

# RELATIVE PRICE VARIABILITY OF GRAINS AND INFLATION RATE MOVEMENT IN NIGERIA.

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## ABSTRACT

The study estimated the functional relationship between relative price variability of grains and inflation rate in Nigeria. The study also estimated price instability indices for major grains and also investigated the impact of government stability and instability on relative price variability of grains in Nigeria. Data were obtained from various publications of Central Bank of Nigeria which covered the period, 1970 to 2007. Ordinary Least Squares method was used to estimate the coefficients of the specified equation. Empirical results reveal that inflation has a positive significant effect on relative price variability of grains. The result further showed that major grain crops in Nigeria have high producer price instability indices. Furthermore, the civilian regimes which were a proxy of government stability brought about a negative significant shift in the coefficient of inflation which implies a reduction in the relative price variability. Hence the civilian regime policies targeted at the grain sub-sector were upheld as these will improve the sub-sector performance.

**KEY WORD:** Relative price variability, Inflation, Grains, Instability, Fluctuation

## INTRODUCTION

Output of grain sub-sector plays an important role in economic development of Nigeria. Grains or cereals constitute a large proportion of staple food stuff in Nigeria (Akande, 1999). In 1985 and 1995, grains accounted for almost 50% of the total food supply in Nigeria expressed in grain equivalent (Olayemi, 1998). The most important grain crops grown in Nigeria are maize, rice, sorghum, millet and wheat (Wudiri, 1992; Oguntude 1989). Of these, rice, maize, millet and sorghum constitute the major sources of energy in staple food available and affordable in Nigeria (Maziya-Dixon et al, 2004). This implies that many Nigerians are dependent on grains for their daily dietary need. Price of

grains is one of the factors that determine the extent to which Nigerians can afford these food commodities. The nominal or producer price of individual grain has continuously fluctuated over the past years (CBN, 2000; Okunneye, 2003 and Ukoha, 2005). The Nigerian government realizing the importance of grain sub-sector had on several times intervened in stabilizing grain prices through policy reformation (Garba, 2000). Some of the instruments include: input subsidies, ban on importation of maize in 1985, strategic grains reserve scheme of 1976 and the liberalization of the economy in 1986. Despite these lofty attempts, the producer prices of grains continue to fluctuate as can be demonstrated in table 1 below.

**Table 1: MAJOR GRAIN CROP PRICES AND INFLATION FLUCTUATION IN NIGERIA**

YEAR	RICE		MAIZE		MILLET		SORGHUM		Inflation rate Mean (%)
	Mean price (₦)/ton	CV(%)							
1970-1974	301.4	17.12	157.4	14.79	140.0	39.56	148.4	17.27	10.36
1975-1979	604.0	20.12	375.8	28.57	141.0	19.32	274.6	12.24	19.78
1980-1985	1423.7	38.85	788.0	21.22	622.7	35.36	582.3	32.80	17.80
1986-1993	7483.1	67.97	2938.3	69.39	2759.6	83.97	2689.9	70.64	27.13
1994-1999	39789.8	24.53	20113.8	37.89	19201.0	35.99	18562.0	33.23	30.70
2000-2005	46802.6	38.94	26255.0	26.74	32750.7	50.33	23437.0	45.20	12.79
Agg. cv (%)		134.03		138.99		159.13		148.24	

Source: computed by the researcher, data from CBN annual reports of various issue (1987-2006). Where CV = coefficient of variability.

It is obvious from the above table that the major grain crops in Nigeria show a wide dispersion of producer prices across the specified years. Many factors are believed to cause nominal price dispersion of grains in Nigeria. These factors include government instability, low level of innovation in the sub-sector, changes in aggregate investment, savings and inflation (Idachaba 2002; Okunneye 2003 and Udoh et al 2007). Among all these factors that trigger producer price dispersion, "inflation" appears to be most severe considering its negative effect on producer price and its multiplier effect on the entire economy (Nath, 2003). The monetary and fiscal cost of adjustment including the risk associated with such relationship is enormous (Ukoha, 2005).

Relative price variability is a proxy of the variance across a set of commodities of the rate of change of individual nominal price (Lapp and Smith 1992). It reflects the real cost of inflation in relation to its effect on grain price changes. Real cost of inflation occurs due to changes in relative prices that result from differential transmission of inflation across particular commodities. Therefore, variation in the nominal price of grain crops in Nigeria is more reflected in the relative price variability of grains.

