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FOOD SECURITY AND AGRICULTURAL OUTPUT; PANACEA FOR THE SUSTAINABILITY OF THE NIGERIAN ECONOMY

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ABSTRACT

The Nigerian economy witnessed a robust economy in time past before the discovery of oil. The agricultural sector was neglected and government attention was dully registered on the oil sector which culminated into vices that hindered economic growth and development. This study investigated the agriculture production and food security and their impact on economic growth in Nigeria. Secondary data was collected from Central Bank of Nigeria Statistical Bulletin for the period 1981 – 2021. The presence of unit root was checked by using Augmented Dickey-Fuller (ADF). The Johansen Co-integration technique was employed to determine the long run equilibrium relationships among the variables. Thereafter, the ordinary least square regression analysis was used to determine the direction and magnitude of the independent variables on the dependent variable. The study revealed a strong correlation between the dependent variable and the independent variables. Specifically, the R-Squared of 0.96 and the Adjusted R-Squared of 0.95 showed that 95% of the changes in the dependent variable was explained by the independent variables. The coefficient of loan granted was negative, implying an inverse relationship with GDP, implying a probable diversion of the money into unproductive ventures or the high rate of interest charged on the loans that probably dominated the accrued benefit. Food production, transport and storage had positive relationship with GDP. The study recommended that the government builds more access roads to ease transportation and provide more storage facilities for the sustainability of human security.

Keywords: robust economy, access roads, equilibrium relationship, agriculture, food security, sustainability.

1.0 INTRODUCTION

The discovering of oil in Nigeria has inhibited the role of Agriculture as been the main stay of the Nigerian economy and the benefactor of food for economic sustainability. The result of this is that the economy has become monoculture and a rising food import bill, including poverty, hunger, low standard of living, high cost of living with the long run effect of slow economy growth rate. The by-product of agriculture which is food as an essential basic need for human existence cannot be overstated. It’s the lack would cause man to suffer malnutrition and die. Food security is essential for the preservation of life and the sustainability of the economy and should be enhanced in order to increase productivity, increases wages and household income, reduce poverty and fosters economic growth (Ramachandran, 2007).

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The most widely used definition of food security originates from the 1996 Food Summit at the Food and Agriculture Organization of the United Nations (FAO, 1996):

Food security exists when all people, at all times, have physical and economic access to sufficient, safe and nutritious food that meets their dietary needs and food preferences for an active and healthy life.

The definition incorporates issues of food availability, economic and social access, individuals' ability to transform the food they eat into good health outcomes (commonly referred to as the utilization dimension), and their ability to maintain stability in each of these dimensions over time (Coates, 2013).

Food insecurity is contagious and can affect both physical development and mental capacity of an individual and the economy at large, wielding lasting physical and economic effects over the course of a lifetime (Glewwe and Miguel, 2008). For society as a whole, food insecurity can contribute to political and social unrest and ultimately economic losses (Bellemare, 2015). The United States has played a leading role in global efforts to alleviate food insecurity through international food aid, development programs, and bilateral and multilateral trade agreements. Some of these assistances are in the form of direct donations of United States agricultural commodities through the Food for Peace, Food for Progress, and McGovern-Dole programs, as well as additional contributions through support of the World Food Program. (Schnepf, 2016).

Food insecurity has become very rampant in the world economy particularly the developing economy with particular reference to Nigeria, due to the soaring hike in the prices of food items, including the prices of goods and services occasioned by the incessant killings by unknown gunmen, Fulani herdsmen, Boko Haram and kidnappers, in the farmlands and rural villages. The resultant effect of farmers not being able to access their farms and businesses because of insecurity of life and properties is, acute food shortage and hike in the prices of the few available ones. Additionally, the flood disaster which occurred in the country in the month of September and October 2022 contributed in no small measure to the challenges of food security in Nigeria.

Sustainable economic growth is feasible when there is food security. The challenges of food security will evoke a huge financial burden on countries when they import food to fill in the gap thereby creating insecurity problems with the attendant evil vices.

However, the United States has made commitments to end global food insecurity by 2030 as part of the 2015 global Sustainable Development Goals. The Global Food Security Act (GFSA), plays the role of reducing food insecurity and poverty through agricultural led growth, increased resilience, and a broad commitment to improved nutrition, was enacted in 2016, yet food security still poses a challenge to developing economies.

2.0 STATEMENT OF PROBLEM

Agriculture is a major significant contributor to economic growth and development. It acts as corner stone to human existence by providing food and Industrial raw materials for other sectors of the economy. As a considerable user of natural resources, particularly land and water,

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its activities have a major role on the availability of these resources and their effective and efficient utilization. It contributes about two fifth to the country's Gross Domestic Product-GDP and a major sustainer of the Nigerian economy (Ojo, 2004). Hence this study takes a look at the security of food and agricultural production as they affect the sustainability of the Nigerian economy. The indicators as; Gross Domestic Product (GDP), Loans Granted (LGT), Food Production (FPD), Agricultural Production (AGP), Trade (TRD), Population (POP), and Transportation and Storage (TSR) are examined in this study.

Given the high food import bill and the slow growth rate of agricultural production in Nigeria, one may seek to ask the questions of how agricultural production could be improved in order to enhance food security and the roles played by the government in ensuring economic growth through food security and agricultural production. The objective of this paper is to examine the impact of agriculture and food security on economic growth in Nigeria.

3.0 LITERATURE REVIEW

3.1 Conceptual Literature

Food security is the access to enough food by all people at all times for an active and healthy life. Surprisingly, more than 700 million people in developing world lack the food necessary for such a life, with no adequate arrangement for food security. However, investment in food security could be likened to investment in human capital that ensures economic development given that a properly fed healthy, active, and alert population contributes more effectively to economic development than one that is plague with poor diet (World Bank, 1986).

At the household level, food security refers to the ability of the household to secure, either from its own production or through purchases, adequate food for meeting the dietary needs of all members of the household (FAO,2008). Consequently, "food insecurity is a state where consistent access to adequate food is limited by a lack of money and other resources at times during the year" (USDA., 2015).

The Nigerian economy is highly endowed with both human and natural resources is an obvious fact but yet the largest food importer in Africa. Despite the prevailing resources, undernourishment has become the order of the day and has increased by 2% (UNDP, 2005) in recent times.

Food Production is the creation of food through farming on the farmland or through life stocks by rearing of animals. To achieve food security, it is necessary that countries engage in food production. The Food and Agricultural Organizations have identified five input resource for production. These are land and Irrigation, labour, machinery, fertilizers and pesticides (FAO, 2002).

According to the United Nations projections, by 2050 the world population will be over 9 billion compared to less than 7 billion now and to achieve a global average food consumption of 3130kcal per person per day, an additional billion tones cereals and 200 million tones meat would need to be produced annually (UN, 2010).

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Food security and agricultural production interact with each other in a mutually reinforcing process to enforce development and economic growth. Most economies have not been able to achieve this but Timmer (2004) is of the view that the policy initiative of the government to satisfy the need for food security can speed economic growth in developing countries.

The International Fund for Agricultural Development (IFAD, 2012) observed that the GDP growth generated by agriculture is up to four times more effective in reducing poverty and hunger than growth generated by other sectors.

The World Food Summit (1996) opined that food security exists when all people, at all times, have physical and economic access to sufficient safe nutritious food that meets their dietary needs and food preferences for an active and healthy life. They adduced four main dimensions of food security which include; the physical availability of food, economic and physical access to food, food utilization and the stability of the other three dimensions over time.

The issue of food insecurity has become rampant due to the unprecedented environmental and economic mishap globally. Notably among them is the global warming and the Greenhouse effect which has imposed a severe consequence of hike in the prices of food and a fall in the purchasing power in the African continent.

3.2 Theoretical Literature

The theoretical literature is anchored on the Neoclassical Growth synthesis who assume that the growth of an economy results from a present-day sacrifice of their current consumption whose proceeds are stored for investment; to reap future economic benefits. This theory, which was masterminded by Solow (1956) and Swan (1956) and coined "the Solow-Swam Model" applies to a steady state rate of growth in output per worker which is considered equal to the exogenously determined rate of technological progress. Within this framework, returns to government expenditure or good governance is viewed to be sufficiently large enough to prevent diminishing returns to capital and the sources of long-run growth which is exogenously determined. Thus any policy aimed at achieving long run persistent growth can affect the rate of growth only during the transition to steady state.

The Solow-Swan philosophy considers from an institutional perspective that economic growth is a transfer problem solved by the movement of capital and technology from rich nations to the LDC's. Accordingly, the model gave credence to policies focusing on the expansion of the industrial capital stock and increasing savings rates to different countries. Based on the assumptions of the diminishing returns to capital, exogenous technology and perfect competition, the Neoclassical Growth models were not able to explain the divergence in growth rates between the rich and poor countries. Apparently based on the above weakness, the Endogenous Growth Models (EGMs) were developed in the post 1980 era by Romer (1986) and Lucas (1988) to explain properly the income divergence between poor and rich nations as they assume that more efficient human capital accumulation resulted in faster growth rate.

