PRINT: ISSN: 2814-0842
Online: ISSN: 2756-4428

POLAC ECONOMICS REVIEW (PER)

A PUBLICATION OF THE DEPARTMENT OF ECONOMICS, NIGERIA POLICE ACADEMY, WUDIL-KANO, NIGERIA

Vol. 6 No. 3, MARCH, 2026

POLAC ECONOMICS REVIEW (PER)

A Bi-annual Publication of the Department of Economics, Nigeria Police Academy,

Wudil-Kano, Nigeria

Vol. 6 No. 3, MARCH, 2026

P- ISSN: 2814-0842
E - ISSN: 2756-4428

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Volume 6, No.3
MARCH, 2026

Publisher: **Department of Economics**
Faculty of Social and Management Sciences
Nigeria Police Academy, Wudil-Kano
Phone: +2348036949298
Email: pijemsjournal@gmail.com, inzehty01@gmail.com
Website: http://www.pemsj.com

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All correspondences to:
The Managing Editor
Dr Titus Wuyah Yunana
PER
Department of Economics
Nigeria Police Academy, Wudil-Kano
Email:153pijemsjournal@gmail.com,
inzehty01@gmail.com
Phone: +23408036949298

List of Contributors

POLAC ECONOMIC REVIEW (PER)
DEPARTMENT OF ECONOMICS
NIGERIA POLICE ACADEMY, WUDIL-KANO

TRADE OPENNESS AND FOOD PRICE DYNAMICS: IMPLICATIONS FOR FOOD SECURITY IN NIGERIA

Shekwoduza Sarah Agara Department of Economics, Faculty of Social Sciences, Federal University of Lafia

Rebecca Dominic Apeh Department of Economics, Faculty of Social Sciences, Federal University of Lafia

Abstract

The study assessed the impact of trade openness and food prices on food security in Nigeria using a time series data that covers the period of 1981-2022. The data were sourced from world development indicator and central bank of Nigeria statistical bulletin. The study employed Augmented Dickey Fuller (ADF) and Phillip Perron Unit Root Tests, and Bound testing Co-integration as pre-estimation technique and used ARDL model estimate both long run and short run coefficients. The findings in long run model, shows LCPI (food prices) and LAGLD (agricultural land) positively and significantly impact food security in Nigeria. While LREER (real effective exchange rate) was significant, but negatively related to food security. The study therefore, recommends the government through monetary and fiscal authorities manage the foreign exchange in order for local currency to appreciate and control inflation so that the purchasing power of the household consumer will rise in the country thereby making food more accessible and affordable to the people. Also, the government should make agricultural policies that encourage mechanized farming to fully utilise the idle vast land to boost food security in Nigeria.

Keyword: Trade Openness, Food Security, Food Prices

JEL Classification: C23; C0; O55

1. Introduction

The issue of ensuring food sufficiency has taken a global stage today and attracted serious discourse on how to get it across to the entire population of the world. Food insecurity is widely spread all over the world, hunger and malnutrition have imposed serious humanitarian economic and political challenge both in the present and in the future, especially in low- and medium-income countries where many rural and urban households are both income and asset poor. Food and Agriculture Organization (FAO) world assessment of the prevalence of undernourished people in 2022 reveals an increasing level of hunger in the world. The level of global food insecurity measured by the prevalence of undernourishment shows that the proportion of the world population facing chronic hunger was about 9.2 percent, compared with 7.9 percent in 2019 in previous years, translating to about 735.1 million in 2022 more than 612.8 million people in 2019. The invasion of Ukraine by the Russian armed forces couple with other drivers of food insecurity such as conflicts, natural disasters and weather-related events deepen the global food crises through the rise in prices of food, agricultural inputs and energy in the world market making countries that highly depend on food importation (e.g. sub–Saharan Africa) to suffer inflation of staple food prices on average of 23.9 percent in 2020 and 2022 (FAO, 2023 & Okou, Spray, & Unsal, 2022).

