POVERTY EFFECTS OF FUEL AND FOOD PRICE CHANGES IN TANZANIA

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Abstract

Among the recent major welfare shocks in Tanzania and globally is the 2007-2010 food and fuel prices surge. While sharp increases in food prices have the potential of increasing real production in agriculture, higher fuel prices increase production costs that affect all sectors in the economy negatively. The increase in both fuel and food prices therefore negatively affects real consumption. Simulation analysis using the 2007 Tanzania Household Budget Survey shows that both the poverty incidence and the poverty gap increased following the increase in fuel and food prices. Agricultural, rural and poor and middle income households are identified to have suffered more than the others. Policy implications on substitution for less costing and domestically available fuels, and the increase of food crops productivity are suggested.

Keywords: *food, fuel, price changes, poverty*

1.0 Introduction

Food and fuel prices globally have been increasing sharply for quite some years now and Tanzania is not an exception. Fuel and food price changes in Tanzania are partly driven by global prices as Tanzania is a net importer of petroleum fuel and pass-through effects of imported foods. Domestically high food and fuel prices are due to low agricultural productivity and predominance of subsistence farming, and poorly performing energy and transportation sectors.

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The retail prices of fuel rose from an average of TShs. 1,140/= per litre in January 2009, to an average of TShs. 2,000/= per litre in December 2011 in real terms, which is equivalent to 75% increment (EWURA, 2011). A study by Leyaro *et al.* (2010) has shown that between 1991 and 2007 food prices increased by 440% in real terms. This was partly a result of low agricultural productivity and predominance of subsistence farming. According to Wolter (2009) the average food crop productivity in Tanzania is 1.7 tones per hectare, whereas good management and optimal fertiliser use should result in yields of 3.5-4.0 tones per hectare. As a result, such higher prices of fuel and food may exacerbate the higher cost of living and lower household welfare that Tanzanians have been experiencing already and by extension worsen poverty levels. This article is a product of a study of which aim was to analyse the poverty effects of the current fuel and food price surges, on the wellbeing of Tanzanians.

There are two major channels through which changes in price, particularly the price of fuel and food, may affect the wellbeing of the poor – either through what they consume (hence consumption effects), or through what they produce (hence production/income effects). Thus, changes in food and fuel price faced by both consumers and producers affect net consumers and net producers in different ways. Rise in food and fuel prices affects the overall inflation in the economy. It affects the real growth of the sectors differently by affecting production costs and supply patterns of the output of different sectors. It also affects the real consumption levels of individuals and their demand patterns. These will in turn affect the level of poverty in the country.

Various social indicators attest to the fact that Tanzania is one of the world's poorest countries. According to the Human Development Report by UNDP (2011) Tanzania is among countries with the lowest Human Development Index (HDI), scoring 0.466 in 2011 and ranks the 152nd among 187 countries, and with a gross per capita income of $1,328 (constant PPP 2005). Despite the stable and high economic growth Tanzania has achieved for the past decade (ranging from 5% to 7%), such high national economic growth has not trickled down in terms of welfare improvement. It has a core feature of a 'growth without jobs' problem: no formal employment creation and no

poverty reduction. What seems to be happening is a booming informal sector with low and irregular incomes. The analysis of Tanzania Household Budget Surveys for 1991/1992, 2000/2001 and 2007 and the National Panel Survey for 2008/2009 have shown that basic needs poverty levels have fallen very marginally to 38.6%, 35.7%, 33.6% and 34%, respectively, during this period.

Evidence from Tanzania shows that since November 2008, food-price inflation has been higher than aggregate inflation, particularly in rural areas. Poor people spend a large proportion of their household budget on food up to around 65% (Leyaro *et al.*, 2010); so food price inflation hits the poor hard. As a result of this high food inflation, households will shift their spending budget by limiting the resources they can spend on non-food items such as assets, education, health and investment to meet the big budget for food.

It is not likely that people in different sectors of the economy such as those in agricultural, industrial and service sectors or those in different location of the country such as those in urban areas and rural areas will be affected in the same way. Hence, there are issues about who gains and who loses when it comes to surges in fuel and food prices.

Although there has been a couple of studies that have attempted to ascertain the immense impact of such poverty effects on the poor (Baker, 2008; Aksoy & Hoekman, 2010; Ackah & Appleton, 2007; Wodon & Zaman, 2008; Hella *et al.*, 2009; Leyaro *et al.*, 2010), much empirical evidence is still needed to help in addressing poverty in most of developing countries. It is therefore imperative to ask whether Tanzania as a whole and in its segments have benefitted or suffered from the recent rise in fuel and food prices. This study attempts to address this information gap by analysing the effects of a surge in food and fuel prices for households in different sectors and different geographical locations. This is done using disaggregated data at household level from the Household Budget Survey of 2007 that captures the latest information on consumption pattern.

The rest of the article is organised as follows: Section 2.0 gives an overview of the general economic performance, inflation and poverty trends; Section 3.0 provides the conceptual framework; Section 4.0 presents the empirical model; Section 5.0 presents the empirical results and discussion, and lastly, Section 6.0 gives the conclusions and policy implications.

2.0 Overview of general economic performance, inflation, and poverty trends in Tanzania

2.1 Real and nominal per capita GDP and sectoral growth

The real per capita income has been increasing over time in the period 2001-2010. This trend shows improvement in people's standard of living. In this period, the average growth rate of nominal per capita GDP was 10.8% per annum while the average growth rate of real GDP per capita was 3.8% per annum. The gap between the two is due to the effect of inflation and it is observed to widen faster since 2007.

Over the same period of time, the real GDP growth of the industrial sector has been higher than that of the other sectors notably from 2001 to 2005, but in 2008 its growth was almost equal to that of the service sector due to a drop in its performance mainly because of the energy crisis. The period of high industrial GDP growth reflects the time of privatisation of the poorly performing government owned industries, followed by their high performance immediately after privatisation. The service sector has been performing well especially with large contribution from tourism, financial institutions, and telecommunication companies, except when the global economic crisis started hitting Tanzania in 2008-2009. Agricultural GDP growth has been constantly low and below that of all the other sectors. This is due to the subsistence nature of agriculture in Tanzania, and occasional adverse weather conditions.

2.2 Monthly annual inflation (Old and New CPI) trends

In October 2010, the National Bureau of Statistics started calculating and using the new Consumer Price Index (CPI) composed of a new basket of 12

major groups with new weights different from the old one. The major groups are aggregated in four main categories namely food, energy and fuels, non-food, and non-food non-energy. The old CPI had only three categories, with the non-food non-energy category missing. The new CPI is also calculated using the Geometric Mean instead of Arithmetic Mean used formerly. The graphs in Figure 2.1 represent the annual inflation recorded each month. The straight line in the graph separates the old CPI inflation to the left and the new CPI to the right.