This study assumes the difference between the two models (endogenous and exogenous), that is whether food security will have an effect on economic growth. Practically, the endogenous growth model not only predicted that higher levels of investment in physical capital and labour can sustain higher levels of growth, but also investment in knowledge and the development of human capital. Food security is necessary ingredient for the development in human capital. From this viewpoint, the model supports that any temporary change in economic environment is capable of generating permanent effects, which open up the possibility of fiscal policy to have a long run effect on growth. Put differently, in the spirit of the endogenous growth model, labour cannot be regarded as a single input but decomposed into skilled and unskilled Labour. By breaking the linked between economic growth, physical capital accumulation and diminishing returns, endogenous growth models have been able to account for the income divergence between the rich and the poor nations.

Since endogenous growth model holds human capital as the most influential factor of production, they therefore suggest that human capital which is only obtained through health investments, education and training should attract appropriate government policies that are immensely important in affecting this rate of accumulation through research and development to ensure abundant supply of high-quality human capital.

3.3 Empirical Literature

Ramachandran (2007) in his study on women and food security in South Asia, opined that despite the positive change in food production, endemic pockets of hunger still remain with seasonal shortfalls and widespread malnutrition across the region, rampaging women and children. In his opinion, the "Asian enigma", as it is termed, of food scarcity and malnutrition amidst plenty, has defiled all attempts; and poverty alleviation strategies, livelihood generation programmes and direct food interventions have all been tried to no avail.

Osabohien (2018) examined food security and institutional framework in Nigeria using auto-regressive distributed lag (ARDL) model. Their result showed a high level of food insecurity as a result of low attention on food production, occasioned by the pervasive influence of oil that become a major export product.

Manap and Ismail (2019) in their study on the impact of food security on economic growth directly and through poverty, life expectancy and total employment employed a dynamic panel data model known as the Generalized Methods of Moments (GMM). Their findings revealed that food security has an impact on economic growth especially in dry-land developing countries

Fernandes and Samputra (2022) carried out a study on linkages between food security and economic growth using a systematic mapping review. Their findings confirm a 76.92% correlative relationship between food security and economic growth.

The Global Food Security Index (2022) in their study of food security in 113 countries using such variables as Sustainability and Adaptation; Quality and Safety; Availability and Affordability of food, ranked Finland as the 1st, Ireland 2nd, Norway 3rd while Nigeria as 107th position. This however portrays the food security status in Nigeria and a clarion call for immediate attention.

In the same vein, Pourreza, Geravandi & Pakdaman (2018) in their study on food security, health and economic growth opined that food security plays a very important role in human health which invariably serves as the basis for the achievement of sustained economic growth.

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They opined that without a country's own strategy on food security strategy, there will be a continued negative effect on human capital that results in negative consequence on government expenditure and the long run effect on stagnated economic growth.

Food and Agricultural Organization et al. (2015) noted that women and men must be equal partners in improving global food security. Given equal access to productive resources, women would increase their yields by 20-30% and raise total agricultural output in developing countries by 2.5-4%.

The study of Jenkins & Scanlan (2011) on food security on economic growth in less developed countries between 1970 and 1990 identified six issues relating to food security which include modernization, economic dependence, urban bias, population pressure, ecological evolutionary process and militarism.

Timmer (2004) in his study on food security, observed that food security has been improved in Asia due to the modernization of economic structures. He itemized some strategic approaches for achieving food security to include; the distribution of pro-poor growth, stabilization of food price, and the domestic price stability which increases the efficiency of the private marketing sector.

FAO (2010) observed that food security has continued to pose a challenge due to the poorly developed systems for handling, storage, packaging, transportation and marketing of agricultural products in developing countries which results in post-harvest losses ranging from 15-50%. To curb this effect, they suggest that investment in food infrastructure and training in food handling for those employed in the food system can reduce these losses significantly and help to ease pressure on available resources.

The problem of food waste is not limited to developing countries (University of Arizona, 2010) observed that as much as 40-50% of the food that is ready for harvest in the United States is not consumed and that US households waste an average of 14% of their food purchases.

Kader (2005) also estimates that over 30% of the fresh produce (fruit and vegetables) harvested in both developed and developing countries is lost, with the rate being highest (20%) in retail, foodservice and consumer parts of the system in developed countries, whereas in developing countries the wastage rate is highest from farmers to retail (22%).

(Cuéllar and Webber, 2010) in their study estimated the energy embodied in wasted food in the United States as equivalent to 2% of total energy consumption – roughly the same percentage as agriculture consume. They emphasized that there is need for infrastructural development especially in the food system in order to improve efficiency in meeting food needs.

3.4 Research Methods

This section is devoted to theoretical framework, model specification, sources of data and method of data analysis.

Theoretical Framework and Model Specification

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In order to examine agriculture and food security and its implication for economic growth in Nigeria, this study adapted the Neoclassical Solow Growth Model which has technical progress as the main explanatory variable that could explain production capacity of a country especially agricultural production. The Solow Neoclassical Growth model is a function of technology, capital and labour. However, Arcand (2001) added effective labour as input, given that productivity of labour depends on the prevalence of food adequacy or food security. Other variables considered in the model are as follows; the dependent variable, Gross Domestic Product (GDP) and the explanatory variables such as loans granted (LGT), food production (FPD), agricultural production (AGP), trade (TRD), population (POP), transport and storage (TRS). These variables form a useful framework for analyzing agricultural production and food in Nigeria. Looking at Population, it is obvious that as population increases and food production remains constant, there will be food insecurity because more people will tend to chase the little food available, thereby creating over-crowding.

Mankiw, Romer, and Weil (1992) developed another theory relating to food security called the Human Capital Augmented Solow Model where they emphasized that the concept of human capital comes from investment in human knowledge and health which include enough food. The model assumes a functional relationship between indicators of food determinant and agricultural production. Thus:

$Y=f(K,L)$……………………………………………………………………………………(1)

Adapting the Neoclassical Solow Growth Model, we transform equation (1) into a functional form for food security, with the assumption that food security enhances economic growth. Thus equation (1) is transformed into a functional form as shown in equation (2) below

$GDP=f(LGT,FPD,AGP,TRD,POP,TRS)$. -------------------------------(2)

Where:

GDP = Gross Domestic Product

LGT= Loans Granted

FPD = Food Production

AGP = Agricultural Production

TRD = Trade

POP = Population

TRS = Transportation and Storage

In the equation (2) above, GDP growth only occurs if there are increases in the explanatory variables in the model, hence if any of these variables improves, economic growth will be positively affected. We express eqn. (2) in econometric form as follows:

$lnGDP_t=\alpha_0+\alpha_1 lnLGT_t+\alpha_2 lnFPD_t+\alpha_3 lnAGP_t+\alpha_4 lnTRD_t+\alpha_5 lnPOP_t+\alpha_6 lnTRS_t+\mu_t$------(3)

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Where:

α_0,α_1,α_2,α_(3,) α_(4 ,) α_5 and α_6 are the long run parameter coefficients.

μ_t= Error term,

ln = Logarithm of the variable.

The a priori signs of all the explanatory variables are expected to be positive.

Symbolically, the a priori expectations are: α_0,α_1,α_2,α_(3,) α_4,α_5 and α_6>0.

Considering the short-run and long-run dynamics and the causal interactions among the variables, an ARDL representation of equation (3) is formulated in expressions (4) and (5) as stated below:

$$\Delta(GDP_t) = \alpha_0 + \alpha_1 GDP_{t-1} + \alpha_2 LGT_{t-1} + \alpha_3 FPD_{t-1} + \alpha_4 AGP_{t-1} + \alpha_5 TRD_{t-1} + \alpha_6 POP_{t-1} + \alpha_7 TRS_{t-1} + \sum_{i=1}^{p} \alpha_{1i}\,\Delta(GDP_{t-1}) + \sum_{i=0}^{p} \alpha_{2i}\,\Delta(LGT_{t-1}) + \sum_{i=0}^{p} \alpha_{3i}\,\Delta(FPD_{t-1}) + \sum_{i=0}^{p} \alpha_{4i}\,\Delta(AGP_{t-1}) + \sum_{i=0}^{p} \alpha_{5i}\,\Delta(TRD_{t-1}) + \sum_{i=0}^{p} \alpha_{6i}\,\Delta(POP_{t-1}) + \sum_{i=0}^{p} \alpha_{7i}\,\Delta(TRS_{t-1}) + \mu_t \text{ ---------------------------------(4)}$$

Where Δ is the first difference operator, α_0 is the drift component, and ut is the white noise residual.

$$\Delta(GDP_t) = \sum_{i=1}^{p} \alpha_{1i}\,\Delta(GDP_{t-1}) + \sum_{i=0}^{p} \alpha_{2i}\,\Delta(LGT_{t-1}) + \sum_{i=0}^{p} \alpha_{3i}\,\Delta(FPD_{t-1}) + \sum_{i=0}^{p} \alpha_{4i}\,\Delta(AGP_{t-1}) + \sum_{i=0}^{p} \alpha_{5i}\,\Delta(TRD_{t-1}) + \sum_{i=0}^{p} \alpha_{6i}\,\Delta(POP_{t-1}) + \sum_{i=0}^{p} \alpha_{7i}\,\Delta(TRS_{t-1}) + \lambda ECT_{t-1} + \mu_t \text{ ----------------- (5)}$$

Where λ is the speed of adjustment parameter and ECT is the residual obtained from the estimation of equation (4).

