Bozok Journal of Agriculture and Natural Sciences
(Bozok Tarım ve Doğa Bilimleri Dergisi)
https://dergipark.org.tr/en/pub/bojans
e-ISSN: 2822-4604

Research Article

Nijerya'da Kredi Politikalarının Mahsul Üretimi Üzerindeki Etkisi

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Makale Tarihçesi

Geliş: 09.12.2023
Kabul: 03.07.2024
DOI: 10.59128/bojans.1402648

Anahtar Kelimeler

Mahsul
Kredi
Çıktı
Tarım politikası
Nijerya

Öz: Bu araştırmada Nijerya'da bitkisel üretim endeksi ile kredi politikası değişkenleri arasındaki ilişkiler araştırılmıştır. Seriler arasında eşbütünleşmenin varlığı otoregresif dağıtılmış gecikme (ARDL) sınır testi kullanılarak belirlendi. Tahmin edilen kısa ve uzun vadeli modeller bir araya geldi, en kaliteli, verimli ve kapsamlıydı. Ampirik kredi sonuçları, tarım sektörünün verilen ticari banka toplam kredisinin ve alt mahsul ticaretinin izniyle yönetim garanti planı fon kredisinin hem uzun hem de kısa süreli bitkisel üretim rejimi üzerinde önemli bir pozitif olayların gösterildiğini göstermektedir. Kısa kredi harcaması, bitkisel üretim rejimi hem borç verme faiz oranı hem de özel sektöre verilen toplam yurt içi ile kayıt değeri bir negatif gelişme göstermektedir. Tarım sektörünün verdiği toplam kredinin kurulumu ve kredi yönetimi garanti planı fonu kredisinin ürün alt sektörünün genişletilmesi pazarları ile doğrulanmaktadır. Mahsul alt sektöre yerli özel yatırımı çekebilmek için alt sektöre özgü desteklerin yapılmasını büyük önemsemek. Ayrıca ülkelerdeki çiftçilerin tarım kredisine erişiminin arttırılması amacıyla kredi faiz oranlarının belirli aralıklarla azaltılması önemle tavsiye edilmektedir.

Atıf Künyesi: Akpan S. B., Patrick I. V., Okon U. E. ve Nkanta V. S. (2024). *Nijerya'da Kredi Politikalarının Mahsul Üretimi Üzerindeki Etkisi, Bozok Tarım ve Doğa Bilimleri Dergisi,* 3(1), 1-15. **How To Cite:** Akpan S. B., Patrick I. V., Okon U. E. and Nkanta V. S. (2024). *The Impact of Credit Policies on Crop Output in Nigeria, Bozok Journal of Agriculture and Natural Sciences,* 3(1), 1-15.

The Impact of Credit Policies on Crop Output in Nigeria

Article Info

Received: 09.12.2023
Accepted: 03.07.2024
DOI: 10.59128/bojans.1402648

Keywords

Crop
Credit
Output
Agricultural policies
Nigeria

Abstract: The relationship between crop production index and credit policy variables in Nigeria was investigated in this research. The presence of co-integration among series was established using the autoregressive distributed lag (ARDL) bound test. The short and long run models estimated were stable, best quality, efficient, and unbiased. The empirical results showed that the commercial bank total credit to the agricultural sector and agricultural credit guarantee scheme fund loan to the crop sub-sector have a significant positive impact on crop production index in both the long and short run. In the short run, the crop production index shows a notable negative correlation with both the lending interest rate and the total

domestic credit to the private sector. The need to increase the total credit to the agricultural sector and scale up the agricultural credit guarantee scheme fund loan to the crop sub-sector is justified by the findings. To attract domestic private investment in the crop sub-sector, it is crucial to offer strategic incentives peculiar to the subsector. Additionally, it is highly recommended to periodically decrease the lending interest rate in order to enhance farmers' access to farm credit in the country.

1. Introduction

Agricultural credit is an essential tool to promote agricultural production, especially among rural agricultural households in developing countries (Idiong et al., 2010; Akpan et al., 2012, Jeiyol et al., 2013; Aladejebi et al., 2018; Akpan et al., 2020; Balana and Oyeyemi, 2022). Agricultural credit has been positively linked to agricultural productivity in several studies in Nigeria (Akpan et al., 2013; Awotide et al., 2015; Abu, et al., 2017; Adewale et al., 2022). Inspite of this direct link, some studies have revealedinstances of insufficient credit among rural farmers in Nigeria (Adebayo and Adeola, 2008; Ololade and Olagunju, 2013; Assogba et al., 2017; Asom et al., 2023). Credit is considered an essential tool for creating sustainable income, mobilizing resources and creating a competitive landscape for production and economic eactivities (Akpan et al., 2013; Essien and Arene, 2014). Credit is crucial because most farmers have limited resources and agricultural activitiesa are time-dependent. Beck and Demirguc-Kunt (2006) found that the provision of credit increases the well-being of the vulnerable through income smoothing. Jeiyol et al. (2013) and Akpan et al. (2013) have emphasized the significance of credit as a crucial element for sustainable agricultural production and processing. Hence, the availability and requirement of credit are crucial for achieving the national objective of rural poverty reduction, establishing sustainable employment opportunities, and ensuring self-reliance in food production.

