European Journal of Business and Management
ISSN 2222-1905 (Paper) ISSN 2222-2839 (Online)
Vol.6, No.22, 2014

Analysis of Price Volatility and Implications for Price Stabilization Policies in Mozambique

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Abstract

High food price instability is one of the major risks facing agricultural households from developing countries. Resulting from agronomic factors as well as the historically low levels of world grain stocks and climate change, increased food price volatility has attracted renewed interest among policy experts in identifying appropriate policy instruments to counter its effects. This paper applies the GARCH model to data from twelve maize markets in Mozambique to estimate price seasonality and volatility. The results reveal the presence of seasonality, and high volatility. There is scope for improving price stability through the use of both market and non-market based price stabilization interventions that encourage investments in market infrastructure such as roads, warehouses and a market information system; institutions such as warehouse receipt system, credit and insurance; maintaining a strategic reserve and reduced tariffs and food-for-work programmes.

Key words: Price volatility, Maize, GARCH, Mozambique

Introduction

Agricultural households in developing countries are increasingly facing high food price instability which negatively affects their consumption and investment patterns. Moreover, as expressed by Rashid (2007), in the presence of credit and insurance market failure; commodity price instability can discourage investments and lead to inefficient resource allocation. Poor consumers suffer more as they have to spend a large share of their income on food, yet an unusual price increase forces them to cut down food intake, take their children out of school, or, in extreme cases, simply to starve. Indeed while high commodity prices raise farm income and lower government farm program costs, they also cause food price inflation by raising feed and input costs for livestock producers and food processors. High and volatile food prices can be quite problematic particularly for import-dependent, less developed nations. In worst cases, price instability has resulted in macroeconomic instability and social unrest. For example, Lagi et al (2011) report that food prices are the precipitating condition for social unrests in North Africa and the Middle East in the year 2011 as well as earlier riots in 2008 which coincided with large peaks in global food prices. In Maputo there were violent demonstrations against price rise in staple foods and general cost of living in the year 2010 (Hanlon, 2010). In a nutshell, extremely volatile prices increase the risk associated with production and marketing eventually slowing down economic growth.

Literature largely classifies causes of price instability into four categories as follows; (1) agronomic factors such as bad weather which affects the agronomy of the crop, (2) inadequate infrastructure and asymmetric information, (3) incomplete or missing institutions, and (4) high volatility in the world market. Other studies (Rashid, 2007; Gilbert, 2010) have identified the most common causes of food price volatility as climatic factors, infrastructure, policy shocks and exchange rate uncertainty.

The motivation for this paper is that if seasonal fluctuations can be discerned and measured, it will be easier to make predictions about prices and to understand their behaviour over the year. Furthermore, commodity investment behaviour, farm income, policy, and food security are all impacted by agricultural price volatility. Seasonal analysis of price data for food commodities is therefore an important part of food markets analysis.

Such an analysis should lead to the generation of evidence required for developing appropriate policies for price stabilization.

Governments have in the past employed both market and non-market based price stabilization policies, yet such interventions have yielded mixed results. In light of these mixed experiences with structural adjustment programs as well as other global trends, it is being increasingly recognized that food price instability and risk are important problems in many low-income countries, and finding appropriate policy responses for dealing with these problems has re-emerged as a contemporary policy issue (Byerlee et al., 2006; World Bank, 2005). As expressed by Rashid (2007) there are at least three reasons behind renewed interest in the subject. First, it is becoming evident that food market reforms have been partial, and in the wake of increased price volatility, many countries are reversing the policies they adopted under the structural adjustment programs. Second, world grain stock is at historically low levels, and even a relatively small swing in exports or imports from large countries, such as China and India, can send major shock waves through world grain markets. This vulnerability has serious implications for developing countries, especially those that have food deficits and limited capacity to import owing to low foreign currency reserves. Finally, there is growing concern that global climate change is likely to expose poor countries to droughts, floods, and other extreme climatic events that can increase the risk of food price shocks.

In Mozambique, output markets for staple foods are volatile. The cycles of crop surpluses and deficits commonly follow crop price booms and busts, respectively (Benson et al 2012). Uncertain crop prices make it difficult for farmers using high value inputs such as fertilizer and improved seed to be confident that they will obtain a sufficient return from the sale of the additional harvest that they obtain from the use of fertilizer to pay for the input. It is therefore, in the interest of government to establish policies that help stabilize food prices This study aims at contributing to government policy efforts of identifying strategies for reducing price volatility. Against this background, this paper analyses the volatility of maize prices in Mozambique and identifies potential policies for price stabilization. The rest of the paper is structured as follows; section two discusses the agricultural sector in Mozambique. Various policy responses to past food price volatility and their impacts are discussed in section three. In section four sources of data and method of data analysis are explained while empirical results are presented and discussed in section five. The conclusions are presented in section six.

Agriculture in Mozambique

Agriculture is the main economic activity in Mozambique, with about 80 per cent of the population dependent on agriculture for their livelihoods (Cunguara and Hanlon 2010). Subsistence agriculture is predominant, and smallholders account for 99 per cent of total rural households (Cunguara and Hanlon 2010; Donavan and Tostão, 2010). Donavan and Tostão (2010) reports that farmers in Mozambique are characterized by small land holdings (0.9 ha), with low productivity which leaves most households as net buyers of food staples.

Poor access to good road networks and high transport costs fragments markets hindering both social development and economic productivity. Infrastructural challenges limit farmers' ability to access government services, agricultural inputs and market agricultural and other products. Furthermore, the percentage of the population with access to the road networks declines in the wet season due to poor road conditions. Moreover, Cunguara (2011) links low productivity of the agricultural sector in Mozambique to the weak public investment in agriculture.

