*Table 4.2)*, the five food items claiming the highest budget shares in 2006 were diverse. In descending order, these included: cereal (maize grain), fat (cooking oil), protein (chicken and bream fish) and sugar. In 2010 however, the top five consumption shares were less diverse as the list contained more calorie-rich foods (maize grain, cassava flour and hammermill maize flour/ pounded maize) and only 1 animal-source protein (chicken). The fifth item on the list was vegetables.

Another observation in rural areas is that the share of the budget that households devoted to cereal products remained relatively unchanged between 2006 and 2010. This could be a result of households already consuming primarily less expensive staples in the pre-crisis period. The same is true for animal source foods such as beef. This finding is similar to that of Jensen and Miller (2008) in China where the poor were already consuming the cheapest variety of grains leaving them with little room to substitute in an effort to mitigate the nutritional impacts of price changes. The share of the household budget allocated towards chicken, bream fish and kapenta was however significantly lower in 2010 relative to 2006 for the Zambian case.

In urban areas, the top five commodities in 2006 were refined maize flour, chicken and beef (protein), bread (carbohydrate), cooking oil (fat) and vegetables. When comparing consumption levels between 2006 and 2010 in urban areas, less-refined maize flour displaced refined maize flour among the five commodities claiming the highest shares in 2010. In percentage terms, refined maize flour declined by about 7 percentage points (9.4 to 2.2 percentage points) during the reference years. On the other hand, household food budgets devoted towards less-refined maize flour increased from 3 to 8 percentage points. In 2010, the refined maize flour was displaced by less-refined maize flour in the top five list. Furthermore, while households maintained the budget share devoted to chicken and bream fish, the budget share towards beef declined. These results suggest that in 2010, urban households substituted the more expensive cereals (refined maize flour) by cheaper cereals (less-refined maize flour) but maintained the consumption of some protein-rich foods such as bream fish and kapenta.

Given the mixed results evidenced in this chapter, we were unable to confirm the hypothesis that households, particularly those in urban areas, will respond to higher food prices by reducing consumption of protein as they substitute animal-source protein for energy-rich foods such as maize. The results suggest that there was a more evident decline in animal-source foods in rural households than there was in urban areas. Within the maize group however, there was a stronger budget share adjustment in urban areas.

Table 4.2: Consumption share by region and year

Commodity	Rural			Urban		
	2006	**2010**	**Difference**	**2006**	**2010**	**Difference**
Maize grain	0.152(0.187)	0.164(0.190)	-0.012***	0.031(0.087)	0.049(0.099)	-0.018***
Refined maize flour	0.011(0.067)	0.022(0.084)	-0.011***	0.094(0.136)	0.022(0.072)	0.072***
Less-refined maize flour	0.011(0.069)	0.018(0.066)	-0.008***	0.031(0.104)	0.082(0.102)	-0.052***
Hammermill maize flour	0.021(0.090)	0.044(0.110)	-0.023***	0.011(0.067)	0.012(0.050)	-0.001*
Rice	0.026(0.057	0.016(0.015)	0.009***	0.035(0.042)	0.040(0.058)	-0.001
Cassava	0.062(0.139)	0.078(0.161)	-0.016***	0.009(0.049)	0.013(0.060)	-0.004***
Millet	0.010(0.054)	0.010(0.050)	-0.000	0.001(0.012)	0.001(0.016)	-0.000**
Sorghum	0.006(0.047)	0.004(0.036)	0.002***	0.001(0.015)	0.001(0.010)	0.001***
Bread	0.030(0.054)	0.031(0.062)	-0.001	0.073(0.073)	0.078(0.083)	-0.005***
Sweet Potatoes	0.003(0.021)	0.012(0.042)	-0.009***	0.002(0.011)	0.010(0.029)	-0.009***
Irish Potatoes	0.004(0.020)	0.004(0.020)	0.000	0.016(0.026)	0.013(0.031)	0.003***
Chicken	0.080(0.104)	0.050(0.086)	0.030***	0.080(0.070)	0.076(0.084)	0.004***
Other poultry	0.002(0.016)	0.001(0.013)	0.001***	0.001(0.012)	0.002(0.001)	-0.001
Beef	0.025(0.061)	0.016(0.053)	0.009***	0.060(0.064)	0.045(0.065)	0.015***
Pork	0.015(0.054)	0.007(0.033)	0.008***	0.010(0.030)	0.009(0.029)	0.001***
Goat meat	0.019(0.058)	0.012(0.048)	0.007***	0.008(0.027)	0.007(0.030)	0.000
Mutton	0.001(0.016)	0.001(0.010)	0.000	0.000(0.007)	0.000(0.009)	-0.000
Game meat	0.011(0.047)	0.008(0.040)	0.003	0.006(0.026)	0.006(0.028)	0.000
Bream fish	0.078(0.104)	0.029(0.066)	0.049***	0.058(0.061)	0.058(0.070)	0.000
Kapenta	0.059(0.075)	0.034(0.059)	0.024***	0.048(0.050)	0.042(0.053)	0.006***
Vegetables	0.032(0.059)	0.132(0.121)	-0.100***	0.061(0.060)	0.080(0.074)	-0.020***
Beans	0.035(0.057)	0.029(0.054)	0.006***	0.035(0.037)	0.033(0.044)	0.002***
Onion	0.012(0.025)	0.012(0.022)	-0.000	0.022(0.024)	0.023(0.027)	-0.001
Tomatoes	0.033(0.046)	0.025(0.037)	0.008***	0.047(0.041)	0.039(0.035)	0.008***
Eggs	0.010(0.028)	0.010(0.029)	-0.001	0.027(0.032)	0.027(0.038)	0.001
Cooking Oil	0.085(0.088)	0.044(0.050)	0.042***	0.071(0.053)	0.050(0.046)	0.021***
Groundnuts	0.027(0.061)	0.017(0.044)	0.010***	0.014(0.033)	0.013(0.028)	0.002***
Butter	0.002(0.011)	0.001(0.008)	0.001***	0.011(0.018)	0.009(0.021)	0.002***
Sugar	0.067(0.073)	0.042(0.059)	0.025***	0.057(0.047)	0.048(0.044)	0.009***
Honey	0.003(0.028)	0.001(0.016)	0.002***	0.001(0.010)	0.001(0.013)	0.000***
Tea/ coffee	0.004(0.014)	0.003(0.011)	0.001***	0.012(0.018)	0.009(0.021)	0.003***
Fresh milk	0.011(0.034)	0.011(0.035)	0.000	0.021(0.036)	0.018(0.036)	0.003***
Powdered milk	0.001(0.010)	0.001(0.010)	0.000	0.004(0.016)	0.003(0.015)	0.001***
Salt	0.044(0.072)	0.017(0.032)	0.028***	0.014(0.024)	0.010(0.023)	0.004***
Fruits	0.002(0.013)	0.027(0.055)	-0.025***	0.010(0.022)	0.032(0.044)	-0.022***
Non-alcoholic drink	0.008(0.029)	0.012(0.042)	-0.005***	0.017(0.033)	0.005(0.020)	0.012***
Total	1.00	1.00		1.00	1.00	

Source of Data: Estimated from LCMS raw data

*Notes: Standard deviations in parenthesis. Significance of the difference in means based on a t-test for continuous variables. ***p<0.01, **p<0.05, *p<0.1*

These quantitative findings further confirm the evidence from the household interviews conducted by IDS and Oxfam (field interview, IDS/ Oxfam project, 2008

- 2009). Respondents in both the rural (Chikwanda) and urban (Kabwata) sites of Zambia reported that they had reduced the quality and diversity of food consumed. In the rural site, when asked about some of their coping strategies in relation to high food prices, respondents revealed that some households substituted the more expensive, bream fish and Kapenta, for beans. During focus group discussions in the urban site, participants indicated that they normally have 2 to 3 meals a day. According to the participants, these meals primarily consist of the staple food *nshima* and relish such as vegetables (field interview, IDS/ Oxfam project, 2008).

In an interview, the Chief of Chikwanda community observed that availability of food was a major challenge in general but that community members also relied on wild foods. He further observed that the households' reliance on wild foods was more important than usual for the reference period (2008-2009). An illustration of household consumption pattern could be further highlighted through the story of Mrs. M, a widow with 4 children. In a day, Mrs. M has 1 to 2 meals. Breakfast and lunch are often skipped or eaten alternately. Her household members usually eat nshima (made from maize flour), vegetables, beans or Kapenta. On rare occasions she would eat rice with beef (field interview, IDS/ Oxfam project, 2009).

Similarly, using the IDS/ Oxfam qualitative data for six countries[50], Hossain and McGregor (2011) found that household responses to the food price shock included spending a larger share on food; changing food shopping habits by buying smaller quantities more often and from cheaper sources; and a reduction in the quality and diversity of food. These choices have significant bearing on the nutrition status of a household. Campbell, et al., (2010) suggest that because dietary diversity and animal-source foods are recognised as key components of high quality diets, rising food prices can lead to a reduction in the quality of the diet. The authors further argue that reduced quality of the diet would in turn adversely affect both nutrition and health over time.

[50] These six countries are: Bangladesh, Indonesia, Jamaica, Kenya Yemen and Zambia.

4.2.2. Evolution of consumption shares by quintiles

We further divided the consumption shares into quintiles to assess the variation across household income. *Tables 4.3* and *4.4* compare the commodity consumption shares for rural and urban areas in 2006 and 2010 respectively. For purposes of presentation and argument, only two quintiles are represented per region (the richest 20 per cent and the poorest 20 per cent).

It is interesting to note that the households in the highest quintile in rural areas in both 2006 and 2010 devote a higher budget share towards products that are typically consumed in urban areas such as bread and rice. Indeed, four of the five top commodities among the richest households in rural and urban areas in 2006 are the same (bream fish, refined maize flour, chicken and beef). This suggests that in a normal period (non-price peak), the wealthiest households in rural areas have similar standards of living to households in urban areas.

The results in *Table 4.4* show that in 2010 in rural areas, beef and rice featured among the commodities that claimed higher consumption shares in the highest quintile but not the lowest quintile. For the poorer households, this finding confirms the earlier suggestion that they were already consuming less expensive staples. One inconsistent factor here is that poorer households allocate some of their household budget (3 per cent) towards the more expensive and refined maize flour. Instead, households in the top quintile devoted hardly any of the income towards refined maize flour.

Even among top commodities that featured in both quintiles, the shares varied. In the 2006 rural category, a significant difference is notable in maize grain (20.6 and 4.9 per cent for the lowest and highest quintile respectively). Similarly, poorer households spent a higher portion of their budget on cassava, hammermill flour (a cheaper source of maize flour) and vegetables. To the contrary, richer households spent less of their total budget on cereals and instead reallocated their budget share to other commodities such as animal-source proteins (for example 6.2 per cent towards beef in comparison to only 1.8 per cent among poorer households). Therefore, among the households in the sample, there is a tendency for poorer households to maintain consumption of calorie-rich foods and spend less on animal-source proteins.

Food consumption patterns vary even more starkly in urban areas. The results in *Table 4.3* reveal that in 2006, the poorest households allocated a higher percentage of their budget towards the staple crop, maize grain, while the richer households spent a higher budget share on the more expensive starchy foods such as rice and refined maize flour. The variation in consumption patterns is further demonstrated for animal-source proteins. While the richer households devoted 8 per cent of their food budget share towards beef, poorer households only allocated 1 per cent. In relation to chicken, richer households allocated a much higher budget share (9 per cent) in comparison to only 2 per cent among poorer households. Instead, the poorer households allocated about 7 per cent each towards bream fish and kapenta. In 2010 (*Table 4.4*), the pattern of allocation of the budget share towards animal-source proteins is similar to 2006. The variation is observed in the allocation towards maize products where richer households allocate more towards less-refined maize flour relative to poorer households.

In general therefore, this finding supports the earlier suggestion that in the face of a spike in food prices, richer households in urban areas actually only substitute to cheaper cereals but maintain consumption of proteins. On the other hand, poorer households still allocate a low share of their food budget towards animal-source proteins. This is a more nuanced finding than the hypothesis that the wellbeing of urban households would in general decline while those in rural areas would rise. Furthermore, given the budget shares and price observations in Zambia, the expectation is that a rise in the price of vegetables, kapenta, beans and cooking oil would have the biggest impact on nutrition outcomes in the country. This assertion will be tested in *chapter 6*.

Another striking factor is that commodities such as kapenta, cooking oil and vegetables that faced the highest price spike were more intensively consumed by the less well off before the crisis (2006). This is particularly so in urban areas. For example, poorer households in urban areas devoted about 7 per cent of their food budget towards kapenta in comparison to only 3 per cent among the richer households. This finding suggests that the poorer households in urban areas would be worse off by virtue of them consuming commodities that faced the largest price increases.

Table 4.3: 2006 consumption shares by quintile

Commodity	2006 Rural			2006 Urban		
	Lowest Quintile	Highest Quintile	Difference	Lowest Quintile	Highest Quintile	Difference
Maize grain	0.206(0.237)	0.049(0.093)	0.157***	0.159(0.240)	0.009(0.039)	0.151***
Refined maize flour	0.003(0.051)	0.065(0.154)	-0.062***	0.041(0.169)	0.115(0.153)	-0.074***
Less-refined maize flour	0.004(0.055)	0.019(0.099)	-0.014***	0.047(0.171)	0.019(0.096)	0.028***
Hammermill maize flour	0.019(0.089)	0.022(0.111)	-0.003	0.034(0.133)	0.006(0.053)	0.028***
Rice	0.017(0.060)	0.044(0.056)	-0.027***	0.017(0.060)	0.044(0.056)	-0.027***
Cassava	0.088(0.175)	0.022(0.104)	0.066***	0.050(0.160)	0.003(0.014)	0.047***
Millet	0.011(0.063)	0.004(0.038)	0.007***	0.003(0.045)	0.00(0.006)	0.002
Sorghum	0.008(0.062)	0.001(0.006)	0.008***	0.007(0.051)	0.001(0.007)	0.007***
Bread	0.017(0.048)	0.061(0.058)	-0.044***	0.021(0.072)	0.089(0.074)	-0.069***
Sweet Potatoes	0.002(0.014)	0.005(0.027)	-0.003***	0.001(0.016)	0.002(0.009)	-0.000
Irish Potatoes	0.001(0.015)	0.018(0.038)	-0.017***	0.002(0.013)	0.021(0.027)	-0.020***
Chicken	0.077(0.133)	0.06(0.056)	0.015***	0.022(0.074)	0.093(0.064)	-0.070***
Other poultry	0.001(0.014)	0.004(0.027)	-0.003**	0.000(0.005)	0.002(0.012)	-0.001***
Beef	0.018(0.066)	0.062(0.066)	-0.045***	0.009(0.040)	0.082(0.067)	-0.073***
Pork	0.014(0.052)	0.016(0.061)	-0.002	0.012(0.047)	0.009(0.026)	0.003
Goat meat	0.011(0.049)	0.026(0.066)	-0.014***	0.005(0.027)	0.008(0.027)	-0.003**
Mutton	0.000(0.008)	0.003(0.031)	-0.002	0.000(0.000)	0.001(0.010)	-0.001***
Game meat	0.008(0.049)	0.015(0.047)	-0.006***	0.002(0.020)	0.009(0.030)	-0.007***
Bream fish	0.075(0.122)	0.071(0.087)	0.003	0.065(0.107)	0.056(0.052)	0.009*
Kapenta	0.054(0.088)	0.049(0.064)	0.005*	0.068(0.096)	0.034(0.037)	0.033***
Vegetables	0.029(0.070)	0.028(0.032)	0.001	0.072(0.121)	0.046(0.041)	0.026***
Beans	0.032(0.068)	0.027(0.029)	0.004**	0.043(0.074)	0.026(0.023)	0.017***
Onion	0.008(0.025)	0.017(0.026)	-0.010***	0.017(0.036)	0.020(0.019)	-0.003*
Tomatoes	0.028(0.052)	0.032(0.036)	-0.004**	0.049(0.081)	0.037(0.028)	0.012***
Eggs	0.004(0.023)	0.026(0.028)	-0.022***	0.007(0.004)	0.031(0.030)	-0.025***
Cooking Oil	0.087(0.113)	0.063(0.056)	0.024***	0.107(0.119)	0.051(0.031)	0.056***
Groundnuts	0.025(0.069)	0.017(0.038)	0.009***	0.013(0.039)	0.012(0.027)	0.001
Butter	0.000(0.003)	0.015(0.019)	-0.015***	0.000(0.003)	0.018(0.019)	-0.018***
Sugar	0.064(0.091)	0.058(0.003)	0.007**	0.067(0.096)	0.049(0.038)	0.018***
Honey	0.003(0.029)	0.004(0.033)	-0.001	0.000(0.000)	0.002(0.009)	-0.002***
Tea/ coffee	0.001(0.008)	0.016(0.023)	-0.015***	0.003(0.015)	0.016(0.020)	-0.013***
Fresh milk	0.008(0.033)	0.025(0.045)	-0.017***	0.004(0.021)	0.033(0.040)	-0.029***
Powdered milk	0.000(0.007)	0.010(0.029)	-0.010***	0.000(0.000)	0.007(0.019)	-0.007***
Salt	0.072(0.104)	0.012(0.018)	0.060***	0.048(0.084)	0.008(0.011)	0.040***
Fruits	0.001(0.011)	0.010(0.023)	-0.010***	0.001(0.007)	0.017(0.026)	-0.016***
Non-alcoholic drink	0.004(0.027)	0.024(0.035)	-0.019***	0.006(0.058)	0.028(0.036)	-0.022***
Total	1.00	1.00		1.00	1.00	

Source of Data: Estimated from LCMS raw data

*Notes: Standard deviations in parenthesis. Significance of the difference in means based on a t-test for continuous variables. ***p<0.01, **p<0.05, *p<0.1*

Table 4.4: 2010 consumption shares by quintile

Commodity	2010 Rural			2010 Urban		
	Lowest Quintile	Highest Quintile	Difference	Lowest Quintile	Highest Quintile	Difference
Maize grain	0.193(0.223)	0.117(0.166)	0.076***	0.108(0.166)	0.026(0.066)	0.082***
Refined maize flour	0.030(0.113)	0.008(0.040)	0.022***	0.064(0.146)	0.006(0.028)	0.058***
Less-refined maize flour	0.010(0.065)	0.027(0.066)	-0.017***	0.079(0.161)	0.068(0.074)	0.011***
Hammermill maize flour	0.064(0.146)	0.025(0.073)	0.040***	0.034(0.090)	0.004(0.021)	0.030***
Rice	0.005(0.027)	0.041(0.078)	-0.037***	0.005(0.027)	0.041(0.078)	-0.037***
Cassava	0.087(0.176)	0.044(0.137)	0.043***	0.031(0.102)	0.005(0.026)	0.026***
Millet	0.013(0.058)	0.004(0.031)	0.009***	0.002(0.017)	0.001(0.019)	0.001
Sorghum	0.005(0.047)	0.002(0.012)	0.003***	0.001(0.019)	0.000(0.005)	0.001
Bread	0.015(0.043)	0.060(0.10)	-0.045***	0.043(0.073)	0.087(0.085)	-0.044***
Sweet Potatoes	0.008(0.037)	0.012(0.054)	-0.004**	0.011(0.032)	0.008(0.029)	0.002***
Irish Potatoes	0.001(0.011)	0.010(0.027)	-0.009***	0.003(0.019)	0.020(0.036)	-0.017***
Chicken	0.035(0.093)	0.061(0.079)	-0.026***	0.021(0.072)	0.101(0.081)	-0.080***
Other poultry	0.000(0.010)	0.001(0.011)	-0.001***	0.001(0.018)	0.002(0.016)	-0.001**
Beef	0.008(0.038)	0.043(0.096)	-0.035***	0.014(0.048)	0.069(0.075)	-0.055***
Pork	0.007(0.037)	0.009(0.044)	-0.002	0.008(0.034)	0.010(0.030)	-0.002**
Goat meat	0.007(0.036)	0.020(0.066)	0.013***	0.005(0.026)	0.009(0.037)	-0.008***
Mutton	0.000(0.006)	0.002(0.020)	-0.002*	0.001(0.014)	0.001(0.009)	-0.000
Game meat	0.007(0.044)	0.007(0.029)	0.000	0.002(0.019)	0.008(0.031)	-0.007***
Bream fish	0.024(0.067)	0.044(0.072)	-0.020***	0.029(0.069)	0.074(0.073)	-0.046***
Kapenta	0.028(0.058)	0.039(0.071)	-0.011***	0.043(0.060)	0.038(0.053)	0.005***
Vegetables	0.168(0.141)	0.078(0.096)	0.090***	0.135(0.114)	0.057(0.055)	0.078***
Beans	0.025(0.056)	0.031(0.060)	-0.007***	0.032(0.054)	0.027(0.035)	0.005***
Onion	0.011(0.024)	0.014(0.028)	-0.004***	0.024(0.037)	0.020(0.030)	0.005***
Tomatoes	0.025(0.046)	0.023(0.034)	0.002	0.049(0.050)	0.030(0.030)	0.019***
Eggs	0.005(0.024)	0.019(0.034)	-0.014***	0.014(0.040)	0.030(0.035)	-0.015***
Cooking Oil	0.046(0.061)	0.038(0.050)	0.008***	0.069(0.072)	0.039(0.039)	0.030***
Groundnuts	0.012(0.040)	0.018(0.037)	-0.007***	0.009(0.030)	0.012(0.024)	-0.030***
Butter	0.000(0.004)	0.006(0.013)	-0.005***	0.001(0.011)	0.014(0.027)	-0.013***
Sugar	0.042(0.069)	0.040(0.046)	0.002	0.061(0.063)	0.041(0.039)	0.020***
Honey	0.001(0.010)	0.002(0.013)	-0.001***	0.000(0.001)	0.002(0.020)	-0.002***
Tea/ coffee	0.002(0.013)	0.005(0.010)	-0.003***	0.005(0.015)	0.009(0.030)	-0.004***
Fresh milk	0.007(0.032)	0.019(0.045)	-0.012***	0.005(0.027)	0.026(0.045)	-0.021***
Powdered milk	0.000(0.004)	0.006(0.019)	-0.006***	0.000(0.003)	0.005(0.018)	-0.005***
Salt	0.025(0.040)	0.010(0.051)	0.015***	0.021(0.039)	0.006(0.027)	0.015***
Fruits	0.021(0.056)	0.035(0.066)	-0.014***	0.024(0.051)	0.039(0.044)	-0.015***
Non alcoholic drink	0.013(0.049)	0.015(0.061)	-0.002	0.007(0.029)	0.004(0.020)	0.003***
Total	1.00	1.00		1.00	1.00	

Source of Data: Estimated from LCMS raw data

*Notes: Standard deviations in parenthesis. Significance of the difference in means based on a t-test for continuous variables. ***p<0.01, **p<0.05, *p<0.1*

4.3. Price adjustments

In order to conduct meaningful household welfare analysis, it is important to make prices comparable across time (temporal differentiation) and space (spatial differentiation). A price index helps achieve this purpose. The price indexes are also very relevant for the estimation of poverty. As suggested by Coudouel, Hentschel and Wodon (2002), ignoring the regional and inter-temporal corrections can lead to important distortions of poverty measurement. In the context of this research, this exercise will also help us understand the districts that were most affected by high prices. There are two ways of obtaining a price index in the context of this research. The first is to use the official consumer price index estimated by the governments' Central Statistical Office (CSO). The second is to estimate the index using the LCMS household data.

For the period under review (2006 to 2010), the CSO was using an old index, derived from the 1993/94 Household Budget Survey. As such, it was not representative of current household consumption patterns. As recognised by members of the CSO, comparing current prices with that of almost two decades ago has negative implications on the calculation of the Index (Government of the Republic of Zambia, 2011f).

Furthermore, given the price spike in 2007/8 and the evidence in the previous section, patterns of household food consumption changed after the crisis. It was therefore imperative to estimate a new price index using revised weights. In this context, we estimated the price index using more recent household surveys (2006 and 2010). This was done by using updated weights from the shares calculated in *section 4.2*. Furthermore, we aggregated the index calculations at district level unlike the CSO that estimates the inflation at national level only.

There are different types of price indexes that make temporal and spatial adjustments of prices. In this research, three indexes are initially considered, the Laspeyres, Paasche and Fisher Indexes (see for example, Deaton and Tarozzi 2000). The Laspeyres index is the most commonly used index. It measures the changes in the cost of a fixed basket of goods from a base period. It therefore uses the base period budget shares as weights and is estimated as:

$$L_{dt} = \sum_{i=1}^{n} W_{di2006} \left(\frac{P_{dit}}{P_{ni2006}}\right), \qquad \text{(ii)}$$

where W_{di2006} is the average household budget share of the total food consumption at district level devoted to the food commodity i in the base year (in this case, 2006). P_{dit} is the price of food item i for district d in period t (2006). P_{ni} is the national average price of food item i. To construct the index, the district commodity price in

2006 is divided by the national commodity price in the same year. This is then multiplied by the 2006 budget share of each commodity at district level. To calculate the index, we compute district level shares (w_{di}) by taking the average household shares estimated through equation (i)[51]. These household budget shares are therefore taken as the weighted average of the comparable budget shares across all households in the district and period under consideration.

As the Laspeyres index measures the cost of a fixed basket of goods by using base period budget shares as weights, it assumes no substitution due to relative price changes and usually overestimates the "true" cost-of-living index (Boskin et al., 1998; p. 7-8). Therefore, we also estimate the Paasche Index. The Paasche index is at the other end of the spectrum from Laspeyres as it weights by current consumption pattern. That is, it uses the budget shares for the current period as weights (in this case, 2010). This likely overstates substitution and understates the change in cost-of-living index relative to an earlier base period *(ibid)*. The Paasche index is estimated as follows:

$$P_{dt}^{P} = \sum_{i=1}^{n} W_{di2010} \left(\frac{P_{dit}}{P_{ni2006}} \right), \tag{iii}$$

where W_{di} is the average budget share for a particular food commodity for households in each district in the specified year. For this research, we aggregate the index at district level where the price of food item i in district d in the base year is denoted in the equation by P_{dit}. t denotes the period (either 2006 or 2010 for this research). The variable P_{nit} is the national average price of the food item in the base year. Deaton and Tarozzi (2000; p.6) argue that "neither Laspeyres nor Paasche indexes do an adequate job of capturing consumer substitution, that when faced with differences in relative prices, consumers are likely to adjust their consumption patterns towards relatively cheap goods, and away from relatively more expensive ones".

[51] This is done using a collapse command in stata.

To address the under and over-estimation of substitution by the Laspeyres and Paasche indexes, we also estimate a third index called the Fisher Ideal Index. This index tries to overcome the weaknesses of the other two indexes by taking the square root of the product of the Laspeyres and Paasche indexes. The Fisher Index is therefore the geometric mean of the Laspeyres and Paasche indexes (Fisher, 1922). Deaton and Tarozzi (2000; p.16) noted that the Fisher Ideal Index does a better job than the Laspeyres and Paasche indexes in reflecting substitution. Another advantage noted by these authors is that the Fisher Index uses budget shares from initial and terminal periods, rather than just one of the periods.

The following is the equation for the Fisher Index:

$$F_{dt} = \sqrt{L_{dt} P_{dt}^{P}} \tag{iv}$$

Since 2012, the CSO revised their methodology by adopting the Fisher index to calculate the national level index (Central Statistics Office, 2011). The new consumption weights were calculated from the 2002/03 LCMS. In addition, the CSO will be publishing provincial level rates of inflation in the second quarter of each year (Government of the Republic of Zambia, 2012). While this is a step in the right direction, it would be better to have the indexes estimated at a smaller geographical unit, for example, district-level rather than provincial[52].

As stated above, in this research, we use the calculation of the price index made here as the CSO's most recent updates do not cover the period of interest (2006 and 2010). Furthermore, calculating the index from the 2006 and 2010 LCMS ensures the use of updated household consumption data. This is imperative due to the price shock experienced in 2007/8. Perhaps more importantly, the governments' Consumer Price Index (CPI) reflected the national level price adjustments. Conversely, we estimate the index for this research at district level, which is a

[52] In this analysis, we estimate price indexes for the 41 districts where price data exists.

smaller geographical unit than a province. By virtue of using different budget shares and estimating indexes for different geographical units, the indexes calculated for this research are not comparable to the governments' indexes.

Another reason why these indexes have to be understood in the context of this research alone is that, as mentioned in *chapter 3*, the process for selecting the food items used to calculate the price indexes involved making the food items consistent across the 2006 and 2010 survey rounds. Some commodities from the 2010 list were excluded due to lack of price information. As prices are from an external source (CSO monthly price data), we only included those food items with price observations. The final list shown in *Table 4.5* features 29 food items. Furthermore, five non-food commodities (charcoal, water, candles, electricity and paraffin) were also included in the estimation due to their importance in the preparation of food.

On the other hand, the estimates exclude the majority of the non-food costs, some of which are important costs such as housing and transportation. Considering that the excluded non-food items such as housing and transport are costly and therefore important to household budgets, particularly in urban areas, the rate of inflation in this research is likely to be understated. A similar decision was made by Deaton and Tarozzi (2000) where up to a third of the budget were excluded, including housing and transportation. In the case of D'souza and Jolliffe (2013), only kerosene was included in their analysis. Attanasio et al., (2013) constructed a price index using only food prices of the eight individual elementary food items including rice, fruits and vegetables, pulses, etc.

According to the annual inflation estimates by the government, the food component showed more volatility than the non-food component, which was relatively stable between January 2008 and December 2010 (see Government of the Republic of Zambia, 2010a for specific figures)[53].

[53] Also visible in *figure 1.3*.

Table 4.5: List of commodities used to calculate the indexes

Maize grain	Fruits	Groundnuts
Refined maize flour	Kapenta (small dried fish)	Cooking Oil
Less-refined maize flour	Bream fish (tilapia)	Vegetables
Millet	Chicken	Tomatoes
Sorghum	Beef	Onions
Rice	Pork	Salt
Bread/ Bread rolls	Beans	Water
Sweet potatoes	Sugar	Electricity
Irish potatoes	Eggs	Charcoal
Cassava	Butter	Paraffin
Milk (fresh)	Tea leaves/ tea bags	Candles
Milk (powdered excluding baby milk)		

Source of Data: LCMS raw data

4.3.1. Price index estimates

This section provides a series of measures of price changes based on the price index theory *section (4.3)*, which highlights the differences among the three indexes. Note also that unlike a standard Consumer Price Index, which estimates the variation in prices over time (temporal variations), the present research extends the CPI definition to also reflect the variation in prices across the districts (spatial variations). The extended CPI definition provides a more accurate understanding of welfare effects, which may be different across time and space in a developing and heterogeneous country like Zambia.

Table 4.6 presents the results for the three indexes (Laspeyres, Paasche and Fisher). The results confirm the theory that Laspeyres estimates are the upper bound, Paasche estimates are the lower bound and the Fisher index provides a mid-range estimate. For both 2006 and 2010, the Fisher index consistently lies between the Laspeyres and Paasche indexes. Further interpretations of the price adjustments in this research will therefore be based on the Fisher index only (*Table 4.7*).

Table 4.6: Indexes by district

District	Province	Paasche		Laspeyres		Fisher	
		2006	**2010**	**2006**	**2010**	**2006**	**2010**
Chibombo	Central	0.749	1.204	0.831	1.321	0.789	1.261
Kabwe	Central	0.741	1.177	0.760	1.230	0.750	1.203
Mkushi	Central	0.807	1.353	0.861	1.422	0.834	1.387
Mumbwa	Central	0.771	1.194	0.786	1.218	0.778	1.206
Serenje	Central	0.712	1.183	0.797	1.414	0.753	1.294
Chingola	Copperbelt	0.838	1.295	0.895	1.421	0.867	1.356
Kalulushi	Copperbelt	0.742	1.226	0.783	1.299	0.763	1.262
Kitwe	Copperbelt	0.772	1.113	0.824	1.197	0.797	1.154
Luanshya	Copperbelt	0.707	1.216	0.711	1.151	0.709	1.183
Mpongwe	Copperbelt	0.857	1.367	0.921	1.441	0.889	1.403
Mufulira	Copperbelt	0.728	1.177	0.787	1.256	0.757	1.216
Ndola	Copperbelt	0.844	1.328	0.823	1.312	0.833	1.320
Chadiza	Eastern	0.813	1.406	0.751	1.285	0.781	1.344
Chipata	Eastern	0.793	1.221	0.794	1.260	0.794	1.241
Katete	Eastern	0.722	1.097	0.772	1.214	0.747	1.154
Lundazi	Eastern	0.842	1.141	0.883	1.280	0.862	1.209
Petauke	Eastern	0.757	1.182	0.769	1.297	0.763	1.238
Kawambwa	Luapula	0.754	1.118	0.785	1.166	0.769	1.142
Mansa	Luapula	0.710	1.167	0.795	1.285	0.751	1.225
Mwense	Luapula	0.646	0.934	0.741	1.135	0.692	1.030
Nchelenge	Luapula	0.745	0.933	0.802	1.108	0.773	1.017
Samfya	Luapula	0.709	1.232	0.757	1.250	0.733	1.241
Chongwe	Lusaka	0.923	1.280	0.938	1.329	0.931	1.304
Luangwa	Lusaka	0.890	1.426	0.952	1.623	0.920	1.521
Lusaka	Lusaka	0.857	1.420	0.874	1.456	0.865	1.438
Isoka	Northern	0.664	1.121	0.721	1.243	0.692	1.180
Kasama	Northern	0.711	1.103	0.757	1.213	0.734	1.157
Luwingu	Northern	0.756	1.455	0.853	1.387	0.803	1.420
Mbala	Northern	0.773	1.116	0.853	1.266	0.812	1.189
Mpika	Northern	0.716	1.141	0.786	1.273	0.750	1.205
Kasempa	North Western	0.913	1.417	0.872	1.311	0.892	1.363
Mwinilunga	North Western	0.850	1.208	0.821	1.311	0.835	1.258
Solwezi	North Western	0.876	1.371	0.849	1.331	0.862	1.351
Choma	Southern	0.847	1.274	0.794	1.226	0.820	1.249
Kalomo	Southern	0.737	1.280	0.790	1.392	0.763	1.335
Livingstone	Southern	0.836	1.326	0.846	1.313	0.841	1.319
Mazabuka	Southern	0.799	1.266	0.843	1.287	0.821	1.277
Monze	Southern	0.793	1.366	0.814	1.361	0.803	1.363
Kaoma	Western	0.894	1.285	0.973	1.376	0.933	1.330
Mongu	Western	0.884	1.086	0.815	1.123	0.849	1.104
Senanga	Western	0.866	1.349	0.812	1.316	0.839	1.332

Source of Data: Estimated from LCMS raw data

In relation to *Table 4.7*, the most expensive districts in 2006 were Luangwa and Chongwe in Lusaka province and Kaoma in Western province. In 2010 however, the districts with the highest prices were Lusaka city and Luangwa in Lusaka province, Mpongwe on the Copperbelt province and Luwingu in Northern province. By implication, households in these areas are expected to experience the highest welfare loss due to the steep increase in prices. However, the effect will also depend on the households' net selling position. The lowest prices post 2007/8 food crisis were observed in Mongu district (Western province) and Nchelenge and Mwense districts in Luapula province.

In general, *Table 4.7* shows that prices rose in all districts in 2010 relative to 2006. The results in column 5 show that the price increase was uneven ranging from 30.12 per cent in Mongu district (Western province) to 76.88 per cent in Luwingu (Northern province). As suggested by Deaton (1997; p.283), in developing countries, markets are not always well integrated. Similarly, the finding in this research resonates with that of the FAO during the assessment of the 2007/2008 food price swing in Eastern and Southern Africa, which found that it took between 3.1 and 8.3 months before prices fully adjusted to the South African market (see discussion in *section 1.3*). Furthermore, Ferreira, et al., (2013) observed that spatial heterogeneity in infrastructure, transport costs, and market structures within countries often causes non-trivial regional differences in prices, even inside a given country. The results also show that for the majority of the districts, the inflation levels were between 50 and 76 per cent.

A second observation is that, aside from Monze and Kalomo, which are along the line of rail, the districts that faced an inflation of about 70 per cent were relatively more remote. This result may be as a result of the added transport costs being passed on to consumers. The result also suggests that increases in food prices were highest in places that are not typically considered to be high cost towns, such as the 4 major cities of Zambia. Among the cities, Lusaka had the highest price inflation (66 per cent) followed by Ndola (Copperbelt province) at 58 per cent, Livingstone in Southern province (57 per cent) and finally Kitwe (Copperbelt province) at 47 per cent. In general, districts in Western province had the lowest rise in inflation.

The possible reasons for these observations are varied. First, for some districts such as Lusaka city, the high prices are a result of limited agriculture production (see *Table 2.1* in *chapter 2*). For others such as Mpongwe, Chongwe and Luangwa, proximity to big cities could be a factor. Also, as suggested above, other districts are remote hence, the cost of transport is passed on to consumers, for example, Luwingu. In a focus group discussion with the market executive committee in Chikwanda area (Mpika district), the participants attributed the rise in food prices to higher transport costs. The narration was as follows: "*The rise in food prices, in particular, fish and Kapenta, has been due to the high transport costs. From Nakonde (a fish and Kapenta harbour in the Northern province), the cost of transport a year ago was between K100,000 and K120,000 but transport costs currently range between K150,000 to K180,000 depending on the form of transport used"* (field interview, IDS/ Oxfam project, 2011).

