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Contemporary Price Trends and their Economic Significance in the Ashanti Region of Ghana

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Abstract
The objective of this study was to examine the current trend in price of staples and the possible effect on income. Price volatility is explained by changes in the trend itself, and to a lesser extent by variation around its mean (historical volatility approach), which is based on observed past prices. This measure was adopted to gauge the variation in commodity price around the mean. The results show that although prices increased steadily over the years, volatility was relatively minimal between 2002 and 2006 as compared to the period after. Unlike the cereals, more than 50% of vegetables traded on the markets are imported from neighbouring countries. The price range for vegetables was thus much wider than cereals. Supply shortfalls and transportation cost were cited as the two most significant factors contributing to rising prices on the markets. The findings confirm theoretical evidence that unexpected increase in prices erode the purchasing power of consumers, especially the poor who spend much of their incomes on food. A consumer receiving the current minimum wage and spending everything on the respective commodities within one month lost substantially in terms of volumes purchased between 2006 and 2013. For instance, the quantity of tomatoes and maize purchased declined by 74% and 65% respectively between 2006 and 2007. The trend suggests that uncontrolled volatility in prices has serious effects on income and for that matter food security. Stakeholders need to target production increase and improved distribution systems as means to reduce price volatility, which will protect poor consumers against the challenge of coping with wide price variations.
Keywords: Price trend, volatility, income, coefficient of variation, standard deviation

1. Introduction

Growing at a rate (average) of 4.5% over the last two decades, Ghana's economy was dominated by agriculture, which contributes 34% to GDP and employs 55% of the labour force (World Bank, 2008). In 2011, oil production further boosted growth in the economy to 14.4% per annum, which has since declined to about 6%. These achievements notwithstanding, low productivity and poorly functioning markets for agricultural produce appear to promote poverty conditions. Between 2006 and 2008 world market price (average) of rice, wheat, corn and soybean increased astronomically, thereby affecting developing countries the worst (FAO, 2005). Elsewhere, maize and rice recorded 20-30% price increase during the last quarter of 2007 and beginning of 2008 (Wodon et al., 2008). These increases were variously attributed to demand-driven forces, domestic supply shocks, population expansion as well as under funding to agriculture (Cooke & Robles, 2009; OECD, 2008; Graziano et al., 2012). In Ghana, increase in food prices was attributed to low production, caused by bad weather, poor storage and transport systems, as well as policy failure (Ganidekam, 2013).
The demand for Ghana's most important food items (Maize and rice) is projected to grow at a compound rate of 2.6% and 11.8% respectively between 2010 and 2015. However, the country is not self-sufficient in production, registering shortfalls of 12% and 69% in domestic supplies for the two commodities respectively (MiDA, 2010). Whereas overall demand is expected to increase by 1.1% per annum between 2007 and 2050, some countries may have difficulty increasing consumption due to low incomes and rising food prices (Alexandratos & Bruinsma, 2012). The Organization for Economic Co-operation and Development (OECD) projects that world market price for rice and maize will increase faster (in real terms) by 36-48% from 2015/16 to 2019/20. Price volatility affects both producers and consumers because it influences household decisions, which affect demand and supply on the markets (Gosh, 2010). For producers, it increases uncertainty, making it difficult to make sound production decisions (IFPRI 2012). For the consumer, sudden and unexpected price increase erodes the purchasing power, leading to food rationing, increased malnutrition and indebtedness, which affect general wellbeing (IFAD, 2012; ISSER, 2008; ODI, 2005). The average daily caloric food intake per person in least developed and developing countries were estimated at 2,120 kcal and 2,640 kcal, respectively in 2010, while that of developed countries was 3,430 kcal. This difference, according to the FAO (2012) manifests in the form of increased number of undernourished people (925 million in 2010) in developing countries and rising obesity in developed countries (1.5 billion people by 2008)(UNEP, 2012; WHO, 2011). The situation was described as *worrying* because over consumption by the rich and under nourishment of the poor have significant health, economic and environmental implications. In 2009 and 2010, about 26% and 24% of incomes among the urban poor in Ghana was spent on food respectively (WFP, 2010). Other studies in Ashanti region also revealed that

food constitutes up to 74.6% of urban household budget (Frimpong, 2013). In view of the serous effects of price increase on real income and consumption in sub-Saharan Africa, this study examines the trend in price of staple food in the Ashanti region, the forces driving those trends and their likely economic effects. An examination of the factors will help to fashion out possible interventions that could reduce price variability in order to minimize the impact on market participants and help them adjust to such changes.

