DETERMINANTS OF RISING PRICE OF YAM IN NIGERIA: TIMES-SERIES APPROACH

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ABSTRACT

With a contribution of up to 71% to world output of yam, Nigeria remains the largest producing country with rural farmers having yam as second most commonly harvested tuber crop. Given its nutritional superiority to most roots and tubers in terms of digestible proteins and minerals and its relevance as a source of income for the poor majority of rural-farmers, the importance of yam in Nigeria cannot be overemphasized. There has however been a persistent price increasein yam, as well as other food commodities, in Nigeria. This study was therefore designed to investigate the determinants of rising yam price in Nigeria over the period 1970-2015. The study relied on time-series data sourced from FAOSTAT, Federal Bureau of Statistics and CBN Bulletin. Inferential statistics including unit-root test, cointegration and error correction model were employed in analysis. Autocorrelation was present in the model hence necessitating Cochrane-Orcutt approach. Results indicated that variables were non-stationary but became stationary after first differencing.At 5% significance level, on the long run, price of yam was determined by annual production (coef.=-0.8095), GDP (coef.=-3.009) and annual money supply (coef.=0.829). It is consequently recommended that programmes and strategies implemented to boost food production in Nigeria should be carried on viz-a-viz robust economic planning that keeps the significant macroeconomic variables at optimal levels in order to maintain the balance required for stabilization in food commodity prices. Likewise, efforts should be concerted in putting insurgency in Nigeria under checks considering the ill effect it has on farming and trading activities.

KEYWORDS: Autocorrelation, Cochrane-Orcutt, Cointegration, Error Correction Model, Yam

INTRODUCTION

The edible yam (Dioscôrea species) is one of the carbohydrate foods in Sub-saharan Africa and is nutritionally superior to most roots and tubers in terms of digestible proteins and minerals (Ca, Mg, and P) (Green, 2003; Chukwu and Nwosu, 2008). According to Mbah (2010), Yam is a preferred staple food, appreciated for its taste and cultural role as yams have high relative value per unit of land used in their cultivation, when compared with other crops.With a contribution of up to 71% to world output of yam, Nigeria remains the largest producing country with rural farmers having yam as the second most commonly harvested tuber crop and fifth most-widely harvested crop in Nigeria.

Yams are so widely acceptable in Nigeria to such an extent that so many indigenous communities have earmarked specific dates to carry out festivals which may be likened to a yearly unveiling of yam which is not the norm for other staples that they produce. General Household Survey Panel carried out by the NBS and World Bank in 2010/2011 affirmed that Yams are an integral component of food consumption and agriculture sales in Nigeria. Based on the 2011 Living Standard Measurements Study-Integrated Surveys on Agriculture (LSMS-ISA) Project carried out following the household survey, it was further revealed that yams' role differs for the poor and non-poor. Relatively better off households are consuming more yams (particularly those acquired through purchases), but selling less harvested yam than poorer households. Whereas, the poorer households

consume fewer yams, but depend more heavily on yam sales and income than their richer counterparts. Interestingly, this study further revealed that yams represent over 12 percent of total agricultural income from staple foods in Nigeria.

Across yam belt of Nigeria, yam commands the highest socio-cultural value among food crops (Orkwor *et al.*, 1998). In West Africa, yams are major sources of income and have high cultural value. They are used in fertility and marriage ceremonies, and a festival is held annually to celebrate its harvest (IITA, 2015). The place of yam in food security cannot be over emphasized in Nigeria. According to Ajibade *et al.*, (2014) yam, a well acceptable staple food, forms the basic carbohydrate component for people as it is found in the food basket of many Nigerians, contributing to the caloric requirement in the diet of the people. Yam plays an important role in diversified cropping system therefore it may impact food security since growing a single crop can result in complete crop failure when unpredictable harsh weathers, pest or diseases suddenly affect crops.According to Akangbe *et al.* (2012,) yam production serves as a source of income generation to peasant farmers and the labourers who work on yam farms as well as for those that engage in its sale, the itinerant traders who assemble the crop from village to village, and the urban center marketers who retail the commodity. Babaleye(2003), opined that yam contributes more than 200 dietary calories per capitadaily for more than 150 million people in west Africa while serving as an important source of income to the people. The contribution of yam to food security as well towards improving the Nigerian economy cannot be overemphasized. A very tangible percentage of the rural farmers living in the yam belt of Nigeria are involved with yam production and hence have their source of livelihood from related activities while on the other hand, they provide the populace with this important energy source in their daily diets.

