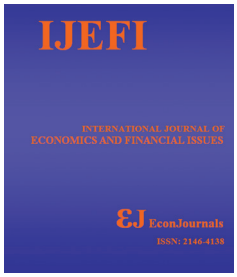

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The Impact of Deposit Money Bank's Agricultural Credit on Agricultural Productivity in Nigeria: Evidence from an Error Correction Model

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ABSTRACT

This paper examined the impact of deposit money bank agricultural credit on agricultural productivity in Nigeria using an error correction model and annual time series data for the period 1981-2014. The results indicate that an equilibrium relationship exists between the variables. In addition, we find that deposit money bank's agricultural credit impacts positively and significantly on agricultural productivity in the long-run, but this impact is quite negligible in the short-run. We also find that agricultural land and labour force impact negatively on agricultural productivity both in the long-run and short-run. However, the impact of climate change variables, namely annual rainfall and average temperature remained negligible throughout. The paper therefore supports policies that will enhance and sustain the availability of bank credits at affordable interest rates for the agricultural sector, ensure easy access to land for agricultural purposes, and mechanize the agricultural system to attract the youth population.

Keywords: Deposit Money Bank, Agricultural Credit, Agricultural Productivity, Error Correction Model, Nigeria
JEL Classifications: E51, Q14, O13, C22, N57

1. INTRODUCTION

Agriculture is the science or practice of farming, including cultivation of the soil for the growing of crops and the rearing of animals to provide food, wool and other products. It is as old as man. It is also an important development in the rise of sedentary human civilization, whereby farming of domesticated species created food surpluses that nurtured the development of civilization. It is the first occupation of mankind. Agriculture is a major branch of the Nigeria economy, providing employment for about 70% of the labour force. Nigerian agriculture is characterized by considerable regional and crop diversity. In 1990, 82 million hectares out of Nigeria's total land area of about 91 million hectares were found to be arable. Much of this land was farmed under the bush fallow system, whereby land is left idle for a period of time to allow natural regeneration of soil fertility. 18 million hectares were classified as permanent pasture, but had the potential to support crops. Most of the 20 million hectares covered by forests and woodlands are believed to have agricultural potential.

In the 1960's, the agricultural sector was the most important in terms of contributions to domestic production, employment and foreign exchange earnings (National Bureau of Statistics, 2014). Agriculture contributed 32% to gross domestic product (GDP) in 2001. Agricultural holdings are generally small and scattered, characterized by simple farm tools and shifting cultivation. These small farms produce about 80% of the total food. The situation remained almost the same three decades later with the exception that it is no longer the principal foreign exchange earner, a role now being played by oil. The agricultural sector remained stagnant during the oil boom decade of the 1970's, and this is accounted largely for the declining share of its contributions. The trend in the share of agriculture in the GDP shows a substantial variation and long-term decline from 60% in the early 1960's through 48.8% in the 1970's and 22.2% in the 1980's. Unstable and often inappropriate economic policies, the relative neglect of the sector and the negative impact of oil boom were also important factors responsible for the decline in its contributions (Philip et al., 2009).

In recent times, there have been different policies developed by the government to help in financing the agricultural sector in Nigeria in order to boost productivity. Some of the policies include the Nigerian Agricultural and Co-operative Bank which was established in the year 1973 as part of government efforts to inject oil wealth into the agricultural sector through the provision of credit facilities to support agriculture and agro-allied industries. Also the Rural Credit Scheme was introduced in 1977 by the Central Bank of Nigeria, whereby commercial banks were required to open rural branches. The Agricultural Credit Scheme was also set up in 1977 with the primary aim of inducing banks to increase and sustain lending to agriculture. There are other policies which were set up by the federal government and linked up with commercial banks for the purpose of encouraging the farmers to produce more food such as National Food Security Programme, Special Programme on Food Security Programme and Fadama which are introduced to diversify agricultural products into other uses. Another great measure for improving the flow of credit to the agricultural sector was an attempt to improve the credit mix by lending in the form of cash and in kind to farmers. These measures are based on the realization that a strong and growing agricultural sector has the potential to enable a country feed its growing population, generate employment, earn foreign exchange and provide raw materials for industries. Growth in agricultural production is necessary not only to increase food availability and nutrition levels of the population; it is essential to the development process (Colman and Young, 1989).

