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AN ESTIMATION OF THE LONG-RUN AND SHORT-RUN RELATIONSHIP BETWEEN RICE IMPORTATION AND ITS DETERMINANTS IN NIGERIA, 1981 AND 2021

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ABSTRACT

Although, rice is a major staple food in Nigeria, its inadequate supply necessitates importation, which is not economically sustainable. This study assessed the relationship between rice importation and its determinants in Nigeria. Time series data obtained for the study between 1981 and 2021 were subjected to stationarity and cointegration tests, vector error-correction, short-run and error-correction models. Findings showed that the series were all *I*(1) and cointegrated. Also, the mean rice production was lower than consumption. Imported milled rice was statistically ($p<0.05$) reduced by domestic production of rice but increased by WRP in the long-run. In the short-run, DPR reduced IMR while CBL (0.653) and lending rate (2.022) increased imported milled rice. The error-correction term was negative and statistically significant ($p<0.01$), suggesting 2.08 years at a speed of adjustment of 48.02% to restore to long-run equilibrium. Hence, the FMARD-CBN should encourage sustainable domestic rice production through capital injection and favourable agricultural credit policies to reverse rice import.

Keywords: Rice; cointegration; vector error-correction model; short-run; error-correction term.

INTRODUCTION

The triple bottom line concept of sustainability underscores economic sustainability vis-à-vis social and environmental lines (Arowoshegbe & Uniamikogbo, 2018). Among other things, economic sustainability implies that nations are not adversely hurt through frequent importation of a food commodity that has widespread relevance to their populace. Rice (*Oryza sativa*) is a major staple food in Nigeria (Ademiluyi *et al.*, 2021; Gbenga *et al.*, 2020). However, its production is not commensurate with consumption. Abiola *et al.* (2021) blamed the inability of the rice subsector to produce enough rice for local consumption on the poor performance of the sector over the years. According to Mboyerwa *et al.* (2022), the most critical challenge to global rice production is meeting up with an estimated 34% rise in worldwide population by 2050. For Nigeria, Ali *et al.* (2020) deduced that annual production is less than demand by approximately 1.9 million mt. At an average yield of 1.86 mt/ha, the cultivation of about 1,022 million hectares of rice would be required to bridge the gap and eliminate import.

Rice represents about 29% of global grain crops output (Iweka & Ederewhevbe, 2018). In Nigeria, rice is grown in the various ecological zones and under different production systems. These include upland, lowland, irrigated and mangrove/deep water production systems (Ogunsumi *et al.*, 2013; Rapu, 2016). Rapu (2016) held that the lowland system, which is associated with moderate yield, is done in waterlogged areas with variable flood levels. Ogunsumi *et al.* (2013) reported that the irrigated system relies on artificial supply of water from the river, wells and boreholes to supplement rainfall. Rapu (2016) indicated that the mangrove systems are found along the coastline and freshwater swamps but characterized with low yield. The profitability of rice production varies across ecological zones. For instance, Chidiebere-mark *et al.* (2019) reported that the return per hectare for swamp, lowland and upland production systems were 29.37%, 20.10% and 13.03%, respectively. Similarly, Oloyede *et al.* (2020) reported that the gross margins for lowland, upland and combined rice production systems were N65,735.73, N67,900.89 and N78,015.57 per hectare, respectively.

Rice is produced mainly by small-scale farmers, whose farm holding ranges from 1 to 5 hectares. From 1981 to 2021, Nigeria cultivated a total of 89.86 million hectares of rice, with a mean yield of 1.87 mt/ha. While rice area harvested rose steadily within the period, the yield declined. Declining yield amidst rising population, rice demand and urbanization are unhealthy. Against the backdrop of rice consumption by a majority of Nigeria’s population, the trends that are depicted in Figure 1, portray deepening food insecurity.

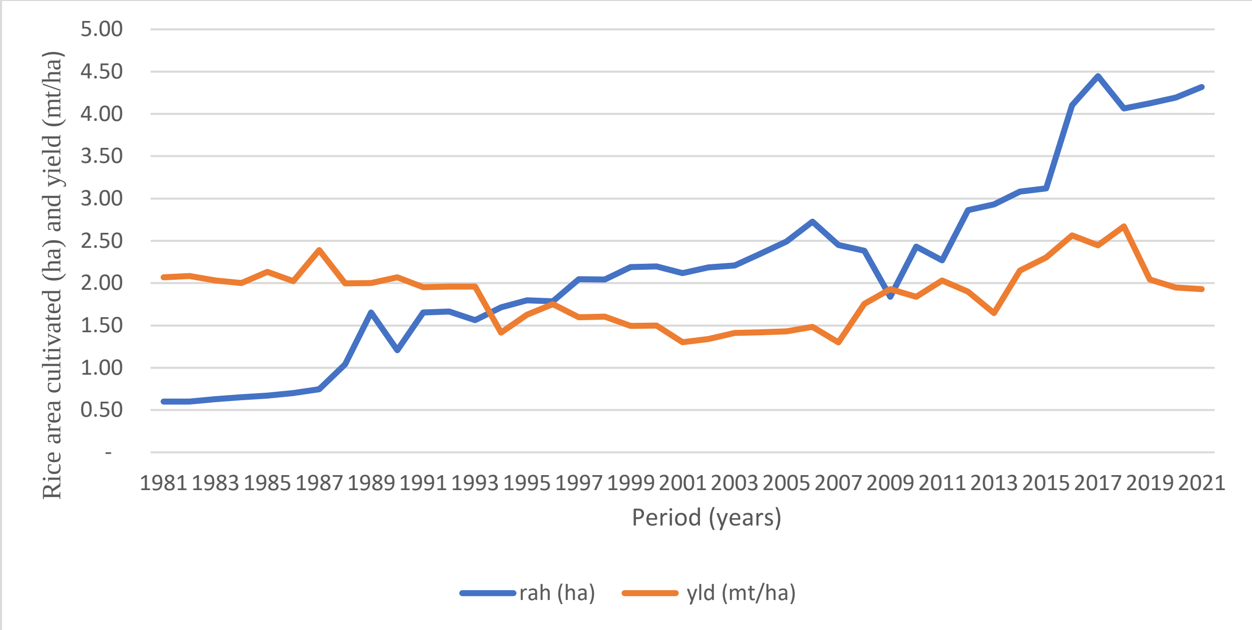

Figure 1: Rice Area Cultivated (ha) and Yield (mt/ha
Source: FAOSTAT, 2023

Iweka & Ederewhevbe (2018) stated that rice is a staple for an estimated 180 million Nigerians. Household rice consumption is influenced by the incursion of women into the workforce and the resultant search for foods that can be cooked very quickly (Akpokodje *et al.*, 2003). Rice is price inelastic. Fakayode *et al.* (2010) stated that household preference for either a combination of local or imported rice was not affected by the price per kilogramme. Other users of rice, according to Abbas *et al.* (2018) and Rapu (2016), include the food and drink, pharmaceutical, pasta and bread, and beer and liquor industries and distilleries. In the near future, rice consumption will rise since it does not have an effective close substitute.