Figure 2.1: Monthly inflation (Old and New CPI) January 2008 – December 2011
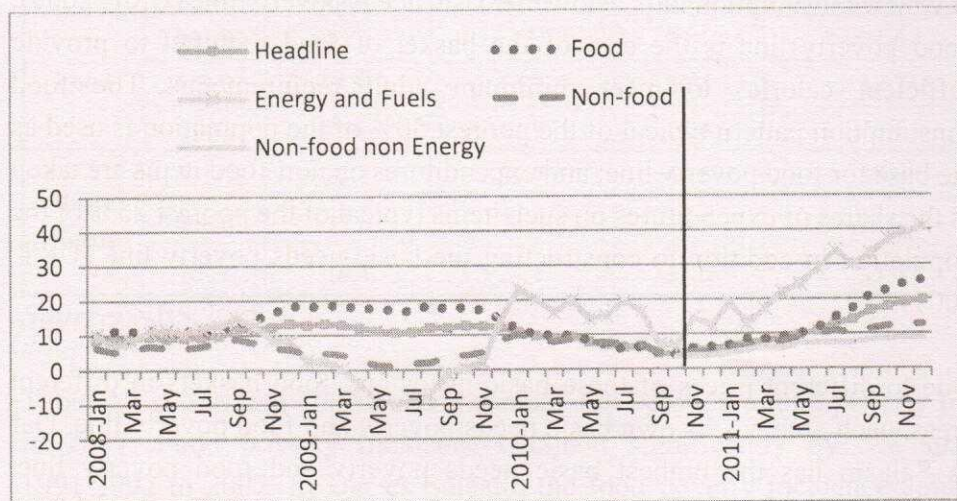
Source: Various Annual Economic Surveys

Energy and fuel inflation shows high fluctuations in the period 2008-2011. It has a record low of -7.2 in June 2009 and a record high of 41% in November 2011. All this happened due to shocks that usually occur in the global market for crude oil, and more due to electricity problems in Tanzania that compel people to shift into using generators for domestic and economic activities, thus raising the demand for fuels higher. Except for the year 2010, food inflation has been very high and in double digits. Recently since February 2011, food inflation has been increasing very sharply reaching 25% in December 2011. The non-food and non-food non-energy inflation rates are relatively lower than inflation in other categories. But the trend of inflation in these categories closely follows the fuel inflation trend. This implies that there is a significant pass-through from fuel inflation to non-

food and non-food non-energy inflation rates. The overall/headline inflation is high due to the influence of food and fuel inflation.

2.3   Poverty incidence, depth and severity in Tanzania

A predetermined poverty line is one of the main requirements in carrying out quantitative poverty analysis. Basically, two poverty lines are used: basic needs poverty line and food poverty line. Basic needs poverty line is the cost of the basic basket of food and non-food items necessary for a minimum standard of living. Individuals are considered poor if they live in a household of which consumption falls below the basic needs poverty line (URT, 2009). Food poverty line is the cost of the basket of food required to provide sufficient calories to meet minimum adult requirements. The food consumption pattern typical of the poorest 50% of the population is used as the base for food poverty line; and expenditures on non-food items are taken as the shares of expenditures on such items typical of the poorest 25% of the population in addition to constructing the basic needs poverty line (URT, 2009).

Due to different prices of these basic needs and food baskets in different areas, each area has its own basic needs poverty and food poverty line. Dar es Salaam has the highest basic needs poverty and food poverty line, followed by other urban areas; rural areas have the lowest. The three round Household Budget Surveys show that the poverty lines per adult equivalent to 28 days have been increasing since 1991/1992 to early 2007 for all categories due to increase in price. By using the Fisher index, the increase in price in 2007 is 1.93 times higher than that in 2000/2001 according to the surveys.

There are three standard measures of poverty: poverty headcount (incidence), poverty gap (depth), and poverty gap square (severity). The poverty incidence measure is the proportion of the population living below the poverty line; whereas the poverty gap is the average shortfall from the poverty line as a percentage of the poverty line. Poverty severity is the square of poverty gap, which gives additional weight to people further below the poverty line (URT, 2009). The Millennium Development Goal is to reduce

poverty by 50% between 1990 and 2015. In 1991/1992, basic needs poverty incidence was 38.6%; this implies that poverty incidence should be reduced to 19.3% come 2015. This seems to be almost impossible given that this is only two years away. In Mainland Tanzania, the basic needs poverty incidence has been marginally declining over time. In 1991/1992 the basic needs poverty incidence was 38.6%; it declined to 35.7% in 2000/2001 and further down to 33.6% in 2007 as shown in Table 2.1.

Table 2.1: Incidence of poverty in Tanzania

	Year	Dar es Salaam	Other Urban areas	Rural areas	Mainland Tanzania
Food	1991/92	13.6	15	23.1	21.6
	2000/01	7.5	13.2	20.4	18.7
	2007	7.4	12.9	18.4	16.6
Basic Needs	1991/92	28.1	28.7	40.8	38.6
	2000/01	17.6	25.8	38.7	35.7
	2007	16.4	24.1	37.6	33.6

Source: NBS 2008

Table 2.1 shows that 16.6% of Tanzanians fell below the food poverty line in 2007. Food poverty incidence declined significantly by 5% since 1991/1992 to 2007. In Dar es Salaam, the food poverty incidence almost halved in that period, while other urban areas recorded a decline of 2.1%, and the rural areas a decline of 4.7%. All areas recorded good performance in reducing food poverty in the period since 1991/1992 to 2000/2001 compared to 2000/2001 to 2007. Since 20010/2001 to 2207 the decline in food poverty concentrated in rural areas with minute declines in Dar es Salaam and other urban areas.

The incidence of basic needs poverty in rural areas has remained at 37.6%. Dar es Salaam has the lowest proportion of people falling below the basic needs poverty line recording 16.4% in 2007. Poverty incidence has declined the most in Dar es Salaam and declined the least in the rural areas since 1991/1992. But since 2000/2001 the decline in basic needs poverty incidence has been of similar magnitude in all areas.

The aim of 'Mkukuta I' was to reduce basic needs poverty incidence to 24% in rural areas and to other urban areas excluding Dar es Salaam to 12.9% by 2010. According to the National Panel Survey (NPS) round one of 2008/2009, this target seemed to fall off target since by 2009 the poverty incidence in rural areas had increased to 40.1% and fallen to 18.1% in urban areas excluding Dar es Salaam. The financial crisis of 2007-2009 and food and fuel crisis are said to have been among the major factors halted down the efforts to reduce poverty to the target goal.

Table 2.2: Depth and severity of poverty in Tanzania

	Poverty gap		Poverty Severity	
	2000/01	2007	2000/01	2007
Dar es Salaam	4.1	4.1	1.6	1.7
Other Urban areas	7.7	7.5	3.4	3.4
Rural areas	11.5	11	4.9	4.7
Mainland Tanzania	10.6	9.9	4.5	4.3

Source: Hoogeeveen & Ruhinduka, 2009

Poverty depth and severity have slightly declined since 2000/2001. Poverty depth and severity are higher in rural areas compared to Dar es Salaam and other urban areas, as shown in Table 2.2.