Nonetheless, the agricultural sector in Nigeria is still faced with the problem of accessibility to funds. With the introduction of new technology which promotes higher productivity there is need for credit. In Nigeria today these credits needed for the purchase of new technology are not available and this jeopardizes output growth and hence the farmers resort to subsistence farming. Even when the credits are available the lending rates tend to very high and hence making borrowing difficult and discouraging the farmers. Also there is no collateral for these credit since most people engaged in agriculture are mostly rural dwellers. Hence, this work seeks to examine the relationship between commercial bank credit and on agricultural productivity in Nigeria. The specific objectives are: (i) To ascertain the impact of agricultural credit on agricultural productivity in Nigeria, (ii) to ascertain the impact of climate change and other agricultural inputs such as labour force and agricultural land on agricultural productivity in Nigeria, (iii) to determine the direction of causality between agricultural credit and agricultural productivity in Nigeria. Here, agricultural productivity, which means the ratio of agricultural output to agricultural input is measured using agricultural value added.

2. AN OVERVIEW OF THE LITERATURE

Several theories are relevant for this study. The credit channel theory explains that central banks' policy changes affect the amount of credit that deposit money banks issue to firms and consumers, which in turn affects the real economy. The quantity theory of credit distinguishes between GDP-transactions (i.e., productive transactions) and non-GDP transactions (i.e., unproductive transactions) so that the effect of bank credit depends on its quantity and quality, the latter being whether it is used for unproductive transactions or productive transactions (Nnamocha and Eke, 2015; Werner, 1993). The Bank Lending Channel explains that monetary policy works by affecting bank assets (loans) and liabilities (deposits) so that monetary policy besides shifting the supply of deposits also shifts the supply of bank loans. The balance sheet theory posits that the size of the external finance premium should be inversely related to the borrower's net worth such that the greater the net worth of the borrower, the more likely he may be able to use self-financing as a means to fund investment (Bernake et al., 1996). The Cobb-Douglas production function is widely used to represent the technological relationship between amounts of two or more inputs, particularly physical capital and labor and the amount of output that can be produced by these two inputs so that bank credit affects agricultural output through the finance of physical capital.

The bulk of the empirical literature for Nigeria indicates that there is a positive relationship between agric credits and agric productivity in Nigeria, though sometimes not significant. Using OLS, Agunuwa et al. (2015) finds that there is a positive relationship between commercial banks' credit and agricultural productivity in Nigeria. Similarly, Ogbanje et al. (2012) studied the effect of commercial banks' loan on agricultural GDP in Nigeria over the period 1981-2007 and find that commercial banks' loan significantly and positively affects agricultural GDP. Furthermore, Obilor (2013; 2014) have also made remarkable contributions. Specifically, Obilor (2013) finds that Agricultural Credit Guarantee Scheme Fund in Nigeria affected agricultural productivity positively and significantly. Using annual data for 1970-2013 and an error correction model (ECM), Nnamocha and Eke (2015) finds that bank credit affects agricultural output in Nigeria only in the long-run. Ibe (2014) examined the impact of bank and public sector financing activities on agricultural output in Nigeria. The results show that commercial bank credit to agricultural sector, government financial allocation to agriculture and agricultural product prices are significant factor that influence agricultural productivity in Nigeria. Ubah (2009) investigated the impact of agricultural credit on agricultural output in Nigeria using an ECM. The study finds that agricultural credits have insignificant positive effect on agricultural output in Nigeria. It is the goal of this study to re-examine the impact of deposit money bank loans to the agricultural sector on agricultural productivity in Nigeria. However, unlike the studies examined above, this study will also examine the roles of climate change and other input factors.

Agricultural credit has also been shown to affect agricultural productivity in other countries. Girabi (2013) examined the impact of microfinance on smallholder farm productivity in Tanzanian and finds that agricultural credit beneficiaries have higher agricultural productivity than non-credit beneficiaries. Ahmad (2011) used Granger causality analysis to show that credit plays a significant role in the agricultural sector in Pakistan. Baffoe et al. (2014) studied the relationship between credit and agricultural production in Ghana. The results show that farmers that have access to credit had larger average profit is larger while their profitability is statistically different from farmers that do not have access to credit. Chisasa and Makina (2013) analyzed the impact of bank credit

on agricultural output in South Africa using the Cobb-Douglas production. The results indicate that bank credit has a positive and significant impact on agricultural output in South Africa. Chandio et al. (2016) analyzed the impact of formal credit on agricultural output in Pakistan by using secondary data from 1996 to 2015. The findings show that formal credit has a positive and significant impact on agricultural output. However, Alvaro et al. (2012) used panel data from surveys conducted in 2006 and 2008 to study the impact of access to credit on farm production of fruit and vegetable growers in Chile. The findings show that short term credit does not have an impact on agricultural productivity.