4.0 EMPIRICAL RESULTS AND DISCUSSION

Method of Analysis:

4.1 Descriptive Analysis

Figure 1: Graphs

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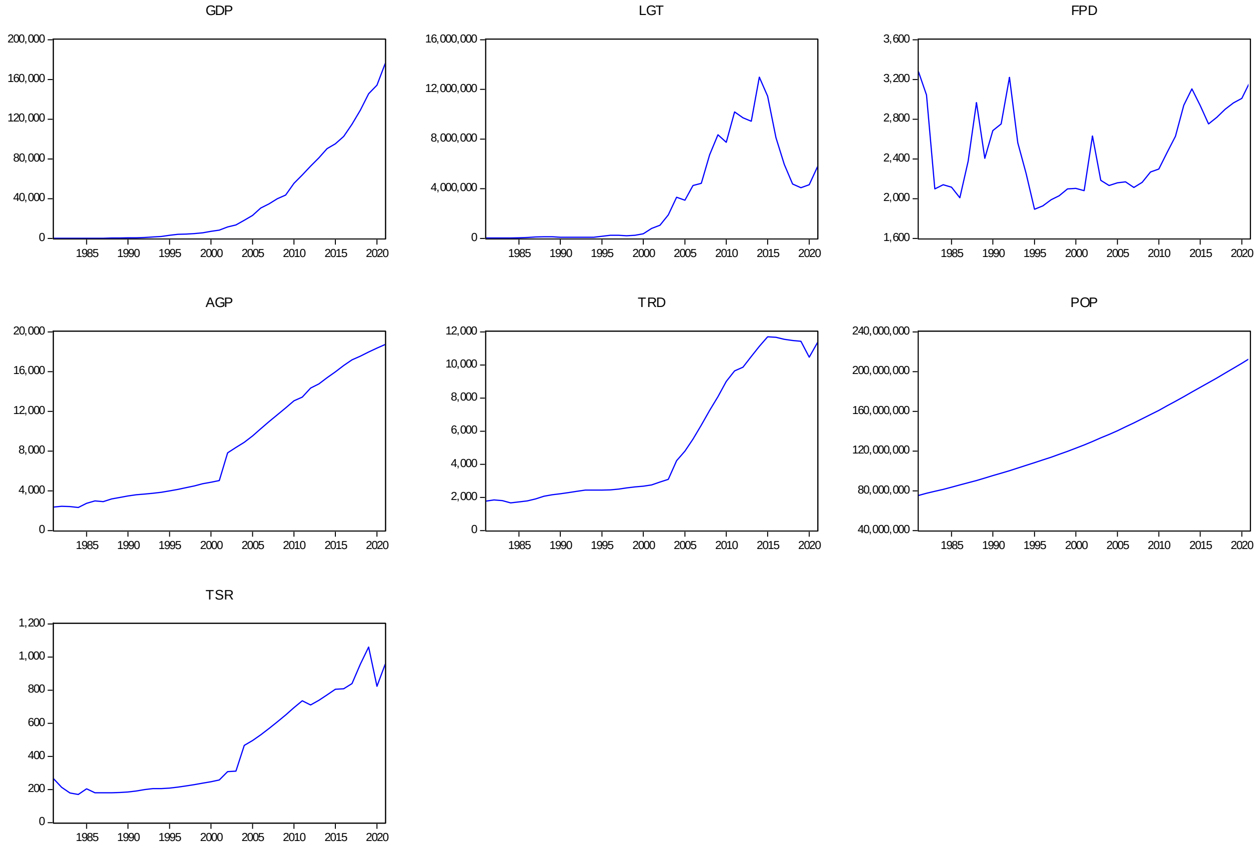

Source: Author's Computation from Eviews 12

Considering the graphs in Figure1, it is obvious that the GDP growth rate increased over the years while there was much fluctuations in loans granted within the period under study. However, food production experienced more crisis over the period under study. This could be accounted for by the insecurity that prevailed in the country where farmers were unable to approach their farmlands due to incessant killings by Fulani herdsmen and unknown bandits.

The LGT increased sequentially over time but experienced a pitfall in 2015 and beyond. AGP though increased over time but experienced a gradual increased, kit off from 2006 to 2015, but began to experience a down turn, probably due to Covid 19 and is beginning to gain momentum. Population has continued to increase over the period under study but TRS experienced a slow growth rate, increased as from 2005 to 2017, got to its peak in 2018 and experienced a sharp decline in 2019 but gradually picking up now. The volatility of (FPD) shows the insecurity of food in the country and an urgent need for government intervention.

However, all the graphs depict non-stationarity of the variables used in the study, so they are subjected to unit root test using the Augumented Dickey Fuller test statistic both at levels and first differencing.

Figure 2: Descriptive Statistics

	GDP	LGT	FPD	AGP	TRD	POP	TRS
Mean	37550.91	3183081.	2483.697	8473.149	5328.871	1.33E+08	443.5324
Median	8234.490	808820.1	2376.360	5024.540	2742.340	1.26E+08	264.5100
Maximum	176075.5	12997004	3278.240	18738.41	11697.59	2.13E+08	1059.270
Minimum	139.3100	25154.90	1893.220	2303.510	1662.300	75175387	170.2800
Std. Dev.	50434.86	3869825.	419.1985	5702.712	3876.321	41471452	283.1426
Skewness	1.284324	0.968179	0.374998	0.496468	0.637686	0.374437	0.625757
Kurtosis	3.459285	2.682852	1.718933	1.687839	1.660950	1.924503	1.883890
Jarque-Bera	11.63186	6.577190	3.764529	4.625634	5.841869	2.934071	4.803816
Probability	0.002980	0.037306	0.152245	0.098982	0.053883	0.230608	0.090545
Sum	1539587.	1.31E+08	101831.6	347399.1	218483.7	5.46E+09	18184.83
Sum Sq. Dev.	1.02E+11	5.99E+14	7029095.	1.30E+09	6.01E+08	6.88E+16	3206789.
Observations	41	41	41	41	41	41	41

Source: Author's Computation from Eviews 12

From the summary statistics shown in figure 2 above, looking at the measures of normality, all the variables have normal skewness (o) and they are positively skewed. The skewness measures the degree of asymmetry of the series and normal skewness implies that the distribution is symmetric around the mean and the skewness value is zero. While GDP mirrors normal skewness and Leptokurtic because it has kurtosis value greater than 3, it will have a long slim right tail and the distribution is peaked relative to normal distribution. Meanwhile LGT, FPD, AGP, TRD, POP and TRS have their kurtosis values less than 3 because their kurtosis is less than 3 and all the variables have Positive skewness implying that the distribution has a long flat tail and there are lower values than the sample mean. Though mirrors normal distribution but is Platykurtic meaning series are flat or short tail, relative to normal distribution and there are lower values than the sample mean.

Jarque-Bera is a test statistic for testing whether the distribution is normally distributed. It measures the difference of the skewness and kurtosis of the series with those of the normal distribution. The probability values of GDP and LGT are less than 0.05 implying that the distribution is below normal while the other variables have their probability values greater than 0.05 it means that the distribution for all the variables are normal.

Following the descriptive statistics in figure 2, we conduct a unit root test in order to avoid a Spurious regression result given that most time series data are non-stationary.

4.2 Unit Root Tests

The unit root test is performed to ascertain the order of stationarity of the variables in the model. The Augmented Dickey-Fuller (ADF) test statistic is used and the results reported in the table below.

Augmented Dickey-Fuller Test Results

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The result of the unit root test, as presented in Table 5.1, showed that the series were I(0) and I(1). Specifically, only Gross Domestic Product (GDP) integrated at first difference, I(1), while other variables integrated at levels, that is, I(0). The result further revealed that at 1%, 5% and 10% levels of significance, all the variables were stationary at levels and first difference, on the basis of this, the null hypothesis of non-stationary is rejected and we conclude that the variables are stationary at levels and 1st difference.

TABLE 4: Taking the Log form of all the variables and subjecting to Augmented Dickey

Variable	Stage	Critical Value	1%	5%	10%	Prob. value	Conclusion
GDP	1st Difference with Intercept.	**-3.459570**	**-3.610453**	**-2.938987****	**-2.607932**	**0.0147**	I(1)
LGT	At levels with Intercept.	**-1.244886**	**-3.610453**	**-2.938987****	**-2.607932**	**0.6451**	I(0)
FPD	At levels with Intercept.	**-2.471179**	**-3.605593**	**-2.936942****	**-2.606857**	**0.1299**	**I(0)**
AGP	1st Difference no Intercept no Trend.	**-1.896998**	**-2.627238**	**-1.949856****	**-1.611469**	**0.0560**	I(1)
TRD	1st Difference with Intercept.	**-2.282735**	**-3.615588**	**-2.941145****	**-2.609066**	**0.1825**	I(1)
POP	@ levels with Intercept.	**0.025431**	**-3.653730**	**-2.957110****	**-2.617434**	**0.9542**	**I(0)**
TSR	@ levels with Intercept.	**0.791919**	**-3.610453**	**-2.938987****	**-2.607932**	**0.9926**	**I(0)**

*** (**) * significant at 1%, 5% and 10% respectively.

Source: Author's computation

The optimal lag length for the analysis is determined using the Vector Autoregressive (VAR) lag length criteria. The result is shown in Table 6 below.