Table 4.7: Fisher index results

District	Province	Fisher		Inflation (base year=2006)
		2006	2010	
Chibombo	Central	0.789	1.261	159.78
Kabwe	Central	0.750	1.203	160.38
Mkushi	Central	0.834	1.387	166.42
Mumbwa	Central	0.778	1.206	154.91
Serenje	Central	0.753	1.294	171.76
Chingola	Copperbelt	0.867	1.356	156.51
Kalulushi	Copperbelt	0.763	1.262	165.47
Kitwe	Copperbelt	0.797	1.154	144.72
Luanshya	Copperbelt	0.709	1.183	166.92
Mpongwe	Copperbelt	0.889	1.403	157.91
Mufulira	Copperbelt	0.757	1.216	160.58
Ndola	Copperbelt	0.833	1.320	158.39
Chadiza	Eastern	0.781	1.344	171.96
Chipata	Eastern	0.794	1.241	156.31
Katete	Eastern	0.747	1.154	154.55
Lundazi	Eastern	0.862	1.209	140.21
Petauke	Eastern	0.763	1.238	162.24
Kawambwa	Luapula	0.769	1.142	148.40
Mansa	Luapula	0.751	1.225	162.99
Mwense	Luapula	0.692	1.030	148.80
Nchelenge	Luapula	0.773	1.017	131.48
Samfya	Luapula	0.733	1.241	169.39
Chongwe	Lusaka	0.931	1.304	140.12
Luangwa	Lusaka	0.920	1.521	165.31
Lusaka	Lusaka	0.865	1.438	166.16
Isoka	Northern	0.692	1.180	170.56
Kasama	Northern	0.734	1.157	157.65
Luwingu	Northern	0.803	1.420	176.88
Mbala	Northern	0.812	1.189	146.37
Mpika	Northern	0.750	1.205	160.63
Kasempa	North Western	0.892	1.363	152.74
Mwinilunga	North Western	0.835	1.258	150.64
Solwezi	North Western	0.862	1.351	156.62
Choma	Southern	0.820	1.249	152.39
Kalomo	Southern	0.763	1.335	174.94
Livingstone	Southern	0.841	1.319	156.88
Mazabuka	Southern	0.821	1.277	155.55
Monze	Southern	0.803	1.363	169.69
Kaoma	Western	0.933	1.330	142.58
Mongu	Western	0.849	1.104	130.12
Senanga	Western	0.839	1.332	158.82

Source of Data: Estimated from LCMS raw data

The immediate impact of such levels of inflation was ably depicted through the research conducted by IDS and Oxfam (IDS/ Oxfam, 2008 – 2009). Community members in Kabwata, the urban site for the food price volatility project, were asked to illustrate how food prices had changed over the past year. This was demonstrated by collecting food items amounting to K5000[54] and arranging them according to the current prices and then what that same amount could purchase the previous year. The results of this exercise are illustrated in *figure 4.1*.

Figure 4.1: Comparison of prices and food items over a period of one year - urban site

February 2008 February 2009

Source: IDS/ Oxfam (field interview, IDS/ Oxfam project, 2008 – 2009)

The households interviewed in both the rural and urban sites confirmed that the persistent rise in food prices during 2006 and 2010 eroded the purchasing power of households. In *Box 3.1*, a single mother, Ms. K, shows how she is rationing her income in the context of the deteriorating purchasing power owing to the less than proportionate increase in her income. Ms. K supplements her income with regular remittances received from her siblings. Occasionally, she borrows money to meet other personal and household needs.

[54] As at February 2009, an average middle exchange rate of ZM K5000 was equivalent to 1US$.

Box 4.1: **Case study of how a female headed household is rationalising her income**

Ms. K is a 29 year old single mother to a three year old child. She lives alone with her daughter in a two bed-room family house. She works as an administrator in a law firm and her monthly net salary is K800, 000. The following is a list of her monthly expenditure:

Food Item	**Quantity**	**Cost (K)**
Maize flour	1 x 10kg bag	18, 500
Beef	1kg	18,000
Chicken	2	40,000
Eggs	1 unit	6,700
Milk	2 litres	10,100
Juice	2.5 litres	18,000
Beans	1kg	11,400
Kapenta	500 grams	23,500
Vegetables	20 bundles	20,000
Tomatoes	30	16,800
Onion	10	17,600
Cooking Oil	750mls	18,000
Sugar	1kg	5,100
Bread	8 loaves	30,400
Sub-total		**254, 100**
Non food items		
Bathing soap (lifebuoy)	3 tablets	5,400
Laundry soap (boom)	2 x 400 g	8,200
Tissues	4 rolls	20,000
Vaseline	1 x 250mls	4,500
Electricity	250 units	70,000
Water and Sanitation (average cost)		50,000
Sub-total		**158,100**
Some other additional costs		
Health scheme at Kabwata clinic (her and child)		4,000
Nanny wage		180,000
Transport (bus fare round trip)		212,000
Tithe (taken to church)		80,000
sub-total		**476, 000**
Grand Total		**888, 200**

Source: IDS/ Oxfam Food Price Volatility field interviews in Lusaka, February 2009

4.4. Conclusion

This chapter contributes to the understanding of the evolution of food budget shares and price indexes in Zambia. While such estimations are not enough to make claims on the welfare of households, they are a necessary preliminary step for the assessment of the impact of rising food prices on household poverty and nutrition. We did this by examining the change in the share of the household budget allocated to each food commodity in 2006 and 2010. The budget shares were further disaggregated by geographical location and quintile. We also estimated the food price index using the Fisher index.

The results in this chapter show that on average, the household food budget share as a proportion of total consumption increased in 2010 relative to 2006. In general, households spent a higher share of their food budget on cheaper cereals such as less-refined maize flour in 2010 in comparison to 2006. Once disaggregated by geographical area, in urban areas, the reallocation of food consumption in 2010 negatively affected the consumption of refined maize flour and beef. The interpretation of these findings could be that households maintained calorie consumption by reallocating a higher budget share away from the superior and more refined maize flour and towards inferior maize flour. The findings are similar to other authors including Ruel et al., (2010) who argued that households may switch from cheaper and often less preferred quality staples to protect energy intake. Whether the energy intake in Zambia was protected is a discussion that will be returned to in *chapter 6*.

Furthermore, the consumption pattern between the top and bottom quintile varies across regions. In 2006, the poorer households (bottom quintile) in rural areas spent 21 per cent of their food budget on maize grain while the richer households (top quintile) spent only 5 per cent of their food budget on maize grain. On the other hand, the top quintile allocated a higher portion of their food budget share towards animal-source proteins. The quintile-disaggregated results further show that while the changes in budget shares were in the expected direction for rural households (increasing cereals but reducing proteins), this was more nuanced in urban areas.

The richer households in urban areas adjusted the consumption of maize flour by devoting a higher share of their food budget towards less-refined flour while the share towards protein-rich foods was similar to 2006. In some cases, the budget share for animal-source protein foods (bream fish and chicken) increased. For poorer households in urban areas however, the budget share towards protein-dense foods remained low in both years. As suggested by Jensen and Miller (2008), this scenario could occur for poorer households who may already be consuming a cheap diet and therefore, have limited substitution options.

The findings therefore suggest that households in rural Zambia reduced the diversity of food consumed. Richer households in urban areas on the other hand maintained the consumption of protein but reduced the share of the food budget towards refined maize flour while increasing the share of the budget for less-refined maize flour. Furthermore, the evidence in this chapter suggests that when assessing the impact of rising food prices on consumption, it is important to focus on a number of food commodities rather than only focussing on a staple crop.

In relation to the price index, the Fisher index results show that the inflation level was over 50 per cent in the majority of the districts. These results suggest that the effects of rising food prices on household welfare in Zambia are expected to be relatively homogenous across regions.

Chapter 5: Impact of rising food prices on poverty

5.1. Introduction: the distributional effects of price changes

The previous chapters (*1 through 4*) established that food prices in Zambia rose steeply between 2006 and 2010, which subsequently affected household consumption patterns. *Chapter 4* specifically showed that there were changes in consumption patterns across geographical locations and across quintiles. The present chapter mainly relates to the first question of our research where we seek to examine the differentiated impacts of the rising food prices on distribution of income and household poverty[55] in Zambia. The analysis in this chapter will therefore be two-fold. The first part draws upon the literature on net sellers/ net buyers, which we presented in the literature review section. But in a country like Zambia, who are these net buyers and who are the net sellers?

To answer this question, we will draw on, and aim to contribute to, one major strand of literature on who the likely winners and losers from the rise in food prices are. Intuitively, net food sellers are expected to benefit from high food prices while net food buyers would suffer a welfare loss. The expected finding for this question is that poverty among the urban households will increase while the effect among rural households is indeterminate.

In order to estimate the net effects of rising food prices among Zambian households, we will use nonparametric regression techniques initially developed by Deaton (1989). Utilising data from rural Thailand, he estimated the net benefit ratio, which is the value of net sales of a commodity as a proportion of income. The net benefit ratio of a commodity can therefore be interpreted as a "before response" or the effect

[55] According to Deaton (1997; p. 206), "a person is poor when he or she does not have enough to eat, or in more explicitly economic terms, when they do not have enough money to buy food that is required for basic sustenance". Normally, poverty is estimated using poverty lines. In general, there are two types of poverty lines: "extreme" poverty is the inability of a household to meet basic nutritional requirements even if their consumption basket is defined to include food alone; "overall" poverty on the other hand is the inability of an individual/ household to meet non-food needs, while meeting basic minimum food requirements.

in the short term, before producers and consumers respond to a price change (Minot and Goletti, 2000). Deaton did this by conducting a nonparametric regression of the net benefit on the logarithm of household per capita expenditure. He found that while rural households at all levels of income would benefit, the households in the middle of the income distribution would gain the most.

Deaton's NBR methodology has a number of advantages. It does not impose any structure on the data and hence makes full use of the information (Wodon and Zaman, 2009). In other words, it captures the important differences in impact between net buyers and net sellers across the entire income distribution. As suggested by Budd (1993), the manner in which this ratio varies across the income distribution illuminates how a price change affects income across the distribution. It also measures the impact of higher food prices relative to a household's overall consumption level. Furthermore, it recognises the dual role of households as consumers and producers. Deaton further argues that his proposed methodology does justice to the richness of the household survey data and allows convincing demonstration and presentation of results with only a minimum of unnecessary assumptions (Deaton, 1989; p.2). However, Deaton did not distinguish between food production and food sales and between food consumption and food purchases (see *section 2.1.1* for the distinction).

By nature, this methodology estimates first-order approximations or short-term effects and ignores the possibility of consumers shifting their consumption patterns in response to higher prices. Despite these weaknesses, the method helps to better understand the behaviour of households as consumers and producers, particularly those in rural areas. In the context of this chapter, we will provide a graphical depiction of the net effect of rising food prices across the entire income distribution disaggregated by geographical location. We will also attempt to broaden the discussion on net effects by showing the fraction of the net benefit share that is captured by the producers and provide possible reasons driving the difference between net effects calculated using producer prices and those estimated from consumer prices. This will provide an understanding of the share of the price captured by producers.

In the second part of the chapter, we estimate the change in household poverty levels, first, by using the standard first-order approximation to the compensating variation (the amount required to restore a household to the same level of welfare as before the price change) method (see for example Ferreira et al., 2013). We also estimate the second-order effects by allowing for a change in the production supply response. We do this by using secondary data on the elasticity of supply for maize in Zambia, given a rise in commodity prices.

Specifically, the chapter is structured as follows: *section 5.2* describes the empirical methods utilised, the data specific to this chapter and also presents a brief summary of descriptive statistics. *Section 5.3* discusses the results on net buyers and net sellers and the variation in the net benefit ratio between consumer and producer prices. *Section 5.4* assesses the change in poverty estimates (with and without supply elasticity). *Section 5.5* elaborates the robustness of poverty results and section 5.6 concludes.

5.2. Empirical strategy and data

The basic net benefit ratio model used in this chapter and based on Deaton's methodology is as follows:

$$\left(\frac{\mathrm{Pr_{pdi}} \cdot \mathrm{QS_{ih}} - \mathrm{Cr_{pdi}} \cdot \mathrm{QP_{ih}}}{X}\right) \qquad \text{(v)}$$

The equation in brackets is used where $\mathrm{Pr_{pdi}}$ representing the district producer selling price for commodity i is multiplied with the physical amount sold (quantity) from the households' own-produce ($\mathrm{QS_{ih}}$). Conversely, consumer prices at the district level $\mathrm{Cr_{pdi}}$ are used to estimate the selling price at district level for an item multiplied with the quantity purchased of an item by the household ($\mathrm{QP_{ih}}$). The net effect is therefore estimated as a proportion of total value of household consumption (X). Therefore, the net benefit ratio is simply the net sales divided by total household consumption.

As in Deaton's method, we treat production and consumption prices as disjoint variables. This is particularly sensible for Zambia where in the case of maize (country's main staple), producers sell maize grain, which is relatively cheaper but may purchase maize flour (either in a refined or less-refined form), a product that is generally more expensive than maize grain.

The intuition here is that the producers usually sell their produce in bulk and at cheaper prices to either wholesalers or private middlemen who buy at farm gate prices directly from a farmer. In Zambia for example, the bulk of maize produce is normally sold at a set price to the Food Reserve Agency (FRA) at a local depot (*see section 2.2.3*). Some of the maize grain is sold at wholesale prices to retailers. On the other hand, consumer prices are those faced by consumers usually after buying from a retailer in smaller quantities. In the case of maize in Zambia, there is another layer of cost added in the sense that most households would consume maize flour (refined or less-refined) rather than maize grain. The added processing cost by the millers is likely to be passed on to the consumers. Therefore, the prices faced by a consumer are different from those passed on by the producers. In this regard, it is more realistic to use a different set of prices for the value of sales and another for purchases values. Therefore, if the net effect is negative, then a household is making net purchases and if positive, then a household is recording net sales.

To estimate the change in welfare ($\Delta \mathrm{wf}_{\mathrm{hdi}}$) for household (h) in district (d) after facing a rise in prices for food commodity (i), we first introduce the change in prices of a particular commodity ($\Delta \mathrm{P}_{\mathrm{id}}$) between 2006 and 2010.

$$\Delta \mathrm{wf}_{\mathrm{hdi}} = \Delta \mathrm{P}_{\mathrm{id}} \left[\left(\frac{\mathrm{Pr}_{\mathrm{pdi}} \cdot \mathrm{QS}_{\mathrm{ih}} - \mathrm{Cr}_{\mathrm{pdi}} \cdot \mathrm{QP}_{\mathrm{ih}}}{X} \right) \right] \tag{vi}$$

Given that the change in producer and consumer prices for maize grain between 2006 and 2010 in Zambia was about the same[56], the decision we made was to use

[56] 54 per cent for consumer prices and 56 per cent for producer prices

the percentage change in consumer prices (which had a slightly lower percentage change) to represent ΔP_{id}. The implication of this decision could be that the benefit to net sellers may be slightly underestimated. Most authors including Deaton (1989), Simler (2010) and Vu and Glewwe (2011) assumed that the change in the producer price is the same as that of the consumer price, which may not always be the case. Scarcity of producer prices makes this assumption imperative for most authors. As argued by Vu and Glewwe, "producer prices of food are often unavailable or updated less often than food consumer prices" (2011, p.26).

To estimate the price effect on the poverty headcount, poverty gap and squared poverty gap, the initial step we took was to replicate the 2006 LCMS poverty statistics for Zambia using the class of poverty measurements by Foster, Greer and Thorbecke (1984), popularly known as FGT[57].

$$P_\alpha = \frac{1}{N}\sum_{i=1}^{q}\left[\frac{Z-Y_i}{Z}\right]^\alpha \qquad \text{(vii)}$$

In the equation, N is the total number of individuals or households and q signifies the number of households below the poverty line (Z). In the present research, Y_i represents per capita consumption estimated as adult equivalent. The parameter α measures the individual or household's aversion to poverty and the larger it is, the more emphasis is given to poor households.

P0 is the headcount poverty index, which calculates the percentage of people below the poverty line. That is, it estimates the share of the population that cannot afford basic needs as set at either the national or international level. This measure has been criticised for not providing enough information about how poor households actually are. It just separates the individuals/ households above and below the poverty line. Nevertheless, the headcount poverty index is the most widely used indicator of welfare. The second, P1 is the poverty gap estimated by multiplying the incidence of poverty with the gap between average income of the poor and the poverty line. It

[57] The Central Statistics Office of Zambia uses the FGT measurements to officially estimate poverty in Zambia

provides information regarding how far off households are from the poverty line (Coudouel, Hentschel and Wodon, 2002). Aside from estimating the distance from the poverty line, the last index, P2 is the poverty severity index, which takes into account the variability of income among the poor. In other words, $P_{\alpha} = 2$ measures the income inequality among the poor and gives greater weight to those further below the poverty line.

We then merged the net benefit estimates with the poverty data. This enabled the estimation of the change in total consumption per adult equivalent by multiplying the net benefit ratio with the observed price change between 2006 and 2010, estimated by the expression $\Delta \mathrm{P}_{\mathrm{id}}$.

Next, we calculated the compensating variation in the standard way using the difference between the consumption functions at the new and old price vectors (see Ferreira et al., 2013). Note that the compensating variation is positive for net buyers and negative for net sellers. The smaller the cost price increase, the larger the (uncompensated) price response (Deaton, 1997). In the next step, we calculated the consumption effect using a similar equation to Ferreira et al., (2013):

$$\mathrm{E}^{\mathrm{h}} = -\sum_{\mathrm{i}} \mathrm{w}_{\mathrm{i}}^{\mathrm{h}} \frac{\Delta \mathrm{p}_{\mathrm{i}}}{\mathrm{p}_{\mathrm{i}}} \tag{viii}$$

where the consumption effect E^{h} was computed for each household (h) using food consumption shares $(\mathrm{w}_{\mathrm{i}}^{\mathrm{h}})$ and proportional price increases for each food item (i). The compensating variation was then subtracted from the initial household consumption in order to estimate the new consumption value adjusted by the change in prices.

To calculate the short-run impact of higher prices of food on poverty, the simulated total consumption was used to re-estimate poverty by incorporating it into the standard poverty equation. Therefore, the above process for estimating poverty simulates the change in poverty after taking into consideration the change in food prices.

Following some of the studies such as Vu and Glewwe (2011) and Friedman and Levinsohn (2002) highlighted in the literature review section of this thesis, we further incorporated the supply elasticity ($\varepsilon_{rr}s$) of maize to estimate a second-order effect. This is the own-price elasticity of the maize supply. The following equation is used:

$$\Delta \mathrm{wf}_{\mathrm{hdi}} = \Delta \mathrm{P}_{\mathrm{id}} \left[\left(\frac{\mathrm{Pr}_{\mathrm{pdi}} \cdot [\mathrm{QS}_{\mathrm{ih}} . \varepsilon_{\mathrm{rr}} \mathrm{s}] - \mathrm{Cr}_{\mathrm{pdi}} \cdot \mathrm{QP}_{\mathrm{ih}}}{X} \right) \right] \tag{ix}$$

The term $\varepsilon_{rr}s$ was introduced in the equation to account for changes in quantity produced as a response to a rise in commodity prices. The supply elasticity for maize therefore measures producers' response to price adjustments. If the elasticity of maize with respect to prices is high, the welfare effects on net sellers of maize are expected to be high.

A few studies have been conducted in Zambia to estimate the maize supply response with respect to price changes. Based on a review of literature spanning the period 1984 to 1992, Dorosh et al., (2009) found that the supply elasticity with respect to own price of maize in Zambia ranged between 0.21 and 0.8. We however use the empirical work by Foster and Mwanaumo (1995) for the estimation of supply elasticity[58]. The selection of this specific work is justified by the fact that, to the best of our knowledge, it is the latest empirical research conducted on supply elasticity on Zambia. Furthermore, the papers referenced by Dorosh et al., (2009) are unpublished academic thesis while Foster and Mwanaumo's paper was published in a peer reviewed journal. Foster and Mwanaumo (1995) found that in the short-term, supply response for maize was 0.54, which is in the middle of the range of the findings highlighted by Dorosh et al., we therefore take this figure (0.54) into account to estimate the second-order effect in this chapter.

[58] Foster and Mwanaumo used a profile of dynamic multipliers for both maize and fertiliser price changes to estimate the supply response.

Since we only incorporate the supply elasticity in this research, the effects are only partially estimated. This is because other factors were not considered. Wages within the agriculture sector have been ignored for two reasons. First, there is inadequate data on income in Zambia (see McCulloch and Grover 2010) and second, within the agricultural sector, very few people earn wages. Our analysis of the LCMS data shows that of those employed in the agriculture sector, only about 3 per cent were paid employees in 2006. This figure increased to 4.7 per cent in 2010. These results resonate with the 2008 Labour Force Survey for Zambia, which found that at 5 per cent, the combined sector of Agriculture, forestry and fishing had the lowest share of paid employees (Government of the Republic of Zambia, 2011c; p.38). Most of those employed in the sector are unpaid family workers. Therefore, only a small proportion of people would benefit from wage adjustments. Furthermore, the prospect of a wage increment during this period is unlikely.

As suggested by Ivanic and Martin (2008), returns to skilled labour can be ignored on the grounds that these returns make an extremely small contribution to the incomes of the poor. In Zambia's case, the proportion of employees that are in a position to negotiate wages is very small. Another justification is an argument by Ravallion (1990) that it takes some time before commodity price change affect wages for unskilled workers in developing countries.

A recent study conducted on paid work in Zambia showed that the wages of unskilled workers, particularly in the agriculture sector, were only adjusted as and when the government announced a new minimum wage (Chibuye, 2014). The monthly minimum wage - basic pay minus allowances - (Government of the Republic of Zambia, 2011h) was revised in January 2011 to K419,000 ($87) from K268,000 ($56), a prevailing wage since 2006. Similar observations were made by Mason, et al., (2011) who found that agricultural wages in the formal economy were lower and grew at a significantly slower rate than other types of formal economy wages. It is possible therefore that during the period under consideration in this research, the income effect on unskilled labour was not significant.

Based on the study by Ivanic and Martin (2014), neglecting the wage effects could bias the results downwards. However, these authors found that the supply response were actually larger than the wage response. While all these findings are insightful, they preclude informal wages, which could have trended differently. The Governments' Labour Force Survey report estimates that about 89 per cent of the labour force were in informal employment[59] and earned an estimated monthly average of K530, 265 while those with formal jobs earned K2,045,082 (Government of the Republic of Zambia, 2011c). Due to inadequate data, we are unable to provide more insight into the informal wage response in light of a rise in food prices, which could also have a downward bias on the results.

While we are unable to empirically contribute to this argument, authors such as Lipton (1984) and Ravallion (1990) have argued that high food prices may benefit the rural poor through the induced wage response, even when the poor are net demanders of food. Similarly, Headey (2014) empirically found that the ultra-poor may benefit even more from higher prices than the more marginally poor. According to the author, reducing the duration of the poverty episodes made no difference to their results, suggesting that factor price adjustments occurs relatively quickly. There are considerable discussions about the conditions and extent to which a rise in food prices could lead to wage increases. Lipton (1984) for instance suggests that the underlying dynamics of stimulating food production and the demand for agricultural labour should exist. Dorward (2012) provides further insights by arguing that a positive effect of food price rises on poverty reduction requires larger stimulating effects from a significant proportion of net sellers. Some of the pre-requisite conditions suggested by Dorward include: raising production by investing in technical change and, increasing total payments earnings to labourers with very low opportunity cost for their labour.

We further ignore the substitution effects in our poverty estimates. This may also not highly influence the results as evidenced by Caracciolo, Depalo and Macias (2014) who found negligible substitution effects in Zambia. Using the Hicksian demand system, they found that the cross-price elasticities for maize were small (between

[59] Informal employment is defined as a form of employment where any one of these conditions are fulfilled: (i) working in an establishment where workers are not entitled to paid leave (ii) working in an establishment where the employer does not cover employees under any form of social security and (iii) an establishment employing less than 5 persons (Government of the Republic of Zambia, 2011c; p.47).

0.05 and 0.2). Nevertheless, given that these author's results are based on broad food groups, it is possible that elasticities for individual food commodities may be different. Furthermore, disaggregating maize by type (that is maize grain, refined and less-refined maize flour) could offer useful insights and may lead to different results given the findings in the current research (*chapter 4*) that households significantly adjusted their share of maize flour (refined and less-refined) budgets between 2006 and 2010 in opposite ways.

Finally, we ignore government policy responses such as social protection measures as the government did not implement any such policies in response to the food price spike. Currently, the government of Zambia is yet to meet the target of providing cash transfers to 10 per cent of the most vulnerable population.

While there may be good reasons for excluding some aspects of the second-order effects, it is possible that the poverty estimates in this research are slightly overestimated. But, as concluded from the literature in *chapter 2*, the studies that incorporated second-order effects found that in general, wages and substitution offset a rise in poverty only in a limited way.

5.2.1. Data

The analysis presented here mainly requires pre-crisis household data (2006 LCMS) and price data[60]. However, for some descriptive statistics such as how production has evolved, the latest LCMS conducted in 2010 has also been used. The relevant modules used in this chapter are the agriculture and consumption modules. We utilised adult per capita equivalent scales to estimate changes in poverty in an attempt to correct for the positive correlation between household consumption and family size and also household consumption and characteristics of the family (e.g. age of household members). As argued by Deaton (1997; p. 223), even in cases where welfare is the same for all household members, per capita consumption measures will generally not provide a correct ranking of the living standards of

[60] In principle, this type of analysis could be conducted in many developing country contexts where they may at least have access to cross-section household data on consumption and production prior to the crisis.

different households or of the members within them. For example, children will often require less than adults to obtain the same standard of living.

The poverty line used in this research is the official 2006 poverty line for Zambia, which corresponds to the value of consumption needed to satisfy the required nutritional needs of 2,100 calories per person per day. In 2006, the overall poverty line (reflecting food and non-food) was K365,468. Finally, some information from our qualitative research, collected in October and November 2012, is used to provide interpretations to the quantitative findings (see Appendix F on the generic history on poverty and Government estimates).

Net buyers/ sellers are considered across the entire country and not just in rural areas. The use of a single period to classify households as net food sellers or buyers may not capture the dynamic of households shifting from net food buyers to net sellers across the different seasons. A lack of consistent panel data makes estimation of the magnitude of such shifts difficult.

5.2.2. Descriptive statistics

We start by providing information on who the net buyers and net sellers are in Zambia using equation (v). We mainly focus our analysis on maize and maize products. As pointed out in *chapter 2*, the crop dominates both production and consumption in the Zambian food market. We also estimate the net effect of all cereals. The combined ‘cereal’ variable is made up of the following crops: maize, cassava, rice, sorghum and millet [61].

The majority (85 per cent) of Zambias’ population is engaged in agriculture related activities. The 2010 Census of Population and Housing for Zambia indicates that 61 per cent of Zambians resided in rural areas and 39 per cent resided in urban areas (Government of the Republic of Zambia, 2011a). While the main occupation of those in rural areas is agriculture, about 14 per cent of urban households are also engaged in agriculture production (Government of the Republic of Zambia, 2011d).

[61] Cereals provide almost two-thirds of the dietary energy supply (FAO 2009).

Table 5.1 summarises some variables of interest (crops harvested and sold). In subsequent analysis, we have combined local and hybrid maize. More households moved towards planting hybrid maize, which is known to be superior. As suggested by Benson (1999), the most common hybrids significantly out-yield the local unimproved maize most farmers plant, even when unfertilized. In general, the table shows that there was an increase in the quantities harvested and quantities sold between 2006 and 2010. This information is indicative of a possible supply response with respect to the rise in food prices.

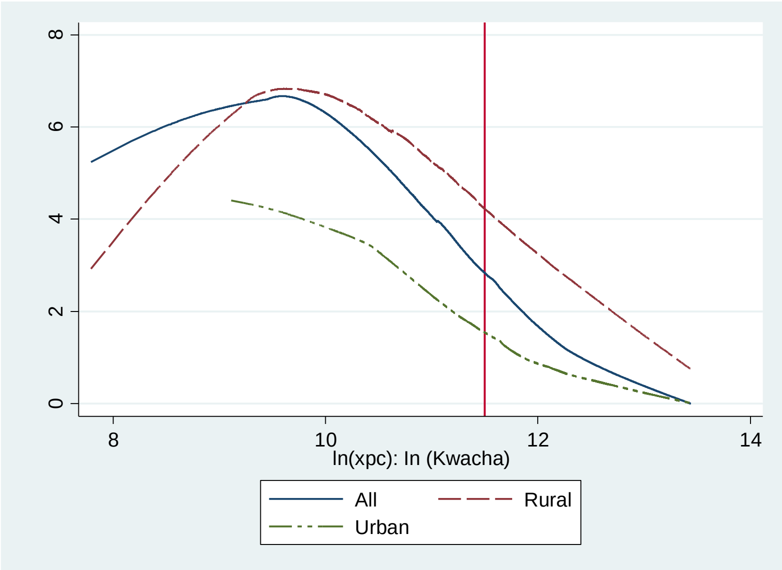
Table 5.1: Changes in agriculture production per household

Crop	**Harvested (kg)**		**Sold (kg)**	
	2006	**2010**	**2006**	**2010**
Local Maize	726.2	696.7	226.6	256.7
Hybrid Maize	1073.6	1413.5	714.7	986.5
Cassava	150	205.7	35.1	41.9
Millet	19.9	17.7	6.3	9.1
Sorghum	12.3	10.4	1.8	1.8
Rice	17.8	15.2	9.7	7.1
Mixed Beans	21.9	33.8	11.6	18.5
Sweet Potatoes	65	126.8	36.2	65.7
Irish Potatoes	5.4	11.1	3.8	9.6
Groundnuts	58.3	98.4	0.11	0.14

Source: authors' calculations based on 2006 LCMS

F*igure 5.1* plots the share of maize as a function of log of total value of household per capita consumption. The graph shows the share of maize reducing with total per capita consumption.

Figure 5.1: Maize share of consumption regressions



Source: authors' calculations based on 2006 LCMS

In general, the data (especially for urban areas) confirms Engel's law that the share of the budget spent on food (in this case maize grain) declines as the standard of living increases. However, the pattern is not exactly the same for rural households, as the share of consumption budget spent on maize among the very poorest households is very low. It then increases to about 6.5 per cent before exhibiting a declining trend.

5.3. Results - net benefit effects

In all subsequent graphs, the poverty line (in logs) divides households below the line (to the left of the curve) and those above it (to the right of the curve). On the horizontal axis, all graphs depict household log consumption. Households above the zero horizontal line are net sellers while those below zero are net buyers. Following Deaton (1989), the logarithmic transformation in this chapter is used to normalise consumption data as the distribution of consumption per capita is strongly positively skewed.

The analysis is first conducted on maize grain and maize products (refined and less-refined maize flour). This break-down is important as households consume *nshima* made from either refined or the less-refined maize flour. Among poorer households, particularly in rural areas, households rely on maize grain, which is milled to maize flour using local hammer mills called '*chigayo*'. This is a cheaper maize milling process. In addition to maize, the net effect is also estimated for all the major cereals in Zambia as a combined variable.

As urban areas differ in character from the four major cities of Zambia (Lusaka, Kitwe, Ndola and Livingstone), we separate out cities from rural and urban categories for the purpose of the NBR analysis. *Figures 5.2 to 5.6* show results for the following locations: 'rural', 'urban' and 'cities'.

Locally weighted regressions (Lowess) were used to produce the graphs. Ideally, in order to explore the sensitivity of the estimates at each point of the consumption distribution, one would also estimate confidence intervals. However, because of the values of the Net-Benefit Ratio are themselves estimated from the data (Deaton, 1989) we cannot use the usual standard errors to estimate the confidence intervals. The typical solution in the Econometrics literature is to apply bootstrap methods (see Brownstone and Valletta, 2001). However, applying them in a non-parametric regression such as Lowess is not straightforward and not available in the standard statistical packages. We solved this issue by exploring the sensitivity of our estimates by re-estimating the original Lowess curve (depicted in red in figures. 5.2 to 5.17) using randomly selected sub-samples.[62] Akin to bootstrap methods, we randomly dropped 5 per cent of the sample in each repetition. For each sub-sample, the Lowess curve was computed for every value of x (consumption) and the smoothed ys (net benefit ratios) were stored. The graphs showing the regression results in the present section were obtained using the original Lowess curve (in red) and 100 repetitions based on the randomly selected sub-samples (in grey). Deaton (1997) suggests that about 100 repetitions will typically give a good idea of variance.

The grey lines in each graph represent the repeated regressions. Among rural households in *figure 5.2,* the NBR appears to be positive among the poorest households (left part of the diagram), which would suggest that the poorest

[62] We thank Kalle Hirvonen of IFPRI for suggesting this solution.

households in rural areas are net sellers of maize. However, the noticeable wide dispersions depicted on that left part of the graph suggest that the estimates are sensitive to few extreme values in the data. This therefore significantly questions the validity of the results for these poorest households, particularly those with log consumption value below nine (corresponding to significantly less than 1 per cent of the sample in rural areas). We return to this issue in section 5.5 where we check to what extent these extreme values in the data may be driving the poverty estimates.

As noted in Deaton (1997: 197-198), the sensitivity of the results at the tail ends of the graphs created from locally weighted regressions occurs when at the point of estimation both the regression function and the density of x (consumption) have non-zero derivatives. Deaton further argues that this phenomenon is likely to be most serious at the "ends" of the estimated regression and that these biases diminish for observations located towards the centre of the distribution and away from the tails. In the present research, this suggests that the results in the graph showing that some poor rural households are net buyers may be unreliable. Hence, the results at the bottom tail of the distribution must be interpreted with caution.

If one ignores the very poorest households (as done in Subramanian and Deaton, 1996) considering the uncertainty around the regression estimates, the results show that the graph density that corresponds to higher net sales is mostly in the middle of the consumption distribution. This finding is in line with earlier studies, which found that in general, middle income households gain the most (Deaton, 1989, Budd, 1993, Vu and Glewwe, 2011) but departs from authors who found that the wealthiest households gained the most (Barrett and Dorosh, 1996)[63]. It is interesting to note that in the Zambian case, the middle income households mainly fall around the poverty line. This suggests that many households in Zambia are indeed poor. Another observation in relation to the graphs is that in general, the net sellers in rural areas make very small net sales of about 1.8 per cent, at the most. The implication here is that if prices of maize doubled, as a proportion of income, the households making net sales would gain only about 1.8 per cent.

[63] We return to this issue in the next section (5.4) and Appendix H as the finding has implications for the assessment of poverty in both the long and short run.

Poor urban households (figure 5.3) and poor households in cities (figure 5.4) would generally lose. Households above the poverty line in urban areas and cities however are largely unaffected by a rise in maize grain prices (the net benefit ratio is very close to zero in both cases). This could mainly be a result of the difference in consumption patterns where maize flour is more consumed by households in these locations than maize grain.

Figure 5.2: NBR regression estimates for maize grain[64] (rural areas)

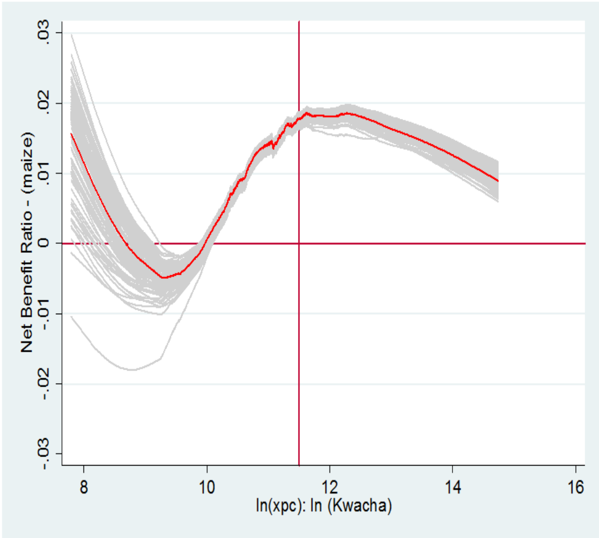


Figure 5.3: NBR regression estimates for maize grain (urban areas)

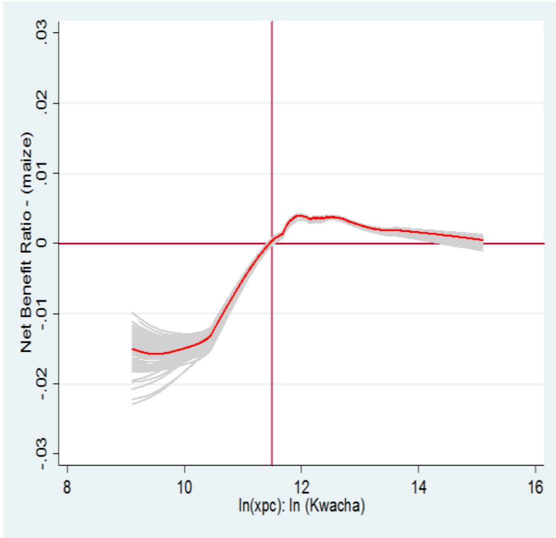
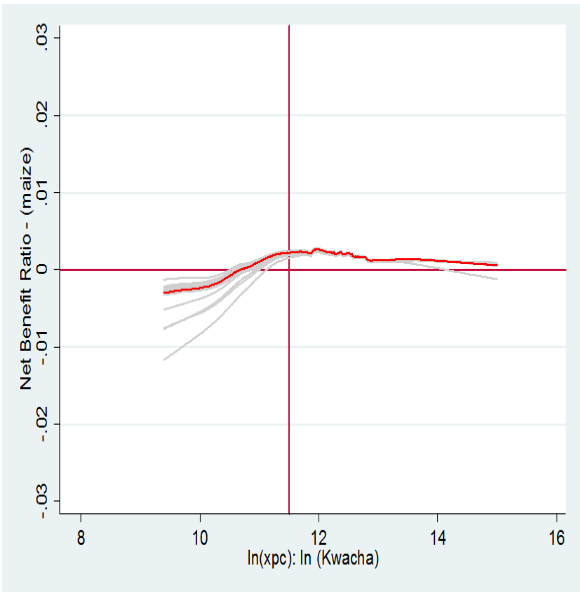


Figure 5.4: NBR regression estimates for maize grain (cities)



Source: authors' calculations based on 2006 LCMS
Note: the grey lines show the sensitivity of the estimates when 5 % of the sample is randomly excluded

[64] See the distinction between maize grain, refined and less-refined maize flour in *chapter 1*.

About 47 per cent of the rural households are net buyers of maize grain while 27 per cent are net sellers, hence, would gain if prices increased. For urban households, 20 per cent are net buyers, 11 per cent are net sellers and 69 per cent are neither net buyers nor sellers. In cities, the percentage of households who are neither net buyers nor net sellers is much higher (90 per cent). This result therefore confirms the point made above that households, particularly in cities, hardly consume maize grain but rather, its products. As found by Mason and Jayne (2009) who conducted a survey on 4 districts in Zambia, households in all consumption quintiles in Lusaka and Kitwe (both cities) and relatively wealthy households in Mansa[65] mainly consume commercially milled maize flour. On the other hand, poor households in Mansa consume mainly locally milled maize grain. It is therefore necessary to conduct a net benefit ratio analysis on maize flour.

