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LONG-RUN AND SHORT-RUN MACROECONOMIC DETERMINANTS OF POTATO EXPORT IN NIGERIA

Onwusiribe, C.N., Mbanasor, J.A. and Agwu, N.M.
Department of Agribusiness and Management, Michael Okpara University of Agriculture Umudike, Abia State, Nigeria

ABSTRACT
This study analyzed the short-run and long-run determinants of potato exports from Nigeria from 1961-2016. The data were sourced from secondary sources. Unit root tests conducted revealed that the variables were integrated at level I(0) and first difference I(1). Autoregressive distributed lag model was used to estimate the long-run and short-run determinants of potato exports. The results revealed that the long-run determinants of potato exports include potato production, world export of potato, inflation, interest rate, gross domestic product (GDP), tariff, exchange rate and potato price. In the short-run, exchange rate is a major determinant of potato export. The stabilization and regulation of macroeconomic variables such as inflation, exchange rate, tariff rate and interest rate will boost the export of potato.

Introduction

Potato is a major source of food for man (for consumption and industrial purposes) and for feeding livestock (Afuakwa, 1996). The consumption of potato are increasing by the day, as Nigeria produces a large quantity of potato for consumption, raw material and export. Potato is very affordable but rich in nutritional values required meeting the dietary demands of the Nigeria fast-growing population and they have high demand in local and international markets. The export and production of potatoes are very vital economic and nutritional therapy for fighting poverty, hunger and malnutrition in a tropical developing economy like Nigeria when properly harnessed to its full potentials. Most of the farming households cultivate root and tuber crops as means of sustainable livelihood (Nteranya, 2015). Though the export potentials of potato has not been utilized optimally due to the lack of knowledge of processing techniques and product development there have some conscious effort to export potato to our neighbouring countries like Niger, Togo, and Benin (FAOSTAT, 2008). The international demand for potato is on the increase especially demand for potato from Asia, but the export of potato is being influenced by some macroeconomic variables such as tariff rate, price, inflation, exchange rate etc. However, the international markets for potato are largely unstable in terms of volume, price and carry a high degree of risk and uncertainty as well as low income elasticity. The performance of agricultural exports in Nigeria has been noted to be very poor. This is due to the neglect of the agricultural and manufacturing sectors following the oil boom, with over valuation of exchange rate, double digit interest rate, misappropriation of credit facilities and fall of the export prices in the world market as well as the country's inability to compete on prices and product quality (Ilegbinosa, Uzomba & Somiari, 2012). This is due to the volatile nature of macroeconomic variables affecting the export of potato from Nigeria making them less competitive globally.

Methodology

The study was carried out in Nigeria. Nigeria is a country located in West Africa along the Atlantic Ocean's Gulf of Guinea, its land borders are with Benin to the West Cameroon and Chad to the East and Niger to the North. It is between latitudes 4^0N and 14^0N and longitudes 3^0E and 15^0E Meridian. Nigeria's equatorial position gives it tropical climate but this does not mean a single environment. It has a tropical climate with

relatively high temperatures throughout the year annual average temperature varying from 35^0c in the North to 31^0C in the south. Temperature is highest from February to April in the South and from March to June in the North and lowest in July and August over most of the country. Nigeria has a land area of about 923,769km^2 (FOS, 1989), a north-south length of about 1450km and west-east breath of about 800km. its total land boundary is 4047km while the coastline is 853km. Nigeria enjoys the humid tropical climate with two clear identifiable seasons, the wet and dry seasons. The climate condition varies among regions: equatorial in the south, tropical in the centre and arid in the north. It is a country of marked ecological diversity and climatic contrast. Nigeria has a population of over 173.6 million people, with diverse biophysical characteristics, ethnic nationalities (more than 250), agro-ecological zones and socio-economic conditions. This study adopted principally secondary data obtained from the Central Bank of Nigeria statistical bulletin, National Bureau of Statistics (NBS), Food and Agriculture Organization database, World Bank Statistical Bulletin, statistical reports and other sources for a period of 1961-2016. Unit Root Test using the ADF test, and Philip-Perron technique to test if the time series data is stationary, the tests were done one by one for confirmation of the presence of constant means and Autoregressive Distributed Lag (ARDL) model were adopted).

