Explaining Rice Price Shocks in Nigeria: Implications for Policy Intervention

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Abstract

At the microeconomic level, in predominantly agrarian society of Nigeria where majority of the farmers are poor and unable to obtain insurance, price and production shocks would have adverse impact on growth and development. Particularly, there is a growing concern that current levels of rice production will not meet future demand. The general objective of the paper is to examine the key factors influencing rice price variability, and how to address these effects in policy terms. Time series data of price which cover the period of 1990-2004 from the National Bureau of Statistics were used. Coefficient of variation was used in the analysis of variability. The time varying conditional variances were estimated by using a Generalized Autoregressive Conditional Heteroscedasticity model. Coefficient of variation (CV) for rice was calculated as 40.92%. This value shows that the price of rice fluctuates at important level in the period of 1990-2004. There were price shocks because both the supply of and demand for rice vary widely over time in addition to the effect of some variables, which are not under control of both producers and suppliers. Gross income equals to the value that yield of a product is multiplied by its price. Therefore, a fluctuation in either yield or price affects gross income of farmers. A GARCH based measure indicates considerable time variability. The study suggests policy measures to support research, provide storage and processing technologies.

Key words: Rice, price shocks, Coefficient of variation, GARCH, Policy intervention.

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Introduction

Volatility has been one of the most active and successful areas of research in agricultural commodities in the context of the policies to improve governance and reduce price fluctuations affecting developing countries like Nigeria. At the microeconomic level, in predominantly agrarian society of Nigeria where majority of the farmers are poor and unable to obtain insurance, price and production shocks would have adverse impact on growth and development. Generally, price variability that cannot be managed with existing risk management tools can destabilize farm income, inhibit producers from making
investments or using resources optimally, and eventually drive resources away from agriculture. Moreover, because demand and supply of farm products, particularly basic grains, are relatively price-inelastic and because weather can produce large fluctuations in farm production, potentially large swings in farm prices and incomes have long been characteristics of the sector and a farm policy concern. In such circumstances, farmers are inclined either to scale back their investment and innovation owing to their apprehension about using riskier techniques or, even in a period of price drops, to suffer setback in their standard of living. They do not possess the requisite know-how for crop diversification and also lack access to appropriate technology. Commodity price volatility poses problems also for the governments and exporters of primary commodity-producing developing countries. For governments, unforeseen variations in export prices can complicate budgetary planning and jeopardize attainment of the debt reduction targets. For exporters, price volatility increases cash-flow variability and reduces collateral value of inventories. Both factors result in increasing borrowing costs. Moreover, smallholder farmers, often with poor access to efficient saving instruments, cope with revenue variability through crop diversification with the consequence that they largely forego the potential benefits obtainable through specialization (International Task Force on Commodity Risk Management in Developing Countries, 1999).

In spite of the aforementioned problems there is considerable evidence that nominal prices of agricultural commodities exhibit much more variability than those of non-agricultural commodities. Rausser et al., (1986) and Frankel (1986) interpret this evidence as a rejection of the ‘new classical paradigm’ and suggest modeling macroeconomic impacts in a flex-price versus fix-price framework. In sub-Saharan Africa generally, seasonal price rise between 25 and 85 percent in the several weeks following the harvest are the norm (Sahn and Delgado, 1989). Traditionally, volatility in agricultural prices has been attributed to the following: a) low price and income elasticities of agricultural products; b) inherently unstable agricultural production as a result of unforeseeable and unpreventable exogenous shocks like weather; and c) the very different nature of agricultural planning process where production decisions for most farm products are made much in advance of the time the product is marketed (Starleaf, 1982).

