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Research Paper

Root and Tuber Crop Market System in Nigeria: Macroeconomic Determinants

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ABSTRACT:

Root and tuber crops are food security crop and thus have wide market preference and value in many economies. However, they are constrained by a convergence of external factors that impact on their production, marketing and export potential. The study opened conversations on the market system of root and tuber crops and examined macroeconomic variables that influence Nigeria market commercialization drive and competitiveness in both regional and international trade, using cross sectional data from 1960 to 2016 sourced from the Central Bank of Nigeria (CBN) statistical bulletin, Food and Agriculture Organization (FAO) database and World Bank Development indicators. Analytically, the study employed econometric tools such as unit root tests, trend analysis (i.e. quadratic equation), Generalized Method of Moments, Malmquist productivity index, Autoregressive Distributed Lag (ARDL) model. Findings revealed that macroeconomic variables of exports, imports, and inflation, exchange rate, tariff, price and world exports had long-run and short-run impacts on the exports of root and tuber crops. The study recommends market-oriented strategy by caution against protectionist led interventions such as outright ban on importation, as they impact negatively on market behaviour; rather advocated for effective policing of border to check smuggling, also improvement in policies that improve production to check price instability, which characterize root and tuber crop marketing in Nigeria. There is need for effective regulation and policies that protect risk and guarantee returns in the supply chain of root and tuber crops so that supply-chain actors can benefit substantially from international trade.

KEYWORDS: Export, import, market, root, tuber, macroeconomic

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INTRODUCTION

Root and tuber crops are among the crops in developing economies that are mentioned in the context of food security (Saediman et al., 2019; Petsakos et al., 2019) because they constitute a significant source of food and fibre for man (both for consumption and industrial purposes) and for feeding of livestock (Chandrasekara & Joseph, 2016).Tubers and roots have cultural affinity and serve as a functional food to households across Africa, Asia and Latin America (Saranraj et al., 2019), who depend on it to obtain their daily energy and protein (Bayata, 2019; Afuakwa, 1996). It is considered a functional food (Leidi et al., 2018; Choquechambi et al., 2019) because of its healing properties

(Campos et al., 2018; Naabol & Namo, 2019), vitamin C and dietary fibre (Chandrasekara & Joseph, 2016) among other nutritional values. As a result, the crops have continued to command high market acceptance, making them a critical crop in Nigeria's agricultural transformation agenda and food policy (Eke-Okoro et al., 2014). However, despite Nigeria being the largest producer of tuber and root crops in the world (Bassey, 2017), contributing 45% to global tuber and root production (Edem & Nkereuwem, 2015), about 95% of its total production is consumed locally (Nanbol & Namo, 2019), implying that less than ten percent are used for the industrial purpose (Otekuniru & Sawicka, 2019) and further suggesting that the productive capacity of Nigeria to contribute to global tuber and root market to meet global demand-supply gap is low, making the country to import tuber and root crop derivatives such starch, sweeteners and adhesives from other countries (Eke-Okoro et al., 2014). This importation has severe consequences on Nigeria's agricultural contribution to Gross Domestic Product (GDP) amidst the growing global demand for tuber and roots for food, fibre and other industrial uses, with spillover effect on price and market behaviour for tuber and root crop derivatives (de Oliveira et al., 2019; Kathiravan & Churaman, 2021). This is because the export and production of these root and tuber crops are vital economic and nutritional therapy for fighting poverty, hunger and malnutrition in a tropical developing economy like Nigeria when harnessed adequately to its full potential.

Prior studies predominantly focus on challenges of production and marketing tuber and root crops such as agronomic practices (Daryanto et al., 2017), seedling and planting materials (Ubalua et al., 2016; Wossen et al., 2019), labour, land and pest management (Bassey, 2017), small-scale farming, incoherent policy and credit availability (Otekuniru & Sawicka, 2019). Others are marketing and market-related challenges, such as fragmented markets, which primarily serve the local economy and thus prevent the development of economies of scale (Redmond, 2018); with further evidence showing lack of market to absorb large production (Nanbol & Namo, 2019), which impacts on price and exacerbate post-harvest challenges; an asymmetry market information system that hinders the export market and an imperfect pricing system (Bezabih & Mengistu, 2011). These challenges are seen as the motivation behind the present agricultural transformation policy on tuber and roots to enhance their production and value–addition to meet global demand (Hesser, 2019) by implementing agricultural policies such as strategic priorities in the market system and market-oriented intensification (Adjei-Nsiah et al., 2019) that will facilitate export marketing of tuber and root crops. There are many convincing reasons for encouraging the production of these modest tropical root and tuber crops for sustainable food production and export earnings in Nigeria (See, Nteranya, 2015), such as improving the sustainable livelihood of farmers (Mbanasor & Nto, 2017). Whilst these challenges have been extensively researched, certain external factors are less studied, especially in the current Nigeria business environment, known as macroeconomic factors, which influence and impact the market system of tuber and root crops.