Maize is an important staple food crop that is widely produced and consumed throughout the country and provides income to households in rural areas. Although the country has a high agricultural potential, some regions are still not self-sufficient in terms of production of maize. The country relies on imports to meet the deficit, particularly that which occurs in the southern region of Mozambique (Traub et al., 2010). On the other hand, maize produced in the central region is often exported to Malawi (Tschirley and Abdula, 2007).

In terms of food production, Mozambique is divided into three regions: South, Central and North. The southern region is known as deficient as far as agricultural production is concerned and relies on the central and northern regions for staple food supply. The central and northern on the other hand are regarded as areas of surplus production because of their good agro-ecological conditions. About half of the total maize production comes from the central region, 40 percent is produced in the north while the remaining is produced in the south

(WFP/FAO, 2010). Domestic food prices of most agriculture commodities vary from year-to-year, depending on weather, yield, and imports (Fews Net, 2009).

Domestic maize consumption is expected to continue increasing due to population growth, urbanization and increasing demand for animal feed. However, the flow of maize from surplus area in the north to deficit provinces in the south is affected by inadequate access to roads, high transportation costs, the seasonal nature of production, and market preferences of traders for low cost imports from South Africa. Given these factors, it appears to be more profitable for traders to import food products from neighbouring countries such as South Africa, than to transport them from the northern to the southern region of the country (Corzine, 2008; Fews Net, 2009).

The government has attempted to address low agricultural productivity through its Strategy Plan to Reduce Poverty (PARPA I and PARPA II) which focuses on promoting sustained agricultural production and growth by increasing investment in agricultural research and extension services, improving agricultural infrastructure, and increasing agricultural inputs-outputs accessibility. These commitments continued in the recent Strategic Plan for Agricultural Sector Development (PEDSA 2010) and Agricultural Investment Plan (2013). The government has also embarked on efforts to revitalize Mozambique institute of Cereals (ICM) to provide market infrastructure and create a strategic grain reserve.

Despite the efforts to increase productivity, Mozambique continues to experience food deficits, estimated to over 400,000 metric tons per year, part of which the government considers to be due to weaknesses in storage and marketing of agricultural products (Coulter and Schneider, 2004). As expressed by Coulter and Schneider (2004), storage losses have been reported to range between 20% and 40% depending on the crop and geographical location. Aside from causing hunger, storage losses force farmers to sell their products early to avoid physical losses and hence reducing opportunity to sell at favorable prices. Coulter and Schneider (2004) report that most farmers sell half or more of their crops within the first three months of harvest, due in large part to the problem of pests, and notably insects. This exposes farmers to lower farm gate prices during harvest and to high consumer prices when they purchase during the lean season, hence exacerbating price volatility.

Policy Responses to Food Price Volatility in Mozambique

Mozambique heavily depends on imported food making the country vulnerable to international price shocks. For instance the 2007-9 price shocks greatly affected the prices of food and caused poverty rates to persist. In response to volatility of food prices, the government of Mozambique adopted both direct and indirect policies. In the 1980’s and early 90’s the government intervened in maize markets. The Government bought and sold maize through the Cereals Institute of Mozambique (ICM) in order to maintain low and stable maize prices. The restructuring of ICM in 1996 reduced its role as a buyer and seller to that of renting granaries to the private sector. Thereafter, the private sector actors set the market prices.

After the 2007/9 food price crisis, the Government of Mozambique (GoM) embarked on policies to reduce the dependence on imported food commodities by increasing production, storage, distribution and processing. The trade policies adopted included reducing import tariffs on maize. In early 2008, the tariffs were reduced from 25 to 2.5 percent. In response to an increase in international prices, the GoM embarked on policies to maintain an overvalued exchange rate and subsidize fuel prices.

The impacts of the policies to mitigate the negative effects of food crisis were generally mixed. The trade policies were effective in reducing the impact of international prices of food and fuel. This was important since Mozambique (especially south) is still not self sufficient in the production of food staples. Policies to increase agricultural productivity were necessary since agriculture is the main economic activity in Mozambique. However, according to Cunguara and Hanlon (2010) poverty has actually been increasing. The situation was made worse by weather shocks especially in the central and southern provinces which reduced productivity. The result is that the country has continued to be a net importer of food staples and policies to reduce the vulnerability of the agrofood sector have not fully achieved the desired effect.

In an effort to stabilize prices the government reduced import tariffs. Although the interventions shielded the consumers from unstable food prices, the government had to forego revenue which slowed down investment. The cost of the scheme in terms of foregone taxes and increased subsidies increased both public and external debt. In addition, food insecurity problem persisted. The Action Plan for food production 2008-2011(PAPA) was implemented with the main purpose of reducing staple food deficit. The programme included subsidies, social protection, and monetary policies among others. Subsidies decreased prices and increased production and a stable currency stabilized prices for imports. However, sustainability of the programme is questionable since it was more of a stopgap measure. For instance government transfers to the vulnerable households were insignificant considering the cost of staple food basket.

Methodology

Data and Data sources

The study utilized time series price data, literature review from relevant documents and key informant interviews with key stakeholders including Government officials, development partner organizations and key selected actors working on warehouse receipts, and post-harvest loss management. The estimation of seasonality analysis and price volatility made use of monthly prices of maize covering 10 years period (2003-2013) obtained from Agricultural Market Information System (SIMA). The price gaps identified were filled with the mean of the surrounding prices and through linear interpolation. The analysis focuses on maize since it is by far the most important staple food in Mozambique.

Since Mozambique is divided into three production regions, four markets were selected from each region to represent the overall country's price trends. The south is a maize deficit region while the central (depending on the season) and north are maize surplus regions. Twelve markets were selected for data analysis: Maputo, Xaixai, Chokwe and Massinga in the southern region; Gorongonza, Mutarara, Manica and Tete in the central region; Nampula, Lichinga, Cuamba and Nacala in the Northern region.

