

F. Agricultural Economics and Extension: Activity I

ANALYSIS OF SUGAR IMPORTATION AND SUGARCANE PRODUCTION IN NIGERIA

G.O. Akinsola

INTRODUCTION

Sugarcane, (*Saccharum officinarum*) is an important crop in the world because of its nutritional and industrial value. This highly productive crop is used as a main source of sugar and more recently to produce ethanol (a renewable transportation bio-fuel). As at 2017, the estimated sugarcane production of Nigeria was put at about 1.49 million tons (FAOSTAT, 2018). This figure includes sugarcane for both domestic and industrial use. Busari and Mlisari (2007) noted that sugarcane produced for domestic use was more than that produced for industrial uses, hence chewing sugarcane accounts for between 55-65% of the total sugarcane production. More of the sugarcane produced for domestic use are chewed raw while some are processed into a variety of products like sugar, molasses, bagasse and sweet (Busari and Mlisari, 2007).

Even though there was vast potential for the commercial production of sugarcane in Nigeria, its processing industry did not come until early 1960 (Abdullahi, 2000). About 1.49 million tons of sugarcane was planted on over 89 thousand hectares in Nigeria (FAOSTAT, 2018). This production is deficient as compared to other nations like Brazil, India, Thailand and China whose production ranged from 100 million to 700 million tons on 1.3 million hectares to 10 million hectares in the same year 2017. Since domestic consumption is mostly unmet, importation of raw sugar has to be done in Nigeria (MAFAP, 2013). According to FAOSTAT (2011), Nigeria's accumulated expense on sugar and sugar products importation in the last 50 years is valued at \$8.188 (N1267.6B) showing that much of the sugar needs have been met through importation. According to FMARD (2011), Nigeria spent ₦217 billion on sugar importation in 2010 alone.

Godwin (2013) noted that there were four major sugar production mills in Nigeria. Collectively, they possess installed capacity of about 120,000 metric tons of processed sugar annually, however, the total domestic production has been between 16,000-50,000 tons annually, satisfying only a meager 5% of the national demand (Ja'afar-Furo, Ahmed & Alsharif, 2013). Poor infrastructure and incentives are the main problem for the production of sugar in large quantity in Nigeria thereby causing her to spend large amount of money on importation. This is why Ja'afar-Furo et al. (2013)

conclusively stated that the sugar industry in the country has been operating below the economic capacity mainly due to general neglect. This study therefore examines the relationship between sugarcane production and sugar importation in Nigeria.

METHODOLOGY

The study area is Nigeria. The study uses time series data spanning from 1987 – 2017 (30 years) sourced from Food and Agriculture Organization (FAO) publications and National Sugar Development Council (NSDC). To analyze the trend in sugarcane production and sugar import, trend analysis and descriptive analysis was used. Trend analysis was used to look for changes in sugar import and sugarcane production over the time series periods. Granger Causality Test was used to determine the direction of causality of sugar importation and sugarcane production in Nigeria. Co-integration analysis was used to analyze the long term equilibrium relationship between the variables.

Model specification

Madala (2001) considered a time series as a collection of random variables (X_t) and such random variables arranged in time is called a stochastic process, which corresponds to a stationary time series. A time series data is stationary if the joint distribution of any set of n observations $X_{t(1)}, X_{t(2)}, \dots, X_{t(n)}$ is the same as joint distribution of any set of $X_{t(1-k)}, X_{t(2-k)}, \dots, X_{t(n-k)}$ for all n and k . A non-stationary time series model is the one where mean U_t is a function of time and it is a weakly stationary series.

According to Gujarati (2004), considering the equation:

$$Y_t = \rho Y_{t-1} + U_t \quad 1 \leq \rho$$

$\rho \leq 1$ where U is the white noise error.

If Y_t is regressed on its lagged value of Y_{t-1} and the estimated ρ is statistically equal to 1 then Y_t is non-stationary that is, it exhibit unit root [I (1)]. On the other if the estimated value of ρ is not statistically equal to 1, the Y_t is stationary that is, has no Unit root [I (0)].

Augmented Dickey-Fuller (ADF) test was used to test for stationarity in the variables.