Yet, rice yield is on the decline, amidst interventions to reverse the trend. This is due to the prevalence of rudimentary technologies in rice production and processing (Abbas et al., 2018; Bwala & John, 2018); over reliance on rain-fed production system (Bitrus *et al.*, 2018), which is not sustainable; and poor access to farm credit and climate change (Chidiebere-mark *et al.*, 2019), among others. Lawal et al. (2023) assure that sustainable agricultural technologies increase yields and enhance efficiency towards stability in supply. The Food and Agriculture Organization (2014) asserted that the stability dimension of food security is a function of the area under cultivation for staple food crops.

Should the declining rice yield and supply deficit subsist, import will grow but with attendant tradeoff. Nigeria is among the largest rice importers globally. Abbas *et al.* (2018) attributed this high importation of rice in Nigeria to the rapid increase in population and demand for rice. For instance, the Federal Ministry of Agriculture and Rural Development (2016) reiterated that rice supply deficit is usually offset by import. Abbas *et al.* (2018) indicated that rice importation depletes foreign reserves and raises exchange rate for the local economy (Akinniran & Faleye, 2020). Rice importation also de-markets local rice. These tradeoffs occur because consumer's choice is an important market force that affects the market share of an economic commodity. This consumer's choice includes taste, neatness, fast cooking, colour and stickiness after cooking (Emodi & Madukwe, 2011; Iweka & Ederewhevbe, 2018; Ogundele, 2014). Others are swelling quality, sweetness and minimal starch content. For these reasons, imported rice appears to be superior to local rice. The preference for imported rice heightens if import is not purely based on temporary shortfalls in domestic production.

These tradeoffs elucidate the fact that rice importation is antithetical to sustainable economic development. According to Emas (2015), the concept of sustainable development emphasizes development that meets the needs of the present without compromising the ability of future generations to meet their own needs. While increased domestic production is always advocated as a remedy to importation, caution is necessary in order to strike a balance between economic and environmental sustainability. For instance, Win & Win (2020) and Jayeoba (2023) emphasized that rice production itself is a source of anthropogenic gas emission. Thus, Delabre *et al.* (2021) indicated that, sustainably obtaining sufficient food for people while conserving and restoring biodiversity is an overarching goal of any food import reversal policy.

To minimize the negative impacts of rice importation, some policies evolved in the past to trigger domestic production and also meet up with domestic demand but with price control. Rapu (2016) reported that there was a six-month ban on all rice imports in September, 1979; in October 1980, rice was put under no-quantitative import restrictions. Also, a 100% tariff was imposed on rice in 1995. This was reviewed downwards to 50% from 1996 to 2000. Between 2005 and 2006, the full tariff reappeared but came down to 30% in 2009-2010. Between 2013 and 2014, the ban became stiffer as the tariff was raised to 110%. This analysis shows inconsistent and unsustainable commitment by the government to boosting domestic production of rice. According to Adeniyi *et al.* (2019), Nigeria's policy on rice import ban had been inconsistent, having oscillated between import tariff and imports restrictions. Udemezue (2018) lamented that even within the period of rice import ban, Nigeria recorded massive rice importation. Akpokodje *et al.* (2003) decried the expenditure of $4 billion on rice importation between 1961 and 1999 amidst local capacity to produce. Hence, for years, Nigeria incurred humongous expenditure on rice to the detriment of boosting local production.

In 2015, the full ban on rice importation resurfaced. Prior to that, the Dr. Adesina-led Federal Ministry of Agriculture and Rural Development (FMARD) established the Rice Transformation Agenda that fostered a result-oriented rice value chain to increase local production but gauged with an effective off-take strategy in order to control the consequential spike in price. The Anchor-Borrowers' Programme (Bitrus *et al.*, 2021; Central Bank of Nigeria (CBN), 2016; Umeh & Adejo, 2019) was also developed to provide the necessary financial support for smallholder rice farmers. The cumulative impact of these policies is expected to manifest in narrowing rice supply deficit and significantly reduce rice import. However, Udemezue (2018) indicated that the various policy measures to match domestic rice production with consumption has not been effective. This concern has triggered policy evaluation among researchers over time.

There is a dearth of empirical literature on rice demand-supply gap in Nigeria, especially with respect to the determinants of rice importation. Hence, in consideration of the diverse relevance of rice to Nigeria's economy, the specific objectives of this paper were to assess the trend of rice imports and its determinants; determine the long-run relationship between rice import and its determinants; determine the short-run relationship between rice import and its determinants; and establish the possibility of restoration to the long-run equilibrium in the event of any shocks to the economic system. It was hypothesized that the short-run relationship between rice import and its determinants is not statistically significant.

This study has policy implications for the availability and affordability components of food security as its findings will encourage the government to channel funds meant for rice importation into local production that will increase rice supply and force the price downwards. In addition, the management of Sustainable Development Goals can use the findings of this study to review its policies on food security and poverty reduction especially among smallholder rice farmers who are usually vulnerable to economic shocks. Furthermore, the nascent Africa Continental Free Trade Agreement (AfCFTA) will utilize the findings of this study in basing its food trade policies on empirical results in a manner that the determinants of food importation will form the fulcrum of such policies for the purposes of effectiveness and sustainability.

Yusuf *et al.* (2020) assessed the short and long-run determinants of rice import demand in Nigeria, relying on data from the Central Bank of Nigeria and National Bureau of Statistics between 1961 and 2013. The result revealed that, in the short-run, rice consumption, price of meat, price of maize, local rice quantity, demography development and stock variance were statistically significant ($p<0.05$). In the long-run, rice import demand increased significantly with increase in rice consumption, price of meat, price of maize and demography development.

Biam & Adejo (2017) analysed rice importation trend in Nigeria and how it affects local production between 1970 and 2013. Using annual time series data, their findings showed that local rice output increased instantaneously by 5.7% and cumulatively by 5.9%, whereas imports of rice increased by 12.3% and 12.7%, respectively. Additionally, rice consumption increased by 6.58% and 6.8% while rice yield decreased by 0.15 instantaneously and 0.14 cumulatively. Onu *et al.* (2017) estimated the response of rice production and import to long-run and short-run changes in price and non-price factors in Nigeria between 1970 and 2016. The findings revealed that the factors influencing rice production in Nigeria in the long run were rice import, rice area harvested, rice consumption, government capital investment in agriculture, value of rice imports, rice domestic price, labour force in agriculture, and trend variable.