Table 6: VAR Lag Length Selection Criteria

Lag	LogL	LR	FPE	AIC	SC	HQ
0	-2799.964	NA	3.41e+55	147.7350	148.0366	147.8423
1	-2335.321	733.6469	1.13e+46	125.8590	128.2723*	126.7176
2	-2261.976	88.78638*	4.11e+45*	124.5777	129.1026	126.1876*
3	-2199.041	52.99783	4.53e+45	123.8443*	130.4808	126.2055

* 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

Source: Author's Computation

We have the lag structure from 0 to 3, and 6 information criteria to make our chooses. We look for that criterion that is asterisked and also the lowest figure. From table 6, AIC is asterisked at lag 3 and it has the lowest figure at 123.8443. Hence lag 3 is the best optimal lag to choose for this model. Thus: lag 3 is used to run the analysis as indicated by the AIC criterion.

The study now proceeds to confirming the relationship that exit among the variables of food security, agricultural production and economic growth, by conducting a correlation analysis using levels and 1st difference for all the variables.

A necessary but not sufficient condition for cointegration and VECM is that all the series should share the same integrational properties in a univariate sense. The integrational properties of each of the variables was carried out by applying unit root testing procedure using the Augmented Dickey-Fuller ADF unit root test. The results of this test statistics in Table 4 suggest that some of the variables were integrated at order zero I(0) while some were integrated at order one I(1), this implies that their compatibility in the long run can be determined using cointegration.

4.3 Cointegration Test

The cointegration test was carried out to establish the existence of a long run association between the variables. The test result using Johansen Cointegration technique is reported in the table 5 below. From the table there exist five cointegrating equations as the null hypothesis of no cointegration equation is rejected at 5% due to the fact that the Trace statistics is higher than the critical values. This is corroborated with the p-values of less than 0.05. By implication, in the long run, the variables chosen can attain equilibrium and be able to move in the same direction in the long run even when there is short-term distortion.

4.4 Result of the Johansen Cointegration Test

Date: 04/30/23 Time: 13:24
Sample (adjusted): 1983 2021
Included observations: 39 after adjustments
Trend assumption: Linear deterministic trend
Series: GDP LGT FPD POP TSR TRD AGP
Lags interval (in first differences): 1 to 1

Unrestricted Cointegration Rank Test (Trace)

Hypothesized No. of CE(s)	Eigenvalue	Trace Statistic	0.05 Critical Value	Prob.**

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None *	0.931671	238.4084	125.6154	0.0000
At most 1 *	0.712435	133.7550	95.75366	0.0000
At most 2 *	0.511706	85.14905	69.81889	0.0019
At most 3 *	0.492083	57.19235	47.85613	0.0052
At most 4 *	0.361437	30.77230	29.79707	0.0385
At most 5	0.165255	13.27944	15.49471	0.1050
At most 6 *	0.147745	6.234917	3.841466	0.0125

Trace test indicates 5 cointegrating eqn(s) at the 0.05 level
* denotes rejection of the hypothesis at the 0.05 level
**MacKinnon-Haug-Michelis (1999) p-values

Unrestricted Cointegration Rank Test (Maximum Eigenvalue)

Hypothesized No. of CE(s)	Eigenvalue	Max-Eigen Statistic	0.05 Critical Value	Prob.**
None *	0.931671	104.6535	46.23142	0.0000
At most 1 *	0.712435	48.60591	40.07757	0.0044
At most 2	0.511706	27.95669	33.87687	0.2155
At most 3	0.492083	26.42005	27.58434	0.0699
At most 4	0.361437	17.49286	21.13162	0.1500
At most 5	0.165255	7.044528	14.26460	0.4839
At most 6 *	0.147745	6.234917	3.841466	0.0125

Max-eigenvalue test indicates 2 cointegrating eqn(s) at the 0.05 level
* denotes rejection of the hypothesis at the 0.05 level
**MacKinnon-Haug-Michelis (1999) p-values

Unrestricted Cointegrating Coefficients (normalized by b'*S11*b=I):

GDP	LGT	FPD	POP	TSR	TRD	AGP
0.958421	0.273389	4.242099	-17.46461	1.480808	10.71510	7.844238
1.871285	-3.866915	3.773666	16.26126	2.222530	-19.15337	-6.860191
3.029876	2.192406	10.22326	0.618937	-9.056540	-34.02284	6.853067
2.282287	-1.076589	3.890024	8.959768	10.86809	-37.91561	-9.621797
3.239669	-2.281125	-2.814422	13.64103	2.331463	-50.59066	1.822820
3.177266	-1.511403	-0.147317	0.134056	6.046994	-16.16688	-5.968234
-1.258662	0.239465	-0.189696	-3.947547	-1.065694	16.53354	3.479302

Unrestricted Adjustment Coefficients (alpha):

D(GDP)	-0.026122	0.027896	-0.013485	-0.007367	-0.031235	-0.002822	-0.023448
D(LGT)	-0.052225	0.044190	-0.026234	-0.128994	0.047778	0.027965	-0.040975
D(FPD)	-0.048659	-0.042586	-0.039920	-0.011445	-0.016144	-0.003642	0.010291
D(POP)	0.001521	-0.021928	0.015343	-0.020275	-0.021714	-0.000972	-0.005391
D(TSR)	-0.045853	0.006094	0.014023	-0.009885	0.000474	-0.000279	-0.001030
D(TRD)	-0.000311	-0.000346	5.68E-05	-6.96E-05	6.75E-05	2.76E-05	-0.000143
D(AGP)	-0.073093	-0.001672	0.027508	-0.007325	-0.014616	0.014821	-0.002554

1 Cointegrating Equation(s): Log likelihood 552.4146

Normalized cointegrating coefficients (standard error in parentheses)

GDP	LGT	FPD	POP	TSR	TRD	AGP

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1.000000	0.285250	4.426134	-18.22228	1.545050	11.17995	8.184545
	(0.24655)	(0.55937)	(1.33831)	(0.77706)	(1.78871)	(0.87120)

Adjustment coefficients (standard error in parentheses)

D(GDP)	-0.025036
	(0.01573)
D(LGT)	-0.050053
	(0.04304)
D(FPD)	-0.046636
	(0.01527)
D(POP)	0.001458
	(0.01032)
D(TSR)	-0.043947
	(0.00494)
D(TRD)	-0.000298
	(0.00010)
D(AGP)	-0.070054
	(0.01099)

2 Cointegrating Equation(s): Log likelihood 576.7176

Normalized cointegrating coefficients (standard error in parentheses)

GDP	LGT	FPD	POP	TSR	TRD	AGP
1.000000	0.000000	4.133871	-14.95796	1.501706	8.582371	6.747128
		(0.42576)	(0.93965)	(0.55594)	(1.58298)	(0.60283)
0.000000	1.000000	1.024586	-11.44372	0.151953	9.106338	5.039156
		(0.31774)	(0.70125)	(0.41489)	(1.18137)	(0.44989)

Adjustment coefficients (standard error in parentheses)

D(GDP)	0.027165	-0.115011
	(0.03279)	(0.06047)
D(LGT)	0.032639	-0.185157
	(0.09289)	(0.17127)
D(FPD)	-0.126326	0.151372
	(0.02924)	(0.05392)
D(POP)	-0.039575	0.085208
	(0.02101)	(0.03874)
D(TSR)	-0.032542	-0.036102
	(0.01058)	(0.01952)
D(TRD)	-0.000945	0.001252
	(0.00018)	(0.00034)
D(AGP)	-0.073183	-0.013515
	(0.02411)	(0.04446)

3 Cointegrating Equation(s): Log likelihood 590.6959

Normalized cointegrating coefficients (standard error in parentheses)

GDP	LGT	FPD	POP	TSR	TRD	AGP
1.000000	0.000000	0.000000	49.60093	-11.16819	-64.12232	-15.64637
			(4.23847)	(2.45135)	(7.03425)	(2.72067)
0.000000	1.000000	0.000000	4.557293	-2.988297	-8.913619	-0.511101
			(0.99055)	(0.57289)	(1.64394)	(0.63584)
0.000000	0.000000	1.000000	-15.61705	3.064897	17.58756	5.417076
			(1.16682)	(0.67484)	(1.93647)	(0.74898)

Adjustment coefficients (standard error in parentheses)

D(GDP)	-0.013692	-0.144575	-0.143401
	(0.05680)	(0.06860)	(0.18012)
D(LGT)	-0.046847	-0.242673	-0.322981
	(0.16197)	(0.19560)	(0.51361)
D(FPD)	-0.247277	0.063853	-0.775227
	(0.04369)	(0.05276)	(0.13854)
D(POP)	0.006912	0.118846	0.080560
	(0.03538)	(0.04273)	(0.11219)
D(TSR)	0.009945	-0.005359	-0.028158
	(0.01599)	(0.01930)	(0.05069)
D(TRD)	-0.000773	0.001377	-0.002043
	(0.00032)	(0.00038)	(0.00101)
D(AGP)	0.010163	0.046794	-0.035156
	(0.03802)	(0.04591)	(0.12056)

4 Cointegrating Equation(s): Log likelihood 603.9060

Normalized cointegrating coefficients (standard error in parentheses)

GDP	LGT	FPD	POP	TSR	TRD	AGP
1.000000	0.000000	0.000000	0.000000	16.10552	-25.02232	-9.907011
				(2.87413)	(4.15266)	(3.09405)
0.000000	1.000000	0.000000	0.000000	-0.482411	-5.321143	0.016226
				(0.46644)	(0.67394)	(0.50214)
0.000000	0.000000	1.000000	0.000000	-5.522340	5.276762	3.610016
				(0.95994)	(1.38697)	(1.03340)
0.000000	0.000000	0.000000	1.000000	-0.549863	-0.788292	-0.115711
				(0.08352)	(0.12067)	(0.08991)