3.0 Conceptual framework

A micro-simulation model combining macroeconomic projections with pre-price change from micro-data to predict income and consumption at the household level under different scenarios is employed. Predicted income and consumption were then compared to measure poverty effects. A simulation model developed by the World Bank Indonesia Country Team was adopted for this study with some extensions to include disaggregated analysis by spatial distribution.
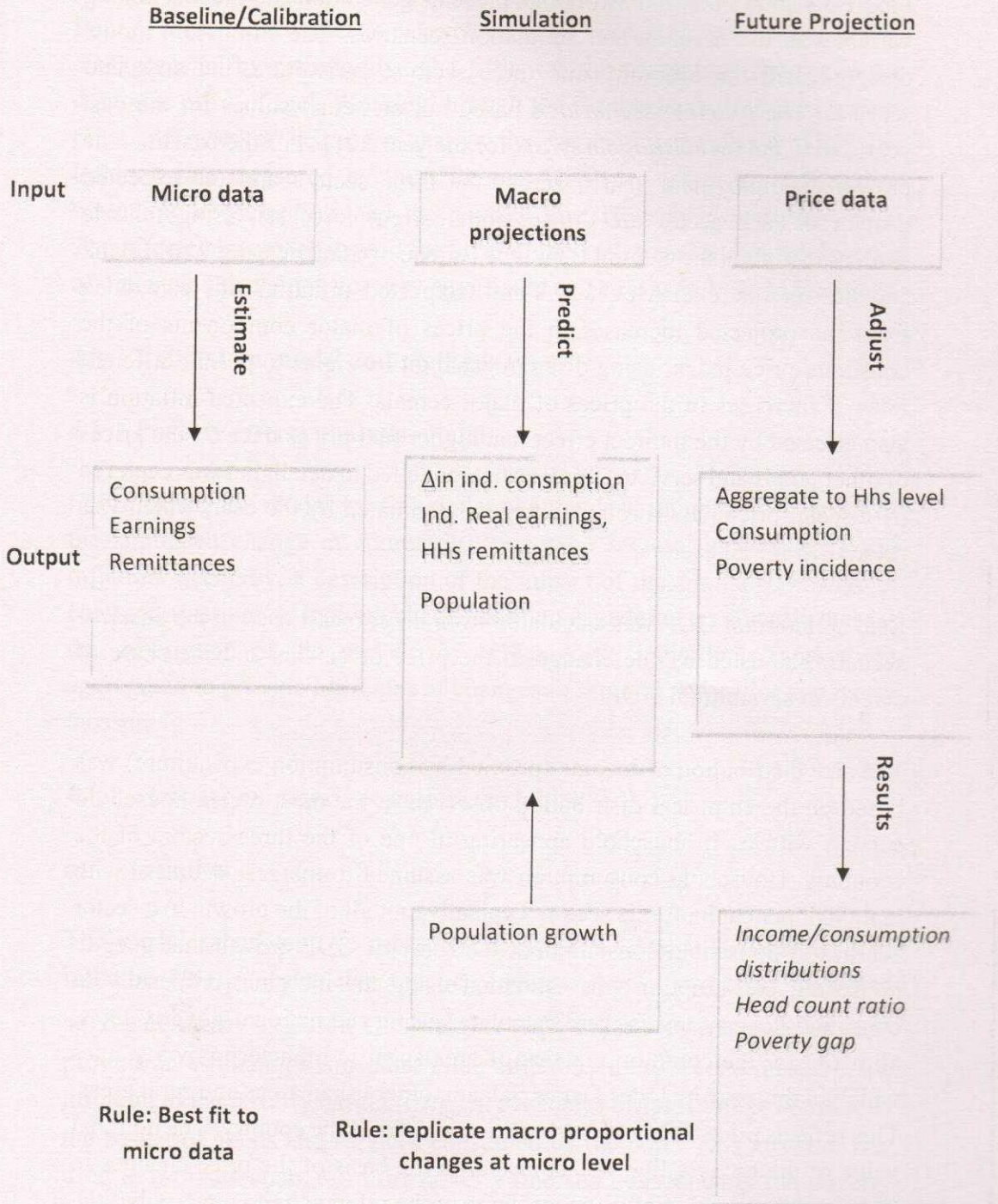
Baseline/Calibration	Simulation	Future Projection

Input

Micro data	Macro projections	Price data

Estimate ↓　　　Predict ↓　　　Adjust ↓

Output

Consumption Earnings Remittances	Δin ind. consmption Ind. Real earnings, HHs remittances Population	Aggregate to Hhs level Consumption Poverty incidence

↑ Population growth

Results ↓

		Income/consumption distributions Head count ratio Poverty gap

Rule: Best fit to micro data　　　**Rule: replicate macro proportional changes at micro level**

Figure 3.1: Conceptual framework
Source: Adopted from World Bank (2010)

Figure 3.1 shows the framework that presents generation and the link among variables in the baseline and simulation scenarios. The simulation model disaggregated the economy into three sectors: agriculture, industry, and services. The *baseline scenario* is based not on actual values for the past year, 2010, but on *existing forecasts* for the year 2011. For the baseline, the projected employment shares across the three sectors and the expected growth in each sector are drawn from current forecasts, using reliable sources including the Central Bank, the Bureau of Statistics, the World Bank and the International Monetary Fund. Expected inflation was calculated from the projected increases in the prices of major components of the consumer price index, using disaggregated CPI weights to permit different rates of increases in the prices of major cereals. The expected inflation is also affected by the indirect effect that higher fuel prices have on the prices of other goods and services; this was not modelled in detail, but was captured by a scalar price pass-through parameter estimated by the user, which was set at 0.75 for all sectors.

Real agricultural GDP was calculated from the forecast used in the baseline scenario, adjusted by the change in the price of cereals and the share of cereals in agricultural GDP.

The size distribution of income (proxied by consumption expenditure) was based on the empirical distribution observed in the most recent household survey, with each household appearing in one of the three sectors of the economy. Household consumption was assumed to increase/decrease with real GDP per capita for its sector. Typically, not all of the growth in a sector accrues to household consumption, the share of GDP growth that goes to household consumption was estimated using the marginal propensity to consume. Poverty levels were calculated using the national poverty lines, allowing for the common practice of area-specific monetary poverty lines which in this case includes Dar es Salaam, other urban areas and rural areas. This reflects price differences in various regions of the country. The nominal value of the poverty line was adjusted on the basis of the price changes in 2011 and the weights of different items in the reference the poverty basket, which typically gives greater weight to food items, especially staple cereals, than the general CPI.

