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RICE OUTPUT SUPPLY RESPONSE TO THE CHANGES IN REAL PRICES IN NIGERIA: AN AUTOREGRESSIVE DISTRIBUTED LAG MODEL APPROACH

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ABSTRACT

Several constraints have been identified as hindering rice output growth in Nigeria and the rest of West Africa. These include trade and exchange rate policies, pricing policy; fiscal Policy, fertilizer Policy, land policy and many others. These constraints have led to widespread a controversy of whether Nigerian rice farmers are responsive to the real price changes and to what degree? Other concerns are whether policies put in place were effective as supply shifters and adequate enough to induce positive response from farmers both short and long term. These issues limit further any decisive policy in the Nigeria rice sub-sector. This study therefore analyzed rice farmers' responsiveness on the aforesaid issues from the period of 1974 to 2006. The Error Correction version of ARDL approach to cointegration, which provides a feasible application on mixed regressors and permits distinct estimates of both long-run and short-run elasticities were employed. The estimated coefficient of the lagged long run price elasticity is 0.271 inelastic, indicating that the farmers are facing structural constraints. The short-run price is positive but insignificant. Weather and area are statistically significant at 1%, trend is significant at 5% while lagged maize price is negative and not significant at any reasonable level. The magnitude of adjustment of the price from short-run disequilibria to the changes in rice supply in effort to attain long-run equilibrium is 58%.

The result of the findings showed that pricing policy in the form of economic incentive alone is not a sufficient instrument for effecting domestic rice farmers' response as indicated by the inelastic low price elasticity. An improved policy package that comprises economic, non-economic incentives as well

as effective transmission mechanism could play a critical role to elicit a better response from Nigerian rice farmers.

Keywords: Rice Supply Response, Speed of Adjustment; Co-integration and Autoregressive Distributed Lag

INTRODUCTION

Agricultural supply response has remained a fundamental issue for sustainable economic development in Nigeria. It dominates economic developmental policies and its positive response is crucial for economic growth. The role of agriculture in the Nigeria's economy cannot be overemphasized given that 70% of the population derives their livelihood and other related activities. It is also a major source of raw materials for the agro-allied industries and a potent source of the much-needed foreign exchange (World Bank, 1998; Okumadewa, 1997). A significant and positive response from agricultural is justified as a means of improving the overall performance of the economy.

Nigeria agricultural system like elsewhere in the region is characterized by structural rigidities, low private investment, large government regulations, weak support services and institutional frame work. These innate features, inconsistent and unfocussed government policies have been described as the fatal perturbations that rocked the boat of food security in Nigeria (Okuneye 2001). The structural problems in food production system and the shrinking oil revenue (upon which the imports depend) led to agricultural reform policies in the mid 70s that aimed to boost food production through various agricultural programmes such as Operation Feed the Nations (OFN), Green Revolution (GR) and many others. Under these programmes, dissemination, adoption and diffusion of agricultural technology in the form of fertilizer and selected seed were issued to farmers to boost food production. Initially the policy achieved significant production gains particularly crops destined for export, As usual with the country, the implementation of policies relaxed with time. However, most of these programmes were discontinued even before the Structural Adjustment Programme (SAP) came into existence in 1986.

The SAP was designed to induce structural and institutional changes necessary to recognize the productive structure of the economy so as to achieve self-sustaining growth. The SAP also includes currency devaluation based on the presumption that price incentive will lead to positive and significant supply response. As a result of this substitution policy, Nigeria's agricultural sector was not only shielded from the rest of the world but also was an "inward looking strategy" that aimed at providing economic incentive for farmers to increase domestic food supply. Incidentally, foods importations particularly rice were very low during the period. The gains of the SAP in terms of rice imports reduction were lost in 1995 as a result of trade liberalization; rice importation then took an upward turn.

Similarly, in the recent years, there has been a guaranteed minimum price policy for some selected crops particularly rice. The rationale behind this policy is to motivate and encourage rice farmers to increase production so as to boost the nation's food security, poverty alleviation and reduce rural urban drift. Nevertheless the expected response by rice farmer may still not be achieved if the aforementioned structural problems particularly non-price constraint still exist. Then the immediate questions we need to ask; have rice farmers responded positively to any of these economic incentives? Secondly, what is degree of responsiveness in short and long term. Finally, whether these economic incentives were effective as supply shifters and adequate enough to change these farmers production habit?