3. DATA AND METHODOLOGY

The data consists of annual time series observations for the period 1981-2014. The variables of interest are: Agricultural value added per worker, AVA, measured in constant 2010 US$ (proxy for agricultural productivity); deposit money bank credit to the agricultural sector, DMC (measured in billions of naira); agricultural labour force, ALF (measured as number of economically active population in the agricultural sector); annual rainfall, ARF (mm per year); annual temperature, TEMP (measured in °C); and agricultural land, LAND (measured in sq. km.). Here, annual rainfall and annual temperature are used as climate change variables. The data were collected from the CBN Statistical Bulletin, 2014; the World Development Indicators; EconStats (www.econstats.com) and the Nigerian Meteorological Agency (NIMET). To achieve robust estimates, reduce the effect of noise and ensure that the estimated parameters can be interpreted economically, the entire dataset was logged prior to estimation.

Following Agunuwa et al. (2015) and Nnamocha and Eke (2015), the model that captures the first two specific objectives of this study can be specified in its implicit form as follows:

$$AVA = f(DMC, ALF, ARF, TEMP, LAND) \quad (1)$$

The model in equation 1 can be expressed in its mathematical form as follows:

$$AVA = \alpha+\beta_1 DMC+\beta_2 ALF+\beta_3 ARF+\beta_4 TEMP+\beta_5 LAND \quad (2)$$

Where: α is the intercept, and b's are parameters to be estimated. Equation 2 can also be specified econometrically by including the error term as follows:

$$AVA = \alpha+\beta_1 DMC+\beta_2 ALF+\beta_3 ARF+\beta_4 TEMP+\beta_5 LAND+\varepsilon \quad (3)$$

It must be emphasized that the model in equation 4 will be estimated in its error correction form if the preliminary data analysis indicates that a stable long-run relationship exists among the variables.

As proposed by Granger (1969), causal relationships are useful in understanding how an economic variable can be used to forecast another economic variable. Accordingly, the last specific objective of this study seeks to determine the direction of causality between agricultural credit and agricultural productivity in Nigeria. If we let DMC and AVA denote the logged agricultural credit and agricultural value added respectively, then the Granger-causality model may be written as follows:

$$AVA_t = \sum_{i=1}^{q} a_i DMC_{t-i} + \sum_{j=1}^{q} b_j AVA_{t-j} + e_{it} \quad (4)$$

$$DMC_t = \sum_{i=1}^{q} l_i DMC_{t-i} + \sum_{j=1}^{q} g_j AVA_{t-j} + e_{2t} \quad (5)$$

Where, α_i and λ_i are coefficients of DMC, while β_j and γ_j are coefficients of AVA.

4. EMPIRICAL RESULTS AND DISCUSSION

This empirical analysis started with tests of stationarity on all the variables, using both the ADF unit root test and the Phillips-Perron unit root test procedures. With the lag length selected automatically by Schwarz Information Criteria and including trend and intercept, the results of these tests are shown in Table 1. The results indicate that except for agricultural labour force and average annual temperature, all the variables are integrated of order one, that is, stationary after first difference. These results suggest that there may be a stable long-run relationship between the variables since the agricultural productivity variable has the same order of integration with majority of the variables.

To ascertain if indeed a stable long-run relationship exists between the variables, this study conducted the Johansen test for cointegration. The results are shown in Table 2. Both the trace test and the max-Eigen test indicate the existence of at least three cointegration equations. In essence, both tests point towards the existence of a stable long-run relationship. To ensure that this cointegration result is not spurious, we conducted a robustness check using the residual approach. First, we estimated the presumed long-run relationship between the variables and generated the residual. Second, we subjected the residual to ADF unit root test. The result shows that the residual is stationary at levels, thereby confirming our earlier finding of a cointegrating relationship between the variables. Following the establishment of this equilibrium relationship, we then proceeded to estimate the long-run relationship using the robust OLS estimation technique underlined by the Newey-West HAC method. This is to ensure that potential problems of residual serial correlation and Heteroscedasticity are avoided.

