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Credit Access and Agricultural Output in Nigeria

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ABSTRACT

In Nigeria, oil contribution to Gross Domestic Product has continued to overshadow that of the non-oil sectors despite the numerous policies and programs that have been adopted by the Nigerian government. This, alongside the role of agriculture in poverty reduction and sustainable agricultural development constituted the motivation for this study. Principally, access to credit is evidently the limitation for agro-based entrepreneurs to expand. The study therefore aimed at ascertaining the determinants of agricultural credit as well as its effect on sustainable development of agricultural output. The study employed the General Household Survey (GHS) data 2012 and used a propensity score matching method and descriptive statistics to analyze its specific objectives. The findings of the study suggest that the significant determinants of access to agricultural credit in Nigeria are sex, per capita expenditure and experience. The average treatment effect of the propensity score model showed that agricultural credit does not have a significant impact on output given that its t-value of 1.626 is less than 1.96. The study therefore recommends that the government should make more conscious efforts to promote access and availability of formal credit at an attractive interest rate and with fewer requirements to improve access and develop the agricultural sector in Nigeria.

Keywords: credit access, agricultural output, subsistence farmers.

INTRODUCTION

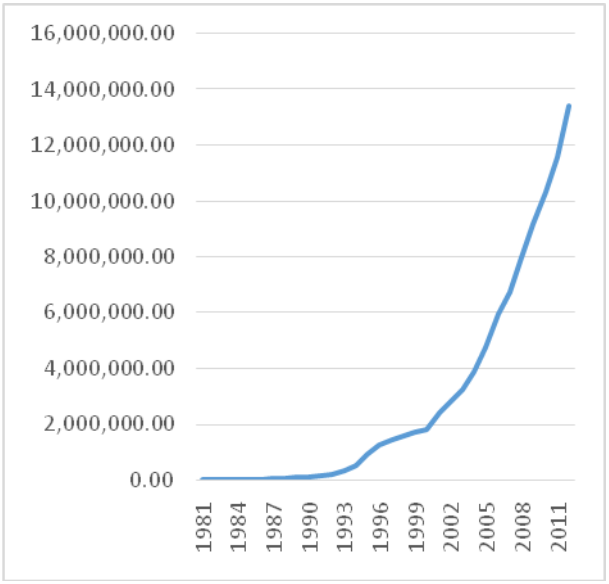
In Nigeria, the importance of credit to agricultural development cannot be overemphasized. Granting farmers more access to credit enables them to advantageously use improved farm inputs and other factors of production. The traditional argument for the provision of agricultural credit is that additional capital can be temporarily used to enhance the level of household's productive and physical capital [1]. [2, 3, 4, 5, 6, 7, 8] attributed the decline in the agricultural output to lack of agricultural credit. According to Agu, insufficiency of capital has prevented agricultural development in Nigeria.

An examination of the Nigerian agricultural sector shows that the sector is not in a position to finance its own development [9, 10]. The institutional lending system has failed to meet up with the objectives for which they were set up [11]. The major shortcomings of their transactions were due to the inaccessibility of these funds to rural farmers as a result of the bureaucratic procedures and high service cost, which are very difficult for the farmers to meet [12].

Accessibility of credit to peasant farmers and higher interest rates imposed on loans relative to those by the formal banking sectors are the principal characteristics of informal credit [13, 14]. According to [15], the lack of bank accounts, collateral, and information regarding the procedure for accessing credits from banks limit peasant farmers and rural women's access to credit from formal institutions.

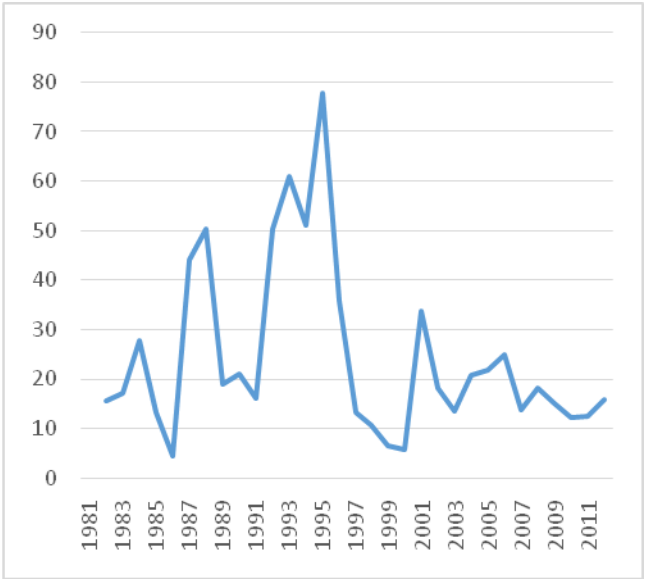
Sequel to this lack of access to agricultural credit and other bureaucratic bottlenecks from the financial institutions, agricultural output in Nigeria has witnessed a dramatic trend over the years.