Be that as it may, the importance of rice as a staple crop in Nigeria is getting clearer as it is displacing other traditional staples, such as cassava, yam and plantains, which are bulkier and more perishable. Because of its convenience, rice has found sizable markets in the cities and peri-urban Nigeria. Other dietary virtues of rice include rich vitamins and minerals, low level of fat and salt, and free of cholesterol. Clearly, the degree of food grain price variability is important in a country like Nigeria, where grains comprise a large share of national consumption, and where a significant share of the population is vulnerable to adverse food supply shocks and poverty. Therefore, the government has to balance the twin objectives of expanding
output through the provision of remunerative prices to the producers and protecting the interests of consumers by making sure that prices remain within certain limits. In this study, we examine the fluctuations in annual and monthly prices of rice. The paper sets to contribute to a better understanding of the key factors influencing rice price variability, and how to address these effects in policy terms. Section two of the paper presents the methodological framework for the study; section three shows and discusses the results while sections four concludes the paper.

2. Methodology

2.1. Data

The annual rice prices from 1999 to 2010 were collected from the National Bureau of Statistics, Abuja. The data were collected as part of the National Integrated Survey of Households (NISH). The NISH is an ongoing programme of household surveys enquiring into various aspects of households and agriculture. In order to provide information on the intra-year price variability and because of the difficulty of getting high frequency data on rice at the national level, the monthly domestic data were collected from the office of one of the major producers of rice in the country, Oyo State Agricultural Development Programme (ADP).

2.2. Analytical method

The analytical framework follows Massell (1969) who opines that society benefits by stabilizing prices of storable commodities through stock policy provided the storage costs are not excessively high. This model is an interesting amalgamation of the earlier Waugh (1944) and Oi (1961) models. In this model there are both gainers and losers, although the society as a whole is a gainer. However, one group of the society gains more from stability than what the other group loses. Therefore, through some form of compensation, everyone can gain from a stabilization policy. This is analysed further, first by examining the major courses and consequences of rice price variations. Coefficient of variation (CV) was employed as a measure of shocks, defined as the ratio of mean over standard deviation. Coefficient of variation is calculated using the following formula:

\[ CV = \frac{S}{Y} * 100 \]  

where CV is coefficient of variation, S is standard deviation of the series and \( \bar{Y} \) is the mean of the series. Further, in the literature on volatility, the measure commonly used for price instability is inter-year variability. However, as the prices used in calculating this measure are the annual averages, they tend to conceal short-run fluctuations in prices. For this reason, this study employs both intra-year and inter-year variability measures to analyze domestic markets of rice. Here, variability of the series was calculated by measuring the standard deviation of \( \log (P^t / P^{t-1}) \) over a period, where \( P^t \) is price in period ‘t’ and \( P^{t-1} \) is the price in period \( t-1 \). This is, in other words, the standard deviation of the growth rates (ratio method).

Intra-year variability was calculated as the standard deviation of the 12 monthly growth rates in the year. However, inter-year variability the
method of calculating it is slightly different. The process follows first, the estimation of the annual average prices as a simple average of the 12 monthly prices, then the growth rates of annual prices are calculated as \( \log \left( \frac{P^t}{P^{t-1}} \right) \). Apart from these, time varying conditional variances was estimated by using a Generalised Autoregressive Conditional Heteroscedasticity (GARCH) model (Bollerslev, 1986). The use of GARCH models in the context of commodity goods analysis has increased considerably over the past ten years. Yang and Broersen (1992) use GARCH analysis in addressing nonlinearities in the daily cash prices of seven different agricultural commodity prices, Holt (1993) adopted a GARCH in Mean model to infer relative risk premia in U.S. beef margins, McKenzie and Holt (1998) used both GARCH and ARCH in mean models to examine market efficiency in agricultural futures prices, while Weaver and Natcher (2000) using a univariate GARCH model analyze the effect of changes in US market conditions precipitated by changes in US farm programmes on the volatility of agricultural prices. Following Weaver and Natcher (2000) a GARCH(1,1) model used is given by:

\[
Y_i = a_0 + b_1 Y_{i-1} + b_2 Y_{i-2} + \varepsilon_i; \quad t = 1, 2, ..., T \tag{2}
\]