Over the years, like most other crops, the prices of yams in Nigeria has mostly been on an upward trend with the rising prices affecting the consumers mostly. In recent times, the recession experienced in Nigeria has brought about hardships for substantial proportion of the population who in most cases are living below the poverty line. The rising cost of food commodities has not really impacted positively on farmers in terms of higher revenues considering the rising costs of other components of daily living which erodes such benefits even faster than they are amassed. It therefore becomes pertinent to understand the factors that have been driving food prices higher in Nigeria over the years. This study focuses on yam having established the relevance of the crop to livelihood and food security in Nigeria. This study was therefore designed to examine the determinants of rising prices of yams in Nigeria over the period 1970-2015. The study is justified by the fact that having insight into the dynamics that have driven food cost over the years will furnish one with information required to enable better positioning as a nation to tackle the soaring prices of food commodities in Nigeria.

MATERIALS AND METHODS

The study area was Nigeria. The country is a federal constitutional republic comprising 36 states and its Federal Capital Territory, Abuja. The country is located in West Africa on the Gulf of Guinea and has a total area of 923,768 km^2 (356,669 sq mi). The population is growing rapidly, rising from 88.9 million people in 1991 to 140 million in 2006 and 193.4 million in 2017 (NPC, 2017). Nigeria is endowed with rich natural resources, of which oil and gas have been the mainstay of the economy in the last few decades, providing 20% of GDP, 95% of foreign exchange earnings, and about 65% of budgetary revenues (World Facts, 2012). About 70% of the population are engaged in agricultural production. However, the largely subsistence agricultural sector has failed to keep up with rapid population growth, and Nigeria, once a large net exporter of food, now must import food (World Bank, 2015). This study engaged time series data sourced from Food and Agriculture Organization statistical data base for United Nations, publications of National Bureau of Statistics and Central Bank of Nigeria. Times series data spanning 1970-2015 were used in this study. In order to examine the determinants of yam prices in the long- and short-run periods which were the aim of the study, various econometric tools were used. Prior to investigating the determinants of yam price over the study period, the time series data were first subjected to unit root test which is a basic preliminary test carried out on time series data to establish the order of integration of the variables included in the

model. In this study, the augmented dickey fuller test (Dickey and Fuller, 1979) was employed in testing for unit root in the variables. Following establishing the order of integration of the modelled variables, the cointegration test was carried out which was to investigate whether time series of the modelled variables display a stationary process in a linear combination despite presence of non-stationarity characteristics in the different variables. This study engaged the two stage Engel-granger procedure (Engel and Granger, 1987).

The results from this procedure were subjected to diagnostic testing to identify the presence of challenges of heteroskedasticity, autocorrelation, multicollinearity in the specified model and only autocorrelation was observed to be present in the model. This therefore necessitated the approach of Cochrane-Orcutt towards the analysis in order to solve for autocorrelation and hence validate the results obtained.

The presence of cointegration would imply the existence of long run relationship between the dependent and independent variables indicating that at least one of the variables modelled react to deviations from the long-run relationship. Following the establishment of the presence of long run relationship among the variables, the error correction model was specified in order to determine the roles of the modelled independent variables in correction for disequilibrium.