Tiamiyu *et al.* (2014) determined the trend of rice consumption and its implication on rice self-sufficiency target by 2020. The findings showed that 6,720,512 metric tonnes of milled rice would be needed in 2020, requiring a 100% increase in the nation's rice production capacity. Oyinbo *et al.* (2013) estimated the instantaneous and compound growth rates of rice demand and supply in Nigeria from 1970 to 2011. The results revealed that the instantaneous and compound growth rates of rice demand were greater than those of rice supply (6.5% and 6.7%) by 7.5% and 7.8%, respectively. The current study adds economic sustainability dimension to the debate.

METHODOLOGY

Study area

Nigeria, Africa's most populous country, is the study area. It is Africa's largest economy (Ismail & Kabuga, 2016), with an estimated population of 200 million. The country is located between latitudes 4°16 and 13°53 north and between longitudes 2°4[1] and 14°4[1] east. It also has a highly diversified agro-ecological climatic condition (Hamzat *et al.*, 2006; Ogbanje & Salami, 2022). Nigeria' six ecological zones range from a belt of mangrove swamps and tropical forests to the semi-arid plains, which are dominant in the north and the highlands to the north east (Eregha, 2014). Agriculture remains the backbone of the economy. Nevertheless, rice production is largely subsistent and dominated by resource-poor and small to medium-scale farmers (Abdulahi Taiwo Olabisi, 2012; Girei *et al.*, 2018; Oke *et al.*, 2022).

Rice is produced mostly under rainfed system by several states of the federation. In 2012, the government launched Rice Transformation Agenda to boost rice value chain. The Commercial Agricultural Credit Scheme (CACS) in 2009 (Aiyede, 2021; Azubugwu & Osuafor, 2019; CBN, 2018; Federal Ministry of Agriculture and Rural Development (FMARD), 2017); Economic Recovery and Growth Plan (2017-2020) of the Federal Republic of Nigeria, 2020) and the Anchor Borrowers Programme (ABP) in 2015 (Ayinde et al., 2018; FMARD, 2017; Giroh et al., 2021; Tinuke & Joseph, 2018) represented the government's major landmark efforts to boost local rice production and curtail rice importation. These efforts were based on the facts that Nigeria consumes more rice than it produces and consequently import rice massively (Abbas *et al.*, 2018; Akinbode, 2013; Ali *et al.*, 2020). The map of Nigeria is shown in Figure 1.

Data Collection

Quantitative method of data collection was used to collect data on domestic rice production from the Food and Agriculture Organization; domestic rice consumption and world rice price from World Development Indicators' site; and commercial banks' loan to agricultural sector, exchange rate and lending rate from the Central Bank of Nigeria. These datasets spanned from 1981 to 2021.

Estimation techniques

Three groups of estimation techniques were used. These were pre-estimation tests (PET), including stationarity tests (Augment Dickey-Fuler (ADF) and Philips Perron (PP)) and long-run test (Johansen-Juselius cointegration); actual estimation test, consisting of long-run relationship (vector error-correction model), the short-run relationship and error-correction model; and post-estimation tests (POET), including normality (Jarque-Bera), serial autocorrelation (Breusch-Godfrey Serial Correlation LM Test), heteroskedasticity (Breusch-Pagan-Godfrey test), structural stability (Ramsey reset and CUSUM square) tests.

Figure 1: Map of Nigeria, showing some states as well as international boundaries

Stationarity Test

Many time series variables have unit root due to shocks and fluctuations over time (Musa, 2015). Unit root is associated with nonstationary series or exhibition of autocorrelation (Gujarati & Porter, 2009). The absence of unit root, or stationarity, must be ascertained in order for the result of the time series to be adjudged as reliable and not spurious (Arize, 2003; Djokoto *et al.*, 2014; Ogbanje & Ihemezie, 2021). This means a condition where the mean and variance of a series are constant and the covariance is not time-dependent (Gujarati, 2003). The study used the ADF to test for stationarity of the series. According to Gujarati & Porter (2009) and Ogbanje & Ihemezie (2021), the ADF is the most popular unit root test. Further to this, Ogbanje & Ihemezie (2021) used the Philips-Perron (PP) approach as a confirmatory method. While the ADF test uses a parametric autoregression to approximate the structure of the errors in a regression, the PP test ignores any serial correlation in the regression (Wiah & Twumasi-Ankrah, 2017). The model for ADF is as shown in Equation (1):

$$\Delta Y_t = \beta_1 + \beta_{1t} + \delta Y_{t-1} + \sum_{i=1}^{m} \propto_i \Delta Y_{t-1} + \varepsilon_t \qquad (1)$$

Ho: $\delta = 0$ $(There\ is\ unit\ root)$

Ha: $\delta < 0$ $(There\ is\ no\ unit\ root)$

where,

Yt = time series variables, including IMR, DPR, DRC, WRP, CBL, EXR and LR

Y_{t-1} = lagged value of Yt

$\beta, \delta = parameters\ to\ be\ estimated$

$\Delta = first - difference\ operator$

Ɛt = pure white noise or error term which is assumed to be serially uncorrelated

Johansen-Juselius test

Johansen-Juselius' (JJ) cointegration test predicts the existence of a long-run relationship or co-integration among a given set of series (Adongo *et al.*, 2020; Ogbanje & Ihemezie, 2021). The JJ test has two statistics, the trace and maximum Eigenvalue (Siaw *et al.*, 2017), which also indicate the number of co-integrating equations in a systems equation. While the confirmation of co-integration recommends the adoption of vector error correction model (VECM), the absence recommends the use of vector autoregression (VAR) model for estimation, thereby presupposing only short-run relationship (Ogbanje & Ihemezie, 2021; Ogbanje & Salami, 2022). Sukati (2013) and Anetor *et al.* (2016) affirmed that if cointegration is found to exist between series, it is appropriate to use vector error correction model (VECM), rather than VAR. Mencet *et al.* (2006) added that the existence of cointegration implies that an equation is a stationary process.