Data Analysis

To test for seasonality, a price multiplicative model for time series decomposition was employed for data analysis to achieve the stated objectives of the study. This method follows the work of Goetz and Weber (1986). The basic idea behind decomposing a price series is that there are four components composing a price, namely, a trend, a cyclical pattern, a seasonal pattern and a random or disturbance component. The most common approach is to assume that these components are related multiplicatively (Trotter, 1992). That is

$$P = T \times C \times S \times E \tag{1}$$

Where

P = Prices series
T = Trend component
C = Cyclical component
S = Seasonal component
E = Random component.

Focus is on the seasonal component rather than all the price components so as to ignore the influence of inflation, random events, and production cycles. Seasonality is defined as a systematic movement that repeats itself every 12 months. The most common reason for seasonal price movement is the seasonal fluctuations of supply. Demand fluctuations can also cause seasonal price changes.

Seasonality Analysis

Seasonal index and grand seasonal index, both based on centered moving averages (CMA) were used in the seasonality analysis. To estimate the seasonal index the centered moving average over 12 months was used. The formula for CMA is:

$$CMA^{12} = \frac{\left[\sum_{i=t-6}^{i=t+5} P_i + \sum_{i=t+6}^{i=t-5} P_i\right]}{24} \tag{2}$$

CMA completely eliminates seasonal and random components of a price series. This it represents the trend and cyclical components of the original price series and eliminates seasonality and randomness. The seasonal index (SI) is then calculated as a division of the original price series by CMA:

$$SI_i \frac{P_i}{CMA^{12}} \times 100 \quad (3)$$

Where SI_i is the seasonal index for month i, P_i is the price during month i, and CMA^{12} is the 12 month centered moving average. To remove the random component in the SI the Grand Seasonal Index (GSI) is calculated as:

$$GSI = \overline{SI} \times \frac{1200}{\sum \overline{SI}_i} \quad (4)$$

Where $\overline{SI}$ is the average seasonal index for month i.
The GSI summarises the typical seasonal behaviour of a time series. GSI represents the pure seasonal averages of the series during the period of analysis. Since it shows the real seasonal fluctuation for the prices in the markets, it is a good starting point of analysis of feasibility of storage.

Calculation of Gross Storage Returns

Calculating the Gross Storage Returns (GSR) of maize was used to evaluate the feasibility of storage. Maize is stored for the creation of time utility. According to Trotter (1992), GSR can be estimated from GSI, because the GSI is a measure of average change in the seasonal components of prices. The GSR can be calculated by computing the percentage increase from seasonal price low to seasonal price high. The computation is given as follows;

$$GSR = \frac{Highest\ GSI - Lowest\ GSI}{Lowest\ GSI} \times 100 \quad (5)$$

The GSR for maize in the various markets was calculated in order to understand the prevailing opportunities in time for farmers and traders involved in maize marketing. They do not represent profits since they are not adjusted for storage costs. A higher value of GSR will indicate that the return to storage of maize is higher in the market.

Estimating Volatility

Coefficient of variation, computed as the ratio of the standard deviation to the mean, was used in the estimation of price volatility. In addition, estimating a GARCH models was used to analyze the dynamics of volatility in the maize markets.

In order to compute the extent of price volatility, the generalized autoregressive conditional heteroscedasticity (GARCH) model was fitted. Before fitting the GARCH model, autoregressive integrated moving average (ARIMA) filtration was done to identify the best fit ARCH term and then GARCH model was fitted (Bollerslev, 1986). The representation of the GARCH (*p, q*) is given as:

$$Y_{it} = a_0 + b_1 Y_{it-1} + b_2 Y_{it-2} + e_{it} \quad (6)$$

(autoregressive process)

and the variance of random error is:

$$\sigma_{i,t}^2 = \omega + \sum_{i=1}^{p} \beta_i \sigma_{t-i}^2 + \sum_{i=1}^{q} \alpha_i \varepsilon_{t-1}^2 \quad (7)$$

Where, Y_{it} is the price in the t^{th} period of the i^{th} commodity, p is the order of the GARCH term and q is the order of the ARCH term. The sum of $\alpha_i+\beta_i$ gives the degree of persistence of volatility in the series. The closer is the sum to 1, the greater is the tendency of volatility to persist for a longer time. If the sum exceeds 1, it is indicative of an explosive series with a tendency to meander away from the mean value.

Time series data analysis approaches require that the economic variables must be non stationary. The unit root test separates and tests for order of economic integration i.e. the number of times the series needs to be differenced before transforming it into a stationary series. The finding of a unit root in time series data indicates non-stationarity. The Augmented Dick-Fuller (ADF) was used to test for stationarity. According to Dickey and Fuller (1979), the test is based on the statistics obtained from applying the Ordinary Least Squares (OLS) method to following regression equation:

$$\Delta P_{i,t} = \delta_0 + \delta_1 P_{i,t-1} + \sum_{h=1}^{m} \phi_h \Delta P_{i,t-h} + \vartheta_t \qquad (8)$$

Where ϑ for t=1,……,n is assumed to be Gaussian white noise, Δ is the difference operator; m is the number of lags; and δ's and ϕ's are parameters to be estimated. The null hypothesis is that cointegration coefficient, $\delta_1=0$, that is, there is a unit root in P_i (P_i is non-stationary) (Dickey and Fuller, 1979; Fuller, 1976). If the unit-root null is rejected for the first difference of the series but cannot be rejected for the level, then we say that the series contains one unit root and is integrated of order one, I(1).The number of lagged terms m is chosen to ensure the errors are uncorrelated. Akaike information criterion (AIC) was used choose the number of lag terms.