In Africa the number of people in severe food insecurity situation is at increase from 268.1 million (20.2 percent) in 2019 to 341.8 million (24 percent) in 2022. Similarly, the prevalence of food insecurity rose in Western Africa

by 5.4 percentage points, the equivalent of 28.3 million more in Western Africa faced food insecurity in 2022 compared to 2019. This wave of hunger did not spare Nigeria. According to Verter (2019), between 2014 – 2016 on average Nigeria had 9 percent (16.4 million) out of its total population undernourished. The percentage of severely food insecure population 22.4, that is (40.7 million) and by the end of 2017 the percentage of undernourishment rose to 11.5 accounting for 21.5 million people, raising the acute hunger level to 24.8 percent (46.1 million persons). By 2022 World Food Program (WFP) reported that 26 states and the Federal Capital Territory (FCT) were having challenge of food insecurity with about 34 percent of the population. Similarly, IMF in (2023) said about 40 percent of the Nigerian population was branded as food insecure based on household survey of expenditures report.

In order to curb the tide of hunger and malnutrition in the country, successive governments over the years implemented various agricultural policies since independence to boost domestic production of key staples and grow the economy. Such policies include; Agricultural Credit Guarantee Scheme Fund set up in 1978 to provide agricultural loan guarantees for commercial banks, National Special Program on Food Security in 2002, National Economic Empowerment and Development Strategy 2004, Root and Tuber Expansion Program (RTEP) in 2008 empowered small-scale farmers with less than two hectares of land in commercial root and tuber agriculture. Others policies were, Agriculture Transformation Approach from 2011- 2015, Agricultural Promotion Policy and Anchor Borrowers Program established in 2016 to support farmers with single digit interest rate loans, The Economic Recovery and Growth Plan covering 2017-2020), and the National Agricultural Technology and Innovation Policy in 2022 (Thomas and Turk 2023). Despite these efforts by the government to shift the economy away from oil dependence to other non-oil activities and agriculture to promote food security, food insecurity is still a nightmare in Nigeria which is why this seeks to examine the impact of trade openness and food prices on food security in Nigeria. other sections of this work are, section two which considers review of related literatures, section three is described the methodology, section four deals with results and analysis while section five conclude and give policy recommendations

2. Literature Review

2.1 Stylized Facts about Food Insecurity in the World

FAO (2002) defined food security as a condition in which all the people, at all times, have physical, social and economic access to sufficient, safe, and nutritious food to meet their dietary needs and food preferences for an active and healthy life. Food is considered sufficient when it can generate a calorie requirement of about 2200-2300 calories per day for adult females and 2900-3000 calories per day for adult males. Children require a lower calorie level to maintain themselves in adequate health. There are four basic dimensions of food security; physical availability - means food supplies from domestic production, stocks and imports should be sufficient to meet the national need, economic access- the population should have sufficient purchasing power to gain access to its food needs. This relates to incomes, expenditures and market prices. Food utilization- balance diet or the sufficient energy and nutrient intake by individuals that gives the body most of the various nutrients in the food. Stability- this refers to steadiness or constancy of food availability, food accessibility and food utilization throughout the year in order to prevent any form of undernourishment among people. Table 1 presents the summary of global prevalence of undernourishment'

Table 1. Prevalence of Undernourished people ('million) and percentage (%) from 2015 – 2022)

	2015	**2017**	**2019**	**2020***	**2021***	**2022***
World	588.9	571.8	612.8	701.4	738.9	735.1
%	7.9	7.5	7.9	8.9	9.3	9.2
Africa	189.6	207.9	225.1	254.7	270.6	281.6
%	15.8	16.5	17.0	18.7	19.4	19.7
Sub-saharan Africa	177.3	193.5	210.6	239.6	253.0	262.0
%	18.2	18.9	26.7	28.1	28.4	28.5
West Africa	37.9	40.1	43.8	55.8	60.8	62.8
%						
	10.6	10.6	11.0	13.7	14.5	14.6

Source: extracted from FAO. 2023. FAOSTAT: Suite of Food Security Indicators. In: *FAO*. [Cited 12 July 2023].

NOTES: * Projected values are based on the projected midranges

People who are vulnerable to food insecurity (or undernourished) are broad classified in two groups; the chronically food insecure which includes those lack adequate income, assets or resource to meet their household food needs and temporally or transitory food insecure are households who have access to their basic food needs but are vulnerable to supply problem when there is temporally external shock that affect their food production system or distribution. The two scenario is captured in panel A and Panel B respectively in table 2.