Therefore, examining these issues is expected to have an immense contribution for future decisive policy formulation in the sector. The measurement of supply response parameters will go a long way in facilitating informed decision making by rice farmers and other players in the production-marketing chains. The responsiveness of farmers to price and non-price incentive or disincentives provides a clear picture of contribution of agricultural sector to the economy. This depends often on the responsiveness of domestic agricultural production to price in particular. Furthermore the measurement of agricultural supply response is a valid means of assessing the impact of economic policy reforms, in the view that policies which provide good incentives always bring high supply response while those that act as disincentives are unlikely to do so.

Self-sufficiency in rice production has remained Nigerian government political-economic goal to end hunger, reduce poverty and ameliorate the country's food security. It is also a developmental strategy aimed to reduce foreign exchange disequilibrium arising from rice import. As a renewed interest to boost food production, a clear understanding of the factors that shaped rice output supply response to real prices in Nigeria could constitute a further issue for policy formulation. Such policy may possibly improve the socio-economic dynamics and institutional environments within which rice farmers operate. And might be justified as a means through which farmers can earn livelihood as well as enhancing their efficiency and productivity. Therefore, any meaningful attempt to reform the structure of incentives provided by rice farmers will require a detailed knowledge of rice supply parameters. Hence, the provision of these rice supply response estimates in order to create a possibility for adjustment or further policy reforms that will enhance farmers efficiency, improve food security in the country and create room for sustainable economic development underlies my study motivation.

The reminder of this study is structured as follows. Section 2 discusses briefly the overview of Nigeria Rice Policy, Section 3, Material and Methodology, this section comprises data definitions, integration, and as well as model specification. Section 4 discusses ECM version of ARDL approach to cointegration followed by the empirical findings. Finally, Section 5 summarizes findings drawn from the study.

A BRIEF OVERVIEW OF NIGERIA RICE POLICY

The historical overview of rice policy in Nigeria reveals frequent changes, and discontinuities in general rules and economic bodies behind the sector are intermittent. It also showed that the policies discontinuities heightened during the Structural adjustment period. In addition, the discontinuities and frequency of new programs are linked to political changes. Therefore it is plausible to infer that the frequent changes and discontinuities were an indication of unstable governments and policy regimes. However, further assessment of the instability of the growth of important domestic policy variables is useful to shed more light and provide more evidence. Therefore, this report focused briefly Nigeria rice policies between 1971 and 2006.

Nigeria's rice policy can be discussed in reference to three significant periods. These are the pre-ban, which includes food crises period, ban and post-ban periods. These periods are crucial as a result of the policies put in place had a great impact on the domestic rice output growth in country (Akpokodje, et al., (2001). The pre-ban period is the era before the introduction of absolute quantitative restrictions on rice imports (1971-1985). And were further divided into two – pre-crisis (1971-1980) and crisis (1981-1985). Pre-crisis period was largely characterized by liberal policies on food imports particularly rice. During this period, agricultural policy was more or less laissez- faire while stagnation of food production became clear (Shimada, 1999). The government commenced policies to encourage food production to respond to acute food shortages in the country. It also corresponds to the launching of various agricultural programs and projects aiming at developing the rice production.

In the ban period (1986-1995), it was prohibited to import rice into the country though illegal importation through the country's porous borders increased. However, in recognition of the important linkages between trade and economic growth, the Nigerian government undertook major macroeconomic and trade policy reforms. Restrictions on rice importation were lifted while the country generally adopted a more liberal trade policy approach towards rice. However, the impact of trade policy on domestic rice production in Nigeria can be determined by examining the growth trend in the output before, during and after ban on rice imports.