2. Methodology

Volatility refers to variation of commodity price cycles around the mean value. The two kinds identified in literature are historical (realized) and implicit (future) volatility (European Commission, 2009; Matthews, 2010). Historical volatility is based on observed past prices and specifically expresses how unstable prices were. Implicit volatility on the other hand relates to the expectation of commodity markets regarding how unpredictable prices will be in the future. Literature suggests that most of the variation in prices can be attributed to changes in the trend itself rather than that around the mean (Dehn et al., 2005). In this paper, we are interested in assessing the realized volatility based on observed market prices. Historical analyses of the respective commodity price movements since 2002 was carried out using market prices of four cereals and three vegetables. Measurements focused on the Standard Deviation (SD) and Coefficient of Variation (CV) of the prices. Both primary and secondary data were used for the study. Primary data was sourced from traders in the respective commodity markets in the regional capital using semi-structured questionnaires. Secondary data was collected from the Ashanti regional directorate of Ministry of Food and Agriculture (MOFA). The time series data covering a period of 12 years was split into two periods (2002-2007) and (2008-2013) to allow for comparison of the nominal price movements. The study adopted a multi-stage sampling technique, involving a combination of purposive and systematic sampling methods to select the markets (five) and respondents respectively. The data was analysed using descriptive statistical tools, trend and correlation analysis in SPSS and Microsoft Excel. Price volatility in the respective commodity markets was measured using the CV, defined as the ratio of the SD of price over a specified time interval to the mean price over the same period.

$$CV = \frac{Standard\ deviation}{mean} = \frac{\sqrt{\frac{\sum_{i=1}^{n}(P_i - \bar{P})^2}{n}}}{P}$$

Mean test on volatility was also carried out to measure the difference between two periods (2002-2007 and 2008-2013) to determine if mean volatility in the latter 6 years is statistically different from that in the preceding period. The test is under the null hypothesis that: H0: $vol_1 = vol_2$where $vol_1$and vol_2 are the means of the volatility measurement for each period 1 and 2. The statistic is represented as

$$t = \frac{vol_1 - vol_2}{\sqrt{\frac{s_1^2}{n_1} + \frac{s_2^2}{n_2}}}$$

Where 's' is the standard deviation for the respective periods. The calculated t-statistic is compared to a student 't' with ($n_1 + n_2 - 2$) degrees of freedom.

3. Results and discussion

3.1 Maize

Figure 1 shows the overall price change and quarterly average price for maize from 2002-7 and 2008-13. Prices were relatively stable between 2002 and 2007, increased sharply in 2008 and remained volatile thereof. The quarterly average price increased between 2008 and 2013 (irregularly), declining on certain occasions. Prices increased sharply from GH¢3.3 in 2007 to GH¢28.2 in 2008, representing 755% in just 12 months.

Table 1. (right) is the summary statistics of prices per 100kg bag of maize.

Year	N (Months)	Range	Min.	Max.	Mean	Standard Deviation	Coef. of variation
Av(2002-06)	12	0.99	1.82	2.82	2.27	0.33	14.5%
2007	12	6.88	2.47	9.35	6.50	1.20	18.4%
2008	12	49.93	28.22	78.15	48.78	14.13	29.0%
2009	12	29.20	46.01	75.21	59.97	9.50	15.8%
2010	12	16.28	43.32	59.60	52.10	5.48	10.5%
2011	12	53.23	54.30	107.53	75.41	16.71	22.2%
2012	12	56.62	72.36	128.98	100.53	21.51	21.4%
2013	8	5.75	73.65	79.40	76.96	2.10	2.7%

Source: Field data (MOFA), 2013

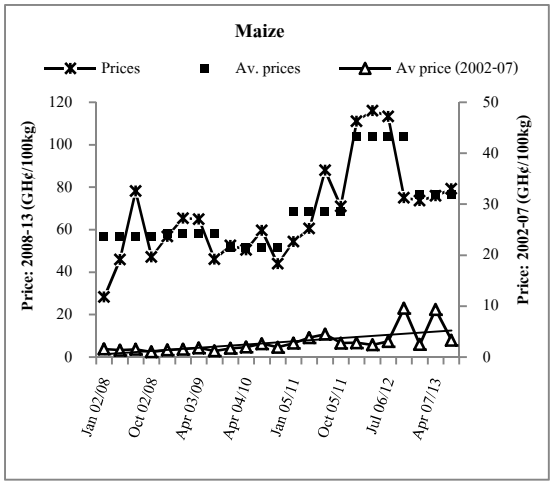


Figure. 1. (left) shows the overall trend in price & quarterly averages for maize for 2002-07 and 2008-13).