Table 2. Global grouping of food insecurity between 2015 – 2022 at glance

	Panel A. Number of severely food – insecure people in (' million) and percentage (%)						**Panel B.** Number of moderately or severely food – insecure people in (' million) and percentage (%)					
	2015	**2017**	**2019**	**2020**	**2021**	**2022**	**2015**	**2017**	**2019**	**2020**	**2021**	**2022**
World	561.	623.	719.	850.	927.	900.	1612.	1817.	1966.	2307.	2342.	2356.
%	5	8	8	7	3	1	4	0	4	2	5	9
	7.6	8.2	9.3	10.8	11.7	11.3	21.7	23.9	25.3	29.4	29.6	29.6
Africa	206.	252.	268.	305.	331.	341.	544.8	650.6	695.0	761.7	834.5	868.3
%	3	2	1	0	1	8	45.4	51.5	52.3	56.0	59.9	60.9
	17.2	20.0	20.2	22.4	23.8	24.0						
Sub-saharan Africa	185. 8	227. 2	246. 6	281. 2	302. 4	310. 6	484.9	571.9	623.7	685.8	747.6	783.9
%							49.8	55.8	57.7	61.8	65.7	67.2
	19.1	22.2	22.8	25.4	26.6	26.6						
West Africa	41.0	53.9	66.1	81.1	90.8	94.4	142.7	174.5	205.7	240.8	279.1	285.1
%	11.4	14.3	16.6	19.9	21.7	22.0	39.8	46.2	51.7	59.0	66.7	66.4
Asia	293.	295.	377.	449.	486.	456.	791.0	857.4	981.8	1196.	1151.	1144.
%	7	0	3	5	1	9	17.7	18.9	21.2	8	5	9
	6.6	6.5	8.1	9.6	10.4	9.7				25.7	24.5	24.2

Latin America &	45.3	61.7	62.5	81.8	91.1	83.4	169.8	209.7	203.8	256.4	264.3	247.8
Caribbean	7.3	9.7	9.7	12.5	13.9	12.6	27.3	33.0	31.5	39.3	40.3	37.5
%												
Oceanic	1.1	1.7	1.7	1.1	2.0	1.5	4.0	6.0	5.9	5.3	5.8	5.9
%	2.6	4.1	3.8	2.6	4.5	3.4	10.0	14.4	13.6	12.1	13.0	13.0
North America & Europe	15.1	13.2	10.3	13.3	17.0	16.5	102.8	93.3	79.8	87.0	86.4	90.0
%	1.4	1.2	0.9	1.2	1.5	1.5	9.3	8.4	7.1	7.8	7.7	8.0

Source: extracted from FAO. 2023. FAOSTAT: Suite of Food Security Indicators. In: *FAO*. [Cited 12 July 2023].

2.2 Theoretical Framework

According to classical trade theories, notably, the Heckscher–Ohlin model (H–O model) depends on a country's factors of production like land labour and capital. It states that countries stand to gain from trade if they specialize in the production and exportation of commodities of their comparative advantage and import products of their comparative disadvantage. Such gains include fuller utilization of otherwise idle domestic resources, better access to external markets, the inflow of foreign capital, new technology, new ideas and skilled personnel, greater competition and efficiency, improved productivity and incomes, and better prices. Therefore, these international trade related welfare outcomes facilitate ultimately the availability, access, stability, and utilization of diverse, safe, and nutritious food products from international markets (see Bonuedi, Kamasa and Opoku 2020 & Dithmer and Abdulai 2017). International trade has the potential of increasing food availability by accelerating the movement of goods across borders and guaranteeing timely delivery of food from international markets to bridge supply gaps. In terms of access, international could improve food security by reducing transaction costs, through the comparative cost advantage thereby lowering relative prices of imported foods. Moreso, international trade facilitates stability of food security by ensuring consistent, efficient, and timely food supplies, as this could help avert crisis of shortfalls in domestic food production. Furthermore, variety of food products as well as the nutrition mix available in local markets can be improved through international trade, thereby enhancing the utilization dimension of food security (Smith and Glauber 2020 & Anderson 2022).