Figure 1: Growth in Real Prices and Output of Rice and Maize 1971-2006

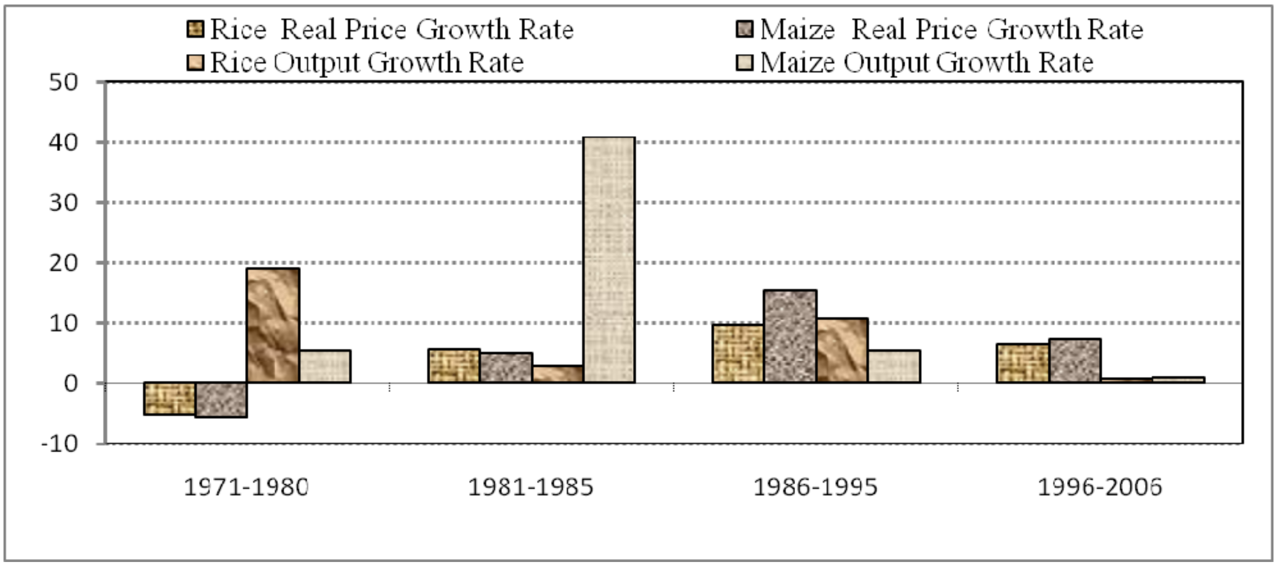


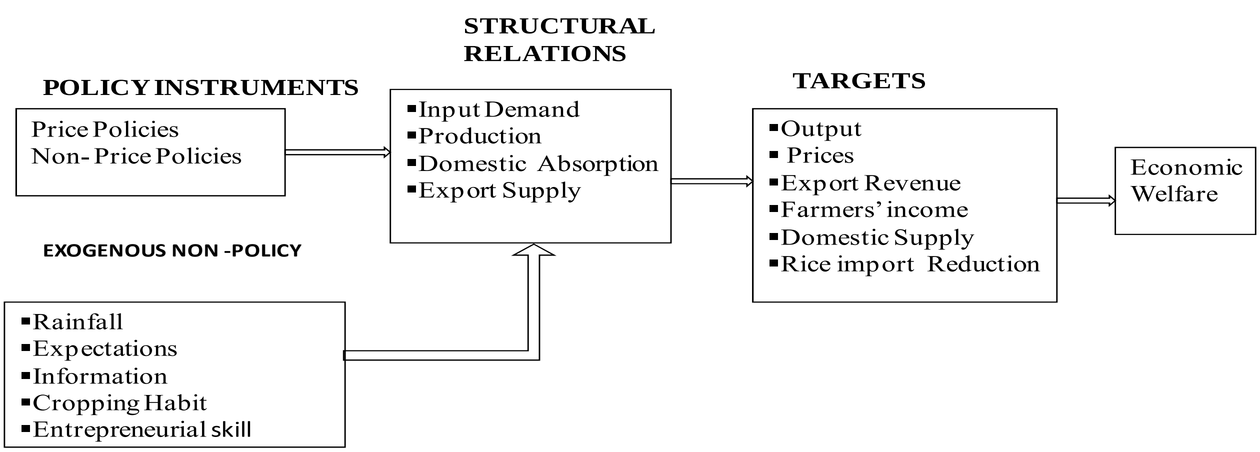
Figure 1 shows rice and maize output and their real price growth rate. During pre-ban (1971-1980), the average annual rice output growth was 19% and maize 5.37% while real price growth rate were -5.26 % and -5.52%, respectively. However, rice output growth plunged to 3% during the 1981-1985, a period when Nigeria depend considerably on rice importation. While maize output growth skyrocketed to 40% as a result of infrastructure and input subsidizing policy.

Nigeria imposed a ban on rice imports during the 1986-1995. During this period, the average annual growth in rice production increased 11% and maize output fell 5.52% as input subsidy policy was discontinued. But after the removal of the ban in 1995, the average annual rice and maize growth nose-dived to 0.7% and 1.07%, respectively. The rice output growth between 1986 and 1995 implied that there is a positive connection between government trade policies and domestic rice supply during the ban periods, showing that rice farmers responded to government trade policies on rice imports by increasing their output. However, the most crucial question is what was the channel through which trade policy affected domestic rice output response during SAP period? Was it through an import ban which then compelled Nigerians to purchase local rice? The imposition of a ban on rice imports is expected to result in decrease in rice import, while increased in demand for local rice led to upward review in the price of the commodity, which serves as an incentive for increased production. Similarly changes in the growth in producers' real prices could have contributed to the changes observed in the growth in rice production. The figure reveals that a significant improvement in the growth in real prices of rice during the ban period was linked with increased output growth while a falling in the output followed a considerable decline in producer prices of rice after the ban was lifted in 1995.