Due to the importance of agricultural credit and in response to the desire of farmers, the Federal Government of Nigeria had in the past introduced various agricultural credit policies and programs to improve agricultural production by providing cheap and subsidized finance to farmers at a preferential interest rate (Akpan et al., 2012). For example, in 1990, community banks were introduced into the country's financial landscape to provide banking and financial services to the rural economy and micro-enterprises in urban centres. In 1996, the Central Bank of Nigeria issued guidelines for sectorial concessional credit to agriculture (Manyong et al., 2005). In 2009, the Central Bank of Nigeria (CBN), in partnership with the Federal Ministry of Agriculture and Water Resources (FMAWR), founded the Commercial Agriculture Credit Scheme (CACS) to provide financing for agricultural processing, storage and marketing (Olomola and Yaro, 2015). Other credit policies introduced by the Federal Government include the Nigeria Incentive-Based Risk Sharing System for Agricultural Lending (NIRSAL) launched in 2011 and the Micro, Small, and Medium Enterprises Development Fund (MSMEDF) launched in 2013 (Salisu and Alamu, 2023). Furthermore, the manipulation of the macroeconomic environment through instruments such as exchange rate policy, lending interest rate policy and other monetary and fiscal policy measures has been deliberately used to stimulate development of the real sectors (CBN, 2022). Followwing the various forms of incentives provided by the government to farmers and agribusinesses in the country to improve their performances (Akpan et al., 2012); the existence of formal and informal credit market structures that guarantee flexibility in credit supply and demand as well as the spread of an effective market system; Many researchers have reported that the abysmal performance of the agricultural sector is due to inadequate credit to farmers and agribusinesses in the country (Oyedele et al., 2009; Essien et al., 2016; Assogba et al., 2017; Balana and Oyeyemi, 2022; Asom et al., 2023). As reported by Essien et al. (2016), Akpan et al. (2016) and Akpan et al. (2019), the low performance of farmers and small agribusinesses would likely lead to increased poverty, hunger, unemployment and poor living standards for many rural agricultural households. Likewise, Adebayo and Adeola (2008) and

Adewale et al. (2022) stated that credit is a good means of acquiring facilities to improve agricultural production and increase farmers' income and improve living standards.

Given the crucial role of agricultural credit in promoting agricultural production, there is a need to establish the empirical connection between the credit policy environment and agricultural production indicators in the country. The crop production subsector is one of the components of the agricultural sector that has played a significant role in the development of rural livelihoods and the economy of developing countries (Akpan, 2022). The crops subsector consists of cash crops or export-oriented crops and food crops (crops intended for domestic consumption). Its rich and complex value chain is a source of income, livelihood and employment for many rural households. Crop production, particularly cash crops, serves as an important capital reserve and safety net for many poor rural agricultural households. In 2020 and 2021, the crop production subsector contributed about 89.09% and 88.39% of the agricultural GDP, respectively. The sub-unit has contributed to the country's food supply by providing calories and protein sources to Nigerians. Despite these performances of the crop subsector, the subsector's production had recorded increasing deficits relative to demand over the years. The subsector's per capita production has been declining for years due to poor technology adoption. Agricultural land intensification has increased due to increasing urbanization and population pressure, limiting the area available for crop production. Labour demand in the crop sector is inelastic in most regions of the country and therefore poses a serious problem for production (Akpan et al., 2023). The subsector has suffered from policy inconsistencies in recent years, while the cost of agricultural inputs has risen enormously. Due to these deficits, the country is a net importer of certain crops such as rice and wheat among others, which has a huge financial impact on Nigeria's economy. To alleviate these occurrences, the sub-sector requires urgent interventions through the introduction and adoption of improved technologies in production

Credit has been identified as one of the potent sources of financing farm technology adoption in developing countries. According to Adewale et al. (2022), credit plays a crucial role in facilitating and modernizing agricultural production. Mohsin et al. (2011) asserted that agricultural credit provides incentives for farmers to adopt new technologies. According to Oyelade (2019), one of the reasons for the decline in production in the agricultural sector is the lack of access. These reports need to be verified, particularly given the high levels of poverty, malnutrition and increasing food insecurity in the country. Furthermore, the country has invested heavily in the provision of agricultural credit, particularly to the crop sector, through several interventions, hence the need to re-examine its impact on the sub-sector's production growth in light of current realities. In this direction, several authors have recognized the importance of the relationship between credit and agricultural production and have tried to establish empirical facts about this relationship. For example, Imoisi et al. (2012) found a significant positive relationship between bank deposit loans and advances and agricultural production in Nigeria. Also Ogbanje et al. (2012) and Agunuwa et al. (2015) confirmed a positive relationship between commercial bank credit and agricultural production in Nigeria. In the same vein, Ibe (2014) found that credit from commercial banks to the agricultural sector, government financial allocations to agriculture and prices of agricultural products are significant factors affecting agricultural production in Nigeria. Similarly, Ammaini (2012) found that formal credit has a positive and significant association with crop production in Nigeria. Nnamocha and Eke (2015) showed that bank credit contributed greatly to agricultural production in Nigeria in the long run. Udoka et al. (2016) confirmed a positive and significant relationship between the Agricultural Credit Guarantee Fund and agricultural production in Nigeria. They also found that loans from commercial banks to the agricultural sector had a significant impact on agricultural production, while there was a negative relationship between interest rate and agricultural production. Orok and Ayim (2017) established a positive and significant relationship between the Agricultural Credit Guarantee Scheme Fund (ACGSF) and the crop sector in Nigeria. Furthermore, Olowofeso et al., 2017) confirmed that positive changes in agricultural credit trigger growth in agricultural production in Nigeria. In the same vein, Ogbuabor and Nwosu (2017) point out that agricultural credit from deposit-taking banks has long-term positive and significant impacts on agricultural productivity. Asekome and Ikojie (2018) and Iliyasu (2019) found that lending interest rate has a negative impact on agricultural investment in Nigeria. Abdulrafiu and Dabo (2022)

found a significant positive relationship between government agricultural financing, commercial bank financing and crop production in Nigeria. While Adewale et al. (2022) submitted that bank credit has a significant positive effect on agricultural production and productivity in Nigeria. Salisu and Alamu (2023) claimed that commercial bank lending to agriculture and interest rate have a positive and statistically significant effect on agricultural production in Nigeria.