Model specification

Unit root test: Augmented Dickey-Fuller (ADF) test (for stationary test)

The ADF test consist of estimating the following regression

$\Delta Y_t = \beta_1 + \beta_1 + \delta Y_{t-1} + \Sigma^m_t=1 \propto_i \Delta Y_{t-1} + e_t$ .... (1)

Autoregressive distributed lag (ARDL)

Basically, the ARDL approach to cointegration (see Pesaran et al., 2001) involves estimating the conditional error correction (EC) version of the ARDL model for potato exports and its determinants:

$$\begin{bmatrix} \Delta(Yl)_t = \alpha_0 + \sum_{i=1}^{p} \phi_i \Delta(Yl)_{t-i} + \sum_{i=0}^{p} \theta_i \Delta(GM)_{t-i} + \sum_{i=0}^{p} \lambda_i \Delta(GDP)_{t-i} \\ + \sum_{i=0}^{p} \varphi_i \Delta(EX)_{t-i} + \sum_{i=0}^{p} \chi_i \Delta(W)_{t-i} + \sum_{i=0}^{p} \nu_i \Delta(TR)_{t-i} + \sum_{i=0}^{p} \varpi_i \Delta(M)_{t-i} + \sum_{i=0}^{p} \vartheta_i \Delta(Y)_{t-i} \\ + \delta_1 (Yl)_{t-1} + \delta_2 (GM)_{t-1} + \delta_3 (GDP)_{t-1} + \delta_4 (EX)_{t-1} + \delta\ (W)_{t-1} \\ + \delta_6 (TR)_{t-1} + \delta_7 (M)_{t-1} + \delta_8 (Y)_{t-1} + u_t \end{bmatrix} \quad \ldots \quad (2)$$

where Yl is export of potato in tonnes, GM is average world price of potato (in US dollars), EX is exchange rate Naira to US dollars, IN is interest rate in percentage, TR is tariff rate in percentage, GDPis Gross Domestic Product in Naira, M is potato imports in tones and W is world export of potato in tones. Δ is first-difference operator and *p* is the optimal lag length. The *F* test is used for testing the existence of long-run relationship. When long-run relationship exists, *F* test indicates which variable should be normalized. The null hypothesis for no cointegration among variables in equation (1) is H_0: $\delta_1 = \delta_2 = \delta_3 = \delta_4 = \delta_5 = \delta_6 = \delta_7 = \delta_8 = 0$ against the alternative hypothesis H_1: $\delta_1 \neq \delta_2 \neq \delta_3 \neq \delta_4 \neq \delta_5 \neq \delta_6 \neq \delta_7 \neq \delta_8 \neq 0$. The *F*-test has a non-standard distribution which depends on (i) whether variables included in the model are I(0) or I(1), (ii) the number of regressors, and (iii) whether the model contains an intercept and/or a trend. The test involves asymptotic critical value bounds, depending whether the variables are I(0) or I(1) or a mixture of both. Two sets of critical values are generated which one set refers to the I(1) series and the other for the I(0) series. Critical values for the I(1) series are referred to as *upper* bound critical values, while the critical values for I(0) series are referred to as the *lower* bound critical values. If the *F* test statistic exceeds their respective upper critical values, we can conclude that there is evidence of a long-run relationship between the variables regardless of the order of integration of the variables. If the test statistic is below the upper critical value, we cannot reject the null hypothesis of no cointegration and if it lies between the bounds, a conclusive inference cannot be made without knowing the order of integration of the underlying regressors. The following long-run model is estimated:

$$(Yl)_t = \alpha_1 + \sum_{i=1}^{p} \phi_{1i}(Yl)_{t-i} + \sum_{i=0}^{p} \theta_{1i}(GM)_{t-i} + \sum_{i=0}^{p} \lambda_i(GDP)_{t-i} + \sum_{i=0}^{p} \varphi_{1i}(EX)_{t-i} + \sum_{i=0}^{p} \chi_{1i}(W)_{t-i} + \sum_{i=0}^{p} \nu_{1i}(TR)_{t-i} + \sum_{i=0}^{p} \varpi_{1i}(M)_{t-i} + \sum_{i=0}^{p} \vartheta_{1i}(Y)_{t-i} \quad \ldots (3)$$