The results of our long-run estimation are shown in T**able** 3. We summarize the main findings as follows. First, we find that

Table 1: Unit root test results

Variable	ADF	Phillips-Perron	Result
AVA	I (1)	I (1)	I (1)
DMC	I (1)	I (1)	I (1)
ALF	I (2)	I (2)	I (2)
LAND	I (1)	I (1)	I (1)
ARF	I (1)	I (1)	I (1)
TEMP	I (0)	I (0)	I (0)

I (0), I (1) and I (2) denote stationary at level, after first difference and after second difference, respectively. The unit root tests were performed at 5% level controlling for trend and intercept and using the natural logs of the variables

Table 2: Johansen cointegration test results

Hypothesized no. of CE (s)	Trace statistic	5% Critical value	P value	Hypothesized no. of CE (s)	Max-Eigen statistic	5% Critical value	P value
None*	175.7791	95.7537	0.0000	None*	74.8388	40.0776	0.0000
At most 1*	100.9403	69.8189	0.0000	At most 1*	44.6525	33.8769	0.0018
At most 2*	56.2878	47.8561	0.0066	At most 2*	31.2994	27.5843	0.0159
At most 3	24.9885	29.7971	0.1618	At most 3	16.9322	21.1316	0.1752
At most 4	8.0563	15.4947	0.4594	At most 4	6.1858	14.2646	0.5895
At most 5	1.8704	3.8415	0.1714	At most 5	1.8704	3.8415	0.1714

Note: The * indicates that the Trace statistic or the Max-Eigen statistic is greater than the corresponding 5% critical value.

Table 3: Robust long-run estimation results for equation 3 (dependent variable=AVA)

Variable	Coefficient	Diagnostic checks	
Constant	259.77**	Adjusted R-squared	0.91
DMC	0.43***	F-statistic	68.42***
ALF	−24.54**	Durbin-Watson statistics	0.86
LAND	−3.27***	Breusch-Godfrey test [observed χ^2]	12.44***
ARF	0.51	Breusch-pagan-Godfrey test [observed χ^2]	7.17
TEMP	5.96*	Jarque-Bera	0.83

The reported standard errors are Newey-West corrected standard errors. ***.** and *denote significance at 1%, 5% and 10% levels; respectively. Breusch-Godfrey Test and Breusch-Pagan-Godfrey Test are the standard tests for autocorrelation and heteroscedasticity, respectively

agricultural credit impacts positively on agricultural productivity in Nigeria. Indeed, the results show that this impact is significant even at the 1% level. This result is quite interesting and suggests that agricultural productivity in Nigeria can be boosted through adequate funding. Second, we find that our climate change variables (i.e. annual rainfall and annual temperature) impact positively on agricultural productivity in Nigeria. However, while the impact of rainfall is not statistically significant, that of annual temperature is significant only at the 10% level. These results are very informative since they show that Nigeria has a very clement climate that is supportive of agricultural production. Third, we find that agricultural land impacts negatively but significantly on agricultural productivity in Nigeria. The negative impact can be explained by the land ownership system in Nigeria which makes it difficult for people to acquire land for agricultural purposes. Fourth, we find that agricultural labour force impacts significantly but negatively on agricultural productivity in Nigeria. This result is not too surprising because agricultural activities in Nigeria are still predominantly at the subsistence level such that human labour is still a key input to production. However, the nature of the labour force is such that it comprises mainly of old and tired hands since most young people, especially university graduates, hardly join the agricultural sector.

The diagnostic checks reveal that the underlying assumptions of our OLS estimation have been adequately satisfied. The Breusch-Pagan-Godfrey Test for heteroskedasticity shows that there is no problem of heteroskedasticity in the results. However, even though the Breusch-Godfrey serial correlation LM test shows that autocorrelation is a problem, we corrected the estimated standard errors using the Newey-West HAC approach in order to restore the validity of our t-tests and F-test. The F-test shows that the model as a whole is statistically significant at the 1% level. The Jarque-Bera statistic shows that our residual is normally distributed. Even though the Durbin-Watson statistics is low, suggesting the presence of serial correlation, we have adequately addressed this problem using the Newey-West HAC method. All in all, our model is well behaved and can be used for inference.