From the literature reviewed, it appears that the focus of this research in Nigeria is concentrated on the agricultural sector as a whole, while the sub-sectoral growth is ignored. The crop production subsector contributes more than 50% of agricultural GDP and should be given priority. Furthermore, much has changed in Nigeria's macroeconomic environment in the last decade and the human development indices have deteriorated further while the attainment of the SDGs number 2 is becoming more difficult (Adedokun,2021; Shaibu,2020). Given these indices, the country urgently needs proactive policy interventions. Nigeria fundamentally being agrarian society, there is a need to update and re-examine the current information on the relationship between crop production and credit environment in Nigeria. The study was therefore particularly aimed at establishing the empirical relationship between the agricultural credit policy environment and production growth of crop sub-sectors in Nigeria.

2. Material and Method

2.1 Study Area

Nigeria is a country found in the tropical zone of West Africa in the Gulf of Guinea. The country is located between latitudes 4° and 14° north of the equator and longitudes 3° and 15° east. Nigeria is rich in agricultural resources and majority of her population is engaged in some forms of agricultural activities. Some of the notably crops produced in Nigeria include; rice, yam, cassava, cowpea, wheat, maize, sorghum, onions, tomatoes, melons and vegetables etc. Nigeria. The country is also rich in animal husbandry or production such as Poultry, ruminants; monogastric, snail production etc. The most important cash crops are cocoa, cotton, peanuts, palm oil and rubber (Federal Ministry of Environment, 2021).

2.2 Data Source

The study used secondary data from the World Bank, Central Bank of Nigeria and Food and Agriculture Organization (FAO). The data covered the period from 1991 to 2021. The choice of time period was based on data availability.

2.3 Model Specification/Analytical Technique

The contribution of the agricultural credit policy environment to the growth of the crop subsector (proxy by crop production index) in Nigeria is been implicitly stated in a Cobb-Douglas form as shown in Equation 1. The specification of the model followed the production theory. Acquired credit is assumed to be used to acquire factors of production such as labor, capital and land etc. According to Omolade and Adepoju (2019), agricultural credit is directly related to agricultural production factors. Implicitly, agricultural production is a function of agricultural credit. The estimated coefficients of the given model represent the elasticity. However, we consider different categories of credit that are directly or indirectly available to the agricultural sector. In the model, each credit variable was transformed by weighting to reduce the tendency for multicollinearity.

$$\mathrm{CRPI_t} = \mathrm{f}(\mathrm{CACL_t}, \mathrm{CAGR_t}, \mathrm{LENR_t}, \mathrm{DCPS_t}) \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots .. (1)$$

Where,

$CRPI_t$ = Crop gross production index (2014-2016 = 100) (%)

$CACL_t$	=	Guarantee loan for crop sub-sector/total fund guarantee by Agricultural Credit Guarantee Fund Scheme (%)
$CAGR_t$	=	Total credit to the agricultural sector from the commercial banks/economy GDP (%)
LENRt	=	National lending rate (%).
$DCPS_t$	=	Domestic credit to private sector (% of GDP)

The explanatory variables represent independent credit policy instruments implemented by the Nigerian government over the years. For example, the Agricultural Credit Guarantee Fund was established to guarantee funds/credit to farmers with the Central Bank of Nigeria acting as the sole guarantor (CACLt) (Umoren et al., 2016 and Umoren et al., 2018). Furthermore, the Federal Government of Nigeria had over the years required commercial banks to disburse a certain proportion of their total loans and advances to the agricultural sector (CAGRt). Additionally, the Central Bank of Nigeria has maintained a market-regulated lending interest rate in the country to moderate the volume of credit in the economy (LENRt). In addition, the central government has introduced a credit policy that incentivizes the financial sector to stimulate private investment in the real sector of the economy (DCPSt).

2.4 The Relationship between the Agricultural credit environment and Crop production growth

The Autoregressive Distributed Lag (ARDL) model was specified to determine the relationship between crop production growth and agricultural credit environment policy instruments. The ARDL-bound test technique (developed by Pesaran and Shin, 1999 and Pesaran et al., 2001) was used to confirm the presence of cointegration among series specified. After confirming cointegration, the short- and long-run models of crop production growth were estimated. The ARDL-bound model has some advantages compared to the two-stage method of Engle and Granger (1987) and the cointegration method developed by Johansen and Juselius (1990: 169). The ARDL-bound test method is used to handle series with mixed stationary problems (i.e. a mixture of 1(0) and 1(1)). Therefore, the assumption that all series must be integrated in the same order is relaxed. However, ARDL can also be applied to series that are stationary at the level or first difference. The next advantage is that ARDL test is relatively more efficient for small and finite sample data sizes. The method provided unbiased and sufficient estimates of the long-run model (Harris and Sollis, 2003). The bounds test is a simple technique because, unlike other multivariate co-integration methods, it allows the co-integration relationship to be estimated by OLS once the lag order of the model is identified.