The maize market in Ashanti region followed the trend that characterised world commodity markets around 2007/2008. For instance, the average price range in the first five years (2002-2006) was just under GH¢1.0 per bag (table 1). This increased to about GH¢6.9 in 2007 and GH¢49.9 in the 2008 crop year. The market showed similar behaviour in 2011 and 2012. The highest variability in price was recorded in 2008, 2011 and 2012 with a standard deviation of GH¢14.13, GH¢16.7 and GH¢21.5 and coefficient of variation of 29.0%, 22.2% and 21.4%respectively. The mean price over the period however trended upwards.

3.2 *Millet*

Figure 2 shows the price movement and quarterly average price for millet over the same period. The price followed a similar trend as maize. It however increased steadily between 2008 and 2013, after rising sharply by 1,363% between 2007 and 2008. The price range (average) between 2002 and 2006 was GH¢0.93 per bag with a standard deviation of 9.9% (table 2). The variability in prices over the 13 years period was single digit except for 2012 when the highest variability was recorded. The standard deviation was GH¢20.4 with a coefficient of variation of 16.4%. Like maize, average price of millet trended upwards over the entire period.

Table 2. (right) shows the summary statistics of prices per 93kg bag of millet.

Year	N (Months)	Range	Min.	Max.	Mean	Standard Deviation	Coeff. Of variation
Av(2002-06)	12	0.93	2.37	3.3	2.87	0.27	9.9%
2007	12	1.85	3.15	5.00	3.62	0.54	14.9%
2008	12	21.01	48.05	69.06	60.75	8.03	13.2%
2009	12	16.08	63.12	79.20	71.28	4.64	6.5%
2010	12	21.10	69.71	90.81	79.29	7.18	9.1%
2011	12	30.09	77.83	107.92	85.46	8.50	9.9%
2012	12	64.37	100.00	164.37	124.80	20.42	16.4%
2013	8	14.75	139.25	154.00	145.59	5.00	3.4%

Source: Field data (MOFA), 2013

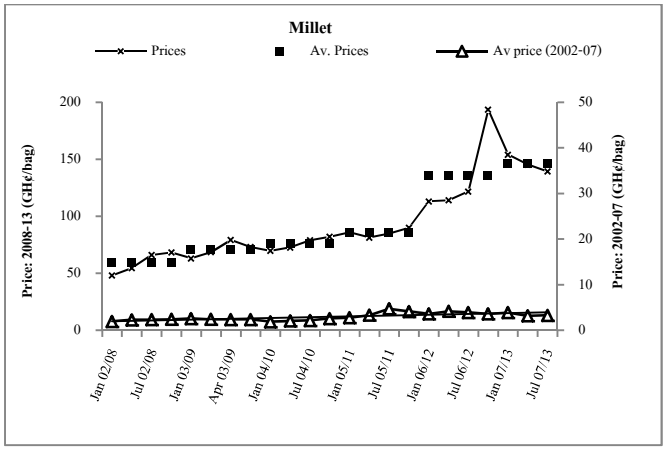


Figure 2. (left) shows the overall trend in price & quarterly averages for millet for 2002-07 and 2008-13).

3.3 Sorghum

Prices were relatively stable between 2002 and 2007(Figure 3). Price increased sharply from GH¢3.0 in the last quarter of 2007 to GH¢41.0 in the first quarter of 2008. This represents 1,242% increase, which obviously affects (negatively) the purchasing power of consumers who are very unlikely to get a corresponding compensation by way of income. Table 3 shows that price variability for sorghum was generally low compared to the other cereals. The year 2008 posted the highest variability in the price, with a standard deviation of GH¢11.1 and a coefficient of variation of 13.2%, the second highest estimated between 2008 and 2013. The mean price of sorghum also trended upwards from GH¢2.8 per bag between 2002 and 2006 to GH¢129 in the third quarter of 2013.