Roots and tubers have extensive market systems in domestic and international markets, bringing buyers and sellers to the exchange process. In Nigeria, like many developing economies, the market for tuber and root crops is fragmented and mostly inside villages (Nanbol & Namo, 2019), limiting it to small commercial firms (Dorward et al., 2008) that lack an understanding of market dynamics (Nanbol & Namo, 2019). Therefore, as the market structure evolves and the demand for staple grows, the need for market development for indigenous products such as tuber and root crops (Babah-Daouda et al., 2019) has continued to advance, captivating for improve measures like expanding market infrastructure that creates market exchange and improves regulations and access (Layton, 2019). Despite these efforts, external factors continue to converge to influence dynamic global trade and systems (Yatsenko et al., 2019), including advancing asymmetry market access and information (Magesa et al., 2014), which affect the business ecosystem, market behaviour and performance. To facilitate export, market expansion and inclusion, there is a need to understand market system dynamics and specific macroeconomic factors that impede the market and prevent the development of economies of scale and competitiveness. Evidence shows massive macroeconomic imbalance in

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the agricultural markets (Kherallah et al., 2002). Therefore, a corrective policy reform to address the supply of tuber and root crops in Nigeria must start with identifying critical macroeconomic factors because they stimulate supply and price movement (Magrini et al., 2018).
Our study focuses on these macroeconomic factors as they impact on market system for tuber and root crops in Nigeria. Evidence shows that regions with the highest production volume are usually not the highest exporter of goods (Yatsenko et al., 2019), hence our thesis that market performance and competitiveness respond to macroeconomic factors (Nwachukwu et al., 2013). Prior studies have been advanced to understand the effect of macroeconomic factors on the agricultural market in South Africa (Kargbo, 2007) and Nigeria (Eyo, 2008), identifying macroeconomic variables such as import, export, price, exchange rate, inflation, interest rate, GDP per capita and agricultural labour on agricultural output and price movements (Kargbo, 2007) leading to volatility in the agricultural markets (Garrido et al., 2016)with a spillover effect on agricultural commodity prices (Frank & Gracia, 2010) and food security (Kavallari et al., 2014). Generally, the outcome of these studies has been mainstreamed into policies that gear towards enhancing stable supply. However, the outcomes are not deep enough to steer overwhelming influence in crops critical to the growth and food security, such as tuber and root crops. Hence it becomes difficult to generalise their outcome since the international markets for root and tuber crops are largely unstable in terms of volume and price and carry a high degree of risk and uncertainty as well as low-income elasticity. This uncertainty is due to the volatile nature of macroeconomic variables affecting the export of root and tuber crops from Nigeria, making them less competitive globally. Therefore, our study attempts to understand how specific macroeconomic variables influence the market system of tuber and root crops in Nigeria. This study becomes necessary following the increased demand for staples in the international market and its profound consequences for the market system.

This study makes two key contributions. The study is the first to x-ray the influence of macroeconomic variables on tuber and root crops in Nigeria. By doing that, the study provides a policy instrument that will assist Nigeria in taking advantage of the recent Africa Free Trade Continental Agreement and policy. Therefore, it guides supply development to advance the tuber and root crops market system. Second, the study shines light on the critical challenges faced by endogenous African businesses in managing the macroeconomic factors and advance conversation around their role in the food security debate. Therefore, our study adds to unexplained factors that impact market development and the capacity of the market to meet demand. Therefore, small-scale businesses will find the outcome of this study practical as it provides insight that improves their resilience in a complex business environment.

LITERATURE REVIEW / THEORETICAL BACKGROUND

Tuber and root crops export and marketing system

Root and tuber crops have been traded internationally for a very long time (Scott et al., 2000). They are a crucial part of the world food system and significantly influence societies and economies worldwide (Prain&Naziri, 2020). Root and tuber crop exports from Nigeria are influenced over the long term by global exports of crops like potatoes, yams, and cassava (d'Amour et al., 2016; Gaffney et al., 2019). Nigerian roots are also shipped to Europe in powder form as a finished good (Asante-Pok, 2019; Onwsiribe & Nto, 2020). As a result, the performance of Nigeria's exports of root and tuber crops is significantly influenced by the global trade of these crops (Verter, 2016). The advantage of Nigeria in both land and productive capacity can be leveraged to harness value for sustained economic growth using transformed policy in roots and tubers production and marketing. In this instance, the marketing system's role is to harmonise the expectations of consumers and market. According to Jonathan and Collin (2008), marketing systems play a decisive role in vibrant

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economies as exchange mechanisms. Therefore, if small-scale domestic producers are to take advantage of the projected domestic demand growth, then marketing systems in the supply chains linking producers to consumers must be able to support low-cost production and timely delivery of the product. This support is because of severe implications, such as levels of customer satisfaction, producer's profits, and overall welfare of society (Beierlein et al., 2014). Connecting the root and tuber crop to the global market requires understanding of market system dynamics. This connection is achieved through market expansion for root and tuber crops (Nwafor et al., 2022), amplified through agricultural marketing extension, which increases capacity and access of Base of Pyramid (BoP) producers to markets (local and global) and also their marketing orientation and commercialisation (Gebremedhin et al., 2012). As demand for developing countries' traditional export is inelastic relative to the demand for industrial goods (Nwachukwu et al., 2013), there is always a market system and supply issues. Given this understanding, it becomes crucial to ascertain macroeconomic variables that contribute to the weak market structure critical to Nigeria's commercialisation and competitiveness of root and tuber crops both at the regional and international market.