Figures 5.5 to 5.7 depict the net benefit ratio of the refined maize flour. The results show that the net loss in cities and urban areas in general is much larger, relative to maize grain. This is explained by the fact that maize flour is not the same commodity as maize grain, which is mainly grown by farmers. Maize flour incurs added transaction and milling costs, making it mostly inaccessible to poor households in rural households. Conversely, the magnitude of welfare loss to consumers may be higher given the high cost. Recall from equation v that we are subtracting net purchases from net sales, this implies that the proportion of net sales will be higher among rural households who may sale more of the maize grain but purchase very little or nothing of the maize flour. Hence, the net benefit ratio for refined maize flour in rural households is higher relative to maize grain. As was established in chapter 4, the share of the budget that rural households spend on refined maize flour was less than 3 per cent.

A similar issue was discussed by Deaton (1989) and Deaton (1997) on rice paddy, which is not the same commodity as milled rice. Following the net benefit ratio logic, he explained that the value of sales of paddy is purchases of rice less sales of paddy multiplied by the change in price. He therefore argues that this is still the ratio of the value of net sales of rice (or paddy) to total expenditure, so that provided

[65] Mansa is the provincial capital of Luapula province in Zambia. It is located on the Northern part of the country.

everything is measured in money terms, the benefit ratio is correctly computed by subtracting the value of consumption from the value of sales (Deaton 1997: 185).

In relation to figure 5.5, once again, the slope at the extreme left end of the consumption distribution in rural areas is imprecisely estimated. The shape of the regression function suggests that the highest gain accrues to some of the rural households just below the poverty line. As such, these households are more likely to benefit the most from an increase in the price of refined maize flour. The value of net sales in rural areas diminishes as consumption per capita increases.

Only 4 per cent are net buyers in rural areas while 37 per cent are net sellers. In urban areas, households above the poverty line are mainly net buyers while those below the poverty line are made up of both net buyers and net sellers. The size of the net benefit in urban areas falls from an elasticity of about 4 per cent to about -0.3 per cent for households below the poverty line (Figure 5.6). 53 per cent recorded net purchases while only 12 per cent recorded net sales. Households above the poverty line are generally net buyers. Most households in cities (77 per cent) are net buyers with net refined maize flour purchases among the poorest households of almost 6 per cent (Figure 5.7). The importance of net purchases decreases as households become richer in cities. Therefore, households below the poverty line in cities would suffer the most welfare loss if prices of refined maize flour increased.

Figure 5.5: NBR regression estimates for refined maize flour (rural areas)

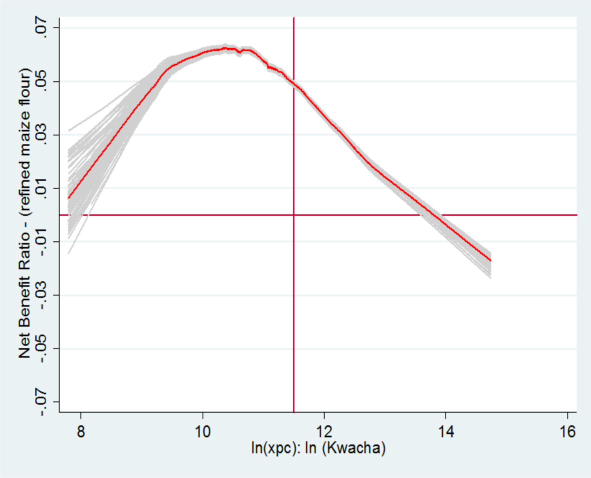


Figure 5.6: NBR regression estimates for refined maize flour (urban areas)

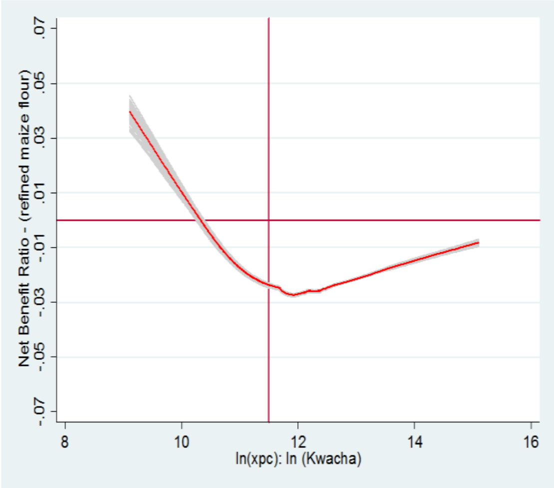
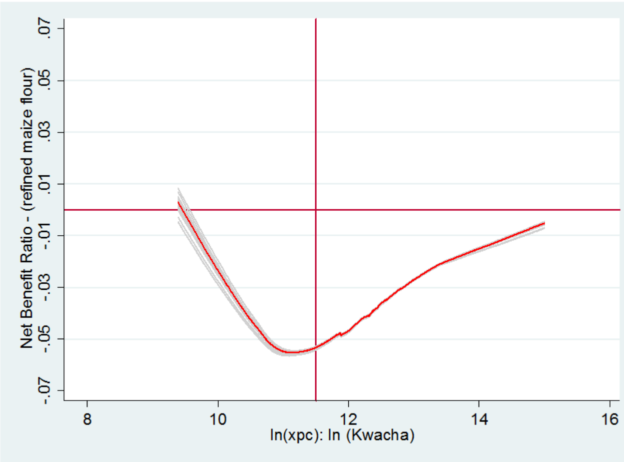


Figure 5.7: NBR regression estimates for refined maize flour (cities)



Source: authors' calculations based on 2006 LCMS
Note: the grey lines show the sensitivity of the estimates when 5 % of the sample is randomly excluded

Figures 5.8 to 5.10 show a similar analysis but for a much less-refined form of maize flour that is normally consumed by relatively poorer households. It is therefore expected that households below the poverty line in both urban areas and cities would suffer the most welfare loss if the price of less-refined maize flour increased while the effect would mostly be neutral for households above the poverty line who may mostly allocate a higher value of consumption towards refined maize flour as shown in *Table 4.3*. Similar to maize grain and refined maize flour, these results suggest that increases in the price of less-refined maize flour would generally have direct benefits to rural areas, particularly for households around the poverty line, with the highest benefits accruing to households just below the poverty line. While the result for rural areas (figure 5.8) suggests that the poorest are net buyers of the product and therefore would suffer a welfare loss, the results are not very precisely estimated.

Figure 5.8: NBR regression estimates for less-refined maize flour (rural areas)

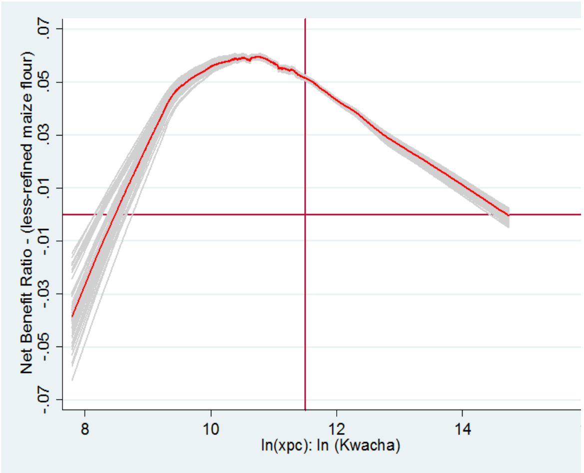


Figure 5.9: NBR regression estimates for less-refined maize flour (urban areas)

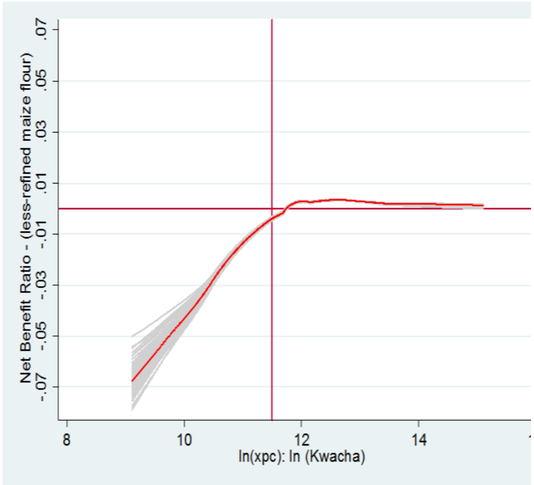
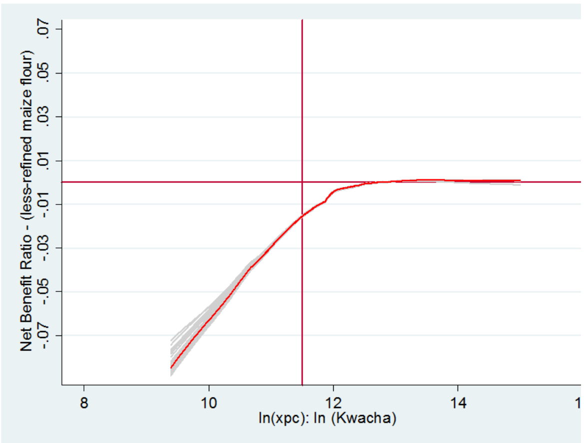


Figure 5.10: NBR regression estimates for less-refined maize flour (cities)



Source: authors' calculations based on 2006 LCMS
Note: the grey lines show the sensitivity of the estimates when 5 % of the sample is randomly excluded

Running a regression on maize grain for selected provinces (*figures 5.11 to 5.14*) shows that the net effects vary across these geographical boundaries. Of the 9 provinces in Zambia, 3 provinces with high level of agriculture production (central, southern and eastern province) are selected. Lusaka on the other hand has insignificant agriculture production and therefore acts as a control. Of the selected provinces, central province is the only province that recorded net sales, mainly for the middle income households. The wide dispersion of results for the poorest households is an indication of the imprecise estimation of results. Similar to the finding in *chapter 2*, Eastern province, the province with the largest proportion of farmers in Zambia and producing the majority of the maize *(Table 2.1)*, gains less than central province. This indicates that levels of production may not be reflective of the net buyer/ seller position. Even here, the value of net sales is insignificant.

Figure 5.11: NBR regression estimates for maize – Central Province

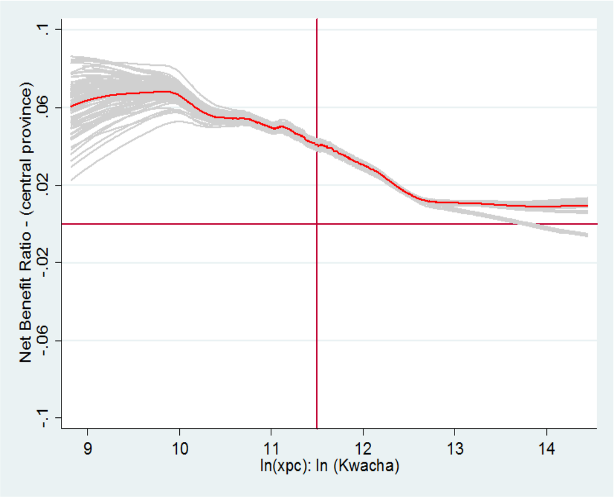


Figure 5.12: NBR regression estimates for maize – Eastern Province

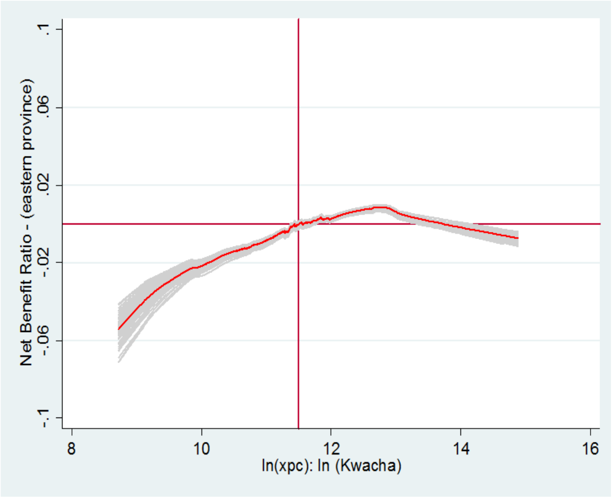


Figure 5.13: NBR regression estimates for maize – Southern Province

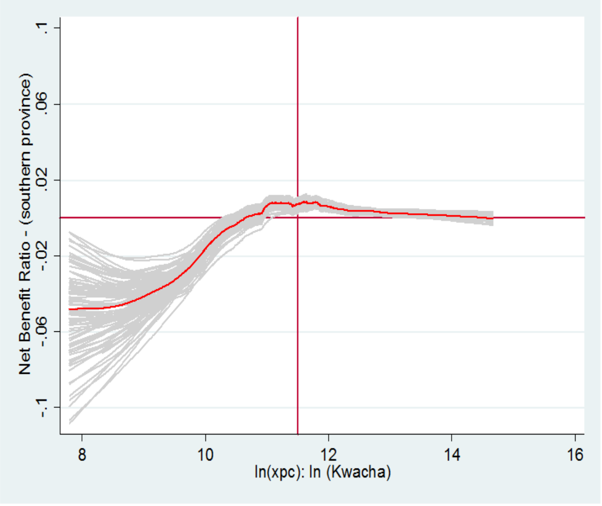
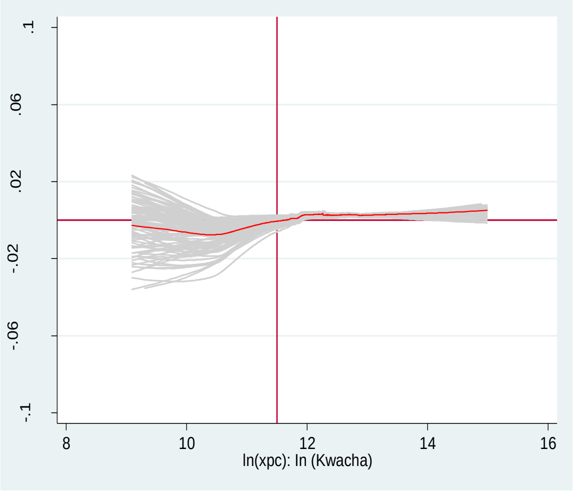


Figure 5.14: NBR regression estimates for maize – Lusaka Province



Source: authors' calculations based on 2006 LCMS

Note: the grey lines show the sensitivity of the estimates when 5 % of the sample is randomly excluded

A net benefit analysis on a composite cereal commodity *(figure 5.15 to 5.17)* however, is regressive across all areas. Only about 24 per cent in rural areas are net sellers but the net effect is an insignificant proportion of their income. The negative effect is highest on poorer households.

***Figure 5.15:* NBR regression estimates for cereals (rural areas)**

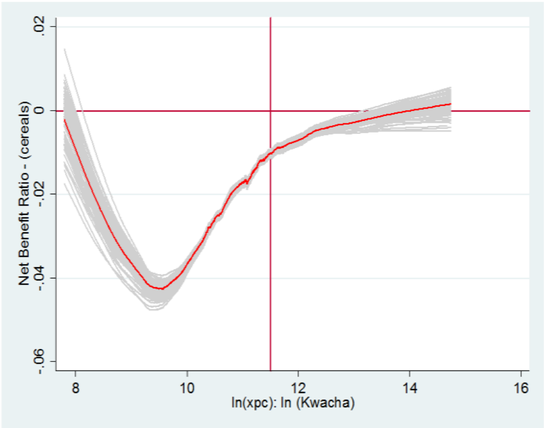


Figure 5.16: NBR regression estimates for cereals (urban areas)

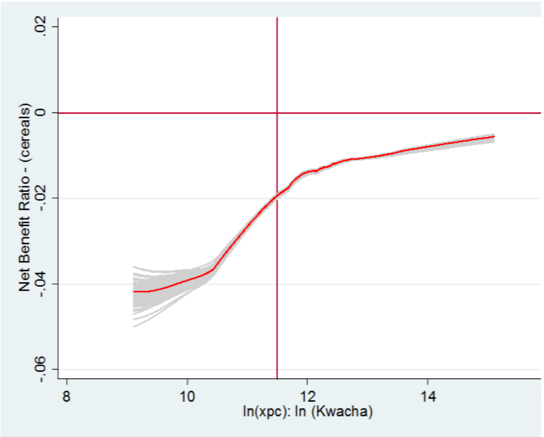
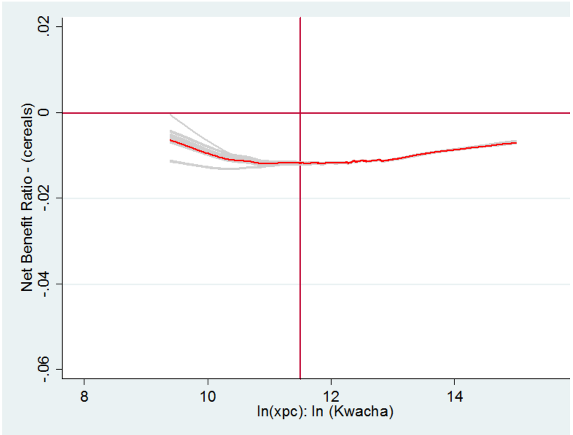


Figure 5.17: NBR regression estimates for cereals (cities)



Source: authors' calculations based on 2006 LCMS
Note: the grey lines show the sensitivity of the estimates when 5 % of the sample is randomly excluded

Table 5.2 summarises the information on maize grain production and the net buying position of the households. The information is disaggregated by quintile and by province. On average, a higher proportion of households within the lowest quintile produce maize. The proportion reduces as households get richer.

Once the results are disaggregated by rural and urban areas, on average, there are more net buyers than there are net sellers in all quintiles. Evidently, in each of the quintiles, urban households have fewer net buyers than rural households. As suggested above, this is because urban households mainly consume pre-packaged maize flour (refined and less-refined) rather than maize grain.

The disaggregation by province confirms earlier results that Eastern province has the highest proportion of maize producers. However, this province also has the highest number of net buyers in both rural and urban areas. In addition and in all provinces, there are more net sellers in rural areas than there are in urban areas. In general, this result confirms the main finding in this section that in case of an increase in maize prices, rural households are more likely to gain than urban households in Zambia. However, the net effect depends on income distribution.

In general, the findings show that households clustered around the poverty line would gain the most from an increase in prices of maize and maize flour.

Table 5.2: Shares of net sellers and net buyers of maize in Zambia (per cent)

Quintile	Households Producing maize	Rural			Urban		
		Net sellers	Net buyers	Neither net seller/ buyer	Net sellers	Net buyers	Neither net seller/ buyer
Lowest	72.47	22.14	45.67	32.19	12.15	34.01	53.84
2nd	69.4	29.07	50.4	20.53	11.8	33.8	54.4
3rd	64.84	31.43	48.49	20.08	12.89	25.84	61.27
4th	62.68	29.38	44.63	25.99	13.19	17	69.81
Highest	47.02	30.87	35.98	33.15	8.73	10.97	80.3
By Province							
Central	54.23	47.14	39.29	13.57	12.26	22.62	65.12
Copperbelt	62.69	41.49	38.31	20.2	11.43	10.97	77.6
Eastern	83.56	21.56	68.6	9.84	17.41	49.83	32.76
Luapula	50.84	19.33	31.97	48.7	21.08	25.75	53.17
Lusaka	56.8	26.43	44.39	29.18	2.19	6.29	91.52
Northern	47.38	30.87	30.56	38.57	19.96	36.48	43.56
North Western	69.21	31.61	49.62	18.77	24.75	28.74	46.51
Southern	65.13	23.73	52.55	23.72	3.54	19.16	77.3
Western	79.87	13.1	58.87	28.03	11.24	21.9	66.86

Source: authors' calculations based on 2006 LCMS

5.3.1. Producer and consumer prices – net benefit effects

In this section, we contribute to the growing literature on net effects of rising food prices on household welfare by graphically depicting the variation in net benefit effects between the producer and consumer prices. Recall that the net benefit estimates above are based on producer and consumer prices. This has been possible due to availability of both consumer and producer prices in Zambia. Vu and Glewwe (2011) attempted to explore the relationship between consumer and producer prices in different regions of Vietnam but were impeded by data limitations. According to these authors, "producer prices of food are often unavailable or updated less often than food consumer prices" (2011, p.26).

In *figures 5.18 to 5.21*, the broken line represents net benefit ratio calculated using consumer prices. The assumption here is that farmers sell their produce at prices faced by consumers and capture the full benefits from a rise in prices. On the other hand, the solid line represents the net benefit ratio estimated using producer or farm gate prices. As expected, the results show that the net benefit share would be higher if farmers sold their produce at consumer prices. In the case of maize, the net benefit ratio is negative (about -0.1) for some rural households below the poverty line when estimated using producer prices but positive and large (5 per cent) when consumer prices are used.

As producers in Zambia do not capture the full benefits of the price increase, the question is, how is the difference in the share accounted for? Possible responses are that the variation is made up of supply-side costs such as living in a remote area with limited access to the market, transport and input costs. However, it may as well be that part of the difference is captured by the maize buyers (middlemen). As suggested by Wodon et al., (2008), market intermediaries may be able in some cases to keep a large share of the increase in consumer prices for themselves.

To better understand this finding and why the effect is larger on households at the bottom of the income distribution, the maize marketing system in Zambia should be considered. As discussed in detail in *chapter 2*, while Zambia has liberalised its economy, the government still purchases maize through the FRA. Sitko and Jayne (2014) point out that the Zambian government routinely spends 30 per cent or more of its total agricultural budget on the FRA, which buys maize from farmers at prices that generally exceed prevailing market prices. Annually, the government announces the floor price prior to the harvest period to encourage farmers not to sale below the set price. As described by a respondent from a research institute in Zambia, "*some of the governments' food security policy is about cushioning farmers but as they implement the policies, for example, setting the floor price of maize at K65,000 may disadvantage net buyers while it benefits net sellers.... The intentions of the government may be good but it disadvantages others*" (authors' field interview, Lusaka, 2012).

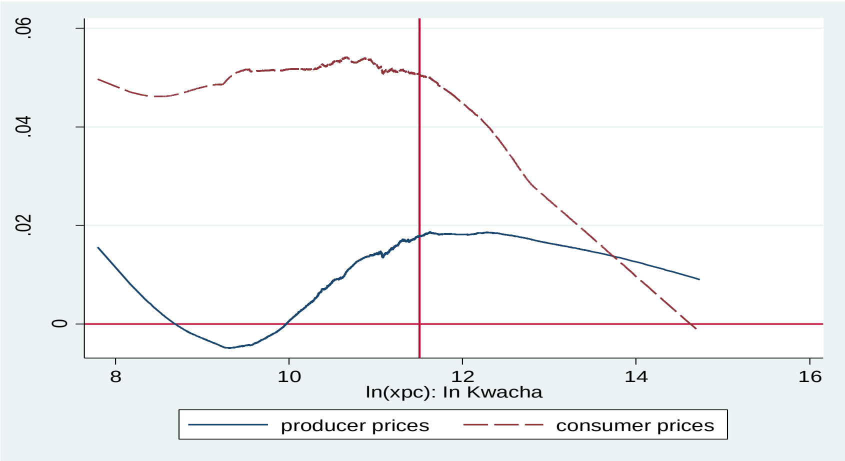
While these policies may seem progressive in relation to enhancing small scale farmer's welfare, the implementation of government as a buyer is not without criticisms. Some farmers we interviewed expressed concern over government buying the maize around August, which is months past the harvest period (March to June). This could increase the cost of storage and the possibility of crop loss if it is not properly stored.

A further challenge is that government does not make on-the-spot cash payments, rather pays through more formal arrangements after a number of months. One respondent complained that for the 2011/12 agricultural season, the government made the payment after the start of the subsequent agricultural season, in November 2012. As described by one farmer we interviewed in Masaiti district, "*we sell our maize to FRA. The 15 bags we produced this year was sold at K65,000 per bag. In 2010, we sold 9 bags at the same price. The challenge is that it takes long before FRA pays us. This year, we were told we would be paid by November. We sold to FRA in August but we are not yet paid*". While the maize market is guaranteed and the maize price is generally favourable to a farmer, poorer farmers are unlikely to benefit from this scheme. This is because they may be more likely to have immediate needs for their income, which makes them prone to selling their produce soon after harvest to private traders, usually at less than the market price. Some authors including Sitko and Jayne (2014) criticise this system of the Zambian governments' intervention in the acquisition and distribution of staple grains.

These challenges could be exacerbated by poor infrastructure in some areas, hence increasing the transaction cost. Dorward (2001) points out that high transaction costs may be associated with poor communication, dispersed producers and buyers, and the need to monitor commodity quality characteristics.

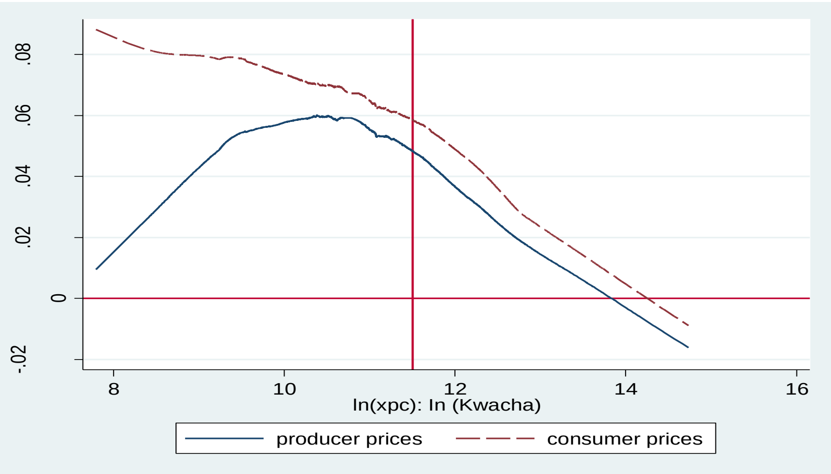
For refined and less-refined maize flour (*figure 5.8-5.9*), the variation is similarly much larger for the poorest households but more reasonable as household income increases.

Figure 5.18: Maize grain



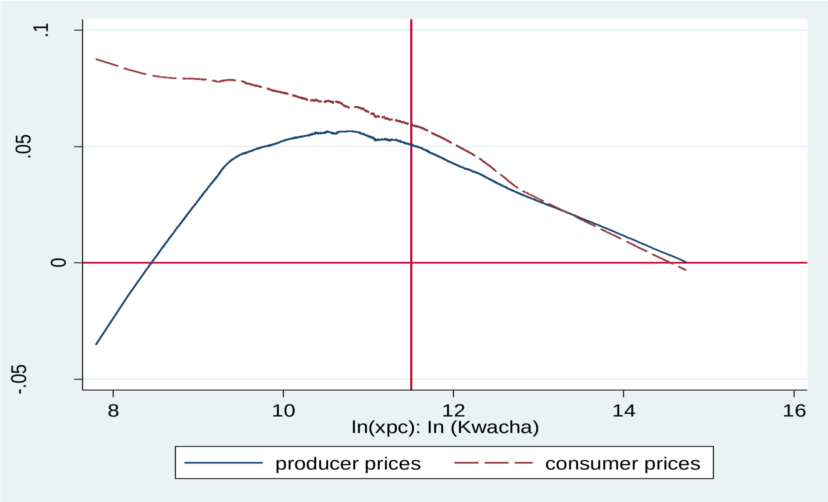
Source: authors’ calculations based on 2006 LCMS

Figure 5.19: Refined maize flour



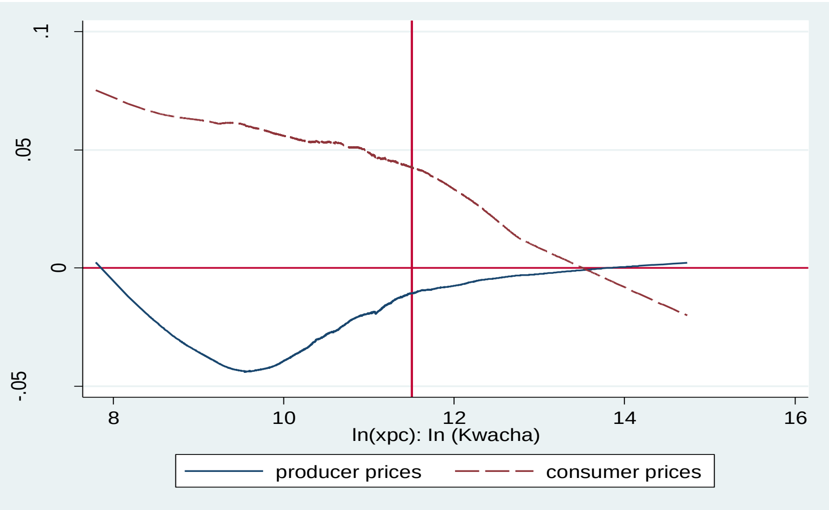
Source: authors’ calculations based on 2006 LCMS

Figure 5.20: Less-refined maize flour



Source: 2006 authors' calculations based on 2006 LCMS

Figure 5.21: Cereal



Source: authors' calculations based on 2006 LCMS

5.4. Impact of rising food prices on poverty in Zambia [66]

The net benefit ratio analysis in *section 5.3* shows that households around the poverty line in rural areas tend to be net sellers of maize and maize products. In urban areas, the households are on average net buyers of maize and its' products. As

[66] See appendices*: chapter 5* for a theoretical discussion on poverty.

outlined in the previous sections, the impact of rising food prices on poverty is dependent on the share of income that households devote towards a particular food item, their net selling position and how the household adjusts to higher food prices in the long run. While acknowledging that poverty estimates should take into consideration the budget shares and spatial differentials in price as discussed in *chapter 4,* in this section, we use the poverty estimates from the government. This enables us to make comparisons based on official poverty estimates. Therefore, we first replicated the 2006 LCMS poverty estimates using the FGT class of poverty measurements (equation vii).

The headcount results are reflected in the first column of *Tables 5.3 and 5.5,* marked baseline. The baseline results show that the proportion of poor people is higher in rural than urban areas. Furthermore, the majority of Zambians (62.8 per cent) lived below the poverty line in 2006. Having successfully replicated the baseline results (CSOs' headcount poverty calculations), we then estimated the change in poverty levels given the rise in prices. As this analysis incorporates the net benefit ratio (equation vi), the results presented here may be biased upwards given the unreliability of results among the poorest households in rural areas. This assertion is however tested in section 5.5 where we conduct sensitivity checks of the poverty effects on such observations.

Table 5.3 and 5.4 presents the short-run effects on poverty headcount (P0), poverty gap (P1) and severe poverty gap (P2). The commodities analysed here are maize grain, maize products, rice and a combination of major cereals (maize, cassava, rice, sorghum and millet). The results show that the effect of prices is different depending on the location and the product. In general, rural poverty reduced in all cases, except for rice[67] and the extreme poverty estimate on a composite variable, cereals.

Urban poverty increased in all instances. The increase was more significant for refined maize flour (2.2 and 4.5 percentage points for severe and overall poverty respectively) and cereals. However, the overall effect on the country varied. An increase in the price of less-refined maize flour between 2006 and 2010 was poverty

[67] This may be as a result of few households growing rice. Table 2.2 (*chapter 2*) for example showed that between 2006 and 2010, there was a perpetual rice deficit in the food balance sheet.

reducing while for the rest of the commodities, the impact of the rise in prices on poverty was regressive. The overall effect in some instances was negligible. For example, a rise in the price of maize grain led to a rise in poverty levels by 0.1 percentage points only. As suggested by Ivanic and Martin (2008), the overall impact on poverty rates in poor countries depends on whether the gains to poor net sellers outweigh the adverse impacts on net buyers. In general, the short-term poverty results are consistent with the net benefit ratio findings that the effects were more regressive in urban than in rural areas.

Table 5.4 estimates the first-order estimation of a rise in the prices on poverty gap and the inequality among the poor. Note that while we replicated the baseline figures for the P0 and P1 estimates following the LCMS results, the P2 baseline estimates are our original calculations. This is because P2 results were not reported in the 2006/2010 LCMS report. Given that the net benefit ratio results showed that the benefit among rural households was not homogenous, it is important to understand the extent of inequality among the poor as measured by P2. In rural areas, the poverty gap declined across all commodities, excluding in the case of rice. In urban areas, the gap in poverty increased in all cases. The national results show that the price rise on average increased the poverty gap in all instances. The results for the squared poverty gap follow a similar trend as the poverty gap. By and large, the gap in poverty and levels of inequality are much higher in rural than urban areas, despite slight reductions post 2007/8 food crisis.

Table 5.5 and *Table 5.6* on the other hand include the partial equilibrium effects given the price increase. The analysis was conducted by taking into account supply elasticity. As the only available information was the supply price elasticity for maize, the poverty estimates in the tables only depict the changes in poverty from an increase in prices of maize and maize products. The headcount poverty results *(Table 5.5)* show that the gain in welfare in rural areas was much larger in the long run (once supply response is incorporated) as estimated by both severe and overall poverty.

Given that for our sample, a substantial proportion of the households across quintiles in both rural and urban areas were net buyers, their real incomes would decline as food prices increase. We also found that it is the households in the middle of the consumption distribution (who are also mainly clustered around the poverty line) that gained the most from a rise in food prices, it is likely that the effect may be different across the consumption distribution. Furthermore, since we observed in Chapter 4 that the poorest spend a higher proportion of their income on maize grain relative to richer households, it is likely that these households may suffer a higher welfare loss. However, this conclusion is only based on the supply response alone where the expectation is that the poorest households are largely producing for own-consumption. The wage effect however may be different, especially considering the large informal economy in Zambia.

While many authors, including Barrett and Dorosh (1996) and Vu and Glewwe (2011) found that the poorest farmers were vulnerable to an increase in the price of the staple crop, some authors such as Headey (2014) and Ravallion (1990) argue that contrary to intuitions based on partial equilibrium analyses, which ignore wage responses, the effect on welfare of a price increase appear to be positive for the poorest households than for those who are less poor. Ravallion (1990) further explained that for Bangladesh, this is because the share of income from wage labour tends to increase as income falls. As such, the welfare loss among the poorest may be mitigated by the response of wages. But, as noted earlier in this chapter (section 5.2), this requires stimulating food production and increasing total payments earnings to labourers with low opportunity cost for their labour (Lipton 1984; Dorward 2012).

In urban areas, the results suggest that there was a slight reduction in poverty relative to the short-term estimates. In comparison to the short-term, the decline in the headcount in urban areas was negligible (ranging from 0.1 to 0.2 percentage points). On average, urban households are still worse-off relative to rural households. Therefore, the findings confirm the hypothesis that "*households in urban areas would suffer a welfare loss while those in rural areas would gain from an increase in commodity prices*".

In general, the poverty headcount rates for Zambia declined by 0.7, 1.3 and 0.1 percentage points once supply response were incorporated for maize, less-refined and refined maize flour, respectively. These results suggest that in the long-term and on balance, the overall gain to net-sellers, though slight, outweigh the adverse welfare loss to net-buyers resulting in a decline in poverty. The magnitude of the decline in poverty as a result of the rise in food prices is very small. This may be a result of net sales not being significant enough to have a larger effect on reversing the poverty trends. Nevertheless, the results have strong significance for policy options that the government can consider (we discuss policy options in the concluding chapter).

A similar observation is made for the poverty gap and severe poverty gap except for maize grain *(Table 5.6)*. Therefore, the short-term results are in the opposite direction as those implied in the long-term, which points to difficult decisions for policy makers due to the implied trade-offs between short run-mitigation and long-term net income benefits. It is imperative to stress here that the extent of inequality among rural households as measured by the squared poverty gap post-2007/8 food crisis is still high. The implications of this result is that while on average, both the poverty gap and squared poverty gap may seem to decline (albeit slightly), some households in rural areas would be significantly affected by a rise in food prices.

Based on these results, a rise in the price of maize and maize products is generally poverty reducing. However, and as discussed above, the results presented in this section neglect the wage response, hence, the analysis is only partial. While these results can only be treated as suggestive rather than conclusive, given the structure of the Zambian economy where the agriculture sector is the biggest employer, it is likely that once the wage response is incorporated, the overall conclusion may not change.

Nevertheless, the finding in this chapter is in line with a recent publication by Ivanic and Martin (2014). As highlighted in *section 2.1.1* of the literature review, these authors found that in the short-run, poverty in Zambia increased at a much higher rate (6 percentage points) than observed in the current section. In the long run, once wages and supply response were incorporated, the poverty levels in the country declined by 1.1 percentage points. While these results were based on a simulated 54 per cent increase in maize prices, it is unclear from their paper what food commodities were used in their estimate. Aside from the difference in methodology, the variation between their results and ours could partly be explained by the difference in commodities used to estimate poverty. The results presented in the current paper are much more disaggregated than those presented in Ivanic and Martin's (2014) paper. However, the general observation that high food prices appear to be poverty-reducing in the short-run but poverty-increasing in the long run holds. Headey (2014) also found that higher food prices reduce poverty in the long-run, after conducting a cross-country analysis. The implications of these findings will be returned to in the concluding chapter. In general, the findings raise questions about policy decisions that governments could make when faced with a covariate shock that has opposite effects on households.

Finally, *Table G.1* in *Appendix G* breaks down the short and long-term poverty results by district. In relation to the price index findings in *chapter 4*, the results in *Table G.1* show that the effects are varied. Among the districts with the highest price inflation, only the capital city Lusaka exhibited a rise in levels of poverty. Other districts such as Mpongwe, Luangwa and Luwingu experienced a decline in levels of poverty (both in the short and long-run). This is possibly a result of fewer households in Lusaka being engaged in agricultural activities.