Year	N (Months)	Range	Min.	Max.	Mean	Standard Deviation	Coef. Of variation
Av(2002-06)	12	1.06	2.262	3.328	2.80	0.36	12.0%
2007	12	1.62	2.88	4.50	3.64	0.50	13.0%
2008	12	28.58	41.35	69.93	59.36	11.06	13.2%
2009	12	18.99	58.81	77.80	70.47	5.61	6.5%
2010	12	16.31	65.08	81.39	75.47	4.44	9.1%
2011	12	30.59	80.81	111.40	89.03	8.75	9.9%
2012	12	21.43	97.00	118.43	108.84	6.69	16.4%
2013	8	23.17	119.33	142.50	129.46	6.68	3.4%

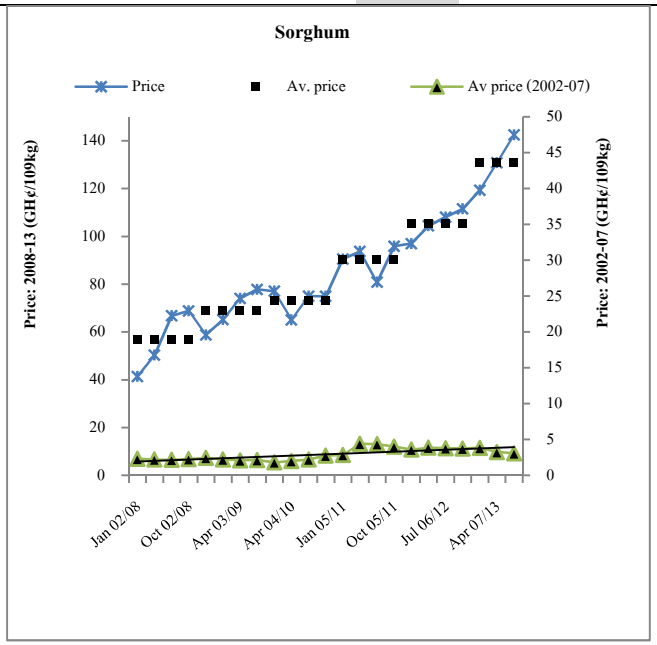


Figure 3. (left) shows the overall trend in price & quarterly averages for sorghum for 2002-07 and 2008-13). Table 3. (right) shows the summary statistics of prices per 93kg bag of sorghum.
Source: Field data (MOFA), 2013

3.4 Rice

There was relative stability in the price of rice between 2002 and 2007. It however increased by about 9% between 2007 and 2008, having increased sharply by 807% in the preceding quarter of the same year. Table 4 shows that 2007 posted the highest variability in price with a SD of GH¢27.6 and a CV of 97%. The following year (2008) saw a decline in variability, although the second highest over the period, with an SD and CV of GH¢13.7 and 16.8% respectively. Again, the overall yearly average price per bag increased steadily up to the third quarter of 2013. The GH¢40.50 price range in 2008 suggests that the local rice market was also affected by the global price trend. It declined in two consecutive years following 2008 before increasing again in 2011. Generally, the observed trend in price movement for the cereals corroborated findings from cereal markets in the Northern region of Ghana (Fearon, 2013).

Year	N (Months)	Range	Min.	Max.	Mean	Standard Deviation	Coef. Of variation
Av(2002-06)	12	0.97	3.93	4.91	4.48	0.31	6.92%
2007	12	57.34	5.85	63.19	28.39	27.55	97.0%
2008	12	40.50	61.87	102.37	81.21	13.67	16.8%
2009	12	24.09	90.98	115.07	105.37	6.70	6.4%
2010	12	13.49	98.03	111.52	105.56	4.22	4.0%
2011	12	39.25	102.36	141.61	115.26	12.23	10.6%
2012	12	29.28	132.53	161.81	147.60	11.10	7.5%
2013	8	25.87	151.76	177.63	166.18	9.03	5.4%

