

Estimating Grain Relative Price Variability and Inflation Rate Movement in Different Agricultural Policy Regimes in Nigeria

S.B. Akpan and E.J. Udoh

Department of Agricultural Economics and Extension,
University of Uyo, Uyo Akwa Ibom State, Nigeria

Abstract: The study estimated the functional relationship between relative price variability of grains and inflation rate in various agricultural policy periods in Nigeria. Data were obtained from various publications of Central Bank of Nigeria, which covered the period from 1970 to 2008. 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 the SAP and civilian post SAP agricultural policy regimes brought about a positive significant shift in the coefficient of inflation, which implies an increased in the relative price variability of grains. Hence such Policy that will ensured adequate incentive to grain farmers to absorb the effect of loss of real income, decline welfare and production risks during inflationary period was advocated as these will improved grain sub-sector performance in Nigeria.

Key word: Relative price variability, Inflation, Grains, Policy, Regime

INTRODUCTION

Grain sub-sector plays an important role in economic development of Nigeria. The output of the sub-sector constituted a large proportion of staple food stuff in Nigeria [1]. In 1985 and 1995, grains accounted for almost 50% of the total food supply in Nigeria expressed in grain equivalent [2]. The most important grain crops grown in Nigeria are maize, Rice, Sorghum, Millet and wheat [3, 4]. Of these, rice, maize, millet and sorghum constitute the major source of energies staple food available and affordable in Nigeria [5]. This implies that many Nigerians dependent on grains for their daily dietary need. Price of grains is one factor that determines the extent to which Nigerians can pay for these food commodities. The nominal or producer price of individual grain has continuously fluctuated over the past years [6-8]. The Nigerian government realizing the important of grain sub-sector had on several times intervened in stabilizing the grain prices through agricultural price policy reformation [9]. Some of the instrument includes: input subsidies, ban on importation of maize in 1985, strategic grains reserve scheme of 1976 and the liberalization of the economy in 1986 among others. Despite these lofty attempts, the producer prices of grains continue to fluctuate as demonstrated in Table 1.

It is obvious from the above table that the major grain crops in Nigeria show a broad dispersion of producer prices across the specified policy periods. For instance, between 1970 and 1974 the mean producer price of rice was N301.40/ton and 17.12% coefficient of variability in prices. In 1975 to 1979 the mean price of rice increases more than 100% compare to pre-OFN period. The fluctuations were the increasing function of time across the specified policy periods. Similar trend was obtained in producer prices of maize, millet and sorghum. The highest coefficient of variability was obtained during SAP period for all the crops. It was 67.97% for rice, 69.39% for maize, 83.97% for millet and 70.64% for sorghum.

Corresponding Author: Dr. E.J. Udoh, Department of Agricultural Economics and Extension,
University of Uyo, Uyo Akwa Ibom State, Nigeria

Table 1: Major Grain Crop Prices and Inflation Rates under Different Agricultural Policy Regimes in Nigeria

Year	Rice		Maize		Millet		Sorgumim		Inflation
	Mean price (N)/ton	Cv%	Mean price (N)/ton	Cv%	Mean price (N)/ton	Cv%	Mean price (N)/ton	Cv%	Rate (%) Mean
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
2000-2008	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 (1987-2008).

Where CV = coefficient of variability of producer price.

1970-1974=Pre-Operation Feed the Nation Period

1975-1979=Operation Feed the Nation Period

1980-1985=Green Revolution Period

1986-1993=Structural Adjustment Programme (SAP) period

1994-1999=Military Post SAP Period

2000-2008=Civilian Post SAP Period.

Table 2: 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
α	-4.426	-3.709	-2.983	-2.623

Note: variables are as defined in equation 11

Table 3: Result of Regressing Relative Price Variability of Grains on Inflation, Government stability and Government instability

Variable	Coefficient	Standard Error	t-Value
$a_1 (\alpha_t)$	0.0065	0.0029	2.24**
a_2 (OFN)	0.0457	0.0217	2.11
a_3 (OFN * α_t)	0.004	0.025	0.16
a_4 (GR) _t	-0.0155	0.3674	-0.04
a_5 (GR * α_t)	-0.0013	0.0083	-0.16
a_6 (SAP) _t	0.0402	0.0230	1.75**
a_7 (SAP * α_t)	0.0085	0.0044	1.93**
a_8 (MPSAP) _t	0.0235	0.2946	0.08
a_9 (MPSAP * α_t)	-0.0016	0.0064	-0.25
a_{10} (CPSAP) _t	-0.0040	0.0088	0.46
a_{11} (CPSAP * α_t)	0.0010	0.00046	2.11**
Constant (a_0)	0.05971	0.0260	2.30**
R^2	0.4031		
\bar{R}^2	0.3667		
F-stat.	4.9936***		