For the *simulation scenario*, a set of five choice variables was specified. Four of these were domestic price changes for cereals (in percentage terms) disaggregated by commodity. The fifth was the percentage change in the domestic price of fuel. Working through the mechanisms described above, price increases or decreases change the value of agricultural GDP, the inflation rate measured by the CPI, real GDP per capita in each sector, household consumption, and the poverty line. Household consumption is also affected by any change in the level of the cash transfer; but for the case of Tanzania this item is not very significant and so was left out of the study.

4.0   Estimation model and methods

4.1   Poverty effects analysis model

In estimating the model we first undertake the description of the impact of the simulated change in commodity prices on sectoral growth rates and inflation. Secondly, a description of the impact of the simulated change in commodity prices on individual consumption is undertaken. Finally, there is the description of the method by which these individual impacts are aggregated to provide estimates of changes in sectoral and national poverty measures.

4.1.1   Impact on macro-economic variables

a)   Inflation

The model calculates two measures of inflation. The first measure, CPI inflation (inf_{cpi}) calculates the percentage increase in cereal, fuel and aggregate prices based on CPI weights (w_i^{cpi}). This measure was used to provide an estimate of consumer price inflation. In the second measure, the inflation of the poverty basket (inf_{pov}), calculates the percentage increase in the basket of goods and services consumed by the poor. This measure was used to estimate changes in the poverty line and consequently the poverty impact of the simulated changes on commodity prices. Since the poor typically consume less meat and fuel and more cereals, these measures were

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generally different. The two measures of cereal inflation were calculated as indicated below:

$$inf_{cpi}^{cereal} = \sum_i inf_i \, w_i^{cpi}; \qquad inf_{pov}^{cereal}$$

$$= \sum_i inf_i \, w_i^{pov} \dots\dots\dots\dots\dots\dots\dots\dots (1)$$

$$i \in \{\text{Maize, Wheat, Rice, Other Cereals}\}$$

Two measures of the aggregate food and energy inflation were calculated in a similar manner. Non-food non-energy (NFNE) inflation was assumed to depend on energy prices. Higher energy prices drive up the cost of production and distribution of most goods. This idea is captured by the following equation:

$$inf_{nfne} = inf_{nfne}^{direct} + PT_{nfne}^{fuel}$$

$$* inf_{fuel} \dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots (2)$$

The value of the pass-through of increases in fuel prices into non-food non-energy prices (PT_{nfne}^{fuel}) was approximated by estimating the coefficient of the differenced version of the equation above.

Consumer price inflation (inf_{cpi}) and poverty basket inflation (inf_{pov}) were calculated as described below:

$$inf_{cpi} = \sum_i inf_i \, w_i^{cpi}; \qquad inf_{pov}$$

$$= \sum_i inf_i \, w_i^{pov} \dots\dots\dots\dots\dots\dots\dots\dots. (3)$$

$$i \in \{\text{Fuel, Food, Other}\}$$

b) **Sectoral GDP**

The economy was divided into three sectors - agriculture, industry and services. Data on sectoral real GDP for year $(t-1)$ and a forecast for sectoral real GDP for the simulated year t were used. This forecast was considered

to be the baseline. In the simulation, the forecast for agricultural GDP was adjusted for unexpected changes in cereal prices (i.e. any change in cereal prices that corresponds to a deviation from the baseline cereal inflation forecast):

$$GDP^s_{Ag}(t) = GDP^b_{Ag}(t)\left[1 + \left(inf^{cereal}_s - inf^{cereal}_b\right) * GDP^{cerealshare}_{Ag}\right] \dots \dots \dots (4)$$

Where inf^{cereal}_s and inf^{cereal}_b were simulated and baseline measures of cereal inflation and $GDP^{cerealshare}_{Ag}$ was the share of cereal production in Agricultural GDP. This equation captured the fact that an unexpectedly large increase in cereal prices will typically result in a greater than expected increase in the value added from agricultural production, proportionate to the share of cereal production in agricultural GDP. The real sectoral GDP (simulated) forecasts in industry, services and agriculture were adjusted to reflect deviations from baseline inflation.

GDP per capita for sector i (GDP_{pci}) in the simulated year t was calculated in the following manner:

$$GDP_{pci}(t) = GDP_i(t)/[L_i(t) * Pop(t)] \dots \dots \dots \dots \dots \dots \dots \dots \dots \dots \dots \dots \dots (5)$$

Where the population (Pop) and the employment share in sector i (L_i) in year t were based on best available forecasts.

The baseline and simulated change in sectoral GDP_{pc}, given by (ΔGDP^b_{pci}) and (ΔGDP^s_{pci}) respectively, were calculated in the following manner:

$$\Delta GDP^b_{pci} = [GDP^b_{pci}(t) - GDP_{pci}(t-1)] * PT_i/GDP_{pci}(t-1) \dots \dots \dots (6)$$
$$\Delta GDP^s_{pci} = [GDP^s_{pci}(t) - GDP_{pci}(t-1)] * PT_i/GDP_{pci}(t-1) \dots \dots \dots (7)$$

Where the pass-through in sector $i, PT_i,$[4] measured the extent to which sectoral GDP changes translate into consumption changes for households. It is worth noting that if simulated cereal inflation is equal to the baseline cereal inflation, agricultural GDP will be equal to the baseline, and consequently baseline and simulated sectoral GDP_{pc} will be identical. Only a larger than expected increase in cereal prices will raise expected agricultural GDPpc.

4.1.2 Impact on individuals

The model used information on individual consumption expenditure (C) and the sector that employed the household head. The household survey provided information on the poverty line. A household was defined to be poor if its consumption expenditure was lower than the poverty line. The model simulated the impact of higher commodity prices on households by simulating attendant changes in consumption and the poverty line. The use of household survey data made it possible for the model to generate more accurate estimates of the poverty impact of these simulated changes.

a)   Changes in real consumption

It was assumed that simulated and baseline consumption by household j in sector i, $C_{ij}^s(t)$ and $C_{ij}^b(t)$, respectively, increased in sector i's GDP_{pc}, in the following manner:

$$C_{ij}^0(t) = C_{ij}(t)\left[1 + \Delta GDP_{pci}^o\right]o$$
$$\in \{b, s\} \dots \dots \dots \dots \dots \dots \dots \dots \dots \dots \dots \dots \dots \dots (8)$$

This implies that the simulated percentage change in consumption was identical for every household in a sector.

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[4] The extent of this pass-through depends on the tax structure, distribution of land ownership, market structure and several other socioeconomic, institutional and governance characteristics. The study used the World Bank's default value for a developing country in Sub-Saharan Africa set at 0.75 for all sectors.

b)   Changes in the real poverty line

An increase in commodity prices will increase the cost of the poverty basket. Baseline and simulated increases in the real poverty line (PL) were calculated as follows:

$$PL^o(t) = PL(t-1)\big[1 + inf^o_{pov}\big] o \in \{b, s\} \dots \dots \dots \dots \dots \dots \dots \dots \dots \dots \dots (9)$$

While the simplicity of this equation has led to its widespread use in the analysis of the poverty impact of increases in food and fuel prices, it is worth noting a well known bias that arises from its use. Individual food and fuel prices rarely increase by the same percentage. An individual would typically substitute away from a good whose relative price has increased. Therefore, this assumption results in a substitution bias that overestimates the poverty impact of the increase in food prices. However, given the short-run orientation of this simulation model, it is possible that this bias is not large.