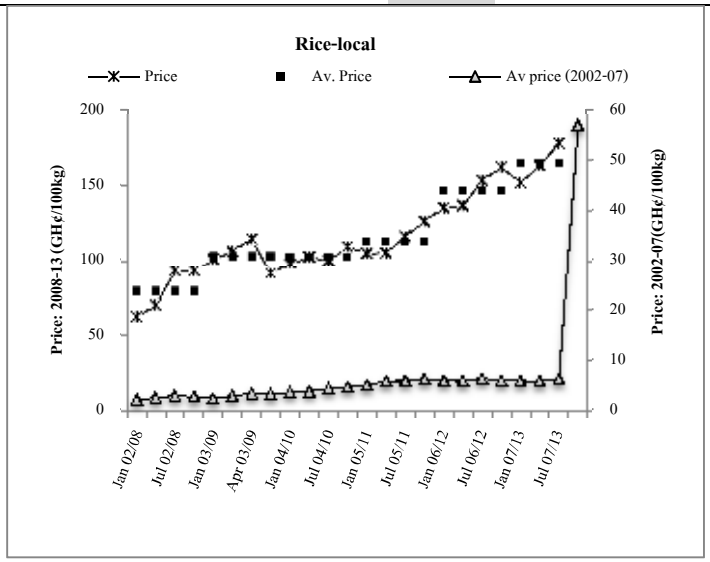


Figure 4 (left) shows the overall trend in price & quarterly averages for locally produced rice for 2002-07 and 2008-13). Table 4 (right) also shows the summary statistics of prices per 93kg bag of rice.

Source: Field data (MOFA), 2013

3.5 Vegetables

Figure 5 shows the yearly price trends for three vegetables (tomato, onions and dried pepper). Two distinct trends can be established based on the periods between 2000-2006 and 2007-2013. As in the case of cereals, the trend after 2006 shows that prices rose significantly above what pertained in the preceding 7 years. Onion and dried pepper traded along similar price paths until 2012 when they showed some divergence while tomatoes sold at a much lower price after 2008. Overall, average prices before 2007 were below GH¢5.00 (appendix). The price of onions increased by 564% in 2007 while that of dried pepper (16kg bag) and tomatoes (52kg create) increased by 253% and 54% respectively. Between 2008 and 2013, variability in the prices of tomato was relatively high. The standard deviation in all years was double digit except 2006 that recorded a single digit. The price range for 2013 was GH¢182.1 which posted the highest standard deviation of 58.43 with coefficient of variation being 41%.

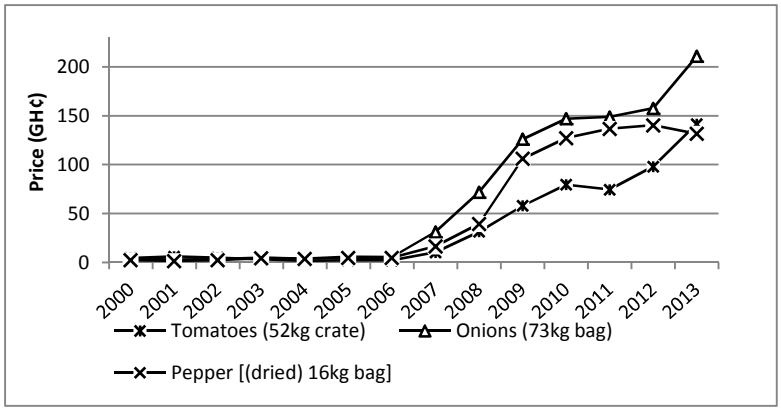


Figure 5: Annual trends in vegetable prices in Ashanti Region (2000-2013)

An independent sample test comparing volatility between the two periods showed that there was no significant

difference for maize, sorghum, tomatoes, and pepper (table 5). The difference was however statistically significant for onions, millet and rice with negative signs meaning that the average volatility in recent times is significantly higher than that observed in the period before 2008.

Table 5: Test of equality in volatility (p-values in brackets)

	Coefficient of variation (CV)		
Cereals		**Vegetables**	
Maize	0.59	Tomato	-0.16
	(0.57)		(0.87)
Millet	-2.55**	Onion	-6.79 ***
	(0.04)		(0.00)
Sorghum	-0.86	Pepper	-0.65
	(0.41)		(0.53)
Rice (local)	-2.73**	-	-
	(0.03)		

*, **, *** Significant at 10%,5% and 1% significance level respectively.
Source: Author's computation

Generally, price changes in any economy are attributed to inflation. The study therefore sought to examine any possible relationship between changes in the average year-to-year price and the regional inflation over the period. The Ashanti regional consumer price index (CPI) (year-to-year) generally declined in the second half of the period under consideration (Figure 6).