Table 5.3: Estimated food price effects on poverty headcount (without supply elasticity)

		Percentage point change in poverty headcount ratio				
	Baseline (2006 LCMS)	Maize grain	Less-refined maize flour	Refined maize flour	Rice	Cereals
		Rural (per cent)				
Severe	**58.5**	-0.8 (57.7)	-3.7 (54.8)	-3.9 (54.6)	0.8 (59.3)	1.7 (60.2)
All rural	**80.3**	-1.5 (78.8)	-2.5 (77.8)	-2.5 (77.8)	0.7 (81)	-0.2 (80.1)
		Urban (per cent)				
Severe	**13**	1.3 (14.3)	2.1 (15.1)	2.2 (15.2)	1 (14)	2.4 (15.4)
All urban	**29.7**	1.7 (31.4)	2.4 (32.1)	4.5 (34.2)	2.1 (31.8)	2.9 (32.6)
All Zambia	**62.8**	0.1 62.9	-0.4 62.4	0.3 63.1	1.7 64.5	1.4 64.2

Source: authors' calculations based on 2006 LCMS. Baseline Results are based on Government LCMS poverty estimates (Government of the Republic of Zambia, 2011d)
In parenthesis: shows actual poverty level

Table 5.4: Estimated food price effects on poverty gap and squared poverty gap (without supply elasticity)

	Percentage point change in poverty gap				
	Baseline	Maize grain	Less-refined maize flour	Refined maize flour	Rice
Rural	42.7	42.3(-0.4)	42.2(-0.5)	42.5(-0.2)	42.8(0.1)
Urban	10.6	11.2(0.6)	11(0.4)	11(0.4)	11.2(0.6)
National	31.5	31.9(0.4)	31.7(0.2)	31.9(0.4)	32.2(0.7)
	Percentage point change in squared poverty gap*				
Rural	27	26.9(-0.1)	26.9(-0.1)	26.9(-0.1)	27(0)
Urban	5.2	5.5(0.3)	5.45(0.25)	5.5(0.3)	5.5(0.3)
National	19.4	19.7(0.3)	19.6(0.2)	19.7(0.3)	19.8(0.4)

Source: authors' calculations based on 2006 LCMS. Baseline Results for poverty headcount are based on Government LCMS poverty estimates (Government of the Republic of Zambia, 2011d).
In parenthesis: change in gap/ squared poverty gap relative to baseline
**Squared poverty gap results are based on authors' estimates as these were not reported in the LCMS report*

Table 5.5: Food price effects on poverty headcount (with supply elasticity)

	Baseline (2006 LCMS)	Maize grain	Less-refined maize flour	Refined maize flour
		Commodity		
		Rural (per cent)		
Severe		-2.6	-4.9	-5.2
	58.5	(55.9)	(53.6)	(53.3)
All rural		-3	-3.7	-3.9
	80.3	(77.3)	(76.6)	(76.4)
		Urban (per cent)		
Severe		1.2	1.9	2.1
	13	(14.2)	(14.9)	(15.1)
All urban		1.5	2.3	4.3
	29.7	(31.2)	(32)	(34)
		-0.7	-1.3	-0.1
All Zambia	**62.8**	(62)	(61.5)	(62.1)

Source: authors' calculations based on 2006 LCMS
In parenthesis: shows actual poverty level

Table 5.6: Estimated food price effects on poverty gap and squared poverty gap (with supply elasticity)

	Baseline	Maize grain	Less-refined maize flour	Refined maize flour
	Percentage point change in poverty gap			
Rural	42.7	41.6(-1.1)	39.6(-3.1)	40.2(-2.5)
Urban	10.6	11.2(0.6)	12(1.4)	12(1.4)
National	31.5	31.4(-0.1)	30.3(-1.2)	30.7(-0.8)
	Percentage point change in squared poverty gap*			
Rural	27	26.6(-0.4)	24.7(-2.3)	25(-2)
Urban	5.2	5.5(0.3)	6.1(0.9)	5.9(0.7)
National	19.4	19.5(0.1)	18.5(-0.9)	18.6(-0.8)

Source: authors' calculations based on 2006 LCMS. Baseline Results for poverty headcount are based on Government LCMS poverty estimates (Government of the Republic of Zambia, 2011d).
In parenthesis: change in gap/ squared poverty gap relative to baseline
**Squared poverty gap results are based on authors' estimates as these were not reported in the LCMS report*

5.5. Sensitivity Analysis

Recall that the estimation of the effect of rising food prices on poverty takes into consideration the net benefit ratio. Given that section 5.3 graphically showed a wide dispersion of the regression estimates for the poorer households, especially maize grain in rural areas, further consideration of how this phenomenon would influence poverty effects is required. Despite having conducted the usual consistency checks and elimination of gross outliers before any analysis (as elaborated in section 3.2), we assess separately the relative importance of observations at the tail ends by excluding one per cent of observations from the bottom and top of the consumption distribution.

Using this sub-sample, we re-estimate all the poverty results, that is, the baseline results and the short and long-run effects of higher food prices. The results are presented in the tables in Appendix H. For the poverty headcount results (without supply elasticity), it should be noted that there was a slight variation in the baseline results for severe poverty in both urban and rural areas and for the overall poverty estimates in urban areas. The implication is that we were unable to fully replicate the poverty results as estimated by the Government. This is likely to be driven by the disparity between the Governments' sample and our sub-sample given that we excluded some observations. In all instances, the variation in baseline results is not more than 0.3 percentage points.

In general, the poverty estimates in the short-term (Table H.1) and once prices are taken into consideration remains about the same. Specifically, the estimated severe poverty headcount, relative to the full sample, are the same except for a further marginal reduction in poverty for refined maize flour (0.1 percentage point) in rural areas. This may result from excluding a proportion of the poorest households in the sample. In terms of overall poverty in rural areas and in comparison with the full-sample results, a further decline in poverty is observed but the difference is slight (not more than 0.2 percentage points). In urban areas, the direction of poverty estimates is the same, that is a rise in food prices is poverty increasing. The increase is however slightly less than in the full-sample (not more than 0.3 percentage points in each of the cases where a variation is observed).

Similarly, poverty headcount estimates in the long-run (Table H.3) despite slight variations relative to the full sample show that the rise in food prices was poverty reducing in rural areas and poverty increasing in urban areas. Here too, excluding 1 per cent on both sides made the poverty results in the long-run decline more among rural households. Analogous to the short-term results and relative to the full-sample, the results varied by 0.3 percentage points or less. Similar observations are also made for poverty gap and severe poverty gap estimates.

This implies that the poverty estimates in the present research are not driven by the extreme values in the data as depicted in graph 5.4 where the poorest rural households exhibited a positive net selling position. Therefore, the results confirm prior findings that the rise in food prices may be poverty reducing in rural areas but poverty increasing in urban areas. Furthermore, the finding that poverty levels may decline slightly in the long run given the rise in food prices also holds.

5.6. Conclusion

By following the commonly used non-parametric framework by Deaton (1989), this chapter assessed the distributional impact of higher food prices on household welfare in Zambia. We then examined the effect of these higher prices on poverty using the first-order effects and also incorporated the supply elasticity. The net benefit ratio results show that rural households would benefit from high prices of commodities. In particular, the households around the poverty line in the case of maize grain would gain the most. For example, if prices of the refined maize flour doubled, poor households in rural areas would gain up to about 6 per cent. Also notable however is that some households below the poverty line in rural areas would suffer a welfare loss. On average, the poor households in urban areas and cities would suffer the highest welfare loss if prices of refined maize flour increased. This result was consistent across other maize products.

In relation to comparing the net benefit ratio using producer and consumer prices, predictably, we found that producers did not capture the full benefits of the price increase. More importantly, the results show that the net benefit share was much less for poorer households in rural areas. In the case of maize, the net benefit ratio was negative (about -0.1) for some rural households below the poverty line when estimated using producer prices but positive and large (5 per cent) when consumer prices are used.

A first-order estimation on poverty confirms the finding that in general, food prices appear to be poverty reducing in rural areas but poverty increasing in urban areas. This confirms the graphical evidence from the net benefit ratio analysis that indeed, most urban households are net buyers of food. Once the supply elasticity of maize is taken into account, poverty declines further (between 1.2 and 1.5 percentage points for maize grain, refined and less-refined maize flour) in rural areas. In urban areas, the reduction is slight (between 0.1 and 0.2 percentage points). The poverty gap and squared poverty gap results portray a similar trend. Specifically, the poverty gap results show that on average, households in rural areas fall far below the poverty line in comparison to urban areas.

Interestingly, the results further show that poverty levels for the entire country increases in the short run for almost all commodities but declines slightly in the long run. As suggested by Minot and Goletti (2000), even if a rise in food prices reduces poverty in the long run, the poor still bear the burden of adjustment in the short-run. This finding suggests that in the long run, the gains to rural households outweigh the loss incurred by urban households, which results in a slight improvement in overall wellbeing of Zambian households. This finding is similar to a small body of literature that finds that short and long-term results could be in opposite directions (for example, Ravallion 1990; De hoyos and Medvedev 2009; and Headey 2014).

While these findings offer useful insights on the impact of rising food prices on household welfare in Zambia, the results could be improved by incorporating more second-order effects (such as wages in both the formal and informal economy) or conducting a general equilibrium approach. In general, the findings point towards a policy challenge of whether to protect consumers from rising food prices or enable producers to fully benefit from it. In the Zambian context however, this issue is more challenging as the current practice is such that the government purchases maize from farmers at a higher price (K65,000) and sales to millers at a lower price (K44,000)[68]. It is possible that the floor price is an incentive to farmers. As argued

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[68] The figure of K44,000 is referenced from field interviews with a non-state actor in Zambia in 2012. According to the respondent, governments' practice of subsidising both consumption and production discourages the private sector from actively participating in the market.

by a government official within the Ministry of Agriculture, the increase in production levels between 2006 and 2010 is mainly a result of government intervention through the favourable price and the assured market provided by the Food Reserve Agency (Field interview, 2012).

Chapter 6: Impact of rising food prices on nutrition

6.1. Introduction

One of the consequences of a rise in food prices is that it would induce households to substitute away from expensive foods *(see chapter 2 and 4)*, which may have consequences on nutrition outcomes. Skoufias, Tiwari and Zaman (2012) argue that even short-lived price spikes can reduce calorie intake and compromise dietary diversity. It may also have adverse long run consequences, particularly when infants are affected (Alderman et al., 2006).

This chapter responds to two research questions. *Section 6.2* contributes to the discussion started in *chapter 4* related to whether Zambian households adjusted their consumption patterns between 2006 and 2010. Based on the findings in *chapter 4*, the hypothesis that households consumed fewer proteins and more calorie-rich foods after the food crisis was confirmed. However, after disaggregating these results by rural and urban areas, the adjustment from protein to calorie-rich foods was only evident among rural households. In urban areas, households maintained the consumption of protein-rich foods (particularly animal-source proteins) but substituted within the maize group. More specifically, urban households increased their consumption of the cheaper, less-refined maize flour while consumption of refined maize flour declined.

The hypothesis being tested in the present chapter on adjusting consumption patterns arises from the concern that high prices of food commodities may induce households to substitute away from foods that are high in required nutrients. As discussed in the literature section of *chapter 2*, some authors who have written on this subject find that in general, households substitute across and within food groups when food prices increase (see for example D’souza and Jolliffe, 2010). *Section 6.3* on the other hand explores the possible effect of the changes in food consumption patterns on height for age z-scores for children below five years old. The assumption here is that a rise in food prices may have important impacts on height-for-age z-scores (HAZ) for children under the age of five. Furthermore, it can be expected that the impact of high food prices on HAZ varies across regions (rural/ urban), gender and age groups. *Section 6.4* concludes the chapter.

Unlike the first two empirical chapters that focused on households (by using variables such as household consumption shares), the second part of the present chapter focuses on the impact on individual health outcomes. For this analysis, it would be ideal to observe food and nutrient intakes at an individual level. However, as the LCMS collects data at household level and person-specific costs with the price data cannot be distinguished, we make the assumption that consumption is equally distributed within households. This assumption may not be very realistic, as has been argued by the vast literature that looked at intrahousehold resource allocation. Haddad, Hoddinott and Alderman, (1997) for instance argue that the unitary model (where the household acts as one) analysis may lead to incomplete understanding of household preferences and policy failures. Others, such as Quisumbing and Maluccio (2000), have used the concept of "bargaining power" to understand the allocation of resources among individuals within the household. These authors find that relative to wives in Indonesia, husbands' paddy land has a negative effect on the food expenditure share, hence, rejecting the unitary model.

Despite this data challenge, the analysis presented in this section shows the importance of assessing the effect of such covariate shocks on long term effects. The focus on children below the age of five is crucial given the potential irreversible effects that could arise from poor child nutrition (more details in *section 6.3* below).

6.2. Changes in nutrients consumed

Unlike *chapter 4,* where the adjustment in consumption across and within food groups was estimated using the share of the household food budget devoted towards a particular commodity, the current section provides information on actual nutrients consumed. It also shows estimates of the change in macro and micro nutrients consumed between 2006 and 2010.

To conduct the analysis in this section, information on quantities of food consumed was used. However, as described in the data section of *chapter 3*, this information was not collected in the 2006 survey. Therefore, we imputed the monthly quantities consumed from the total consumption and district level prices for each product. We then converted the quantities to specific nutrients (e.g. kilocalories) utilising the figures from the National Food and Nutrition Commissions' food composition table for Zambia (National Food and Nutrition Commission, 2007). The food composition table contains data on various macro and micro-nutrients for each food item.

Using this information, we were able to directly assess the nutritional impact of the price increases, rather than just the changes in consumption. The conversion was made for the following macro and micro-nutrients for each of the food commodities considered in this research: calories, protein, vitamin A, vitamin C, zinc, calcium and iron. For *Table 6.4* (described below), we further divided the quantities by the effective adult equivalent to obtain quantities consumed per person per day.

Since we estimated the nutrients from data on consumption and not dietary intake diaries, the results indicate *calorie availability* rather than *calorie intake*. Jensen and Miller (2011) argue that consumption data may not accurately measure nutrition due to food given to others or wasted, or food eaten from elsewhere. Using data from rural Philippine, Bouis and Haddad (1988) found that there is a difference between the estimated responsiveness of household nutrient availability and nutrient intakes of household members to total changes in consumption. According to these authors, the difference arises from a substantial amount of food availability being made up of food provided to labourers and guests. Furthermore, we estimated these nutrients from raw products and hence, did not estimate the loss arising from the cooking process. Measurement errors in nutrients may also arise from "plate wastage" and food fed to domestic animals (Bouis and Haddad, 1992). Therefore, the estimated nutrients reported in this section as having been consumed by households is likely to have been overestimated.

Table 6.1 provides details of some macro (calories and proteins) and micro-nutrients (vitamin A, vitamin C, zinc, calcium and iron) per 100 grams of the selected commodities[69]. All these nutrients have different functions and play a significant role in the well-being and health of individuals. Protein and calories provide energy to the body. Vitamin A is an important nutrient for strengthening the immune system, visual system, reproduction, growth and development (Food and Agriculture Organisation and World Health Organisation, 2001). Vitamin C helps protect cells and keeps them healthy. As suggested by FAO and WHO (2001), insufficient vitamin C in the diet may lead to a potentially lethal deficiency disease called scurvy. On the other hand, zinc helps make new cells and enzymes and deficiency in zinc is associated with an increased risk of severe and persistent diarrhoea, pneumonia and stunting (Christian, 2010). Calcium helps build strong bones and teeth while iron helps make red blood cells, which carry oxygen around the body. The FAO and WHO (2011) further suggest that worldwide, the highest prevalence of iron deficiency is found in infants, children, adolescents, and women of childbearing age, especially pregnant women. The weaning period in infants is especially critical because of the very high iron requirements at that stage.

In general, negative health outcomes are known to occur if the intake of these nutrients is below requirements. As discussed by Murphy and Allen (2003), the negative health outcomes can be comparatively mild (e.g. anaemia, reduced energy, night blindness and poor growth) or very severe (e.g. rickets, impaired cognitive development, blindness and death). Black, et al., (2008) conducted estimates of micro-nutrient deficiencies on global health and found that the largest disease burdens were attributed to vitamin A and zinc deficiencies. The authors estimated that 6.5 per cent per cent of deaths of children under 5 can be attributed to vitamin A deficiency, while 4.4 percent of deaths in children under 5 result from zinc deficiency.

The information in *Table 6.1* reveals that bream fish has the highest energy levels per 100 gram of food, followed by less-refined and refined maize flour. Furthermore, bream fish contains the highest levels of protein followed by kapenta. As recently asserted by the High Level Panel of Experts on Food Security and Nutrition, fish is more nutritious than staple plant foods, and provides high levels of

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[69] Similar analysis was conducted for all food commodities used in this research. The commodities reflected in the table are illustrative only.

animal protein and micronutrients (High Level Panel of Experts, 2014). The panel further argued that fish can play an extremely important role in improving the nutritional status of individuals, in particular those at risk of malnutrition such as children and pregnant women. Aside from having higher protein contents, animal-source foods such as fish also have high contents of micronutrients such as iron and vitamin A, which are critical for growth and cognitive development (Sari et al., 2010). Perhaps more important is that animal-source proteins contain all the twelve essential amino acids that make up a protein. By contrast, the protein found in grains and pulses lacks one or two of these essential amino acids. Therefore, an individual would have to consume a combination of food items, such as grains and pulses, to get all the essential amino acids (see for example, Jensen and Miller, 2011).

However, the main source of protein for Zambian households is maize grain and its products (*Table 6.2*), as households consume higher quantities of maize than they do fish as found in chapter 4.

Table 6.1: Nutrients for select food commodities (per 100 grams)

Commodity (raw)	Energy (kcal)	Proteins (g)	Vitamin A (ug)**	Vitamin C (mg)	Zinc (mg)	Calcium (mg)	Iron (mg)
Maize grain	172	4.4	0	0	0	25	1
Refined maize flour	354	7	0	0	0	9	2
Less-refined maize flour	363	7	0	0	0	9	2
Cassava	160	1.4	1	20.6	0.3	16	0.3
Rice	309	6	0	100.8	0.56	1.1	20.9
Vegetables*	78	6.76	0	49.4	0.13	0.61	5.53
Chicken	219	24.7	44	0	1.8	13	1.2
Bream Fish	382	67	0	0	0	0	6
Kapenta	209	63	540	0	0	3000	8.5
Beef	202	19	0	0	0	10	3
Eggs	158	13	300	0	0	55	2.8

Source: Food Composition Table (National Food and Nutrition Commission, 2007) and authors' calculations based on 2006 and 2010 LCMS

*the nutrients reflected here are for the most commonly consumed vegetable in Zambia called Rape plant

**ug is micrograms

Similar to household food budget shares discussed in *chapter 4*, *Table 6.2* shows that households indeed acquired more calories from less-refined maize flour in 2010 relative to 2006 when their calorie consumption was dominated by refined maize flour. Both refined and less-refined maize flour show striking changes during the period under review. The share of calories from refined maize flour declined by 12 percentage points while the share of less-refined maize flour shows an upward spike of 21 percentage points. Similarly, the share of nutrients from vegetables increased.

Table 6.2: Calorie and protein shares for 2006 and 2010

	Calories			Proteins		
Commodities	**2006**	**2010**	**Difference**	**2006**	**2010**	**Difference**
Maize grain	0.178(0.266)	0.145(0.260)	0.034***	0.165(0.254)	0.124(0.230)	0.041***
Refined maize flour	0.186(0.263)	0.062(0.188)	0.124***	0.144(0.217)	0.050(0.155)	0.09***
Less refined maize flour	0.052(0.180)	0.264(0.319)	-0.212***	0.044(0.156)	0.208(0.265)	-0.164***
Rice	0.040(0.061)	0.004(0.025)	0.036***	0.028(0.046)	0.003(0.018)	0.025***
Cassava	0.058(0.172)	0.028(0.108)	0.030***	0.029(0.108)	0.011(0.054)	0.018***
Millet	0.009(0.063)	0.010(0.074)	-0.001	0.007(0.053)	0.008(0.061)	-0.001
Sorghum	0.005(0.050)	0.001(0.023)	0.004***	0.005(0.052)	0.001(0.023)	0.004***
Bread	0.065(0.084)	0.049(0.083)	0.016***	0.066(0.086)	0.050(0.084)	0.016***
Sweet Potatoes	0.003(0.021)	0.022(0.071)	-0.020***	0.001(0.012)	(0.041)0.011	-0.001***
Irish Potatoes	0.006(0.015)	0.006(0.019)	0.000	0.005(0.013)	0.005(0.017)	0.000
Chicken	0.024(0.039)	0.028(0.048)	-0.004***	0.086(0.100)	0.092(0.120)	-0.007***
Beef	0.013(0.026)	0.011(0.026)	0.002***	0.038(0.060)	0.031(0.060)	0.006***
Pork	0.004(0.022)	0.004(0.021)	0.000	0.006(0.028)	0.005(0.024)	0.001*
Bream fish	0.013(0.034)	0.002(0.012)	0.011***	0.071(0.100)	0.012(0.044)	0.059***
Kapenta	0.008(0.024)	0.004(0.012)	0.004***	0.071(0.098)	0.036(0.066)	0.035***
Vegetables	0.039(0.056)	0.103(0.157)	-0.064***	0.108(0.124)	0.231(0.228)	-0.123***
Beans	0.015(0.030)	0.015(0.034)	0.000	0.034(0.548)	0.032(0.061)	0.002***
Onion	0.004(0.011)	0.005(0.010)	-0.001***	0.004(0.011)	0.004(0.012)	-0.001***
Tomatoes	0.006(0.016)	0.005(0.010)	0.001***	0.011(0.021)	0.010(0.276)	0.001***
Eggs	0.006(0.010)	0.007(0.015)	-0.001***	0.015(0.025)	0.018(0.033)	-0.002***
Cooking Oil	0.142(0.126)	0.098(0.105)	0.044***	-	-	-
Groundnuts	0.029(0.068)	0.026(0.068)	0.003***	0.050(0.103)	0.041(0.091)	0.009***
Butter	0.004(0.013)	0.003(0.011)	0.001***	0.000(0.000)	0.000(0.000)	0.000***
Sugar	0.083(0.083)	0.076(0.092)	0.007***	-	-	-
Tea/ coffee	0.000(0.000)	0.000(0.000)	0.000	-	-	-
Fresh milk	0.005(0.015)	0.005(0.015)	0.000	0.009(0.022)	0.008(0.026)	0.000*
Powdered milk	0.001(0.001)	0.001(0.006)	0.000***	0.002(0.011)	0.002(0.011)	0.000***
Salt	0.000	0.000	0.000	-	-	-
Fruits	0.002(0.009)	0.014(0.036)	-0.011***	0.001(0.005)	0.007(0.022)	-0.006***

Source: authors' calculations based on 2006 and 2010 LCMS

*Notes: Standard deviations in parenthesis. Significance of the difference in means based on a t-test for continuous variables. ***p<0.01, **p<0.05, *p<0.1*

An analysis of protein shares suggests that households are substituting from animal-source foods known to be rich in proteins to more starchy foods. The share of proteins from bream fish and kapenta declined significantly while that of chicken and beef remained about the same. However, as the protein rich foods such as kapenta also have other high micro nutrients, there is a displacement in shares of some other nutrients such as vitamin A and reductions in others such as calcium. After disaggregating by rural and urban areas *(appendix J.1 and J.2)*, the results are similar. Unlike the findings observed in *chapter 4*, where urban households maintained the share of the budget allocated towards animal-source foods like fish and beef, there is a significant decline in the share of nutrients from bream fish and kapenta. This observation is expected in view of the price rise. On average, the findings therefore suggest that households increase consumption of calories while reducing the intake of animal-source proteins. Similar to chapter 4, this finding is stronger for rural than urban areas. As such, the hypothesis that *households, predominantly those in urban areas, will reduce consumption (and hence intake) of protein and micro-nutrients as they substitute protein rich food for energy rich foods such as maize* is not entirely met.

To reiterate, despite the fact that animal-source foods have higher levels of protein (*Table 6.2*), the main source of protein for households in both 2006 and 2010 were vegetables and commodities that are typically rich in calories such as maize grain. One explanation for this scenario is that households consumed higher quantities of maize products and vegetables than animal source foods. T*able 6.3* shows the estimated proteins consumed using information from *Table 6.2* and *Table 6.1*. This estimate reveals that some animal-source proteins were relatively more expensive than proteins from maize grain. Using the average cost of commodity prices in 2006, it would cost about K1,285 to obtain 100g of protein from chicken and K2,956 for kapenta while 100g of protein from maize grain and vegetables would cost K67.9 and K168, respectively.

As earlier referenced, Jensen and Miller (2011) argued that households (especially those who are poorer) consume higher staple quantities to get enough calories and if there is extra income, they use it to purchase animal-source foods. As a result, consumers spend a higher fraction of their budget on, and receive most of their nutrition from the staple food.

Table 6.3: Cost of protein per 100g

	Commodities	Maize grain	Refined maize flour	Less-refined maize flour	Vegetables	Chicken	Beef	Bream fish	Kapenta
	Protein content per 100g	**4.4**	**7**	**7**	**6.76**	**24.7**	**19**	**67**	**63**
2006	Quantities consumed	27.4	60.3	61.2	12.2	3.0	2.9	0.74	0.6
	Total Protein	1205.6	2653.2	2692.8	536.8	132	127.6	32.6	26.4
	Price per 100g (Kwacha)	**67.9**	**148.5**	**110.3**	**168**	**1285**	**1399**	**1177**	**2956**
2010	Quantities consumed	56.0	28.4	55.3	18.6	5.0	3.5	0.9	0.6
	Total Protein	2464	1249.6	2433.2	818.4	220	154	39.6	26.4
	Price per 100g (Kwacha)	**104.25**	**217.2**	**155.04**	**277**	**1775**	**2081**	**1553**	**5974**

Source: authors' calculations based on 2006 and 2010 LCMS

Based on the findings and adjustments in food consumed, we also analysed the average nutrients consumed by a household (*Table 6.4*). In general, the table shows that both the 2006 and 2010 consumption levels fall below the recommended daily allowance for energy, protein and vitamin A. The NFNC recommends about 2,300 kilocalories (kcal) as the daily allowance per person per day, slightly higher than the conventional nutritional benchmark of 2,100 kcal per person per day. The total consumed kcals in 2006 and 2010 (*Table 6.4*) fall below either of these targets. Considering the levels of deficit across both years, it is therefore not surprising that stunting levels are very high in Zambia.

Analysis of the data shows that the overall levels of stunting was 39.5 percentage points in 2006 and 38.9 percentage points in 2010. However, the difference in stunting levels is not statistically different from zero. Once disaggregated by region, stunting in rural areas declined slightly from 43.8 to 41.7 percentage points between 2006 and 2010. In urban areas, a marginal increase in stunting from 35.8 to 36.6 percentage points in 2006 and 2010 respectively was recorded. We draw two conclusions from these results. The first is that without the food price crisis, it is possible that child health outcomes in Zambia would have been significantly better. As these levels of stunting are averages within the population, it is possible that the results are being influenced by other welfare changes at household level. As such, the estimates point towards the need to control for other relevant variables to further understand the impact of the rise in food prices of individual items on child health.

By way of comparison, in 2005, stunting levels in all developing countries were at 32.5 per cent and declined to 29.2 per cent in 2010. In Southern Africa, the average was 33.5 per cent in 2005 and declined slightly to 32.9 per cent in 2010 respectively (De Onis et al., 2011). However, other micronutrients such as vitamin C, calcium and iron[70] are actually consumed in excess. For example, *Table 6.4* shows that while a total of 1,440mg of iron are required for an average family in Zambia, 2,198 and 2,125 were consumed in 2006 and 2010 respectively.

While households fail to meet the recommended nutrition benchmark, in general, the results in *Table 6.4* suggest that despite the increase in prices, consumption of nutrients increased slightly in 2010. Note however that the difference is not statistically different from zero for nutrients gained from energy-rich foods such as maize and its products.

[70] Within the nutrition literature, evidence exists that iron supplementation can lead to serious illness, particularly in malaria endemic areas. Therefore, WHO currently recommends administration of iron supplements in malaria endemic areas on the stipulation that malaria prevention and treatment is made available (Bhutta, et al., 2013; Sazawal et al., 2006; WHO 2011).

Table 6.4: Total nutrients consumed

Nutrients	Total Require-ment for an Average family^	Require-ment per person per day	Require-ment per person per day (adult equivalent)	Total consumption levels		Differ-ence (based on total consumption levels)	Consumption per person per day (adult equivalent)	
				2006	**2010**		**2006**	**2010**
Energy (kcal)	**294,000**	1,960	2,333	**223,998**	**227,496**	**-3498**	1,778	1,806
Proteins (g)	**7,380**	49	59	**5,946**	**6,322**	**-376*****	47	50
Vitamin A (ug)	**84,750**	565	673	**10,734**	**11,103**	**-369***	85	88
Vitamin C (mg)	**3,600**	24	29	**9,029**	**10,401**	**-1372*****	72	83
Zinc (mg)	**66**	0	1	**139**	**153**	**-14*****	1	1
Calcium (mg)	**84,000**	560	667	**30,211**	**31,469**	**-1258***	240	250
Iron (mg)	**1,440**	10	11	**2,198**	**2,125**	**73***	17	17

Source: authors' calculations based on 2006 and 2010 LCMS raw data, Central Statistical Office district price data and National Food and Nutrition Commission food composition table

^Estimated for an average family of 5 in Zambia by the NFNC using daily allowance recommendations

*Notes: Standard deviations in parenthesis. Significance of the difference in means based on a t-test for continuous variables. ***p<0.01, **p<0.05, *p<0.1*

Finally, we supplement the above analysis by estimating the ratio of starch found in the staple diet of a household. As described in *chapter 3*, Bennett's law states that the "starchy staple ratio - SSR" declines as household incomes increase. The SSR is calculated as the calories obtained from starchy staple foods such as cereals and tubers as a share of total calories. Skoufias et al., (2012) argues that the SSR is a more useful aggregate measure of welfare than is total caloric availability per capita, as it captures diversity in diets.

The commodities we used to calculate the SSR are maize grain, maize flour (refined and less-refined), cassava, millet, sorghum, rice, bread, sweet potatoes and Irish potatoes. The results *(Table 6.5)* show that in 2006, the total SSR in rural areas was 0.6 but declined to 0.51 in 2010. In urban areas however, the SSR increased slightly from 0.6 to 0.64. Following Bennett's law, this implies that incomes increased in rural areas but declined in urban areas. After disaggregating the results by quintile, the confirmation of Bennett's law is even stronger between 2006 and 2010. However, within-year analysis of Bennett's law reveals some mixed results. In general, the SSR in the quintile 2, 3 and 4 are about the same implying that the level of diversification of the food consumption bundle in these quintiles is very similar. This is especially so for 2010 estimates (both rural and urban areas). For quintile 5, SSR is as expected, slightly lower. The anomaly therefore lies largely with quintile 1. The implications of the results for this quintile are more difficult to assess given that we observed a high level of dispersion when estimating the NBR for the poorest households, especially in rural areas. To reiterate, across year results confirm Bennett's law but not the within-year results.

Table 6.5: SSR by geographical location and year

	Rural			Urban		
	2006	2010	Difference	2006	2010	Difference
Quintile 1	0.606(0.305)	0.474(0.367)	0.132***	0.508(0.324)	0.582(0.327)	-0.074***
Quintile 2	0.601(0.235)	0.535(0.302)	0.066***	0.592(0.246)	0.638(0.256)	-0.046***
Quintile 3	0.597(0.230)	0.542(0.276)	0.056***	0.624(0.197)	0.666(0.213)	-0.042***
Quintile 4	0.573(0.206)	0.544(0.260)	0.030**	0.624(0.176)	0.657(0.189)	-0.033***
Quintile 5	0.574(0.200)	0.512(0.238)	0.062***	0.594(0.159)	0.614(0.174)	-0.020***
All	0.600(0.261)	0.512(0.321)	0.088***	0.604(0.200)	0.637(0.219)	-0.033***

Source: authors' calculations based on 2006 and 2010 LCMS raw data, Central Statistical Office district price data and National Food and Nutrition Commission food composition table

**Estimated for an average family of 5 in Zambia by the NFNC using daily allowance recommendations*

*Notes: Standard deviations in parenthesis. Significance of the difference in means based on a t-test for continuous variables. ***p<0.01, **p<0.05, *p<0.1*

The next section further explores the impact of rising food prices on child nutrition. Considering the high levels of stunting in the country, child height, conditional on age and gender, is used instead of low weight for age z-scores as a measure of child nutrition outcomes. Stunting is a good predictor of long run cognitive and other human capital deficits, particularly when children are below minus two standard deviations (-2 SD) in first 2 years of life (Thomas et al., 1990, Barrera, 1990, Government of the Republic of Zambia, 2009d). Therefore, stunting is an indicator of longer term health outcomes while wasting could be transitory[71]. For example, a child may lose weight quickly when they are ill. As asserted by Waterlow et al., (1977), wasting is an indicator of present state of nutrition while stunting is an indicator of past nutrition.

[71] We also estimated the impact of high food prices on weight for height z-scores (WHZ) and the weight for age z-scores (WAZ). Results are presented in *Appendix J*.

6.3. Impact of rising food prices on child nutrition[72]

This section responds directly to question three on the impact of rising food prices on child health outcomes. It therefore compares the nutritional outcomes of children under 5 years old before and after the 2007/8 price rise in Zambia. The accompanying hypothesis therefore is that a rise in food prices may have important impacts on height-for-age z-scores (HAZ) for children below the age of five.

There is a significant amount of literature on the importance of nutrition in early childhood. For example, using longitudinal data from rural Zimbabwe, Alderman, Hoddinott and Bill (2006) showed that improved pre-schooler nutritional status, as measured by height for age, is associated with increased height as a young adult, higher level of grades attained, and an earlier age at which the child starts school. Behrman and Hoddinott (2005; p.548) and Brinkman,., (2010; p. 153) argue that physical growth lost in early years as a consequence of malnutrition is, at best, only partially regained during childhood and adolescence, particularly when children remain in poor environments. Similarly, the FAO (2013) suggests that stunting causes permanent impairment to cognitive and physical development that can lower educational attainment and reduce adult income.

On the other hand, the potential for catching up during adolescence for previously stunted children has been studied by some researchers. For example, using longitudinal data from Tanzania, Hirvonen (2014) found considerable catch-up growth for individuals who were stunted in childhood. Despite these findings, questions remain on the lasting effect of deficits in cognitive development among children. Grantham-McGregor et al., (2007) argue that early childhood under-nutrition is associated with long-term deficiencies in cognition and educational outcomes.

Meanwhile, Thomas and Strauss (1992) investigated the effect of prices on child heights using Brazilian data. Focusing on food groups, which are likely to have an impact on the health of children, they found that higher prices for dairy products and sugar are associated with shorter children and that this effect is greater for urban

[72] A substantial part of this section has been published as a paper in Harris, Haddad, & Grütz (eds.) 2014.

children. They also found that a rise in the price of cereals has positive effects on rural children. In urban areas, a rise in the price of beans was associated with taller children at the bottom of the consumption distribution. Similarly, a study by Christiaensen and Alderman (2004) in Ethiopia found that higher teff (Ethiopia's main staple) prices are associated with shorter children while higher maize, sorghum, beef and milk prices are associated with taller children. These studies confirm that the effects of rising prices on nutrition outcomes of children are dependent on the commodity and other factors such as the area of residence and age.

The analysis in this section contributes to the literature in four ways: (i) unlike previous studies, this study analyses the effect of 17 different food commodities on child nutrition outcomes. Previous studies analysed a limited number of food products or food groups (ii) instead of treating all under-five children as one group, age has been categorised into three groups: six months and below; between 6 months and 2 years and between two and five years (see below for details). This is because the impact of rising food prices is likely to vary across age groups, (iii) We utilize datasets that coincide with the period of the crisis and (iv) to the best of our knowledge, this is the first empirical work on Zambia that focuses on the direct link between the change in prices of particular food commodities and their effect on child health outcomes. A number of papers have been written on the effect of food prices on households in Zambia but none of them focuses on the link to stunting.

In the analysis, height for age is converted into the standardised z-scores using the U.S data as an international reference standard (see Kuczmarski et al., (2000)). The growth of children with a z-score of -2 SD is considered unhealthy growth (World Health Organisation, 1995; p.7).

6.3.1. Impact pathway and empirical strategy

Impact pathway

Assessing the cause of the health outcome of a child is complex. This is because there are multiple factors that contribute to the health status of the child. These include food access, caring practices, health care and the health environment, which maybe outside an individual's control (Brinkman et al., 2010, Thomas et al., 1990, Pitt and Rosenzweig, 1985, United Nations Children's Fund, 1990). Some important aspects in the environment are access to water and sanitation conditions.

One of the most comprehensive conceptual frameworks to guide the causes of malnutrition among children and women was developed by UNICEF (1990). The framework traces the pathway from causes to manifestation (in this case, nutrition status of children). It groups the causes into the following clusters:

a) *basic causes* (social, economic and political context)
b) *underlying causes* (inadequate supply of food, mothers not devoting enough time to care for their children and poor environmental health) and
c) *immediate causes* such as inadequate dietary intake and disease.

This framework has been adapted by others such as the WFP (2012) who expanded the framework to include livelihood strategies as the link between basic and underlying causes. These include household food production, income generating activities, loans, savings and transfers.