2.3 Empirical Review

Erokhin and Gao (2020) evaluated interactions between the food security status of people and the dynamics of COVID-19 cases, food trade, food inflation, and currency volatilities in 45 developing economies distributed to three groups by the level of income using autoregressive distributed lag method, Yamamoto's causality test, and variance decomposition analysis, the findings shows that COVID-19 have more appreciable effects on food insecurity in the developed and developing economies than in the least developed countries. In the least developed economies, food insecurity resulting from the emergence of the COVID-19 was primarily associated with economic access to adequate food supply (food inflation), whereas in advanced and developing economies, their dimension of food insecurity majorly related to availability (food trade restrictions and currency depreciation). In the same manner Alabi and Ngwenyama (2022) descriptively evaluates the influence of COVID-19 pandemic on food security and global food supply chains using Canada and the United States. The result established that COVID-19 pandemic had significant negative impact on the food security and global food supply chains due to disruption of the food supply chain

(i.e. poor economy, shortage of farm worker, limitation to food accessibility, restriction in the transportation of farm commodities, changes in demand of consumers, shutdown of food production facilities, uncertainty of food quality and safety, food trade policies restriction, delays in transportation of food products) leading to increase food insecurity in Canada and the United States.

Luo and Tanaka (2021) in evaluating the effects of food import reliance on price or price volatility transmissions to local markets, constructed a dynamic conditional correlation (DCC)–generalized autoregressive conditional heteroscedasticity (GARCH) model to assessed whether wheat import dependency could make a country vulnerable to external shocks by analyzing the inter-relationships between the foreign wheat price and domestic retail wheat flour prices in 10 net importing countries beginning from January 2005 to December 2019. The result indicates a positive correlation between international and retail price volatilities in each region for most of the period. It means, reducing import dependency of wheat enhances stability, accessibility and availability of food without losing utility. Glauben, Svanidze, Götz, Prehn, Jaghdani, Đurić and Kuhn (2022) in their study on the war in Ukraine, agricultural trade and risks to global food security empirically proved that the invasion of Russian forces in Ukraine has sent prices soaring higher, affecting import-dependent countries in the Middle East and North Africa (MENA) region and sub-Saharan Africa, which rely mostly on Russian and Ukrainian wheat.

Fusco, Coluccia and De Leo (2020) analyzed the impact of trade openness on the level of food security in European countries, employing a dynamic panel analysis with the generalized method of moments (GMM) approach, it was found that trade openness on average was statistically significant with net positive effect on the food security of European countries. Another similar study by Bonuedi, Kamasa and Opoku (2020) assessed the effects of easing trade across borders, through reductions in documents, time, and costs to export and import on food security outcomes in Africa through first-difference instrumental variable estimator controlling for endogeneity using panel data of 45 African countries from 2006–2015, the results revealed that poor trade facilitation constitutes a significant driver of food insecurity in Africa. The results also showed that documentation requirements and lengthier export and import times could significantly limit the availability and accessibility of food. In a descriptive analysis of trade, policy, and food security, Smith and Glauber (2020) found that free trade policies allow countries to exploit their comparative advantages in economic activity, increasing average per capita incomes, longer-term growth rates and a country's capacity to fund social safety nets for the poor. The study also stated that trade expansion (open international markets) for staple food commodities make the per capita consumption of those commodities more stable leading to less volatile prices and mitigating price spikes associated with local and global production shortages which support food security especially for developing countries, as the climate becomes warmer and more volatile (also see, Anderson 2022 & Thomas and Turk 2023).

Verter (2019) studied the dynamics of trade in food products and food security in Nigeria. adopting descriptive methods, the findings show a significant adverse trade balance index in total agri-food trade and many food products in Nigeria. It also reveals factors militating against food security in Nigeria, such as infrastructure deficit, population growth, poverty, corruption, inadequate government support to farmers and absence of safety net programmes. Corroboratively, Assoumou-Ella (2019) assessed the effect of external trade on food security in countries of the Economic and Monetary Community of Central Africa (CEMAC) from 1961-2017 using instrumental variables approach that modifies the problems of endogeneity and omitted variables, the result shows an overall opposing impact of external trade on food security in these countries. Same findings were validated by Assoumou-Ella and Eba-Nguema (2019) who compare the effect of trade openness on food security in countries of the Economic and Monetary Community of Central Africa (CEMAC) and the West African Economic and Monetary Union

(WAEMU) Countries between 1987–2014 through error component model.

Ogundipe, Obi and Ogundipe (2020) investigate the effects of environmental degradation on food security in Nigeria using an annual data for the period 1970-2017. using the Johansen and vector error correction analysis. The empirical evidence suggests an inverse relationship between food production and environmental degradation implying that food security is threaten with rising degradation of the environment which is the function of income at the initial development stages. On the other hand, the study reveals a positive effect of agricultural land and population growth on food production.