The ADF test consists of the following regression:

$$\Delta Y_t = \beta_1 + \beta_2 \tau + \delta Y_{t-1} + \alpha \sum_{\tau=1}^n \Delta Y_{t-\tau} + \varepsilon_t$$

Where;

$$E_t = \Delta Y_{t-1} = (Y_{t-1} - Y_{t-2}), \Delta Y_{t-2} = (Y_{t-2} - Y_{t-3}).$$

Granger causality approach as proposed by Granger (1969) is to explain how much of the current Y can be explained by the past values of Y and to see whether the lagged values of X can improve the prediction of Y , of equivalent if the coefficient on the lagged X 's are

lagged X's are statistically significant. This test assumes that the information relevant to the prediction of variables in question is contained solely in the time series data on these variables. The Granger causality analysis used in the study involves the estimation of the following pairs:

$$Y_t = \alpha Y_{t-1} + \sum \beta_i X_{t-1} + U_t$$

$$Y_t = \sum \beta_i X_{t-1} + U_t$$

$$Y = Y_t - Y_{t-1}$$

Where it is assumed that the disturbance terms U_t is uncorrelated

Y_t and X_t are time series

Y_t = Sugarcane production at time t

X_t = Sugar import at time t

U_t = error

By this model, variables that causes the other is identified. This leads to a bivariate regression model with lag variables

$$Y = \beta_0 + \beta_1 + \beta_3 + \beta_4 + \beta_5 + U_t$$

Where Y_t = dependent variable identified by the causality model (W_t or Z_t)

Y_{t-1} , X_{t-1} = lagged dependent and independent variable

U_t = disequilibrium term

According to Gujarati (2004), the regression of non-stationary time series on stationary time series data would produce a spurious result; thus the non-stationary data is transformed by differencing as in equation below

$$\Delta Y_t = Y_t - Y_{t-1}$$

Co-integration Methodology was employed to establish a long run relationship between sugarcane production and climate variables.

The Johansen procedure was used to test for the number of co-integration vectors in the model.

Johansen technique was used not only because it is vector auto-regressive based but because it performs better in multivariate model Maddala (2001).

Fully Modified Ordinary Least Squares (FMOLS)

The FMOLS method was originally introduced and developed by Philips and Hansen (1990) for estimating a single co-integrating relationship that has a combination of $I(1)$. The FMOLS method has an advantage over the EG techniques in introducing appropriate correction to overcome the inference problem in EG method and hence, the t-test for long-run estimates are valid (Himansu, 2007). The Fully Modified Ordinary Least Squares (FMOLS) method utilizes "Kernal estimators of the Nuisance parameters that affect the asymptotic distribution of the OLS estimator. In order to achieve asymptotic efficiency, this technique modifies least squares to account for serial correlation effects and test for the endogeneity in the regressors that result from the existence of Co-integrating Relationships" (Rukhsana & Shahbaz, 2008).

RESULTS AND DISCUSSION

The result of trend analysis, unit root test, Granger causality test and the Fully Modified Ordinary Least Square (FMOLS) are presented in this section.

Trend of Sugarcane Production in Nigeria

Sugarcane production was on a gradual increase from 1987 to 1990, it dropped down in 1992 and maintained a stable level of production to 1993, it fell drastically in 1994 through to 1996, it increased gradually from 1997 to 2006, from 2006 to 2007 it increased greatly. The trend shows a decline in production from 2008 to 2010 in sugarcane production and from 2011 to 2017 it increased gradually. The fluctuation in production might be a result of several programmes such as SAP, which had a great impact on all agriculture in Nigeria.

Trend of Sugar Importation in Nigeria

From 1987 to 1990, the quantity of sugar imported in Nigeria fluctuated. From 1990 to 1991, the quantity of sugar imported increased. 1991 through 1993, the quantity of sugar imported fell drastically. From 1994 through to 2017, it showed a great fluctuation in its movement.