Therefore, if inflation should relate to relative price variability, such relationship may reduce economic welfare of the producers and consumers of grain crops in Nigeria. Production activities in the sub-sector may be retarded due to producer price uncertainty and production risk. Resource use efficiency will decrease because farmers would have less useful information on prices to guide them in production decision. Farmers may suffer loss of nominal or real income to inflation, a situation that could be averted in an economy with zero relationship between relative price variability and inflation rate movement. However, total elimination of price dispersion among grains is not a rational policy for the government, as price differential among production resources and output is a panacea for effective resource allocation, enterprise combination, technology transfer, demand and supply determinants and overall efficiency of resource use (Udoh et al, 2007 and Ukoha, 2005).

Now the pertinent question is; does relative price variability of grains in Nigeria actually vary with inflation rate changes? In an attempt to answer this question, the study specifically focused on the determination of the nature of association between inflation and relative price variability of grains in Nigeria. In addition, the study will estimate the price instability indices for four major grain crops (rice, maize, sorghum and millet) in the country. Based on the nature of

relationship between inflation and relative price variability, appropriate policy implications would be highlighted to cope with the anticipated problems arising from the relationship.

**Theoretical Framework and Literature Review**

The study adopts menu-cost model. The menu-cost model was proposed by Sheshinski and Weiss (1977). The model postulates that, there is a lump sum cost of changing prices and that firms follow one-sided (S, s) pricing rule when faced with inflation. Firms will adjust prices once the real price implied by the level of inflation, falls below a theoretical threshold, 's'. And if the real price increases, firms will wait until the real price of their commodities increases more than the upper bound 'S'. The dispersion of the critical interval (s, S) across different products and the unsynchronized price setting behaviour creates relative price dispersion. And as inflation is expected to increase, the optimal interval (s, S) widens leading to a greater dispersion of prices simultaneously. Ukoha (2005) and Udoh et al (2007) use the model to study relationship between inflation and relative price variability in Nigeria. The link between inflation and relative price variability is found in the framework of supply and demand. Lucas (1973) type of supply model assumes that quantity supplied,  $q_t$  in an industry of commodity  $i$  in period  $t$  consists of trend output  $q_{it}^n$  and cyclical output  $q_{it}^c$ . That is,

$$q_{it} = q_{it}^n + q_{it}^c \dots \dots \dots (1)$$

The cyclical component of output is further divided into the lagged value of the cyclical component of output  $q_{it-1}^c$ , plus a relative price effect, which is proportional to the deviation from the mean price level  $P_t$  of the relative price  $P_{it}$ , which firms in the industry receive. Hence the supply equation becomes.

$$q_{it} = q_{it}^n + \rho q_{it-1}^c + \beta(P_{it} - P_t) \dots \dots (2)$$

Note that all variables are expressed in logarithm but for simplicity we use arithmetic form. Also  $\rho < 1$  and  $\beta$  are constant parameters ( $\beta$  is price elasticity of supply),  $P_t$  is the mean price level in period  $t$  and  $P_{it}$  is the price of output  $i$ . On the other hand, demand is a function of relative prices and income (Jaramillo, 1990). Hence our demand equation becomes

$$q_{it} = \alpha(P_{it} - P_t) + \delta M_{it} \dots \dots \dots (3)$$

Where  $M$  is income,  $\delta$  is the income elasticity of demand for good  $i$ , and  $\alpha$  is the price elasticity of demand for the same good. Equating demand to supply and rearranging terms, an expression for the commodity-specific rate of price change is given by:

$$P_{it} = (\beta - \alpha)^{-1} [\delta M_{it} - q_{it}^n - \rho q_{it-1}^c] + P_t \dots \dots (4)$$

$$P_{it} - P_{it-1} = (\beta - \alpha)^{-1} [\delta (M_{it} - M_{it-1}) - (q_{it}^n - q_{it-1}^n)] - \rho [q_{it-1}^c - q_{it-2}^c] + \rho [P_t - P_{t-1}] \dots \dots (5)$$

In this framework, commodity inflation rates are a result of demand shocks and the anticipated aggregate inflation rate transmitted through sector-specific elasticity. Aggregate demand shock has an effect in each market that is identical for positive or negative changes in income. Consequently, an increase in demand has the same aggregate effect on inflation and relative price variability as an equivalent variation of opposite sign. Using this framework, we analyzed the change in relative agricultural prices due to inflation and government instability. Many researchers have established a positive relationship between inflation and

relative price variability of various commodities. Lapp and Smith (1992) in United States, Lach and Tsiddon (1992) in Israel, Zanas (1997) in Greece, Loy and Weaver (1998) in Russia, Ukoha (2005) and Udoh et al (2007) in Nigeria. Reinsdorf (1994) found a negative relationship between inflation and relative price variability in the United States of America.