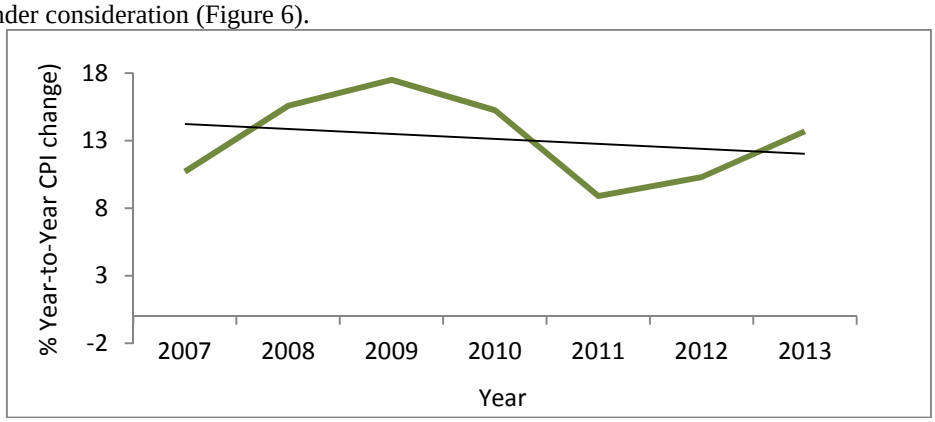


Figure 6: Year-to-year change in the CPI in the Ashanti region
Source: Ghana Statistical Service, CPI (Regional-Ashanti)

The correlation coefficient between the average year-to-year price and inflation was determined as shown in table 6. Although the results for maize and onion were negative, they were statistically not significant at all levels. The other staples showed very little or no relationship at all. This suggests that there is no statistical relationship between the two variables. It is also important to note that the negative coefficients reported could be a result of faulty reporting by the responsible agencies or that, extremely low index for other commodities in the basket negates the influence of the prices of these staples. It is therefore reasonable to ascribe the observed trend in prices to other factors including supply and demand conditions as well as distribution factors over the period.

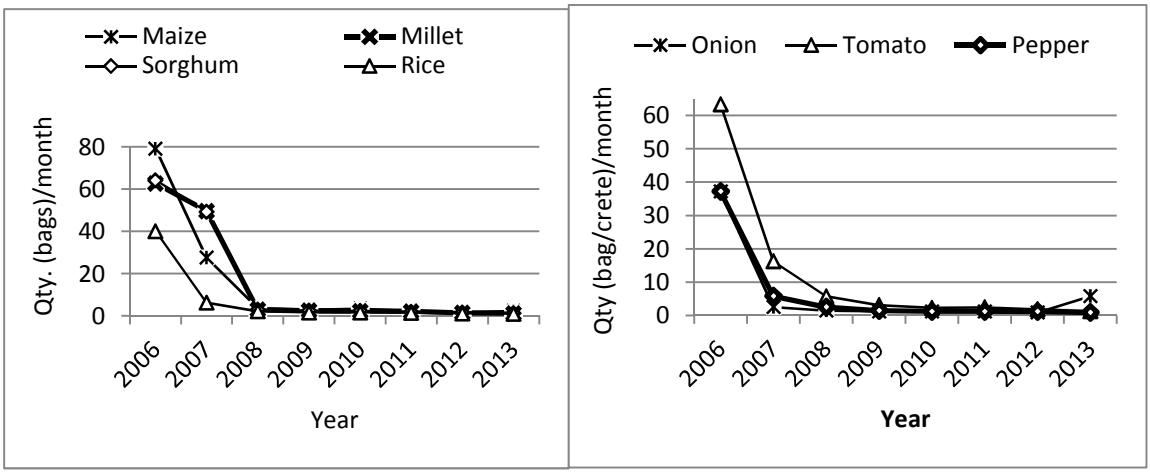
Table 6: Correlation coefficients for the selected staples

Staple	**Maize**	**Millet**	**Sorghum**	**Rice**	**Onion**	**Pepper**	**Tomato**
Correlation Coefficient	-0.15	-0.02	-0.01	0.00	-0.14	0.00	0.06

Source: Authors' computation

3.6 Income implications

The daily minimum wage in Ghana as announced in April 2014 by the National Tripartite Committee (NTC) was GH¢6.00. This represents an increase of 14.5% over the previous figure of ¢5.24. Figure 11 shows how incomes are affected by the *realised* prices volatility. A consumer receiving the minimum wage (GH¢6/day or GH¢180/month) and spending the whole amount on the respective commodities at a time could, between 2006 and 2013 purchase the quantities shown in the figures below.



Effects of price increase on quantity purchased for cereals (figure 11: left) and vegetables (figure 12: right) per month

The results show a steep drop in the quantity purchased (for all the commodities) over the period. For instance, the quantity of tomatoes purchased declines by 74% between 2006 and 2007. The quantity of maize also reduced by 65% within the same period and further by 87% in 2008. These trends suggest that uncontrolled volatility in prices has serious effects on consumer purchasing power in the region and for that matter food security.