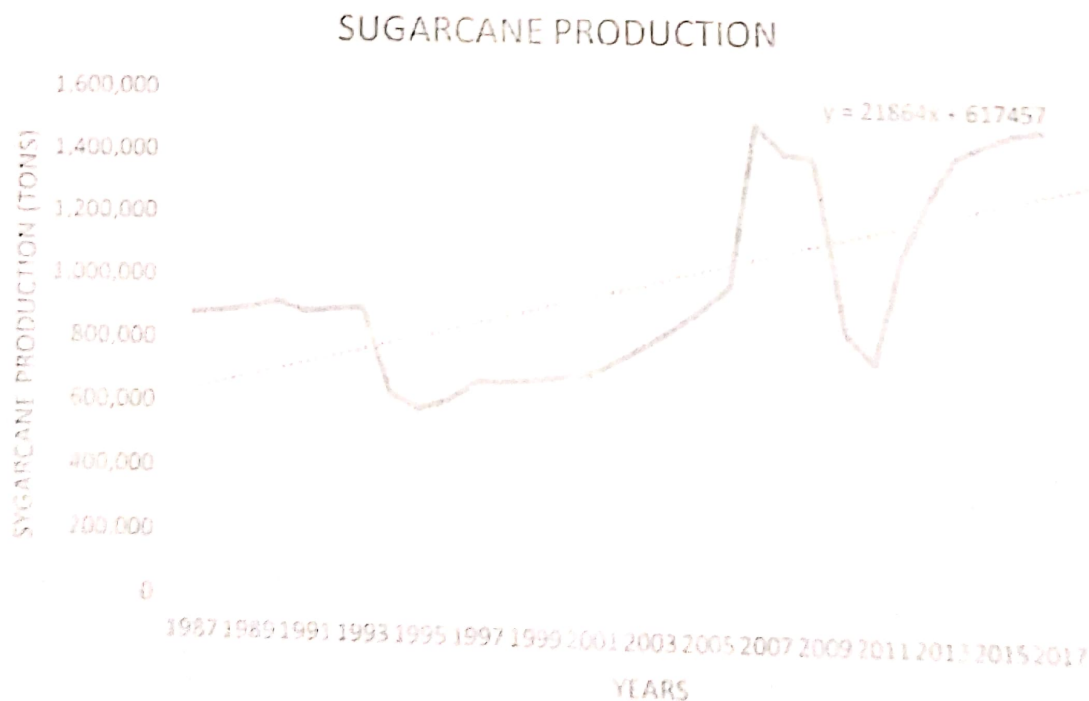


Figure 1: Trend Analysis of Sugarcane Production in Nigeria (1987-2017)
Source: Data Analysis, 2019

Import Tonnes

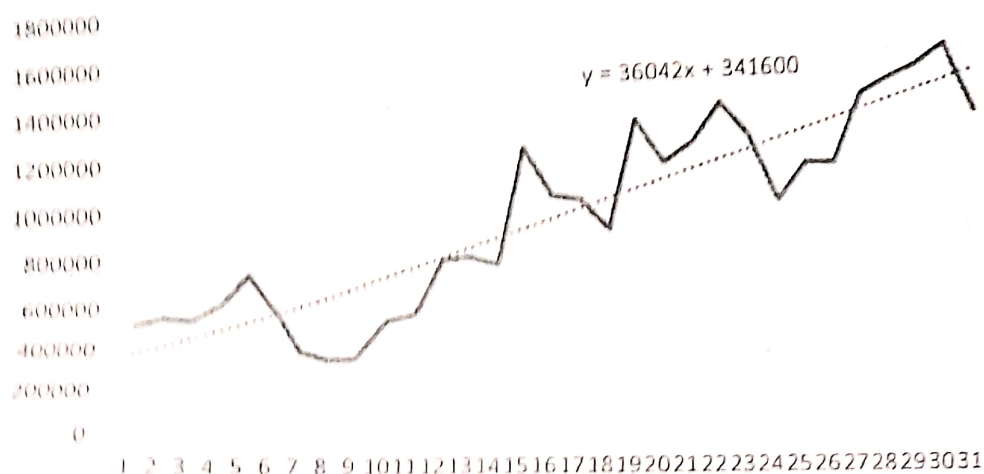


Figure 2: Trend Analysis of Quantity of Sugar Imported in Nigeria (1987-2017)
Source: Data analysis, 2019

Table 4: Result for Granger Causality Test

NULL HYPOTHESIS	F-statistics	Probability	Decision
IMPORTTIONS does not Granger cause SUGARCANEPROD	3.71709	0.0392	Accept
SUGARCANEPROD does not Granger cause IMPORTTIONS	1.97451	0.1607	Accept

Source: Data analysis 2019

From table 4, the result shows that there is no directional running from sugar import tons and sugarcane production.

Result For Augmented Dickey – Fuller Test

Prior to the co-integration test, the ADF test was used to test for stationarity in the variables to use in the co-integration analysis namely; sugarcane production, sugar import (quantity), sugar import (price), exchange rate and inflation.

Variables	Level Series			First Difference			Second difference		
	ADF Statistic	ADF Critical Value	Remarks	ADF Statistic	ADF Critical value	Remark	ADF Statistic	ADF critical value	Remark
Sugarcane production	-1.055901	-2.963972	Unit root	-4.502869	-2.967767	No unit root			
Sugar Import price	-1.176869	-2.963972	Unit root	-6.392673	-2.967767	No unit root			
Exchange rate	0.750008	-2.963972	Unit root	-1.884331	-2.967767	Unit root	-5.652233	-2.971853	No unit Root
Import tons	-1.369368	-2.963972	Unit root	-6.642143	-2.967767	No unit root			
Infla. rate	-3.694405	-2.998064	No unit root						

Source: Data Analysis, 2019

Note : The H_0 is that the series is non- stationary (presence of unit root) against alternative hypothesis H_1 of series being stationary (No unit root). The rejection of H_0 for the ADF test is based on MacKinnon critical values. Lag length were determined in accordance with the SIC.