**Measuring relative price variability**

Relative price variability is the change in the relative prices, and is used as an indicator of the real costs of inflation in relation to its effect on commodity

price changes (Loy and Weaver, 1998). It is measured by constructing an index to show changes over time in relative prices among a commodity group. The nominal rate of price change consists of two aggregate components, inflation and a relative price component (Lapp and Smith, 1992).

$$P_{i,t} = P_t^* + Z_{i,t} \dots\dots\dots (6)$$

Where  $P_{i,t}$  = Nominal price of ith commodity in period t,  $P_t^*$  = Producer price index (PPI) in period t,  $Z_{i,t}$  = Relative price of product i in time t. All variables are expressed in natural logarithm but we use arithmetic form for simplicity. The rate of change of  $P_t^*$  measure the rate of inflation ( $\pi_t$ ) in period t.

$$\pi_t = \ln P_t^* - \ln P_{t-1}^* \dots\dots\dots (7)$$

The rate of change in  $P_{i,t}$  measures the nominal rate of price change ( $\pi_{i,t}$ ) in period t.

$$\pi_{i,t} = \ln P_{i,t} - \ln P_{i,t-1} \dots\dots\dots (8)$$

Then relative price variability as defined by Parks (1978) is

$$V_t = \sqrt{\sum_{i=1}^k w_i (\pi_{i,t} - \pi_t)^2} \dots\dots\dots (9)$$

where  $w_i$  denotes the weight of the price index, so that

$$P_t^* = \sum_{i=1}^k W_i P_{i,t} \dots\dots\dots (10)$$

This study used 1/N as weight attached to each commodity (where N is the total number of observations in  $t_k$ ). Lasperes price index was used to compute PPI.

**METHODOLOGY**

**Data Source**

Data were obtained from the publications of Central Bank of Nigeria (CBN), Federal Office of Statistics (FOS) and the Federal Ministry of Agriculture and Natural Resources (FMANR). Four (4) grain crops were used for the analysis (rice, maize, sorghum, and millet). The data were annual nominal price and output of crops. The data collected covered the period 1970 to 2007.

**EMPIRICAL MODEL**

An instability index model to estimate the instability index of grain price is shown below (Idachaba, 2000).

$$I_D = \left( n^{-1} \sum_{i=1}^n |p_i - \bar{p}| \right) / \bar{p}$$

**WHERE**

- $I_D$  = price instability index for ith commodity
- $P_i$  = nominal price of ith commodity
- $\bar{P}$  = arithmetic mean of ith commodity price
- $P$  = estimated price equation (where  $p = a + a_t$  and  $t$  = time in year)

$n$  = number of observations

The value of ( $I_D$ ) for different grain components are rated appropriately for high or low instability. To investigate relationship between relative price variability and inflation including factors affecting relative price variability in Nigeria, we specify the following  $V_g = a_0 + a_1 \alpha_t + a_2 (GS) + a_3 (GS * \alpha_t) + a_4 (G1) + a_5 (G1 * \alpha_t) + U_t \dots\dots\dots (12)$

**WHERE**

- $V_g$  = relative price variability of grain in period t
- $\alpha_t$  = absolute value of inflation in period t
- GS = period of civilian regime as a proxy of government stability (Dummy 1 for civilian regime years and zero otherwise)
- G1 = period of military regime as a proxy of government instability (Dummy 1 for military period and zero otherwise).
- $U_t$  = error term. Where  $(GS * \alpha)$  and  $(G1 * \alpha)$  are interactive terms. Equation 12 will be estimated by ordinary least squares method. The Augmented Dickey-Fuller (ADF) will be used to determine the time series properties of the stochastic variables.

**RESULTS AND DISCUSSION**

**Price Instability Index of Grain Producer Price in Nigeria**

Four major grain crops were used in the analysis because of their popularity in production and consumption in the country. The crops were rice, maize, sorghum and millet.

**Table 2: Instability Index of Grain**

Grain	Instability index (%)
Rice	64.99
Maize	62.87
Millet	74.96
sorghum	69.71

Source: computed by the researchers

The indices were ranked as shown below. Four points continuum scaling concept was used (Idachaba 2000).

Rank	Range (%)
Mild instability	0.01 - 19.9
Moderate instability	20.00 - 49.9
High instability	50.00 - 99.9
Severe instability	100 and above

From the above classification, all the grains annual producer prices used in the analysis exhibit high instability status. The result is in consonance with the assertion of Osakwe (1982) and Ayoola (2004), who on their separate empirical studies supported high producer's price instability of agricultural produce in Nigeria.