The root and tuber crop market system is primarily in the hands of farmers, retailers, and middlemen in Nigeria (Nwafor et al., 2022; Asante-Pok, 2019), and they are confronted with complex interaction of systemic challenges. Nwafor et al. (2022) observed that root and tuber marketing in Nigeria is influenced by economic variables, such as government policies on agriculture sector development. Other variables that impact production and marketing include market prices and consumer demand, among others (Nguyen et al., 2019), export market of root and tuber crops, which are primarily influenced by the international price and demand for these products (Petsakos et al., 2019; Onwusiribe et al., 2018b). According to Gereffi et al. (2013), the falling external supply of foreign exchange has negatively affected the market prices of agricultural products, thus adversely affecting the marketing of the crops. The exchange rate and interest rate critically influence the crops' price and greatly influence crop sales (Ufoeze et al., 2018; Orji et al., 2019). When interest rates increase, it also increases the cost of credit, thereby putting farmers at a disadvantage and discouraging them from producing and selling their produce (Osabohien et al., 2020). The higher interest rate discourages domestic investment in root and tuber crops production and marketing, resulting in lower production and productivity (Abbas et al., 2022). This low-level production is because the increased cost of credit makes it challenging to finance farm inputs such as fertiliser, pesticides and other essential tools required for agricultural production (Igwemeka & Ekwunife, 2020). Therefore, the rise in the interest rate reduces the capacity of farmers to produce and sell high-quality root and tuber crops to buyers at competitive and profitable prices (Nwafor et al., 2022). Another factor that has limited the ability for domestic production and marketing of root and tuber crops is the decline in consumers' purchasing power due to high inflation rates (Obiageli, 2020; Mbam et al., 2020; Ali et al., 2022). The tariff rates and other protectionist policies in Nigeria affect the ability of the farmers to get the necessary equipment and other resources for producing good quality root and tuber crops. The imposition of tariffs on imported agricultural equipment and machinery makes it very expensive for farmers to acquire these tools.

The external business environment is complex and its variables and government policies most times do not protect local producers, affecting their competitiveness with foreign producers (Omeje et al., 2019; Ugwuja & Chukwukere, 2021). These challenges affect local producer’s capacity to contribute to GDP, which affects the quantity of investment in agricultural production (Ge & Tang, 2020). If GDP is low, then the quantity will be low or inadequate therefore leading to poor market supply, which in turn will deter potential investors from entering the agriculture sector hence restraining agricultural exports (Sabu & Kumar, 2020; Ogundipe et al., 2019; Ge & Tang, 2020; Ekananda, 2022).

Theoretical Literature

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Export promotion strategies theory is the main theory that underpins this study, because it identifies that certain factors affect the export and international marketing decision of a country (Milner, 1990). These factor sare divided into two types - internal and external factors. External factors affecting a country's export decision include market, demand, and price. Internal factors include availability or supply, price, exchange rate and interest rates (Milner, 1990; Acikdilli et al., 2022; Moradi et al., 2021; Cooper et al., 2018). Market and demand are external factors such as world supply, world price, and global demand that influence the decision to export a product (Edeh et al., 2020; Safari & Saleh, 2020). These factors determine the product's price in the market, which in turn affects the decisions of the exporter on whether or not to export the product (Hussain et al., 2020; Abdullahi et al., 2021). If the price is high, then the producers will not want to export their product as it is not profitable for them to do so.

On the other hand, if the product is cheap in the international market, the exporters will want to export their product to make a profit (Milner, 1990). Similarly, the demand for the product also influences whether to import or export it (Milner, 1990). Finally, the product's price is another crucial factor determining an exporter's profits when exporting the product (Hussain et al., 2020).

The export promotion strategies theory supports the selection of GDP, exchange rate, interest rate and local price as the internal or domestic factors affecting roots and tubers export from Nigeria. In contrast, world prices and exports of roots and tubers are the external factors affecting the exports of roots and tubers in Nigeria.

Empirical Literature

Sirnvas (2020) adopted the comparative advantage model to analyse the export market system and determinants of tropical tuber crops and found that India has lost its comparative advantage in cassava production to developing countries like Nigeria; the study observed that price and tariff rates were critical determinants in the export market. Boasik et al. (2022) used multiple regression analysis to consider significant macroeconomic variables such as inflation, imports and exports in analysing food availability, especially roots and tubers in developing countries, while Okorie (2022) considered interest rates as a critical determinant of agricultural exports using the Johansen co-integration model. In their study, Shaheen et al. (2022) considered import, close substitutes and GDP as the significant determinants of export as revealed by the Autoregressive Distributed Lag (ARDL) model. The export competitiveness of Pakistan and Ethiopia's agriculture was modelled using the ARDL, in which the exchange rate was significant (Abbas, 2022; Keyemo, 2022). Furthermore, Jannat et al. (2022) used the ARDL model to impact of export and import of non-cereal, especially roots and tubers in Bangladesh; the study indicated that economic factors such as imports, local prices, and world prices are very significant. Interest rate, price, world export, exchange rate, and price are the factors affecting the export of potatoes in Nigeria, as revealed by the ARDL model applied by Onwusiribe et al. (2018a). However, no study has considered this using ARDL model for Nigeria tuber and root crop.