\[
\sigma_i^2 = \alpha \varepsilon_i^2 + \beta \sigma_{i-1}^2 \tag{3}
\]

where \( Y_{it} \) is the price index in time \( t \) of commodity \( i \). \( \sigma_i^2 \) denotes the variance of \( \varepsilon_i \) conditional upon information up to period \( t-1 \). The fitted values of \( \sigma_i^2 \) give the measure of uncertainty of \( Y_{it} \). The sum of \( \alpha_i \) and \( \beta_i \) gives the degree of persistence of volatility in the series. The closer the sum to 1, the greater is the tendency of volatility to persist for longer time. If the sum exceeds 1, it is indicative of an explosive series with a tendency to meander away from mean value. The GARCH estimates have been used to identify periods of high volatility.

3. Results and discussion

3.1. Patterns in monthly agricultural price variability

The examination of price behaviour based on monthly data could be very illuminating in analyzing intra-year variations. One way of analyzing variability in monthly prices is by examining the extent of divergences between the highest and the lowest price. Here we are interested in two things (1) to correctly identify the timing of a season's high and low harvest; and (2) to estimate the magnitude of the difference between the high and low price. A result of the analysis of the extent of divergence of the lowest price from the highest price of rice is presented in Table 1. It is evident from Table 1 that the average difference between the lowest price and the highest price of rice is high during the 1990s period. The average deviation for the 1990s was about 31.5 percent compared to the deviation of 19.6 percent during the 2000 period. This could be explained in part by the growth in research and introduction of stress resistant and high yielding varieties as well as better storage methods of rice in Nigeria. Analysis of the lowest price month and the highest price month reveals that high price occurred in July and August 40 percent of the time while high price occurred in September and October about 26.7 percent of the time. Other months with high prices were November and January. Rice often has the lowest price in February. Other months include May, June and March which shares 20 percent of the proportion. This is to say that timing is important for speculative purposes, whereas magnitude is often more important for hedging purposes.
3.2. Seasonality and causes

Attempt was made to assess another price volatility factor, the seasonality. This is the phenomenon that may cause crop prices to behave in a rather predictable manner. To a large extent this could result in (1) the "harvest lows", followed by (2) the "post-harvest rally". Sometimes seasonality plays a strong element in the pattern of crop export and domestic consumption.

Given the fact that the dominant (but not the only) factor driving seasonality is the "on-off" nature of crop harvests, expectedly, the sudden increase in supply during the harvest provides the most dramatic evidence of seasonality – the harvest lows. A corollary to the "harvest lows" is the "post-harvest rally." This supply will be subsequently reduced by the inevitable huge domestic consumption. Unexpectedly, unlike many crops, the study reveals that rice has not shown marked steep seasonal increase in price with alarming frequency, climbing from harvest time and peaking in the “lean” season. Estimated inter–year coefficient of variation was 0.353. However, on the analysis of the intra-year variability the results of the coefficient of variation show that there was high price variability in the 1990s and suddenly dropped in the early 2000s.

Estimates for the variability of the series calculated as the standard deviation of the log (P / Pτ) shows a very low variability as 0.1. This is in consonance with the earlier results on intra–year variability.

Table 1: Yearly deviation of the lowest price from the highest in percentage of coefficient of variation from 1990s to 2000s