Vector Error-Correction Model

In the VECM, all variables are endogenous. The VECM model includes the error-correction term (ECT), represented by Lamda (λ). Following the works of Andrei & Andrei (2015), Ijirshar (2015) and Ogbanje & Tor (2022a), the VEC model for this work is specified in Equation (2):

$$\Delta LIMR_t = \theta_1 + \sum_{i=1}^{k} \beta_{1i}\Delta LIMR_{t-1} + \sum_{i=1}^{k} \delta_{1i}\Delta LDPR_{t-1} + \sum_{i=1}^{k} \delta_{1i}\Delta LDRC_{t-1} + \sum_{i=1}^{k} \gamma_{1i}\Delta LWRP_{t-1} + \sum_{i=1}^{k} \alpha_{1i}\Delta LCBL_{t-1} + \sum_{i=1}^{k} \delta_{1i}\Delta LEXR_{t-1} + \sum_{i=1}^{k} \delta_{1i}\Delta LLR_{t-1} + \lambda_1\Sigma_{t-1} + \mu_{1t} \quad (2)$$

$$\Delta LDPR_t = \theta_2 + \sum_{i=1}^{k} \beta_{2i}\Delta LIMR_{t-1} + \sum_{i=1}^{k} \delta_{2i}\Delta LDPR_{t-1} + \sum_{i=1}^{k} \delta_{2i}\Delta LDRC_{t-1} + \sum_{i=1}^{k} \gamma_{2i}\Delta LWRP_{t-1} + \sum_{i=1}^{k} \alpha_{2i}\Delta LCBL_{t-1} + \sum_{i=1}^{k} \delta_{2i}\Delta LEXR_{t-1} + \sum_{i=1}^{k} \delta_{2i}\Delta LLR_{t-1} + \lambda_2\Sigma_{t-1} + \mu_{2t}$$

$$\Delta LDRC_t = \theta_3 + \sum_{i=1}^{k} \beta_{3i}\Delta LIMR_{t-1} + \sum_{i=1}^{k} \delta_{3i}\Delta LDPR_{t-1} + \sum_{i=1}^{k} \delta_{3i}\Delta LDRC_{t-1} + \sum_{i=1}^{k} \gamma_{3i}\Delta LWRP_{t-1} + \sum_{i=1}^{k} \alpha_{3i}\Delta LCBL_{t-1} + \sum_{i=1}^{k} \delta_{3i}\Delta LEXR_{t-1} + \sum_{i=1}^{k} \delta_{3i}\Delta LLR_{t-1} + \lambda_3\Sigma_{t-1} + \mu_{3t}$$

$$\Delta LWRP_t = \theta_4 + \sum_{i=1}^{k} \beta_{4i}\Delta LIMR_{t-1} + \sum_{i=1}^{k} \delta_{4i}\Delta LDPR_{t-1} + \sum_{i=1}^{k} \delta_{4i}\Delta LDRC_{t-1} + \sum_{i=1}^{k} \gamma_{4i}\Delta LWRP_{t-1} + \sum_{i=1}^{k} \alpha_{4i}\Delta LCBL_{t-1} + \sum_{i=1}^{k} \delta_{4i}\Delta LEXR_{t-1} + \sum_{i=1}^{k} \delta_{4i}\Delta LLR_{t-1} + \lambda_4\Sigma_{t-1} + \mu_{4t}$$

$$\Delta LCBL_t = \theta_5 + \sum_{i=1}^{k} \beta_{5i}\Delta LIMR_{t-1} + \sum_{i=1}^{k} \delta_{5i}\Delta LDPR_{t-1} + \sum_{i=1}^{k} \delta_{5i}\Delta LDRC_{t-1} + \sum_{i=1}^{k} \gamma_{5i}\Delta LWRP_{t-1} + \sum_{i=1}^{k} \alpha_{5i}\Delta LCBL_{t-1} + \sum_{i=1}^{k} \delta_{5i}\Delta LEXR_{t-1} + \sum_{i=1}^{k} \delta_{5i}\Delta LLR_{t-1} + \lambda_5\Sigma_{t-1} + \mu_{5t}$$

$$\Delta LEXR_t = \theta_6 + \sum_{i=1}^{k} \beta_{6i}\Delta LIMR_{t-1} + \sum_{i=1}^{k} \delta_{6i}\Delta LDPR_{t-1} + \sum_{i=1}^{k} \delta_{6i}\Delta LDRC_{t-1} + \sum_{i=1}^{k} \gamma_{6i}\Delta LWRP_{t-1} + \sum_{i=1}^{k} \alpha_{6i}\Delta LCBL_{t-1} + \sum_{i=1}^{k} \delta_{6i}\Delta LEXR_{t-1} + \sum_{i=1}^{k} \delta_{6i}\Delta LLR_{t-1} + \lambda_6\Sigma_{t-1} + \mu_{6t}$$

$$\Delta LLR_t = \theta_7 + \sum_{i=1}^{k} \beta_{7i}\Delta LIMR_{t-1} + \sum_{i=1}^{k} \delta_{7i}\Delta LDPR_{t-1} + \sum_{i=1}^{k} \delta_{7i}\Delta LDRC_{t-1} + \sum_{i=1}^{k} \gamma_{7i}\Delta LWRP_{t-1} + \sum_{i=1}^{k} \alpha_{7i}\Delta LCBL_{t-1} + \sum_{i=1}^{k} \delta_{7i}\Delta LEXR_{t-1} + \sum_{i=1}^{k} \delta_{7i}\Delta LLR_{t-1} + \lambda_7\Sigma_{t-1} + \mu_{7t}$$

Where,

IMR = imported milled rice (million mt)

DPR = domestic paddy rice (million mt)

DRC = domestic rice consumption (million mt)

WRP = world rice price (million ₦)

CBL = commercial bank loan (million ₦)

EXR = exchange rate (equivalence of US$)

LR = lending rate (%)

λ = Lambda, vector of restoration to long-run

Short-run dynamics

The short-run relationship complements the long-run relationship. Joshi *et al.* (2019) stated that the appropriate sign and significance of the ECT imply that the disequilibria in the dependent variable in the first model from the previous years' shock can adjust back to the long-run in the current year. Orji *et al.* (2021) stated that the coefficient (Lamda) of ECT measures the speed of adjustment between the short-run and long-run equilibria and shows how long it takes the long-run equilibrium to be restored, should any shock occur to the economic system. Egwuma *et al.* (2017) also noted that the short-run impact is often examined with the aid of ECT. The model for estimating the impact of ECT in the short-run dynamics is given in Equation (3) as follows:

d(limr) c d(limr(-1)) d(ldpr)d(ldpr(-1)) d(ldrc)d(ldrc(-1)) d(lwrp)d(lwrp(-1)) d(lcbl)d(lcbl(-1)) d(lexr)d(lexr(-1)) d(llr)d(llr(-1)) ect(-1) (3)

The Vector-Error Correction (VEC) term

The VEC must be negative and significant to signal the possibility of restoration to the short-run equilibrium (Chimaliro, 2018). This will further confirm the existence of long-run relationship. The speed of adjustment (SPA) is calculated by using equation (4).

$$SPA = {}^{1}/_{ECT\ coefficient} \qquad (4)$$

RESULTS AND DISCUSSION

Descriptive Statistics Variables

The results of the summary statistics of variables in Table 1 shows that the mean of imported rice (million mt) between 1981 and 2021 was 0.77. This means that Nigeria imported an average of 770,000 mt of milled rice within the period. The sum of imported milled rice was 31,750,000 mt of rice, costing $312,020,000.00 or ₦37,918.570,000.00. If this amount is devoted to domestic production, it can generate large supplies, boost the local economy and save foreign reserves. According to the Asian Development Bank (2011), such yield improvements would need to come from an investment that requires the application of good agronomic management practices.