## UNIT ROOT TEST

Table 3: Unit Root Test Statistics

VARIABLE	ADF TEST STATISTICS	CRITICAL VALUE OF ADF		
		1%	5%	10%
$V_g$	- 4.563	- 3.709	-2.983	-2.623
$\alpha$	- 4.426	- 3.709	-2.983	-2.623

Note: variables are as defined in equation 12.

After comparing the ADF test statistic with MacKinnon critical values, the stochastic variable are stationary in their levels suggesting absence of non stationary

tendency in the stochastic variables. This validates the use of OLS in estimating equation 12.

Table 4: Result of Regressing Relative Price Variability of Grains on Inflation, Government stability and Government instability.

VARIABLE	COEFFICIENT	STANDARD ERROR	TO VALUE
$a_1 (\alpha_t)$	0.088	0.040	2.200**
$a_2 (Gs)$	0.226	0.222	1.021
$a_3 (Gs*\alpha_t)$	- 0.680	0.350	-1.942*
$a_4(G1)$	0.067	0.318	0.212
$a_5(G1*\alpha_t)$	0.074	0.040	1.850*
Constant ( $a_0$ )	0.045	0.013	3.462***
$R^2$	0.418		
$\bar{R}^2$	0.337		
DW-stat.	2.437		
F-stat.	6.440***		

Note; \*, \*\* and \*\*\* denote significant at 10%, 5% and 1 percent levels respectively. All variables are as defined in equation 12.

The diagnostic statistics showed goodness of fit of the regression equation. Auto correction (DW =2.437) was not a serious problem. The results reveal that inflation has a positive significant impact (at 5% significance level) on relative price variability of grains in Nigeria. This means that as aggregate inflation rate increases, the relative price variability of grain also increases. The result is in agreement with the findings of Lapp and Smith (1992), Ukoha (2005), Udoh et al (2007). The results suggest that grain producers in Nigeria are exposed to increase risks and uncertainties in their production activities during periods of high inflation. Also, there may be high tendency of reallocation of resources from grain sub-sector to other agricultural sub-sectors during period of increasing rate of inflation. In addition, due to high anticipated probability of production risk, there would be reduced welfare for both producers and consumers of grains in Nigeria during periods of high inflation.

GS\*inflation has a negative significant effect (at 10% significant level) on relative price variability of grains in Nigeria. The result means that, the programmes or policy package of the civilian regimes targeted at grain sub-sector shifted the coefficient of inflation which impacted negatively on relative price variability of grains in the country. This implies that, the policy package for the grain sub-sector during civilian regimes reduces inflation rate variation and this negatively and significantly impacted on relative price variability of grains. This relationship suggests movement of resources into grain sub-sector, reduced production risk and a better welfare for both consumers and producers of grains.

GI\*Inflation has a positive significant effect (at 10% significance level) on relative price variability of grains in Nigeria. This implies that the policies of the military regimes targeted at grain sub-sector brought about a shift in the coefficient of inflation which in turn affected relative price variability positively. This means that, the military policy causes the unsteady increase in inflation rate which triggers high relative price variability of grain. This relationship suggests that, there was reallocation of production resources from grain sub-sector to other agricultural sub-sectors as well as high production risk during military regimes in Nigeria.

## CONCLUSION AND POLICY IMPLICATION

The results reveal relatively high producer price instability of grains in the country. A positive significant relationship between relative price variability of grains and inflation was discovered. Also programmes of government geared towards grain sub-sector during military regimes shifted the coefficient of inflation that impacted positively on relative price variability of grains in Nigeria. On the other hand, civilian regimes which were a proxy of government stability shifted inflation coefficient that in turn has a negative significant impact on relative price variability. Following the above results, we highlight the following policy implications.

- Government policies that are directed towards reducing production constraints would also reduce variation in producer price of grains. A reduction in dispersion of producer price will reduce price instability indices. Input subsidies

- could be a very useful tool to achieve this policy objective.
- Policies that reduced aggregate rate of inflation in Nigeria will favour lower relative price variability of grains. Therefore such policies are advocated as lower price dispersion will increase welfare of Nigerians.
  - The civilian policy package for the grain sub-sector in Nigeria reduces the relative price variability of grains. Hence such policy objectives and instrument should be strengthened to further improve the performance of the sub-sector.
  - Policy that will ensure adequate incentive to the farmers to absorb the effect of loss of real income and production risks during inflationary periods should be formulated and implemented.

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