The empirical works of literature support the choice of the ARDL model for this study, given the rich foundation of the model. The Autoregressive Distributed Lag (ARDL) model is a time-series forecasting methodology that employs an autoregressive distributed lag (ARDL) process to generate future values (See, Pesaran & Shin, 1995). The basic idea of the model is to combine past data with current data and predict future values based on this combined data set (Gujarati, 2013). The ARDL model is unique because, unlike many other models, it can deal with non-stationary time series data that changes over time. The ARDL model also uses the auto-correlation function to determine the likelihood that the data will remain stationary in the future. This function means that the model can cope with changing trends and can still be used effectively for prediction purposes even if the trends constantly change (Gujarati, 2013). Another advantage of this model is that it provides a simple and

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accurate way of estimating various parameters without requiring additional assumptions or estimation techniques (Dereli, 2019).
In most cases, only a few parameters are estimated, and the predictions are easy to interpret and understand. The model reveals the long-run and short-run relationships between variables in different periods and units (Pesaran*et al*., 2001). The model is generally specified as

$$Y_t = \alpha + \beta_0 X_t + \beta_1 X_{t-1} + \beta_2 X_{t-2} + \cdots + + \beta_k X_{t-k} + u_t \ \ldots \ 1$$

$Y_t$represents a dependent or output variable, αrepresents a constant, X_{t-1} through X_{t-k}represents lags of variables, X are independent or input variables, u is the error term, t is time, and β represents the parameters of the model.

METHODS

Nigeria is the research location for this study. Nigeria enjoys the luxury of a land area of about 923,769km^2 (Federal Office of Statistics 1989). Nigeria's water bodies consist of about 13,000 sq. km while the remaining land is about 910,769sq km (Boomie, 1998; Cleaver & Schreiber, 1994). This article adopted principally secondary data obtained from the Food and Agriculture Organization (FAO) database and the World Bank Statistical Bulletin (World Development Indicators) from 1961 to 2017. Specifically, production and producer price data were sourced from the FAO database, while data on the other variables were sourced from the World Bank Development Indicators. 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. Autoregressive Distributed Lag (ARDL) model was adopted.

Model specification

The ADF test consists of estimating the following regression.

$$\Delta Y_t = \beta_1 + \beta_1 + \delta Y_{t-1} + \Sigma^m{}_{t=1} \alpha_i \Delta Y_{t-1} + e_t \quad \ldots . (2)$$

It is a one-tail test whose null hypothesis is δ=0 versus δ<o (thus, expansive negative estimations of the test measurements prompt the dismissal of the invalid), and Δ is the difference operator. Under the alternative, Yt must be differenced to accomplish stationarity; under the option, Yt is, as of now, stationary, and no differencing is required (Dickey & Fuller,1981).

Consider a model

$$Y_t = \theta_0 + \phi Y_{t-1} + a_t \quad \ldots \ (3)$$

$$PP \text{ test equation} : \Delta Y_t = \theta_0 + \delta Y_{t-1} + a_t \quad \ldots (4)$$

Autoregressive distributed lag (ARDL) structure by (Gujarati, 2013); Pesaran and Shin (1995, 1999); Pesaran et al. (1996), and Pesaran (1997) as presented in equation 1 is used to build up the direction of causation between factors. This approach is utilised when managing an extensive arrangement of factors whose level of incorporation might be I(0), simply I(1) or a blend of both, which implies that the test on the present connection between factors in levels is pertinent independent of whether the basic regressors are I(0), absolutely I(1) or blend of both (Duasa, 2006).

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Fundamentally, the ARDL way to deal with cointegration (Pesaran*et al*., 2001) includes evaluating the restrictive mistake remedy (EC) form of the ARDL show.

The F test was utilised for testing the presence of the long-run relationship. When a long-run relationship exists, the F-test shows which variable ought to be standardised. The invalid speculation for no cointegration among factors in condition (1) is H0: δ1 = δ2 = δ3 = δ4 =...= δn =0 against the option theory H1: δ1 ≠ δ2 ≠ δ3 ≠ δ4 ≠...≠ δn ≠ 0. The F-test has a non-standard circulation which relies upon (i) regardless of whether factors incorporated into the model are I(0) or I(1), (ii) the number of regressors, and (iii) whether the model contains a catch or potentially a pattern. The test included asymptotic fundamental esteem limits, contingent upon whether the factors are I(0), I (1), or a blend of both. Two arrangements of basic esteems are produced. One set alludes to the I(1) arrangement, and the other to the I(0) arrangement. Basic esteems for the I(1) arrangement are alluded to as upper-bound basic esteems, while the basic esteems for I(0) arrangement are alluded to as lower-bound basic esteems.

On the off chance that the F test measurement surpasses their particular upper basic esteems, we can infer that there is confirmation of a long-run connection between the factors paying little heed to the request of a combination of the factors. On the off chance that the test measurement is underneath the upper fundamental esteem, we cannot dismiss the invalid theory of no cointegration, and on the off chance that it lies between the limits, a convincing surmising cannot be made without knowing the request of a combination of the basic regressors.

If there is confirmation of a long-run relationship (cointegration) of the factors, the accompanying long-run display is assessed:

$$\left[\begin{array}{l}\Delta(yl\ )_t = \alpha_0 + \sum_{i=1}^{p}\phi_i\Delta(yl\ )_{t-i} + \sum_{i=0}^{p}\theta_i\Delta(G_m)_{t-i} + \sum_{i=0}^{p}\varphi_i\Delta(EX)_{t-i} \\ + \sum_{i=0}^{p}\varphi_i\Delta(IN)_{t-i} + \sum_{i=0}^{p}\varphi_i\Delta(TR)_{t-i} + \sum_{i=0}^{p}\varphi_i\Delta(y)_{t-i} + u_t\end{array}\right]$$ …**(5)** The lags in the ARDL model are chosen by either the Akaike Information Criterion (AIC) or the Schwarz Bayesian basis (SBC) before the selected model is assessed by ordinary least squares. Pesaran and Shin (1999) prescribed picking a maximum of 2 lags for yearly data. From this, the lag length that limits SBC is chosen.