The linear regression model used in order to investigate the determinants of the prices of yam in the period under investigation is considered to be of the general form specified as:

$$\text{Ln } Y_{yi} = \beta_0 + \beta_1 LnX_{1yi} + \beta_2 LnX_{2yi} + ... + \beta_9 LnX_{9yi} + D_{1yi} + D_{2yi} + \varepsilon_i, \quad i = 1,2,...,46 \quad .....(i)$$

While, the short run dynamicsbetween the exogenous variables and the price of yam is specified as:

$$\Delta LnY_{yi} = \theta_0 + \theta_1 \Delta LnX_{1yi} + \theta_2 \Delta LnX_{2yi} + ... + \theta_9 \Delta LnX_{9yi} + \theta_{10} D_{1yi} + \theta_{11} D_{2yi} + \theta_{12} ECT_{yi-1} + \tau_{mi} \quad .....(ii)$$

Where Y_{yi} = Annual producer price of yam (₦/Tonne), X_1,= Annual Production of yam (Tonnes); X_2= Annual harvested hectarage of yam (Ha), X_3= Annual World price of yam ($/Tonne), X_4 = Gross Domestic Product (2005 prices), X_5= Annual Money Supply(₦), X_6= Annual Interest rate %, X_7= Annual USD:₦ Exchange rate, X_8 = Crude oil Prices ($/barrel), X_9 = Constant Price Inflation %, D_1 = Insurgency (1 for yes; 0 otherwise), D_2= Liberalization era (1 for Post; 0 for Pre), ε_i = Stochastic error term and $\varepsilon_i \sim$ iid $(0,\sigma^2)$, ECT_{yi-1} is the error correction term and τi is the error term from static regression equation (i). The significance of ECT_{yi-1}, is that there exists adjustment mechanism of yam price as the response to the changes in the exogenous variables modelled in the study.

RESULT AND DISCUSSION

Result of the Augmented Dickey Fuller Unit root test is as shown in Table 1. This test revealed that the variables were non-stationary but became stationary after first differences which implies they are integrated of order one i.e. I (1) which is an authentication to carry on the analysis as planned.

Table 1: Summary of the Unit Root Stationarity Tests Using Augmented Dickey Fuller (ADF) Statistics (Yam Study)

			Levels		*First Differences*	
Variable Description	**Variable**	**Statistics**	**RWC**	**RWCT**	**RWC**	**RWCT**
Yam Annual producer Price	Ln Y_y	t Stat	-1.2518	-0.6748	-8.2933	-8.3827
		P value	0.6434	0.9688	0.0000***	0.0000***
Yam Annual Production	LnX_1	t Stat	-0.6062	-1.9199	-6.3420	-6.4854
		P value	0.8586	0.6269	0.0000***	0.0000***
Yam Annual Harvested Hectarage	Ln X_2	t Stat	0.0678	-3.3388	-4.4424	-4.8210
		P value	0.9596	0.0731	0.0010***	0.0018***
Annual World Price of Yam	Ln X_3	t Stat	-2.6407	-2.9057	-9.0137	-9.0812
		P value	0.0926	0.1704	0.0000***	0.0000***
GDP 2005 Prices	Ln X_4	t Stat	1.1341	-0.4119	-4.6804	-4.9741
		P value	0.9972	0.9841	0.0004***	0.0011***
Annual Money Supply	Ln X_5	t Stat	-1.4891	-2.2031	-4.1092	-4.2748
		P value	0.5298	0.4762	0.0024***	0.0078***
Annual Real Interest Rate	Ln X_6	t Stat	-2.1997	-3.2269	-8.2184	-8.1375
		P value	0.2095	0.0934*	0.0000***	0.0000***
Annual Official Exchange rate	Ln X_7	t Stat	-0.2531	-1.6111	-5.4884	-5.4231
		P value	0.9236	0.7728	0.0000***	0.0003***
Annual Crude Oil Prices	Ln X_8	t Stat	-2.5140	-2.3114	-6.2716	-6.3623
		P value	0.1191	0.4193	0.0000***	0.0000***
Constant Price Inflation	Ln X_9	t Stat	-2.4125	-2.6690	-6.7908	-6.7114
		P value	0.1447	0.2541	0.0000***	0.0000***