The orders of the lags in the ARDL model are selected by either the Akaike Information criterion (AIC) or the Schwarz Bayesian criterion (SBC), before the selected model is estimated by ordinary least squares. For annual data, Pesaran and Shin (1999) recommended choosing a maximum of 2 lags. From this, the lag length that minimizes SBC is selected. The ARDL specification of the short-run dynamics can be derived by constructing an error correction model (ECM) of the following form:

$$(Yl)_t = \alpha_2 + \sum_{i=1}^{p} \phi_{2i}(Yl)_{t-i} + \sum_{i=0}^{p} \theta_{2i}(GM)_{t-i} + \sum_{i=0}^{p} \lambda_{2i}(GDP)_{t-i} + \sum_{i=0}^{p} \varphi_{2i}(EX)_{t-i} + \sum_{i=0}^{p} \chi_{2i}(W)_{t-i} + \sum_{i=0}^{p} \nu_{2i}(TR)_{t-i} + \sum_{i=0}^{p} \varpi_{2i}(M)_{t-i} + \sum_{i=0}^{p} \vartheta_{2i}(Y)_{t-i} + \psi ECM_{t-1} \quad \ldots (4)$$

Results and Discussion

Since all the variables are not integrated in the same order, there is a need for a co-integration test. This implies that some linear combinations of the series must be co-integrated, such that even though the individual series may be integrated in the order I(0) and I (1) the series may drift apart in the short-run, and then follow a common trend which permits stable long-run relationship between them in Table 1.

Table 1: Unit root test of the variables

	ADF test		Philips-perron		
	Level	1st difference	Level	1st difference	Decision
potato import	-1.80783	-5.62857	-2.55751	-7.94026	I(1)
potato export	-0.08535	-6.12107	-0.31121	-9.75577	I(1)
potato world export	-1.67993	-7.77966	-2.17531	-12.536	I(1)
potato producer price	0.306471	-7.61671	-0.34671	-16.4837	I(1)
Exchange rate	2.15693	-3.26868	0.433331	-0.91299	I(1)
inflation	-3.90159	-7.61771	-3.35038	-7.30175	I(0)
real interest rate	-5.59578	-9.40358	-6.99084	-15.7352	I(0)
GDP per capita	3.786716	-3.62077	3.930985	-7.20249	I(0)
agricultural labour	3.13827	-3.78589	-1.84579	-2.05975	I(1)
Tariff	-4.25954	-9.49748	-6.16896	-14.7568	I(0)

-3.7498, -2.5005 & -1.9793 are Mackinnon critical value for rejection of hypothesis of unit root applied at 1%, 5% & 10% respectively. I(0) & I(1) indicates that the variable has a constant mean at the level, first difference & second difference respectively. Source: FAO database, World Bank development indicators, CBN statistical Bulletin various issues, UNDP climate data, Index Mundi, 2016 computed using Eviews 9.5

Long-run and short-run macroeconomic determinants of potato export

The long-run and short-run determinants macroeconomic determinants of potato exports, having conducted the unit root test autocorrelation tests using Breush-Godfrey serial correlation test.

Long-run macroeconomic determinants of potato exports

With the value of the F-statistics was found to be statistically insignificant which implies that we accept the null hypothesis of no serial correlation in the long run determinants of potato export model estimated as presented in Table 2.

Table 2 Breusch-Godfrey Serial Correlation LM Test: Long-run determinants potato exports

F-statistic	2.185611	Prob. F(2,2)	0.3139
Obs*R-squared	30.87398	Prob. Chi-Square(2)	0.0000

Source: FAO database Source: FAO database, World Bank development indicators, CBN statistical Bulletin various issues, UNDP climate data, Index Mundi, 2016 computed using Eviews 9.

From Table 3 the Akaike Info Criterion (AIC) and the Schwarz criterion values of 6.602 and 8.249 which were minimal resulting in the selection of 4 lag lengths. The Durbin-Watson value of 2.347 confirms that the model is free from auto-correlation. The calculated F-statistics (F-statistic = 1076.031), showing that the null hypothesis of no cointegration can be rejected at 1.0 percent level as it was observed from the bound test that there is long run relationship running among the variables. This implies that there exists a long-run relationship or cointegration between potato exports and its determinants. Having established the cointegration relationship, the next step is to estimate the long-run coefficients by estimating an ARDL. The result indicates that the long run overall model is well fitted as the independent variable explained over 99.9% (R^2) movement in the dependent variable. Potato exports in the previous years were observed to be statistically significant and were all negatively influenced the long run Nigerian potato exports. Nigerian potato exports in the previous years have not been enough to cause an increase in the quantity of potato exports. Previous Potato productions were statistically significant and had both negative and positive influence the long run potato exports. This results that the production of potato has not been enough always to sustain increased potato exports.