3. Methodology

3.1 Model Specification

The study examines the effects of trade openness and food prices on food security in Nigeria. Annual time series data from 1981-2022 were sourced from world development indicator and the Central Bank of Nigeria statistical bulletin. The variables of interest are Agricultural Gross domestic product (AGDP), which is the dependent variable proxy for food security, while the explanatory variables of interest are Trade Openness (TROP), food prices proxy for consumer price index (CPI), Agricultural credit guarantee scheme fund (ACGS), agricultural land (AGLD), population growth rate (POPG), rear effective exchange rate (REER), Gross national income per capita (GNIC) and food production index (FOPX). Autoregressive Distributive Lag (ARDL) bound test approach which can be applied whether the regressors are I (1) and or I (0) was used to evaluate the effects of trade openness and food prices on food security. The baseline model for this study was adapted from Assoumou-Ella and Eba-Nguema (2019) who in their work depended on the international trade theory of the Heckscher–Ohlin model that places emphasis on a country's factors of production as a basis to gain from trade through specialization in the production and exportation of commodities of their comparative advantage and importation of the products of their comparative disadvantage with assumption that this specialization has a significant effect on food security. The model is specified as:

AGDP = f(ACGS, AGLD, CPI, FOPX, GNI, POPG, REER, TROP) - - - - - - - - - - - - - (1)

Transforming equation (2) into an econometric model gives

$AGDP_{it} = \alpha_o + \beta_1 ACGS_t + \beta_2 AGLD_t + \beta_3 CPI_t + \beta_4 FOPX_t + \beta_5 GNI_t + \beta_6 POPG_t + \beta_7 REER + \beta_8 TROP + \mu_{it}$ ------(2)

Where:

αo = is the intercept

μ = error term at time t, assume to be a white noise process.

β_1 to **β_8** = Parameters of the independent variables.

Table 3: Measurement and Sources of Data

Variable	Measurement	Sources
GDP	Agricultural GDP implicit price deflator	CBN statistical bulletin
TROP	Trade Openness (% GDP)	World development indicator
GNIC	Gross national income per capita	CBN statistical bulletin
AGLD	Agricultural land as a percentage of land area	World development indicator
ACGS	Agricultural credit guarantee scheme fund	CBN statistical bulletin
FOPX	food production index (index value)	World development indicator
CPI	consumer price index (index value)	World development indicator
POPG	population growth rate (percentage form)	World development indicator
REER	rear effective exchange rate	World development indicator

Source: *Authors computation using E-views 10*

4. Results and Discussion

4.1 Descriptive Statistics

The descriptive statistics helps us to have a hint of the data used in the study about the distribution of the

variables. The descriptive statistics are presented on a sample period of 2002-2022.

Table 4: Descriptive Statistics

Variables	Mean	Min	Max	STD	Skewness	Kurtosis	Prob
LAGDP	3.1066	-0.3268	5.3912	1.8428	-0.5948	1.8696	0.1002
LACGS	9.7620	5.8901	12.4134	1.7645	-0.6550	2.0711	0.4337
LAGLD	4.2474	4.1303	4.3223	0.0670	-0.6555	1.8001	0.0673
LCPI	3.0220	-0.7146	5.8701	2.0854	-0.4962	1.8742	0.1460
LFOPX	4.1052	3.1709	4.7161	0.4774	-0.6093	2.1441	0.1503
LGNI	6.9141	5.7365	7.9963	0.7093	-0.0486	1.5987	0.1854
LPOPG	0.9613	0.8781	1.0996	0.0459	0.6829	3.6600	0.1400
LREER	4.7872	3.9075	6.2858	0.5961	1.0244	3.1628	0.0270
LTROP	3.4338	2.8042	4.1392	0.3281	-0.2479	2.2436	0.4972