3.7 Source of supply

The study revealed two main sources of supply for the two commodity categories. All the cereals on the markets except millet, are obtained from internal sources. About 58% of maize supply comes from the Brong Ahafo region. Proximity of the supply source of maize to the target market (121-190km) appears to exert little or no effect on its price, suggesting that other important factors may working. Between 2009 and 2013, contribution of transport cost to national inflation increased consistently from 0.71% to 26.4% (GSS, 2014). According to the traders all the rice (local) on the market, are obtained from three main areas including Bawku and Tolon (figure 9). Figure 7 shows that 17% of millet supplies comes from Burkina Faso while the remaining 83% comes from Bawku, Tumu and Tamale (361-636km). The long distances suggest higher cost, especially with the recent increases in fuel prices.

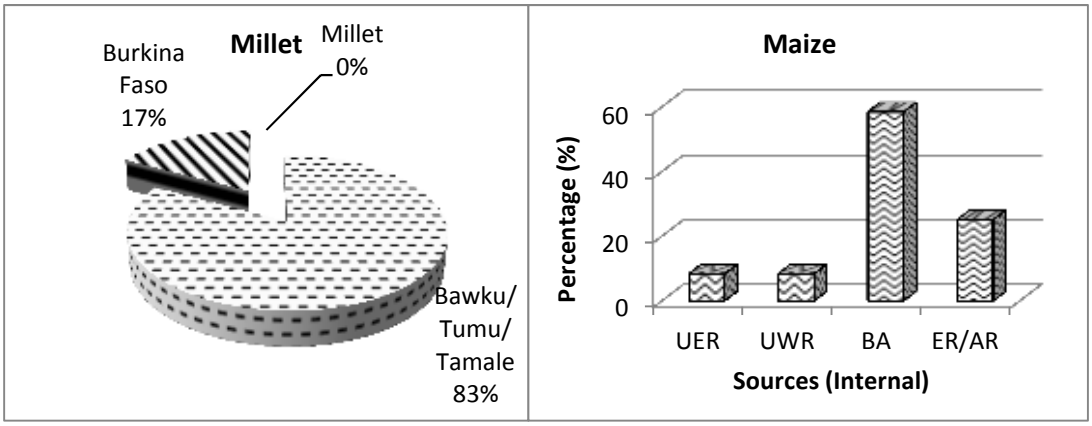


Figure 7 (left) shows the source of millet supply. Figure 8 (right) shows the source of maize supply

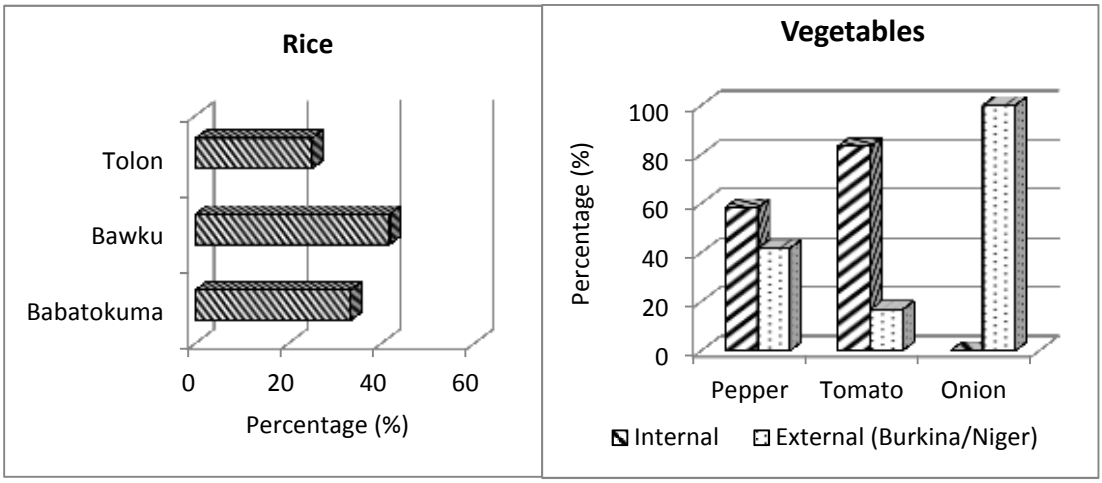


Figure 9 (left) shows the current source of rice supply. Figure 10 (right) shows the sources of vegetable supply