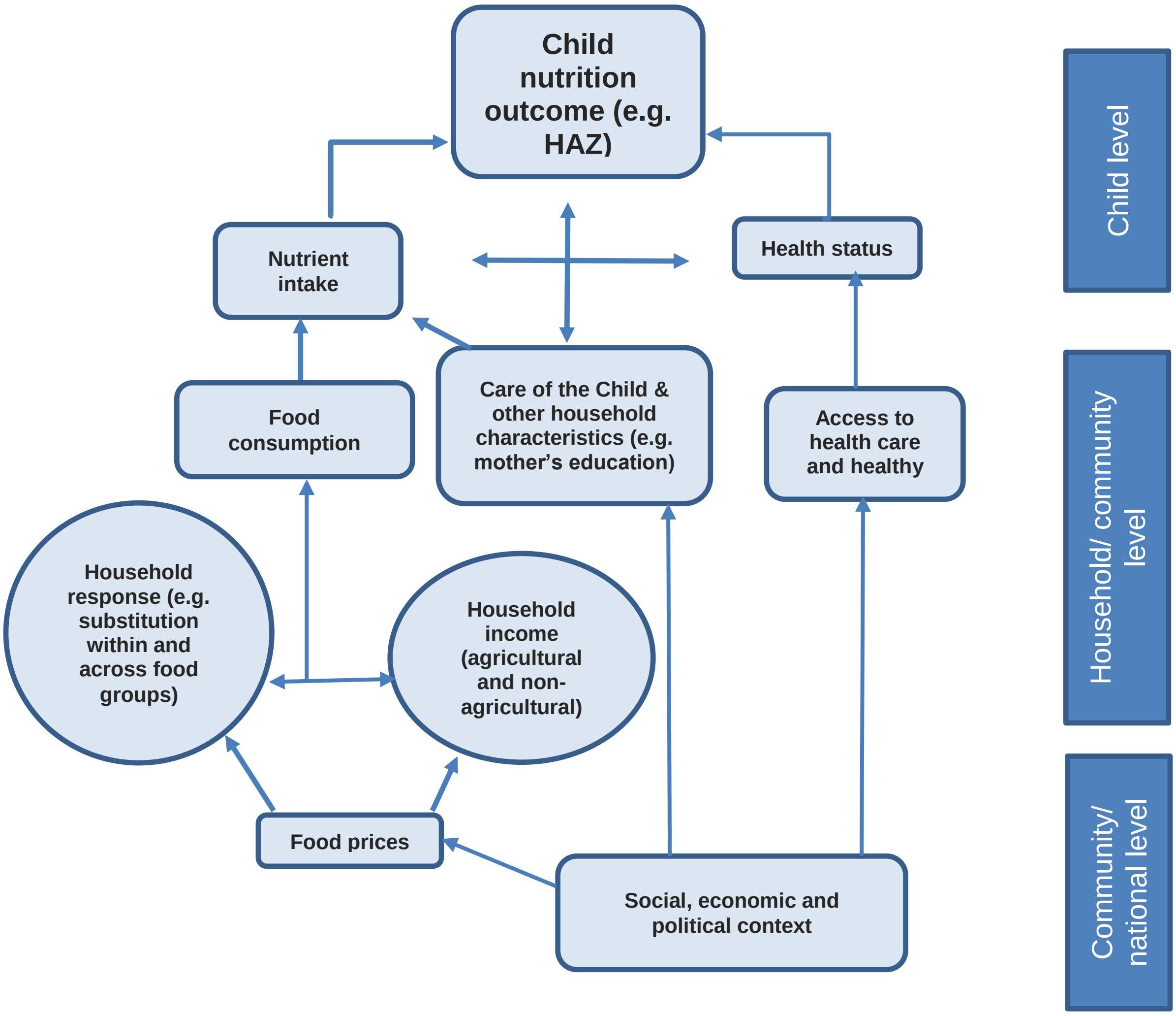
It is more complex to infer the link between food prices and child health outcomes, in this case, the height-for-age z-scores. As argued by Pitt and Rosenzweig (1985), little can be inferred from theory about how a change in food prices facing a household affects the food consumption of the individual members of that household or the health impact of food price changes. These authors further argue that additional ambiguities arise because of lack of information on (i) how the household distributes food and therefore nutrients or other resources to each household member in response to changes in food prices and (ii) how foods or nutrients affect the health for each individual. As earlier described, Deaton (1997) argued that while children consume special foods, they require less of most things than do adults to obtain the same standard of living. This is one reason why the value of per adult equivalent consumption is used in this research.

A number of frameworks that analyse pathways through which an economic crisis would affect health exist. For example, Waters, Saadah and Pradhan (2003) proposed a framework for analyzing the impact of the 1997/98 East Asian economic crisis on health in Indonesia. Their framework mainly included macro-economic factors such as currency devaluation and unemployment. They also highlighted other factors such as social protection and health service delivery.

However, these frameworks provide little guidance on how the health outcome of a child might change in light of rising food prices. Brinkman et al., (2010) adapted the UNICEF framework for the analysis of the global financial crisis on malnutrition. The authors added a layer of effects, which included food prices and government expenditures. But Behrman (1988) argues that nutrients are not valued directly in and of themselves but because of their effect on health and simply because they are consumed as part of food, which directly affects satisfaction. That is, people may gain satisfaction from the taste, variety, status value, and health provided by eating food, but not from the consumption of specific nutrients per se. Christian (2010) came up with a nutritional pathway describing how the economic crisis and increase in food prices may affect child mortality. The author asserted that such covariate shocks influence maternal undernutrition, micronutrient deficiency (vitamin A and zinc) and child undernutrition. A combination of these three factors subsequently leads to increased infant and child mortality.

Furthermore, Headey, Chiu and Kadiyala (2011) outlined a theoretical model of the various channels (including food prices) through which agricultural development influences nutrition outcomes of Indian women and children. This framework was later adapted by authors such as Gillespie, Harris and Kadiyala (2012) who also mapped an agriculture-nutrition disconnect in India. Based on the literature on the impact pathway between food prices and child nutrition, we propose using the following framework to understand the impact of rising food prices on child nutrition outcomes:

Figure 6.1: Framework to analyse the impact of food prices on HAZ



Source: adapted from the UNICEF Nutrition Framework and Headey, Chiu and Kadiyala (2011)

As illustrated in *figure 6.1*, child health outcomes are linked to the rise in food prices through the characteristics mentioned above (including child, household and community characteristics). We have included household income (agricultural and non-agricultural sources) and household responses (e.g. substituting across and within food groups) as additional channels. These in turn influence food consumption and utilization of the food and are subsequently manifested in the health outcome of the child.

Empirical Strategy

As illustrated in the proposed nutrition framework, the health status of children is not only influenced by rising food prices but other factors too. For instance, Christiaensen and Alderman (2004) argue that household access to (and distribution of) food, availability and utilization of health services and care provided to children influence the children's nutrition status. Hence, the econometric strategy applied in this chapter employs district level fixed effects while controlling for idiosyncratic (e.g. age and gender) and covariate factors such as household and community characteristics.

Since growth faltering varies with age, (see for example, Shrimpton et al., 2001), we categorise age into three groups: six months and below; between 6 months and 2 years and between two and five years. This will facilitate a more precise analysis on food price effects on HAZ for children with the first two categories corresponding to the crucial 1000 days from conception to a childs' second birthday. This categorization also fits into the notion that child health outcomes generally exhibit a U-shaped pattern of deterioration and subsequent improvement where children face a decline from six months of age through the second year of life, followed by a slight improvement thereafter (Barrera, 1990; p. 70).

In the reduced form specification in equation (vii), the height-for-age z-score (HAZ) for child i from district d at time t is further modelled as a function of child (X) and household characteristics (H') that affect child height. One of the characteristics included is the logarithm of household food consumption, which is used to control for food purchases at the household level and to provide a proxy for general welfare level of the household. Other household factors include some of the mothers' characteristics (e.g. education and age), and binary variables for the following: access to tap water and ownership of a radio. All these characteristics are meant to enhance a childs' nutrition and health outcome. Following from the nutrition framework, the rationale for including these characteristics is that children of better educated mothers are healthier (Thomas et al., 1990, Smith and Haddad, 2001, Alderman et al., 2006, Rosenzweig and Schultz, 1982). Other authors assert that access to household and community assets such as a radio (medium of nutrition information), clean water and sewerage can significantly affect child height (Behrman and Wolfe, 1987, Alderman, 1990). Furthermore, Thomas and Strauss (1992) found that children of better educated mothers and higher income urban households benefit more from the availability of sewerage and electricity.

Community level characteristics (E') include variables such as logged distance to a health centre. The model also incorporates a vector of 41 districts[73] level food prices P' of primary food commodities consumed by the household for the corresponding months when the LCMS was conducted, that is December 2006 and December 2010. The food prices are expressed in (natural) log terms, which allows the coefficients to be interpreted as semi-logarithmic elasticity that varies with the value of the HAZ. δ_{d} represents district-level fixed effects while $(\theta_p * r_{\mathrm{t}})$ is the province-by-year interaction terms (explained below). $\varepsilon_{\mathrm{idt}}$ represents the error term. The estimated model is formulated as:

$$HAZ_{\mathrm{idt}} = \mathrm{X}_{\mathrm{idt}}\beta_1 + \mathrm{H}'_{\mathrm{idt}}\beta_2 + \mathrm{E}'_{\mathrm{idt}}\beta_3 + P'_{\mathrm{dt}}\beta_4 + \delta_{\mathrm{d}} + (\theta_p * r_{\mathrm{t}}) + \varepsilon_{\mathrm{idt}}, \tag{x}$$

Modelling the impact of price changes is difficult due to various endogeneity concerns related to omitted variables that are not controlled for. For example, prices are likely to be correlated with time-invariant characteristics, such as local governance efficacy and geography. To address these concerns, we include district-level fixed effects (δ_{d}) in an attempt to capture the observed and unobserved time-invariant characteristics of the districts. But, unobserved time-varying factors may lead to similar omitted variable bias resulting in a biased estimate of β_4. For example, it is plausible that positive macro-economic shocks (e.g. new discovery of mineral resources) increase economic activity in the area, leading to higher prices. β_4 would not only capture the effect of the price change but also the effect of the improvement in the general macro-economic situation.

In an attempt to alleviate these concerns, we add province-by-year interaction terms $(\theta_p * r_{\mathrm{t}})$ to the model. These interaction terms capture all observed and unobserved changes between the two years at the province level. Now, in the presence of district fixed effects and province-by-year interaction terms, the impact of the price changes on child health is identified from district specific changes in prices after controlling

[73] Each district has an average of 190 households. More information about the rationale for selecting these districts is in the price data section (*3.2.2*).

for macro-shocks common to all districts in a given province. This strategy yields an unbiased estimate of β_4 if the unobserved time-variant characteristics that influence both district level prices and child health do not vary across districts within a province. While this approach removes a large amount of the potential bias in the price estimates, some correlation between P'_{dt} and $\varepsilon_{\mathrm{idt}}$ may remain. The price estimates that follow should therefore be interpreted with some caution.

6.3.2. Data

The data analysed here are taken from two sources: the 2006 and 2010 LCMS and the district retail price data collected on a monthly basis. The two LCMSs are used to signify the pre-food crisis period and the period after the initial food crisis. Food prices in Zambia continued to rise and exhibited volatility post the 2007/8 global food crisis period. Hence, the expectation is that households would have adapted to high prices by 2010 and the effects on child health outcomes would be observable by then, especially for children below two years of age.

In other words, the two rounds of cross-sectional data are pooled. With the inclusion of district fixed effects and province by year interaction terms, the idea is to compare two cohorts of children originating from the same district at two points in time (2006 and 2010). These cohorts are exposed to very different prices as the 2007/08 food price crisis fell between these two years. Seventeen (17) food commodities representing various nutrition groups are used in this model.

Therefore, only the children from the districts with information on prices and also without missing information on relevant variables such as height and age are included. As such, a sub-sample of 11,338 children under five years is used. Of the total, 6,167 reside in urban areas while 5,171 reside in rural areas. Furthermore, as height is normally measured in centimetres, we have converted the estimated units to centimetres using data from the National Centre for Health Statistics/ Centres for Disease Control and Prevention (NCHS/CDC). This simplifies the interpretation of the results.

6.3.3. Results and discussion

Accounting for the rise in commodity prices, this section assesses the health outcomes of children below five years. *Table 6.6* provides descriptive statistics for the variables used in the analysis. There is an equal representation of boys and girls. The highest level of education attained by the mother is relatively higher in urban areas (on average, mothers completed lower secondary education) than in rural areas (mothers completed primary education on average). In relation to other household characteristics and as expected, a considerably higher proportion of households in urban areas use a tap as the main source of drinking water in comparison to rural areas.

Table 6.6: Means and standard deviations of determinants of Height-for-Age Z-Scores

	National		Rural		Urban	
	Mean	SD	Mean	SD	Mean	SD
Child characteristics						
Height for age z-scores	-1.41	1.93	-1.54	1.90	-1.31	1.94
Sex (1=male)	0.50	0.50	0.49	0.50	0.50	0.50
Child age (months)	28	15.4	27.2	15.2	28.6	15.5
Household and Community Characteristics						
Household size	6.7	2.98	6.9	3.3	6.6	2.7
Mother's education (in years)	8.5	3.5	7.0	3.1	9.8	3.2
Log of household expenditure on food	10.6	0.86	10.2	0.84	10.9	0.77
Main source of drinking water is tap (1=yes)	0.24	0.43	0.06	0.23	0.40	0.49
Household owns radio	0.59	0.49	0.53	0.50	0.63	0.48
Mothers age (in years)	28.2	6.2	28.3	6.4	28.1	6.0

Source: authors' calculations based on 2006 and 2010 LCMS raw data and Central Statistical Office district price data

Table *6.7* provides the results based on Equation (x). Column 1 presents the results for the rural areas while column 2 shows the results for the urban sample. First the model estimates indicate that, *ceteris paribus* and on average, male children are relatively worse off than their female counterparts. The coefficients on the age dummies confirm the declining trend in HAZ scores in these years (between 6 months and 5 years) as found in Shrimpton et al., (2001).

Household and community characteristics by region

As expected, *Table 6.7* shows that other things being equal, an increase in food expenditure increase child HAZ scores, on average, in urban areas. More specifically, a 10 per cent increase in expenditure increases the z scores on average by 0.021 units in urban areas. The effect is not statistically different from zero in rural areas.

The model in this section suggests that the better educated the mother is in urban areas, the taller the children are. However, the effect in rural areas is not significantly different from zero. A similar pattern was observed by Thomas, Strauss and Henriques (1990). This might be because the rural mothers are generally less educated in comparison to mothers residing in urban areas, as observed in *Table 6.6*.

Many authors have found that maternal education positively affects child health outcomes as children of more educated mothers tend to be taller (see for example Barrera, 1990; p. 87) and healthier (as shown in Smith and Haddad, 2001). Glewwe (1999) identifies three possible causal mechanisms through which schooling may influence health and nutrition in developing countries: (i) formal education may directly transfer health knowledge to future mothers, (ii) literacy and numeracy skills acquired in school may assist future mothers in diagnosing and treating child health problems, and (iii) exposure to modern society from formal schooling may make women more receptive to modern medical treatments.

In rural areas, holding all other variables constant, the older the mother is the better for the child nutrition outcomes. The most likely explanation here is that older mothers are better equipped to provide for their children. The effect in urban areas is not statistically significant. These findings however differ from those by Thomas, Strauss and Henriques (1990) who found that survival rates decline with age since children of older mothers will tend to have been exposed to mortality risk for longer.

The results also suggest that owning a radio is a positive determinant of children's nutrition outcomes in rural areas. Christiaensen and Alderman assert that ownership of a radio or television facilitates the acquisition of (nutritional) information, allowing a more effective allocation of resources to produce child health. In their study however, neither radio nor television ownership affected child height. Furthermore, in the current research, the model indicates that the coefficients are not statistically significant for other household and community characteristics such as tap water and household size. These results could be a reflection of consumption rising with household assets as in the case of Alem and Söderbom (2012).

Food price effects by region

For the main variable of interest, food prices, the results show that the effect on children's height, holding all other variables constant, is dependent on the type of food commodity. The results in this analysis are only based on individual food commodities and are not aggregated into major nutrition groups such as cereals, proteins and oil and fats. This is because, after running regressions on major nutrition groups, the results were largely statistically insignificant and the coefficients were too small to have any economic meaning. For this reason, the section focuses on individual food commodities only. This decision is also more informative for policy making, especially in light of the importance of the first 1,000 days of a childs' life.

The results in *Table 6.7* show that higher prices of maize products (refined and less-refined maize flour) are associated with lower Z-score in both rural and urban areas. More specifically, a 10 per cent price increase of the refined maize flour would reduce rural children's height-for-age z-scores by 0.36 units and by 0.23 units in urban areas. For an average child of 28 months old in the sample, these effects translate approximately into 1.29cm and 0.85cm reduction in height, respectively[74]. Assuming that the average child remains in this growth curve, this further translates into a reduction of 2.6cm and 1.7cm in adult heights[75].

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[74] One standard deviation in the CDC distribution at the age of 28 months corresponds approximately to 3.6 cm.

[75] One standard deviation in the CDC distribution at the age of 20 is 7.2 cm for boys and 6.5 cm for girls.

In relation to the less-refined maize flour, a price increase of 10 per cent is associated with a reduction in children's height-for-age z-scores of 0.07 units (0.25cm) and 0.17 units (0.63cm) in rural and urban areas respectively.

Given the empirical findings in *chapter 4 and 5*, the results suggest that the impact of soaring prices of refined and less-refined maize flour result in an income effect. We would have expected that the rural households would benefit from the rise in maize prices and consequent rise in income due to some rural households being net food sellers. However, the results suggest that the rise in household income is not fully captured through changes in nutrition for children below five. A body of literature on the disconnect between income and nutrition exists. For example, while Bouis and Haddad (1990) found a strong positive association between income and HAZ for children less than 1 year old in the Phillipines, this association was however weak for preschoolers at 4 years of age. That is, HAZ decreases much faster for higher-income children than lower-income children as they grow older. These authors suggested that this was mainly because households chose to purchase non-food items and higher-price calories while pre-schoolers continue to consume well below recommended intakes.

Based on a review of various empirical literature, von Braun and Kennedy (1986) concluded that one of the reasons why these positive effects of increased cash income on calorie consumption may be quite small, even among the poor, could be as a result of income composition and income control within the household. In relation to income composition, the authors suggested that income received in a lump sum was associated with the purchase of consumer durables, whereas continual forms of income were more likely to be spent on food. On the control of income, these authors argued that the concept of a household being one homogenous decision-making unit, maximizing one utility function, and pooling income, may be inappropriate in many developing countries. According to them, in many cultures men controlled cash income.

In addition, it may also be the case that when prices are high, households may decide to sell some of the maize meant for consumption. Geier (1995), cited in Devereux (1996), noted that in Tanzania the commoditization of staple food crops undermined household food security and child nutrition. However, in the case of Zambia and as suggested in *chapter 5*, it is possible that rural net-sellers do not fully benefit from a rise in maize prices due to a significant proportion of the profit being captured by others, e.g. middle men. Furthermore, the results for these two products show that households do not easily substitute from the staple crop, maize, to other starchy products, such as cassava, once prices rise.

Another explanation is in relation to the results observed in *chapter 5* that not all rural households benefitted from food price spikes. As depicted in section 5.3, some rural households are net buyers of maize whose real income would reduce given the spike in food prices. In this section, we also observed that the net selling rural households gained only marginally. Therefore, the net gain as a proportion of income may have been too marginal to lead to meaningful long term effects on child health outcomes. We also recognised in *chapter 3* that for consumers, higher food prices restrict the range of foods and other commodities and services that can be purchased, while lower food prices permit greater food intake, a wider variety of foodstuffs, and a higher quality diet.

A related issue is the level of inequality as measured by the squared poverty gap (P2), which was still very high post 2007/8 food crisis. While a decline in P2 was recorded, this figure was low. For example, from the baseline (2006) figure of 27 per cent, a rise in the price of maize grain reduced the squared poverty gap to 26.9 and 26.6 per cent in the short and long-run respectively. This decline therefore implies the welfare gain may have been too small to have long term effects on children's health outcomes. This point is strengthened by results in *Table K.2* of *Appendix K* where HAZ is estimated by quintile. The results in this table indicate that on average, children from the poorest households in rural areas are more malnourished. The level of malnourishment decreases as households get richer.

Considering that the household budget share of bread in urban areas is about double that of rural areas in both 2006 and 2010 (see for example, *Table 4.2* and *appendix E.2*), on average and as expected a rise in the price of bread only affects urban households. Specifically, a 10 per cent increase in the price of bread is associated to a 0.20 unit (0.71cm) reduction in children's height-for-age z-scores in urban areas. In rural areas, the effect is not significantly different from zero.

Regarding other food items, a 10 per cent increase in the price of eggs is associated with shorter children in both regions. Similarly, a rise in the price of beans is associated with a reduction in child health outcomes of up to 0.10 units (0.37cm) in rural areas. Though the coefficient is negative, the results are not statistically different from zero in urban areas. Conversely, higher beef prices are associated with taller children in urban areas. This result could be explained by the adjustment in consumption of chicken and beef. While the budget share (*Table 4.2*) remained about the same for chicken between 2006 and 2010 (8 per cent), the share of the budget allocated to beef declined from 6 per cent to 4.5 per cent during the same period. A substitution from beef to chicken could be beneficial for poor households who may mostly consume lean rather than high fat beef. As depicted in *Table 6.1*, in comparison to lean beef with only 202 kilocalories, energy levels in each 100g of chicken is higher (219 kilocalories) [76]. Chicken also has higher protein and other micro-nutrients such as vitamin A and calcium content. However, with this substitution, children would lose out on higher traces of vitamin B6 and B12 found in beef. Vitamin B6 is particularly important for boosting immunity as well as brain development during pregnancy and infancy. Due to this substitution link, it is a major concern that the coefficient of chicken in rural areas is negative and highly significant. Therefore, a 10 per cent increase in the price of chicken is associated to a reduction in children's health outcomes in both rural and urban areas by 0.20 units (0.71 cm) and 0.17 units (0.61 cm) respectively.

In their paper, Thomas and Strauss (1992) found that if the prices of dairy products rises by two standard deviations, then mean standardized height would decline by 2cm. Other food commodities that are associated with taller children when prices rise in Zambia include: bream fish, groundnuts, tomatoes and sugar in both regions and cooking oil in urban areas. The rest of the results are based on a split sample by gender (*Table 6.8*) and by age (*Table 6.9*).

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[76] The nutrition contents are based on a fresh boiled chicken containing a neck, meat and skin; and boiled lean beef. Note that this claim may not hold for a different quality, for example, high fat beef.

Table 6.7: Impact of food prices on children's nutrition in Zambia

Dependent Variable: HAZ	(1) Rural	(2) Urban
Child characteristics		
Male child	-0.224***(0.041)	-0.161***(0.040)
≤ 6 months	1.031***(0.109)	0.947***(0.093)
>2 - 5 years	-0.522***(0.065)	-0.578***(0.101)
Household and Community Characteristics		
Log of household expenditure on food	0.060(0.036)	0.209***(0.038)
Household size	0.016(0.011)	0.022(0.014)
Mothers age	0.009**(0.004)	0.006(0.005)
Mother's education	0.008(0.010)	0.014* (0.009)
Distance to health facility (logs)	-0.025(0.038)	0.118**(0.055)
Tap water	0.026(0.133)	0.044(0.070)
Radio ownership	0.104*(0.061)	0.069(0.048)
Food Prices (in logs)		
Refined maize flour	-3.575**(1.543)	-2.265*(1.327)
Less-refined maize flour	-0.692*(0.418)	-1.735***(0.589)
Rice	-0.034(0.339)	-0.082(0.340)
Bread	0.442(0.787)	-1.961***(0.557)
Beef	0.716(0.651)	1.821***(0.520)
Chicken	-1.951**(0.876)	-1.693*(0.936)
Kapenta	0.361*(0.195)	0.018(0.327)
Bream fish	0.612***(0.173)	0.424**(0.194)
Beans	-1.033***(0.278)	-0.405(0.337)
Eggs	-1.549***(0.576)	-1.392**(0.545)
Milk (fresh)	0.112(0.357)	1.234*(0.713)
Cooking oil	1.411(1.089)	1.611**(0.661)
Groundnuts	0.639***(0.217)	0.541**(0.226)
Vegetables	-0.198(0.216)	-0.303(0.241)
Tomatoes	0.934***(0.233)	0.920***(0.144)
Onion	-0.574***(0.113)	-0.483***(0.123)
Sugar	3.475*(1.952)	4.232***(1.183)
District Fixed Effect	Yes	Yes
Province by Year Terms	Yes	Yes
Number of observations	5,171	6,167
R-squared	0.076	0.074
Adjusted R-squared	0.069	0.068

Source: authors' calculations based on 2006 and 2010 LCMS raw data and Central Statistical Office district price data

Note: Robust standard errors in parenthesis *** p<0.01, ** p<0.05, * p<0.1

Food price effects by gender and age

For some commodities, the nutrition effects from price increases vary for boys and girls. In urban areas, *Table 6.8* shows that a rise in the price of refined maize flour and chicken and beans is associated with shorter girls but the effect is not statistically different from zero for the boys. The opposite is true for eggs. A rise in the price of eggs is associated with shorter boys but the coefficient for girls in urban areas is not statistically significant. On the other hand, a rise in the price of bread is regressive for both boys and girls.

Results for the rural areas show that relative to boys, the rise in the price of refined maize flour, less-refined maize flour and chicken is associated with shorter girls. However, an increase in the prices of beans and onion negatively affects the health outcomes of both girls and boys.

Table 6.8: Impact of food prices on children's nutrition in Zambia – gender effects

Dependent Variable: HAZ	(1) Rural Boys	(2) Rural Girls	(3) Urban Boys	(4) Urban Girls
Child characteristics				
≤ 6 months	1.378***	0.740***	1.144***	0.749***
	(0.159)	(0.192)	(0.146)	(0.132)
>2 - 5 years	-0.489***	-0.537***	-0.600***	-0.537***
	(0.085)	(0.080)	(0.120)	(0.110)
Household and Community Characteristics				
Log of household expenditure on food	0.095*	0.037	0.273***	0.165***
	(0.050)	(0.050)	(0.040)	(0.047)
Household size	0.025	0.007	0.006	0.043**
	(0.016)	(0.011)	(0.014)	(0.021)
Mothers age	0.018***	-0.001	0.015***	-0.003
	(0.006)	(0.006)	(0.006)	(0.005)
Mother's education	0.008	0.004	-0.004	0.029**
	(0.014)	(0.014)	(0.008)	(0.012)
Distance to health facility (logs)	0.059	-0.107**	0.160**	0.079
	(0.044)	(0.048)	(0.069)	(0.053)
Tap water	-0.003	0.066	-0.002	0.082
	(0.153)	(0.189)	(0.099)	(0.103)
Radio ownership	-0.020	0.216***	0.108	0.004
	(0.084)	(0.070)	(0.073)	(0.063)
Food Prices (in logs)				
Refined maize flour	-2.909	-3.837**	-1.408	-2.821*
	(2.051)	(1.665)	(1.784)	(1.596)
Less-refined maize flour	0.938*	-1.909***	-1.440*	-2.247***
	(0.570)	(0.588)	(0.798)	(0.619)
Rice	-0.696	0.605	-0.244	0.006
	(0.527)	(0.495)	(0.464)	(0.283)
Bread	-0.848	1.080	-2.435***	-1.645***
	(1.147)	(0.817)	(0.754)	(0.509)
Beef	0.605	0.717	1.098	2.581***
	(0.797)	(0.881)	(0.676)	(0.463)
Chicken	-0.118	-3.608***	-1.730	-1.749***
	(0.912)	(1.386)	(1.252)	(0.606)
Kapenta	0.174	0.483*	-0.414	0.611**
	(0.277)	(0.250)	(0.422)	(0.281)
Bream fish	0.116	0.977***	0.255	0.760***
	(0.220)	(0.263)	(0.277)	(0.204)
Beans	-0.778**	-1.237***	-0.172	-0.540**
	(0.314)	(0.374)	(0.427)	(0.267)
Eggs	-1.145	-1.434*	-2.374***	-0.556
	(0.798)	(0.744)	(0.748)	(0.587)
Milk (fresh)	0.013	0.243	1.428	0.704
	(0.375)	(0.537)	(1.122)	(0.684)

Table 6.8: Impact of food prices on children's nutrition in Zambia – gender effects (continued)

Dependent Variable: HAZ	(1)	(2)	(3)	(4)
	Rural Boys	**Rural Girls**	**Urban Boys**	**Urban Girls**
Cooking oil	2.197	1.037	2.120*	0.772
	(1.664)	(1.068)	(1.121)	(0.733)
Groundnuts	0.538**	0.724**	0.039	0.882***
	(0.238)	(0.358)	(0.281)	(0.196)
Vegetables	-0.112	-0.399	-0.203	-0.270
	(0.264)	(0.277)	(0.289)	(0.204)
Tomatoes	0.876***	1.041***	0.918***	0.884***
	(0.239)	(0.314)	(0.245)	(0.137)
Onion	-0.595***	-0.549***	-0.422***	-0.581***
	(0.137)	(0.180)	(0.132)	(0.151)
Sugar	0.162	7.271***	2.892*	5.483***
	(2.427)	(2.351)	(1.652)	(0.871)
District Fixed Effect	Yes	Yes	Yes	Yes
Province by Year Terms	Yes	Yes	Yes	Yes
Number of observations	2,539	2,632	3,082	3,085
R-squared	0.092	0.072	0.090	0.067
Adjusted R-squared	0.078	0.059	0.079	0.056

Source: authors' calculations based on 2006 LCMS raw data and Central Statistical Office district price data

Note: Robust standard errors in parenthesis *** p<0.01, ** p<0.05, * p<0.1

Table 6.9 disaggregates the results by age group. As expected, an increase in the price of milk decreases the height for age z-scores for children between 6 months and 2 years old in rural areas. The result is expected as this is the period children are weaned but are still dependent on milk for the relevant macro (animal-based protein) and micro nutrients (vitamin A, calcium, zinc and iron). As suggested by UNICEF (1990), stunting in children appears most frequently during the weaning period. The same age group in urban areas however is positively affected by the rise in the price of milk. In rural areas, this age group is further affected by the rise in the price of refined maize flour. These results are similar to Hoddinott, Headey and Dereje (2014) who found an effect for children in the 6-24 months age group in relation to consumption of milk in rural Ethiopia. According to these authors, children of this age are also vulnerable to other diseases of an environmental nature. Thomas, Strauss and Henriques' (1990) study found that the supplementation of breastfeeding with other foods, typically starting around six months, may give rise to problems stemming from unclean water or poorly prepared foods.

In urban areas an increase in the price of bread reduces the height-for-age z-scores for children between 6 months and 2 years. Furthermore, the nutritional outcomes of children below 6 months old in urban areas are negatively affected by an increase in the prices of rice and chicken. In rural areas on the other hand, a rise in the price of bread, chicken, eggs and vegetables negatively affects the health outcomes of infants who are under 6 months. These commodities are a reflection of the effect through maternal nutrition as children under 6 months would be too young to consume solid foods.

Table 6.9: Impact of food prices on children's nutrition in Zambia - age effects

Dependent variable: HAZ	**(1) Rural (≤ 6m)**	**(2) Rural (>6m ≤ 2y)**	**(3) Rural (>2 - 5y)**	**(4) Urban (≤ 6m)**	**(5) Urban (>6m ≤ 2y)**	**(6) Urban (>2 - 5y)**
Male child	0.207	-0.347***	-0.223***	0.115	-0.176**	-0.215***
	(0.276)	(0.073)	(0.057)	(0.182)	(0.085)	(0.053)
Household and Community Characteristics						
Log of household expenditure on food	0.193	-0.053	0.134***	0.434**	0.179***	0.185***
	(0.143)	(0.056)	(0.049)	(0.174)	(0.064)	(0.037)
Household size	0.071*	0.025	0.000	-0.022	0.034	0.013
	(0.037)	(0.018)	(0.016)	(0.032)	(0.025)	(0.014)
Mothers age	0.021	-0.000	0.015***	0.011	-0.014**	0.016***
	(0.019)	(0.007)	(0.005)	(0.021)	(0.007)	(0.004)
Mother's education	-0.056	0.018	0.015	-0.072**	-0.001	0.039***
	(0.052)	(0.012)	(0.017)	(0.036)	(0.014)	(0.010)
Distance to health facility (logs)	-0.055	-0.090*	0.030	-0.340*	0.324***	0.028
	(0.163)	(0.053)	(0.044)	(0.189)	(0.064)	(0.073)
Tap water	-0.584	0.229	-0.044	-0.039	0.051	0.035
	(0.431)	(0.213)	(0.142)	(0.354)	(0.068)	(0.102)
Radio ownership	-0.199	0.040	0.165**	0.031	-0.083	0.159**
	(0.264)	(0.108)	(0.066)	(0.201)	(0.075)	(0.070)
Food Prices (in logs)						
Refined maize flour	-1.591	-5.501***	-2.779	1.703	-4.411**	-2.285
	(3.996)	(1.133)	(1.757)	(5.726)	(1.815)	(1.448)
Less-refined maize flour	3.062**	0.253	-1.341	-4.134	-3.090***	-1.117
	(1.378)	(0.502)	(0.891)	(2.655)	(0.766)	(0.735)
Rice	-1.301	-0.519	-0.787	-4.140**	-0.063	0.055
	(1.600)	(0.485)	(0.837)	(1.950)	(0.536)	(0.510)
Bread	-3.706**	0.530	-0.087	6.128*	-1.408**	-1.306
	(1.842)	(0.555)	(0.713)	(3.526)	(0.601)	(0.851)
Beef	2.411	1.671*	-0.621	-3.285	2.217**	0.609
	(1.704)	(0.927)	(1.062)	(2.369)	(1.112)	(0.564)
Chicken	-3.143**	-1.155**	-0.651	-3.450**	-3.702***	1.253**
	(1.226)	(0.504)	(0.663)	(1.705)	(0.537)	(0.601)
Kapenta	0.509	0.254	0.675**	0.155	0.812***	0.477*
	(0.580)	(0.198)	(0.334)	(0.710)	(0.283)	(0.252)
Bream fish	2.311***	0.049	0.248	1.484	1.287***	0.031
	(0.672)	(0.187)	(0.384)	(1.643)	(0.357)	(0.348)
Beans	0.206	0.199	-0.843*	-0.885	-1.474***	0.958**
	(1.074)	(0.378)	(0.510)	(1.254)	(0.336)	(0.434)
Eggs	-7.105***	-0.266	-0.255	-3.945	-2.023**	-0.291
	(2.438)	(0.657)	(1.137)	(3.095)	(0.876)	(0.832)
Milk (fresh)	2.233**	-0.960***	0.139	-0.679	1.389**	0.793*
	(1.023)	(0.275)	(0.499)	(1.359)	(0.649)	(0.451)
Cooking oil	1.234	-0.378	4.357***	1.972	-0.258	2.509
	(1.983)	(1.033)	(1.175)	(5.790)	(1.080)	(1.569)
Groundnuts	-0.219	0.318	-0.083	2.997***	-0.083	0.570
	(1.093)	(0.200)	(0.368)	(0.636)	(0.309)	(0.367)

Table 6.9: Impact of food prices on children's nutrition in Zambia - age effects (continued)

	(1)	(2)	(3)	(4)	(5)	(6)
Dependent variable: HAZ	**Rural (≤ 6m)**	**Rural (>6m ≤ 2y)**	**Rural (>2 - 5y)**	**Urban (≤ 6m)**	**Urban (>6m ≤ 2y)**	**Urban (>2 - 5y)**
Vegetables	-2.210***	0.678**	0.036	-1.223	-0.360	0.001
	(0.737)	(0.268)	(0.286)	(0.758)	(0.294)	(0.283)
Tomatoes	1.187**	0.665***	0.284	1.773**	1.471***	-0.165
	(0.583)	(0.209)	(0.299)	(0.714)	(0.212)	(0.308)
Onion	-0.467	-0.082	-0.244	-0.598	-0.658**	-0.112
	(0.684)	(0.164)	(0.263)	(0.783)	(0.270)	(0.178)
Sugar	13.134***	2.381	2.366	-11.796	6.093***	0.873
	(4.471)	(1.448)	(2.418)	(8.806)	(2.276)	(2.287)
District Fixed Effect	Yes	Yes	Yes	Yes	Yes	Yes
Province by Year Terms	No	No	No	No	No	No
Number of observations	432	1,987	2,752	450	2,259	3,458
R-squared	0.084	0.054	0.041	0.148	0.057	0.052
Adjusted R-squared	0.023	0.041	0.031	0.093	0.046	0.044

Source: authors' calculations based on 2006 and 2010 LCMS raw data and Central Statistical Office district price data
Note: Robust standard errors in parenthesis *** p<0.01, ** p<0.05, * p<0.1

6.4.Sensitivity analysis

In this section, we report the results of the robustness check conducted. To do this, we re-estimated the effect of a limited number of commodities on the specification used to construct *Table 6.7*. In this robustness estimation, our price variable only includes the following commodities: refined maize flour, bread, kapenta, chicken, beef, milk, cooking oil and vegetables. The results are presented in *Table M.1* (*Appendix M)*. Overall, the results are robust. We obtain a similar pattern of results for all but chicken and beef. The results for chicken are the same sign but not statistically significant in this specification. The coefficient for beef is also not statistically significant and the sign for the rural area is negative unlike in the original specification.

6.5. Conclusion

The first section of this chapter estimated the changes in nutrients shares using actual nutrients rather than value of consumption as in the case of *chapter 4*. Similar to the budget shares findings, on average, the results in this section were nuanced as the adjustment was more evident between refined and less-refined maize flour. A significant decline was observed in the share of protein obtained from bream fish and kapenta between 2006 and 2010 in urban areas. Another striking finding in this section was that in spite of animal-source foods having higher levels of protein, the main source of protein for households in both 2006 and 2010 were vegetables and commodities that are typically rich in calories such as maize grain. Kawarazuka and Bene (2010) suggest that this is a normal result from developing countries where the main source of protein is vegetable, not meat. In relation to maize grain and in the Zambian case, one explanation for this scenario is that it is a cheaper source of proteins.

The second part of the chapter highlights the effects of an increase in various food prices on the height-for-age z-scores of children less than five years. The results confirm the hypothesis that a rise in prices of food is indeed an important determinant for height-for-age z-scores (HAZ). Furthermore, they suggest that the level of importance varies across rural and urban areas, gender and age of the child.

The results show that the rise in prices of some food commodities has a negative effect on children's heights while others have a positive effect. In general, the estimated results in this chapter show that child height-for-age z-scores are negatively affected by an increase in the price of nutrient-dense foods such as chicken, beans and eggs. We suggest that the positive health outcomes associated with the rise in the price of commodities such as beef in urban areas may be a result of substitution with other products such as chicken, which has comparatively higher values for some nutrients.

These results depart from the findings by Thomas and Strauss (1992) that the rise in price of cereals had positive effects on rural children. Instead, we find that a rise in prices of maize products and beans is associated with shorter children in both rural and urban areas. This is despite rural areas having more net sellers than urban areas. Nevertheless, these findings are somewhat similar to Christiaensen and Alderman (2004) on Ethiopia who found that higher teff (Ethiopia's main staple) prices are associated with shorter children. Likewise, in their research on the likely impact on Ugandan households of rising global food prices, Mugarura et al., (2008) suggested that the quality of diets may suffer as families shift part of the income that they were initially spending on animal-source foods to then purchase energy-dense cereals or tubers. As theoretically argued in standard micro-economics, consumers will purchase less items due to the loss in real income and that even if they were compensated for the real income loss, consumers would buy less of the commodity facing a price rise.

The results highlighted here show that the effects of high food prices could have long lasting detrimental effects. The findings suggest that stunting is sensitive to a wide range of food prices. Given the direct link between changing food prices and nutrition, it is imperative to understand how children, who are most vulnerable to changing diets, may be impacted. This issue is particularly important in a country with high levels of undernutrition. As observed in a recent special publication on nutrition by Harris, Haddad and Grütz (2014), "Zambian malnutrition rates have been high for a very long time, remaining stubbornly high despite high GDP growth for long periods in Zambia's history".