Furthermore, while the mean domestic milled rice produced was 2.76 million tonnes, the mean domestic rice consumption was 3.65 million tonnes, leaving a mean deficit of 0.89 million tonnes, approximately 890,000 metric tonnes. This result confirms Ali *et al.* (2020) who reported an annual rice demand of 5.2 million tonnes as against the annual domestic production of 3.3 million tonnes. Gbenga *et al.* (2020) had earlier reported the inability of local rice production to meet up with consumption. According to Ayuba *et al.* (2020), the rapidly growing population would have exacerbated the rice supply deficit. Oyinbo *et al.* (2013) justified the gap in their finding that the instantaneous and compound growth rates (7.5% and 7.8%) of rice demand were higher than those of rice supply (6.5% and 6.7%).

Also, mean DPR exceeded both DRC and DMR by 0.49 and 1.38 million tonnes, respectively. In other words, DPR exceeded DMR by 33.33%. This difference accounts for husk or hull, dust and bran layers that are removed from the paddy in the processing operation. This draws attention to efficiency of processing technology and variety of rice. The FAO and IRRI reported between 67% and 69% of the starchy endosperm are obtainable from the paddy during processing. Average loan (million) that was granted by commercial banks to agriculture was ₦192,613.83. This amount supplements budgetary expenditure for the sector. It is a deliberate policy of the government that commercial banks provide loan to the sector. The credit portfolio is in response to the preponderance of credit need among farmers in empirical literature.

The mean EXR was N115.47. Within the period, it rose curiously from 0.62 in 1981, when the local currency was strong and there was a conscious regulation, to 433.69 in 2020, an era when the value of the naira crashed in the international market. This declining value of the naira makes international trade to be cost ineffective for Nigeria, especially for international transactions. It also raises the cost of rice importation and the price for the vulnerable consumer.

The mean WRP in naira per metric tonne was 47,399.88. On one hand, this price makes rice export attractive. This assertion is supported by the trend of WRP which rose consistently from 289.67 in 1982 to 217,634.65 in 2020, though dropped to 183,890,86 in 2021 On the other hand, it should also discourage rice import as it also depicts foreign exchange depletion per metric tonne of imported rice. This finding conforms to Dawe (2002) that the world rice market has been unstable for much of the post-world war II era, with volatile prices and uncertainty in supplies.

Average LR (17.45) was high, as against the clamour for a single-digit lending rate to encourage borrowing towards robust investment that would trigger growth in all subsectors of the economy, especially agriculture. Also, it is unaffordable to the resource-poor farmers that dominate rice production in the country. Given that a profitable rice production requires optimum inputs, this rate discourages rice production and heightens import with its attendant consequences.

Table 1: Descriptive Statistics Variables

Variables/ Statistics	Mean	Median	Maximum	Minimum	Std. Dev.	Sum
IMR	0.77	0.54	2.46	0.02	0.67	31.75
IMRD	312.02	223.52	1,550.00	8.05	365.19	12,792.81
IMRN	37,918.57	10,003.57	243,832.36	84.52	59,784.36	1,554,661.17
DPR	4.14	3.28	10.89	1.24	2.65	169.73
DRC	3.65	3.05	7.25	1.04	2.01	149.67
DMR	2.76	2.18	7.26	0.83	1.77	113.21
CBL	192,613.83	48,561.50	1,457,821.88	590.60	317,806.97	7,897,167.13
EXR	115.47	111.23	433.69	0.62	111.68	4,734.10
WRP	47,399.88	30,567.36	217,634.66	289.67	52,067.99	1,943,395.05
LR	17.45	16.94	31.65	8.92	4.81	715.29

Sources: FAOSTAT, World Bank Database, 2023

Stationarity Test of Variables in the Model

The summary result of stationarity is presented in Table 2. The result shows that none of the variables was stationary at level. The reason was that the absolute values of the series were less than their corresponding critical values at 5%. This was the position of Ribaj & Mexhuani (2021), Joshi *et al.* (2019) and Ee (2016) in their separate studies. However, the absolute value of these series became *I*(1). In other words, the ADF and PP values for all the variables were greater than their corresponding critical values at 5%. The same approach was adopted by Ogbanje & Ihemezie (2021), Zehra *et al.* (2019) and Akinwale *et al.* (2018).

This was followed by the optimal lag determination. In Table 3, lag one was recommended and selected by four criteria. These were the FPE, AIC, SC and HQ.

Table 2: Summary Result of Stationarity Test of Variables

Variable	Level			First difference		
	Augmented Dickey-Fuller	**Phillips-Perron**	**Stationarity Status**	**Augmented Dickey-Fuller**	**Phillips-Perron**	**Stationarity Status**
LIMR	0.2758	-0.1932	Not stationary	-2.2172***	-5.8342***	I(1)
	(-3.5266)	(-3.5266)		(-1.9499)	(-3.5298)	
LDPR	-2.7284	-2.5633	Not stationary	-8.2430***	-8.0474***	I(1)
	(-3.5330)	(-3.5266)		(-3.5298)	(-3.5298)	
LDRC	-3.3619	-3.4736	Not stationary	-7.0848***	-7.3314***	I(1)
	(-3.5266)	(-3.5266)		(-3.5484)	(-3.5298)	
LWRP	-0.9726	-1.1763	Not stationary	-5.2384***	-5.2388***	I(1)
	(-3.5266)	(-3.5266)		(-3.5298)	(-3.5298)	
LCBL	-2.6220	-2.5618	Not stationary	-7.0906***	-7.9657***	I(1)
	(-3.5298)	(-3.5266)		(-3.5298)	(-3.5298)	
LEXR	-1.5683	-1.1732	Not stationary	-4.5866***	-4.5866***	I(1)
	(-3.5298)	(-3.5266)		(-3.5298)	(-3.5298)	
LLR	-1.6837	-1.6771	Not stationary	-6.2863***	-6.2866***	I(1)
	(-3.5266)	(-3.5266)		(-3.5298)	(-3.5298)	

Figures in parentheses represent the critical values at 5%; I(1) = Integrated of order one

*** Statistical significance at 1% level

Table 3: Lag order selection

Lag	LogL	LR	FPE	AIC	SC	HQ
0	-149.93	NA	9.80e-05	7.796	8.049	7.888
1	90.785	397.179*	3.59e-09*	-2.439*	-0.665*	-1.798*

* indicates lag order selected by the criterion

LR: sequential modified LR test statistic (each test at 5% level)

FPE: Final prediction error

AIC: Akaike information criterion

SC: Schwarz information criterion

HQ: Hannan-Quinn information criterion

Johansen's Unrestricted Cointegration Rank Tests (Trace and Maximum Eigenvalue)

The Cointegration Test result in Table 4 shows that the 'none' hypothesis was rejected at 5%, because the trace statistic was greater than the critical value. Although, both tests eventually suggested differing number of cointegrating equations, this result implies that there is long-run relationship among the series. These are in conformity with Ajayi *et al.* (2017), Oparinde *et al.* (2017) and Ogbanje & Tor (2022) who concluded that there is the possibility of long-run relationship as long as the 'none' hypothesis is rejected.