To capture the short-run responses of agricultural productivity to changes in our regressors, we estimated an ECM. The results are shown in Table 4. We find that the results are qualitatively the same as those of the long-run model, though the variables are no longer statistically significant even at the 10% level. Agricultural credit and the climate change variables retained their positive impacts on agricultural productivity, while agricultural labour force and agricultural land also maintained their negative impacts. The error correction term also has a negative sign, which is consistent with theoretical expectation. Our results are consistent with Nnamocha and Eke (2015), which found that agricultural credit impacts on agricultural production in Nigeria only in the long-run. Indeed, our results are consistent with the bulk of the empirical literature that found a positive relationship between agricultural credit and agricultural productivity in Nigeria, such as Agunuwa et al. (2015), Ogbanje et al. (2012), Obilor (2013), Ibe (2014). However, our results are contrary to Ubah (2009), which found that the role of agricultural credit in agricultural productivity is statistically negligible.

On the direction of causality between agricultural credit and agricultural productivity in Nigeria, we estimated the Granger causality model specified in equations 4 and 5 at lag 2. The results are shown in Table 5. We find that there is no causality running between agricultural credit and agricultural productivity in Nigeria. This is consistent with our earlier results in Table 4 showing that in the short-run, there is not statistically significant relationship between these variables. However, our results show that in the long-run, there is a stable positive relationship between them.

5. CONCLUSION AND POLICY IMPLICATIONS

The findings in this study confirm that credits from deposit money banks in Nigeria contribute greatly towards increasing agricultural productivity. Hence, there is need for government and/or regulatory policies that will ensure that the banking system provides sufficient credits to the agricultural sector every year and at reduced interest rates. The need to diversify the Nigerian economy through massive investments in agriculture by both the private and public sectors cannot be overstressed. For instance,

Table 4: ECM estimation results [dependent variable=D (AVA)]

Variable	Coefficient	Diagnostic checks	
Constant	0.06***	R-squared	0.15
D (DMC)	0.01	F-statistic	0.78
D (ALF)	−7.24	P (F-statistics)	0.59
D (LAND)	−0.43	Durbin-Watson statistics	1.99
D (ARF)	0.11	Breusch-Godfrey Test [observed χ^2]	0.03
D (TEMP)	0.04	Breusch-Pagan-Godfrey Test [observed χ^2]	7.21
ECM(−1)	−0.14		

*** denotes significance at 1% level. ECM is residual from long-run model estimation. Breusch-Godfrey test and Breusch-Pagan-Godfrey Test are the standard tests for autocorrelation and heteroscedasticity, respectively, ECM: Error correction model

Table 5: Granger causality test result

Null hypothesis	Observed	F-statistics	P value
DMC does not Granger cause AVA	32	1.21047	0.3137
AVA does not Granger cause DMC		0.53519	0.5916

agricultural provides a veritable means of tackling the challenges of unemployment, food insecurity, rising inflation rates, and unfavorable external balances. This means that the monetary authority in Nigeria (i.e. the Central Bank of Nigeria) must ensure that adequate and sustainable levels of credit are extended to the agricultural sector by the banking system.

Furthermore, our findings indicate that government policies should target the reform of the land use act in order to make land easily available for agricultural purposes. Achieving such easy access to land for agriculture will require synergy between the federal government, state governments, local governments, and other stakeholders in the agricultural sector. Adequate funding for the sector and easy access to land means that mechanizing agriculture in Nigeria is a goal that can be attained through proper policy frameworks. Such policy frameworks should also include other incentives that will encourage young Nigerians, especially graduates, to venture into agriculture. Doing this will address our finding of negative impact of agricultural labour force on agricultural productivity in Nigeria. The insignificance impact of annual rainfall may be attributed to the inclement weather conditions in most parts of the country. Consequently, irrigation facilities should be targeted by government policies at all levels of government, especially at the local government level. Such facilities will in turn encourage the youth to embrace agriculture in Nigeria. Overall, our findings in this study have shown that mechanization of agricultural activities holds the future for the sector in Nigeria.

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