Results and Discussion

Descriptive Statistics

The time series price data was recorded in Mozambiqan Meticais per kilogram (MzM/Kg). During the ten year period the average nominal maize price was 6.76 MzM/Kg (Table 1). As expected, the mean prices were highest in the southern region and lowest in the northern region. The mean maize price was highest in Maputo at 9.12MZM/Kg and lowest in Cuamba at 5.51MZM/Kg. The standard deviations were highest in the central region while the north recorded the lowest. This implies that price fluctuations were highest in the markets in central Mozambique.

Maputo is the largest city in Mozambique and a major consumption area. Maize is the preferred crop in the southern region and being a low production area, the deficit may have caused the prices to be higher than for the other markets. The northern and southern regions are surplus areas thus the prices are lower. Maize from the central region (especially from Zambezia and Tete provinces) is usually exported to neighbouring Malawi and often imports occur during periods of shortages. This may have caused high variations in prices for the markets in the region. Tostão and Brorsen (2005) found that markets in the north were isolated from the other markets. Less integrated markets are expected to have lower price variations since prices in such markets are not influenced by prices in other areas. This may explain the low standard deviations observed for the markets in the north.

Price Trends

The seasonal patterns of maize for different markets in the three production regions are reported in figure 1. The figure indicates quite similar price patterns across all the markets in the three regions. There are price swings during the period under consideration with 2005 and 2008 having the highest peaks. The prices showed signs of stabilization in 2009/10 but began to increase during the first three months of 2013.

The food crisis of 2007 are the main causes of the price spikes in 2008 which persisted until the year 2009. The flooding in the central provinces (along River Zambezi) and a drought in the south further contributed to the price hikes in 2008/9. Since then, price fluctuations have been experienced with another rapid upward trend observed from early 2012 followed by another downward trend in early 2013. The 2004/5 drought especially in the south caused the price hikes during the cropping year. Mozambique has been a net importer of maize and this may have further contributed to the sharp increase in prices in 2005/6.

Seasonality Analysis

The results for GSI are summarised in figure 2(A-C). The 100% line represents the average value of the time series over the period of analysis. The bar graphs indicate by how much each month's seasonal index values lies above or below this overall average. The figures show that the GSI values deviated from 100 which is an indication that seasonality exists. The highest GSI were observed in January, February and March. The GSI start to decline in April and June recorded the lowest GSI for all markets.Thereafter, GSI rises until the end of the year. Monthly price variations are related to harvest period which begins in march and continue upto end of april.

GSI represents seasonal averages for the period under analysis thus showing the monthly fluctuation for the prices. The pronounced and almost similar seasonal variances have implications on incomes and food security. This shows that producers and traders faced enormous risks in production and marketing maize. However, the observed GSI also mean that there are opportunities in time and space for farmers and traders to store maize and benefit from high prices later in the season.

Maize is harvested once a year while demand remains constant throughout. Since maize is a storable commodity it is important to evaluate its feasibility. Gross storage returns considers the seasonality in price changes which sellers can utilise to get better prices for their maize. The feasibility for storage is reported in Table 2.

Gross storage returns are the nominal price margins within a season.Table 2 shows that generally the returns to storage were lowest in the markets in the south and highest in the markets in the north. The average returns to storage per region was 35.13 percent, 66.91 percent and 92.12 percent for south, central and northern regions respectively.The returns to storage was lowest in Maputo at 22 percent while the highest returns were observed for Cuamba at 113 percent.

The results imply that the producers will make highest returns if they stored and sold to the markets in the north during periods of high prices and lower returns if they sold in the south, where seasonal price variability is lower. The observations are consistent with the markets in the north being poorly integrated with the markets in the central/south. The high range in seasonality index means that maize prices in the northern region are not fully transmitted to other markets in times of gluts and shortages.

Testing for Volatility

Unit Root Test

Tables 3 presents the results for testing for unit roots in maize retail price series by the Augmented Dick-Fuller (ADF) test. The number of lags included in the test was selected using the Akaike's information Criterion (AIC). The test for all the maize price levels could not reject the hypothesis of unit roots at 5 percent critical level. When the price series are differenced once, they all become stationary and the null hypothesis of unit roots is rejected. Thus, the maize price series for the markets under consideration are integrated of order one.

4.4.2 Conditional Variance and Volatility Persistence

Conditional variance (CV) based on estimates of the ARCH GARCH model of price volatility shows that the series were excessively peaked as evidenced by excessive kurtosis (figure 3). Excess kurtosis suggests that price distribution in most markets is highly leptokurtic, which implies large price changes follow even larger changes and smaller changes follow smaller changes.

The observed leptokurtic changes indicate ARCH disturbances hence persistent price volatility. All the markets recorded volatility clustering around the years 2005/6 and 2008/9. This is a period during which domestic production dropped. The natural disasters of 2004/5 and the food crisis of 2007-9 caused price shocks hence the observed volatility clustering around that time.

The average maize price volatility in Mozambique as implied by the mean conditional variation show that it varied between 17.2 percent and 26.7 percent. The findings in table 4 suggest that maize prices in Maputo were the most volatile as compared to the other markets as indicated by the high average conditional variance of 28.1 percent. This is followed by Chokwe (26.7%), Nacala (26.4%) and Xaixai (24.5%), while Mutarara had the least volatile maize price with a variation of 17.2 percent.