5.0   Aggregate poverty impact

The primary purpose of the model was to estimate the poverty impact of changes in commodity prices. The focus was on two measures of poverty - poverty incidence and the poverty gap. Poverty incidence (the proportion of individuals below the poverty line) measures the extent of poverty in a country. The poverty gap (mean relative distance from the poverty line with the non-poor counted as being at zero) measures the depth of poverty in a country. The discussion above explains how the model calculated potential changes in poverty at a household level. To make inferences about aggregate poverty measures there is a need to find out the population weights for each of these individuals. In what follows, the use of employment shares and population data to adjust these sample weights is described. This adjustment was done in order to improve the accuracy of the aggregate estimates. Then the estimates of the aggregate poverty measures using these updated sample weights were provided.

5.1 Adjustments to the sampling weights

The estimated population growth rate was calculated as follows:

$$\Delta Pop = \frac{[Pop(t) - Pop(t-1)]}{Pop(t-1)} \quad\text{...} (10)$$

The population growth rate in sector i is:

$$\Delta Pop_i = [L_i(t)/L_i(t-1)](1 + \Delta Pop) - 1 \text{........................} (11)$$

The simulated year's population and sectoral employment shares are estimates and assumed to be exogenous. The population weight ($PW_{ij}(t-1)$) for household j in sector i was adjusted to reflect (estimated) changes in population and employment shares:

$$PW_{ij}(t) = PW_{ij}(t-1)(1 + \Delta Pop_i) \text{.........................} (12)$$

5.2 Simulated impact on poverty incidence and depth

Let I_{pj} be a dummy variable indicating whether household j is poor. Poverty was defined in the following manner:

$$C_{ij}^o(t) < PL^o(t) \rightarrow I_{pj}^o = 1,$$
$$C_{ij}^o(t) \geq PL^o(t) \rightarrow I_{pj}^o = 0 \quad o \in \{b,s\} \text{......} (13)$$

The national poverty incidences for the baseline and simulation outcomes (Hb and Hs, respectively) are given by:

$$H_o = \sum_j \left[I_{pj}^o * PW_{ij}(t)\right] / \sum_j \left[PW_{ij}(t)\right] \quad o$$
$$\in \{b,s\} \text{.........................} (14)$$

Let I_i be an indicator variable that denotes employment in sector i. The sectoral poverty incidences for the baseline and simulation outcomes are then given by:

$$H_o^i = [\frac{\sum_j[I_i I_{pj}^0 * PW_{ij}(t)]}{[\sum_j[I_i PW_{ij}(t)]} o$$

$$\in \{b, s\} \dots \dots \dots \dots \dots \dots \dots \dots \dots \dots \dots \dots (15)$$

Let I_k be and indicator variable that denotes spatial distribution in area k. The poverty incidence for the people living in area k and employed in sector i for the baseline and simulation outcomes are then given by

$$H_o^{ik} = [\frac{\sum_j[I_k I_i I_{pj}^0 * PW_{ij}(t)]}{[\sum_j[I_k I_i PW_{ij}(t)]} o \in \{b, s\} \dots \dots \dots \dots \dots \dots \dots \dots \dots \dots (16)$$

The national poverty gaps for the baseline and simulation outcomes (PGb and PGs respectively) are given by:

$$PG_0 = [\sum_j [(PL^0(t)$$

$$- C_{ij}^0(t))/PL^o(t)]I_{pj}^0 * PW_{ij}(t)]$$

$$/ \sum_j [PW_{ij}(t)] \dots \dots \dots \dots (17)$$

$$o \in \{b, s\}$$

The sectoral poverty gap for the baseline and simulation outcomes is given by:

$$PG_o^i = [\sum_j I_i[(PL^0(t)$$

$$- C_{ij}^0(t))/PL^o(t)]I_{pj}^0 * PW_{ij}(t)]/ \sum_j I_i[PW_{ij}(t)] o$$

$$\in \{b, s\} \dots (18)$$

The area poverty gap for the baseline and simulation outcome is given by:

$$PG_o^{ik} = [\sum_j I_k I_i [(PL^0(t)$$
$$- C_{ij}^0(t))/PL^0(t)] I_{pj}^o * PW_{ij}(t)]$$
$$/ \sum_j I_k I_i [PW_{ij}(t)] \dots \dots (19)$$
$$o \in \{b, s\}$$

5.3   Excess consumption

To find the effect of fuel and food price changes according to income groups of the people, the excess consumption above the poverty line as a proportion of poverty line was found for both the baseline and simulation scenarios. In this study, this measure is referred to as excess consumption (EC). This measure gives the number of times a person can purchase the basic basket necessary for a minimum standard of living. A negative excess consumption implies that an individual cannot afford the basic basket necessary for a minimum standard of living. Excess consumption is given by the formula:

$$EC = \frac{C_j^o - PL^o}{PL^o} ; \qquad o \in \{b, s\} \dots \dots \dots \dots \dots \dots \dots \dots \dots \dots \dots \dots \dots (20)$$

Where EC is excess consumption, C_j^o is consumption of household j and PL^o is poverty line.

The median EC for the five consumption quintile groups were calculated in both the baseline and simulation situations. The percentage changes of EC from the baseline situation to the simulation situation were calculated. These percentage changes determine the extent to which food and fuel prices surges affected the individuals in different income groups.

6.0   Data type and sources

The study used the micro data extracted from the Household Budget Survey of 2007. This is the latest Household Budget Survey in the country and is collected by the National Bureau of Statistics. The unit of study in this case

was the household. The data from the survey used covered a sample of 10,466 households. The sampled households represented all of the mainland regions and were grouped in three strata: Dar es Salaam, other urban areas and rural areas. Of the sampled households, 33.0% were in Dar es Salaam, 35.7% were in other urban areas and 31.7% were in rural areas. Due to the fact that some of the households were oversampled while others were under-sampled, the household weights were attached to make each household appropriately representative. The members of household are employed in different sectors. For the sake of household level analysis in this study, the main activity sector of the head of household was used as the main sector of employment of the household.

The macro data was obtained from the Economic Survey published yearly by the Ministry of Finance. The best forecasts for the baseline situation were obtained from various authorities including the Central Bank of Tanzania, National Bureau of Statistics, ministries, World Bank, and International Monetary Fund.