Table 4: Johansen's Unrestricted Cointegration Rank Tests

Hypothesized No. of CEs	Trace Test		Maximum Eigenvalue Test	
	Trace	Critical Value	Trace	Critical Value
None *	155.05	125.62	51.51	46.23
At most 1 *	103.54	95.75	39.09	40.08
At most 2	64.46	69.82	21.13	33.88
At most 3	43.33	47.86	19.09	27.58
At most 4	24.24	29.80	13.00	21.13
At most 5	11.24	15.49	10.91	14.26
At most 6	0.33	3.84	0.33	3.84

* denotes rejection of the hypothesis at the 0.05 level

Long-run relationship

The estimation of the long-run relationship between rice import and its determinants is presented in Table 5. The results show that the R-squared was 0.4605, implying that the selected determinants accounted for 46.05% of the variations in imported milled rice (IMR). The results further show that the normalized coefficient of DPR was negative and its t-statistic (10.185) significant ($p<0.05$). The implication is that increase in DPR would decrease IMR in the long-run. This result calls for sustainability in domestic production of rice. Mathis & Harrington (2017) reiterated that sustainability and sustainable development are oriented toward the long-term, noting that the pursuit of sustainability or sustainable development is aimed at maintaining or improving beneficial conditions, particularly with improved capacity to extend desirable conditions over the long term. Shi *et al.* (2019) emphasized that sustainable development has become a fundamental strategy to guide the world's social and economic transformation. However, this finding contradicts Onu *et al.* (2017) who found that domestic rice output increased the quantity of rice import between 1970 and 2016 in the long-run.

The production of paddy rice receives most of the attention of the government and other stakeholders in the rice subsector. Kuku-Shittu & Pradesha (2013) warned that simply producing rice paddy would not effectively displace imports unless the processing sector is revitalized to absorb the increase in demand. Further, the quality of Nigeria's paddy is such that the endosperm yield falls within the range of 67% and 69% of the paddy as documented by the Food and Agriculture Organization and International Rice Research Institute. It is interesting to discover that DPR would decrease IMR in the long-run, given the poor performance of the former as earlier reported. Using the exponential functional form, Biam & Adejo (2017) found that between 1970 and 2013, local rice production had lower instantaneous and compound growth rates (5.7% and 5.9%) than importation (12.3% and 12.7%). Corroborating, Akpokodje *et al.* (2003) indicated that it was not clear as to whether Nigeria's rice importation policy was a response to local or diplomatic pressure and needs. Another dimension to this policy's conflictual outcome is that, despite the fact Malaysia ranks among the top 10 global rice producers (Udemezue, 2018), the country's rice import rose by 14.2% between 2010 and 2013 (Umar *et al.*, 2014).

The results further showed that the normalized coefficient of WRP was positive and its t-statistic (5.012) significant ($p \leq 0.05$). This implied that increase in WRP would lead to increase in IMR in the long-run. It was expected that increase in the price of milled rice at the international market would lead to a cut in rice importation and cause massive local production as dictated by the principle of import substitution, since Nigeria has comparative advantage in rice production. This measure would have led to substantial savings in foreign exchange. Also, the result negates Say's law which establishes an inverse relationship between the price and demand for a commodity, except for ostentatious goods that have abnormal curves, from the demand side, which is importation by Nigeria. Again, the result shows that rice import in Nigeria is done arbitrarily, without observing relevant economic considerations, thereby raising concerns about economic sustainability. This finding is in line with Onu *et al.* (2017) that a direct long-run relationship exist between the quantity of rice imports and world price of rice. This is favourable for the supplier.

Table 5: Long-run Relationship Estimates using VECM

Variables	Coefficient	Normalized Coefficient	t-statistic	P-Value
Constant	33.733	(33.733)		
LDPR(-1)	6.071 [0.596]	(6.071)	10.185**	0.0089
LDRC(-1)	0.450 [0.919]	(0.450)	0.490	0.7762
LWRP(-1)	-2.931 [0.585]	2.931	5.012**	0.0461
LCBL(-1)	-0.967 [0.381]	(0.967)	(2.535)	0.861
LEXR(-1)	2.578 [0.602]	(2.578)	4.280	0.6624
LLR(-1)	-4.333 [0.711]	4.333	-6.091-	0.7326
R-squared			0.460	
Adj. R-squared			0.317	
Sum sq. resids			4.722	
S.E. equation			0.397	
F-statistic			3.200	
Log likelihood			(14.169)	
Akaike AIC			1.188	
Schwarz SC			1.572	
Mean dependent			(0.090)	
S.D. dependent			0.480	
Determinant resid covariance (dof adj.)			0.000	
Determinant resid covariance			0.000	
Log likelihood			134.964	
Akaike information criterion			(3.332)	
Schwarz criterion			(0.346)	

** statistical significance at 5%

Standard error in [ ]

Short-run relationship

The result of the short-run relationship between rice import and its determinants in Table 6 shows that lag one of the coefficient (-1.782) of DPR was negative and its t-statistic (-3.630) significant ($p<0.01$). Thus, a unit increase in DPR would reduce IMR by 1.78% and possibly the associated cost. Although, DPR exhibited poor performance within the period under review, it exerted considerable impact in checking rice importation. This finding validates Yusuf *et al.* (2020) that local rice quantity had significant and negative effect on rice import in Nigeria between 1961 and 2013.

This result suggests that with increase in effectiveness of policy intervention in the rice subsector, domestic production of rice in Nigeria would surpass local consumption, leading to export and foreign exchange earnings. Afterall, the acceptability of local rice has been confirmed by Ekanem *et al.* (2020) who found that the acceptability index for local rice was 0.4029 on a five-point likert scale. Adeniyi *et al.* (2019) assured that if Nigeria produces rice significantly, not only for domestic consumption but for exports, the country would access massive foreign exchange earnings from rice export. To some extent, the result suggests that rice import substitution through boosted local production is fully realizable.

The result further revealed that lag one of the coefficient (1.83) of LR was positive and its t-statistic (3.481) significant ($p<0.01$). Specifically, a unit increase in LR would increase IMR by 34.81%. This means that rice importation defies contraction in available credit as imposed by lending rate in the economy. The result suggests that agricultural finance policies in Nigeria does not consider food import and its consequence on trade imbalance. It also suggests that LR does not encourage rice production in a consistent and sustainable manner that would reduce IMR. Ufoeze *et al.* (2018) found that lending rate did not significantly affect economic growth in Nigeria. Similarly, Utile *et al.* (2018) found that interest rate, a proxy for lending rate, had negative and insignificant effect on Nigerian economy.