Note; *** and ** denote significant at 10, 5 and 1 percent level respectively. All variables are as defined in equation 11

Within the same specified policy period, it was observed that inflation also exhibit undulating trend. It therefore means that, the grain price fluctuations and inflationary trend may relate in the various agricultural policy regimes specified.

Many factors are believed to cause nominal price dispersion of grains in Nigeria. Some of the factors include government instability, low level of innovation in the grain sub-sector, unstable exchange rate, changes in aggregate investment; savings and inflation rate. [7, 10, 11]. Among all these factors that trigger producer price dispersion, “inflation” appears to be the most severe considering its negative effect on producer price and its multiplier effects on the entire economy [12]. The monetary and fiscal cost of adjustment including the risk associated with such relationship is enormous [8].

Relative price variability is a proxy of the variance across a set of commodities of the rate of change of individual nominal price [13]. It reflects the real cost of inflation in relation to its effect on grain price changes or fluctuations. Real cost of inflation occurs due to changes in relative prices that result from differential transmission of inflation across particular commodities. Hence, 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 grain relative price variability in any of the policy period, the extent and direction of such relationship may reduce economy welfare of the producers and consumers of grain crops during the policy regime. Production activities in the sub-sector may be retarded due to producer price uncertainty and production risk. Resource use efficiency may decrease because farmers may have less useful information on prices to guide them in production decision. Farmers may also suffer loss of nominal or real income to inflation, a situation that will be averted in an economy with zero relationship between relative price variability and inflation rate movement. Consequently, such relationship may frustrate the economic objectives of such policy regime. However, attainment of zero price fluctuations among grains and stagnant inflation rate is not a rational policy for the government. The price differential among production resources and manageable single digit variation in inflation rate are panacea for effective resource allocation, enterprise combination, technology transfer, demand and supply determinants and overall efficiency of resource use [8, 11].

Then the important question is; does relative price variability of grains in Nigeria actually vary with inflation rate changes in each of the specified policy regime? 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 the various agricultural policy regimes in Nigeria. Based on the nature of relationship between inflation and relative price variability of grains in the policy periods, appropriate policy implications would be highlighted to cope with the anticipated situation arising from the relationship.

Theoretical Framework and Literature Review: The study adopted menu-cost model. The menu-cost model was proposed by Sheshinski and Weiss [14], they postulate 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 fall 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 behavior creates relative price dispersion. And as inflation is expected to increase, the optimal band (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 and agricultural commodities in Nigeria. The link between inflation and relative price variability is found in the framework of supply and demand. Lucas [15] type of supply model assumes that quantity supplied, q_{it} in an industry of commodity i in period t consist of trend output q_{it}^n and cyclical output q_{it}^c .

Thus:

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

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 supply equation becomes.

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

All variables are expressed in log. Where $\rho < 1$ and β are constant parameter (β 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 [16]. Hence demand equation becomes

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

Where M is income, δ is the income elasticity of demand for good i and α is the price elasticity of demand for the same good. Equating demand to supply and re-arranging terms, an expression for the commodity-specific rate of price change is given by:

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

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

In this framework, commodity price variability is as 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. Using this framework, we analyzed the change in relative agricultural prices due from inflation in various agricultural policy regimes. Many researchers have established a positive relationship between inflation and relative price variability of various commodities. Lapp and Smith [13] in United State, Lach and Tsiddon [17] in Israel, Zanas [18] in Greece, Loy and Weaver [19] in Russia, Ukoha [8] and Edet *et al.*, [20] in Nigeria. Reinsdorf [21] found a negative relationship between inflation and relative price variability in United State.

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 [19]. 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 [13].

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

Where $P_{i,t}$ = Nominal price of i th 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 log. The rate of change of P_t^* measure the rate of inflation (π_t) in period t .

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

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

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

Then relative price variability as defined by Parks [22] is

$$V_t = \sqrt{\sum_{i=1}^{\&} w_i (\pi_{it} - \pi_t)^2} \quad (9)$$

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

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

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

Research Methodology

Data Source: Data were obtained from the publications of Central Bank of Nigeria (CBN), Federal Bureau 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 the annual nominal price and output of grain crops. It covered the periods 1970 to 2008.