The persistence of volatility in the maize prices is summarised in table 4. The results show that apart from Xaixai, Chokwe and Nampula, the estimated $\alpha+\beta$ coefficients were closer to 'one' indicating that the volatility in maize price persisted for a long time. Chokwe had the lowest volatility persistence meaning that prices took a shorter time to stabilize. Price volatility in Gorogonza, Cuamba and Lichinga persisted for a longer time than the other markets. On the other hand, Massinga, Manica, Mutarara and Lichinga prices recorded $\alpha+\beta$ coefficients that were greater than one. This is an indication of explosive series meaning that in times of price shocks, prices tend to meander away from the mean value.

The significance of the ARCH and GARCH term indicate that volatility in any given month prices depend on volatility in the preceding month's prices and that the current price variance depends on the past price variances. The coefficients mean that whenever price spikes occur, the process reverts very slowly. This may explain why even after the food price crisis of 2008/9 high prices continued to persist in Mozambique. The high and persistent volatility made the price stabilization programmes during the price shocks to be very costly.

6. Conclusions

The high volatility in food prices has remained a matter of concern to producers, consumers and policy makers. This study evaluated the seasonality and volatility of maize prices in Mozambique retail markets using grand seasonality analysis and ARCH/GARCH models. The study used ten year- monthly retail price data for maize in twelve markets in three production regions of Mozambique.

The analysis indicates that seasonality exists in maize price series. This means that producers and consumers face production and marketing risks. An estimation of gross returns to storage show that there are opportunities which producers and marketers could exploit to increase benefits. Commodity price volatility as implied by conditional variation show that generally markets in the south had the highest volatility while the markets in the central region had the lowest volatility. Conditional variance was highest in Maputo and lowest for Gorogonza. The extent of volatility in maize prices as measured by coefficients of the GARCH model indicates both persistence and explosive volatilities.

The incidences of seasonality in prices and persistence in food price volatility in Mozambique means that long term interventions will be needed to improve local production and distribution. Since production of maize is mainly rainfed, prices are determined by the season and amount of rainfall. Investing in irrigation infrastructure especially in areas prone to drought will reduce inter seasonal variations in production and thereby stabilize prices. There is also a need for the Government to buy surplus at a competitive price to maintain a buffer stock. This should increase availability throughout the year thereby reducing seasonality and food price increases occasioned by shortages. Institutional support especially crop insurance, credit and warehouse receipt system will help producers to cope with risks and reduce postharvest losses. Warehouse receipt system will further improve quality and grading, attract millers and provide an enabling environment for trading through a commodity futures exchange. The government needs to increase the rural population's access to the road networks in order to facilitate marketing of agricultural inputs and outputs, which is essential for stabilizing food prices.

ACKNOWLEDGEMENTS

The authors wish to thank Alliance for Green Revolution in Africa (AGRA) for providing the financial support for data collection.

References

Benson. T,, Kirama, S.L., Selejio,O (2012).The Supply of Inorganic Fertilizers to Smallholder Farmers in Tanzania Evidence for Fertilizer Policy Development (Ifpri working paper)

Bollerslev, T. (1986). Generalized autoregressive conditional heteroscedasticity. *Journal of Econometrics*, 31, 307–327.

Byerlee, D., Jayne, T. S. & R. J. Myers. (2006). Managing food price risks and instability in a liberalizing market environment: Overview and policy options. *Food Policy,* 31 (4): 275–285.

Corzine, N. M. (2008). An Analysis of Import Tariff Escalation: A Case of Maize Trade between South Africa and Mozambique. Unpublished Master Thesis, Department of Agricultural Economics, Michigan State University, East Lansing MI.

Coulter J and Schneider K (2004): Feasibility Study of Post-harvest Project in Mozambique and Tanzania

Cunguara, B. & Hanlon J. (2010). *Poverty is not being reduced in Mozambique*. London: Crisis State Research Centre, London School of Economics and Political Science.

Donovan, C. & Tostão E. (2010). Staple Food Prices in Mozambique. Paper prepared for the COMESA policy seminar on 'Variation in Staple Food Prices: Causes, Consequence, and Policy Options'. Maputo.

FAO. (2007). *Food outlook*. Rome: FAO

Fews Net. (2009). http://www.fews.net/docs/Publications/Mozambique_200604en.pdf

Gilbert, C.L. (2010). How to Understand High Food Prices. *Journal of Agricultural Economics,* 61, 398–425.

Goetz, S & Weber, M (1986). *Fundamentals of price analysis in developing countries: Food systems.* A training manual to accompany the microcomputer software programme MSTAT. Mus International Development working Paper No. 29. East Lansing, MI. U.S.A: Department of Agricultural Economics, Michigan State University.

Hanlon, J. (2010, September 2). 4-11 dead in price rise riots. Mozambique 167 News reports & clippings. Retrieved from http://www.open.ac.uk/technology/mozambique/sites/www.open.ac.uk.technology.mozambique/files/pics/d135476.pdf

Lagi, M, Bertrand, K.Z. & Y. Bar-Yam. (2011). The Food Crises and Political Instability in North Africa and the Middle East. arXiv:1108.2455 .

Rashid, S. (2007). *Food price stabilization policies in a globalizing world*. Case study #6-8 of the program: Food Policy for Developing countries: The role of Government in the global Food System. Ithaca: Cornell University

Tostão, E., Brorsen, B.W. (2005). Spatial price efficiency in Mozambique's post-reform maize markets. *Agricultural Economics*, 33(2), 205—214.

Traub, L.N., Myers, R.J., Jayne, T.S. & Meyer, F.H. (2010). Measuring Integration and Efficiency in Maize Grain Markets: The Case of South Africa and Mozambique, Paper No 96644, AAAE Third Conference/AEASA 48th Conference, September 19-23, 2010. Cape Town: South Africa.

Trotter, B.W. (1992). *Applying Price Analysis to Market System.* Methods and Examples from the Indonesian Rice Market: Marketing series. Chatman: Natural Resource Institute.