The ARDL model forcrop production growth as specified in equation (1)in logarithm form is expressed as follows in equation 2:

$$\Delta CRPI_t = \vartheta_0 + \vartheta_1 \sum_{i=1}^{n_1} \Delta CRPI_{t-i} + \vartheta_2 \sum_{i=1}^{n_2} \Delta CACL_{t-i} + \vartheta_3 \sum_{i=1}^{n_3} \Delta CAGR_{t-i} + \vartheta_4 \sum_{i=1}^{n_4} \Delta LENR_{t-i} + \vartheta_5 \sum_{i=1}^{n_5} \Delta DCPS_{t-i} + \theta_1 CRPI_{t-i} + \theta_2 CACL_{t-i} + \theta_3 CAGR_{t-i} + \theta_4 LENR_{t-i} + \theta_5 DCPS_{t-i} + U_t \dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots..\dots..(2)$$

When using ARDL, the dependent variable is assumed to be a vector and this implies that equation 2 is also applied to the remaining variables specified in Equation 1. The coefficients from ϑ_1 to ϑ_5 are the short-run coefficients of ARDL, while θ_1 to θ_5 are the long-run coefficients. Also, ϑ_0 is the drift component, n is the maximum lag length, and U_t is the error term. The ARDL bounded F-statistic test was used to test for co-integration between the crop production gross index and credit policy variables. Test procedureS required that, if the calculated ARDL bound F-statistic is greater than the

tabulated upper critical limits by either of the conventional probability levels defined at 1%, 5%, or 10%, the null hypothesis is rejected, meaning the existence of co-integration relationship. The tested hypothesis is stated as follows:

$H_0: \delta_1 = \delta_2 = \delta_3 = \delta_4 = 0$ (There is no cointegration)

$H_a: \delta_1 \neq \delta_2 \neq \delta_3 \neq \delta_4 \neq 0$

However, if the value of the calculated ARDL F-statistic is below the lower limits, the null hypothesis cannot be rejected, indicating the absence of co-integration. Moreover, if the calculated ARDL F-statistic value is between the lower and upper bound limit, the result is considered inconclusive (Pesaran et al., 2001). If the bound test shows evidence of co-integration, the long- and short-run models are specified. Using the equation of interest to us, the long-term and short-term models used in the study are given in equation 3 and 4 respectively as follows:

The long run model:

$$CRPI_t = \vartheta_0 + \vartheta_1 CACL + \vartheta_2 CAGR_t + \vartheta_3 LENR_t + \vartheta_4 DCPS_t + \varepsilon_t \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots (3)$$

The short run model (ECM model):

$$\Delta CRPI_t = \theta_0 + \theta_1 \sum_{i=1}^{q_1} \Delta CRPI_{t-i} + \theta_2 \sum_{i=1}^{q_2} \Delta CAGR_{t-i} + \theta_3 \sum_{i=1}^{q_3} \Delta LENR_{t-i} + \theta_4 \sum_{i=1}^{q_4} \Delta DCPS_{t-i} + \theta_5 \sum_{i=1}^{n_5} \Delta CACL_{t-i} + \forall ECM_{t-1} + U_t \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots (4)$$

Where ∀ is the error correction term or the ECM. The coefficient measures the speed of adjustment of the short run model towards the long-run equilibrium, and the remaining coefficients measure the short-run dynamics. To test the reliability of the estimated short run model, the RESET test, serial correlation, normality and heteroscedasticity tests were conducted, whereas the cumulative sum (CUSUM) test was conducted to verify the stability nature of the model.

3. Results and Discussion

3.1 Descriptive Statistics

The descriptive statistics of the variables used in the analysis are presented in Table 1. The coefficient of variability of the variables was less than 50%, implying minimal fluctuations in the specified variables. For example, the lending interest rate and crop production index had a variability coefficient of 20.14% and 25.30%, respectively. The exponential growth rate values showed that the variables had a single-digit annual growth rate, implying minimal fluctuations within the study period. However, Agricultural Credit Guarantee Scheme Fund for Crop Subsector Beneficiaries (CACLt) and Lending Interest Rate (LENRt) recorded negative annual exponential growth rate of -1.68% and -1.59% respectively.

Table 1. Descriptive Statistics of Variables Used in the Estimated Models

Variable	*Min*	*Max*	*Mean*	*Std. deviation*	*CV*	*Skewness*	*Exponential growth rate (%)*
CRPI	45.260	112.62	78.913	19.972	0.253	0.111	2.840
CACL	47.867	88.200	72.854	12.876	0.177	-0.479	-1.680
CAGR	15.824	76.661	43.488	19.647	0.452	0.193	4.710
LENR	11.483	31.650	18.739	3.7735	0.201	1.294	-1.590
DCPS	5.2411	19.626	10.446	3.4607	0.331	0.880	2.690

Source: *Computed by the author data from the FAO and World Bank.*

3.2 Unit root test

The study used the ADF unit root test developed by Dickey and Fuller (1979) and the ADF-GLS unit root test developed by Elliott et al., (1996) to confirm the unit root of specified variables. The results for the ADF and ADF-GLS unit root tests are presented in Table 2. The results showed that two variables ($CRPI_t$) and ($LENR_t$) were stationary at the level; while others were stationary at the first difference for the ADF equation containing constant and trend.