The ARDL detail of the short-run elements can be determined by developing an error correction model (ECM) of the equations:

$$\left[\begin{array}{l}\Delta(yl\ )_t = \alpha_2 + \sum_{i=1}^{p}\phi_{2i}\Delta(yl\ )_{t-i} + \sum_{i=0}^{p}\theta_{2i}\Delta(G_m)_{t-i} + \sum_{i=0}^{p}\varphi_{2i}\Delta(EX)_{t-i} \\ + \sum_{i=0}^{p}\varphi_{2i}\Delta(IN)_{t-i} + \sum_{i=0}^{p}\varphi_{2i}\Delta(TR)_{t-i} + \sum_{i=0}^{p}\varphi_{2i}\Delta(y)_{t-i} + \psi ECM_{t-1} + \vartheta_t\end{array}\right]$$ …(6)

Where

yl= export of root and tuber crops in tonnes
G_m= average price of root and tuber crops (in US dollars)
H= world export value (in US dollars)
G= world price of root and tuber crops (in US dollars)
EX= exchange rate naira to US dollars
IN= interest rate in percentage
TR= tariff rate in percentage
GDP= Gross Domestic Product in Naira
Δ= Difference operator
Y= dependent variables

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x= independent variables
t= time
In= natural log
$\sum$ = summation sign
ECM = Error correction term
u, ϑ_t = error term are independent identically distributed.
$\delta, \phi, \theta, \lambda, \varphi$= the coefficients
^{P}= lag operator

r = percentage growth in total world exports from
period

RESULTS AND DISCUSSIONS

Unit root test of the variables

Before using the time series data for analysis, the variables were subjected to a stationary test using the Augmented Dickey-Fuller test (ADF) and Philips-Peron test for confirmation and to ascertain the order of integration of the variables (see equation 2, 3 & 4). The unit root test determines whether a given time series data is consistent with a unit root process. The presence of unit roots could lead to false inferences in regression between time series. From the results of the unit root tests presented in Table 1, most variables were stationary at first difference. Variables such as exchange rate, labour, cassava export, ginger import, root and tuber crops import, lead time to export, the average time to clear exports, lead time to import, inflation rate, real interest rate, Gross domestic product, temperature, and tariff were stationary at level.

The coefficients compared with the critical values revealed that all the variables were stationary at the level and first difference, and based on this, the null hypothesis of non-stationary was rejected and safe to conclude that the variables are stationary. This rejection implied that the variables are integrated. If two or more series are individually integrated (in the time series sense), the individual series are first-order integrated (I(1)), but some (co-integrating) vector of coefficients exists to form a stationarylinear combination of them. The series may drift apart in the short-run, then follow a common trend which permits a stable long-run relationship between them.

Since all the variables are not integrated in the same order, there is a need for a cointegration test. This result implies that some linear combinations of the series must be co-integrated, such that even though the individual series may be integrated at 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.

Table 1: Unit root test of the variables continued

	ADF test		Philips-perron		
	Level	1st difference	Level	1st difference	decision
root and tuber import	-5.05821	-8.7093	-7.30146	-16.3664	I(0)
root and tuber export	-2.18363	-10.3861	-3.32149	-15.0601	I(1)
root and tuber world export	-1.6584	-6.98362	-1.60222	-8.37092	I(1)
root and tuber producer price	-0.85439	-7.53306	-1.38305	-16.3741	I(1)
Exchange rate	2.15693	-3.26868	0.433331	-0.91299	I(1)

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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 values for rejection of the unit root hypothesis applied at 1%, 5% & 10%, respectively. I(0) & I(1) indicate 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 root and tuber crops export

The long run and short run determinants of macroeconomic determinants of root and tuber crops exports (equation 5), having conducted the unit root autocorrelation tests using the Breush-Godfrey serial correlation test.

Long-run macroeconomic determinants of root and tuber crops export

The value of the F-statistics found to be statistically insignificantimplies that we accept the null hypothesis of no serial correlation in the long-run determinants of the root and tubers export model estimated. The result is presented in Table 2.

Table 2: Breusch-Godfrey Serial Correlation LM Test: long-run determinants of root & tuber exports

F-statistic	0.494351	Prob. F(4,6)	0.7419
Obs*R-squared	12.64166	Prob. Chi-Square(4)	0.0132

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 16.295 and 17.848 were minimal, resulting in the selection of 4 lag lengths. The Durbin-Watson value of 1.871 confirms that the model is free from auto-correlation.The calculated F-statistics (F-statistic = 28.256) show that the null hypothesis of no cointegration can be rejected at a 1.0 per cent level as it was observed from the bound test that there is a long-run relationship running among the variables. This result implies that a long-run relationship or cointegration exists between root and tuber exports and their determinants. The next step is to estimate the long-run coefficients by estimating an ARDL. The result indicates that the overall long-run model is well fitted as the independent variable explained over 99.1% (R^2) movement in the dependent variable.

Root and tuber crops exports in the previous years were observed to be statistically significant, and all negatively influenced the long-run Nigerian root and tuber crops exports. Nigerian root and tuber crops exports in the previous years have not been enough to cause an increase in the quantity of root and tuber crops exports.

Root and tuber crop production was statistically significant and positively influenced long-run root and tuber crop exports. The increase in the production of root and tuber may increase the long-run growth in the quantity of Nigeria root and tuber crops exports.