A significant share of the vegetables are imported. Figure 10 shows that over 41% of pepper, 16% of tomatoes and 100% of onion are imported from Burkina Fasso or Niger. This explains the observed wide price range for vegetables in the region. Tomatoes is maily supplied from Agogo, Derma, Kumawu (Ashanti region) and Akumadan and Tuobodom (Brong-Ahafo region). Dormaa and Seikwa in the Brong-Ahafo region are the two main sources of pepper supply. From the traders' perspective, supply shortfall was the most important factor that influences price as ranked by 45.8% of respondents. This was followed by high transportation costs with 32% of respondents alluding to that.

5. Conclusion

Although prices were relatively stable between 2002 and 2006, the market registered high variability after 2008 with generally rising mean trends. While most of the cereals are produced locally, more than 50% of the vegetable are imported from neighbouring countries. The price range for vegetable was thus much wider than the cereals. This indicates the highly seasonal nature of vegetable production coupled with the lack of proper storage facilities, which creates shortage and glut situations depending on the season. Absence of statistical relationship between commodity price and regional inflationary trend suggests that the observed trend in price over the period can reasonably be attributed to other factors including supply and demand as well as distribution factors. The fact that prices continue to rise reinforces the point that either production consistently falls short of demand (creating excess demand) or the distribution system is inefficient, making transportation a substantial part of the price build up. Supply shortfall and transportation cost are the most significant factors contributing to high food price. Because poor people spend much of their incomes on food (50–70 percent), they bear a disproportionate burden in the process of adjusting to price increases. Stakeholders need to intensify efforts to increase production and improve the distribution systems to facilitate distribution from production areas to the major marketing centers in order to reduce volatility on the markets, which will save poor consumers the recurrent problems of having to cope with such disparities.

Appendix

Onion

Summary statistics of yearly price/bag (73kg) ofonion (2002-13)

Year	N (Months)	Range	Min.	Max.	Mean	Standard Deviation	Coefficient of variation
Av(2002-06)	12	5.38	2.772	8.152	4.84	1.8	37.2%
2007	12	142.22	35.05	177.27	71.89	44.78	106.4%
2008	12	121.72	64.87	186.59	126.10	46.15	36.6%
2009	12	123.57	88.22	211.79	147.05	39.02	26.5%
2010	12	194.66	98.15	292.81	148.87	53.73	36.1%
2011	12	212.88	79.51	292.39	157.76	86.87	55.1%
2012	12	161.57	137.10	298.67	210.92	63.19	30.0%
2013	8	78.88	3.50	82.38	31.24	33.26	106.5%

Source: Field data (MOFA), 2013

Pepper

Summary statistics of yearly price/bag (16kg) of dried pepper (2002-13)

Year	N (Months)	Range	Min.	Max.	Mean	Standard Deviation	Coefficient of variation
Av(2002-06)	12	5.38	2.772	8.15	4.84	1.80	37.2%
2007	12	78.88	3.50	82.38	31.24	33.26	106.4%
2008	12	142.22	35.05	177.27	71.89	44.78	62.3%
2009	12	121.72	64.87	186.59	126.10	46.15	36.6%
2010	12	123.57	88.22	211.79	147.05	39.02	26.5%
2011	12	194.66	98.15	292.81	148.87	53.73	36.1%
2012	12	212.88	79.51	292.39	157.76	86.87	55.1%
2013	8	161.57	137.10	298.67	210.93	63.19	30.0%

Source: Field data (MOFA), 2013

Tomatoes

Summary statistics of yearly price/crate (52kg) of tomatoes (2002-13)

Year	N (Months)	Range	Min.	Max.	Mean	Standard Deviation	Coefficient of variation
Av(2002-06)	12	4.498	1.308	5.81	2.84	1.5	52.8%
2007	12	25.36	2.01	27.37	11.09	9.31	83.9%
2008	12	26.51	17.75	44.26	31.46	6.86	21.8%
2009	12	65.56	25.73	91.29	58.03	20.68	35.6%
2010	12	117.61	41.21	158.82	79.59	40.62	51.0%
2011	12	55.07	44.39	99.46	74.54	21.49	28.8%
2012	12	106.36	49.49	155.85	98.18	32.05	32.6%
2013	8	182.10	65.03	247.13	141.73	58.42	41.2%

Source: Field data (MOFA), 2013

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