Impact of Inflation and Government Agricultural Policies on Relative Price variability of Cash Crops in Nigeria

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Abstract: The paper investigated the impact of inflation and government agricultural policies on relative price variability of cash crops in Nigeria using co-integration and ECM approach. The analysis was carried out on time series data collected from 1970 to 2008. The result shows that inflation has a significant positive impact on relative price variability in the short-run and long-run. Polices like Structural Adjustment Programme (SAP), Post-Structural Adjustment Programme (PSAP) and Green Revolution (GR) affected price changes that led to efficient re-allocation of resources among cash crops in Nigeria. It is therefore recommended that long-run government agricultural policies should therefore be continued and also, policies that would protect the agricultural sector from the impact of inflation in the short-run should be encouraged. [Report and Opinion 2010;2(5):8-13]. (ISSN:1553-9873).

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1. Introduction

The agricultural sector is an important economic sector in Nigeria's economy. It plays an important role in rapid growth and development of Nigerian economy (Famoriyo and Nwagbo, 1981). It provides food for the growing population, employment for over 70% of the population, raw materials and foreign exchange earnings for the development of industrial sector (Giroh *et al*, 2010). In spite of the predominance of the petroleum sub sector in Nigeria economic growth and development, agriculture remains a major source of economic resilience (Ojo and Akanji, 1996). However, the oil boom in the early nineteen seventies caused a drastic fall in the percentage contribution of the agricultural sector to 35 per cent in the early eighties. According to Okoh (2004), the export of crude oil now constitutes about 96% of total exports. It is imperative to note that Nigeria once a leading exporter of several agricultural products like Cocoa, Rubber, Palm Kernel and Groundnuts has lost her leadership position in the exportation of these agricultural products (Mesike *et al*, 2007).

The realization of this by the government led to the formation of different agricultural programmes and policies aimed at preventing the collapse of the economy and subsequently targeted at short-to-medium-term adjustment to ensure sustainable growth of the economy. Amongst these policies and programmes instituted by the government are: the River Basin Development Authorities (RBDAs) in 1991, the National Accelerated Food Programme (NAFFP) in 1972, Agricultural Development Projects (ADPs) in 1975, the Operation Feed the Nation (OFN) in 1976, the Agricultural Credit Guarantee Scheme Funds (ACGSF) in 1977, the Green Revolution Programme (GRP) in 1980, and Structural Adjustment Programme (SAP) in 1986 (Ojo, 1988).

In Nigeria, the government's agricultural pricing policy objective is to ensure attractive producer prices for agricultural commodities to encourage farmers to produce more. To attain this objective, the government replaced the Regional Marketing Boards, which controlled export cash crops prices from 1949 to 1976, with the National Commodity Board in 1977. By the end of 1985, the commodity boards were abolished because it was obvious that the commodity boards could not achieve most of their functions as evidenced by their pricing, which resulted in implicit taxation of farmers (Akanji and Ukeje, 1995). The study was therefore conducted to determine the impact of inflation and government agricultural policies on relative price volatility of cash crops in Nigeria.

1.1 Measuring relative price variability

Change in relative prices is called relative price variability or volatility 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). Real costs of inflation occur as a result of changes in relative prices caused by a differential transmission of inflation

across particular products or markets. The resulting price structure is distorted from initial cost and preference fundamentals and may induce resource misallocation and welfare loss (Fisher, 1981). Relative price variability is measured by constructing an index to show changes over time in relative prices among a commodity group. A commodity's relative price is defined as its nominal price divided by the average price of all commodities in the group.

Relative price variability is defined as the variance across a set of commodities of the rates of change of individual nominal prices (Lapp and Smith, 1992).The nominal rate of price change of each commodity can be decomposed into an aggregate component, interpreted as the inflation rate, and a relative price component.