Note: RWC – Random Walk model with Contant RWCT- Random Walk model with constant and Trend
Significance at 1%***, 5%** and 10%*
Source: Data analysis, 2016

Cointegration analysis, using the Engel-Granger procedure, indicated the presence of autocorrelation in the model given a Durbin Watson value of 1.5719 (result not presented). It therefore became pertinent to incorporate the Cochrane-Orcutt approach into the cointegration in order to solve for autocorrelation. The rho value used in differencing the variables under the Cochrane-Orcutt approach was 0.3373 and this was obtained at the tenth iteration. Subsequently, the Durbin Watson statistic indicates an appreciable increase from 1.5710 to 1.9867 revealing that the autocorrelation previously existing in the model had been resolved. The long-run dynamic relationship that truly existed among the variables is therefore presented in Table 2.

Table 2: Results of the Co-integration Regression showing the Determinants of Yam Prices in the Long Run Period (Cochrane-Orcutt Approach)

Variable	*COCR est.*	*Std. Error*	*t-ratio*	*p-value*
Const	5.9575**	2.7859	2.1385	0.0400
LnYam production	-0.8095**	0.3304	-2.4503	0.0198
LnYam harvested	0.5179*	0.3047	1.6997	0.0986
LnYam World Average	0.2112	0.2197	0.9613	0.3434
LnGDP2005	-3.0090***	0.5735	-5.2470	<0.00001
LnAnnual Money	0.8290***	0.2019	4.1055	0.0003
LnRealintrate	0.0003	0.0014	0.2285	0.8207
LnOff exchange Rate	0.1985	0.2181	0.9098	0.3695
LnCrude Oil price	0.1321	0.2254	0.5859	0.5619
LnConstant price Infl.	-0.0871	0.0856	-1.0185	0.3159
Insurgency	-0.0554	0.0755	-0.7337	0.4683
Trade liberalization	-0.0398	0.1543	-0.2577	0.7982

Statistics based on the rho-differenced data:			
R-squared	0.9881	Adjusted R-squared	0.9841
lF(11, 33)	107.2328	P-value(F)	1.52E-22
Rho	0.0568	Durbin-Watson	1.9867

Source: Data analysis, 2016

The result revealed that the annual money supply, gross domestic product and yam production were significant at 5 percent. The gross domestic product can be seen to have a negative influence on the price of yam. A unit increase in the GDP resulted in 3.009 units decrease in the price of yam. One unit increase in the annual money supply resulted in an increase in yam price by 0.8295unit. This aligns with the findings of Faheem and Dilawar (2015), in a study carried out to examine the determinants of food price inflation in Pakistan where it was observed that the GDP has a negative influence on food price inflation. Yam production had a negative influence on the price of yam and a unit increase in yam production brought about 0.8095unit decrease in the price of yam. In line with *a priori* expectation, GDP has a negative influence on yam price. This may be attributed to the fact that an increase in the GDP indicates a thriving economy due to increased production across diverse sectors. Increase in production may account for the observed lowered prices as a result of excess supply over demand. Increase in yam price as annual money supply increased is consistent with *a priori* expectation and economic principles because the increase in money supply may in some cases lead to inflation which will cause more money to be available. Without a corresponding increase in output, this may result in a rise in general price level, that of yam inclusive. Production of yam was observed to have negative influence on the price of yam since rise in production is more likely to result in excess supply over demand situation hence lowering prices to attain market equilibrium. In order to examine the determinants of yam prices in the short run, the error correction model was estimated and the result is as shown in Table 3.