7.0 Empirical results and discussion

7.1 Effects on real sector growth

The increase in food and fuel prices depresses the real growth in all sectors of the economy in the simulation situation by the inflation adjustment factor (=0.9438). The results as shown in Table 5.1 depict that the simulated inflation for food and fuel is higher than that in the baseline situation. These reflect the forecasted shock in the prices of food and fuel. The non-food non-fuel inflation in the simulation situation is higher than in the baseline situation, reflecting the pass-through of fuel inflation to the prices of these commodities.

Table 5.1: **Sectoral output growth and inflation rate: Baseline and simulation**

	Baseline	Simulation
Real GDP growth (%)		
Agriculture	3.6	8.2
Industry	7	6.6
Services	6.4	6
Total	5.8	6.8
Inflation (%)		
Food	9.7	16.6
Fuel	18.3	41
Non-Food Non-Fuel	7.8	9.7
Total	9.4	15

Source: Author's construction from macro-economic data from various sources

The simulated growth of agricultural real GDP is more than twice that in the baseline situation. This is because the agricultural sector takes advantage of the increase in price of cereal crops which spurs more production in agricultural crops. The unexpectedly large increase in cereal prices typically results in greater than expected increase in the value added from agricultural production, proportionate to the share of cereals production in agricultural GDP. This increase was large enough to more than offset the effect of the rise in the general price level. The nominal outputs of the services and industrial sectors in the baseline and simulation scenarios are the same. With the inflation rate being higher in the simulation situation than in the baseline situation, the industrial and services sectors suffer less real growth in the simulation situation compared to the baseline situation. The overall growth in real GDP in the simulation scenario is higher than in the baseline scenario by one percentage point due to the higher growth in real GDP of agriculture that overshadows the negative effect of the fall in real GDP of other sectors.

Not all changes in the real GDP of an economic sector are accrued to those employed in that sector. Some go to the government as tax, while some are lost due to market imperfection and during the redistribution process. So, the

growth rates of per capita real personal income for each sector were calculated taking this fact into account. The pass-through factor of 0.75 which measures the extent to which sectoral GDP changes translate into consumption changes for households, was used as a default for each sector.

Four factors affect the sectoral per capita real personal income growth rate: real growth rate of the GPD of a sector, population growth rate, employment share of a sector, and the pass-through factor. For the simulation scenario, a fifth factor is added which is inflation adjustment factor. Population growth rate, the pass-through factor and inflation adjustment factor are the same for all sectors; so, the differences in per capita income growth among sectors will be revealed trough the differences in real growth rate of the GPD of a sector and employment shares. Whereas the employment share of agriculture decreased by 1.5%, the employment share of services and industrial sectors increased by 2.5% and 9.3%, respectively.

Table 5.2 below shows that the per capita real income growth of the agricultural sector in the baseline situation was higher than the service industrial sectors due to the decreasing share of population in the agricultural sector. Despite having a higher real GDP growth rate than that of the service sector, the industrial sector had a negative per capita income growth due to a very high increase in employment share growth.

Table 5.2: Sectoral per capita real personal income growth rate (%)

Sector	Baseline	Simulation
Agriculture	1.86%	5.35%
Industry	-3.46%	-3.27%
Services	0.88%	0.83%

Source: Author's construction from macro-economic data from various sources

Food and fuel price shock affects the per capita income growth for all sectors since it affects the real GDP growth of the sectors. Along with it, the increase in population and employment shares of a sector, have a counter effect on the per capita income of the individuals in the sector. The results show that in the simulation situation, per capita real income growth of the agricultural sector was higher compared to that in the baseline situation and compared

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to other sectors in the simulation situation. This is because a large increase in cereal prices results in greater than expected increase in the value added from agricultural production, proportionate to the share of cereals production in agricultural GDP. The per capita real income growth of the industrial sector was negative in both the baseline and simulation situations, but was more negative in the baseline situation. This is because the sector suffers from the pass-through of higher fuel prices to increased production costs and these costs are imperfectly transferred to consumers. The sector also has potentials to gain especially due to higher prices of manufactured foods, thus the value added does not decrease much in the simulation scenario compared to the baseline scenario. The per capita real income growth of the services sector in the simulation situation is slightly lower than that in the baseline situation. This is because of the pass-through effect of increase of fuel prices to the activities of this sector such as transportation.

7.2   Excess consumption effects

Excess consumption is a measure developed in this study to assess the poverty effects of food and fuel price changes across consumption quintiles. Excess consumption measures the excess consumption above the poverty line as a proportion of the poverty line. The merit of excess consumption over poverty indices is that it measures the effect of food and fuel price changes on all individuals not only the poor. Poverty indices treat all those above the poverty line the same, whereas excess consumption treats them differently. Table 5.3 presents the excess consumption across quintiles in both baseline and simulation scenarios.

Table 5.3: Excess consumption across consumption quintiles

Consumption Quintiles	Baseline	Simulation	% Change
1st quintile (poorest)	-0.282	-0.307	-9.0
2nd quintile	0.298	0.246	-17.5
3rd quintile	0.888	0.802	-9.6
4th quintile	1.719	1.581	-8.0
5th quintile (richest)	4.838	4.512	-6.7
National	0.617	0.543	-12.0

Source: Author's construction from macroeconomic data and HBS 2007 data

The results show that the poorest group had negative excess consumption which implies that on average, they could not afford the basic basket in both baseline and simulation scenarios. The rest of the consumption quintile groups had positive excess consumption implying that on average, individuals in those groups consumed more than the basic basket for necessary minimum standard of living. The percentage declines of excess income following the fuel and food price shock decreased from the second poorest group to the well-offs. However, the poorest quintile was not much affected compared to the next poor and the middle quintiles. It can be concluded that, overall, the poor are hit harder by the price shock compared to the well-off. This is probably due to the fact that the poor spend a large proportion of their income on food.

7.2.1 Excess consumption according to spatial distribution

As others studies have shown, the effect of shock from food and fuel prices may have diverse effects on the poor and the rich in different areas. Table 5.4 below shows the excess consumption effect across consumption quintiles in Dar es Salaam and other urban and rural areas.

Table 5.4: Excess consumption effects across consumption quintiles in different areas

Area	Consumption Quintiles	1st quintile (poorest)	2nd quintile	3rd quintile	4th quintile	5th quintile (richest)	Total
Dar es Salaam	Baseline	-0.018	0.655	1.313	2.209	6.222	1.563
	Simulation	-0.076	0.555	1.173	2.009	5.779	1.407
	% Change	-315.5	-15.2	-10.7	-9.0	-7.1	-10.0
Other Urban Areas	Baseline	-0.295	0.288	0.808	1.565	4.811	1.129
	Simulation	-0.327	0.224	0.71	1.421	4.469	1.012
	% Change	-10.9	-22.4	-12.1	-9.2	-7.1	-10.4
Rural Areas	Baseline	-0.443	-0.098	0.217	0.695	2.311	0.372
	Simulation	-0.461	-0.129	0.173	0.63	2.168	0.319
	% Change	-4.2	-32.5	-20.6	-9.4	-6.2	-14.3

Source: Author's construction from macroeconomic data and HBS 2007 data

The results show that people in rural areas suffered the most, their excess consumption falling by 14.3% on average, compared to those in other urban areas and Dar es Salaam whose excess consumption fell by 10.4% and 10.0% respectively. However, moving across the consumption quintiles, it was found that the poorest group in Dar es Salaam suffered the most; their excess consumption falling by 315% in average, compared to the poorest in other urban and rural areas whose excess consumption fell by 10.9% and 4.2%, respectively. In Dar es Salaam, the poorest suffered most and the richest suffered the least, whereas in other urban areas the middle income groups suffered most followed by the poorest group and then the rich. In rural areas, the middle income group suffered most and the poorest group suffered the least.