<table>
<thead>
<tr>
<th>Year</th>
<th>Deviation of the Lowest Price from the Highest</th>
<th>CV (%)</th>
<th>Month (Lowest)</th>
<th>Month (Highest)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1990-91</td>
<td>31.04</td>
<td>0.0356</td>
<td>June</td>
<td>August</td>
</tr>
<tr>
<td>1991-92</td>
<td>28.54</td>
<td>0.1385</td>
<td>February</td>
<td>July</td>
</tr>
<tr>
<td>1992-93</td>
<td>39.84</td>
<td>0.1574</td>
<td>January</td>
<td>October</td>
</tr>
<tr>
<td>1993-94</td>
<td>27.39</td>
<td>0.0972</td>
<td>March</td>
<td>June</td>
</tr>
<tr>
<td>1994-95</td>
<td>35.20</td>
<td>0.192</td>
<td>February</td>
<td>August</td>
</tr>
<tr>
<td>1995-96</td>
<td>33.61</td>
<td>0.1322</td>
<td>February</td>
<td>September</td>
</tr>
<tr>
<td>1996-97</td>
<td>28.77</td>
<td>0.0996</td>
<td>February</td>
<td>July</td>
</tr>
<tr>
<td>1997-98</td>
<td>15.20</td>
<td>0.035</td>
<td>January</td>
<td>June</td>
</tr>
<tr>
<td>1998-99</td>
<td>43.63</td>
<td>0.1413</td>
<td>March</td>
<td>August</td>
</tr>
<tr>
<td>1999-00</td>
<td>8.56</td>
<td>0.0287</td>
<td>February</td>
<td>November</td>
</tr>
<tr>
<td>2000-01</td>
<td>9.2</td>
<td>0.0227</td>
<td>May</td>
<td>January</td>
</tr>
<tr>
<td>2001-02</td>
<td>16.17</td>
<td>0.05</td>
<td>March</td>
<td>January</td>
</tr>
<tr>
<td>2002-03</td>
<td>30.82</td>
<td>0.0567</td>
<td>February</td>
<td>October</td>
</tr>
<tr>
<td>2003-04</td>
<td>22.16</td>
<td>0.08</td>
<td>February</td>
<td>October</td>
</tr>
<tr>
<td>Average</td>
<td>31.469</td>
<td></td>
<td>St dev</td>
<td>CV</td>
</tr>
<tr>
<td>1990s</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2000s</td>
<td>17.382</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Whole period</td>
<td>26.436</td>
<td>2.89</td>
<td>10.82</td>
<td>40.92</td>
</tr>
</tbody>
</table>

The fitted GARCH (1,1) result in Table 2 shows there is no evidence of marked behaviour in volatility patterns in prices (ARCH coefficient < 1). This is probably the result of recent massive importation of rice into the country which is responsible for dampening the price volatility.

Table 2: Maximum likelihood parameter estimates of the univariate GARCH models

<table>
<thead>
<tr>
<th>Coefficient</th>
<th>Std error</th>
<th>z-Statistic</th>
<th>Pto</th>
</tr>
</thead>
<tbody>
<tr>
<td>0.0026628</td>
<td>0.000516</td>
<td>5.16</td>
<td>000</td>
</tr>
</tbody>
</table>

Log likelihood -9.021578

4. Conclusion

Stabilization of prices of essential agricultural commodities continues to remain an area of major concern for policy makers. So, the major role of agricultural policy is to identify policy changes that may induce technological innovation and productivity growth throughout the food system in order to increase the living standards of the farmers. This is important because high growth in the prices of rice may spill over to other sectors of the economy leading to an increase in the overall rate of inflation. These concerns about commodity price fluctuations have led to pervasive commodity policy interventions by national governments.

There is thus a need to study the price behaviour of essential agricultural commodities and the reasons that underlie the large variations in their prices in order to devise improvements in the system. The current study analyses the behaviour of the rice prices over some years. Results indicate that
there is fairly stability in the price of rice but instability in domestic rice prices can occur due to fluctuations in local rice markets and a large shortfall in domestic production. Perhaps the most likely problem is a shortfall in production. Policy efforts of Nigerian Government along this line should be mainly to insulate local producers and consumers against vagaries of price volatility. This could be through establishment of powerful institutional arrangements for price stabilization programs. This may include strengthening of its current physical buffer stock schemes, through the current integrated strategic grain reserve programme. Provision of stabilization funds will also be an additional complementary effort. In the case of supply shortfall, price stability may be ensured by allowing more people and private firms to go into the production of rice. What is more, stabilization for consumers in the face of shocks to domestic production is maximized by the implementation of incentive packages.

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