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Previous root and tuber crops import were statistically significant and negatively influenced the long-run root and tuber crop exports. The increase in the quantity of root and tuber crop products imported into the country results in a decrease in the quantity of root and tuber crop exports.

World root and tuber crops exports were statistically significant and positively influenced Nigeria's root and tuber crops exports. According to (IFAD, 2005), Nigeria's root and tuber crops are of the best quality as they compete favourably in the international market.

The interest rate was statistically significant at 10% in the first and secondlags and had a positivelong-run impact on Nigeria's root and tuber crops exports. This result implies that the interest rate of lending by the banks wasfavourable for the exporters to borrow to support the long-run export of root and tuber crops during the periods.

The Gross Domestic Product (GDP) negatively impacted the root and tuber crop exports in the long run. The negative impact implies that economic growth did not resultin the growth of root and tuber crop exports.

Tariff rates were statistically significant at the first and secondlag at 5% and 1%, respectively and positively impacting the long run root and tuber crops export, while at the fourth lag, the tariff was statistically significant at 10% and negatively influenced the ginger export in the long run. This finding implies that the tariff policy should be such that it favours the exporters of the root and tuber crops as the increase in any year resultin the exports and vice versa.

Exchange rates atfirst and secondlags were statistically significant at 10% and negatively influenced the export of root and tuber crops in the long run. This finding implies that the exchange rate of naira to the dollar was not favourable to the roots and tuber crops exporters, while the third lag was statistically significant at 1% and positively influenced the roots and tuber crops exports. A favourable exchange rate results in an increase in the number of roots and tuber crops exports.

The selling price of ginger was statistically significant at 10% and 5% in the third and fourthlags, respectively and positively influenced the long-run ginger export. The exporters buy the roots and tuber crops at an attractive price from the farmers, ensuring the growth of the roots and tuber crops exports. The first and fourthlags were statistically significant at 10% and 5%, respectively and negatively influenced the long-run roots and tuber crops exports. The increase in the farm gate price of roots and tuber crops lures the exporters away as the product may not be competitive.

Table 3: Long-run determinants of root and tuber crops exports

Variable	Coefficient	Std. Error	t-Statistic	Level of significance
C	-290.6782	287.3486	-1.011587	
D(root and tuber export (-1))	-0.215012	0.124878	-1.721777	*
D(root and tuber export (-2))	-0.768227	0.212108	-3.621870	**
D(root and tuber export (-3))	-0.805952	0.271006	-2.973926	**
D(root and tuber export (-4))	-1.068265	0.210451	-5.076080	***
D(root and tuber production(-1))	-2.44E-05	0.000129	-0.189218	
D(root and tuber production(-2))	0.000147	0.000127	1.159333	
D(root and tuber production (-3))	7.25E-05	0.000124	0.586297	
D(root and tuber production (-4))	0.000216	9.72E-05	2.224621	*

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D(root and tuber imports (-1))	-8.918222	4.312354	-2.068063	*
D(root and tuber imports (-2))	-23.92523	4.654631	-5.140091	***
D(root and tuber imports (-3))	-24.38483	6.833476	-3.568437	***
D(root and tuber imports (-4))	-18.17653	4.598109	-3.953044	***
D(root and tuber world exports (-1))	-0.028874	0.029979	-0.963138	
D(root and tuber world exports (-2))	0.030167	0.034666	0.870232	
D(root and tuber world exports (-3))	0.040218	0.035127	1.144938	
D(root and tuber world exports (-4))	0.117215	0.043437	2.698496	**
D(Inflation(-1))	17.19595	32.72615	0.525450	
D(Inflation(-2))	12.95526	37.51870	0.345301	
D(Inflation(-3))	3.309278	38.92477	0.085017	
D(Inflation(-4))	-2.829135	25.97620	-0.108913	
D(Interest rate(-1))	32.37666	17.44472	1.855958	*
D(Interest rate (-2))	46.76385	31.08807	1.504238	*
D(Interest rate (-3))	35.63268	34.84754	1.022531	
D(Interest rate (-4))	16.56183	27.88087	0.594021	
D(GDP(-1))	0.587255	0.270562	2.170498	*
D(GDP(-2))	0.129749	0.168561	0.769746	
D(GDP(-3))	-0.130062	0.150341	-0.865111	
D(GDP(-4))	-0.570293	0.101330	-5.628083	***
D(Tariff(-1))	92.41049	35.80959	2.580608	**
D(Tariff (-2))	185.6903	37.39369	4.965820	***
D(Tariff (-3))	28.48908	35.50739	0.802342	
D(Tariff (-4))	-54.80490	25.10665	-2.182884	*
D(Exchange rate(-1))	-140.6248	67.97864	-2.068661	*
D(Exchange rate (-2))	-594.3471	297.6354	-1.996896	*
D(Exchange rate (-3))	921.5800	263.1045	3.502715	**
D(Exchange rate (-4))	-308.9905	251.6041	-1.228082	
D(Price(-1))	-0.847491	0.231233	-3.665087	***
D(Price (-2))	-1.016836	0.397019	-2.561178	**
D(Price (-3))	1.230952	0.540577	2.277109	*
D(Price (-4))	0.663297	0.245248	2.704594	**

R-squared	0.991230	Mean dependent var	423.3696
Adjusted R-squared	0.956149	SD dependent var	4035.669
SE of regression	845.0916	Akaike info criterion	16.29537
Sum squared resid	7141798.	Schwarz criterion	17.84841
Log-likelihood	-374.5319	Hannan-Quinn criteria.	16.88883
F-statistic	28.25581	Durbin-Watson stat	1.870967
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 2 presents an estimate of the CUSUM stability test in the autoregressive distributed lags method (ARDL) for the long-run determinants of root and tuber exports to show the stability of the model. Our variables and data are stable because of the cumulative sum of recursive residuals. The CUSUM graph is within the limits of a 5% significance level.