Tschirley, D.L. & Abdula, D.C. (2007). Toward Improved Marketing and Trade Policies to Promote Household Food Security in Central and Southern Mozambique: 2007 Update", Michigan State University, Department of Agricultural, Food, and Re-source Economics in its series Food Security Collaborative Working Papers with number 56068.

WFP/FAO. (2010). *FAO/WFP Crop and Food Security Assessment Mission to Mozambique*

World Bank. (2008). "Promoting Shared Growth through Empowerment of Citizens and Institutions: Mozambique Country Partnership Strategy 2008-2011." Maputo: World Bank: 1-12.

European Journal of Business and Management
ISSN 2222-1905 (Paper) ISSN 2222-2839 (Online)
Vol.6, No.22, 2014

Table 1: Descriptive statistics for monthly retail prices in MzM/Kg

Region	Market	Minimum	Maximum	Mean	Std. Dev
South	Maputo	4.08	13.45	9.12	3.25
	Xaixai	3.32	13.64	7.33	2.99
	Chokwe	3.23	15.53	7.59	2.84
	Massinga	3.64	18.18	7.84	3.42
	Average	**3.57**	**15.2**	**7.97**	**3.13**
Central	Gorongoza	1.99	15.58	5.98	3.32
	Manica	1.99	16.57	6.33	3.23
	Tete	2.38	15.85	6.51	3.19
	Mutarara	1.14	19.68	6.38	3.71
	Average	**1.88**	**16.92**	**6.3**	**3.36**
North	Nampula	2.57	13.26	6.49	2.68
	Cuamba	1.8	14.29	5.51	2.87
	Lichinga	2.29	18.63	5.57	2.75
	Nacala	2.54	12.07	6.43	2.44
	Average	**2.3**	**14.56**	**6**	**2.68**
All		**2.58**	**15.56**	**6.76**	**3.06**

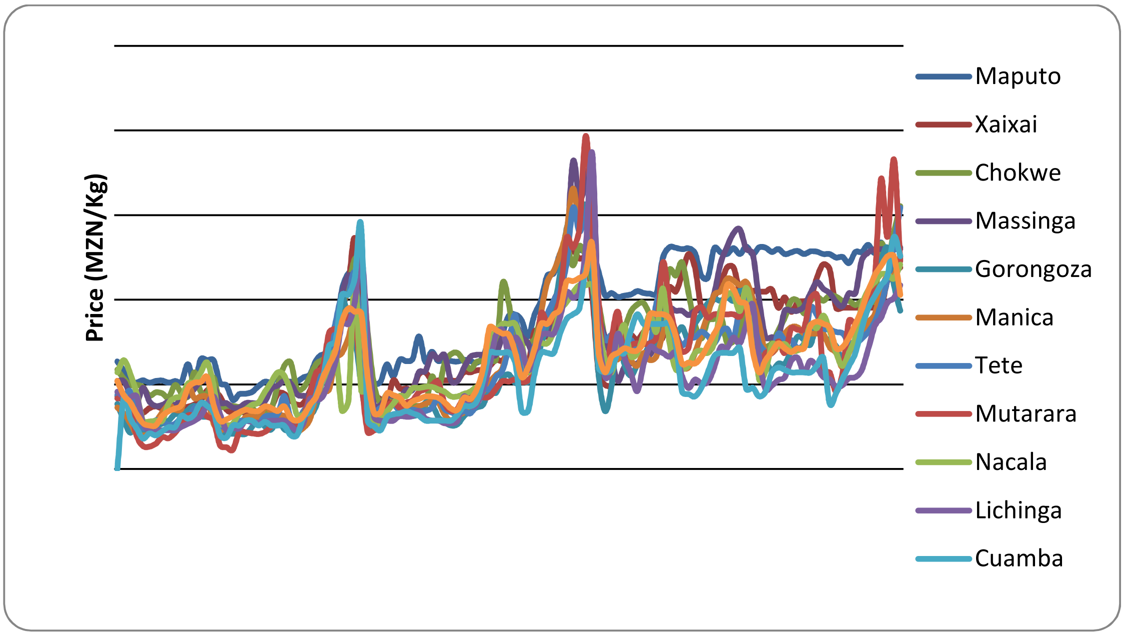

Figure 1: Maize retail price trends (2003-2013)

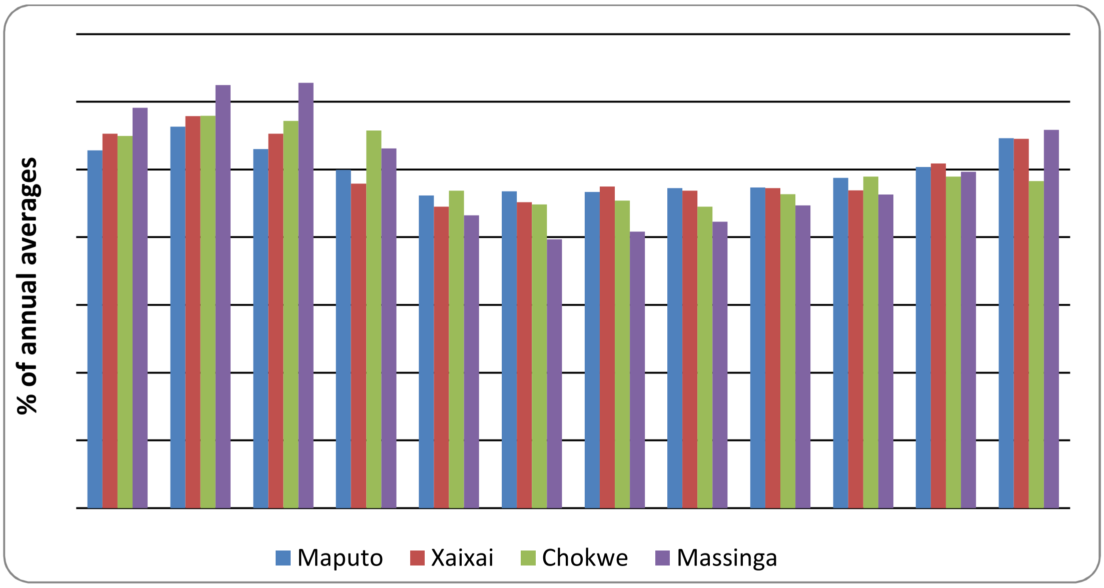

Figure 2A: GSI for maize prices in the southern region (2003-2013)