The result also shows that the coefficient of lag one of CBL (0.653) was positive and its t-statistic (2.332) significant ($p<0.05$), implying that a unit increase in CBL would increase IMR by 23.32%. It was expected that credit supply would trigger domestic production and lead to rice import reduction. The result suggests that the management of CBL was not adequately devoted to the rice subsector in a manner that it would reduce IMR. Gursida (2018) emphasized that models of money supply and demand or utilization clarifies the determinants of long-term price levels as well as fluctuations in short-run economic equilibrium. Credit is expected to increase agricultural production and invariably reduce food importation. While Udoka *et al.* (2016) found that the agricultural credit guarantee scheme fund had statistically significant effect on agricultural production in Nigeria, Akinrinola & Okunola (2020) found that the total volume of agricultural credit guarantee scheme loan did not significantly increase agricultural productivity in the short-run. This finding confirms the submission of Hollinger & Staatz (2015) that subsidised credit tends to be captured mainly by better-off farmers (and non-farmers), thereby hampering sustainable import substitution. As emphasized by Asghar & Salman (2018) and Ayinde *et al.* (2020), the attainment of zero hunger, as encapsulated in the Sustainable Development Goals (SDG), through sustainable domestic food production is feasible by strengthening the credit markets. Todaro & Smith (2012) added that the SDG is driven by an important transformative shift such as integrating the social, economic and environmental dimensions of sustainability.

Table 6: Short-run relationship between rice import and its determinants

Variable	Coefficient	Std. Error	t-Statistic	P-value
C	(0.014)	0.116	(0.122)	0.904
D(LIMR(-1))	(0.768)	0.194	(3.957)	0.001
D(LDPR)	(0.744)	0.387	(1.922)	0.067
D(LDPR(-1))	(1.782)	0.491	(3.630)***	0.001
D(LDRC)	0.062	0.566	0.110	0.913
D(LDRC(-1))	(0.101)	0.479	(0.210)	0.835
D(LWRP)	(0.071)	0.500	(0.141)	0.889
D(LWRP(-1))	(0.242)	0.468	(0.517)	0.610
D(LCBL)	0.216	0.247	0.874	0.391
D(LCBL(-1))	0.653	0.280	2.332**	0.029
D(LEXR)	0.161	0.652	0.247	0.807
D(LEXR(-1))	(0.935)	0.584	(1.601)	0.123
D(LLR)	2.022	0.580	3.488	0.002
D(LLR(-1))	1.830	0.526	3.481***	0.002
ECT(-1)	(0.4802)	0.080	(5.980)***	0.000

R-squared	0.729	Mean dependent var	(0.093)
Adjusted R^2	0.564	S.D. dependent var	0.486
S.E. of regression	0.321	Akaike info criterion	0.853
Sum squared resid	2.370	Schwarz criterion	1.499
Log likelihood	(1.201)	Hannan-Quinn criter.	1.083
F-statistic	4.417***	Durbin-Watson stat	1.521
Prob(F-statistic)	0.001		

, * Statistical significance at 5% and 1% levels.

Hypothesis

The F-statistic of the short-run model was used to test the hypothesis. Referring to Table 6, the F-statistic (4.417) was statistically significant ($p<0.01$). Consequently, the study rejected the null hypothesis. The implication is that the relationship between rice import and its determinants is statistically significant in the short-run. Hence, predictions that are based on this estimation will yield 72.9% accuracy in IMR-related policy. This econometric result has implications for sustainability. While the use of domestic production is sustainable, the loss of foreign exchange to rice importation is not economically sustainable.

Restoration to long-run equilibrium

As shown in Table 6, the error-correction term (-0.480) was appropriately negative and statistically significant ($p<0.01$). These results further confirm long-run relationship between IMR and its determinants. Given any shock to the system, the speed of adjustment to long-run equilibrium is approximately 48.02%. At this speed, it will take the system about 2.08 years to return to equilibrium.

Post-estimation tests

The normality test result in in Figure 2 shows that the Jarque-Bera statistic (1.21) had a probability value (0.545) that was greater than 5%. Therefore, the study failed to reject the null hypothesis that the residual errors were normally distributed. This result satisfies the econometric criterion that the residual errors should be normally distributed with zero mean and constant variance.

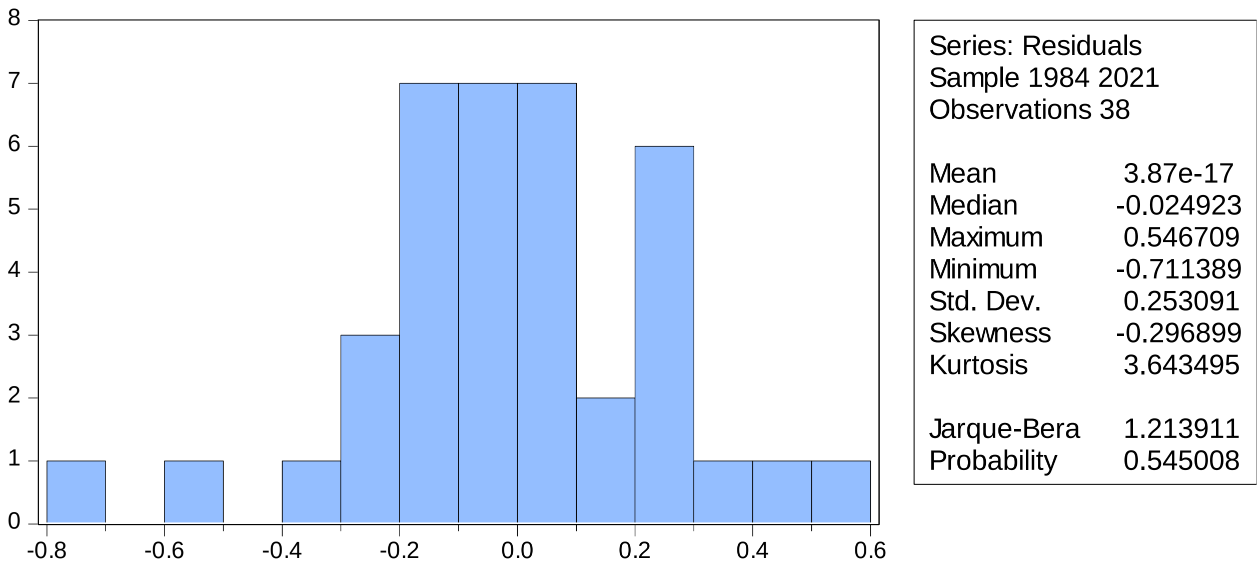

Figure 2: Normality test, using Jarque-Bera test

Serial correlation

The Breusch-Godfrey Serial Correlation LM Test result in Table 7, shows that F-statistic (2.08) of the test had a probability value (0.1499) which was greater than 5%. Again, the study failed to reject the null hypothesis that there was no autocorrelation of errors. This is another attestation to the appropriateness of the result for policy reviews since it conforms to an econometric criterion for a reliable model.