Empirical Model: To investigate relationship between relative price variability of grains and inflation in various agricultural policy regimes in Nigeria, we specify the following equation

$$V_{gt} = a_0 + a_1 \alpha_t + a_2 (\text{OFN})_t + a_3 (\text{OFN} * \alpha)_t + a_4 (\text{GR})_t + a_5 (\text{GR} * \alpha)_t + a_6 (\text{SAP})_t + a_7 (\text{SAP} * \alpha)_t + a_8 (\text{MPSAP})_t + a_9 (\text{MPSAP} * \alpha)_t + a_{10} (\text{CPSAP})_t + a_{11} (\text{CPSAP} * \alpha)_t + U_t \quad (11)$$

WHERE, V_g = relative price variability of grain in period t ; α_t = absolute value of inflation in period t ; OFN = period of Operation Feed the Nation; GR = period of Green Revolution; SAP = period of Structural Adjustment Programme; MPSAP = period of Military Post SAP; CPSAP = period of Civilian Post SAP; U_t = error term

The estimation of equation 11 would help to ascertain whether a particular agricultural policy regime brought about a structural change in the behaviour of inflation and consequently the relative price of grains. The Augmented Dickey-Fuller test (ADF) was used to determine the time series properties of the stochastic variables.

RESULTS AND DISCUSSION

After comparing the ADF test statistic with MacKinnon critical values, the stochastic variable are stationary in their levels suggesting absent of non stationary tendency in the stochastic variables. This validates the use of OLS in estimating equation 11.

The diagnostic statistics show goodness of fit of the regression equation. The results reveal that inflation has a positive significant impact (at 5% significant level) on relative price variability of grains in Nigeria. This means that as aggregate inflation rate increases, the relative price variability of grains also increases. The result is in agreement with the finding of Lapp and smith [13], Ukoha [8], Udoh *et al.*, [11]. The result suggests that grain producers in Nigeria are exposed to increase risks and uncertainties in their production activities during period of high inflation. Also, there is 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 period of high inflation.

SAP policy package had a positive significant effect (at 5% significant level) on relative price variability of grains in Nigeria. The result means that, the programmes or policy package of SAP regime targeted towards grain sub-sector affected positively the relative price variability of grains in Nigeria. Also the policy period shifted the coefficient of inflation which impacted positively on relative price variability of grains in the country. This imply that, the policy package for the grain sub-sector during SAP regime increases inflation rate variation and this positively and significantly impacted on relative price variability of grains. This relationship suggests reallocation of resources within the grain sub-sector through it aggregate price effect, uncertainty in production and a reduced welfare for both consumers and producers of grains in the country.

The civilian post SAP policy package has a positive significant effect (at 5% significance level) on relative price variability of grains in Nigeria. This imply that the agricultural policies of this regime directed towards grain sub-sector brought about a shift in the coefficient of inflation, which in turn affected relative price variability positively. This implies that in the CPSAP policy periods, the unsteady increase in inflation rates, consequently trigger high relative price variability of grains. This relationship also suggests that, there was a relatively lower marginal reallocation of production resources from grain sub-sector to other agricultural sub-sectors during civilian post SAP period under consideration in Nigeria.

CONCLUSION AND POLICY IMPLICATION

The results reveal a positive significant relationship between relative price variability of grains and inflation rate movement in Nigeria. Also agricultural policies of government geared towards grain sub-sector during SAP and civilian post SAP regimes shifted the coefficient of inflation that impact positively on relative price variability of grains in Nigeria. 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 of grains will reduce relative price variability of grains. Input subsidies could be a very useful tool to achieve this policy objective.
- Policies that reduced aggregate rate of inflation in Nigeria will favor lower relative price variability of grains. Therefore such policies are advocated as lower price dispersion will enhance production decision and increased welfare of producers and consumers of grain in Nigeria.
- The SAP and post SAP civilian policy package for the grain sub-sector shifted the coefficient of inflation rates which impacted positively on grain relative price variability. Hence such policy objectives and instrument should be look upon with an intention of strengthening them to improve the future performance of the sub-sector.
- Policy that will ensure adequate incentive to grain farmers to absorb the effect of loss of real income, decline welfare and production risks during inflationary period should be formulated and implemented especially in the grain sub-sector.

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