Table 2. ADF and ADF-GLS unit root tests on variables used in the specified equation

	ADF-GLS (with constant and trend)				ADF(with constant and Trend)			
	LLag	Level	1st Diff.	Dec.	Lag	Level	1st Diff.	**Dec.**
$CRPI_t$	0	-3.4192**	-	1(0)	0	-3.289*	-10.0946	1(0)
$CACL_t$	0	-1.6488	-4.7889***	1(1)	0	-1.5304	-4.6141***	1(1)
$CAGR_t$	0	-2.9062	-6.1434***	1(1)	0	-2.9158	-5.9859***	1(1)
$LENR_t$	0	-3.2602**	-	1(0)	0	-3.1941	-5.7211***	1(1)
$DCPS_t$	0	-2.7776	-4.7252***	1(1)	0	-2.8146	-5.2125***	1(1)
	Critical values				Critical values			
1%		-3.7700	-3.7700		1%	-4.2967	-4.3098	
5%		-3.1900	-3.1900		5%	-3.5684	-3.5742	
10%		-2.8900	-2.8900		10%	-3.2184	-3.2217	

Source: computed by the author. Note: ***, ** and * indicate 1%, 5%and 1% significance levels respectively. Note, variables are expressed in natural logarithm. Dec. means decision.

However, for the ADF-GLS equation with constant and trend, all specified variables were stationary at the first difference. Since the result gave a mixture of stationarity of the specified variables (i.e. 1(0) and 1(1)), it implies that the ARDL model can be used to test the co-integration in the given model.

3.3 The optimal lag length of the ARDL Model

Before estimating the ARDL model, the optimal lag length for the series were determined using the appropriate information criteria, i.e. Akaike information criterion (AIC), Schwarz-Bayes criterion (SBC) and Hannan-Quinn criterion. The corresponding lag length is shown in Table 3. The result showed that lag3 is the best lag for the ARDL model. Figure 3 shows 20 computed ARDL models based on AIC criterion.

Table 3: Optimal lag length of series

Lags	*Loglik*	*P(LR)*	*AIC*	*BIC*	*HQC*
1	*32.467*	*-*	*-2.301*	*-2.005*	*-2.227*
2	*40.059*	*0.000*	*-2.875*	*-2.529**	*-2.788*
3	*41.431*	*0.098*	*-2.907**	*-2.512*	*-2.808**
4	*41.634*	*0.524*	*-2.838*	*-2.393*	*-2.726*
5	*42.404*	*0.214*	*-2.818*	*-2.324*	*-2.694*

Note: The asterisks below indicate the best (that is, minimized) values of the respective information criteria, AIC = Akaike criterion, BIC = Schwarz Bayesian criterion and HQC = Hannan-Quinn criterion.

3.4 The ARDL bound test for cointegration

The bound test was used to confirm the presence of cointegration among specified variables in the model. The calculated F-statistic for the selected equation (6.1915) is shown in the upper part of Table 4. The result implies that the calculated F-test at the 1% probability level is greater than the tabulated upper bound of 4.37.

Table 4: ARDL Bound Test (Restricted Constant and No Trend)

Equations	Lag	F-Statistic	Decision
F_{LISPt}(LISPt|ACGLt, CAGRt, LENRt, DCPSt)	(2, 3, 3, 2, 3)	6.1915	Co-integration
Significant level	Lower (1(0)	Upper 1(1)	
10%	2.20	3.09	
5%	2.56	3.49	
2.5%	2.88	3.87	
1%	3.29	4.37	
Critical Values at Bound (at K = 4 and Finite sample: n = 35			
10%	2.46	3.46	
5%	2.947	4.088	
1%	4.093	5.532	

Source: Extracted from analysis. Actual sample size (n) =28. Null hypothesis: No level relationship.

This means that there is co-integration exists between crop production and the specified macroeconomic variables. The null hypothesis is rejected in this case. The bound test results implies the following: for the specified crop production equation, the long-run equilibrium or stability equation exists. Furthermore, the short-run or ECM model was generated to capture the short-run dynamics and identify the speed of adjustment in response to the deviation from the long-run equilibrium. After establishing cointegration for the specified variables, Table 5 shows the long-run coefficients or parameters for the ARDL model.

3.5 The estimated long run coefficients of ARDL model

The long-run results showed that the total credit to the agricultural sector (CAGRt) has a positive significant elastic relationship with the crop production index with a probability of 1%. This result implies that an increase in total agricultural sector credit per unit will lead to a 2.51% increase in crop production index in Nigeria. This means that the aggregate change in crop production is larger than the aggregate change in total credit to the agricultural sector. The finding meets the a priori expectation since credit is known to stimulate crop production. The crop production subsector is known to play a dominant role in the country's agricultural production. However, the sub-sector still contributes more than 50% of the agricultural GDP and is always a preferred sub-sector for government or non-government interventions in the country. However, the finding confirms the importance of agricultural credit to farmers and the crop production landscape in Nigeria. The finding is comparable to empirical reports by Imoisi et al. (2012); Ammaini (2012); Ibe (2014); Agunuwa et al. (2015); Nnamocha and Eke (2015); Ogbuabor and Nwosu (2017); Abdulrafiu and Dabo (2022); Adewale et al. (2022); Salisu and Alamu (2023).

Table 5: The Long- run Coefficients for Crop production index equation

Variable	Coefficient	Standard error	t-value	Probability
$LENR_t$	0.067954	0.763242	0.089033	0.9308
$DCPS_t$	-3.263960	1.149465	-2.839547**	0.0176
$CACL_t$	0.939315	0.513625	1.828795*	0.0891
$CAGR_t$	2.511998	0.759016	3.309544***	0.0079
Constant	-1.362059	2.776845	-0.490506	0.6344

Source: computed by the author. Note: ***, and ** indicate 1% and 5% significance level respectively. Note, variables are expressed in natural logarithm.