Heteroskedasticity test

The result of the Breusch-Pagan-Godfrey test in Table 8 shows that the p-value (0.4378) of the F-statistic (1.059) was greater than 5%. Consequently, the study failed to reject the null hypothesis and concluded that the series were homoscedastic. This result is also good as it ascertains that the estimation in this study is suitable for policy reviews.

Table 7: Breusch-Godfrey Serial Correlation LM Test

F-statistic	Probability value
2,21	0.1499

Table 8: Heteroskedasticity Test: Breusch-Pagan-Godfrey

F-statistic	1.058619	Prob. F(14,23)	0.4378
Obs*R-squared	14.89094	Prob. Chi-Square(14)	0.3857
Scaled explained SS	7.210395	Prob. Chi-Square(14)	0.9263

Structural Stability test

The result of the structural stability test in Figure 3 shows that the blue line did not cross both the lower and upper boundaries but lies largely in between the boundaries. This implies that the model is structurally stable at 5%. In other words, it can withstand some shocks to a reasonable extent.

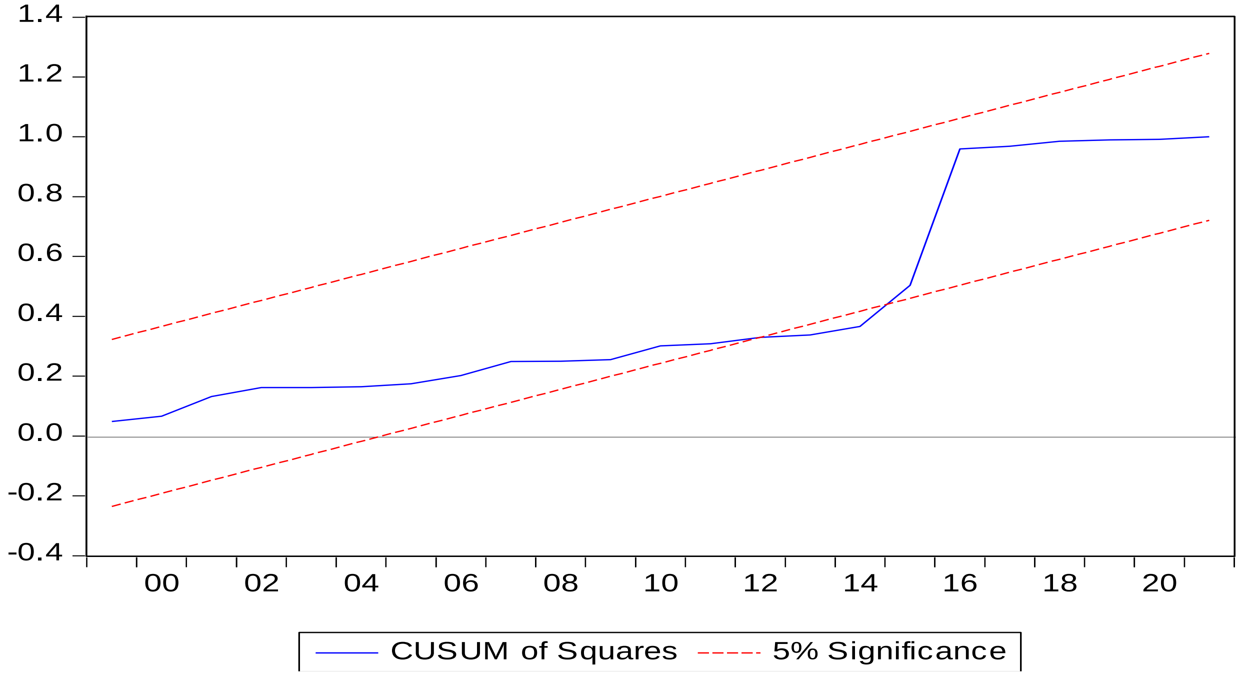

Figure 3: Structural Stability using CUSUM squares test

CONCLUSION AND RECOMMENDATIONS

Economic sustainability requires that dimensions of economic growth are attained without adverse impact on the social, environmental, and cultural aspects of the nation. Specifically, the importation of rice to assuage food insecurity should not have negative impact on sustainable domestic production and critical monetary policy variables.

The general conclusion drawn from this study is that rice importation in Nigeria is necessitated by obvious local supply deficit as local consumption (3.65 million mt) was higher than domestic production of 2.76 million mt. On average, Nigeria spends N37,918.57 million on rice importation, approximately $312.02 million dollar. This is not economically sustainable because of the drain on foreign reserve and capital flight which would have been used to boost local production by small-scale rice farmers. The empirical evidence from this study is that, in both the long-run and short-run, milled rice equivalence of domestic production would statistically reduce imported milled rice, a guarantee of sustainable food system. Another long-run empirical evidence of economic retardation from this study is that increase in world rice price would raise importation of milled rice, thereby attracting more capital flight and is therefore not economically sustainable. Rice importation distorts the effectiveness of monetary policy in Nigeria because the study has proven that commercial bank loan to agricultural sector and lending rate, which should close the supply gap were found to exert upward pressure on imported milled in the short-run.

The error-correction term (-0.4802) was correctly signed and statistically significant ($p<0.01$), implying a speed of adjustment of 48.02% and 2.08 years to restore to long-run equilibrium. The Jarque-Bera (1.21), Breusch-Godfrey (2.08) and Breusch-Pagan-Godfrey's (1.06) were statistically insignificant ($p>0.05$). The model was structurally stable. This model and the associated estimations are useful for policy review because the model attained normality, serial uncorrelation homoscedasticity and structural stability. Thus, econometric models have been used to establish that (i) rice importation is economically unsustainable; and (ii) remedial measures to stem the tide of importation and enhance economic sustainability while ensuring food security are accessible and implementable.

Obviously, the behaviour of commercial bank loan and lending rate, which are critical monetary policy instruments, is not sustainable, thereby calling for a rapid response of the monetary policy authority to restore stability and guarantee effectiveness. Consequently, it was recommended that: the FMARD and CBN should assist small-scale farmers to increase domestic paddy rice production, which takes cognizance of environmental sustainability, through capital injection and improved technology. Also, the FMARD, Federal Ministry of Trade and Industry should encourage rapid rice production using early maturing variety and reallocating rice import fund to domestic production whenever a rise in WRP becomes imminent; the CBN should review agricultural loan policies to make it responsive to rice import reversal; the monetary authority should adjust the lending rate to favour sustainable rice import substitution.

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