World potato exports were statistically significant and positively influenced Nigeria potato exports. According to (Ugonna, Jolaoso & Onwualu, 2013) Nigeria potato is of the best quality as they compete favorably in the international market. The inflation rate was statistically significant and positively influenced the export of potato in the long run. The interest rate was statistically significant at 10% and had a positive long-run impact on the potato exports of Nigeria. This result implies that the interest rate of lending by the banks was favourable for the exporters to borrow to support the long run export of potato at the periods. Exchange rates at 3rd lag were statistically significant at 10% and negatively influence the export of potato in the long run. This implies that the exchange rate of naira to the dollar was not favourable to the potato exporters, while the 2^{nd} and 4^{th} lags were statistically significant at 10% and positively influenced the potato exports. A favourable exchange rate results in the increase in the quantity of potato exports. The selling price of the ginger was statistically significant at 1% in the 1^{st} lag and positively influenced the long run ginger export. The exporters buy the potato at an attractive price from the farmers, ensuring the growth of the potato exports.

Table 3: Long-run determinants of potato exports

Variable	Coefficient	Std. Error	t-Statistic	Level of significance
C	0.738178	3.522725	0.209548	
(potato export (-1))	-1.040813	0.944734	-1.101700	
(potato export (-2))	-0.762937	0.296089	-2.576716	**
(potato export (-3))	-1.794568	0.526732	-3.406983	**
(potato export (-4))	0.459309	0.579883	0.792073	
(potato production(-1))	-0.003357	0.000957	-3.509860	**
(potato production (-2))	-0.002677	0.001388	-1.928411	*
(potato production (-3))	0.001901	0.000570	3.335532	**
(potato production (-4))	-0.002599	0.000324	-8.025241	***
(potato imports (-1))	-0.004678	0.012050	-0.388200	
(potato imports (-2))	-0.014077	0.014003	-1.005224	
(potato imports (-3))	0.003923	0.014246	0.275398	
(potato imports (-4))	0.012850	0.016560	0.775976	
(potato world exports (-1))	4.26E-05	2.41E-05	1.769132	*
(potato world exports (-2))	-4.84E-06	1.01E-05	-0.479696	
(potato world exports (-3))	-1.84E-05	1.12E-05	-1.643426	
(potato world exports (-4))	3.61E-06	6.51E-06	0.554474	
(Inflation(-1))	1.609258	0.920334	1.748559	*
(Inflation (-2))	1.370192	0.976363	1.403362	
(Inflation (-3))	1.666406	0.841721	1.979760	*
(Inflation (-4))	0.599493	0.540600	1.108941	
(Interest rate(-1))	0.822834	0.569826	1.444010	
(Interest rate(-2))	2.034053	1.271296	1.599985	*
(Interest rate (-3))	2.293434	1.410074	1.626463	
(Interest rate(-4))	2.070698	1.089330	1.900892	*
(GDP(-1))	-0.040436	0.035355	-1.143708	
(GDP(-2))	0.000459	0.032013	0.014347	
(GDP(-3))	0.057882	0.027486	2.105886	*
(GDP(-4))	-0.005432	0.021931	-0.247693	
(Tariff (-1))	-2.709762	1.584269	-1.710417	*
(Tariff (-2))	4.275649	2.514057	1.700697	*
(Tariff (-3))	-7.165419	2.590580	-2.765952	**
(Tariff (-4))	0.595785	2.464989	0.241699	
(Exchange rate(-1))	-5.481968	9.693043	-0.565557	
(Exchange rate (-2))	59.54894	29.91898	1.990340	*
(Exchange rate (-3))	-85.14987	50.08770	-1.700016	*
(Exchange rate (-4))	66.29556	17.98154	3.686868	***
(Price(-1))	0.025098	0.022713	1.105043	
(Price (-2))	0.060455	0.009290	6.507763	***
(Price(-3))	-0.011822	0.011729	-1.007962	
(Price (-4))	0.067810	0.054664	1.240480	

R-squared	0.999907	Mean dependent var	48.23071
Adjusted R-squared	0.998978	S.D. dependent var	276.9779
S.E. of regression	8.855412	Akaike info criterion	6.601789
Sum squared resid	313.6733	Schwarz criterion	8.247859
Log likelihood	-107.5402	Hannan-Quinn criteria.	7.215427
F-statistic	1076.031	Durbin-Watson stat	1.956450
Prob(F-statistic)	0.000002		

*,**& *** indicates that the values are significant at 10%, 5% & 1% respectively.
Source: FAO database Source: FAO database, World Bank development indicators, CBN statistical Bulletin various issues, UNDP climate data, Index Mundi, 2016 computed using Eviews 9.