That is, $P_{i,t} = P^*_t + Z_{i,t}$ (1)

Where $P_{i,t}$ is defined as the natural logarithm of the nominal price of the ith commodity in period t, P*t is the natural logarithm of a price index for the *N* commodities in period t, and $Z_{i,t}$ is the natural logarithm of the relative price of commodity i in period t,

$P_t = \sum W_{i,t} P_{i,t}$ (2)

Where the $W_{i,t}$'s are price index weights that sum to one. Taking first differences of equation 2 and rearranging, the rate of commodity i's relative price is given as,

$Z_{i,t} - Z_{i,t-1} = (P_{i,t} - P_{i,t-1}) - (P^*_t - P^*_{t-1})$ (3)

The weighted sum of each commodity's relative price, using $W_{i,t}$ as weight is always zero and this is given in equation 4

$\sum W_{i,t} (Z_{i,t} - Z_{i,t-1}) = \sum W_{i,t} [(P_{i,t} - P_{i,t-1}) - (P^*_t - P^*_{t-1})]$ (4)

The weighted sum of squares of each commodity's relative price change is always positive when nominal rates of change differ among individual commodities, this can be express as

$\sum W_{i,t} [(P_{i,t} - P_{i,t-1}) - (P^*_t - P^*_{t-1})]^2$ (5)

As the differences increase, V_t also increases. Therefore, V_t, which is an approximation of the variance of relative price changes from period t-1 to t for the N commodities, is used as the measure of relative price variability.

2. Methodology

2.1 Study area and source of data

The study was carried out in Nigeria. The country which lies in the coast of West Africa between longitude 20^o and 15^o E and latitude 5^o and 15^o N. Nigeria is the most populous country in Africa and it is situated on the Gulf of Guinea in West Africa. Its neighbors are Benin, Niger, Cameroon and Chad. The lower course of the Niger River flow southwards part of the country into the Gulf of Guinea while swamps and mangrove forests bordering the southern part.

The country experiences dry and wet seasons. It is comprised of the following ecological areas; mangrove swamp, rainforest, Guinea Savannah, Sudan Savannah and Sahel Savannah. It has a total area of 923,768 square kilometer with land area occupying 910,768 square kilometers and water 13,000 square kilometer. Its population is made of 140 million people from the 2006 census figure as released by the National Population Commission.

The data for this study was obtained from secondary sources which include the Central Bank of Nigeria (CBN) Publications such as Annual reports and statements of Account, Statistical Bulletin of CBN and Economic and financial review. The data covers the period from 1970 to 2008

2.2 Method of data analysis

The study employed the Error Correction Model (ECM) within the context of co-integration theory to analyze the data. The estimation procedure was used to overcome the problems of spurious correlation often associated with non-stationary time-series data. Further, the procedure is able to generate long-run relationships (Engle and Granger, 1987; Hendry, 1986; Johansen, 1988; Johansen and Juselius, 1990; Goodwin and Schroeder, 1991; Hallam *et al.*, 1994). Tambi (1999) noted increased importance of co-integration analyses for describing long-run equilibrium relationships.

In using Error Correction Model (ECM), the first step is to assess the order of both the dependent and independent variables in the model. The order of integration ascertains the number of times a variable will be differentiated to become stationary. Dickey-Fuller statistics (DF) and Augmented Dickey-Fuller statistics (ADF) was used in this study to test the stationarity of individual series. The DF and ADF test procedure is indicated in equation 6 and 7.

$\Delta X_t = \alpha_o + \delta X_{t-1}$ (6)

$\Delta X_t = \alpha_o + \delta X_{t-1} + \sum \beta \Delta X_{t-1} + e_t$ (7)

The decision rule states that the t-statistics on the coefficient of the variable δ, which is expected to be negative, must be significantly different from the critical values for a given sample size, if the null hypothesis is to be rejected. The null hypothesis is that the

variable of interest is non-stationary [i.e it is integrated of order one I (1)].

After establishing the stationary properties of the individual series, linear combinations of the integrated series were tested for co-integration. Co-integration is a test of stationarity of the residuals generated from running a static regression in levels of one or more of the regressor variables on the dependent variable.