7.2.2 Excess consumption in different sectors

Individuals in different sectors will be affected by food and fuel price changes differently. This is because of the specific characteristics of the individuals in those sectors. Table 5.5 below presents the excess consumption of the households in agricultural, industrial and service sectors across consumption quintiles.

Table 5.5: Excess consumption across consumption quintiles in different sectors

Area	Consumption Quintiles	Poorest	2nd quintile	3rd quintile	4th quintile	Richest	Total
Agriculture	Baseline	-0.443	-0.080	0.253	0.737	2.278	0.294
	Simulation	-0.461	-0.108	0.214	0.683	2.177	0.253
	% Change	3.9	35.9	-15.4	-7.3	-4.5	-13.7
Industry	Baseline	-0.167	0.461	0.966	1.643	4.385	0.837
	Simulation	-0.218	0.371	0.846	1.481	4.055	0.725
	% Change	30.5	-19.4	-12.5	-9.8	-7.5	-13.4
Services	Baseline	0.115	0.817	1.486	2.485	6.704	1.509
	Simulation	0.044	0.702	1.328	2.264	6.215	1.349
	% Change	-61.5	-14.1	-10.6	-8.9	-7.3	-10.6

Source: Author's construction from macroeconomic data and HBS 2007 data

The results show that the individuals in agricultural sector were hit the hardest by food and fuel price shock, their excess consumption fell by 13.7%; followed closely by those in industrial sector whose excess consumption fell by 13.4%; and those in service sector suffered the least, with their excess consumption falling by 10.6%. The poorest groups in service and industrial sectors suffered more, while in agricultural sector, the middle income groups suffered more. The rich people in all sectors were the least affected groups.

7.3   Poverty effects

Poverty effects of food and fuel price increase are analysed by comparing the changes from the baseline to the simulation situation of the two poverty indices – poverty incidence and poverty gap. However, it should be noted that while both poverty incidences and poverty gap treat the non-poor as equal, poverty incidence treats the poor as equal and poverty gap treats them as unequal. Excess consumption treats both the poor and the non-poor as unequal

Simulation results have shown that increase in fuel and food prices leads to the increase in overall growth of GDP compared to the baseline situation. However, this was only enjoyed by the agricultural sector which experiences increase in production due to more than expected increase in price of cereals and other foods. The remaining sectors, industrial and service, experienced a decrease in growth compared to the baseline situation. The food and fuel price shock affects the real consumption of the people. The two changes in sectoral per capita income growth and changes in real consumption, constitute the possible poverty effects of the shock.

7.3.1 Poverty incidence

Table 5.6 below shows the poverty incidence in baseline and simulation scenarios. The estimations show that the poverty incidence in the baseline year was 35.4% and in a simulation situation poverty incidence increased to 37.3%. This increase of 1.9 percentage point following the simulation

implies that around 817,000 people in Tanzania were pushed below the poverty line following the food and fuel price shock.

Table 5.6: **Poverty incidence in Tanzania: Baseline and simulation situations**

Sector	Baseline	Simulation	% Change
Agriculture	45.4	47.4	4.4
Industry	25.3	26.2	3.6
Services	9.0	10.5	16.7
Total	35.4	37.3	5.4

Source: Author's construction from macroeconomic data and HBS 2007 data

In both baseline and simulation situations, poverty is highly prevalent among agricultural households compared to those in other sectors. Households in the services sector have the lowest level of poverty. The simulation results show that the proportion of the poor increased at a higher rate among the people in the service sector due to fuel and food price shock than among those in the industrial and agricultural sectors. Fuel and food price shock led to 1.5 percentage points increase (equivalent to 16.6% increase) in poverty incidence among households whose main employment sector is service compared to 2.0 and 0.9 percentage points increases (equivalent to 4.4% and 3.6% increases) in poverty incidence among households in agricultural and industrial sectors, respectively.

Table 5.7 shows poverty incidence of different areas in Tanzania. The breakdown analysis shows that on both, the baseline and simulation situations, poverty incidence was more prevalent in rural areas compared to Dar es Salaam and other urban areas. Dar es Salaam had the lowest incidence of poverty. The simulation results following the food and fuel price shock show that the incidence of poverty increase by 2.2, 2.1 and 2.0 percentage points, equivalent to 14.9%, 9.5% and 4.6% increase in Dar es Salaam, other urban areas and rural areas, respectively. This shows that households in all areas were affected by food and fuel price increases in terms of poverty incidence though to different extents.

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Table 5.7: Poverty incidence for different areas: Baseline and simulation

	Dar es Salaam			Other Urban Areas			Rural Areas		
	Base-line	Simula tion	% Cha nge	Base-line	Simula tion	% Cha nge	Base-line	Simula tion	% Cha nge
Agricul ture	26.6	32.6	22.6	36.4	38	4.4	47.5	49.6	4.4
Industr y	21.4	23.5	9.8	25	26.7	6.8	35.2	35.9	2.0
Service s	11	12.8	16.4	10.9	13.5	23.9	14.3	16.4	14.7
Total	14.8	17	14.9	22.2	24.3	9.5	43.5	45.5	4.6

Source: Author's construction from macroeconomic data and HBS 2007 data

The households in the agricultural sector in Dar es Salaam suffered more than any other group in all areas. Poverty incidence increased by 6 percentage points among these households. This might be because these households despite being agriculturalists, they are net food buyers. Thus, despite the advantages gained by agricultural households in Dar es Salaam areas due to high cereal and other food prices, they were affected by higher cost of purchasing the basket necessary for their minimum living standard in urban areas. The least affected group is the households in the industrial sector, in the rural areas. Though this result may seem odd, it might be accounted for by the fact that most of the industrial activities in the rural areas may be of food and non-food crops processing nature. So, those engaged in this sector may increase the cost of processing following the increase in food prices and thus reap the benefits that would have otherwise been borne by the farmers. Those in the rural industrial sector can also charge high processing costs due to increase in fuel prices.