Chapter 7: Conclusions and policy implications

7.1. Introduction

This research is about the food price shock experienced in 2007/8, which affected various countries around the world. As poor households spend the majority of their income on food, high food prices are of significant concern, particularly in developing countries. At the height of the food crisis, countries such as Mexico, Mozambique and India experienced serious unrests as households reacted to high prices of food. The crisis prompted many studies, such as by Ivanic and Martin (2008), who estimated that the poverty headcount in low income countries increased by 105 million people as a result of the price spike. Global projections by the FAO (2008b) estimated an increase to the tune of 75 million people.

One of the mainstream hypotheses related to food price spikes is that urban households are expected to suffer a welfare loss while rural households are more likely to benefit. However, documented evidence also shows that the effect on rural households is more ambiguous (essentially because rural households are usually both producers and consumers). For example Timmer, Falcon and Pearson (1983) highlights that consumers and producers respond to food prices in opposite ways, which makes policy making challenging. Considering the indeterminate impacts associated with rising food prices, particularly for rural households, it is critical that developing countries closely monitor the effects of changing food prices on household welfare.

The central question of this research therefore was: *what has been the impact of the 2007/8 rising food prices on household welfare in Zambia between 2006 and 2010*. The focus on Zambia was influenced by the limited empirical evidence about the effects of the 2007/8 food price shock on household welfare, despite the country facing a price spike. However, as the more ideal long panel datasets do not exist in Zambia, we mainly use the available cross-section data called the Living Conditions Monitoring Survey (LCMS). As such, the analysis used in this research could contribute towards methodological insights for strategies best suited in countries where data limitations are the norm.

To answer the overarching question raised above, the following sub-questions were posed in this research: (i) What were the differentiated impacts of the rising food prices on household distribution of income and poverty across rural and urban Zambia? (ii) Did households change their food consumption patterns within and across major nutrition groups? (iii) Given these possible changes in food consumption patterns, what were the effects on height for age z-scores for children below five years old?

Based on the evidence from literature, the first hypotheses formulated for this research was that urban poverty would increase while the change in rural poverty will depend on whether the benefit to net sellers would outweigh the negative effects to net buyers. Secondly, we expected to find that households, predominantly those in urban areas, would reduce consumption of protein as a response to the price spike as they allocate a lower share of the budget towards protein-rich food for purposes of increasing the budget share of energy-rich foods such as maize. Our final hypothesis was that the adjustment in household consumption patterns, if it happened, could have a negative effect on health outcomes of children under five years old. Specifically, a rise in food prices may have important negative impacts on height-for-age z-scores (HAZ) for children under the age of five.

One of the strengths of this research is that the welfare impacts were assessed based on price data of a variety of food commodities. A number of authors including Barrett & Dorosh (1996) either analysed the welfare impacts based on a staple crop or a very limited number of commodities. However, given that the 2007/8 food crisis affected almost all food groups, the present research contributes to an understanding of welfare impacts based on multiple food items.

Furthermore, in estimating the distributional impact of the food crisis, we utilised unique production price data. To the best of our knowledge, this is the first time that such data is applied to the Net Benefit Ratio method introduced by Deaton. Other authors such as Vu and Glewwe (2011) simulated a variation in price change between production and consumer prices. In the present research, we also used actual producer prices to graphically show the difference in net effects on households if consumer and not producer prices are used.

In addition, this research adds to a very limited body of literature on how high food prices affect child health outcomes. While controlling for various factors, multiple food commodities were used to understand the impact that the price rise for each individual item would have on height-for-age z-scores. Finally, as the study brings together different measures of welfare (consumption, distribution of income, poverty and nutrition), it provides a more comprehensive and rich understanding of how the 2007/8 food crisis affected Zambian households.

7.2. Limitations of the study

As highlighted in *chapter 1*, some of the weaknesses of this research arise from lack of panel data, which is recognized to contain the breadth and depth required to assess the impact of a covariate shock on household welfare. Furthermore, the flaw in the design of the 2006 LCMS questionnaire negatively impacted the extent to which prices or unit values could be estimated from the raw data. Therefore, we utilised the prices from a secondary source, the governments' monthly district level price data instead of estimating them from the household survey.

As cross-section surveys are fraught with various weaknesses, including in our case, using the recall period of a month, it is possible that the welfare deterioration in the present research may be less adverse than we estimated as households may have consumed more than what they reported.

Related to the points above is the inadequate data on wages in both the informal and formal economy, which affected the analysis of the second-order effects in this research. While we made some effort to incorporate the supply response, a more comprehensive assessment could have been made with good income data, particularly from the informal economy. This would have enabled us to understand whether there was any wage effects given the price spikes and if so, the type of households that would have benefitted the most across the consumption distribution.

Some authors such as Ravallion (1990) argue that the share of income from wage labour tends to increase as income falls. Due to poor income data, we were unable to check whether this indeed would be the case in Zambia.

Furthermore, our research topic has many facets as evidenced by the various focus areas of previous studies. However, we were unable to empirically discuss some important aspects, including the issue of cross-price elasticities, which was beyond the scope of our research. While the exclusion of cross-price elasticities may lead to underestimating the observed welfare effects, in our case, the effects may be negligible as was previously observed by Caracciolo, Depalo and Macias (2014).

Given that the analysis in this research is at best partial, the results have to be interpreted with caution. This is particularly relevant as excluding some of the responses, for example wage response could have a downward bias on the results as argued by Ivanic and Martin (2014). Another important point to consider in relation to interpreting the results is that the food crisis occurred around the same time as the economic and fuel crisis. While we control for these effects in the third question, it is possible that the poverty effects are influenced by the other covariate shocks.

Despite the weaknesses articulated above, the current results provide important insights regarding the impact of the 2007/8 food crisis on various aspects of household wellbeing. These results could be helpful to the government when making decisions of a micro (e.g. social protection measures) and macro nature (e.g. export restrictions and consumer/ producer subsidies).

In general therefore, this research has helped identify those whose welfare is likely to decline from the rise in food prices. The information could enable Zambian policy makers to respond in a more targeted and timely manner in case of a similar crisis – such as the current (2013/14) food price crisis which was induced by the removal of consumer subsidies (*see section 2.2*).

7.3. Main research findings

In the first empirical chapter (*4*), the evolution of budget shares among households between 2006 and 2010 was examined. The aim of this chapter was to respond to **sub-question two on whether households adjusted their food consumption patterns within and across major nutrition groups.** The findings in this chapter provided nuanced results that varied across geographical locations (rural and urban). In rural areas, households maintained the consumption of maize grain and its products (refined and less-refined maize flour). However, they significantly reduced the consumption of animal-source proteins while the budget share towards vegetables increased. In urban areas, the major adjustment was between refined and less-refined maize flour as consumption of animal-source protein was maintained. While we hypothesised that the adjustment from protein-rich to calorie-rich foods would be more evident in urban areas, the opposite appeared to be true as on average, only rural households exhibited the behaviour described in the hypothesis. On the other hand, the result obtained for urban areas is in line with observations made by authors such as Ruel, et al., (2010) who argued that as an attempt to minimize the impacts of rising food prices on welfare, households may decide to switch to cheaper, often less preferred or lower quality staples to protect energy intake.

Interestingly, the quintile-disaggregated results showed that while the changes in budget shares were in the expected direction for rural households (increased consumption of cereal but reduced consumption of some animal-source proteins), this was more nuanced in urban areas. The richer households (top quintile) in urban areas adjusted the consumption of maize flour by devoting a higher share of their food budget towards less-refined flour while the share towards animal-source foods (such as bream fish and chicken) was similar to 2006. In some cases, the budget share for animal-source protein foods even increased. Based on these findings, the conclusion of this first empirical analysis is that poorer households (rural households and poorest households in urban areas) in Zambia reduced the diversity of food consumed. Therefore, these findings are only partially similar to those of Behrman (1995), who observed that when household incomes drop, households may keep calorie levels more or less constant through substitutions within and between food groups, while the consumption of protein-rich foods like meat declines. In the Zambian case, this was only observed among rural households and poorer households in urban areas.

The main objective of the second empirical *chapter (5)* was to estimate the distribution of income and household poverty post-food crisis period and by implication, to respond to **sub-question one on the impact of high food prices on income distribution and poverty**. In that chapter, we followed Deaton’s NBR method to assess the impact of food prices on income distribution. The hypothesis that, on average, rural households would win while urban households would lose from higher food prices was partially confirmed. We found that the rural households around the poverty line, representing the middle of the consumption distribution in our sample, would gain the most from higher prices of maize. The results on the poorest households in rural areas were inconclusive due to imprecise estimates. We therefore followed Subramanian and Deaton (1996) and focussed our explanation away from the very poorest households who in our case, exhibited the most imprecise NBR estimates.

This finding is similar to some authors (see for example Deaton, 1989, Budd, 1993, Vu and Glewwe, 2011) who have applied this method and found that it is those in the middle of the income distribution that benefitted the most. The results in the present research however depart from Barrett & Dorosh (1996) who found that it was the wealthiest households who gained the most in Madagascar. At a country level, the results in the present research are similar to those by McCulloch and Grover (2011) who (based on simulations) found that rural households, as food producers, experienced a gain in welfare while urban households who were overwhelmingly net food consumers suffered a large loss of welfare.

In the case of refined and less-refined maize flour, households just below the poverty line had the highest net effect. For example, if prices of the refined maize flour doubled, households just below the poverty line in rural areas would gain about 6 per cent. On the other hand, the poor households in urban areas and cities would suffer the highest welfare loss if prices of refined maize flour increased. This result was consistent across other maize products although the positive net effect as a proportion of the households' income was minimal (less than 1 per cent on average) for products such as maize grain and less-refined maize flour.

Recall that these results are based on actual producer and consumer prices. Being able to compare the net benefit ratio using producer and consumer prices, we found predictable results, specifically that producers do not capture the full benefits of the price increase. More importantly, the results showed that the net benefit share was much smaller, especially for poorer households in rural areas. In the case of maize grain, the net benefit ratio was negative (about -0.1) for some rural households below the poverty line when estimated using producer prices but positive and large (5 per cent) when consumer prices were used. Therefore, this means that there was a significant difference between producer and consumer prices and that a higher margin was likely captured by market intermediaries and not producers. As found by Wodon et al., (2008), market intermediaries may be able in some cases to keep a large share of the increase in consumer prices for themselves without paying farmers much more for their crops.

An estimate on poverty (second part of *chapter 5*) confirmed the hypothesis that in general, food prices could be poverty reducing in rural areas but poverty increasing in urban areas. In the short run in rural areas, extreme poverty levels declined marginally by 0.8 per cent while overall poverty levels reduced slightly by 1.5 per cent as a result of the rise in maize prices. Once the supply elasticity (long-run impacts) of maize was taken into account however, poverty reduced more deeply (2.6 and 3 per cent respectively). In urban areas, poverty increased in both the short and long-run. For instance, for maize grain, severe poverty increased by 1.3 per cent in the short-run and 1.2 per cent in the long-run. Overall urban poverty also followed a similar trend. Using the national average poverty headcount rates for Zambia, we found that the long-run impacts of the 2008 food price peak may have been poverty-reducing. Slight declines in overall poverty of 0.7, 1.3 and 0.1 percentage points were estimated for maize, less-refined and refined maize flour, respectively. These results therefore suggest that in the long-term and on balance, the overall gain to net-sellers outweighs the adverse welfare loss to net-buyers resulting in a slight decline in poverty.

Given the uncertainty around the regression estimates for very poor households in rural areas, sensitivity analysis of the poverty estimates were conducted where we excluded one per cent of the households on either side of the income distribution with the intention of omitting those observations exhibiting large dispersion from the mean. Even with these households removed, the results remained about the same and the poverty effects were generally not reversed.

Overall, the poverty estimates in the current study are rather lower than those recently found by Ivanic and Martin (2014) who used a CGE model to estimate the short and long-run food price effect on poverty in a number of countries, including Zambia (see *section 5.4*). Therefore, while these findings may offer some useful insights on the impact of rising prices on household welfare in Zambia, the finding on long-run effects should be interpreted with caution given that we only conducted a partial equilibrium analysis. What is also clear from the estimates in this chapter is that the poverty gap and squared poverty gap is much higher in rural areas than urban areas. This suggests that poverty is more intense in rural areas.

Our final empirical *chapter (6)* focused on the impact of higher food prices on nutrition. The first section of this chapter responded to a similar question and hypothesis as the first empirical chapter **on whether households adjusted their food consumption patterns within and across major nutrition groups**. The variation here is that we estimated the shares using actual nutrients rather than value of consumption as in the case of *chapter 4*. Similar to the budget shares findings, on average, the results in this section were nuanced as the adjustment was more evident between refined and less-refined maize flour. In urban areas, a significant decline was observed in the share of protein obtained from bream fish and kapenta between 2006 and 2010.

Another finding in this section was that in spite of animal-source foods having higher levels of protein, the main source of protein for households in both 2006 and 2010 were vegetables and commodities that are typically rich in calories such as maize grain. In relation to maize grain and in the Zambian case, one explanation for this scenario is that it is a cheaper source of proteins. For example, using the average cost of commodity prices in 2006, it would cost about K1,285 to obtain 100g of protein from chicken and K2,956 for kapenta while 100g of protein from maize grain and vegetables would cost K67.9 and K168, respectively. As argued by Jensen and Miller (2011), households (especially those who are poorer) consume higher staple quantities to get enough calories and if there is extra income, they use it to purchase animal-source foods. Hence, consumers spend a higher fraction of their budget on, and receive most of their nutrition from the staple food.

Furthermore, the estimation of the starchy staple ratio suggested that in urban areas, income levels declined more than in rural areas between 2006 and 2010. The confirmation of Bennett's law is even stronger between 2006 and 2010, once we disaggregated the results by quintile. However, the relationship for within-year analysis was mixed. We found that the level of diversification of the food consumption bundle in quintile 2, 3 and 4 are about the same, especially for 2010 estimates. The anomaly was largely with quintile 1, which had slightly lower SSRs than the other quintiles. The implications of the results for this quintile were more difficult to assess given that we observed a higher level of dispersion when estimating the NBR for the poorest households, especially in rural areas.

In the second part of *chapter 6*, we used anthropometric measures to estimate the impact of higher food prices on children's height-for-age z-scores (HAZ). This section therefore responded to **sub-question three** on the **effects of high food prices on height for age z-scores for children below five years old**. Unlike the other empirical analysis where interpretations were mainly at household level, this section analysed individual level outcomes. While we used adult-equivalent scales, the interpretation could still be prone to errors, as argued by Haddad, Hoddinott and Alderman (1997), since our consumption data can only be observed at household level. Hence, we made the assumption that intrahousehold distribution of resources is equal. The direction of the bias that could result from this assumption is however not obvious. Using the empirical strategy defined within chapter 6, the results confirm the hypothesis that a rise in prices of food has an important effect on child nutrition. Furthermore, the results suggested that the level of impact varied across rural and urban areas, gender and age of the child. More specifically, the rise in prices of some food commodities had a negative effect on children's heights while others such as bream fish had a positive effect. Child HAZ was negatively affected by an increase in the price of protein-rich foods such as chicken, beans and eggs.

One striking finding in this analysis (see *Table 6.7*) was that, on balance, price increases in refined and less-refined maize flour had negative effects on children in both rural and urban areas. Therefore, the findings of the impact of rising maize (and maize-products) prices on income distribution and poverty (*chapter 5*) and nutrition (*chapter 6*) provide contradictory results. While the rural households were seen to benefit from a rise in maize prices (albeit in a minimal way) after estimating the net benefit effects and poverty measurements, this was not the case with long term child nutrition outcomes. Indiscriminate negative welfare outcomes among children below five years old were observed in both urban and rural areas.

In relation to the nutrition effects, one reason could be that rural households started from a very disadvantaged position (43.8 per cent stunting levels compared to 35.8 per cent in urban areas) and once the early period is missed (first 1,000 days), children may not recover, especially if the household remains deprived. Another explanation related to the results in *chapter 5* is that not all rural households were net sellers hence, some households suffered from the increase in maize product prices. In addition, the net effect to rural households in general, though positive, was small. In the case of maize grain, the gain as a proportion of their income was less than 2 per cent. This was further reflected in the change in poverty levels between 2006 and 2010, which was found to be marginal. In other words, the gain accrued to net sellers in rural areas may have been too small to have any meaningful impact on long term nutrition outcomes such as HAZ.

Another point to consider is that the level of inequality in rural areas as measured by the squared poverty gap was still very high post 2007/8 food crisis despite recording a slight decline. More specifically, the squared poverty gap (P2) pre-crisis was 27 per cent but after estimating the effect of the rise in the price of maize grain on P2, the results declined but only negligibly. In the short run, P2 remained about the same (decline of only 0.1 percentage points) while in the long-run, the decline was by 0.4 percentage points. This may therefore imply that the welfare gain may have been too small to have long term effects on children's health outcomes. Similarly, the disaggregation of HAZ by quintile shows that on average, children from the poorest households in rural areas are more malnourished. The level of malnourishment decreases as households get richer.

On the other hand, many other authors have found this disconnect between income and nutrition. von Braun and Kennedy (1986) interpret such findings to be a result of income composition and income control within the household. In relation to income composition, these authors suggested that income received in a lump sum was associated with the purchase of consumer durables, whereas continual forms of income were more likely to be spent on food. On the control of income, these authors argued that the concept of a household being one homogenous decision-making unit, maximizing one utility function, and pooling income, may be inappropriate in many developing countries. According to them, in many cultures women did not control cash income, which could negatively affect child health outcomes.

Another explanation could be that as their incomes rise, households may choose food that is better tasting, but has lower nutritional value. As suggested earlier and following Bennett's law, the proportion of calories that an individual derives from the basic starchy staples (mostly grains and root crops) -the starchy staple ratio- falls with rising income as the consumer diversifies the food consumption bundle to include higher-priced calories (Timmer et al., 1983). These higher priced calories may not necessarily be more nutritious. For example, the results in the current research showed that poorer households (bottom quintile) in rural areas increased their allocation towards refined maize flour by 3 percentage points -- from 0 to 3 per cent in 2006 and 2010 respectively -- and instead, reduced the share of the budget allocated to maize grain by 2 percentage points (see *Table 4.3 and 4.4*). As evidenced in *Table 6.1*, less-refined maize flour is more nutritious than refined maize flour. Despite this evidence, we cannot draw strong conclusions especially on the poor rural households given the wide dispersion of results observed for the NBR results.

Nevertheless, literature on this phenomenon exists. The FAO, IFAD and WFP (2012) observed that as consumers become wealthier, they tend to place value on being better nourished, but they also want to eat better-tasting but not necessarily healthier food (for example, adjusting consumption patterns from rice that is less thoroughly milled to rice that is whiter and more polished but less nutritious). These authors also suggest that consumers will choose to spend some of their additional income on a wide range of non-food items, such as education, clothes, health or cellular phones. Banerjee and Duflo (2011) also found that as households got richer in India, they bought better-tasting, more expensive food and also spent more on non-food such as entertainment. In our case, the results may not be substantial (poverty estimates) nor strong enough (NBR estimates) to make a strong statement about rural households consuming better-tasting, and possibly, less-nutritious food.

Finally, the results may be driven by intrahousehold distribution of resources, including food. That is, while household income is seen to be improving, the transfer to children may not be enough to positively influence the children's health outcomes.

In summary, and to come back to the initial question that motivated this research, the findings do indeed show that the welfare of households in Zambia is sensitive to food prices. The impact is however mixed, which makes it challenging for policy making (details in *section 7.4* below). While these findings could be improved by better data and use of more robust methodologies (e.g. the CGE), the results point to a need for carefully thinking about policy decisions that would best respond to more nuanced food price impacts as suggested in the findings of the present research. The interplay between households as consumers and producers in Zambia and similar contexts requires a much deeper understanding of how this relationship is impacted by rising food prices.

7.4. Policy implications

The findings in this research as highlighted in the preceding section raise two core policy issues. The first is what Timmer, Falcon and Pearson (1983) called "the food price dilemma" for policy makers in developing countries, that is, the dual role of incentivising farmers and that of inducing higher costs on consumers. In the Zambian case, the evidence in *chapter 5* suggests that in the long term, the benefits accrued to net sellers through an increase in income, though slight, may outweigh the loss to net buyers. Singh, Squire and Strauss (1986) argue that if policy makers want to improve incentives and increase the income of agricultural households, the negative effects evident in the short-term could be offset through indirect effects. That is, in the long run, there may be a substantial change in labour market conditions, which would undoubtedly exert upward pressure on rural wage rates.

This however does not resolve or minimise the adverse welfare consequences faced by net buyers in the short-term. As such, a policy which is only focussed at the long-term may be very unpopular among the net buying urban households who are more politically vocal and influential. Furthermore, some net buying rural households would suffer a welfare loss.

Barrett and Dorosh (1996: p.658) make the following argument:

> "Since in the short term the poor have little room for anything other than demand-side responses to adverse welfare effects, and as such adjustments push them closer to potentially irreversible health or nutritional catastrophe, one needs to consider the short-term implications of policy change on the welfare of the very poor".

Similarly, FAO, IFAD and WFP (2011) argued that severe short-term price changes can have long-term impacts on development. That is, changes in income due to price swings can reduce childrens' consumption of key nutrients during the first 1,000 days of life from conception, leading to a permanent reduction of their future earning capacity, increasing the likelihood of future poverty and thus slowing the economic development process.

In response, policies could be implemented to smooth consumption and prevent the most disadvantaged net buyers in rural and urban areas from a further decline into poverty, including social safety nets. Davies and McGregor (2009) suggested that in times of a crisis, social protection could offer immediate protection and relief from poverty and deprivation in the short term. Given the extent of the negative effects of the increase in prices of food products on children's health outcomes, it is imperative to insulate the most vulnerable groups through appropriate policies.

Another nutrition intervention as suggested by Ivanic, Martin and Zaman (2012) is targeting infants and pregnant mothers and the fortification of food grains. These authors argued that such interventions could mitigate the detrimental impact of sharp increases in food prices on nutritional outcomes, thereby reducing the vulnerability of households to sudden changes in food prices. Additionally, scaling up school feeding programmes could have widespread benefits in Zambia. A recent article reported that the existing government programme has so far only provided food for about 800,000 school children across the country over the last 10 years - against an estimated 3.1 million vulnerable school children annually that need to be on the programme (Zambian Economist, 2013). Using longitudinal data from rural Zimbabwe, Alderman, Hoddinott and Kinsey (2006) showed that improved pre-schooler nutritional status, as measured by height given age, is associated with increased height as a young adult, a greater number of grades of schooling completed, and an earlier age at which the child starts school. Related to the above suggestion is the need for implementing nutrition-sensitive agriculture. In the Zambian case, this could include diversification of crops supported under the Farmer Input Support Programme - FISP (Harris, Haddad and Grütz 2014), which currently focuses largely on the staple crop, maize.

The second core policy issue arises from the potential ambiguity that may exist between income and nutrition outcomes. Following micro-economic theory, Jensen and Miller (2011) argued that since households make choices that maximise their utility, if their decisions reduce their nutrition, then it may be that they gain more from the increased taste or variety than they lose in calories or long-term health status. Given the knowledge from nutritionists and the long-term consequences arising from poor nutrition, one way of responding to the issue of income vs. nutrition could be to increase consumer awareness and to include the impacts of consumption choices on nutrition and child health outcomes in school curricula. Such awareness programs could target different groups. UNICEF (1990) suggests that education emphasis should be placed on providing adolescent girls with useful knowledge about maternal and child care.

In addition and for the Zambian case, low cost interventions such as regular community based nutrition education, which could be integrated within the Ministry of Health, could be implemented. For maximum benefits, this type of education could be tailor-made for districts by taking into account the locally available food commodities and providing information on the precise nutrition contents based on the nutrition tables from Zambia's National Food and Nutrition Commission. Considering the findings in *chapter 6* about the high nutrient properties found in fish, it would be highly beneficial to promote the consumption of this protein-rich commodity. As recommended by the High Level Panel of Experts on Food Security and Nutrition, States should try to include fish more systematically in their nutritional programmes and interventions aimed at tackling micronutrient deficiencies, especially among children and women (High Level Panel of Experts, 2014).

More generally and given the findings in this research, there is scope for longer term responses. In a country like Zambia, where rural infrastructure is still poor, ancillary measures to stimulate market intermediation and to mitigate infrastructural obstacles may need to accompany or precede the "getting prices right" interventions if one wishes to achieve the long term development goals without incurring short term costs (Lipton, 1991, Barrett and Dorosh, 1996).

As highlighted in *section 5.3*, poor infrastructure increases transaction costs. The FAO, IFAD and WHO (2012) suggest that provision of better rural infrastructure, such as roads, physical markets, storage facilities and communication services, will reduce transaction costs and enable smallholder farmers to reach markets. Related to the above argument, high food prices raise the incentives for governments and private companies to invest more in agricultural research, develop technical innovation and new technology, and implement policies and services that will promote adoption of such technologies (Dorward, 2013). Other compensatory actions such as increased extension support and increased credit could also be taken to support producers when there is a price spike, as was done in Vietnam (see McKay and Tarp, 2014).

In sum, it is essential to promote the supply response arising from high food prices through appropriate incentives and investments in public goods, particularly those that benefit small-scale farmers. This may be important given the possibility of the ultra-poor benefitting from higher prices through wages, as argued by Ravallion (1990) and Headey (2014).

A related developmental issue arising from this research is the high leakage between farm-gate prices and consumer prices. While it is expected that there would be a variation in producer and consumer prices, the difference as observed in *chapter 5* seems too large and mostly impacts the households at the bottom of the income distribution. Therefore, limiting this leakage may further reduce overall poverty as more income would accrue to poorer households.

As described in *section 2.2*, one of the main agricultural policies by the Zambian government is the Farmer Input Support Programme, formerly called Fertiliser Support Programme[77]. The intention of this programme is to increase production of the staple food commodity, maize, and reduce poverty. For this to be achieved however, the targeted beneficiaries should mainly be poor households. However, despite being framed as a key component of the nation's poverty reduction strategy, the FISP excludes the poorest households who cannot afford to pay the mandatory membership costs (Burke et al., 2012, Govereh et al., 2006). One discussant in a focus group discussion in Chikwanda area of Mpika narrated the following: "*we have been told that we should all join the agriculture cooperative if we want to get subsidized fertilizer prices, but just to become a member of the cooperative is so expensive. A member is expected to buy shares at the price of K500,000 every year if they are to benefit from the subsidized fertilizer, but who has that kind of money laying around?*[78]" (field interview, IDS/ Oxfam project, 2011).

Finally, the findings in the present research have implications for data collection. The government of Zambia should invest more in regular and comprehensive household surveys to enhance evidence based policy making and more importantly,

[77] In fact, empirical evidence casts some doubt on whether subsidies could lead to better nutrition as the Bennett's Law may apply. In China, Jensen and Miller (2011) found that while subsidies are welfare improving, households respond by substituting away from the subsidised staples towards commodities like meat that are tastier and add variety to their diet but are more costly nutrients. These authors therefore found that caloric intake declined. Similarly, Tarozzi (2005) found that a reduction in food subsidies in Andhra Pradesh, India had little or no effect on child weight-for-age. Nevertheless, others have argued that as long as subsidies improve welfare, as measured by income, this should be adequate.

[78] Subsidized fertilizer for fully paid up cooperative members is purchased at K50,000 as opposed to an average price of K280,000 per bag of Compound D basal fertilizer and Urea top dressing fertilizer.

ensure timely targeted responses when households face covariate shocks. For example, the Statistics Office should build on the more comprehensive ‘2010 LCMS questionnaire’. Adding a separate section on community level prices in the survey questionnaire would increase the understanding of prices at a more localised level.

Given the complexity of the food prices and the effect it has on household welfare in Zambia, the policies suggested here are by no means exhaustive. However, we have attempted to highlight some of the pertinent issues that may have direct links to the findings in the current research and that could input into policy debates on food related discussions in Zambia.

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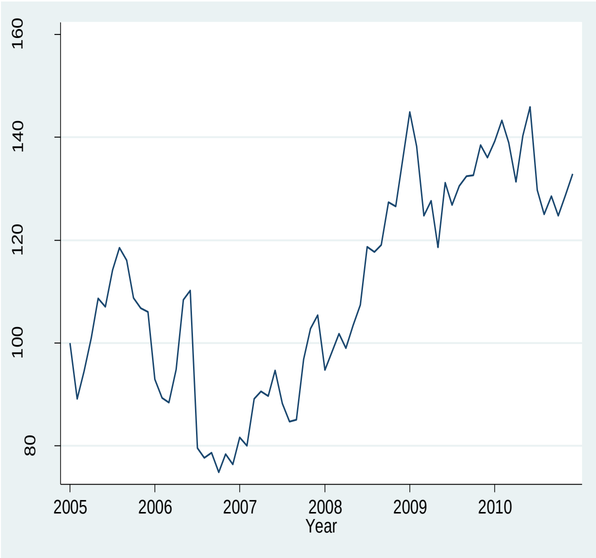
Appendices

Appendices: chapter 1

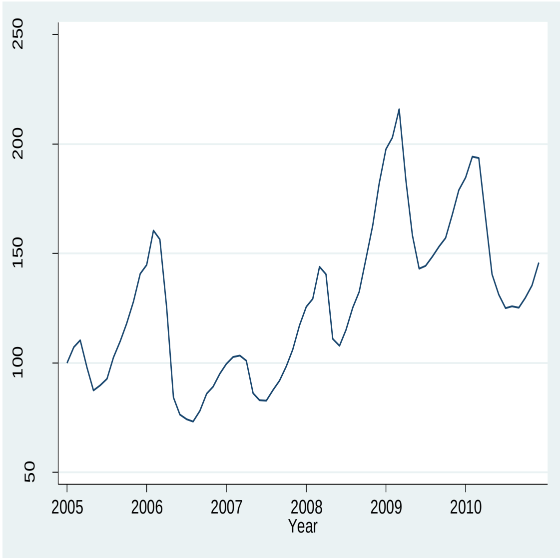
Appendix A: Food price trends

Figure A.1: Maize grain prices



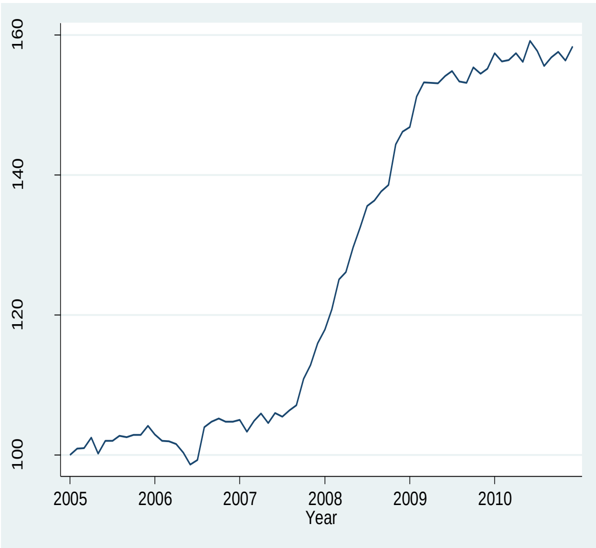
note: 2005=100

Figure A.2: Less-refined maize flour prices



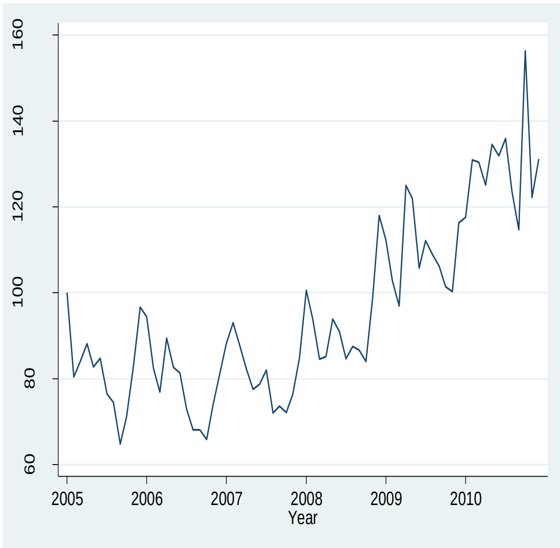
note: 2005=100

Figure A.3: Bread prices



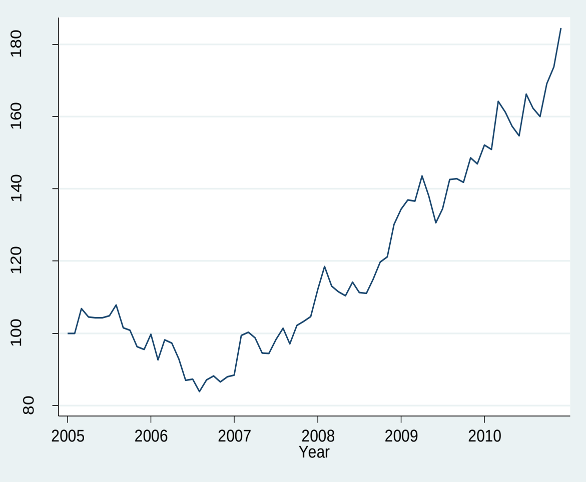
note: 2005=100

Figure A.4: Vegetables prices



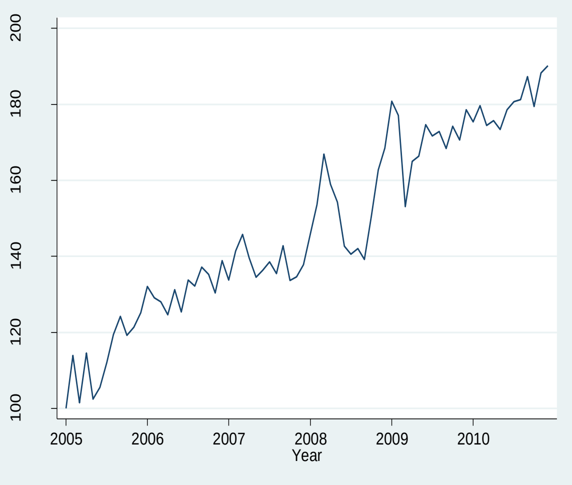
note: 2005=100

Figure A.5: Kapenta prices



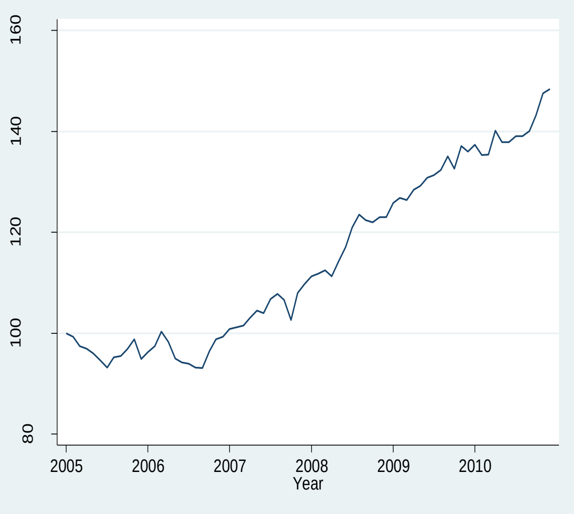
note: 2005=100

Figure A.6: Bream prices



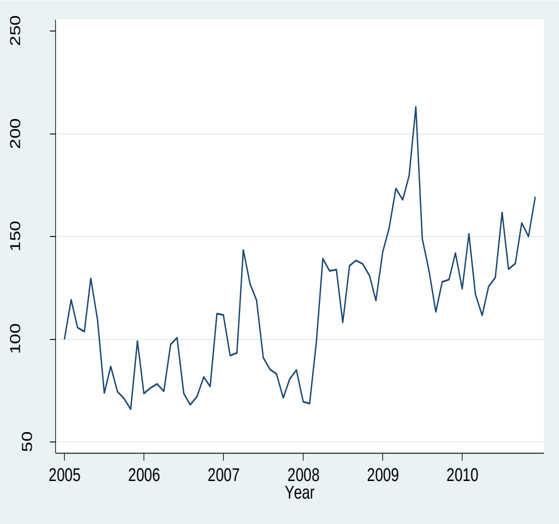
note: 2005=100

Figure A.7: Chicken prices



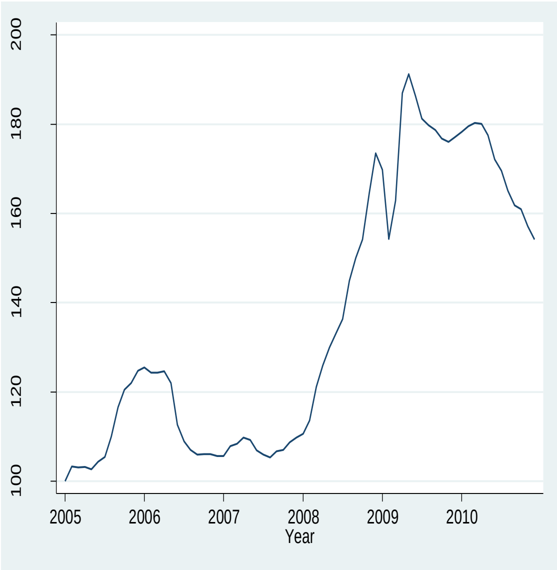
note: 2005=100

Figure A.8: Beef prices



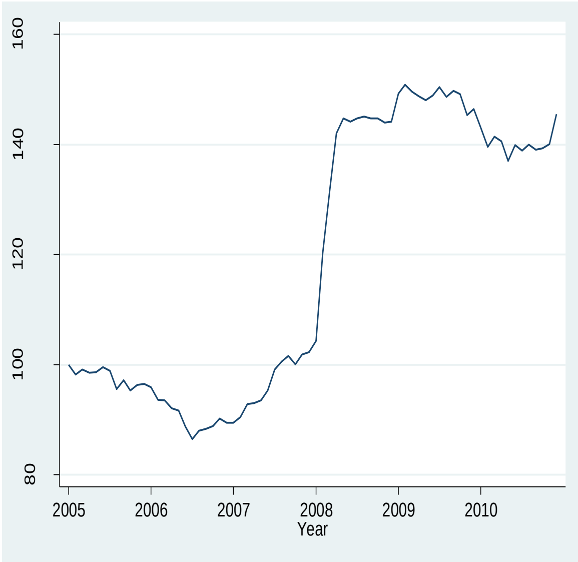
note: 2005=100

Figure A.9: Sugar prices



note: 2005=100

Figure A.10: Cooking oil prices



note: 2005=10

Appendices: chapter 2

Appendix B: reaction to removal of subsidies (2013/14)

Table B.1: Media articles

Date	Title and Synopsis	Source
22 May 2013	*Subsidies cannot continue* – Storella (United States Ambassador) - The article also cited the World Bank as saying "the government's removal of subsidies is an opportunity to realign public resources to meet the country's development goal of achieving inclusive growth".	The Post Newspaper (Mbulo and Chanda, 2013)
30 Sept 2013	*Removing subsidies in Zambia - the way to go?* - The article quotes the Zambia National Farmers Union (ZNFU), which mainly represents commercial farmers, as saying the move was "ill-timed". - It further cites the Jesuit Centre for Theological Reflection (JCTR) that the price of maize flour had already reached ZMW 59.28 ($11.19) in June 2013	(IRIN, 2013)
20 Dec 2013	*There is no shortage of maize in the country to warrant the sharp rise in the prices mealie-meal- Sichinga (Minister of Agriculture and Livestock)* - The article reports that towns throughout the country are selling maize flour at K85[79] per 25kg bag of breakfast meal.	Lusaka Times (2013b)
21 Dec 2013	*Government bans Maize export and offloads 50,000 metric tonnes to stabilise mealie meal prices* - "Mealie-meal prices to the consumers should not exceed K65 per 25 kilogramme bag of breakfast meal, K45 per 25 kilogramme bag of roller meal and K650 per metric tonne of maize,"	Lusaka Times (2013a)
05 Jan 2014	*Mealie-meal prices remain high*	Times of Zambia Sichone et al., (2014)
15 Apr 2014	*High mealie-meal prices shock Simuusa* (Minister of Agriculture and Livestock)	Times of Zambia (Phiri, 2014)

[79] This is a rebased value hence equivalent to K85,000 in the previous Zambian Kwacha.