ECM is accepted when the residuals from the linear combination of non-stationary I(1) series are themselves stationary. The acceptance of ECM implies that the model is best specified in the first differences of its variables. In this context, the application of co-integration paradigm will guard against the loss of information from long-term relationships in the first differences. The information in the error term of the long-run relationship is used to create a dynamic error correction model. The ECM is then used to analyze the effect of inflation and government polices on relative price variability of cash crops in Nigeria.

The effect of government policy that were examined are Operation Feed the Nation (1976-1979), Green Revolution (1980-1985), Agricultural Policies under the structural adjustment programme (1986-1993) and the post-SAP policies (1994 to date). To control for the effects of different government policies, dummy variables was used and this took the value of 1 (one) in the policy period and 0 (zero) otherwise.

The require equation is:

$$\Delta P_t = \beta_0 + \beta_1\Delta(INF)_t\ \beta_2(OFN)_t + \beta_3(GR)_t + \beta_4(SAP)_t + \beta_5(PSAP)_t + \beta_6 ECM(-1) + \delta_t \quad (8)$$

Where *INF* is inflation; *OFN, GR, SAP, PSAP* are dummy variables for Operation Feed the Nation, Green Revolution, Structural Adjustment Programme and Post-structural Adjustment Programme policies. Δ is the difference operator, P_t is the relative prices of cash crops, ECM(–1) is the error correction factor and δ_t is the stochastic error term assumed to be independently and normally distributed with zero mean and constant variance. The *apriori* expectations is that INF, OFN, GR, SAP and PSAP will positively affect the relative price of cash crop

3. Results and Discussion

3.1 Test for order of integration of relative prices of cash crop and inflations

Table 1 reports the ADF tests for the order of integrations of price variability of cash crop and inflation. The tests were applied over the period of 1970-2008 without a time trend. The test results strongly support the null hypothesis that price variability is I (1) or non-stationary while inflation is stationary at is level. Following from this is the need to difference the price variability to become stationary. In essence any attempt to use the non-stationary variable at its level could lead to spurious results.

Table 1 Unit Root Tests of Relative Prices and Inflation

Variable	ADF Test	Critical Value at 1%	Critical Value at 5%	Lag Length	Order of Integration	Remark
PV	-2.5807	-3.6268	-2.9458	2	I (1)	Non-stationary
INF	-4.1256	-3.6210	-2.9434	1	I (0)	Stationary

Lag length selection was automatic based on E-views 5.1 Schwarz information

3.2. Co-integration test for price variability of cash crops

The Engle Granger two-step procedure was adopted to test for co-integration of price variability of cash crops. This was done as a condition for accepting the Error Correction Mechanism (ECM) model. Co-integration would be accepted if the residuals of the series that were I (1) are in fact I (0). The test tries to establish whether there was long-run relationship between the dependent variables and their fundamentals. Table 2 shows the result of the co-integration tests conducted. From Table 2, it is seen that the absolute value of the Dickey-Fuller (DF) test statistic was greater than its critical value at 1%, so co-integration was not rejected based on DF statistic while the absolute value of the ADF test statistic was lower than its critical value at both 1% and 5% but however, it was greater than its critical value at 10% level and co-integration was not rejected.

Table 2. Result of co-integration test for price variability

Variable	Coefficient	Standard error	t-statistic	Probability
Constant	-0.0871	0.0808	-1.0781	0.2888
INF	0.0075	0.0020	3.6477	0.0009
OFN	0.0009	0.1196	0.0079	0.9938
GR	0.0205	0.1071	-0.1913	0.8495
SAP	0.1501	0.1035	1.4503	0.1564
PSAP	0.0620	0.0896	0.6926	0.4934
	Test statistic	Critical value at 1% level	Critical value 5% level	Critical value at 10% level
DF	-2.9701	-2.6290	-1.9501	-1.6113
ADF	-2.9283	-3.6210	-2.9434	-2.6103

3.3. Error correction model for impact of inflation and government policies on relative price variability of cash crop

The existence of co-integration among the dependent variables and its determinants necessitated the specification of ECM for impact of inflations and government policies on prices of cash crop. Table 3 show the result of the short-run error correction model of impact of inflation and government policies on relative price variability of cash crops. Table 3 shows that inflation has a positive impact on relative prices in the short-run. The error correction term [ECM(-1)] is negative in sign as expected and statistically significant at 1% probability level. The error correction estimates indicate quick convergence to equilibrium with intermediate adjustments captured by difference term. The Durbin-Watson statistic shows that autocorrelation is not a serious problem.