7.3.2   Poverty gap

The poverty gap following the food and fuel price shock in the simulation scenario is higher compared to the baseline scenario; it increased by 0.9 percentage points as shown in Table 5.8 below. This implies that the cost of eliminating poverty increased due to fuel and food price increases; the increase is equal to the percentage of the poverty line level per each

individual poor. The results show that the cost of eliminating poverty among households in the service sector increased more than that for households among other sectors after the food and fuel price shock. The poverty gap increased by 6.9%, 16.2% and 26.3% in the agricultural, industrial and service sectors, respectively.

Table 5.8: Poverty gap in Tanzania: Baseline and simulation situations

Sector	Baseline	Simulation	% Change
Agriculture	14.5	15.5	6.9
Industry	6.8	7.9	16.2
Services	1.9	2.4	26.3
Total	11.0	11.9	8.2

Source: Author's construction from macroeconomic data and HBS 2007 data

The changes in the poverty gap due to food and fuel price increases were also disaggregated according to the spatial distribution of the households. This is because it was hypothesised that the effects of food and fuel price shock might have differing effects in different areas. Table 5.9 presents poverty incidence for both the baseline and simulation according to spatial distribution of the households.

Table 5.9: Poverty gap: Baseline and simulation for different areas

	Dar es Salaam			Other Urban Areas			Rural Areas		
	Base-line	Simula tion	% Chan ge	Base-line	Simula tion	% Chan ge	Base-line	Simula tion	% Chan ge
Agricult ure	5.7	6.4	12.3	12.8	13.5	5.5	15.2	16.2	6.6
Industry	4.9	6	22.4	8.5	9.5	11.8	9.3	10.9	17.2
Services	2.5	3.1	24.0	2.8	3.4	21.4	2.7	3.5	29.6
Total	3.5	4.2	20.0	7.2	8	11.1	13.5	14.6	8.1

Source: Author's construction from macroeconomic data and HBS 2007 data

For both the baseline and simulation scenarios, the poverty gap is relatively lower in Dar es Salaam and higher in rural areas. The poverty gap also increased among households in all areas and in all sectors. The poverty gap increased by 20%, 11.1% and 8.1% in Dar es Salaam, other urban areas and rural areas, respectively. Despite a higher increase in poverty incidence among the poor in the agricultural sector in Dar es Salaam, the percentage increase in poverty gap is lower (12.3%) compared to those in the other sectors – the industrial sector (22.4%) and the services sector (24%). This may be due to the benefit they get from selling food at higher prices. In the rural and other urban areas, the increase in the poverty gap was also in the same order as in Dar es Salaam with the poor in the services sector suffering the most and those in the agricultural sector suffering the least. In the other urban areas the poverty gap increased by 5.5%, 11.8% and 21.4% and in rural areas by 6.6%, 17.2% and 29.6% for households in the agricultural, industrial and service sectors, respectively.

7.4   Comparison of results with other studies

Using the same micro data but with different methodology, Leyaro *et al.* (2010) found that the results were similar – that poor people suffered more due to the increase in food and fuel prices. However, it is contrary to the findings by Dessus (2008) who found that the rising food price will have a negative effect in the short-run and the poor people in Tanzania would be less affected. This may be due to the use of a different data set and different methodology. The poor spend a higher proportion of their income on food especially cereals and thus they cannot substitute these with other consumption goods; hence, they are hit more by the price shock.

This study found out that the households in rural areas were affected more than those in urban areas following the food and fuel price shock which is similar to the findings by Leyaro *et al.* (2010). Considering the poor only, this study obtained the same findings as those by Ackah and Appleton (2007) who did a study in Ghana, Arndt *et al.* (2008) who did a study in Mozambique and Baker (2008) who studied the impact of food price rise in East Asia, Middle East, South Asia and Sub-Saharan Africa which found that the poor in urban areas suffered the most due to food price increase. The

poor in urban areas suffer more than the poor in rural areas since in urban areas the cash economy is dominant and the agricultural sector is very small. Also the latter do not enjoy the increase in agricultural income due to food inflation but bear all the food and fuel inflation costs.

8.0   Conclusion and policy implications

Food and fuel prices in Tanzania and globally have been soaring in recent years. Such price shocks have the potential of increasing production due to higher sales prices but also the woe of increasing production costs and consumer prices and thus affecting the real consumption of individuals. This study analysed the effects of domestic food and fuel prices changes on poverty in Tanzania.

The findings from the simulation analysis show that the fuel and food prices surge led to the increase in real GDP growth of the agricultural sector and the overall real GDP growth of the economy of Tanzania and the fall in real GPDs of the industrial and service sectors. As a result, there was an increase in the proportion of people below the basic need poverty line and those who were poor already were pushed further below the poverty line, thus increasing the cost of eliminating poverty. This explains one of the paradoxical aspects where growth in real GDP does not lead to poverty reduction, and why it is becoming more difficult to eliminate poverty.

The analysis of excess consumption revealed that the poor were hit harder by the food and fuel price shock compared to those who were well-off. It has also been found that the people in rural areas suffer more, relative to those in urban areas; and the people whose main sector of employment is agriculture also suffer more, relative to those in the industrial and agricultural sectors. Moreover, it has been revealed that the poorest people in Dar es Salaam and those in the industrial and services sectors suffer the most, relative to other comparative groups.

The disaggregated analysis of poverty incidence and poverty gap shows that the poor in the services sector suffer relatively more in terms of both increased incidence and increased poverty depth compared to those in the

agricultural and industrial sectors. Further analysis has shown that poverty incidence and poverty depth increase more in Dar es Salaam and other urban areas compared to rural areas. These results indicate that food and fuel prices are more of a woe to a poor person living in urban areas and employed in the services sector.

The results obtained raise some policy concerns. High rates of economic growth experienced are not translated into improving the welfare of the people due to high food and fuel prices that heighten the cost of living. These shocks frustrate government efforts to eliminate poverty and improve welfare.

Fuel inflation in Tanzania is highly out of control mainly because imported petrol, diesel, kerosene and gas follow the global increasing trend of fuel prices and poor performance of the energy sector. The government set up a regulatory authority which focuses mainly at smoothing out the high fluctuations in prices but does not solve the long-term problem of fuel prices rise. The increase in fuel price may force people to substitute petroleum products with charcoal and firewood, a practice which is not environmentally friendly. The establishment of reliable energy systems that will lead to using cheaper sources of energy such as natural gas is paramount. Using natural gas, which has been found in large quantities in Tanzania, will not only reduce the energy costs for daily activities but also help conserve and sustain the environment since it is environmentally friendly. Reliable production and supply of electricity will also reduce the fuel price surges as the cost of electricity is not likely to fluctuate much compared to petroleum products.

To reduce food prices, efforts should be exerted towards increasing agricultural productivity especially for food crops. Tanzania has a lot of arable land with a potential for increased irrigation which is underutilised. The country's agriculture should be transformed from its subsistence and rain-dependence nature to the use of more irrigation, mechanisation and improved food storage arrangements. Also, more emphasis should be put on urban agriculture. These will increase food supply as well as the income of those employed in agriculture.

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