Ever since 1986, government policies on rice production are not well defined particularly with respect to trade and exchange rate policy. A substantial and persistent deviation in the implementation of public policies has been an immense constraint to rice output growth in Nigeria. Discontinuities in rice policies could be deduced from a long-term profile of agricultural policies in Nigeria that does not encourage sustainable economic development.

Figure 4 illustrates that rice supply policy variables and exogenous non-policy variables feed into structural relations, which in turn connect the exogenous (price and non-price policy) variables to endogenous (target and non-target) variables. The flow chart also implies that total economic welfare from the rice sector depends on the achieved values of the target variables, and the decisions of Nigerian government makes on the rice sector affect its output supply response.

Figure 2: Flow Chart Illustrating the Relations among Exogenous Variables, Structural Relations, Targets, and Economic Welfare



It is also implies that the behaviors of private economic agents engaged in rice production activities are very sensitive to government policies. With effective policy instrument as well as change production habit particularly post harvest operation will make Nigerian rice more competitive in terms of price and quality. Preliminary results from the analysis conducted by International Food Policy Research Institute (IFPRI) for West Africa highlighted the rewards of Agricultural Rural and Development, particularly for rice and Nigeria. This analysis estimates that a onetime 1% regional increase in rice productivity would result in a benefit of US$ 900,000 to producers and consumers by 2015, of which more than half would accrue to Nigeria. Similarly, a onetime 3% increase in rice productivity in three focus countries (Nigeria, Ghana and Mali) would result in a regional benefit of over US$ 1,000,000 (including spillover) by 2015, of which over half would accrue to Nigeria. Therefore, putting this into perspective, there is a need to find the right balance between output growth, price and quality without falling back in traditional patterns, only then will the Nigerian rice sector will be able to compete favorably with imported rice. Similarly, also it has always been argued that unless rice farmers find ways to increase their lagging productivity and adopt Good Agricultural Practice (GAP), they may not be able to benefit from the economic reforms. In other words, the efforts to improve rice quality in Nigeria are often perceived as a detached prerequisite for benefiting from the economic reforms but farmers poor post harvest operation.

In summary, the policy environment as it affects the Nigeria rice sector is incoherent, unfocussed, not pragmatic and typically based on short-term views. Indeed, institutional memory often seems to be short and many policies reactive instead of proactive.

MATERIAL AND METHOD

The empirical application of the ARDL methodology involves three steps: (i) identifying the order of integration of variables using the unit root tests; (ii) testing for the existence of a unique cointegrating relationship using the bounds testing procedures; and (iii) estimation of the ARDL to obtain the short-run and long-run coefficients.

Data, Integration Properties, and Model Specification: The study covers from 1974 to 2006, and the data were sourced from Federal Office of Statistics (FOS), Food and Agricultural Organization of the United Nation (FAO), Central Bank of Nigeria (CBN) and International Financial Statistics (IFS). Price data are deflated using 2000 consumer's price index. The variable chosen includes rice output, area, real prices of maize and rice, weather and time trend.

A unit roots analysis of each of the time series of the chosen variables were undertaken to ascertain the order of integration. Here, the order of integration for all the variables must be known prior to cointegration analysis, at least to ensure that variable are not integrated of order greater than one Abbott et al. (2000). The Phillip-Perron (1988) unit root test was employed and the results indicate that all variables are non-stationary in levels, but become stationary in first difference at a one percent level except real prices of maize that is stationary in level at 5%. The results of the unit root therefore underscore the presence of nonstationarity in all data series and the results are presented in Table (1).

Table 1: Phillip Perron Unit Root Test

Series	Level	First difference	Conclusion, I(d)	Lag
Area	-1.88	-6.134 ***	I(1)	3
PRice	-2.47	-4.908***	I(1)	2
PMaize	-3.79 **	-6.493***	I(1)	1
Output	-1.89	-6.321***	I(1)	3
Weather	-2.66	-8.193***	I(1)	3

The unit root equation includes a constant and time trend for level series, but only includes a constant for first differenced series. *** P<.01, **P<.05, *P<.10 (one-tailed test) based on critical values for rejection of the hypothesis of a unit root by MacKinnon (1991).