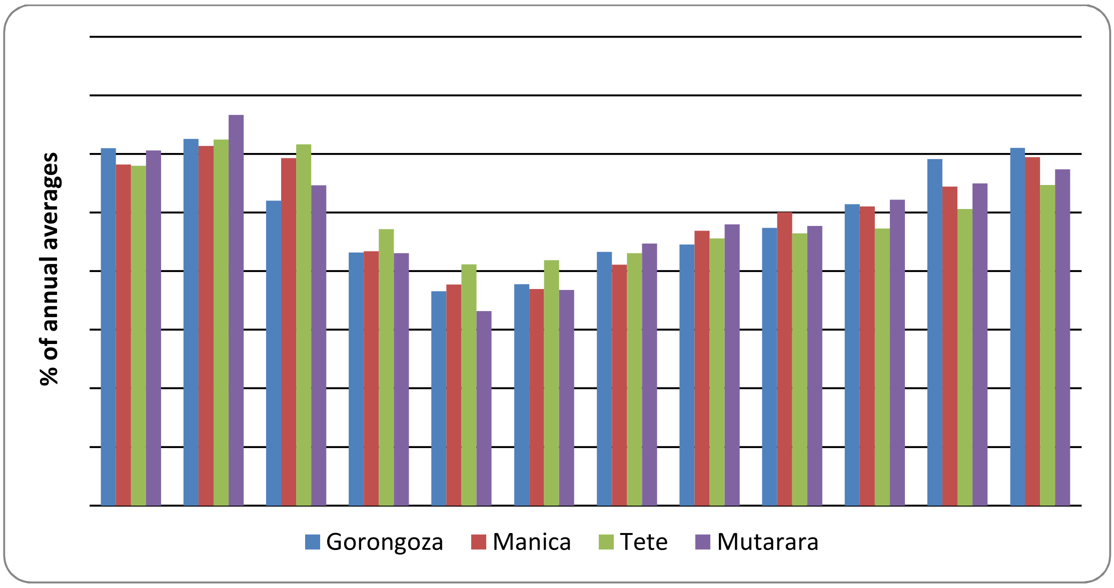

Figure 2B: GSI for maize prices in the central region (2003-2013)

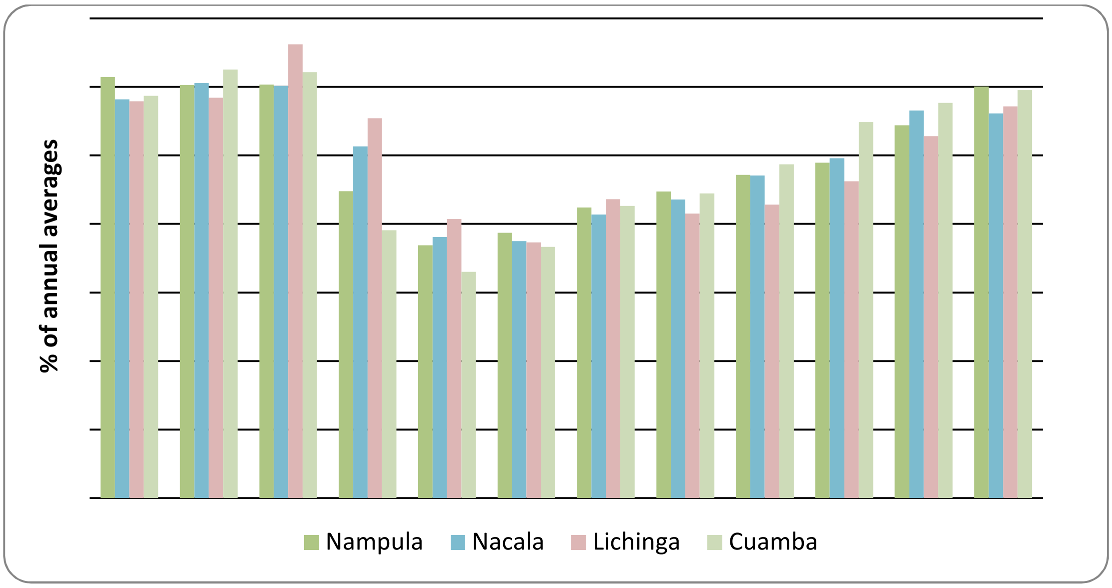

Figure 2C: GSI for maize prices in the northern region (2003-2013)

Table 2. Estimated Gross Storage Returns (GSR) for maize markets

Market	Highest GSI	Lowest GSI	GSR (%)
Maputo	112.64(Feb)	92.28(May)	22.06
Xaixai	115.75(Feb)	88.99(May)	30.07
Chokwe	115.88(Feb)	89.04(Aug)	30.14
Massinga	125.58(Mar)	79.35(Jun)	58.26
Gorongoza	125.19(Feb)	73.12(May)	71.21
Manica	122.79(Feb)	73.95(Jun)	66.04
Tete	124.94(Feb)	83.74(Jun)	49.20
Mutarara	133.37(Feb)	73.61(Jun)	81.18
Nampula	122.87(Jan)	73.76(May)	66.58
Nacala	158.42(Feb)	74.96(Jun)	111.36
Lichinga	132.41(Mar)	74.60(Jun)	77.49
Cuamba	121.70(Feb)	57.12(May)	113.06