The time series behavior of each series under consideration using the ADF is presented in the table. The result therefore shows that at level, inflation rate was stationary while Sugarcane production, Sugar import price, Exchange rate and import tons were non-stationary. Then sugarcane production, sugar importation price, sugar import tons except exchange rate were stationary at first difference. At second difference exchange rate became stationary.

Johansen Co-integration Test

The Johansen Maximum-likelihood test approach was employed to ascertain the long run relationship among the variable. The Johansen procedure was preferred because it performs better in multivariate models not only as auto-regressive based according to Maddala (2001). The number of co-integrating relations from all models on the basis of maximum eigenvalue test using critical values at 5% are presented in tables and Note that the Null hypothesis here is that there is no co-integration in the series.

Unrestricted Co-integration Rank Test (Maximum Eigenvalue)

Hypothesized No. of CE(s)	Eigenvalue	Max-Eigen Statistic	0.05 Critical Value	Prob.**
None *	0.890778	59.78815	33.87687	0.0000
At most 1 *	0.647706	28.16878	27.58434	0.0421
At most 2 *	0.558642	22.08325	21.13162	0.0367
At most 3 *	0.516526	19.62245	14.26460	0.0065
At most 4 *	0.160646	4.728326	3.841466	0.0297

Max-eigenvalue test indicates 5 cointegrating eqn(s) at the 0.05 level

* denotes rejection of the hypothesis at the 0.05 level

**MacKinnon-Haug-Michelis (1999) p-values

The result of Johansen's co-integration test reveals that the null hypothesis of no co-integrating equation is rejected by both tests. Both the Trace test and the Maximum-Eigen test indicate five co-integrating equation 5% level. This shows that only five variables are co-integrated. Only one of the co-integrating equations was chosen. The co-integrating equation was chosen based on the conformity of the coefficient with economic theory and its statistical significance. It is then concluded that there is a stable long run relationship between the series.

Fully Modified Least Square

The results of ADF and co integration tests supported that there is a long-run equilibrium relationship between the variables. The next step is to estimate the long-run elasticity using Fully Modified Least Square. Table 5 reports the estimating result from the Fully Modified Least Square analysis. Exchange rate is positive with a coefficient of 488.1872 and it is statistically not significant. This result shows that a unit increase in sugarcane production leads to 29% decrease in quantity of sugar imported.

Dependent Variable: DIMPORTTIONS

Method: Fully Modified Least Squares (FMOLS)

Date: 05/31/19 Time: 10:04

Sample (adjusted): 1990 2017

Included observations: 28 after adjustments

Cointegrating equation deterministics: C

Long-run covariance estimate (Bartlett kernel, Newey-West fixed bandwidth

= 4.0000)

Variable	Coefficient	Std. Error	t-Statistic	Prob.
DEXCHANGERATE	488.1872	1600.241	0.305071	0.7631
DSUGARCANEPROD	-0.290644	0.136513	2.129065	0.0442
DSUGARIMPORTPRI				
CE	-0.001107	0.000310	3.574992	0.0016
INFLATIONRATE	-378.3965	1376.862	-0.274825	0.7859
C	12699.18	34880.74	0.364074	0.7191
R-squared	0.270425	Mean dependent var	26736.07	
Adjusted R-squared	0.143542	S.D. dependent var	187872.4	
S.E. of regression	173866.6	Sum squared resid	6.95E+11	
Long-run variance	1.35E+10			

Result For Granger Causality Test

NULL HYPOTHESIS	F-statistics	Probability	Decision
DSUGIMPORTPRICE does not Granger cause DSUGCANEPROD	0.81430	0.4553	Accept
DSUGPROD does not Granger cause DSUGIMPORTPRICE	2.13810	0.1407	Accept

Source: Data analysis 2019

The result shows that there is no directional running from sugar importation price and sugarcane production. This implies that sugar importation price have no effect on sugarcane production.

CONCLUSION

This study has shown that a long-run relationship exist between the quantity of sugar imported and sugarcane production in Nigeria.

RECOMMENDATIONS

Based on the result of the findings, this study therefore recommends the following;

- The amount of money being spent on importation should be used to expand the technological capacity for producing raw sugar commercially to meet the country's commercial demand.
- Since a unit increase in sugarcane production leads to 29% decrease in quantity of sugar imported, more farmers should be encouraged to venture into the cultivation and production of sugarcane in large quantity.

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