Therefore, having known that order of integration, the model is specified as rice output supply is a function of area planted, real price of rice and maize, weather and Time trend dummy. The inclusion of real price of maize in the model is to capture inter crop competitiveness. Which implies any increase in real price of maize will attract farmer to shift from rice to maize production and vice versa.

The impact of weather on rice yield variability is measured with a Stalling index (Stalling, 1960). Yield is regressed on time to obtain expected yield. The weather variable is then defined as the ratio of the actual to the predicted yield. This index captures the direct effects of weather such as rainfall and temperature as well as the yield risk in supply response model. Data on infrastructural developments, expenditure on agricultural research and extension, applications of modern techniques like fertilizers and improved rice varieties etc, are hardly available particularly in developing countries like Nigeria. Therefore, these variables cannot be easily represented in the rice supply response equations directly and individually. An attempt is made to capture their effects collectively by introducing time-trend dummy variable.

$$Output_t = \alpha_0 + \alpha_1 Area_t + \alpha_2 PRice_t + \alpha_3 PMaize_t + \alpha_4 Weather + \alpha_5 Trend + \varepsilon_t \qquad (1)$$

All variables except trend and weather are in the natural logarithm form, α_1 α_2 α_3 α_4 and α_5 are the coefficients to be estimated.

The ARDL Cointegration Approach: Most empirical estimations of agricultural supply response are based on the Nerlove (1958) model, which captures the dynamics of agriculture by incorporating price expectations and adjustment costs. This model has been widely criticized because of the possibility of giving spurious regression as a result of non-stationarity of time series (McKay et al., 1999) and ad hoc assumptions. Therefore considering of these limitations, the current study utilizes the new developments of econometric techniques analysis that can estimate distinct short-run and long run elasticities to overcome the problem usually encountered in the traditional Nerlovian model. The cointegration analysis employed only requires a co-movement of domestic rice output supply and all chosen variables in the both short and long run. Nickell (1985) shows that the Error Correction Model (ECM) cointegration analysis can be derived from the minimization of inter-temporal quadratic loss function, thus incorporating forward-looking behavior by agricultural producers.

The most widely known single equation approach to cointegration is the Engle-Granger two-step procedure. This approach has been widely criticized because of some limitations. Firstly, it ignores short-run dynamics when estimating the cointegrating vector. Secondly, when short-run dynamics are complex, it often biases the estimate of the long-run relationship in finite samples. To counter these limitations, Pesaran et al. (2001) has introduced an alternative cointegration technique known as the 'Autoregressive Distributed Lag' or bound test. It has been argued that ARDL has a numerous of advantages over conventional Johansen cointegration techniques. Firstly, the ARDL is a more statistically significant approach for determining cointegrating relationships in small samples, while the Johansen co-integration techniques still require large data samples for the purposes of validity. A further advantage is that while other cointegration techniques requires all of the regressors to be integrated of the same order, the autoregressive distributed lag approach overcomes some of these problems by providing a feasible application on mixed regressors and also captures both short run and long-run dynamics when testing for the existence of cointegration. Another difficulty of using Johansen cointegration technique, which the ARDL avoids, concerns the large number of choices that must be made. These include decisions regarding the number of endogenous and exogenous variables (if any) to be included, the treatment of deterministic elements, as well as the order of VAR and the optimal number of lags to be specified. The empirical results are generally very sensitive to the method and various alternative choices available in the estimation procedure (Pesaran and Smith, 1998). Finally, with the ARDL it is possible that different variables have differing optimal number of lags; while in Johansen-type models this is not possible. Therefore following Pesaran and Pesaran (1997), the ARDL procedure is represented by the following equations:

$$\varphi(L,P)Y_t = \sum_{i=1}^{k} \mu_i (L, q_i) X_{it} + \delta' W_t + e_t \qquad (2)$$

Where $\varphi(L,P) = 1 - \varphi_1 L - \varphi_2 L^2 - \cdots \varphi_p L^p$ and $\mu_{i}(L,q_i) = \mu_{i1} L - \mu_{i2} L^2 - \cdots \mu_{iq_i} L^{q_i}, i = 1, 2, \ldots k$