Table 3: Summary of Error correction model results showing determinants of Yam price in the short run period

Variable	*COCR est.*	*Std. Error*	*t-ratio*	*p-value*
Δ LnYam price/tonne	0.2876	0.2115	1.3599	0.1840
Δ LnYam production	-0.7986**	0.3639	-2.1947	0.0361
Δ LnYam harvested	-0.4504	0.3178	-1.4175	0.1666
Δ LnYam World Price	0.3624	0.2099	1.7266	0.0945
Δ LnGDP2005	-0.0647	1.1225	-0.0576	0.9544
Δ LnAnnual Money	0.2589	0.3194	0.8108	0.4239
Δ LnRealintrate	0.0001	0.0011	0.0732	0.9421
Δ LnOff exchange Rate	0.5544**	0.2301	2.4100	0.0223
Δ LnCrude Oil price	-0.0810	0.2044	-0.3961	0.6948
Δ LnConstant price Infl.	0.0612	0.0735	0.8323	0.4118
Insurgency	0.1587**	0.0769	2.0624	0.0479
Trade liberalization	0.0230	0.1457	0.1579	0.8756
ErrCOCR(-1)	-0.6808**	0.2802	-2.4297	0.0213

R-squared	0.7514	Adjusted R-	0.6570
F(14, 30)	2.6341	P-value(F)	0.0127
Log-likelihood	34.5065	Akaike	-41.0131
Schwarz criterion	-16.0344	Hannan-Quinn	-31.7498
Rho	-0.0005	Durbin-Watson	1.9931

Source: Data analysis, 2016

From table 3, it can be observed that yam production, official exchange rate, insurgency and the error correction term were significant at 5 percent. The annual yam production has a negative influence on the price of yam. One unit increase in yam production resulted in 0.7985 unit decrease in the price of yam. Official exchange rate was shown to positively influence the price of yam and a unit increase in the exchange rate resulted in 0.5544unit increase in the price of yam. On the aggregate, the price of yam rose by 0.1587unit in the years when insurgency was recorded.

Production of yam having a negative relationship with the price of yam is in line with apriori expectation as the increase in production will lead to an upward shift in supply which in turn leads to a decrease in yam price. Farmers will find yam exportation more attractive in the event of rising foreign exchange rate. The effect of this will be negatively felt in the quantity of yam supplied and made available for domestic consumption. Shrinkage in the quantity available domestically will therefore result in a rise in prices given an excess demand over supply situation. Insurgency situation in the country has diverse effect some of which include the internal displacement of a good number of farming communities, inaccessibility of concerned farmgates, inability to be involved with trade among some states to mention but a few. This has a resulting negative effect on the price of food commodities.

Contrary to *a priori* expectation, none of the prices of the three food crops examined indicated a significant relationship with crude oil price in Nigeria. Baffes (2007) submitted that some food commodities can be used to produce substitutes for crude oil and this is particularly true for maize and sugar cane in ethanol production and oil seed rape and other vegetable oils for biodiesel production. Gilbert and Mugera (2014) further stated that the attractiveness of production of ethanol and biodiesel, and of the investment in refining capacity to produce these products, depends directly on the price of crude oil hence a relationship is expected between the price of food commodities and crude oil prices. Yam is a substitute for maize being an energy giving food and it is expected that pressure on maize availability arising from its industrial usage will eventually impact on yam and other related food commodities. However, as revealed in this study, there was no significant relationship observed between price of food crops and crude oil in Nigeria.

CONCLUSION AND RECOMMENDATIONS

The study concludes that in the past years, prices of yam in Nigeria have been affected not merely by the level of production of the commodity but even more by macroeconomic variables such as GDP, annual money supply and exchange rate. This is an indication that rising food price needs to be tackled not only from the aspect of production and productivity but also by a more wholistic approach which tends to curtail volatility in food prices through a robust agricultural planning targeted towards the macroeconomic variables that are capable of affecting such food prices. The negative influence of insurgency on yam prices is a pointer to the fact that peace is pertinent to a sustainable food security status of the nation. Based on the foregoing, the study recommends that programmes and strategies implemented to boost food production in Nigeria should be carried on viz-a-viz robust economic planning that keeps the exchange rate, GDP and annual money supply at optimal levels in order to maintain the balance required for stabilization in food commodity prices. It is also recommended that effort should be concerted in putting insurgency in Nigeria under checks considering the ill effect it has on trading and farming activities which result in soaring prices.

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