The results also showed that the guarantee loan to crop enterprises/farmers from the Agricultural Credit Guarantee Scheme Fund (CACLt) has a positive significant correlation with the crop production index in the long run with a probability of 10%. This suggests that an increase in the guarantee loan for the crop production subsector will increase the crop production index by 0.939%.

It is also known that the crop production sub-sector dominates other sub-sectors in the agricultural sector in terms of the number of beneficiaries of the ACGSF. The finding suggests that the Agricultural Credit Guarantee Scheme Funds (ACGSF) have contributed significantly to the growth of crop production in the country. The finding substantiates the reports of Udoka et al. (2016); Orok and Ayim (2017); and Abdulrafiu and Dabo (2022).

The slope coefficient of domestic credit to the private sector has a significant negative relationship with the crop production index in Nigeria. The result revealed that an increase in domestic credit to the private sector would lead to a 3.264% decline in the country's crop production index. Alternatively, an increase in domestic credit to the private sector would reduce the crop production index in Nigeria. The conclusion from this finding is that the crop production sub-sector is not a preferred investment area for the private sector in Nigeria. The finding calls for the provision of sufficient investment incentives in the crop production sub-sector to enable an increase in private investment in the subsector in the country. The finding is consistent with the reports of Ammaini (2012); Nnamocha and Eke (2011); Olowofeso et al. (2017); Abdulrafiu and Dabo (2022) and Adewale et al. (2022).

3.6 The estimated short run coefficients of ARDL model

The result in Table 6 shows estimates of the error correction representation of the ARDL model. The ECM coefficient is negative and statistically significant at 1% probability level. This confirms the existence of cointegration between the crop production index and the specified macroeconomic variables. The coefficient of the ECM represents the speed of adjustment in the long-run equilibrium after short-run shocks. This shows that annually about 23.85% of the short-run disequilibrium is adjusted towards its long-run equilibrium. Alternatively, about 23.85% of the imbalances from the previous year's shock converge back to the long-run equilibrium in the current year. The diagnostic tests for the ECM model produced an R^2 value of 0.8764, indicating that the agricultural credit policy variables explained about 87.64% of the adjusted total variations in crop production index in the country.

The empirical result showed that the total credit provided for the agricultural sector at current level has a positive and significant impact on crop production in Nigeria in the short run. For example, a 100% increase in total credit to the agricultural sector will positively change the crop production index by 21.13% in the short run. This means that an increase in current total credit to the agricultural sector would increase current crop production in the short run. The result confirms the stimulating role of agricultural credit in crop production in the short run. However, lag 1 and lag 2 of total credit to the agricultural sector had a negative impact on crop production in the short run. However, the finding is corroborates Ammaini (2012); Ibe (2014); Agunuwa et al. (2015); Nnamocha and Eke (2015); Ogbuabor and Nwosu (2017); Abdulrafiu and Dabo (2022); Adewale et al. (2022); Salisu and Alamu (2023).

Tale 6: The Short - run Coefficients for crop gross production Index equation (Restricted constant)

Variable	Coefficient	Standard error	t-value	Probability
D(CRPI(-1))	-0.677337	0.121338	5.582224***	0.0002
D(LEN)	-0.181745	0.062709	-2.898244**	0.0159
D(LEN(-1))	-0.224068	0.066280	-3.380619***	0.0070
D(LEN(-2))	-0.175642	0.047318	-3.711984***	0.0040
D(DCPS)	-0.449285	0.057967	-7.750733***	0.0000
D(DCPS(-1))	0.348335	0.068698	5.070561***	0.0005
D(DCPS(-2))	0.184392	0.060007	3.072857***	0.0118
D(CACL)	0.229869	0.103290	2.225479**	0.0502
D(CACL(-1))	0.220186	0.097496	2.258421**	0.0475
D(CAGR)	0.211274	0.040854	5.171481***	0.0004

D(CAGR(-1))	-0.247500	0.059916	-4.130777***	0.0020
D(CAGR(-2))	-0.083322	0.044273	-1.881995*	0.0892
ECM (-1)	-0.238542	0.031955	-7.464873***	0.0000
Diagnostic Test				
R-Squared	0.876374	Durbin-Watson stat	1.996946	

Source: computed by the author. Note: ***, and ** indicate 1% and 5% significance level respectively. Variables are expressed in natural logarithm difference. ARDL (2, 3, 3. 2, 3) selected based on Akaike info criterion.

The current value of the guarantee loan for the crop subsector by ACGSF and the previous year's value of the loan showed a significant positive relationship with crop production in the short run. This finding implies that a unit increase in the current value of the loan guarantee for crop subsector's beneficiaries, would lead to 0.229 unit increases in crop production index in the country. Similarly, a unit increase in the previous value of agricultural credit guarantee scheme fund for crop subsector would stimulate crop production index by 0.211%. The crop sub sector is considered as the preferred subsector in ACGSF program. The crop sector has the most beneficiaries and receives the largest share from the scheme fund. These results are similar to the long-run relationship. The finding confirms the reports of Udoka et al. (2016); Orok and Ayim (2017); and Abdulrafiu and Dabo (2022).

The coefficient of lending interest rate at level, lag 1 and lag 2 has a significant negative relationship with crop production index in the short run. For example, a 10 percent increase in the lending rate at level, lag 1, and lag 2 would result in an increase in the crop production index of 1.82%, 2.24%, and 1.76%, respectively. This means that as lending interest rate rise, crop production declines accordingly. The result corresponds to the a priori expectation. The result means that crop production in the country is highly dependent on exogenous factors such as credit. The finding is consistent with the reports of Udoka et al. (2016); Asekome and Ikojie (2018); Salisu and Alamu (2023).