Source: *Authors computation using E-views 10.*

The result in table 4 shows the descriptive statistics for all the variables in the data set. Measures of central tendency, the mean summarize of the data, while standard deviation was used to test the measure of dispersion of all the variables incorporated in the study, which agriculture GDP implicit price deflator as a proxy for food security (LAGDP) as the dependent variable, while the independent variables are Agricultural credit guarantee scheme fund (LACGS), Agricultural land as a percentage of land area (LAGLD), Consumer price index (LCPI), Food production index (LFOPX), Gross national income per capita (LGNI), Population growth annual percentage(LPOPG), Real effective exchange rate (LREER), Trade openness (LTROP) for the period 1981 to 2022. The average value of the mean of all the variables between 1981 to 2022 are 3.1066, 9.7620, 4.2474, 3.0220, 4.1052, 6.9141, 0.9613, 4.7872, 3.4338 respectively, the maximum values are positive and greater than the mean. The standard deviations are all positive and less than the mean which indicates the deviation of the series from the mean. The variables are mixture of positive and negative skewness which implies some of the data with positive skewness tailed toward the right while those with negative skeweness tailed toward the left. The values of the kurtosis which are less than three (3) indicates that the variables are platokurtic however LPOPG and LREER are leptokurtic because the values are greater than three (3). From the probability values which are greater than 5% (0.05) indicates that the data are normally distributed except for LREER which has the value 0.0270 implying that the series is not normally distributed.

4.2 Unit Root Result

In order to ascertain the order of stationarity and non-stationarity of variables used in this study, the augmented dickey fuller (ADF) and Phillip Perron unit root test was conducted on all the variables to ensure that variables to avoid spurious regression results.

Table 4: Unit Root Result

Variables	ADF @ level	ADF @ 1st Diff	Remark	PP @ level	PP @ 1st Diff	Remark
LAGDP	-1.7952^{n}	-3.4881**	1(1)	-2.0386^{n}	-6.7019**	1(1)
LACGS	-1.9979^{n}	-6.7016**	1(1)	-2.0870^{n}	-3.5927**	1(1)
LCPI	-1.5997^{n}	-3.7452**	1(1)	-1.6476^{n}	-2.9592**	1(1)
LFOPX	-2.6500**	-2.3851^{n}	1(0)	-3.4946**	-8.0792**	1(0)
LGNI	-1.7761^{n}	-4.0881**	1(1)	-0.6849^{n}	-3.5658**	1(1)

LPOPG	-1.5577[n]	-3.1892[**]	1(1)	-3.1655[**]	-5.4996[**]	1(0)
LREER	-2.2939[n]	-4.8373[**]	1(1)	-2.4909[n]	-4.6952[**]	1(1)
LTROP	-2.2671[n]	-7.0729[**]	1(1)	-2.1452[n]	-7.3528[**]	1(1)
LAGLD	-1.9428[n]	-4.1345[**]	1(1)	-1.5717[n]	4.3875[**]	1(1)

Source: *Authors computation using E-views 10.*

Note: 1%[***], 5%[**], and 10% [*]. [n] denotes no stationarity.

From the result in table 4 of the unit root, the variables were tested using ADF and PP, in both ADF and PP some of the variables were found to be stationary at level which is 1(0) while some were stationary at first difference 1(1). Hence this justifies the application of Autoregressive distributed lag cointegation bound test to ascertain if there is a long run relationship amongst the variables under review.

4.3 ARDL Result

The autoregressive distributed lag bound test was used to test the long run relationship between the variables.

Table 5: ARDL Result

Selected Model: ARDL(4)				
Variable	Coefficient	Std. Error	t-Statistic	Prob.*
LAGDP(-1)	0.696825	0.181916	3.830482	0.0008
LAGDP(-2)	-0.632469	0.188311	-3.358638	0.0026
LAGDP(-3)	0.366188	0.203830	1.796534	0.0850
LAGDP(-4)	-0.234896	0.143792	-1.633585	0.1154
LACGS	0.000715	0.012139	0.058932	0.9535
LAGLD	8.468166	2.877310	2.943084	0.0071
LCPI	0.479024	0.123147	3.889853	0.0007
LFOPX	-0.213809	0.255937	-0.835399	0.4117
LGNI	0.034577	0.069264	0.499207	0.6222
LPOPG	1.177404	0.755256	1.558947	0.1321
LREER	-0.110492	0.044300	-2.494199	0.0199
LTROP	-0.055246	0.070670	-0.781751	0.4420
C	-34.75707	11.88973	-2.923286	0.0074
R-squared	0.998793	Mean dependent var		3.449255
Adjusted R-squared	0.998190	S.D. dependent var		1.590967
S.E. of regression	0.067691	Akaike info criterion		-2.277902
Sum squared resid	0.109968	Schwarz criterion		-1.711904
Log likelihood	55.14119	Hannan-Quinn criter.		-2.078361
F-statistic	1655.249	Durbin-Watson stat		1.658761
Prob(F-statistic)	0.000000			