Figure 1 presents estimate the CUSUM stability test in autoregressive distributed lags method (ARDL) for the long run determinants of potato exports to show the stability of the model. Our variables, data are stable because the cumulative sum of recursive residuals CUSUM graph is within the limits of 5% significance level.

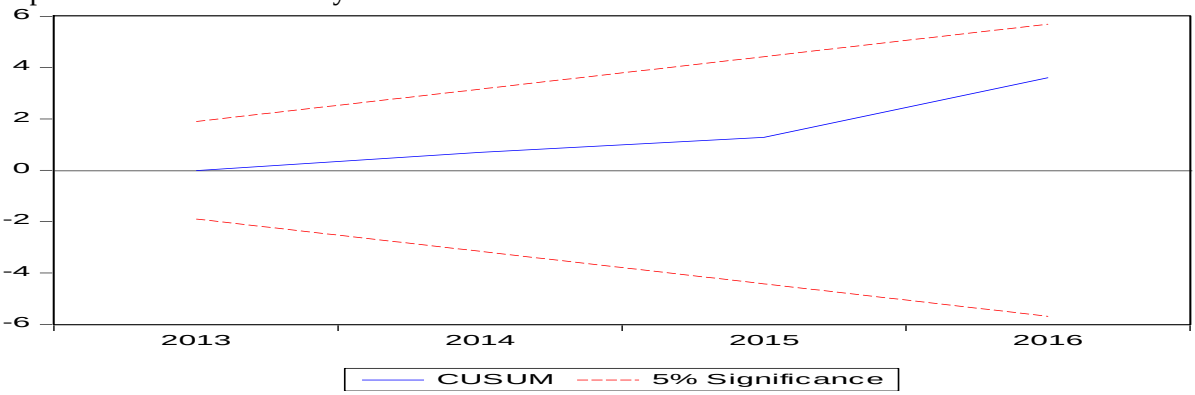

Figure 1: Cumulative sum control chart for long run determinants of potato export
Source: FAO database Source: FAO database, World Bank development indicators, CBN statistical Bulletin various issues, UNDP climate data, Index Mundi, 2016 computed using Eviews 9.

Short-run macroeconomic determinants of potato exports

With the value of the F-statistics was found to be statistically insignificant which implies that we accept the null hypothesis of no serial correlation in the short run determinants of potato export model estimated as presented in Table 4.

Table 4 Breusch-Godfrey Serial Correlation LM Test: short run determinants of potato exports

F-statistic	5.130142	Prob. F(2,26)	0.1032
Obs*R-squared	13.86514	Prob. Chi-Square(2)	0.0010

Source: FAO database Source: FAO database, World Bank development indicators, CBN statistical Bulletin various issues, UNDP climate data, Index Mundi, 2016 computed using Eviews 9.

From Table 5 the Akaike Info Criterion(AIC) and the Schwarz criterion values of 13. 318 and 14.129 which were minimal resulting in the selection of 2 lag lengths. The Durbin-Watson value of 1.785 confirms that the model is free from auto-correlation. The calculated F-statistics (F-statistic = 4.995), showing that the model is statistically significant. The result indicates that the long run overall model is well fitted as the independent variable explained over 78.1% (R^2) movement in the dependent variable. The speed of adjustment from the short term to the long term (ECM) was statistically significant at 1% and suggests a high speed of adjustment from short term to long term. Previous potato exports were statistically significant at 10% in the 1st and 2nd lags and had both positive and negative influence the short run potato exports respectively. This implies that in the short run the previous potato exports were fluctuating which led to both a short-run negative and positive impacts. In the short run, exchange rates were statistically significant at 10% and negatively related to the potato exports.