Furthermore, the coefficients of domestic credit to the private sector in the current year showed a negative significant association with the crop production index in Nigeria. The result showed that with an increase in domestic credit to the private sector, the crop production index would decrease by 0.449% in the current year. This result is consistent with the long-run estimates. The plausible reason is the reluctance of the private sector to invest in the crop production sub-sector and the risk associated with crop production. On the contrary, lags 1 and 2 of domestic credit to the private sector are positively correlated with the crop production index in the short run. It is possible that the previous incentives and the state of the macroeconomic environment promoted investments in the crop sub-sector in the past periods. The finding is supported by the empirical results of Salisu and Alamu (2023).

3.7 Diagnostic test of the short run model

From the result, the value of Breusch-Godfrey serial correlation (LM test) (0.499) was not significant at the conventional probability levels. This indicates the insignificant of serial correlation of the residuals in the estimated short-run model. The ECM model has proven to be robust to residual autocorrelation. Therefore, the presence of serial autocorrelation does not affect the estimates (Laurenceson and Chai, 2003: 160). In addition, the null hypothesis was not rejected for the RESET test, the Breusch-Pagan test of heteroscadasticity, the normality test and the CUSUM test. This means that the estimated ECM model has structural rigidity, no heteroscedasticity, a normally distributed error term, and is stable within the specified time frame.

Table 7: Diagnostic Statistics

Test	Value	Probability
Ramsey RESET Test	2.76169	0.1309
Normality test (Jarque-Bera)	2.04794	0.359
Heteroscedasticity (Breusch-Pagan-Godfrey)	0.41062	0.949
Breusch-Godfrey Serial Correlation LM Test	0.49989	0.624

Note: prepared by authors.

3.8 Test of the Stability of the ARDL ECM

The cumulative sum (CUSUM) and cumulative sum of squares (CUSUMQ) plots derived from the recursive estimation of the ARDL-ECM model are shown in Figures 1 and 2, respectively.

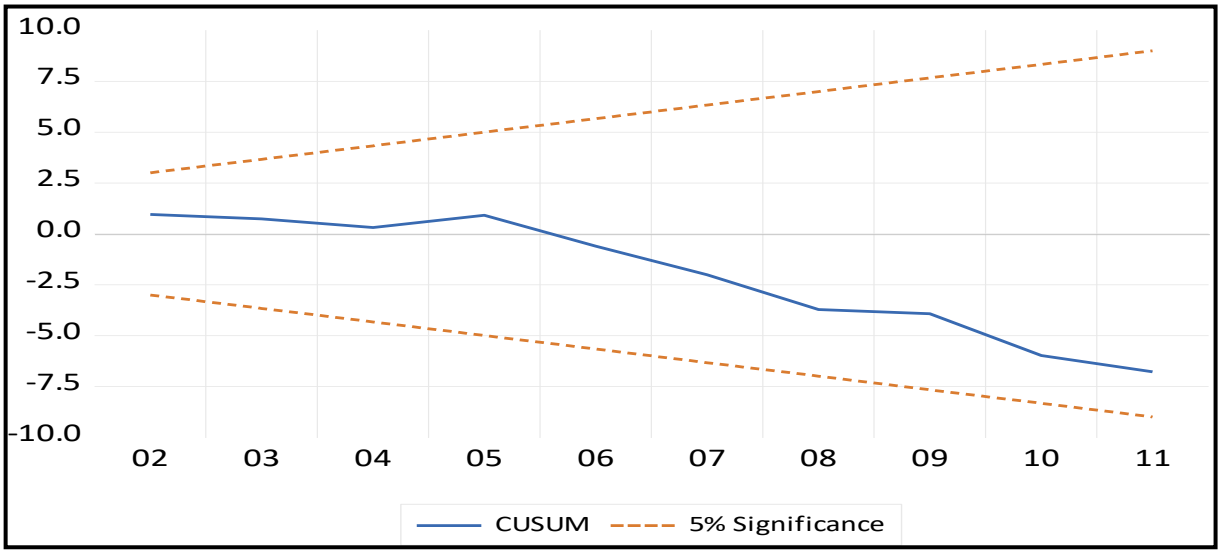

Figure 1: Plot of CUSUM for coefficients' stability of ARDL mode

The results indicate stability of the ARDL-ECM coefficients over the sample period, as the representation of the CUSUM and CUSUMSQ statistics lies within the critical bands of the 5% confidence interval (or 95% probability levels) of parameter stability.