Y_t denotes the dependent variable, X_{it} is the independent variables, L is a lag operator and W_t is the S×1 vector representing the deterministic variables employed, including intercept terms, time trends and other exogenous variables. The optimum lag length is generally determined by minimizing either the Akaike Information Criterion (AIC) or the Schwarz Bayesian Criteria (SBC). Using the ARDL general specific model, the long-run coefficients and their asymptotic standard errors are then obtained. The long-run elasticity can then be estimated as follows:

$$\vartheta = \frac{\beta_{i0} + \beta_{i1} + \ldots + \beta_{qi}}{1 - \varphi_1 - \varphi_2 - \cdots \varphi_p} \qquad \forall i = 1, 2, \ldots, k \tag{3}$$

and the cointegrating vector is given by:

$$Y_t - \vartheta_0 - \vartheta_1 x_{1t} - \vartheta_2 x_{2t} - \cdots \vartheta_k x_{kt}\ \varepsilon_t \quad \forall t = 1, 2, \ldots, n \tag{4}$$

Therefore, the constant term is equal to:

$$\vartheta = \frac{\lambda_0}{1 - \varphi_1 - \varphi_2 - \cdots \varphi_p} \tag{5}$$

Rearranging equation (2) in terms of the lagged levels and first differences of Y_t, X_{1t}, $X_{2t} \ldots X_{kt}$ and W_t obtain the short term dynamics of the ARDL as follows:

$$\Delta Y_t = -\varphi(1,\beta)\, EC_{t-1} + \sum_{i=0}^{k} \mu_{i0}\, \Delta X_{it} + \Delta w_t \sum_{j=1}^{\beta-1} \omega^* Y_{t-j} - \sum_{i=1}^{k} \sum_{j=1}^{q_{i-1}} \mu_{ij}{}^* \Delta X_{it-j} + \varepsilon_t \tag{6}$$

And finally, the error correction term can be define as follow

$$\text{where } EC_t = Y_t \sum_{i=0}^{k} \vartheta_i X_{it} - \omega' w_t \tag{7}$$

In equation (5) ω*, δ* and μ_{ij}* are the short-run dynamic coefficients and φ (1β) denote the speed of

adjustment.

Empirical Result Based on the (ARDL) Approach

Since all observations are annual and the number of observations is limited to 33 sample size, a lag structure of 1 was chosen. The reduced form equation implies that domestic rice output supply is a function of its own lagged value and prices. We estimate equation (6), where *ECT* is the error correction term captures short-run dynamics as well as incorporating the forward-looking behavior. As stated previously, one of the most important advantages for applying the ARDL model is the choice and the order of the distributed lag function. The representation of the ARDL model is given as;

$$\Delta lnOutput_t = \alpha_0 + \sum_{i=0}^{l} b_j \Delta lnArea_{t-j} + \sum_{i=0}^{l} c_j \Delta lnPRice_{t-j} + \sum_{i=0}^{l} d_j \Delta lnPMaize_{t-j} + \sum_{i=0}^{l} e_j \Delta lnOutput_{t-1} + \delta_1 lnOutput_{t-1} + \delta_2 lnPRice_{t-1} + \delta_3 lnPMaize_{t-1} + \delta_4 lnArea_{t-1} + \varepsilon_t \quad (8)$$

Where Δ denotes the first difference. The parameter δ_i where *i=1, 2, 3, 4,* is the corresponding long-run multipliers, whereas the parameters b_j, c_j, d_j and e_j are the short-run dynamic. The direction of the relationship between domestic rice output supply response to its real price and other variables are determined by analyzing the null hypothesis of no cointegration through a joint significance test of the coefficient of lagged dependent variables. Under the null hypothesis of (no cointegration) $HO: \delta_1 = \delta_2 = \delta_3 = \delta_4 = 0$ and alternative hypothesis (a cointegration) $Ha: \delta_1 \neq 0, \delta_2 \neq 0, \delta_3 \neq 0, or\ \delta_4 \neq 0,$ the asymptotic distribution of F-statistic obtained from bound test is non-standard regardless of the degree of integration of the variables. The critical values tabulated by Narayan (2005) are calculated for the different number of regressors and whether the model contains an intercept and or a trend. According to Banmani-Oskooee and Nasir (2004), these "critical values include an upper and a lower band covering all possible classifications of the variable into *I(1)* and *I(0)* or even fractionally integrated". If for a chosen significance level, the computed F-statistic exceeds the upper bound, the null hypothesis of no co-integration can be rejected. If the F-statistic is inferior to the lower bound, the null hypothesis of no co-integration cannot be rejected.

Table 2: Testing for the Existence of Long Run Relationship (Wald Test) 1974-2006

Dependent variable	Output	Area	PRice	PMaize
F-Statistic	5.78***	5.62	2.14	2.64

The reported asymptotic critical value bounds are obtained from Narayan (2005) critical values of unrestricted intercept and trend for K=5, * P< .01 (Wald test) for rejection of null of no cointegration.