Appendices: chapter 3

Appendix C: price data

Table C.1: price assignment rules

District with Prices	Assigned to
Kabwe Rural	- Chibombo
Kabwe urban	- Kapiri mposhi
Ndola Rural	- Mpongwe - Lufwanyama - Masaiti
Lundazi	- Chama - Mambwe
Nyimba	- Katete
Nchelenge	- Chiengi - Milenge
Lusaka rural	- Chongwe - Kafue
Isoka	- Chilubi - Mungwi - Kaputa
Kasama	- Mporokoso - Chinsali
Mbala	- Mpulungu - Nakonde
Kasempa	- Chavuma - Kabompo - Mufumbwe - Zambezi
Kalomo	- Gwembe - Itezhi tezhi - Namwala
Livingstone	- Kazungula
Mazabuka	- Siavonga
Sinazongwe	- Choma
Kaoma	- Kalabo - Lukulu
Senanga	- Sesheke - Shangombo

Source: authors' assignment rules based on Central Statistical Office district price data

Appendices: chapter 4

Appendix D: evolution in quantities consumed between 2006 and 2010

Table D.1: Average quantities consumed (in kilogrammes)

Commodities	2006	2010	Difference
Maize grain	27.36(36.20)	56.03(92.52)	-28.68***
Refined maize flour	60.32(276.50)	28.37(19.13)	31.96***
Less-refined maize flour	61.19(123.76)	55.25(93.76)	5.94*
Rice	5.01 (7.36)	7.70(8.24)	-2.69***
Cassava	24.28 (47.34)	25.73(50.36)	-1.45
Millet	15.79(18.70)	37.91(73.80)	-22.12***
Sorghum	26.87(35.45)	19.64(15.91)	7.22**
Bread	8.96(12.32)	11.23(16.25)	-2.28***
Sweet Potatoes	8.71(18.44)	17.50(44.21)	-8.79***
Irish Potatoes	6.50(7.78)	9.76(12.21)	-3.26***
Chicken	2.96(4.01)	5.04(5.93)	-2.09***
Beef	2.91(3.93)	3.47(5.50)	-0.57***
Pork	0.93(1.57)	1.64(2.76)	-0.71***
Bream fish	0.74(1.08)	0.92(0.89)	-0.18***
Kapenta	0.61(0.93)	0.55(0.86)	0.58***
Vegetables	12.20(14.58)	18.62(56.58)	-6.42***
Beans	2.16(2.22)	2.96(3.94)	-0.80***
Onion	2.45(3.47)	2.81(4.64)	-0.36***
Tomatoes	6.81(9.34)	6.38(59.84)	0.43
Eggs	1.43(2.26)	2.03(14.11)	-0.60***
Cooking Oil	2.81(2.64)	2.66(46.91)	0.15
Groundnuts	1.94(3.04)	3.01(4.53)	-1.07***
Butter	0.44(0.79)	0.49(1.09)	-0.05***
Sugar	4.13(5.40)	4.39(6.08)	-0.27***
Tea/ coffee	0.65(1.03)	0.57(2.18)	0.08***
Fresh milk	5.02(7.38)	4.67(7.49)	0.35***
Powdered milk	0.92 (0.87)	1.19(1.09)	-2.27***
Salt	1.68(2.38)	1.12(5.09)	0.56***
Fruits	4.02(7.72)	7.02(53.59)	-2.99***

Source: authors' calculations based on 2006 and 2010 LCMS raw data and Central Statistical Office district price data

*Notes: Standard deviations in parenthesis. Significance of the difference in means based on a t-test for continuous variables. ***p<0.01, **p<0.05, *p<0.1*

Table D.2: Average quantities consumed (in kilogrammes) by geographical location

	2006	2010		2006	2010	
Commodities	**Rural**	**Rural**	**Difference**	**Urban**	**Urban**	**Difference**
Maize grain	26.08(29.20)	55.54(62.94)	-29.46***	1.80(15.90)	3.82(18.36)	-2.01***
Refined maize flour	49.81(72.85)	29.66(21.72)	20.15***	60.84(282.78)	27.80(17.86)	33.04***
Less-refined maize flour	52.28(64.55)	53.69(101.73)	-1.40	62.64(130.87)	55.40(92.97)	7.24*
Rice	3.20(4.60)	8.33(11.56)	-5.13***	5.62(7.98)	7.61(7.71)	-2.00***
Cassava	28.55(55.73)	31.34(59.71)	-2.79	17.42(27.83)	16.73(27.42)	0.69
Millet	-	-		-	-	
Sorghum	-	-		-	-	
Bread	3.07(5.15)	6.58(12.20)	-3.51***	11.16(13.45)	12.21(16.82)	-1.05***
Sweet Potatoes	7.95(23.11)	19.63(30.43)	-11.68***	9.42(12.60)	16.70(48.41)	-7.27***
Irish Potatoes	4.69(6.98)	9.06(13.20)	-4.37***	6.78(7.85)	9.86(12.06)	-3.09***
Chicken	1.38(1.25)	3.18(4.64)	-1.80***	3.74(4.62)	5.78(6.21)	-2.02***
Beef	1.48(2.62)	3.19(8.46)	-1.7***	3.26(4.12)	3.53(4.62)	-0.28***
Pork	0.59(1.00)	1.46(3.70)	-0.87***	1.14(1.82)	1.72(2.23)	-0.58***
Bream fish	0.51(0.75)	0.82(0.87)	-0.31***	0.87(1.20)	0.96(0.90)	-0.09***
Kapenta	0.47(0.66)	0.47(0.69)	-0.007	0.69(1.03)	0.58(0.91)	0.10***
Vegetables	6.20(7.10)	21.90(48.34)	15.70***	14.40(15.94)	16.82(60.57)	-2.41***
Beans	1.59(1.79)	2.30(4.44)	-1.40***	2.41(2.35)	2.95(3.74)	-0.54***
Onion	1.31(2.99)	2.07(3.06)	-0.76***	2.85(3.53)	3.06(5.03)	-0.21***
Tomatoes	3.12(4.73)	6.15(108.72)	-3.02*	8.68(10.48)	6.47(6.98)	2.20***
Eggs	0.58(0.99)	1.37(1.77)	-0.79***	1.70(2.49)	2.19(15.72)	-0.50***
Cooking Oil	1.65(1.80)	1.62(2.11)	0.03	3.51(2.80)	3.17(57.36)	0.33
Groundnuts	1.95(2.68)	3.71(5.22)	-1.76***	1.94(3.22)	2.71(4.17)	-0.78***
Butter	0.39(0.61)	0.44(0.46)	-0.05	0.44(0.80)	0.50(1.13)	-0.05***
Sugar	2.43(3.12)	3.45(4.95)	-0.02***	5.10(6.15)	4.80(6.47)	0.30***
Tea/ coffee	0.42(0.73)	0.44(0.58)	-0.20	0.70(1.07)	0.60(2.40)	0.10***
Fresh milk	2.16(3.84)	3.43(5.67)	-1.28***	5.85(7.93)	4.99(7.87)	0.86***
Powdered milk	0.62(0.53)	1.37(1.32)	-0.74***	0.97(0.90)	1.15(1.04)	-0.18***
Salt	1.53(2.14)	1.11(2.08)	0.42***	1.78(2.52)	1.13(6.20)	0.65***
Fruits	2.59(5.19)	8.36(99.31)	-5.76***	4.24(8.01)	6.49(11.92)	-2.25***

Source: authors' calculations based on 2006 and 2010 LCMS raw data and Central Statistical Office district price data

*Notes: Standard deviations in parenthesis. Significance of the difference in means based on a t-test for continuous variables. ***p<0.01, **p<0.05, *p<0.1*

Appendix E: evolution in shares consumed between 2006 and 2010

Table E.1: Shares across geographical location by year

Commodities	2006			2010		
	Rural	**Urban**	**Difference**	**Rural**	**Urban**	**Difference**
Maize grain	0.152(0.187)	0.031(0.087)	0.120***	0.164(0.190)	0.049(0.099)	0.115***
Refined maize flour	0.011(0.067)	0.094(0.136)	-0.082***	0.022(0.084)	0.022(0.072)	0.000
Less-refined maize flour	0.011(0.069)	0.031(0.029)	-0.020***	0.018(0.066)	0.082(0.102)	-0.065***
Hammermill maize flour	0.021(0.090)	0.011(0.061)	0.011***	0.044(0.110)	0.012(0.050)	0.032***
Rice	0.026(0.057)	0.035(0.042)	-0.010***	0.016(0.049)	0.036(0.058)	-0.020***
Cassava	0.062(0.139)	0.009(0.049)	0.052***	0.078(0.161)	0.013(0.060)	0.065***
Millet	0.010(0.054)	0.001(0.012)	0.009***	0.010(0.050)	0.001(0.016)	0.009***
Sorghum	0.006(0.047)	0.001(0.015)	0.005***	0.004(0.036)	0.001(0.010)	0.003***
Bread	0.030(0.054)	0.073(0.073)	-0.044***	0.031(0.062)	0.078(0.083)	-0.048***
Sweet Potatoes	0.003(0.021)	0.002(0.012)	0.002***	0.011(0.042)	0.010(0.029)	0.002***
Irish Potatoes	0.004(0.020)	0.016(0.026)	-0.011***	0.004(0.020)	0.013(0.031)	-0.009***
Chicken	0.080(0.104)	0.080(0.070)	0.000	0.050(0.086)	0.076(0.084)	-0.025***
Other poultry	0.002(0.016)	0.001(0.012)	0.000	0.001(0.013)	0.002(0.017)	-0.001***
Beef	0.025(0.061)	0.060(0.064)	-0.034***	0.016(0.053)	0.045(0.065)	-0.029***
Pork	0.015(0.054)	0.010(0.030)	0.005***	0.007(0.033)	0.009(0.029)	-0.001***
Goat meat	0.019(0.058)	0.008(0.027)	0.011***	0.012(0.048)	0.007(0.030)	0.004***
Mutton	0.001(0.016)	0.000(0.007)	0.000***	0.001(0.010)	0.000(0.009)	0.000
Game meat	0.011(0.047)	0.006(0.026)	0.005***	0.008(0.040)	0.006(0.028)	0.002***
Bream fish	0.078(0.104)	0.060(0.061)	0.020***	0.029(0.066)	0.058(0.070)	-0.029***
Kapenta	0.059(0.075)	0.048(0.050)	0.010***	0.034(0.059)	0.042(0.053)	-0.008***
Vegetables	0.032(0.059)	0.061(0.060)	-0.028***	0.132(0.121)	0.080(0.074)	0.053***
Beans	0.035(0.057)	0.035(0.034)	-0.000	0.029(0.054)	0.033(0.044)	-0.004***
Onion	0.012(0.025)	0.022(0.024)	-0.010***	0.012(0.022)	0.023(0.027)	-0.011***
Tomatoes	0.033(0.046)	0.047(0.041)	-0.014***	0.025(0.037)	0.039(0.035)	-0.013***
Eggs	0.010(0.028)	0.027(0.032)	-0.017***	0.010(0.029)	0.027(0.038)	-0.016***
Cooking Oil	0.085(0.088)	0.071(0.053)	0.014***	0.044(0.050)	0.050(0.046)	-0.006***
Groundnuts	0.027(0.061)	0.014(0.033)	0.013***	0.017(0.044)	0.013(0.028)	0.004***
Butter	0.002(0.011)	0.011(0.018)	-0.009***	0.001(0.008)	0.009(0.021)	-0.007***
Sugar	0.067(0.074)	0.057(0.047)	0.009***	0.042(0.059)	0.048(0.044)	-0.006***
Honey	0.003(0.028)	0.001(0.010)	0.002***	0.001(0.016)	0.001(0.013)	0.000
Tea/ coffee	0.004(0.014)	0.012(0.018)	-0.008***	0.003(0.011)	0.009(0.021)	-0.005***
Fresh milk	0.011(0.034)	0.021(0.036)	-0.011***	0.010(0.035)	0.018(0.036)	-0.007***
Powdered milk	0.001(0.010)	0.004(0.016)	-0.003***	0.001(0.010)	0.003(0.015)	-0.002***
Salt	0.044(0.072)	0.014(0.024)	0.031***	0.017(0.032)	0.010(0.023)	0.007***
Fruits	0.002(0.013)	0.010(0.022)	-0.010***	0.027(0.055)	0.032(0.044)	-0.005***
Non-alcoholic drink	0.008(0.029)	0.017(0.033)	-0.009***	0.012(0.042)	0.005(0.020)	0.000***
Total	1.00	1.00		1.00	1.00	

Source of Data: Estimated from LCMS raw data

*Notes: Standard deviations in parenthesis. Significance of the difference in means based on a t-test for continuous variables. ***p<0.01, **p<0.05, *p<0.1*

Table E.2: Shares by region and year

Commodities	Rural			Urban		
	2006	**2010**	**Difference**	**2006**	**2010**	**Difference**
Maize grain	0.152(0.187)	0.164(0.190)	-0.012***	0.031(0.087)	0.049(0.099)	-0.018***
Refined maize flour	0.011(0.067)	0.022(0.084)	-0.011***	0.094(0.136)	0.022(0.072)	0.072***
Less refined maize flour	0.011(0.069)	0.018(0.066)	-0.008***	0.031(0.104)	0.082(0.102)	-0.052***
Hammermill maize flour	0.021(0.090)	0.044(0.110)	-0.023***	0.011(0.067)	0.012(0.050)	-0.001*
Rice	0.026(0.057	0.016(0.015)	0.009***	0.035(0.042)	0.040(0.058)	-0.001
Cassava	0.062(0.139)	0.078(0.161)	-0.016***	0.009(0.049)	0.013(0.060)	-0.004***
Millet	0.010(0.054)	0.010(0.050)	-0.000	0.001(0.012)	0.001(0.016)	-0.000**
Sorghum	0.006(0.047)	0.004(0.036)	0.002***	0.001(0.015)	0.001(0.010)	0.001***
Bread	0.030(0.054)	0.031(0.062)	-0.001	0.073(0.073)	0.078(0.083)	-0.005***
Sweet Potatoes	0.003(0.021)	0.012(0.042)	-0.009***	0.002(0.011)	0.010(0.029)	-0.009***
Irish Potatoes	0.004(0.020)	0.004(0.020)	0.000	0.016(0.026)	0.013(0.031)	0.003***
Chicken	0.080(0.104)	0.050(0.086)	0.030***	0.080(0.070)	0.076(0.084)	0.004***
Other poultry	0.002(0.016)	0.001(0.013)	0.001***	0.001(0.012)	0.002(0.001)	-0.001
Beef	0.025(0.061)	0.016(0.053)	0.009***	0.060(0.064)	0.045(0.065)	0.015***
Pork	0.015(0.054)	0.007(0.033)	0.008***	0.010(0.030)	0.009(0.029)	0.001***
Goat meat	0.019(0.058)	0.012(0.048)	0.007***	0.008(0.027)	0.007(0.030)	0.000
Mutton	0.001(0.016)	0.001(0.010)	0.000	0.000(0.007)	0.000(0.009)	-0.000
Game meat	0.011(0.047)	0.008(0.040)	0.003	0.006(0.026)	0.006(0.028)	0.000
Bream fish	0.078(0.104)	0.029(0.066)	0.049***	0.058(0.061)	0.058(0.070)	0.000
Kapenta	0.059(0.075)	0.034(0.059)	0.024***	0.048(0.050)	0.042(0.053)	0.006***
Vegetables	0.032(0.059)	0.132(0.121)	-0.100***	0.061(0.060)	0.080(0.074)	-0.020***
Beans	0.035(0.057)	0.029(0.054)	0.006***	0.035(0.037)	0.033(0.044)	0.002***
Onion	0.012(0.025)	0.012(0.022)	-0.000	0.022(0.024)	0.023(0.027)	-0.001
Tomatoes	0.033(0.046)	0.025(0.037)	0.008***	0.047(0.041)	0.039(0.035)	0.008***
Eggs	0.010(0.028)	0.010(0.029)	-0.001	0.027(0.032)	0.027(0.038)	0.001
Cooking Oil	0.085(0.088)	0.044(0.050)	0.042***	0.071(0.053)	0.050(0.046)	0.021***
Groundnuts	0.027(0.061)	0.017(0.044)	0.010***	0.014(0.033)	0.013(0.028)	0.002***
Butter	0.002(0.011)	0.001(0.008)	0.001***	0.011(0.018)	0.009(0.021)	0.002***
Sugar	0.067(0.073)	0.042(0.059)	0.025***	0.057(0.047)	0.048(0.044)	0.009***
Honey	0.003(0.028)	0.001(0.016)	0.002***	0.001(0.010)	0.001(0.013)	0.000***
Tea/ coffee	0.004(0.014)	0.003(0.011)	0.001***	0.012(0.018)	0.009(0.021)	0.003***
Fresh milk	0.011(0.034)	0.011(0.035)	0.000	0.021(0.036)	0.018(0.036)	0.003***
Powdered milk	0.001(0.010)	0.001(0.010)	0.000	0.004(0.016)	0.003(0.015)	0.001***
Salt	0.044(0.072)	0.017(0.032)	0.028***	0.014(0.024)	0.010(0.023)	0.004***
Fruits	0.002(0.013)	0.027(0.055)	-0.025***	0.010(0.022)	0.032(0.044)	-0.022***
Non alcoholic drink	0.008(0.029)	0.012(0.042)	-0.005***	0.017(0.033)	0.005(0.020)	0.012***
Total	1.00	1.00		1.00	1.00	

Source of Data: Estimated from LCMS raw data

*Notes: Standard deviations in parenthesis. Significance of the difference in means based on a t-test for continuous variables. ***p<0.01, **p<0.05, *p<0.1*

Appendices: chapter 5

Appendix F: Brief theory and the incidence of poverty in Zambia[80]

Theory

Historically, poverty measurements have been associated with the late nineteenth century British social reformers (Booth, 1892). The initial conceptualization of poverty was income based, and income has remained at the core of the concept’s meaning. The justification for this is that (in market-based economies) lack of income is highly correlated with other characteristics of poverty and is a predictor of associated and future deprivation (Wratten, 1995).

As defined by Townsend (2006), people can be said to be in poverty when they lack, or are denied, the income and other resources, including the use of assets and receipt of goods and services in kind, to obtain the conditions of life – that is, the diets, material goods, amenities, standards and services – that enable them to participate in relationships and follow the customary behaviour that is expected of them by virtue of their membership in society. Ravallion (2008) similarly defines a poverty line for a given individual as the money the individual needs to achieve the minimum level of “welfare” to not be deemed “poor”, given his or her circumstances.

Currently, the World Bank sets the poverty line − the minimum income level to meet basic needs − at US$ 1.25 in 2005 purchasing power parity. This was based on the extreme poverty lines for the 10−20 poorest countries of the world (Chen and Ravallion, 2008). This suggests that everyone at the poverty line is taken to be equally worse off, and all those below the line are worse off than all above it.

Many have criticized the Bank’s conventional measure of poverty, which takes income as a proxy measure of welfare (see for example Wratten, 1995, Mitlin and Satterthwaite, 2013). Other authors proposed different measures of poverty. For example, Sen (1999b) developed his widely used “capabilities” approach and argued

[80] Excerpts of this appendix is based on my published work in the Environment and Development Journal (Chibuye 2014).

that income is not the only instrument in generating capabilities in response to the criticisms. Lipton and Waddington (2004) proposed an adult-equivalent poverty line set by the food energy method (FEM). The FEM expectation is that the poverty line is set at the level of consumption where persons just fulfil minimum calorie requirements rather than focussing on the purchasing power parity (PPP) [81].

The incidence of poverty in Zambia

As in many other countries, poverty levels in Zambia have been at the centre of national debates, with both the figures and their analysis contested by various factions of society. Ideally, it would be better to assess the changes in people's living standards by analysing poverty over time, and while one objective of these Zambian welfare studies is to provide comparable estimates over time, the differences in survey design, and in some instances adjustments in methodologies for estimating poverty, limit the validity of these comparisons. However, as highlighted in *chapter 3*, a few surveys are comparable and these are 1991 and 1993; 1996 is comparable to the 1998 and 2004 LCMSs; and the 2006 is only comparable to the 2010 LCMS. This paper draws mainly from the 2006 and 2010 LCMSs (Government of the Republic of Zambia, 2011d), which were published in one report due to the delayed release of the 2006 results.

Table F.1 provides a summary of poverty levels since 1991. According to the table, the incidence of overall poverty was very high in the early 1990s. This is expected, as during this time the government implemented austerity measures through the Structural Adjustment Programme to reduce the fiscal deficit. As indicated by Ndulo and Mudenda (2004), between 1981 and 1990, formal employment as a percentage of the labour force averaged 23 per cent, but it fell to an average of 12 per cent for 1991–2000 when the liberalization programme was in full swing, and by 2003 it had fallen further to 8.1 per cent.

[81] Currently, there are debates about a further decline in global absolute poverty. Using the World Bank's latest purchasing power parity (PPP) numbers for the world's economies, the Centre for Global Development (CGD) re-estimated the poverty figures and released the results on 02 May 2014. According to the CGD, fewer people were living on less than $1.25 a day (see Dykstra et al., 2014 for details).

The trend between 1996 and 2004 showed that poverty levels increased between 1996 and 1998, from 69 per cent to 73 per cent, but by 2004 had decreased to 68 per cent. Extreme poverty followed the same trend. Based on this data, more than 50 per cent of Zambians in the 1990s were unable to meet their basic nutritional requirements.

Table F.1: Incidence of overall and extreme poverty in Zambia

Residence	1991	1993	1996	1998	2002/03	2004	2006	2010
			Incidence of overall poverty					
All Zambia	70	74	69	73	67	68	62.8	60.5
Rural	88	92	82	83	74	78	80.3	77.9
Urban	49	45	46	56	52	53	29.7	27.5
			Incidence of extreme poverty					
All Zambia	58	61	53	58	46	53	42.7	42.3
Rural	81	84	68	71	52	65	58.5	57.7
Urban	32	24	27	36	32	34	13	13.1

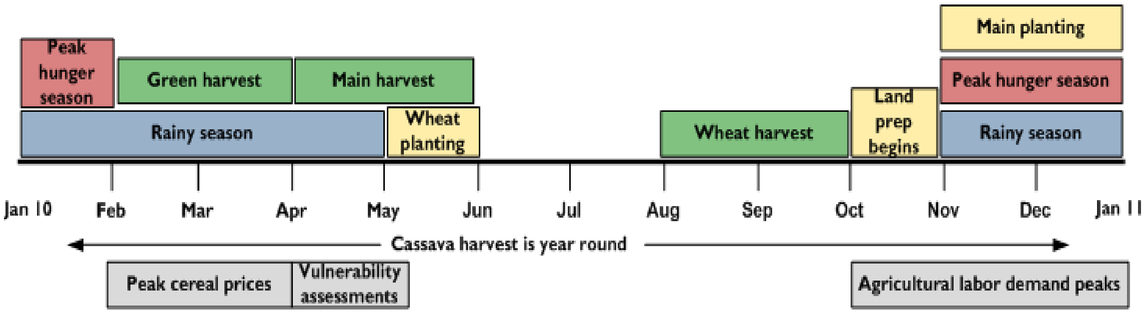
Source: (Government of the Republic of Zambia, 2005, Government of the Republic of Zambia, 2006, Government of the Republic of Zambia, 2004b, Government of the Republic of Zambia, 2011e)[82]

The LCMS of 2002/03 showed an overall poverty rate of 67 per cent, with 46 per cent of the population being extremely poor and unable to afford even the minimum basic food requirements. According to the 2002/03 LCMS, poverty was highest in the fourth quarter, considered to be the lean (peak hunger) period due to low seasonal agricultural production. *Figure F.1* shows a typical seasonal calendar and critical events timeline. In light of this seasonal aspect of poverty, the CSO conducts cross-sectional surveys in the fourth quarter of the year. The aim is to capture the highest poverty levels in the year, taking the 2002/03 results as the norm.

While food availability in rural areas affects food affordability in urban areas in Zambia (Chibuye, 2009), there may be a lag in urban price changes relative to changes in supply in rural areas. The JCTR has observed through its monthly cost of living surveys that, over the years, food prices in urban areas in Zambia are highest in the first quarter of the year, reflecting this lag.

[82] Due to the delay in publishing the 2006 LCMS report, the findings for 2006 and 2010 were published in the same report (2011).

Figure F.1: Typical agriculture calendar in Zambia



Source: FEWSNET (2011)

Critics of the CSO survey methodology have argued that measurements should differentiate between rural and urban areas and take account of this lag in price changes. Adjusting for seasonal cost of living differences is important to ensure equal treatment of urban and rural dwellers. As suggested by Satterthwaite (2004), there is a need for greater attention to understanding and measuring urban poverty in ways that better capture the scale and nature of its deprivation.

There are also disparities in costs related to the methods of accessing food items: urban dwellers typically purchase food items, while rural people consume mainly self-produced foods at lower cost. Urban settlements in Zambia are dense and there are few opportunities for urban agriculture. Even when a market value is estimated for own-produced foods in rural areas, food prices are generally lower mainly due to higher supply and lower transport costs from the farm gate to the local market. Therefore, using an average cost underestimates urban poverty and is likely to overestimate rural poverty.

Table F.2: CSO food basket to meet monthly nutritional requirements of a household of six in December 2006 and December 2010 (price values in Zambian Kwacha)

Consumption items	Quantity	Unit price (Dec 2006)	Average price (Dec 2006)	Unit price (Dec 2010)	Average price (Dec 2010)
White roller (25kg)	3.6	26,288	94,637	47,736	171,849.6
Dried *kapenta* (1kg)	2	30,336	60,672	49,225	98,450
Dried bream (1kg)	1	22,317	22,317	30,522	30,522
Fresh milk (500ml)	4	2,186	8,744	3,298	13,192
Shelled groundnuts (1kg)	3	5,743	17,229	7,705	23,115
Cooking oil (local, 2.5 litres)	1	17,653	17,653	28,698	28,698
Onions (1kg)	4	3,864	15,456	4,765	19,060
Tomatoes (1kg)	4	2,253	9,012	3,073	12,292
Vegetables (1kg)	7.5	2,070	15,525	2,185	16,388
Dried beans (1kg)	2	6,041	12,082	8,746	17,492
Table salt (1kg)	1	2,424	2,424	4,516	4,516
Poverty line in adult equivalent (AE) terms AE scale = 4.52					
Total cost			275,751		435,574

Source: (Government of the Republic of Zambia, 2011d)

However, the CSO uses the same approximated nominal cost of food for the same bundle of food needs without weighting it to reflect actual costs of food and non-food items in different regions at different times. For instance, the 2006 CSO food poverty line was valued across the board at 275,751 Zambian Kwacha (K), the average national price at which the CSO bundle of food items reaches the pre-determined mean food energy requirement of 2,100 calories per person per day. This single national food poverty line does not make sense in the Zambian context, considering the significant disparity in food costs across urban centres. The disparity would be greater between rural and urban areas.

The controversy over poverty statistics in Zambia

Zambia's poverty statistics, particularly for 2006, have proved confusing and controversial. Different government departments produced different results prior to the combined 2006 and 2010 LCMS report publication in November 2011. The preliminary 2006 LCMS poverty estimates provided by CSO alarmed many stakeholders. The estimates indicated that while rural poverty increased from 78 per cent to 80 per cent, urban poverty fell significantly, from 53 per cent to 34 per cent (Government of the Republic of Zambia, 2006). This unprecedented 19 percentage point reduction in urban poverty between 2004 and 2006 was controversial, as socioeconomic indicators had not improved. For example, only about 10 per cent of the entire Zambian labour force was in formal employment (Government of the Republic of Zambia, 2011c). No clear explanations were offered by the government as to why poverty had fallen so dramatically within a two-year period (2004–2006) when the same methodology was used.

In view of this confusion, there was a significant delay in publishing the final 2006 LCMS results, and the CSO published both the 2006 and 2010 results in the same report. According to the CSO, this was necessitated by adjustments in the measurement of poverty (Government of the Republic of Zambia, 2011d).

One trend that remains uncontested throughout all the surveys, based on government statistics, is the geographic pattern of poverty in Zambia: it is more concentrated in rural areas than in urban areas.

Appendix G: impact of rising food prices on poverty (by district)

Table G.1: Poverty levels by district

District name	Base figures*	Poverty (without maize supply effects)	Poverty (with maize supply effects)
Chibombo	70.5	62	57.2
Kabwe	41.8	42.6	42
Kapiri-mposhi	78.9	78.5	74.6
Mkushi	58	55.6	55.3
Mumbwa	83.3	79.2	79.2
Serenje	91	89.1	88.2
Chililabombwe	23.2	25.1	25.1
Chingola	29.5	30.2	30.2
Kalulushi	31.7	33.8	32.4
Kitwe	27.1	28.7	28.5
Luanshya	42.9	43.8	43.8
Lufwanyama	79.6	79	77.4
Masaiti	48.1	44.2	42.2
Mpongwe	87.2	73.3	72.2
Mufulira	33.7	34.6	34.6
Ndola	33.9	35	34.9
Chadiza	79.9	82.7	82.7
Chama	83.9	85.5	85.5
Chipata	73	72	70.8
Katete	79.3	78.9	78.2
Lundazi	77.9	77.6	77.5
Mambwe	71.1	70.7	70.7
Nyimba	79.5	74.9	72.8
Petauke	84.7	80.2	78.7
Chienge	90.5	91	90.6
Kawambwa	48.9	49.1	49
Mansa	77.1	76.4	76.4
Milenge	84.4	85.9	86.3
Mwense	74.6	76.3	74.8
Nchelenge	85.6	84.8	83.2
Samfya	67	67.6	66.7
Chongwe	64.9	64.3	59.9
Kafue	33.6	34.4	34.4
Luangwa	81.8	83.1	81.5
Lusaka	17.3	18.8	18.8
Chilubi	87.6	88	85.9
Chinsali	80.4	78.8	78.8
Isoka	86.5	82.2	79.9
Kaputa	89.8	90	89.7
Kasama	71.2	69.6	65.5
Luwingu	87.9	85.2	85
Mbala	83.5	79	75.7

Table G.1: Poverty levels by district (continued)

District name	Base figures*	Poverty (without maize supply effects)	Poverty (with maize supply effects)
Mpika	62.9	61.1	61.2
Mporokoso	72.4	70.8	68.8
Mpulungu	62	59.9	58.3
Mungwi	86.4	86	86
Nakonde	78.9	75.3	72.6
Chavuma	72.9	74.3	74.3
Kabompo	77	76	74.2
Kasempa	72	71.6	70.2
Mufumbwe	66.1	62.5	54.8
Mwinilunga	68.3	69.3	68.2
Solwezi	68.5	66.7	65.7
Zambezi	75.5	76.8	76.8
Choma	82.7	82.8	82.2
Gwembe	85	79.3	79.1
Itezhi-tezhi	86	87.2	87.1
Kalomo	78.7	79.1	76.5
Kazungula	81.4	76.9	75.8
Livingstone	36.3	37.8	37.8
Mazabuka	63.4	64.1	63.1
Monze	72.2	76.8	76.1
Namwala	84.9	78.5	76
Siavonga	78.5	78.2	78.9
Sinazongwe	71.3	72.8	72.1
Kalabo	94.7	95.9	95.9
Kaoma	84.8	85.2	84.6
Lukulu	75.4	78.2	78.2
Mongu	71.9	72.5	72.5
Senanga	90.4	91.2	91
Sesheke	80.2	80	80
Shang'ombo	88	88.3	88.2

Source: authors' calculations based on 2006 and 2010 LCMS

*Note: *estimated by author as the CSO report did not feature district level poverty figures*

Appendix H: Robustness Tests – Poverty Results

Table H.1: Estimated food price effects on poverty headcount (without supply elasticity)

		Percentage point change in poverty headcount ratio				
	Baseline (2006 LCMS)	Maize grain	Less-refined maize flour	Refined maize flour	Rice	Cereals
		Rural (per cent)				
Severe	**58.3**	-0.8 (57.5)	-3.7 (54.6)	-4 (54.3)	0.8 (59.1)	1.7 (60)
All rural	**80.3**	-1.7 (78.6)	-2.6 (77.7)	-2.7 (77.6)	0.6 (80.9)	-0.3 (80)
		Urban (per cent)				
Severe	**13.2**	1.1 (14.3)	1.9 (15.1)	2 (15.2)	0.9 (14.1)	2.2 (15.4)
All urban	**30**	1.4 (31.4)	2.1 (32.1)	4.2 (34.2)	1.8 (31.8)	2.6 (32.6)
All Zambia	**62.8**	0 62.8	-0.6 62.2	0.23 63	1.6 64.4	1.2 64

Source: authors' calculations based on 2006 LCMS. Baseline Results are based on Government LCMS poverty estimates (Government of the Republic of Zambia, 2011d)
In parenthesis: actual poverty change

Table H.2: Estimated food price effects on poverty gap and squared poverty gap (without supply elasticity)

	Percentage point change in poverty gap				
	Baseline	Maize grain	Less-refined maize flour	Refined maize flour	Rice
Rural	42.6	42(-0.6)	41.9(-0.7)	42(-0.6)	42.5(-0.1)
Urban	10.7	11.2(0.5)	11(0.3)	10.8(0.1)	11.2(0.5)
National	31.5	31.6(0.1)	31.5(0)	31.4(-0.1)	32(0.5)
		Percentage point change in squared poverty gap*			
Rural	26.7	26.5(-0.2)	26.5(-0.2)	26.5(-0.2)	26.7(0)
Urban	5.2	5.5(0.3)	5.46(0.26)	5.5(0.3)	5.5(0.3)
National	19.3	19.4(0.1)	19.4(0.1)	19.4(0.1)	19.5(0.2)

Source: authors' calculations based on 2006 LCMS. Baseline Results for poverty headcount are based on Government LCMS poverty estimates (Government of the Republic of Zambia, 2011d).
In parenthesis: change in gap/ squared poverty gap relative to baseline
**Squared poverty gap results are based on authors' estimates as these were not reported in the LCMS report*

Table H.3: Food price effects on poverty headcount (with supply elasticity)

	Commodity			
	Baseline (2006 LCMS)	Maize grain	Less-refined maize flour	Refined maize flour
		Rural (per cent)		
Severe		-2.8	-5.1	-5.5
	58.5	(55.7)	(53.4)	(53)
All rural		-3.2	-3.9	-4.1
	80.4	(77.2)	(76.5)	(76.3)
		Urban (per cent)		
Severe		1.1	1.9	2
	13.1	(14.2)	(15)	(15.1)
All urban		1.4	2.2	4.2
	29.8	(31.2)	(32)	(34)
		-1	-1.4	-0.8
All Zambia	**62.8**	(61.8)	(61.4)	(62)

Source: authors' calculations based on 2006 LCMS
In parenthesis: actual poverty change

Table H.4: Estimated food price effects on poverty gap and squared poverty gap (with supply elasticity)

	Percentage point change in poverty gap			
	Baseline	Maize grain	Less-refined maize flour	Refined maize flour
Rural	42.6	41.3(-1.3)	39.3(-3.3)	39.1(-3.5)
Urban	10.7	11.2(0.5)	12(1.3)	12.5(1.8)
National	31.5	31.2(-0.3)	30.1(-1.4)	30.1(-1.4)
	Percentage point change in squared poverty gap*			
Rural	26.7	26.3(-0.4)	24.4(-2.3)	24.1(-2.6)
Urban	5.2	5.5(0.3)	6.15(0.95)	6.2(1)
National	19.3	19.3(0)	18.3(-1)	18.1(-1.2)

Source: authors' calculations based on 2006 LCMS. Baseline Results for poverty headcount are based on Government LCMS poverty estimates (Government of the Republic of Zambia, 2011d).
In parenthesis: change in gap/ squared poverty gap relative to baseline
**Squared poverty gap results are based on authors' estimates as these were not reported in the LCMS report*

Appendix I: impact of rising food prices on poverty (by district)