Source: *Authors computation using E-views 10.*

In table 5, the ARDL result was estimated using the lag length 4 automatic selection. The dependent variable which is LAGDP was found to have a positive relationship with its self at lag one and three and was found to be statistically significant in the first lag but was not significant in third lag, this could be an indication that previous year's food production does not guarantee food security in the present time. The results also shows that LACGS with a coefficient of 0.0007 has a positive relationship with LAGDP but was not statistically significant because the probability value of 0.9535 was greater than the 5% level of significant. The weak effect of agricultural credit on food production could be associated with difficulties in reaching out to the real and serious farmers in Nigeria. LAGLD on the other hand was found to have a positive relationship

with LAGDP and is statistically significant. The positive coefficient is an indication that mechanized would cause increase in LAGDP which could solve the problem of hunger in Nigeria. LCPI was also found to be statistically significant and positively related to LAGDP. LFOPX and LGNI had positive relationship with LAGDP but statistically insignificant. On the contrary, both LREER and LTROP revealed a negative relationship with LAGDP but only LREER turn out to be significant.

The ARDL estimation result revealed R^2 of 0.998793, this mean LAGDP the dependent is explained 99.8% by the independent variables which indicated the good fit of the model. The F-statistic with the coefficient of and p-value of 0.00000, explained the overall influence of trade openness, inflation, agricultural credit guarantee scheme fund, agricultural land, gross national income per capita, population growth, real effective exchange rate, food production index (LTROP, LCPI, LAGS, LAGLD, LGNI, LPOPG, LREER, LFOPX) on food security (LAGDP) to be statistically significant at 5% levels of significance. Therefore, the overall result affirmed the rejection of Null hypothesis in favour of Alternative hypothesis and concluded that all the independent variables had significance relationship on dependent variable. The Durbin Waston (DW) value of 1.658761 revealed that there is no presence of serial correlation in the model.

4.4 ARDL Bound Test Result

The ARDL bound cointegration test was carried out to find out if long run relationship exists between the variables.

Table 6. ARDL Bounds Test.

Computed F-statistics: 23.60422***	1(0)	1(1)
Critical values bounds (10%)	3.8	3.98
Critical value bounds (5%)	4.6	4.6
Critical value bounds (2.5%)	5.39	5.39
Critical value bounds (1%)	6.44	5.35

Source: *Authors computation using E-views 10.*
Note: *** denotes 1% level of significance

The result of the ARDL Bounds Test display in Table 6. Shows that the null hypothesis of no long run relationship at 5% significance level is rejected because the value of F-Statistic (23.60) is greater than the I(1) bound critical value (5.35). Therefore, it can be concluded that there exists a long-run equilibrium relationship between the variables in this study.

Table 7. Error Correction Model (ECM)

Variable	Coefficient	Std. Error	t-Statistic	Prob.
D(LGDP(-1))	0.501177	0.122428	4.093661	0.0004
D(LGDP(-2))	-0.131292	0.119263	-1.100856	0.2819
D(LGDP(-3))	0.234896	0.140743	1.668968	0.1081
LACGS	0.000715	0.011851	0.060368	0.9524
LAGLD	8.468166	1.153640	7.340388	0.0000
LCPI	0.479024	0.077447	6.185160	0.0000
LFOPX	-0.213809	0.250766	-0.852625	0.4023

LGNI	0.034577	0.044410	0.778588	0.4438
LPOPG	1.177404	0.627999	1.874851	0.0730
LREER	-0.110492	0.037235	-2.967398	0.0067
LTROP	-0.055246	0.068878	-0.802082	0.4304
CointEq(-1)*	-0.804352	0.114702	-7.012522	0.0000

Source: *Authors computation using E-views 10.*

As expected, the error-correction model is negative, significant and less than unity. This result substantiates the findings of co-integration among the variables reported earlier, but more essentially, it suggests that one cannot overlook the co-integrating relationship amongst variables in the model; else this could introduce misspecification in the underlying dynamic structure. The absolute value of the coefficient of the error correction term (0.804352) indicates that about 80.43 percent of the disequilibrium in food security model is offset by short run adjustment within a year and in this case, accomplishing the full adjustment. Thus, to maintain a long-run equilibrium, it is important to reduce the existing disequilibrium overtime.