When the F-statistic falls between the two bounds, a conclusive inference cannot be made. The calculated F-Statistics is 5.78 when Output is used as dependent variable, which is significant at 0.05% implying that alternative the hypothesis of cointegration could be accepted. The calculated the F-statistic when *Area, PRice*, and *PMaize* appear as a dependent variable in the testing procedure and the results are presented in table (2); weather and trend variables are excluded from the bound testing procedure because they are assumed to be weakly exogenous. It is concluded that there is cointegration among the variables when Output appear as dependent variable at 0.05%. After establishing cointegration in model, ordinary least square regression was employed to investigate the long run coefficients and short run elasticity. The results are both presented in Table 3.

Table 3: Short-run and long-run elasticities of Rice supply Response 1974-2006

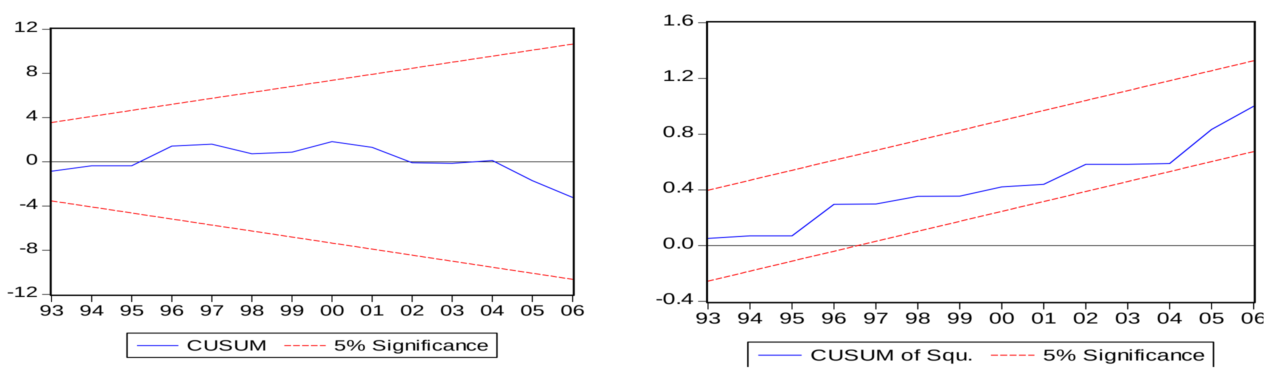
	Short-run elasticities		Long-run elasticities	
Variable	Coefficient	Standard Error	Coefficient	Standard Error
Area (-1)	0.502	0.422	0.560***	0.154
PRice			-0.329**	0.146
PRice (-1)	0.043	0.147	0.271**	0.133
PMaize			0.288*	0.161
PMaize (-1)	0.067	0.134	-0.066	0.146
Output (-1)	-0.409	0.280		
Weather	0.001***	0.000	0.001***	0
Trend	0.053***	0.011	0.037**	0.015
Intercept	6.048***	1.417	3.370***	1.8
ECM	-0.575 ***	0.120		
Diagnostic Test				
Adjusted R-squared	0.514		0.958	
ARCH Test:(1)	0.05 {0.89}			
Serial Correlation LM Test:	0.015 {0.72}			
Jarque-Bera	0.89 {0.64}			
Prob(F-statistic)	0.00		0.00	

***, **, * statistically significant at 1%, 5% and 10%, numbers in parenthesis are the p-values

Diagnostic tests for serial correlation, normality and structural stability (sensitivity analysis) are considered in this study and the results show that the short-run model passed all the diagnostic tests. The LM test shows that there is no evidence of autocorrelation and that the model passes the test for normality test, the error term is also normally distributed. The ARCH (1) test results also indicate the presence of no autocorrelation. Perman (1991) noted that cointegration analysis could serve as a misspecification test to guide variable selection in empirical macroeconomics. The stability of the long-run coefficients together with the R^2-adjusted (goodness-of-fit) explains above 95% variation for the long run equation and about 60% for the short run equation.

Finally, when analyzing the stability of the short-run dynamics and the estimated coefficients of the ECM, the cumulative sum (CUSUM) and the cumulative sum of squares (CUSUM) are applied, and the result in Figure 3 shows that they are within 5% boundary. However, Bahmani-Oskooee (2001) stated the null hypothesis (i.e. that the regression equation is correctly specified) could not be rejected if the plot of these statistics remains within the critical bound of the 5% significance level. As it is shown in Figure 3, the plots of both the CUSUM and the CUSUMQ are within the boundaries and hence these statistics confirm the stability of the long-run coefficients in the model.