Table 51 Short run determinants of potato exports

Variable	Coefficient	Std. Error	t-Statistic	Level of significance
C	0.550392	35.83249	0.015360	
D(Potato exports (-2))	0.259205	0.133632	1.939700	*
D(Potato production (-1))	-0.000845	0.000408	-2.072573	*
D(Potato production (-2))	-0.000329	0.000454	-0.723351	
D(Potato imports (-1))	0.015529	0.137637	0.112826	
D(Potato imports (-2))	0.093154	0.149219	0.624277	
D(Potato world exports (-1))	9.76E-06	6.26E-05	0.155881	
D(Potato world exports (-2))	6.98E-05	5.11E-05	1.366029	
D(Inflation (-1))	-0.068009	2.416554	-0.028143	
D(Inflation (-2))	-0.020308	2.642995	-0.007684	
D(Inflation (-1))	-1.958059	2.183711	-0.896666	
D(Inflation (-2))	-0.625471	2.022693	-0.309227	
D(GDP(-1))	-0.001309	0.006421	-0.203825	
D(GDP (-2))	0.002676	0.007350	0.364041	
D(Tariff(-1))	-2.615654	3.491105	-0.749234	
D(Tariff (-2))	2.363797	2.920963	0.809253	
D(Exchange rate (-1))	7.076176	4.173883	1.695346	*
D(Exchange rate (-2))	10.78484	9.476014	1.138119	
D(Price (-1))	0.005318	0.007543	0.705090	
D(Price(-2))	-0.003779	0.006606	-0.572043	
ECM(-1)	-0.647856	0.167607	-3.865330	***

R-squared	0.781062	Mean dependent var	44.29351
Adjusted R-squared	0.624678	S.D. dependent var	265.5216
S.E. of regression	162.6680	Akaike info criterion	13.31883
Sum squared resid	740904.3	Schwarz criterion	14.12961
Log likelihood	-305.3112	Hannan-Quinn criteria.	13.62644
F-statistic	4.994502	Durbin-Watson stat	1.784795
Prob(F-statistic)	0.000061		

*,**& *** indicates that the values are significant at 10%, 5% & 1% respectively.
Source: FAO database Source: FAO database, World Bank development indicators, CBN statistical Bulletin various issues, UNDP climate data, Index Mundi, 2016 computed using Eviews 9.

Figure 2 presents estimated CUSUM stability test in autoregressive distributed lags method (ARDL) for the short run determinants of potato exports to show the stability of the model. Our variables, data are stable because the cumulative sum of recursive residuals CUSUM graph is within the limits of 5% significance level

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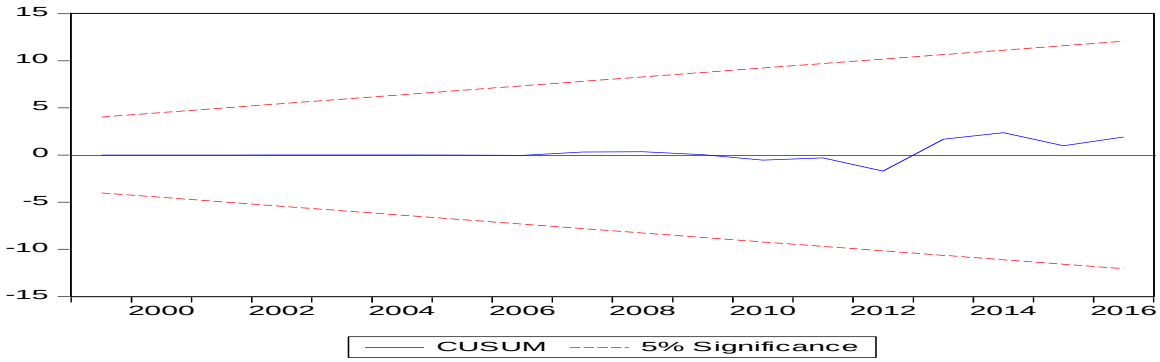

Figure 2: Cumulative sum control chart for short-run determinants of potato export
Source: FAO database Source: FAO database, World Bank development indicators, CBN statistical Bulletin various issues, UNDP climate data, Index Mundi, 2016 computed using Eviews 9.

Conclusion

Potato production and export have strong influence in driving the continuous increase in the export of potato from Nigeria. World export of potato has long-run effect on the export of potato. Macroeconomic variables such as inflation, interest rate, GDP (gross domestic product), tariff rate, exchange rate and price of potato were very significant in determining the long-run export of potato while exchange rate was significant in driving the export of potato in the short-run. We therefore recommend, the stabilization and regulation of macroeconomic variables such as inflation, exchange rate, tariff rate and interest rate will boost the export of potato. There should be more policy efforts to boost potato production of potato in order to enhance exports.

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