Table 8: Post Diagnostic Tests

	F-statistics	**Probability**
Serial Correlation	3.719017	(0.0604)
Heteroscedasticity	1.162887	(0.3610)
Normality	0.89568	(0.6387)

Source: *Authors computation using E-views 10.*

From Table 8, the result of Breusch-Godfrey test of serial correlation for the ARDL model used prove that the error terms are serially independent because the P-value (0.0604) of the F-Statistic (3.7190) is greater than 0.05 significant level. For heteroskedasticity, the result shows that the estimated ARDL model in this study is free from the problem of heteroskedasticity because the P-values (0.3610) of the F-statistics (1.1628) is greater than 0.05 significant. Equally Jarque-Berra test for normality shows that the error terms of the estimated ARDL model is normally distributed because the p-value (0.6338) the F-statistics (0.8956) is greater than the 0.05 significance level.

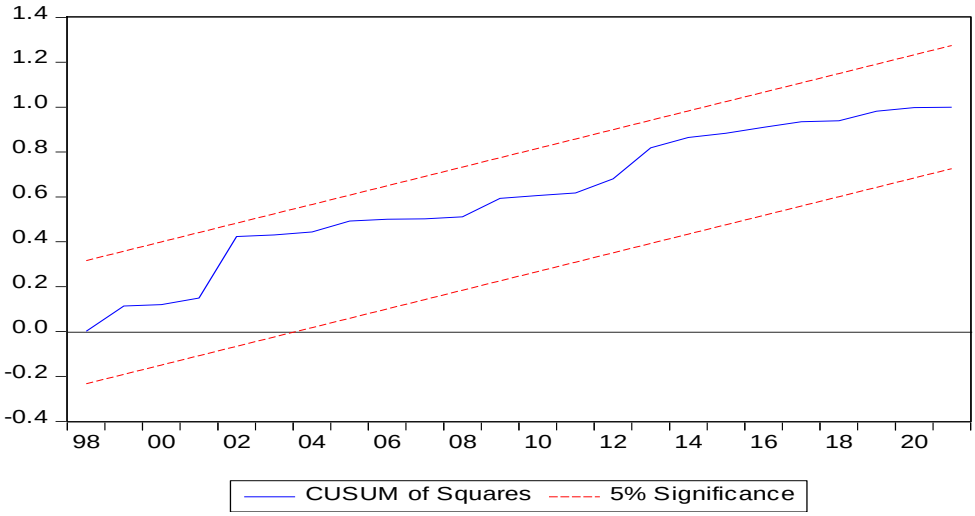

Fig 1: Cusum of Squares.

The figure above showed that cusum square line graph (middle line) fell within the 5% level of significance region that is from the period 1980 to 2022; hence, the model is stable.

5. Conclusion and Recommendations

Trade openness as advocated by Heckcher-Ohlin model of international trade has been found to a large extend to be an encouragement for specialization in economic production among nation leading to improvement in quality and quantity of global output which can translate to improved standard of living. However, trade openness was not significant in explaining food security. LCPI (food prices) was found to be statistically significant and positively related to LAGDP indicating prices need to be managed to secure food for the people. LAGLD was also found to be significant and have a positive relationship with LAGDP. The positive coefficient is an indication that mechanized would cause increase in LAGDP and thus help solve the problem of hunger in Nigeria. While LREER was significant, but negatively related to food security.

The study therefore, recommended that:

i. The government through monetary and fiscal authorities manage the foreign exchange in order for local currency to appreciate
ii. Control inflation so that the purchasing power of the household consumer will rise in the country thereby making food more accessible and affordable to the people.
iii. Also, the government should make agricultural policies priority to encourage mechanized farming to fully utilize the idle vast land to boost food security in Nigeria.

Suggestion for further studies.

It's therefore essential for researchers to note that the specific relationship between these factors can vary depending on a country's unique circumstances and the policies it implements, hence there is need for further studies on this aspect as to study these dynamics to make informed decisions about food Security in Nigeria.

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