Figure 3: CUSUM and CUSUM of Squares Tests (from Table 3)



Interpreting these results, we find many interesting implications; Firstly, the results showed that domestic rice is price inelastic both in the short and long run, meaning that domestic rice is not responsive to real price changes. Such findings compared favorably with similar past studies focused at the aggregate or elsewhere in the region. Therefore, if inelastic price effects are interpreted to mean that farmers are not responsive to prices, then by and large Nigeria rice farmers fit that description, and the sub regional rice farmers are not far behind

Secondly, the coefficients of weather variable remains the outstanding factors in determining of domestic rice output supply response in both long and short run, which shows crop production in Nigeria are still largely influenced by weather variability. The area response is statistically significant in the long run, this further confirm that significant improvement in domestic rice production in recent years was achieved through intensification of land area. The coefficients of the error correction term indicate the speed of the adjustment, which restores equilibrium in the dynamic model. According to Bannerjee et al (1998) highly significant error correction term is further proof of the existence of a stable long-term relationship. The result shows that the expected negative sign of ECM is highly significant at 1%. This further confirms once again, the existence of the cointegration relationship in the models. The error correction term of -0.575 indicates a high speed of adjustment towards the long-run equilibrium. The result also shows that rice output supply response is sensitive real prices of maize although not significant but the sign indicated. Finally, the trend dummy variable is positive and significant at the 5% level, indicating rice output increased in response to technology.

This study, therefore, recommends the following; Nigeria trade policy on rice sector should be appraised periodically and ensures that policies are based long term ‘inward looking strategies” not short term views. The country should also take advantage of the opportunities offered by the sub-regional Organizations such as Economic Organization of West Africa State (ECOWAS) and the regional initiative NEPAD to promote rice production. NEPAD has placed emphasis on agricultural development, through its Comprehensive Africa Agricultural Development Programme (CAADP), which has a goal to attain an agricultural growth rate of 6%.

Effort should be made to disseminate New Rice for Africa (NERICA) to the rice farmers and ensure that farmers’ production conformed to Good Agricultural Practice (GAP).

CONCLUSION

The paper uses the autoregressive distributed lag approach to estimate the responsiveness of rice output supply to real prices in Nigeria. Rice output is regressed as a function of area, its own price and the prices of maize, weather and time trend. The data employed spans different policy regimes from 1974 to 2006. The result shows that rice output supply response in Nigeria is largely depends on its own price and other aforementioned variables, However, the response of area and weather remains outstanding for rice output growth in Nigeria. The estimated short-run and long run elasticities indicate that the domestic rice supply response to price is inelastic.

This is not surprising because changes in patterns of supply and demand operate through price mechanism. An increase in demand will be reflected in an increase in price, necessitating changes in supply and vice-versa. Nonetheless, it should be noted that, price alone has limited influence on farmers' resource allocation decisions, external factors, such as government agricultural and trade policies as well as weather conditions is critical for output supply.

Weather remains one of the most important uncontrollable variables involved in agricultural production Systems, the estimated result shows that weather plays a critical role in rice production in Nigeria both short and long-run term. Rice yields are mainly affected by rainfall conditions throughout the production period and by the number of times the crop is harvested. Rainfall is often one of the most important variables influencing yield and production of a given crop in sub-Sahara Africa countries. This implies that, in as much as rice farmers respond to prices, such exogenous variables such as rainfall and other weather do have a daunting influence on yield. Fortunately Nigeria's has Fadamas, which can be expanded to ensure regular water supply while dysfunction irrigation, infrastructures and dams should also be repaired.

The result shows that past prices do influence current production as much as rationally generated prices do, price of competing crop as well as trend. These led to conclusion that Nigerians rice farmers generally utilize most of the available information, such as changes in supply-demand, other market conditions, government policies, weather conditions in forming expectations about the future prices and production. The significance of the lagged price elasticity reinforces the belief that agricultural producers have adaptive price expectations, which tends support to the Nerlove price expectations model.

In conclusion, for domestic rice supply to be responsive to real prices rice production needs to be mechanized, positive price and other non price incentives are considered necessary as well as. Therefore, instituting price reform policy measures before some of the essential non-price reforms have been fully initiated may prove "abortive or gap in policy" and may have long term in impact on output growth and food security. The study therefore recommends that an improved policy package that encompasses price and non price incentive as well as transmission mechanism is needed to elicit a better response from rice farmers.

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