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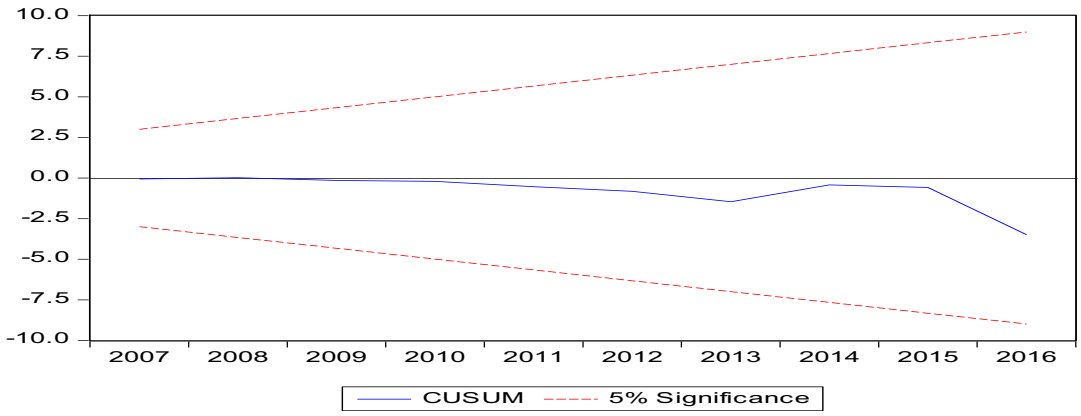

Figure 2 cumulative sum control chart for long-run determinants of Root and tuber export

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 root and tuber crops export

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 the root and tuber export model (equation 6) estimated as presented in Table 4.

Table 4: Breusch-Godfrey Serial Correlation LM Test: Short run determinants root and tuber exports

F-statistic	0.730844	Prob. F(2,29)	0.4902
Obs*R-squared	2.543177	Prob. Chi-Square(2)	0.0804

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 18.853 and 19.670 were minimal, resulting in the selection of 2 lag lengths. The Durbin-Watson value of 1.983 confirms that the model is free from auto-correlation. The calculated F-statistics (F-statistic = 4.295) show that the model is statistically significant. The result indicates that the overall long-run model is well fitted as the independent variable explained over 74.4% (R^2) movement in the dependent variable. The speed of adjustment from the short term to the long term (ECM) was statistically significant at 5% and suggested an average speed of adjustment from the short term to the long term.

Previous root and tuber crop production was statistically significant at 5% and had a positive short-run impact on the export of root and tuber crops. An increase in the production of root and tuber crops results in an increase in the export of the root and tuber crops. The interest rate was favourable to the root and tuber crops exporters in the short run as it was statistically significant at 10%.

Table 5 short-run determinants of root and tuber crops export

Variable	Coefficient	Std. Error	t-Statistic	Level of significance
C	-571.6242	501.1307	-1.140669	
D(root & tuber export (-1))	0.001349	0.352076	0.003832	
D(root & tuber export (-2))	-0.154098	0.212244	-0.726039	

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D(root & tuber production (-1))	2.52E-05	0.000154	0.164218	
D(root & tuber production (-2))	0.000365	0.000133	2.744690	**
D(root & tuber imports(-1))	-3.463949	5.499768	-0.629835	
D(root & tuber imports (-2))	-4.605374	5.487631	-0.839228	
D(root & tuber world exports (-1))	0.022398	0.044054	0.508414	
D(root & tuber world exports (-2))	0.022104	0.044225	0.499802	
D(Inflation(-1))	16.72845	49.85664	0.335531	
D(Inflation (-2))	32.15390	36.43783	0.882432	
D(Interest(-1))	35.06071	35.90348	0.976527	
D(Interest(-2))	54.84836	33.97964	1.614154	*
D(GDP(-1))	-0.013029	0.101098	-0.128874	
D(GDP(-2))	0.088423	0.108928	0.811752	
D(Tariff(-1))	30.07841	26.80748	1.122016	
D(Tariff(-2))	15.10660	29.03272	0.520330	
D(Exchange rate(-1))	-65.83544	68.65867	-0.958880	
D(Exchange rate(-2))	136.7149	86.27446	1.584651	
D(Price(-1))	-0.189357	0.239444	-0.790819	
D(Price(-2))	-0.349427	0.233333	-1.497542	
ECM(-1)	-1.151077	0.363163	-3.169590	**

R-squared	0.744219	Mean dependent var	407.3934
Adjusted R-squared	0.570948	SD dependent var	3958.137
SE of regression	2592.662	Akaike info criterion	18.85264
Sum squared resid	2.08E+08	Schwarz criterion	19.67050
Log-likelihood	-477.5950	Hannan-Quinn criteria.	19.16715
F-statistic	4.295112	Durbin-Watson stat	1.982798
Prob(F-statistic)	0.000131		

*,**& *** 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 an estimate of the CUSUM stability test in the autoregressive distributed lags method (ARDL) for the short-run determinants of root and tuber crops exports to show the stability of the model. Our variables and data are stable because of the cumulative sum of recursive residuals. The CUSUM graph is within the limits of a 5% significance level.