Table 3: Unit root test

Region	Market	ADF test		Order of integration
		Level	First difference	
South	Maputo	-1.459	-6.53	I(1)
	Xaixai	-2.595	-7.504	I(1)
	Chokwe	-2.039	-7.671	I(1)
	Massinga	-2.613	-6.48	I(1)
Central	Gorongoza	-3.373	-6.905	I(1)
	Manica	-2.312	-6.894	I(1)
	Tete	-1.851	-7.384	I(1)
	Mutarara	-2.228	-7.486	I(1)
North	Nampula	-2.821	-7.142	I(1)
	Cuamba	-2.578	-8.174	I(1)
	Lichinga	-3.241	-9.86	I(1)
	Nacala	-2.355	-8.247	I(1)
Critical Values 1%=-3.503, 5%=-2.889, 10%=-2.579				

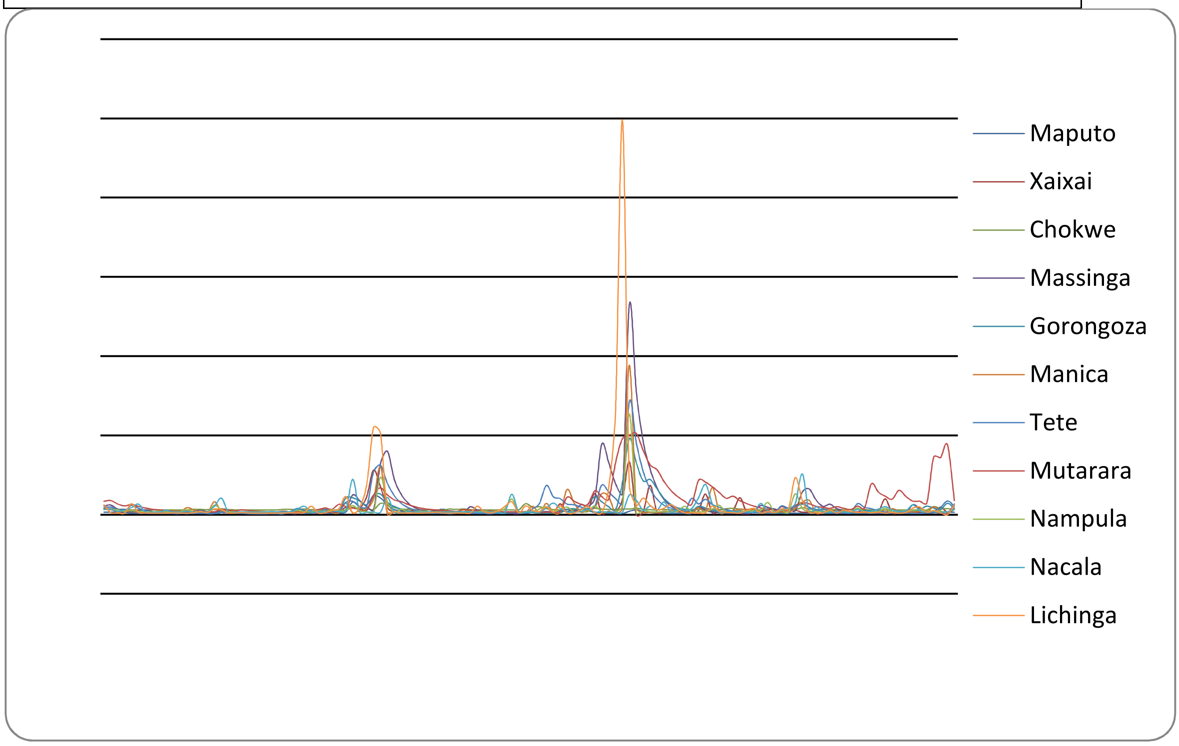

Figure 3:Conditional variation for maize price series (2003-2013)

Table 4. Estimation of ARCH/GARCH model for measuring volatility in maize prices during 2003-2013

	CV	Constant		Estimates of ARCH-term		estimates of GARCH- term		α+β
Maputo	2.81	0.14	(0.04)*	0.334	(0.1)*	0.47	(0.14)*	0.804
Xaixai	2.45	0.69	(0.07)*	0.58	(0.16)*	0.07	(0.04)***	0.51
Chokwe	2.67	0.77	(-0.71)	0.08	(0.09)	0.34	(0.56)	0.42
Massinga	2.29	0.07	(0.03)**	0.63	(0.17)*	0.55	(0.07)*	1.18
Gorongoza	1.8	0.11	(0.03)*	0.42	(0.14)*	0.58	(0.07)*	1
Manica	1.96	0.22	(0.08)*	0.77	(0.24)*	0.26	(0.13)**	1.04
Tete	2.04	0.06	(0.03)**	0.058	(0.16)*	0.59	(0.05)*	0.648
Mutarara	1.72	0.15	(0.04)*	0.34	(0.10)*	0.71	(0.05)*	1.05
Nampula	2.43	0.72	(0.11)*	0.59	(0.13)*	-0.04	(0.11)	0.55
Cuamba	1.92	0.08	(0.02)*	-0.1	(0.01)*	1.04	(0.003)*	0.94
Lichinga	2.02	0.40	(0.17)**	0.89	(0.23)*	0.20	(0.08)*	1.09
Nacala	2.64	0.70	(0.10)*	0.63	(0.20)*	0.07	(0.03)**	0.70

***1% significance, **5% significance, *10% significance