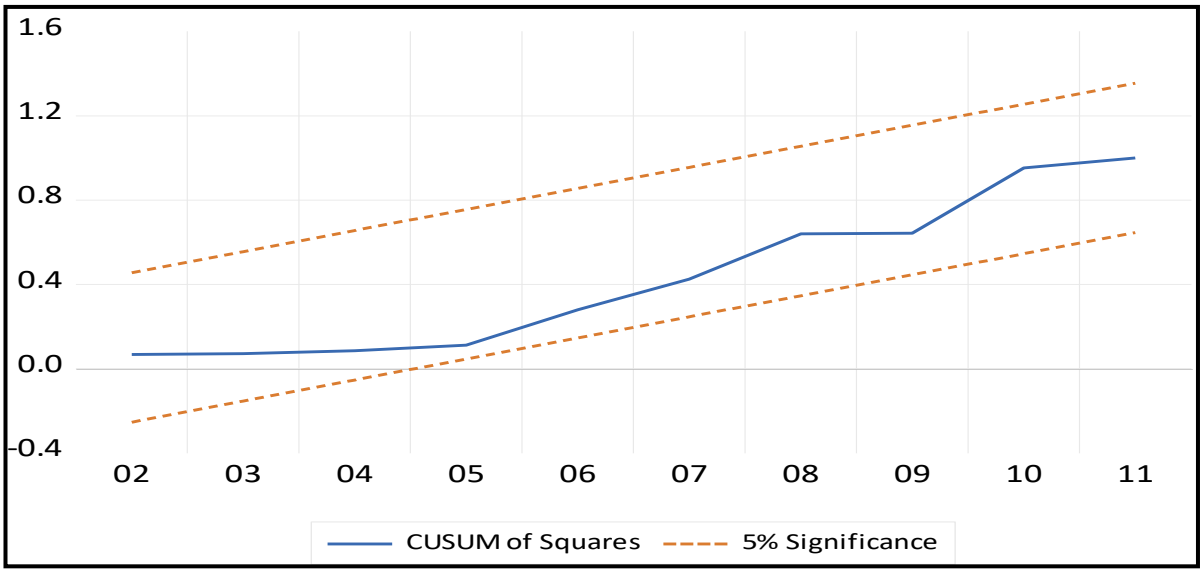

Figure 2: Plot of CUSUMSQ for coefficients' stability of ARDL model.

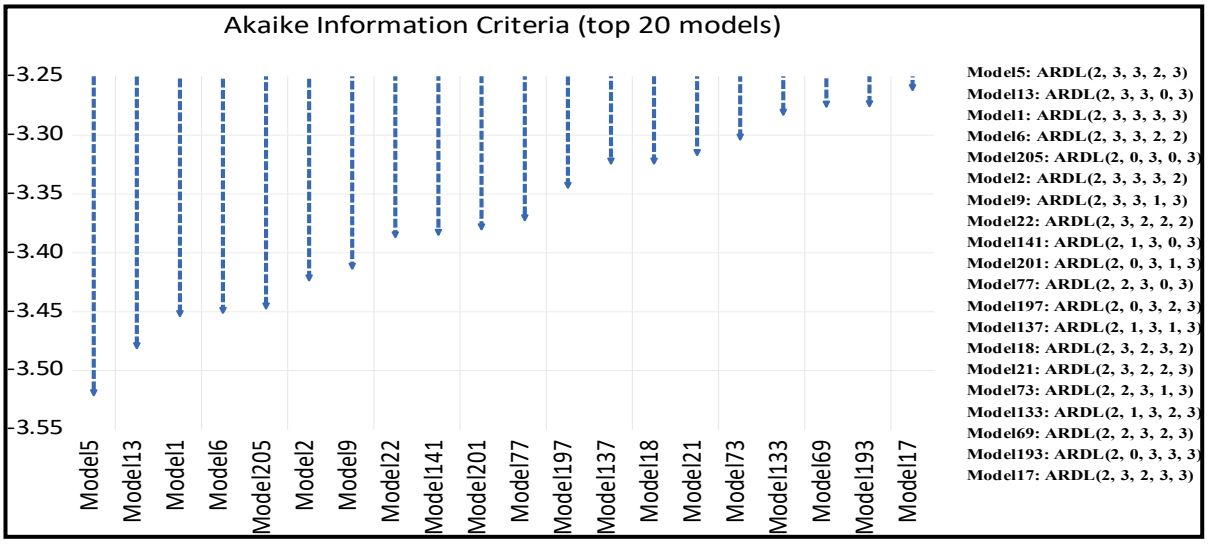

Figure 3:| Akaike information criteria graph

4. Conclusion and Recommendations

The objective of the study was to establish an empirical relationship between some agricultural credit policy variables and the growth of the crop production sub-sector in Nigeria. The study used time series obtained from the World Bank (WB), Food and Agriculture Organization (FAO) and Central Bank of Nigeria (CBN). The ADF and ADF-GLS methods were used to check the stationary or unit root of specified series. The estimated results of ADF and ADF-GLS showed that some variables were stationary at the I(0) level, while others were stationary at the first difference 1(1). The autoregressive distributed lag (ARDL)-linked cointegration test was used to analyze the data for the presence of cointegration. After confirming the cointegration of the specified variables, the long- and short-term models of the crop production index equation were estimated with the error term having the appropriate sign and being statistically significant at the 1% probability level. The results showed that total credit to the agricultural sector had a positive and significant impact on crop production in both the long and short run periods. However, in the short run, the first and second lags in total credit to the agricultural sector showed a negative significant correlation with crop production. In addition, the Agricultural Credit Guarantee System loan allocated to the crop production subsector had a significantly positive association with the crop subsector production in both the short and long run periods. The lending interest rate had a significant negative relationship with the crop production index in the country in the short run. Furthermore, total domestic credit to the private sector showed a significant negative association with crop production in the short run. The results suggest that credit policy variables have a significant impact on the production of the crop subsector in Nigeria.

Based on these empirical facts and the need to increase crop production in Nigeria, it is recommended that overall credit to the agricultural sector be increased to provide more incentives to farmers to increase crop production. Furthermore, strategic incentives should be implemented in the crop sub-sector to attract sufficient domestic credit from the private sector of the economy. Also, the current lending interest rate in the country should be reduced to improve credit access for crop farmers in the country. As a strategy to boost crop production in the country, the Agricultural Credit Guarantee Scheme loan should be increased for the crop sub-sector beneficiaries.

Acknowledgments

The research team appreciate their faimilies, colleagues and friends for their useful contribution and critisms during the period for this resarch work.

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