Adjustment coefficients (standard error in parentheses)

D(GDP)	-0.030506	-0.136644	-0.172058	0.835470
	(0.06654)	(0.07030)	(0.18909)	(0.39121)
D(LGT)	-0.341247	-0.103800	-0.824769	0.458682
	(0.16078)	(0.16986)	(0.45689)	(0.94524)
D(FPD)	-0.273398	0.076174	-0.819748	0.030058
	(0.05058)	(0.05343)	(0.14372)	(0.29734)
D(POP)	-0.039361	0.140673	0.001690	-0.555297
	(0.03839)	(0.04055)	(0.10908)	(0.22567)
D(TSR)	-0.012615	0.005283	-0.066610	0.820025
	(0.01709)	(0.01806)	(0.04857)	(0.10049)
D(TRD)	-0.000932	0.001452	-0.002314	-0.000781
	(0.00037)	(0.00039)	(0.00105)	(0.00218)
D(AGP)	-0.006556	0.054680	-0.063651	1.200731
	(0.04433)	(0.04684)	(0.12598)	(0.26064)

5 Cointegrating Equation(s): Log likelihood 612.6524

Normalized cointegrating coefficients (standard error in parentheses)

GDP	LGT	FPD	POP	TSR	TRD	AGP
1.000000	0.000000	0.000000	0.000000	0.000000	-13.02535	2.568991
					(1.02970)	(0.50737)
0.000000	1.000000	0.000000	0.000000	0.000000	-5.680490	-0.357469
					(0.67969)	(0.33491)
0.000000	0.000000	1.000000	0.000000	0.000000	1.163182	-0.667816
					(0.37955)	(0.18702)

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0.000000	0.000000	0.000000	1.000000	0.000000	-1.197884 (0.07704)	-0.541657 (0.03796)
0.000000	0.000000	0.000000	0.000000	1.000000	-0.744898 (0.24272)	-0.774641 (0.11960)

Adjustment coefficients (standard error in parentheses)

D(GDP)	-0.131698	-0.065392	-0.084149	0.409387	-0.007444
	(0.07711)	(0.07291)	(0.18007)	(0.41190)	(0.20774)
D(LGT)	-0.186462	-0.212787	-0.959237	1.110424	-1.032054
	(0.19505)	(0.18442)	(0.45549)	(1.04192)	(0.52550)
D(FPD)	-0.325700	0.113002	-0.774311	-0.190169	0.032804
	(0.06108)	(0.05775)	(0.14263)	(0.32627)	(0.16455)
D(POP)	-0.109706	0.190205	0.062802	-0.851493	-0.456411
	(0.04284)	(0.04050)	(0.10004)	(0.22883)	(0.11541)
D(TSR)	-0.011080	0.004202	-0.067944	0.826491	-0.287676
	(0.02133)	(0.02017)	(0.04981)	(0.11393)	(0.05746)
D(TRD)	-0.000713	0.001298	-0.002504	0.000139	-0.002343
	(0.00046)	(0.00043)	(0.00107)	(0.00244)	(0.00123)
D(AGP)	-0.053907	0.088021	-0.022516	1.001354	-0.474770
	(0.05342)	(0.05051)	(0.12474)	(0.28535)	(0.14392)

6 Cointegrating Equation(s): Log likelihood 616.1747

Normalized cointegrating coefficients (standard error in parentheses)

GDP	LGT	FPD	POP	TSR	TRD	AGP
1.000000	0.000000	0.000000	0.000000	0.000000	0.000000	-3.505597 (0.47631)
0.000000	1.000000	0.000000	0.000000	0.000000	0.000000	-3.006660 (0.23563)
0.000000	0.000000	1.000000	0.000000	0.000000	0.000000	-0.125347 (0.05237)
0.000000	0.000000	0.000000	1.000000	0.000000	0.000000	-1.100310 (0.04979)
0.000000	0.000000	0.000000	0.000000	1.000000	0.000000	-1.122037 (0.04195)
0.000000	0.000000	0.000000	0.000000	0.000000	1.000000	-0.466367 (0.03950)

Adjustment coefficients (standard error in parentheses)

D(GDP)	-0.140665	-0.061127	-0.083733	0.409008	-0.024510	1.549769
	(0.08935)	(0.07597)	(0.17996)	(0.41163)	(0.22475)	(1.09319)
D(LGT)	-0.097611	-0.255053	-0.963357	1.114173	-0.862952	1.508220
	(0.22389)	(0.19035)	(0.45093)	(1.03142)	(0.56314)	(2.73917)
D(FPD)	-0.337273	0.118507	-0.773775	-0.190657	0.010778	2.962042
	(0.07070)	(0.06011)	(0.14239)	(0.32570)	(0.17783)	(0.86498)
D(POP)	-0.112795	0.191674	0.062945	-0.851623	-0.462290	1.797237
	(0.04966)	(0.04222)	(0.10002)	(0.22877)	(0.12491)	(0.60756)
D(TSR)	-0.011967	0.004624	-0.067903	0.826453	-0.289365	-0.729820
	(0.02473)	(0.02103)	(0.04981)	(0.11393)	(0.06220)	(0.30256)
D(TRD)	-0.000626	0.001256	-0.002508	0.000143	-0.002176	0.000137
	(0.00053)	(0.00045)	(0.00107)	(0.00244)	(0.00133)	(0.00648)
D(AGP)	-0.006817	0.065620	-0.024699	1.003341	-0.385148	-0.909497
	(0.05957)	(0.05064)	(0.11997)	(0.27441)	(0.14982)	(0.72876)

TABLE 5

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From the table showing the Johansen cointegration test, the asterisk * sign tells something is happening. Thus, because None is asterisk *, we reject the null hypothesis of no cointegration in this model. The trace test indicates we have 5 cointegrating equations as the null hypothesis of no cointegrating equation is rejected at 5%, this is due to the fact that the Trace statistic and the maximum Eigen value were higher than the critical values. This is corroborated by the p-values, less than 0.05. By implication, the chosen variables can attain equilibrium in the long run even with the presence of a short-term distortion.

The null hypothesis of the Johansen cointegration test states that there is no cointegrating equation while the alternative states that there are cointegrating equations. From table 5, the values of the Trace Statistics and the Eigen value are displayed on the table. If the values of the trace statistics and max eigen are greater than the 5% critical value, which is corroborated by the p-values of less than 0.05. Hence, in the long run, the chosen variables can attain equilibrium, which means they can move in the same direction in the same direction in the long run in even in the presence of short-term disturbances. The trace statistics and the maximum eigen value statistics and their corresponding critical values presented in Table 5 confirm the existence of co-integrating equations at 5-percent levels of significance suggesting that the null hypothesis of no co-integration can be rejected under both of these tests; and simultaneously implying a long-run relationship existing among the variables in Nigeria at a 5% level of significance and they can be combined in a linear fashion. It also implies that if there are shocks in the short-run, it will affect the individual movement of the series but there will be long-run convergence.

However, apart from relying on the static model that we have estimated, we may also look at the Normalized cointegrating coefficients of the Johanson test and turn it into equation. Thus,

GDP	LGT	FPD	POP	TSR	TRD	AGP
1.000000	0.285250	4.426134	-18.22228	1.545050	11.17995	8.184545
	(0.24655)	(0.55937)	(1.33831)	(0.77706)	(1.78871)	(0.87120)

(standard error in parentheses) Thus, we estimate both the short-run and the long-run model, we also estimate both the VAR and the Vector Error Correction model.

TABLE 6: VECTOR ERROR CORRECTION

Vector Error Correction Estimates
Date: 12/19/22 Time: 15:25
Sample (adjusted): 1984 2021
Included observations: 38 after adjustments
Standard errors in ( ) & t-statistics in [ ]

Cointegrating Eq:	CointEq1
GDP(-1)	1.000000
LGT(-1)	-0.000753
	(0.00114)
	[-0.65950]
FPD(-1)	9.145467
	(2.44898)
	[3.73439]

AGP(-1)	-25.80841 (2.09855) [-12.2982]
TRD(-1)	6.385388 (2.78872) [2.28972]
POP(-1)	-1.51E-05 (0.00028) [-0.05437]
TSR(-1)	78.86580 (38.1581) [2.06681]
C	97402.11