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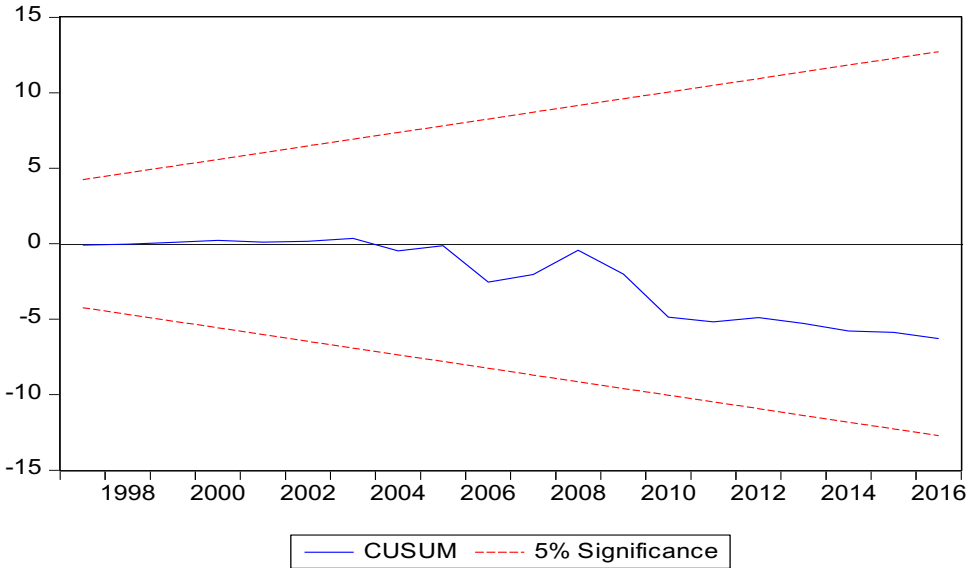

Figure 2 cumulative sum control chart for short-run determinants of Root and tuber export
Source: FAO database Source: FAO database, World Bank development indicators, CBN statistical Bulletin various issues, UNDP climate data, Index Mundi, 2016 computed using Eviews 9.

CONCLUSION AND IMPLICATIONS

Generally, food secuity is determines at supply and demand side, and it is anchored on availability, accessibility, utilization and stability. At the supply side is the issue of availability and it is determined by a nations level of production and net trade among other factor. This study has shown that despite Nigeria's capacity to meet low consumption, it still exports many root and tuber crops to other countries, though this represents a short-run measure as exports in the previous years have not been enough to stimulate increased root and tuber crops exports in the long run, but it has a critical impact on Nigeria food security. The plauisble impact of export of available food inspite of gaps in supply is seen in rising cost of staple foods in the market, food inflation, which has continued to rise monthly accordig to NBS, and lack of access to food, leading more than 133 million Nigerian in the poverty trap. Nigeria requires a potential strategy to enhance production that meets domestic consumption to mitigate rising food insecurity and plausible increase in export for economic growth. The concomitant realisation is that the increase in the quantity of root and tuber crop products imported into the country results in a decrease in the quantity of root and tuber crop exports. It has severe implication for smallholders' producer's food security status, productivity capacity and competitiveness given that these imported products may enjoy specific concessional incentives that makes it economically viable to export; unfortunately, the Nigerian government do not offer such incentives to local producers. A good production-marketing strategy and synergy will enhance economic opportunities and improve producers' food security status. The study also addresses the issue of alternative sources of supply, given the variability of agricultural commodities. Domestic products did not stimulate the long-run increase of root and tuber crop exports; marketing plays a critical role in matching demand with supply. The tariff rates influenced the export of root and tuber crops positively. Exchange rates and the prices of the root and tuber crops had positive and negative long-term impacts on the export of root and tuber crops in Nigeria. In the short run, previous root and tuber crop production positively impacted the production of root and tuber crops.

Some practical implications for stimulating the tuber and root crop business can be advanced from our findings. First, the findings have showns that macro economic variable can be contributing factors to food insecuity crops. The result suggest that it is important to meet food demand and supply at both the short-run and long-run, than exporting food at the short run which can exaceberate food

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insecurity. This may involve improvement in monetary and fiscal frameworks that support small and medium scale enterprises (SME), support critical infrastrutures that enhance production and incentivizing of farmers. Second, to improve the business process, firms in the business must understand the impact of price regulation by the government on the production and export of root and tuber crops. Price is a significant determinant of root and tuber exports both in the long and short run, and price instability is a structural characteristic of root and tuber crop marketing in Nigeria. The Federal Government should ensure that there is only a small margin between the producer prices of root and tuber crops and world prices so that farmers/ exporters can benefit substantially from international trade and producer produce at a good profit margin.

Third, to improve productivity and reduce the price effect that characterises market behaviour as a result of macroeconomic variables, there should be an outright ban on the importation of the root and tuber crops products as this impact the exports of the root and tuber crops negatively. The borders should be closely checked to prevent smuggling.

Finally, to increase the export potentials of tuber and root crops given the growing demand in the global staple market both in the short and long run, Nigeria should rethink its agricultural policies model because macroeconomic policy leads to variability in the agricultural policy (Kadir & Tunggai, 2015). Therefore, the agricultural policy must be built to have resilient measures that absorb shocks and instability in the business environment. Small businesses must be educated on agricultural policies and macroeconomic variables, which will improve their market dynamics and competitiveness.

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