Table I.1: Poverty levels by district

District name	Base figures*	Poverty (without maize supply effects)	Poverty (with maize supply effects)
Chibombo	70.6	62	57.15
Kabwe	42.1	42.6	42
Kapiri-mposhi	78.9	78.5	74.6
Mkushi	58.1	55.7	55.4
Mumbwa	83.3	79.2	79.2
Serenje	91.03	89.1	88.2
Chililabombwe	23.6	25.2	25.2
Chingola	29.5	30.2	30.2
Kalulushi	31.9	33.8	32.4
Kitwe	27.3	28.7	28.5
Luanshya	42.2	42.8	42.8
Lufwanyama	79.3	78.7	77.1
Masaiti	48.1	44.2	42.2
Mpongwe	87.2	73.2	72.2
Mufulira	33.7	34.7	34.7
Ndola	34.1	35	34.9
Chadiza	79.9	82.7	82.7
Chama	84	85.7	85.7
Chipata	73	72	70.9
Katete	79.3	78.9	78.2
Lundazi	77.9	77.6	77.5
Mambwe	71.1	70.7	70.7
Nyimba	79.5	74.9	72.8
Petauke	84.8	80.2	78.7
Chienge	90.5	91	90.6
Kawambwa	48.9	49.1	49
Mansa	77.1	76.4	76.4
Milenge	84.4	85.9	86.3
Mwense	74.6	76.3	74.8
Nchelenge	85.6	84.8	83.2
Samfya	67	67.6	66.7
Chongwe	65.2	64.5	60.1
Kafue	33.7	34.4	34.4
Luangwa	81.8	83.1	81.5
Lusaka	17.4	18.9	18.9
Chilubi	87.6	88	85.9
Chinsali	80.4	78.8	78.8
Isoka	86.5	82.2	80
Kaputa	89.8	90	89.7
Kasama	71.2	69.7	65.5
Luwingu	87.9	85.2	85
Mbala	83.5	79	75.7

Table I.1: Poverty levels by district (continued)

District name	Base figures*	Poverty (without maize supply effects)	Poverty (with maize supply effects)
Mpika	62.4	60.6	60.6
Mporokoso	72.5	70.9	68.8
Mpulungu	62	59.9	58.4
Mungwi	86.2	85.7	86
Nakonde	78.8	75.1	72.4
Chavuma	72.9	74.3	74.3
Kabompo	77	76	74.2
Kasempa	71.8	71.1	69.9
Mufumbwe	66.1	62.5	54.8
Mwinilunga	68.3	69.3	68.2
Solwezi	68.5	66.7	65.7
Zambezi	75.5	76.9	76.9
Choma	82.5	82.5	81.9
Gwembe	84.1	78.1	77.9
Itezhi-tezhi	86	87.2	87.1
Kalomo	79.1	78.7	76.1
Kazungula	81	76.4	75.4
Livingstone	36.6	37.8	37.8
Mazabuka	63.2	63.7	62.8
Monze	72.2	76.8	76.1
Namwala	84.7	78.2	75.6
Siavonga	78	77.7	78.5
Sinazongwe	71.3	72.8	72.1
Kalabo	94.2	95.9	95.5
Kaoma	84.8	85.2	84.6
Lukulu	75.4	78.2	78.2
Mongu	72	72.6	72.6
Senanga	90.3	91.1	90.9
Sesheke	80.2	80	80
Shang'ombo	87.8	88.1	88

Source: authors’ calculations based on 2006 and 2010 LCMS

*Note: *estimated by author as the CSO report did not feature district level poverty figures*

Appendices: chapter 6

Appendix J: evolution of nutrient shares consumed between 2006 and 2010

Table J.1: Calorie and protein share (rural)

	Calories			Proteins		
Commodities	2006	2010	Difference	2006	2010	Difference
Maize grain	0.344(0.303)	0.256(0.315)	0.087***	0.323(0.295)	0.217(0.279)	0.107***
Refined maize flour	0.023(0.115)	0.056(0.183)	-0.033***	0.019(0 .100)	0.045(0.153)	-0.025***
Less-refined maize flour	0.020(0.118)	0.066(0.199)	-0.046***	0.017(0.105)	0.053(0.168)	-0.036***
Rice	0.030(0.063)	0.002(0.018)	0.029***	0.022(0.052)	0.001(0.012)	0.021***
Cassava	0.117(0.240)	0.060(0.158)	0.057***	0.061(0.156)	0.023(0.083)	0.037***
Millet	0.018(0.092)	0.021(0.110)	-0.003**	0.015(0.079)	0.017(0.090)	-0.002*
Sorghum	0.008(0.067)	0.002(0.030)	0.006***	0.009(0.070)	0.002(0.032)	0.006***
Bread	0.032(0.065)	0.020(0.061)	0.012***	0.034(0.071)	0.020(0.060)	0.015***
Sweet Potatoes	0.004(0.029)	0.026(0.087)	-0.022***	0.002(0.016)	0.013(0.050)	-0.011***
Irish Potatoes	0.003(0.014)	0.003(0.014)	0.000	0.003(0.013)	0.002(0.013)	0.000
Chicken	0.023(0.051)	0.025(0.055)	-0.002*	0.082(0.121)	0.071(0.122)	0.011***
Beef	0.008(0.030)	0.007(0.027)	0.000	0.022(0.061)	0.018(0.058)	0.004***
Pork	0.005(0.031)	0.005(0.028)	0.001*	0.008(0.040)	0.005(0.028)	0.003***
Bream Fish	0.017(0.049)	0.003 (0.012)	0.014***	0.087(0.129)	0.012(0.048)	0.075***
Kapenta	0.010(0.031)	0.004(0.014)	0.006***	0.087(0.121)	0.035(0.077)	0.051***
Vegetables	0.028(0.055)	0.173(0.217)	-0.145***	0.076(0.124)	0.342(0.282)	-0.266***
Beans	0.016(0.040)	0.017(0.045)	-0.001*	0.037(0.069)	0.035(0.080)	0.002*
Onion	0.003(0.015)	0.004(0.009)	-0.001***	0.003(0.015)	0.003(0.014)	0.000**
Tomatoes	0.005(0.018)	0.006(0.014)	-0.001*	0.009(0.021)	0.009(0.035)	-0.000
Eggs	0.003(0.009)	0.004(0.013)	-0.001***	0.008(0.023)	0.010(0.032)	-0.002***
Cooking Oil	0.148(0.151)	0.103(0.128)	0.044***	-	-	-
Groundnuts	0.044(0.088)	0.035(0.090)	0.006***	0.071(0.133)	0.050(0.113)	0.021***
Butter	0.001(0.007)	0.001(0.005)	0.000*	0.000(0.000)	0.000(0.000)	0.000*
Sugar	0.088(0.101)	0.080(0.117)	0.008***	-	-	-
Tea/ coffee	0.000(0.000)	0.000(0.000)	0.000*	-	-	-
Fresh Milk	0.003(0.017)	0.003(0.016)	-0.001***	0.005(0.023)	0.006(0.031)	-0.001*
Powdered Milk	0.001(0.004)	0.001(0.000)	0.000	0.001(0.009)	0.001(0.008)	0.000
Salt	-	-	-	-	-	-
Fruits	0.001(0.000)	0.016(0.001)	-0.015*	0.001(0.004)	0.008(0.027)	-0.007***

Source: authors' calculations based on 2006 and 2010 LCMS

*Notes: Standard deviations in parenthesis. Significance of the difference in means based on a t-test for continuous variables. ***p<0.01, **p<0.05, *p<0.1*

Table J.**2: Calorie and protein share (urban)**

	Calories			Proteins		
Commodities	2006	2010	Difference	2006	2010	Difference
Maize grain	0.064(0 .156)	0.082(0.197)	-0.017***	0.056(0.140)	0.071(0.176)	-0.015***
Refined maize flour	0.299(0 .277)	0.066(0.190)	0.233***	0.229(0.233)	0.052(0.157)	0.177***
Less-refined maize flour	0.074(0 .210)	0.377(0.319)	-0.302***	0.062(0.180)	0.295(0.270)	-0.233***
Rice	0.047(0 .058)	0.005(0.028)	0.042***	0.032(0.042)	0.004(0.021)	0.028***
Cassava	0.018(0.078)	0.010(0.057)	0.007***	0.007(0.040)	0.003(0.024)	0.003***
Millet	0.002(0 .027)	0.003(0.040)	-0.001**	0.002(0.019)	0.002(0.033)	-0.001**
Sorghum	0.002(0 .033)	0.001(0.180)	0.001***	0.002(0.033)	0.001(0.016)	0.001***
Bread	0.087(0.088)	0.065(0.089)	0.022***	0.088(0.089)	0.066(0.091)	0.021***
Sweet Potatoes	0.002(0 .013)	0.021(0.060)	-0.018***	0.001(0.007)	0.010(0.034)	-0.009***
Irish Potatoes	0.008(0 .015)	0.008(0.021)	0.000*	0.007(0.013)	0.007(0.018)	0.000
Chicken	0.024(0 .029)	0.030(0.043)	-0.005***	0.088(0.083)	0.104(0.118)	0.016***
Beef	0.016(0.021)	0.013(0.025)	0.003***	0.049(0.057)	0.039(0.061)	0.010***
Pork	0.003(0 .012)	0.004(0.016)	-0.001***	0.004(0.014)	0.005(0.021)	-0.001***
Bream Fish	0.011(0.017)	0.002(0.011)	0.009***	0.060(0.072)	0.012(0.042)	0.048***
Kapenta	0.007(0 .017)	0.004(0.010)	0.003***	0.061(0.077)	0.036(0.058)	0.024***
Vegetables	0.047(0 .055)	0.063(0.087)	-0.016***	0.131(0.117)	0.168(0.161)	-0.038***
Beans	0.014(0.020)	0.013(0.026)	0.001*	0.032(0.042)	0.031(0.046)	0.002***
Onion	0.005(0 .007)	0.005(0.010)	-0.000***	0.004(0.006)	0.005(0.011)	-0.001***
Tomatoes	0.007(0 .015)	0.005(0.008)	0.002***	0.012(0.021)	0.010(0.022)	0.002***
Eggs	0.007(0 .010)	0.008(0.015)	-0.000)	0.021(0.026)	0.022(0.032)	-0.001
Cooking Oil	0.138(0 .104)	0.096(0.090)	0.043***	-	-	-
Groundnuts	0.020(0.048)	0.021(0.051)	-0.001	0.035(0.072)	0.036(0.076)	-0.001
Butter	0.006(0.015)	0.005(0.013)	0.001***	0.000(0.000)	0.000(0.000)	0.000***
Sugar	0.080(0.067)	0.074(0.074)	0.005***	-	-	-
Tea/ coffee	0.000(0.000)	0.000(0.000)	0.000*	-	-	-
Fresh Milk	0.006(0.013)	0.005(0.015)	0.001***	0.011(0.021)	0.010(0.023)	0.001***
Powdered Milk	0.002(0.008)	0.001(0.007)	0.001***	0.003(0.012)	0.002(0.012)	0.001***
Salt	-	-	-	-	-	-
Fruits	0.003(0.010)	0.013(0.028)	-0.009***	0.001(0.005)	0.007(0.018)	-0.006***

Source: authors' calculations based on 2006 and 2010 LCMS

*Notes: Standard deviations in parenthesis. Significance of the difference in means based on a t-test for continuous variables. ***p<0.01, **p<0.05, *p<0.1*

Appendix K: starchy staple ratio (SSR) estimates

Table K.1: SSR estimates by quintile

	2006	2010	Difference
		Rural	
1st Quintile	0.606(0.305)	0.474(0.367)	0.132***
2nd Quintile	0.601(0.235)	0.535(0.302)	0.066***
3rd Quintile	0.597(0.230)	0.542(0.276)	0.056***
4th Quintile	0.573(0.206)	0.544(0.260)	0.030**
5th Quintile	0.574(0.200)	0.512(0.238)	0.062***
		Urban	
1st Quintile	0.508(0.324)	0.582(0.327)	-0.074***
2nd Quintile	0.592(0.246)	0.638(0.256)	-0.046***
3rd Quintile	0.624(0.197)	0.666(0.213)	-0.042***
4th Quintile	0.624(0.176)	0.657(0.189)	-0.033***
5th Quintile	0.594(0.159)	0.614(0.174)	-0.020***

Source: authors' calculations based on 2006 and 2010 LCMS

*Notes: Standard deviations in parenthesis. Significance of the difference in means based on a t-test for continuous variables. ***p<0.01, **p<0.05, *p<0.1*

Table K.2: HAZ estimates by quintile and region

	All	Rural	Urban
1st Quintile	-1.614(1.901)	-1.632(1.912)	-1.565(1.871)
2nd Quintile	-1.539(1.890)	-1.576(1.885)	-1.491(1.898)
3rd Quintile	-1.428(1.913)	-1.496(1.861)	-1.372(1.953)
4th Quintile	-1.355(1.927)	-1.408(1.927)	-1.330(1.928)
5th Quintile	-1.135(1.964)	-1.440(1.917)	-1.058(1.969)

Source: authors' calculations based on 2006 and 2010 LCMS

Notes: Standard deviations in parenthesis.

Appendix L: Impact of rising food prices on WHZ and WAZ

While we considered HAZ in this thesis, we also estimated alternative representations of the outcome variable. This was meant to observe how the effect would vary if other anthropometric indicators were used. We therefore re-estimated our main specification, which is featured in *Table 6.7* of *chapter 6*, using weight-for-height z-scores (WHZ) and weight-for-age z-scores (WAZ)[83] as dependent variables. The results (appendix F.5 and F.6) are mainly statistically insignificant and for those that are, the results are different. As suggested earlier based on recommendation by Waterlow et al., (1977), height-for-age is an indicator of past nutrition. Therefore, WHZ and indeed WAZ may not accurately capture the long term nature of the impacts of high food prices. This is especially so in this research where we assess the impact over a 4 year period (2006 to 2010). Therefore, the rest of the discussion is concentrated on HAZ.

[83] WHZ measures wasting where a child is thin for his/her height but not necessarily short. It is a symptom of **acute malnutrition** and could lead to increased morbidity and mortality. WAZ measures underweight where a child can be either thin or short for his/her age. This reflects a combination of **chronic and acute malnutrition** (WHO 1995).

Table L.1: Impact of food prices on children's nutrition in Zambia

Dependent variable: WHZ	**(1)** **Rural**	**(2)** **Urban**
Child characteristics		
Male child	0.120*(0.066)	-0.017(0.047)
≤ 6 months	0.244***(0.091)	0.159(0.100)
>2 - 5 years	0.019(0.065)	-0.026(0.071)
Household and Community Characteristics		
Log of household expenditure on food	0.050(0.046)	0.008(0.054)
Household size	-0.015(0.011)	-0.013(0.013)
Mothers age	-0.003(0.004)	0.002(0.004)
Mother's education	0.009(0.011)	0.033***(0.009)
Distance to health facility (logs)	0.068(0.048)	-0.109**(0.050)
Tap water	-0.172(0.154)	-0.073(0.091)
Radio ownership	0.004(0.052)	0.031(0.047)
Food Prices (in logs)		
Refined maize flour	3.997**(1.970)	2.249*(1.359)
Less-refined maize flour	1.087*(0.606)	1.176*(0.706)
Rice	0.058(0.297)	0.029(0.329)
Bread	-0.082(0.267)	-0.231(0.271)
Beef	1.002**(0.493)	-0.767(0.860)
Chicken	1.140(0.800)	-0.149(0.672)
Kapenta	-1.115**(0.518)	0.123(0.564)
Fish	0.147(1.169)	0.982*(0.551)
Beans	-0.692**(0.281)	-0.349(0.279)
Eggs	-2.447(1.539)	-0.089(1.029)
Milk (fresh)	0.567***(0.121)	0.453***(0.146)
Cooking oil	-0.994***(0.303)	-0.807***(0.188)
Groundnuts	-0.194(0.251)	0.065(0.185)
Vegetables	1.866*(1.028)	1.978**(1.009)
Tomatoes	-1.829**(0.875)	-1.225**(0.559)
Onion	0.449(0.337)	0.706*(0.416)
Sugar	-7.264***(2.387)	-1.861(1.796)
District Fixed Effect	Yes	Yes
Province by Year Terms	Yes	Yes
Number of observations	5,475	6,278
R-squared	0.046	0.025
Adjusted R-squared	0.039	0.019

Source: authors' calculations based on 2006 and 2010 LCMS raw data and Central Statistical Office district price data

Note: Robust standard errors in parenthesis *** p<0.01, ** p<0.05, * p<0.1

Table L.2: Impact of food prices on children's nutrition in Zambia

Dependent variable: WAZ	**(1)** **Rural**	**(2)** **Urban**
Male child	-0.179***(0.043)	-0.223***(0.035)
≤ 6 months	1.577***(0.075)	1.487***(0.078)
>2 - 5 years	-0.069(0.047)	-0.142***(0.035)
Household and Community Characteristics		
Log of household expenditure on food	0.095***(0.033)	0.163***(0.027)
Household size	0.002(0.007)	0.012**(0.006)
Mothers age	0.004(0.003)	0.008**(0.003)
Mother's education	0.012(0.007)	0.036***(0.008)
Distance to health facility (logs)	0.042(0.027)	0.018(0.042)
Tap water	-0.043(0.158)	-0.003(0.057)
Radio ownership	0.068(0.046)	0.096***(0.029)
Food Prices (in logs)		
Refined maize flour	0.619(0.649)	1.150(1.083)
Less-refined maize flour	-0.306(0.295)	0.197(0.401)
Rice	0.545***(0.153)	-0.083(0.220)
Bread	0.714***(0.151)	-0.041(0.152)
Beef	-0.149(0.199)	0.595(0.406)
Chicken	-1.037**(0.439)	-0.510(0.468)
Kapenta	-1.006***(0.262)	0.196(0.254)
Fish	0.406(0.576)	-0.928**(0.438)
Beans	0.046(0.195)	0.071(0.135)
Eggs	-0.776(0.729)	1.328**(0.651)
Milk (fresh)	0.082(0.068)	-0.033(0.119)
Cooking oil	-0.332*(0.180)	0.264***(0.094)
Groundnuts	-0.141(0.126)	-0.397***(0.128)
Vegetables	-1.365**(0.597)	-0.129(0.564)
Tomatoes	-0.166(0.457)	-0.263(0.336)
Onion	-0.219(0.165)	-0.265(0.239)
Sugar	-2.292*(1.300)	0.110(0.922)
District Fixed Effect	Yes	Yes
Province by Year Terms	Yes	Yes
Number of observations	5,352	6,170
R-squared	0.105	0.112
Adjusted R-squared	0.098	0.107

Source: authors' calculations based on 2006 and 2010 LCMS raw data and Central Statistical Office district price data

Note: Robust standard errors in parenthesis *** p<0.01, ** p<0.05, * p<0.1

Appendix M: Robustness checks

Table M.1: Impact of food prices on children's nutrition in Zambia - fewer commodities

Dependent variable: HAZ	**(1) Rural**	**(2) Urban**
Child characteristics		
Male child	-0.220***(0.041)	-0.163***(0.041)
≤ 6 months	1.036***(0.109)	0.938***(0.094)
>2 - 5 years	-0.523***(0.065)	-0.579***(0.101)
Household and Community Characteristics		
Log of household expenditure on food	0.066*(0.036)	0.209***(0.037)
Household size	0.017(0.011)	0.023(0.014)
Mothers age	0.009**(0.004)	0.006(0.005)
Mother's education	0.009(0.010)	0.016*(0.009)
Distance to health facility (logs)	-0.027(0.038)	0.120**(0.056)
Tap water	-0.017(0.134)	0.045(0.072)
Radio ownership	0.089(0.063)	0.067(0.047)
Food Prices (in logs)		
Refined maize flour	-3.595**(1.481)	-2.070*(1.236)
Less-refined maize flour	0.863(0.617)	-1.824***(0.699)
Kapenta	0.574**(0.250)	0.504(0.394)
Chicken	-0.749(0.870)	-1.014(0.841)
Beef	-0.478(0.555)	0.892(0.548)
Milk (fresh)	-0.296(0.390)	1.255*(0.679)
Cooking oil	0.716(1.033)	1.763*(0.906)
Vegetables	0.221(0.213)	-0.129(0.270)
District Fixed Effect	Yes	Yes
Province by Year Terms	Yes	Yes
Number of observations	5,171	6,167
R-squared	0.071	0.068
Adjusted R-squared	0.066	0.064

Source: authors' calculations based on 2006 and 2010 LCMS raw data and Central Statistical Office district price data
Note: Robust standard errors in parenthesis *** p<0.01, ** p<0.05, * p<0.1

Multicollinearity

One concern that might be raised in the analysis of the impact of rising food prices on HAZ is the issue of multicollinearity due to a possible linear relationship among some of the independent variables. This may be the case particularly because all food prices in Zambia rose in tandem. To detect the existence of multicollinearity in our specification, we re-estimated the regressions by dropping each food item in turn. While the signs remain the same for all results (appendix F.7), some coefficients become statistically insignificant. This is particularly the case for maize products. These results are however inconclusive, partly as a result of this test not being sharp enough. According to Kennedy (2003), some coefficients may become statistically insignificant because of the omitted variable bias. In this case, the omitted variable may be an important control variable. It is therefore not obvious that multicollinearity is a problem in our specification.

Table M.2: Multicollinearity test

	Main results		**1**	
Dependent variable: HAZ	**Rural**	**Urban**	**Rural**	**Urban**
Refined maize flour	-3.575**(1.543)	-2.265*(1.327)	**dropped**	**dropped**
Less-refined maize flour	-0.692*(0.418)	-1.735***(0.589)	-0.252(0.401)	-1.505**(0.585)
Rice	-0.034(0.339)	-0.082(0.340)	0.164(0.434)	0.056(0.313)
Bread	0.442(0.787)	-1.961***(0.557)	0.009(0.803)	-2.381***(0.458)
Beef	0.716(0.651)	1.821***(0.520)	0.396(0.617)	1.774***(0.495)
Chicken	-1.951**(0.876)	-1.693*(0.936)	-1.013(0.841)	-1.305(1.048)
Kapenta	0.361*(0.195)	0.018(0.327)	0.380(0.253)	0.084(0.310)
Fish	0.612***(0.173)	0.424**(0.194)	0.600***(0.230)	0.400**(0.187)
Beans	-1.033***(0.278)	-0.405(0.337)	-0.987***(0.297)	-0.353(0.355)
Eggs	-1.549***(0.576)	-1.392**(0.545)	-2.306***(0.617)	-1.969***(0.388)
Milk (fresh)	0.112(0.357)	1.234*(0.713)	-0.327(0.295)	0.886(0.772)
Cooking oil	1.411(1.089)	1.611**(0.661)	1.552(0.989)	1.847***(0.708)
Groundnuts	0.639***(0.217)	0.541**(0.226)	0.762***(0.234)	0.570**(0.237)
Vegetables	-0.198(0.216)	-0.303(0.241)	-0.508**(0.198)	-0.379*(0.225)
Tomatoes	0.934***(0.233)	0.920***(0.144)	0.881***(0.242)	0.903***(0.155)
Onion	-0.574***(0.113)	-0.483***(0.123)	-0.687***(0.128)	-0.563***(0.125)
Sugar	3.475*(1.952)	4.232***(1.183)	4.206**(1.893)	4.566***(1.155)

Table M.2: Multicollinearity test (continued)

	2		3	
Dependent variable: HAZ	**Rural**	**Urban**	**Rural**	**Urban**
Refined maize flour	-3.038**(1.374)	-1.523(1.362)	-3.557**(1.551)	-2.210*(1.243)
Less-refined maize flour	**dropped**	**dropped**	-0.693(0.424)	-1.736***(0.592)
Rice	-0.056(0.377)	-0.089(0.372)	**dropped**	**dropped**
Bread	0.199(0.783)	-2.520***(0.511)	0.445(0.775)	-1.979***(0.537)
Beef	0.618(0.662)	2.092***(0.574)	0.708(0.645)	1.848***(0.503)
Chicken	-1.712**(0.868)	-1.270(1.050)	-1.939**(0.898)	-1.736*(0.592)
Kapenta	0.413**(0.201)	0.111(0.334)	0.353**(0.175)	0.013(0.330)
Fish	0.533***(0.181)	0.113(0.196)	0.612***(0.173)	0.423**(0.191)
Beans	-0.982***(0.266)	-0.361(0.382)	-1.034***(0.279)	-0.439(0.293)
Eggs	-1.514**(0.625)	-1.220*(0.635)	-1.558***(0.550)	-1.426***(0.522)
Milk (fresh)	0.083(0.363)	1.338*(0.747)	0.109(0.361)	1.216*(0.723)
Cooking oil	1.633(1.073)	1.829**(0.722)	1.393(1.035)	1.582**(0.618)
Groundnuts	0.566***(0.219)	0.306(0.296)	0.646***(0.196)	0.558***(0.211)
Vegetables	-0.266(0.198)	-0.398(0.248)	-0.204(0.207)	-0.319(0.210)
Tomatoes	0.879***(0.227)	0.930***(0.165)	0.942***(0.246)	0.932***(0.139)
Onion	-0.560***(0.118)	-0.449***(0.138)	-0.580***(0.111)	-0.497***(0.113)
Sugar	3.345*(1.956)	3.731***(1.234)	3.478*(1.958)	4.343***(1.050)

Table M.2: Multicollinearity test (continued)

	4		5	
Dependent variable: HAZ	**Rural**	**Urban**	**Rural**	**Urban**
Refined maize flour	-3.402**(1.413)	-3.943***(1.223)	-3.303*(1.765)	-2.044(1.444)
Less-refined maize flour	-0.612(0.390)	-2.429***(0.594)	-0.623(0.464)	-2.135***(0.731)
Rice	-0.046(0.329)	-0.260(0.414)	0.048(0.362)	-0.400(0.519)
Bread	**dropped**	**dropped**	0.740(0.712)	-1.117*(0.573)
Beef	0.856(0.557)	1.110**(0.514)	**dropped**	**dropped**
Chicken	-1.971**(0.885)	-1.885**(0.930)	-1.364**(0.650)	-1.095(0.928)
Kapenta	0.374**(0.185)	-0.040(0.368)	0.359*(0.208)	-0.012(0.361)
Fish	0.572***(0.161)	0.606**(0.286)	0.614***(0.176)	0.552**(0.269)
Beans	-1.036***(0.264)	-0.451(0.369)	-0.962***(0.301)	-0.051(0.362)
Eggs	-1.594***(0.577)	-0.824(0.558)	-1.326**(0.554)	-1.257*(0.662)
Milk (fresh)	0.063(0.327)	1.613**(0.760)	0.165(0.376)	1.483**(0.672)
Cooking oil	1.726**(0.686)	1.415(0.931)	1.260(1.066)	2.382***(0.870)
Groundnuts	0.603***(0.199)	0.627***(0.224)	0.670***(0.215)	0.379(0.279)
Vegetables	-0.236(0.212)	-0.209(0.233)	-0.191(0.222)	-0.196(0.248)
Tomatoes	1.003***(0.211)	0.836***(0.195)	0.818***(0.204)	0.742***(0.172)
Onion	-0.591***(0.112)	-0.473***(0.145)	-0.549***(0.114)	-0.443***(0.134)
Sugar	4.121***(1.246)	2.835**(1.198)	2.283*(1.296)	1.854(1.136)

Table M.2: Multicollinearity test (continued)

	6		7	
Dependent variable: HAZ	**Rural**	**Urban**	**Rural**	**Urban**
Refined maize flour	-2.116(1.655)	-0.906(1.750)	-3.646**(1.652)	-2.748474
Less-refined maize flour	-0.387(0.503)	-1.275*(0.773)	-0.853*(0.462)	-1.742***(0.556)
Rice	0.187(0.459)	-0.147(0.419)	0.294(0.346)	-0.079(0.352)
Bread	0.519(0.871)	-2.130***(0.613)	0.568(0.771)	-1.958***(0.528)
Beef	-0.360(0.552)	1.379**(0.634)	0.708(0.712)	1.820***(0.516)
Chicken	**dropped**	**dropped**	-1.812**(0.919)	-1.692*(0.929)
Kapenta	0.303(0.242)	-0.002(0.356)	**dropped**	**dropped**
Fish	0.471**(0.188)	0.276(0.248)	0.600***(0.157)	0.423**(0.193)
Beans	-0.917***(0.296)	-0.203(0.275)	-1.037***(0.315)	-0.407(0.347)
Eggs	-1.245*(0.653)	-1.341**(0.583)	-1.748***(0.610)	-1.384***(0.469)
Milk (fresh)	-0.071(0.441)	0.924(0.645)	0.174(0.382)	1.235*(0.715)
Cooking oil	1.453(1.178)	1.963***(0.730)	0.994(0.989)	1.584**(0.732)
Groundnuts	0.647***(0.231)	0.401*(0.209)	0.718***(0.225)	0.542**(0.227)
Vegetables	-0.231(0.233)	-0.331(0.259)	-0.234(0.222)	-0.306(0.257)
Tomatoes	0.837***(0.218)	0.877***(0.143)	1.103***(0.249)	0.923***(0.151)
Onion	-0.620***(0.128)	-0.520***(0.141)	-0.664***(0.126)	-0.484***(0.124)
Sugar	1.837(1.963)	2.833**(1.140)	3.649*(2.093)	4.240***(1.212)

Table M.2: Multicollinearity test (continued)

	8		9	
Dependent variable: HAZ	**Rural**	**Urban**	**Rural**	**Urban**
Refined maize flour	-3.477*(1.831)	-2.122(1.347)	-3.230**(1.634)	-2.092(1.399)
Less-refined maize flour	-0.176(0.497)	-1.166*(0.623)	-0.383(0.514)	-1.690***(0.619)
Rice	-0.027(0.423)	-0.064(0.347)	-0.070(0.538)	-0.361(0.325)
Bread	-0.364(0.826)	-2.230***(0.683)	0.501(0.927)	-1.999***(0.552)
Beef	0.734(0.723)	1.981***(0.563)	0.094(0.682)	1.573***(0.534)
Chicken	-1.225(0.903)	-1.445(0.922)	-1.398(1.127)	-1.502*(0.863)
Kapenta	0.335(0.236)	0.004(0.360)	0.369(0.256)	0.052(0.333)
Fish	**dropped**	**dropped**	0.573***(0.181)	0.409**(0.208)
Beans	-0.991***(0.283)	-0.379(0.341)	**dropped**	**dropped**
Eggs	-0.784(0.690)	-1.022(0.575)	-1.352**(0.670)	-1.277**(0.514)
Milk (fresh)	0.006(0.386)	1.164(0.730)	-0.271(0.322)	1.074*(0.644)
Cooking oil	2.035(1.335)	1.390**(0.660)	1.392(1.128)	1.717**(0.676)
Groundnuts	0.358*(0.203)	0.434*(0.251)	0.525*(0.292)	0.421**(0.203)
Vegetables	-0.114(0.265)	-0.297(0.246)	-0.039(0.236)	-0.206(0.184)
Tomatoes	1.094***(0.278)	0.940***(0.139)	0.569**(0.243)	0.789***(0.118)
Onion	-0.525***(0.115)	-0.417***(0.118)	-0.407***(0.145)	-0.406***(0.127)
Sugar	3.928*(2.131)	4.000***(1.102)	2.044(1.810)	3.661***(1.074)

Table M.2**: Multicollinearity test (continued)**

	10		11	
Dependent variable: HAZ	**Rural**	**Urban**	**Rural**	**Urban**
Refined maize flour	-4.981***(1.644)	-3.761***(1.058)	-3.439***(1.331)	-1.040(1.761)
Less-refined maize flour	-0.639(0.562)	-1.597***(0.604)	-0.685*(0.414)	-1.849***(0.568)
Rice	-0.229(0.375)	-0.298(0.396)	-0.023(0.347)	0.076(0.364)
Bread	0.651(0.934)	-1.592***(0.588)	0.404(0.757)	-2.295***(0.639)
Beef	0.228(0.640)	1.747***(0.610)	0.736(0.643)	2.006***(0.567)
Chicken	-1.588*(0.897)	-1.655*(0.925)	-1.915**(0.881)	-1.382(0.874)
Kapenta	0.460**(0.214)	-0.081(0.343)	0.366*(0.192)	0.030(0.320)
Fish	0.435**(0.179)	0.261(0.223)	0.608***(0.174)	0.382*(0.196)
Beans	-0.984***(0.292)	-0.315(0.351)	-1.017***(0.269)	-0.236(0.303)
Eggs	**dropped**	**dropped**	-1.583***(0.554)	-1.719***(0.604)
Milk (fresh)	0.315(0.383)	1.475**(0.735)	**dropped**	**dropped**
Cooking oil	1.447(1.309)	1.319*(0.760)	1.414(1.082)	1.019(0.799)
Groundnuts	0.454**(0.205)	0.382*(0.229)	0.644***(0.218)	0.647***(0.246)
Vegetables	0.003(0.215)	-0.219(0.246)	-0.205(0.212)	-0.298(0.236)
Tomatoes	0.774***(0.241)	0.842***(0.145)	0.930***(0.232)	0.847***(0.160)
Onion	-0.404***(0.110)	-0.344***(0.118)	-0.579***(0.111)	-0.517***(0.139)
Sugar	2.198(1.956)	3.079***(1.085)	3.545*(1.888)	4.513***(1.349)

Table M.2**: Multicollinearity test (continued)**

	12		13	
Dependent variable: HAZ	**Rural**	**Urban**	**Rural**	**Urban**
Refined maize flour	-3.698**(1.700)	-2.658*(1.463)	-4.445***(1.682)	-2.496*(1.449)
Less-refined maize flour	-0.851*(0.454)	-1.848***(0.609)	-0.265(0.445)	-1.145*(0.641)
Rice	0.140(0.317)	0.040(0.357)	-0.540(0.378)	-0.409(0.352)
Bread	1.133**(0.458)	-1.879***(0.597)	-0.213(0.832)	-2.134***(0.528)
Beef	0.560(0.641)	2.091***(0.546)	0.973(0.677)	1.544***(0.575)
Chicken	-1.975**(0.863)	-1.860**(0.922)	-1.987**(0.981)	-1.370(0.925)
Kapenta	0.262(0.173)	-0.191(0.327)	0.511**(0.204)	0.039(0.330)
Fish	0.680***(0.173)	0.361*(0.189)	0.363**(0.180)	0.277(0.214)
Beans	-1.031***(0.316)	-0.458(0.339)	-0.923***(0.253)	-0.112(0.305)
Eggs	-1.566**(0.638)	-1.205**(0.583)	-0.839(0.571)	-0.897(0.580)
Milk (fresh)	0.119(0.352)	0.954(0.721)	0.211(0.382)	1.476*(0.776)
Cooking oil	**dropped**	**dropped**	2.623**(1.164)	2.045***(0.654)
Groundnuts	0.789***(0.205)	0.631***(0.219)	**dropped**	**dropped**
Vegetables	-0.191(0.230)	-0.329(0.247)	-0.012(0.231)	-0.261(0.257)
Tomatoes	0.816***(0.213)	0.917***(0.148)	0.972***(0.247)	0.908***(0.178)
Onion	-0.524***(0.116)	-0.448***(0.127)	-0.475***(0.133)	-0.415***(0.156)
Sugar	2.577(1.701)	4.885***(1.190)	3.687*(1.978)	3.116***(1.187)

Table M.2: Multicollinearity test (continued)

	14		15	
Dependent variable: HAZ	**Rural**	**Urban**	**Rural**	**Urban**
Refined maize flour	-4.315***(1.360)	-2.877**(1.140)	-5.648755	-1.866(1.645)
Less-refined maize flour	-0.825**(0.377)	-1.974***(0.508)	-0.388(0.555)	-1.804**(0.815)
Rice	-0.189(0.335)	-0.412(0.307)	-0.596(0.434)	-0.776(0.527)
Bread	0.670(0.819)	-1.772***(0.589)	1.598**(0.784)	-1.479*(0.81)
Beef	0.696(0.686)	1.640***(0.554)	-0.203(0.601)	0.963(0.663)
Chicken	-2.001**(0.884)	-1.759*(0.967)	-1.531*(0.872)	-1.415(1.018)
Kapenta	0.384*(0.198)	0.117(0.357)	0.666***(0.232)	0.348(0.358)
Fish	0.587***(0.165)	0.416*(0.221)	0.746***(0.228)	0.500**(0.222)
Beans	-0.982***(0.295)	-0.169(0.272)	-0.702**(0.307)	0.497(0.414)
Eggs	-1.289***(0.479)	-1.131**(0.502)	-0.968(0.635)	-0.704(0.656)
Milk (fresh)	0.161(0.344)	1.223*(0.723)	0.007(0.326)	0.758(0.801)
Cooking oil	1.391(1.189)	1.738**(0.707)	0.504(1.094)	1.567(1.044)
Groundnuts	0.577***(0.204)	0.500**(0.253)	0.675***(0.218)	0.507(0.365)
Vegetables	**dropped**	**dropped**	-0.021(0.243)	0.033(0.293)
Tomatoes	0.871***(0.238)	0.801***(0.135)	**dropped**	**dropped**
Onion	-0.517***(0.121)	-0.372***(0.120)	-0.247**(0.117)	-0.142(0.116)
Sugar	2.834(1.843)	3.519***(1.193)	0.187(1.760)	2.140(1.421)

Table M.2: Multicollinearity test (continued)

	16		17	
Dependent variable: HAZ	**Rural**	**Urban**	**Rural**	**Urban**
Refined maize flour	-5.124***(1.779)	-3.823***(1.287)	-4.032**(1.738)	-2.850**(1.356)
Less-refined maize flour	-0.529(0.627)	-1.526**(0.666)	-0.625(0.526)	-1.462**(0.741)
Rice	-0.900**(0.426)	-0.764**(0.382)	-0.054(0.400)	-0.562(0.385)
Bread	1.030(0.900)	-1.908***(0.620)	1.452***(0.548)	-1.348**(0.651)
Beef	0.313(0.690)	1.651***(0.573)	-0.161(0.511)	0.942*(0.503)
Chicken	-2.354**(0.919)	-1.900*(1.042)	-1.293(0.846)	-0.993(0.915)
Kapenta	0.693***(0.248)	0.089(0.365)	0.390*(0.227)	0.083(0.366)
Fish	0.528**(0.207)	0.204(0.260)	0.647***(0.161)	0.355(0.290)
Beans	-0.723**(0.309)	0.055(0.373)	-0.913***(0.335)	-0.103(0.366)
Eggs	-0.291(0.586)	-0.337(0.568)	-1.119*(0.62)	-0.613(0.527)
Milk (fresh)	0.335(0.313)	1.420*(0.734)	0.252(0.378)	1.374*(0.708)
Cooking oil	0.631(1.127)	1.193(0.742)	0.770(0.980)	2.299***(0.808)
Groundnuts	0.449**(0.208)	0.375(0.252)	0.658***(0.220)	0.299(0.253)
Vegetables	0.127(0.254)	-0.031(0.239)	-0.031(0.196)	-0.148(0.248)
Tomatoes	0.265(0.211)	0.626***(0.158)	0.629***(0.227)	0.759***(0.154)
Onion	**dropped**	**dropped**	-0.494***(0.133)	-0.390***(0.131)
Sugar	1.720(2.128)	3.190**(1.382)	**dropped**	**dropped**