Error Correction:	D(GDP)	D(LGT)	D(FPD)	D(AGP)	D(TRD)	D(POP)	D(TSR)
CointEq1	-0.191037 (0.06847) [-2.78998]	60.95781 (34.4157) [1.77122]	0.002463 (0.01038) [0.23735]	0.019035 (0.01606) [1.18535]	-0.023249 (0.00547) [-4.24747]	-0.461183 (2.18152) [-0.21140]	-0.004581 (0.00134) [-3.41116]
D(GDP(-1))	0.119894 (0.24002) [0.49952]	159.3070 (120.638) [1.32053]	0.018643 (0.03637) [0.51263]	-0.082437 (0.05629) [-1.46451]	0.020627 (0.01919) [1.07505]	1.129948 (7.64695) [0.14776]	0.000224 (0.00471) [0.04759]
D(GDP(-2))	0.396742 (0.24094) [1.64665]	51.74325 (121.101) [0.42727]	-0.006499 (0.03651) [-0.17801]	-0.005319 (0.05651) [-0.09412]	-0.010286 (0.01926) [-0.53403]	-6.013217 (7.67626) [-0.78335]	-0.005618 (0.00473) [-1.18903]
D(LGT(-1))	-0.000413 (0.00042) [-0.97345]	-0.263971 (0.21328) [-1.23768]	-1.03E-05 (6.4E-05) [-0.16091]	3.58E-05 (0.00010) [0.35989]	9.18E-05 (3.4E-05) [2.70768]	-0.001294 (0.01352) [-0.09569]	7.12E-06 (8.3E-06) [0.85545]
D(LGT(-2))	9.59E-05 (0.00049) [0.19626]	-0.309310 (0.24572) [-1.25881]	6.34E-06 (7.4E-05) [0.08565]	-2.80E-05 (0.00011) [-0.24432]	6.69E-05 (3.9E-05) [1.71201]	0.004328 (0.01558) [0.27785]	5.13E-06 (9.6E-06) [0.53537]
D(FPD(-1))	0.745866 (1.38025) [0.54038]	-220.6038 (693.743) [-0.31799]	-0.057242 (0.20914) [-0.27370]	-0.144184 (0.32370) [-0.44543]	0.208392 (0.11034) [1.88869]	11.91722 (43.9746) [0.27100]	0.033143 (0.02707) [1.22441]
D(FPD(-2))	0.555961 (1.43286) [0.38801]	-827.6521 (720.186) [-1.14922]	-0.055349 (0.21711) [-0.25493]	-0.347163 (0.33604) [-1.03310]	0.146426 (0.11454) [1.27835]	-48.11882 (45.6508) [-1.05406]	0.029833 (0.02810) [1.06166]
D(AGP(-1))	-4.023321 (1.63888) [-2.45492]	1612.064 (823.733) [1.95702]	-0.138534 (0.24833) [-0.55787]	0.303348 (0.38435) [0.78924]	-0.396287 (0.13101) [-3.02483]	-17.96825 (52.2144) [-0.34412]	-0.093151 (0.03214) [-2.89820]
D(AGP(-2))	-2.714234 (1.51257) [-1.79446]	1658.175 (760.246) [2.18110]	0.097524 (0.22919) [0.42552]	0.277156 (0.35473) [0.78131]	-0.033444 (0.12091) [-0.27659]	13.63995 (48.1901) [0.28304]	-0.016142 (0.02966) [-0.54418]

D(TRD(-1))	-4.908957	6340.035	0.135427	0.288034	0.181021	-66.68343	-0.126847
	(3.49780)	(1758.06)	(0.53000)	(0.82031)	(0.27961)	(111.439)	(0.06860)
	[-1.40344]	[3.60626]	[0.25552]	[0.35113]	[0.64740]	[-0.59838]	[-1.84916]
D(TRD(-2))	-1.221874	-2451.974	0.032666	0.239481	-0.294512	68.90328	-0.014129
	(2.46170)	(1237.30)	(0.37301)	(0.57732)	(0.19679)	(78.4295)	(0.04828)
	[-0.49635]	[-1.98171]	[0.08757]	[0.41481]	[-1.49660]	[0.87854]	[-0.29265]
D(POP(-1))	0.000813	4.526921	0.000324	0.002418	7.18E-05	1.129417	-1.64E-05
	(0.00573)	(2.88213)	(0.00087)	(0.00134)	(0.00046)	(0.18269)	(0.00011)
	[0.14178]	[1.57068]	[0.37269]	[1.79772]	[0.15665]	[6.18211]	[-0.14580]
D(POP(-2))	-0.006826	-3.056793	-0.000202	-0.001014	-0.001160	-0.142078	-0.000158
	(0.00523)	(2.62709)	(0.00079)	(0.00123)	(0.00042)	(0.16652)	(0.00010)
	[-1.30590]	[-1.16357]	[-0.25468]	[-0.82709]	[-2.77526]	[-0.85320]	[-1.53939]
D(TSR(-1))	-1.168849	-29097.66	-1.375762	0.514582	-3.684921	220.1174	-0.073903
	(14.3015)	(7188.23)	(2.16701)	(3.35403)	(1.14326)	(455.644)	(0.28047)
	[-0.08173]	[-4.04796]	[-0.63487]	[0.15342]	[-3.22317]	[0.48309]	[-0.26349]
D(TSR(-2))	-6.957104	13879.13	-0.413282	0.351 431	-0.858598	94.94980	-0.707843
	(15.3928)	(7736.74)	(2.33237)	(3.60996)	(1.23050)	(490.413)	(0.30188)
	[-0.45197]	[1.79392]	[-0.17719]	[0.09735]	[-0.69777]	[0.19361]	[-2.34481]
C	27266.56	-7920619.	-448.1138	-4514.253	4144.547	126714.4	722.5766
	(12940.8)	(6504325)	(1960.84)	(3034.92)	(1034.49)	(412293.)	(253.789)
	[2.10702]	[-1.21775]	[-0.22853]	[-1.48744]	[4.00638]	[0.30734]	[2.84715]
R-squared	0.911117	0.555590	0.148899	0.355441	0.903777	0.997373	0.709211
Adj. R-squared	0.850516	0.252583	-0.431397	-0.084030	0.838171	0.995583	0.510946
Sum sq. resids	94956649	2.40E+13	2180136.	5222690.	606806.1	9.64E+10	36521.35
S.E. equation	2077.549	1044218.	314.7969	487.2320	166.0786	66190.36	40.74385
F-statistic	15.03451	1.833590	0.256591	0.808792	13.77578	556.9261	3.577083
Log likelihood	-333.8152	-570.1689	-262.1086	-278.7075	-237.8089	-465.3464	-184.4129
Akaike AIC	18.41133	30.85100	14.63729	15.51092	13.35836	25.33402	10.54805
Schwarz SC	19.10084	31.54051	15.32680	16.20043	14.04787	26.02353	11.23756
Mean dependent	4629.388	151326.9	28.51684	429.7192	251.5558	3527625.	20.49947
S.D. dependent	5373.454	1207841.	263.1179	467.9668	412.8438	995885.4	58.26176

Determinant resid covariance (dof adj.)	1.36E+45
Determinant resid covariance	2.96E+43
Log likelihood	-2279.237
Akaike information criterion	126.2230
Schwarz criterion	131.3512
Number of coefficients	119

From table 6 which is the Vecto Error Correction Estimate (VECM), the first part of the model explains the breakdown of the error correction term, it represents the cointegrating equation and the long-run model. It is the same thing with the long-run model of the normalized Johansen cointegration test we can infer long run, short run and strong causal effect. The first part is the cointegrating equation, it is the error correction term equation, signifying the long-run relationships among the variables.

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ECTt-1 = 1.000lngdpit-1 - 0.00753lnlgtt-1 + 9.1454lnfpdt-1 - 25.0084lnagpt-1 + 6.3854lntrdt-1 - 1.51E.05lnpopt-1 + 78.8658lntsrt-1 + 97402.1

Below it we have the short-run coefficients and the error correction term and the adjustment coefficients. Hence, we interpret the adjustment coefficients as the previous period deviation from long-run equilibrium is corrected in the current period at an adjustment speed of 19%. For GDP, a percentage change in GDP is associated with 4.13% decrease in lgt on average ceteris paribus in the short-run. For the fpd coefficient, a percentage change in fpd is associated with a 0.55% change in fpd. These are ceteris paribus effect and the equation is as shown below.

lngdpl is the target variable:

lngdplt-1 = -0.191037 ECTt-1 + 0.119894gdp - 0.000413lgt + 0.745866fpd – 4.023321agp – 4.908957trd – 0.000813pop – 1.168849tsr + 27266.56

Apparently, the R-Squared and the Adjusted R-Squared of 91% and 85% respectively show that variable are significant in the determination of food security and economic growth in Nigeria.

5.0 CONCLUSION AND POLICY RECOMMENDATION

This study has analyzed the efficacy of food security on the sustainability of the Nigerian economy within the period of 1981 to 2022. It examined the extent to which such variables like: loans granted (lgt), food production (fpd), agricultural production (agp), trade (trd), population (pop) and transport (trs) impacted on food security and sustainability in Nigeria and discovered that food production and one period lag of agricultural production impacted positively on the sustainability of the Nigerian economy while trade, population and transport had negative relationship with food security and sustainability of the Nigerian economy.

For the Nigerian economy to experience sustained economic growth, the following recommendations should be taken into considerations.

- Appropriate policies that would encourage agricultural production, trade and transport should be put in place.
- Population of the country should be harnessed into some productive ventures that would enhance economic sustainability.
- The loans granted should be made accessible to more people in order to promote growth in the economy
- Good road network, transport and communications should be put in place by the government to enhance economic growth.