On the other hand, Government Agricultural Policies had no short-run effects on the variability of relative prices among cash crops. A possible reason might be that most cash crops are less perishable and their buffer stocks stabilize prices. Also, the long maturation period of most cash crops probably results in delayed response to price incentives.

Furthermore, a number of diagnostic tests were conducted on the residual and the results are shown in the second half of Table 3. The Ramsey's RESET test results indicate that the equation was not mis-specified and that the assumption of linearity is correct. Besides the test for normality and heteroschedasticity showed that the residuals are not normally distributed but there is absence of heteroschedasticity.

Table 3 Short-Run effect of inflation and government agricultural policies on relative price variability of cash crops

Variable	Coefficient	Standard Error	t-statistic
Constant	0.0230	0.0849	0.2708
Infl	0.0048**	0.0019	2.4948
OFN	0.0989	0.1208	0.8187
GR	0.0619	0.1102	0.5614
SAP	-0.0099	0.1040	-0.0949
PSAP	-0.1054	0.0962	-1.0951
ECM(-1)	-1.3210*	0.1704	-7.7544
Adjusted R^2	0.60		
F- statistic	10.05*		
Hetero test	1.30(0.29)		
Normality test	113.08(0.00*)		
Ramsey RESET test	0.12(0.73)		
DW	1.71		

*, **, *** indicate significance at 1%, 5% and 10% probability level

The results for the long-run are presented in linear and double log functional forms in Table 4. The double log model gave the best result. The result shows that inflation has a

positive impact on relative prices in the long-run at 5% significant level. Also, the coefficient of SAP, PSAP and GR, had a significant positive impact on relative prices. A possible reason might be that the export promotion incentives provided in the SAP and PSAP periods probably encouraged the production of cash crops. Among these incentives are liberalization of agricultural exports, liberalization and devaluation of the Naira exchange rate e.t.c. similarly, the GR provided incentives in the form of liberal resource allocation such as agro-chemicals, fertilizer, improved seeds and seedlings, equipments e.t.c. which probably encouraged the production of cash crops.

In contrast, the coefficient of OFN was not statistically significant, implying that the policy did not have a significant effect on relative prices of cash crops. A possible reason for the insignificance of OFN might be because the policy was directed mainly to food production rather than cash crop production.

Table 4. Long-Run effect of inflation and government agricultural policies on relative price variability of cash crops

Variable	Linear	t-statistics	Double log	t-statistic
Constant	-10074	-1.191862	-6.985032*	-6.513844
Infl	0.0092*	4.345444	0.928351**	2.583446
OFN	-0.0293	-0.244065	0.900220	0.876142
GR	-0.0432	-0.399161	1.593189***	1.731174
SAP	0.0859	0.793167	1.751537***	1.929832
PSAP	0.0667	0.726264	1.543200***	1.978831
Adjusted R^2	0.48		0.41	
F- statistic	4.79*		3.79*	
Hetero test	2.99 (0.01)**		1.90 (0.10)	
Normality test	111.34 (0.00)*		4.97 (0.08)***	
Ramsey RESET test	1.51 (0.23)		2.14 (0.15)	
DW	1.79		2.03	

*, **, *** indicate significance at 1%, 5% and 10% probability level
Values in parenthesis are the corresponding probabilities

4. Conclusion

The result shows that there is significant positive effect of inflation on price variability of cash crops in the short-run and long-run. Also the government agricultural policies that have positive effect included SAP, PSAP and GR. From the findings of the study, the significant positive long-run effect of government agricultural policies should therefore be continued. Also, important policies that would protect the agricultural sector from the impact of inflation in the short-run should be encouraged. .

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