APPENDICES

System: UNTITLED
Estimation Method: Least Squares
Date: 12/22/22 Time: 15:17
Sample: 1983 2021

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Included observations: 39
Total system (balanced) observations 273

	Coefficient	Std. Error	t-Statistic	Prob.
C(1)	0.530173	0.268745	1.972769	0.0502
C(2)	0.448751	0.263965	1.700041	0.0910
C(3)	-0.000986	0.000439	-2.244351	0.0261
C(4)	-0.000130	0.000507	-0.255948	0.7983
C(5)	-0.291298	1.421003	-0.204994	0.8378
C(6)	-1.169640	1.224873	-0.954907	0.3410
C(7)	0.281705	0.961640	0.292942	0.7699
C(8)	2.110857	1.118584	1.887079	0.0609
C(9)	-1.583032	3.469686	-0.456247	0.6488
C(10)	2.535218	2.916891	0.869151	0.3860
C(11)	0.009437	0.005304	1.779310	0.0770
C(12)	-0.009754	0.005429	-1.796700	0.0742
C(13)	-12.01282	16.42411	-0.731413	0.4655
C(14)	4.994452	11.36506	0.439457	0.6609
C(15)	2343.319	6792.011	0.345011	0.7305
C(16)	222.2494	131.0895	1.695403	0.0919
C(17)	-185.7280	128.7576	-1.442462	0.1510
C(18)	0.492517	0.214308	2.298179	0.0228
C(19)	-0.155849	0.247267	-0.630285	0.5294
C(20)	-122.1789	693.1410	-0.176268	0.8603
C(21)	-422.8867	597.4721	-0.707793	0.4801
C(22)	20.47095	469.0716	0.043641	0.9652
C(23)	21.10235	545.6263	0.038675	0.9692
C(24)	4146.302	1692.454	2.449876	0.0153
C(25)	-3533.902	1422.810	-2.483748	0.0140
C(26)	5.038139	2.587014	1.947473	0.0531
C(27)	-5.161661	2.647977	-1.949284	0.0529
C(28)	-24992.66	8011.404	-3.119636	0.0021
C(29)	13525.25	5543.685	2.439759	0.0157
C(30)	1147833.	3313028.	0.346461	0.7294
C(31)	0.026059	0.039496	0.659779	0.5103
C(32)	-0.012212	0.038794	-0.314792	0.7533
C(33)	-8.03E-06	6.46E-05	-0.124408	0.9011
C(34)	4.44E-06	7.45E-05	0.059631	0.9525
C(35)	0.539730	0.208838	2.584444	0.0106
C(36)	-0.245663	0.180014	-1.364691	0.1742
C(37)	-0.132713	0.141328	-0.939046	0.3491
C(38)	0.225142	0.164393	1.369537	0.1727
C(39)	0.141511	0.509923	0.277514	0.7817
C(40)	-0.073125	0.428682	-0.170581	0.8648
C(41)	0.000546	0.000779	0.700845	0.4844
C(42)	-0.000567	0.000798	-0.710083	0.4786
C(43)	-2.454881	2.413774	-1.017030	0.3106
C(44)	-1.192617	1.670269	-0.714027	0.4762
C(45)	2470.752	998.1895	2.475233	0.0143
C(46)	-0.050687	0.062989	-0.804704	0.4221
C(47)	0.067154	0.061868	1.085434	0.2793
C(48)	4.96E-05	0.000103	0.481288	0.6309
C(49)	7.50E-05	0.000119	0.630831	0.5290
C(50)	-0.008316	0.333057	-0.024967	0.9801
C(51)	-0.097746	0.287087	-0.340476	0.7339
C(52)	0.675415	0.225390	2.996644	0.0031

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C(53)	0.080265	0.262175	0.306151	0.7599
C(54)	-0.588866	0.813230	-0.724108	0.4700
C(55)	0.248243	0.683665	0.363107	0.7170
C(56)	0.002117	0.001243	1.702966	0.0904
C(57)	-0.002137	0.001272	-1.679775	0.0949
C(58)	4.599620	3.849506	1.194860	0.2338
C(59)	-2.340433	2.663759	-0.878621	0.3809
C(60)	-1709.585	1591.921	-1.073913	0.2844
C(61)	-0.008415	0.021390	-0.393390	0.6945
C(62)	0.002140	0.021010	0.101838	0.9190
C(63)	2.83E-05	3.50E-05	0.809095	0.4196
C(64)	-5.77E-05	4.03E-05	-1.430031	0.1546
C(65)	0.014169	0.113103	0.125279	0.9005
C(66)	-0.194681	0.097492	-1.996889	0.0475
C(67)	0.124065	0.076541	1.620901	0.1069
C(68)	0.355338	0.089032	3.991101	0.0001
C(69)	1.255265	0.276166	4.545331	0.0000
C(70)	-0.372629	0.232167	-1.605007	0.1104
C(71)	0.000703	0.000422	1.666279	0.0975
C(72)	-0.000737	0.000432	-1.705856	0.0899
C(73)	-6.422019	1.307259	-4.912583	0.0000
C(74)	2.520169	0.904590	2.785981	0.0060
C(75)	1349.916	540.6026	2.497058	0.0135
C(76)	0.576483	8.946493	0.064437	0.9487
C(77)	-8.711550	8.787348	-0.991374	0.3229
C(78)	0.008897	0.014626	0.608298	0.5438
C(79)	0.001027	0.016875	0.060837	0.9516
C(80)	4.856274	47.30495	0.102659	0.9184
C(81)	-76.61671	40.77581	-1.878974	0.0620
C(82)	20.44492	32.01284	0.638648	0.5239
C(83)	20.09967	37.23749	0.539770	0.5901
C(84)	-101.5220	115.5053	-0.878938	0.3807
C(85)	88.39029	97.10284	0.910275	0.3640
C(86)	1.381031	0.176557	7.822030	0.0000
C(87)	-0.365422	0.180717	-2.022064	0.0448
C(88)	274.3971	546.7562	0.501864	0.6164
C(89)	307.8237	378.3412	0.813614	0.4170
C(90)	75491.44	226105.0	0.333878	0.7389
C(91)	-0.002364	0.005287	-0.447137	0.6554
C(92)	0.001365	0.005193	0.262808	0.7930
C(93)	-1.04E-05	8.64E-06	-1.206130	0.2295
C(94)	-9.51E-06	9.97E-06	-0.953526	0.3417
C(95)	-0.021963	0.027954	-0.785702	0.4331
C(96)	-0.016035	0.024096	-0.665459	0.5067
C(97)	0.026178	0.018917	1.383832	0.1682
C(98)	0.070173	0.022005	3.189003	0.0017
C(99)	0.012049	0.068256	0.176530	0.8601
C(100)	0.023363	0.057381	0.407151	0.6844
C(101)	0.000138	0.000104	1.320439	0.1885
C(102)	-0.000145	0.000107	-1.355017	0.1772
C(103)	-0.202970	0.323095	-0.628205	0.5307
C(104)	-0.229875	0.223573	-1.028186	0.3053
C(105)	301.6705	133.6122	2.257806	0.0252
Determinant residual covariance		2.22E+43		

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Equation: GDP = C(1)*GDP(-1) + C(2)*GDP(-2) + C(3)*LGT(-1) + C(4)*LGT(-2) + C(5)*FPD(-1) + C(6)*FPD(-2) + C(7)*AGP(-1) + C(8)*AGP(-2) + C(9)*TRD(-1) + C(10)*TRD(-2) + C(11)*POP(-1) + C(12)*POP(-2) + C(13)*TSR(-1) + C(14)*TSR(-2) + C(15)

Observations: 39

R-squared	0.999129	Mean dependent var	39469.20
Adjusted R-squared	0.998621	S.D. dependent var	50991.48
S.E. of regression	1893.618	Sum squared resid	86058952
Durbin-Watson stat	2.194489		

Equation: LGT = C(16)*GDP(-1) + C(17)*GDP(-2) + C(18)*LGT(-1) + C(19)*LGT(-2) + C(20)*FPD(-1) + C(21)*FPD(-2) + C(22)*AGP(-1) + C(23)*AGP(-2) + C(24)*TRD(-1) + C(25)*TRD(-2) + C(26)*POP(-1) + C(27)*POP(-2) + C(28)*TSR(-1) + C(29)*TSR(-2) + C(30)

Observations: 39

R-squared	0.964584	Mean dependent var	3344587.
Adjusted R-squared	0.943925	S.D. dependent var	3900632.
S.E. of regression	923674.8	Sum squared resid	2.05E+13
Durbin-Watson stat	2.233231		

Equation: FPD = C(31)*GDP(-1) + C(32)*GDP(-2) + C(33)*LGT(-1) + C(34)*LGT(-2) + C(35)*FPD(-1) + C(36)*FPD(-2) + C(37)*AGP(-1) + C(38)*AGP(-2) + C(39)*TRD(-1) + C(40)*TRD(-2) + C(41)*POP(-1) + C(42)*POP(-2) + C(43)*TSR(-1) + C(44)*TSR(-2) + C(45)

Observations: 39

R-squared	0.692158	Mean dependent var	2448.985
Adjusted R-squared	0.512584	S.D. dependent var	398.6181
S.E. of regression	278.2960	Sum squared resid	1858768.
Durbin-Watson stat	1.983494		

Equation: AGP = C(46)*GDP(-1) + C(47)*GDP(-2) + C(48)*LGT(-1) + C(49)*LGT(-2) + C(50)*FPD(-1) + C(51)*FPD(-2) + C(52)*AGP(-1) + C(53)*AGP(-2) + C(54)*TRD(-1) + C(55)*TRD(-2) + C(56)*POP(-1) + C(57)*POP(-2) + C(58)*TSR(-1) + C(59)*TSR(-2) + C(60)

Observations: 39

R-squared	0.996135	Mean dependent var	8784.840
Adjusted R-squared	0.993880	S.D. dependent var	5673.490
S.E. of regression	443.8288	Sum squared resid	4727616.
Durbin-Watson stat	2.055208		

Equation: TRD = C(61)*GDP(-1) + C(62)*GDP(-2) + C(63)*LGT(-1) + C(64)*LGT(-2) + C(65)*FPD(-1) + C(66)*FPD(-2) + C(67)*AGP(-1) + C(68)*AGP(-2) + C(69)*TRD(-1) + C(70)*TRD(-2) + C(71)*POP(-1) + C(72)*POP(-2) + C(73)*TSR(-1) + C(74)*TSR(-2) + C(75)

Observations: 39

R-squared	0.999052	Mean dependent var	5509.395
Adjusted R-squared	0.998499	S.D. dependent var	3889.855
S.E. of regression	150.7204	Sum squared resid	545199.6
Durbin-Watson stat	2.590814		

Equation: POP = C(76)*GDP(-1) + C(77)*GDP(-2) + C(78)*LGT(-1) + C(79)*LGT(-2) + C(80)*FPD(-1) + C(81)*FPD(-2) + C(82)*AGP(-1) + C(83)*AGP(-2) + C(84)*TRD(-1) + C(85)*TRD(-2) + C(86)*POP(-1) + C(87)*POP(-2) + C(88)*TSR(-1) + C(89)*TSR(-2) + C(90)

Observations: 39

R-squared	0.999998	Mean dependent var	1.36E+08
Adjusted R-squared	0.999998	S.D. dependent var	40398156

S.E. of regression	63038.25	Sum squared resid	9.54E+10
Durbin-Watson stat	1.355611		

Equation: TSR = C(91)*GDP(-1) + C(92)*GDP(-2) + C(93)*LGT(-1) + C(94)
*LGT(-2) + C(95)*FPD(-1) + C(96)*FPD(-2) + C(97)*AGP(-1) + C(98)
*AGP(-2) + C(99)*TRD(-1) + C(100)*TRD(-2) + C(101)*POP(-1) +
C(102)*POP(-2) + C(103)*TSR(-1) + C(104)*TSR(-2) + C(105)
Observations: 39

R-squared	0.989315	Mean dependent var	454.0623
Adjusted R-squared	0.983082	S.D. dependent var	286.3912
S.E. of regression	37.25120	Sum squared resid	33303.64
Durbin-Watson stat	2.369412		

UNIT ROOT TEST @ LEVELS

Null Hypothesis: GDP has a unit root
Exogenous: Constant
Lag Length: 0 (Automatic - based on SIC, maxlag=9)

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		12.54741	1.0000
Test critical values:	1% level	-3.605593	
	5% level	-2.936942	
	10% level	-2.606857	

*MacKinnon (1996) one-sided p-values.

Augmented Dickey-Fuller Test Equation
Dependent V ariable: D(GDP)
Method: Least Squares
Date: 12/11/22 Time: 13:40
Sample (adjusted): 1982 2021
Included observations: 40 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
GDP(-1)	0.104323	0.008314	12.54741	0.0000
C	842.2661	471.3506	1.786921	0.0819

R-squared	0 .805565	Mean dependent var	4398.405
Adjusted R-squared	0.800448	S.D. dependent var	5332.260
S.E. of regression	2381.988	Akaike info criterion	18.43797
Sum squared resid	2.16E+08	Schwarz criterion	18.52241
Log likelihood	-366.7593	Hannan-Quinn criter.	18.46850
F-statistic	157.4376	Durbin-Watson stat	1.957517
Prob(F-statistic)	0.000000		

GDP @ 1ST DIFFERENCE INCLUDING INTERCEPT & TREND

Null Hypothesis: D(GDP) has a unit root
Exogenous: Constant, Linear Trend
Lag Length: 0 (Automatic - based on SIC, maxlag=9)

	t-Statistic	Prob.*

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-3.744628	0.0309
Test critical values:	1% level	-4.211868	
	5% level	-3.529758	
	10% level	-3.196411	

*MacKinnon (1996) one-sided p-values.

Augmented Dickey-Fuller Test Equation
Dependent Variable: D(GDP,2)
Method: Least Squares
Date: 12/11/22 Time: 13:44
Sample (adjusted): 1983 2021
Included observations: 39 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
D(GDP(-1))	-0.745068	0.198970	-3.744628	0.0006
C	-3066.221	1158.323	-2.647121	0.0120
@TREND("1981")	312.8458	79.94352	3.913335	0.0004

R-squared	0.305009	Mean dependent var	559.3190
Adjusted R-squared	0.266398	S.D. dependent var	3248.937
S.E. of regression	2782.732	Akaike info criterion	18.77406
Sum squared resid	2.79E+08	Schwarz criterion	18.90202
Log likelihood	-363.0941	Hannan-Quinn criter.	18.81997
F-statistic	7.899616	Durbin-Watson stat	1.831009
Prob(F-statistic)	0.001431		

Null Hypothesis: D(GDP) has a unit root *********************
Exogenous: Constant
Lag Length: 1 (Automatic - based on SIC, maxlag=9)

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		0.497483	0.9844
Test critical values:	1% level	-3.615588	
	5% level	-2.941145	
	10% level	-2.609066	

*MacKinnon (1996) one-sided p-values.

Augmented Dickey-Fuller Test Equation
Dependent Variable: D(GDP,2)
Method: Least Squares
Date: 12/14/22 Time: 01:20
Sample (adjusted): 1984 2021
Included observations: 38 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
D(GDP(-1))	0.050513	0.101538	0.497483	0.6220
D(GDP(-1),2)	-0.793288	0.184440	-4.301066	0.0001
C	548.7947	597.2281	0.918903	0.3644

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R-squared	0.352568	Mean dependent var	574.0389
Adjusted R-squared	0.315572	S.D. dependent var	3291.230
S.E. of regression	2722.840	Akaike info criterion	18.73240
Sum squared resid	2.59E+08	Schwarz criterion	18.86168
Log likelihood	-352.9155	Hannan-Quinn criter.	18.77839
F-statistic	9.529876	Durbin-Watson stat	1.970021
Prob(F-statistic)	0.000496		

LGT @ LEVEL INCLUDING INTERCEPT

Null Hypothesis: LGT has a unit root
Exogenous: Constant
Lag Length: 9 (Automatic - based on SIC, maxlag=9)

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		1.713791	0.9994
Test critical values:	1% level	-3.661661	
	5% level	-2.960411	
	10% level	-2.619160	

*MacKinnon (1996) one-sided p-values.

Augmented Dickey-Fuller Test Equation
Dependent Variable: D(LGT)
Method: Least Squares
Date: 12/11/22 Time: 13:51
Sample (adjusted): 1991 2021
Included obse rvations: 31 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
LGT(-1)	0.404459	0.236002	1.713791	0.1020
D(LGT(-1))	-0.239076	0.252601	-0.946456	0.3552
D(LGT(-2))	-0.410393	0.173265	-2.368592	0.0280
D(LGT(-3))	0.382814	0.193871	1.974585	0.0623
D(LGT(-4))	-0.571274	0.217270	-2.629331	0.0161
D(LGT(-5))	0.284303	0.329604	0.862560	0.3986
D(LGT(-6))	0.036976	0.508706	0.072686	0.9428
D(LGT(-7))	-0.563462	0.735995	-0.765579	0.4529
D(LGT(-8))	-2.396146	0.665091	-3.602733	0.0018
D(LGT(-9))	-1.987134	0.598389	-3.320810	0.0034
C	198224.8	253348.2	0.782420	0.4431

R-squared	0.697150	Mean dependent var	183491.5
Adjusted R-squared	0.545725	S.D. dependent var	1339172.
S.E. of regression	902600.9	Akaike info criterion	30.53537
Sum squared resid	1.63E+13	Schwarz criterion	31.04421
Log likelihood	-462.2983	Hannan-Quinn criter.	30.70124
F-statistic	4.603935	Durbin-Watson stat	2.096005
Prob(F-statistic)	0.001805		

FPD @ LEVELS INTERCEPT ONLY

Null Hypothesis: FPD has a unit root
Exogenous: Constant

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Lag Length: 0 (Automatic - based on SIC, maxlag=9)

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-2.562720	0.1091
Test critical values:	1% level	-3.605593	
	5% level	-2.936942	
	10% level	-2.606857	

*MacKinnon (1996) one-sided p-values.

Augmented Dickey-Fuller Test Equation
Dependent Variable: D(FPD)
Method: Least Squares
Date: 12/11/22 Time: 13:57
Sample (adjusted): 1982 2021
Included observations: 40 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
FPD(-1)	-0.282740	0.110328	-2.562720	0.0145
C	694.8627	275.7299	2.520085	0.0161

R-squared	0.147361	Mean dependent var	-2.457000
Adjusted R-squared	0.124924	S.D. dependent var	301.4346
S.E. of regression	281.9785	Akaike info criterion	14.17025
Sum squared resid	3021452.	Schwarz criterion	14.25469
Log likelihood	-281.4049	Hannan-Quinn criter.	14.20078
F-statistic	6.567533	Durbin-Watson stat	1.828951
Prob(F-statistic)	0.014470		

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