Figure 1. Agricultural Output in Nigeria N' Million



Source Authors Computation based on data from CBN. (CBN 2014)

Figure 2 Growth rate of agricultural output



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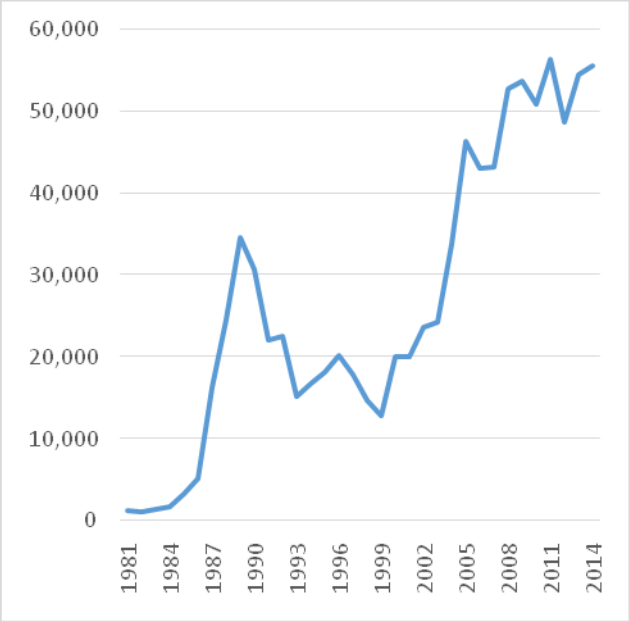
The trend (fig.1), suggests that agricultural output was more or less

stable between 1981 and 1992 and then started increasing at an increasing rate between 1993 and 2012. On the other hand, the growth rate of agricultural output (Fig 2) has been very undulating. The growth reached its peak of about 78% in 1995 and dropped to about 5% 5 years later. This unstable growth rate implies that there is no proper policy framework being implemented to guarantee an increasing or steady growth rate of agricultural output.

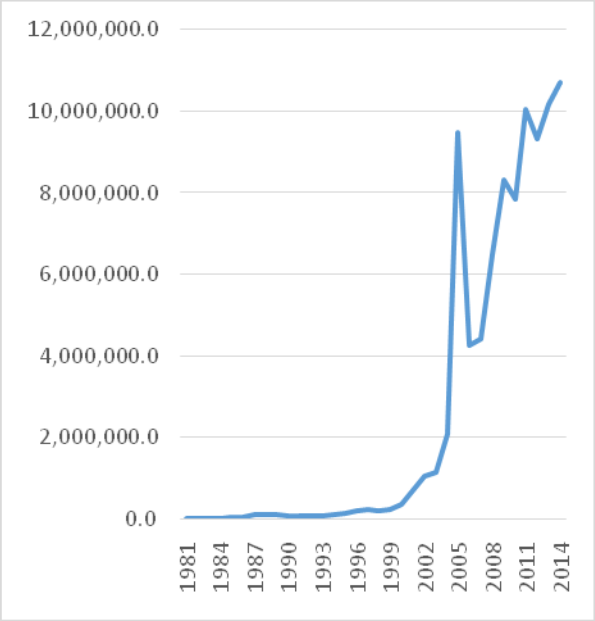
Furthermore, an examination of the loans that they have been guaranteed by the Agricultural Credit Guarantee Scheme Fund for over three decades (fig 4)

Figure 3 Number of loans guaranteed by the ACGSF



Source Authors Computation based on data from CBN. (CBN 2014

Figure 4 Value of loans guaranteed (N' thousand)



Source Authors Computation based on data from CBN. (CBN 2014)

suggests that the value of loans were relatively very low until 2003 and reached ₦2 billion for the first time only in 2005. It however increased to around 9.5 billion in 2006 and further dropped considerably to 4 billion naira in 2007. It then increased in an undulating manner till 2012.

These figures nevertheless, are relatively very small considering the number of loans offered vis-à-vis the population of Nigeria. Nigeria is estimated to be about 180 million people currently with a booming 80% agricultural based. Meanwhile there is no point in which the number of loans offered between 1981

and 2013 got to 60,000. Though there was a relatively increasing trend from 1999, the amount of loans offered is far below capacity and what is needed especially when compared with the population involved in agriculture.

This study therefore intends to ascertain the determinants of credit access for both formal and informal sources and to examine its impact on agricultural production.

METHODOLOGY

Research Design

The study adopted ex-post factor design. The study employed cross sectional secondary data from the National Bureau of Statistics [15, 16]. The sample data used for this study, General Household Survey, constitutes 22,000 households carried out in 36 states plus the Federal Capital Territory [17]. The sample however comprises of individuals in several sectors. The study employed a propensity score matching method and descriptive statistics to analyze the specified objectives. The propensity score approach estimated the determinants of credit access using a logit regression. The determinants are age, sex, collateral security, educational attainment, per capita expenditure, experience, and marital status. It also used the propensity score to estimate the effects of credit on agricultural output in Nigeria.

The theoretical framework on the access to credit was built on the model of Blancard et al. (2006) [7]. Accordingly, the study considers the case of a representative profit-maximizing farmer with the possibility of input credit constraints. The constant returns to scale production technology (f(X,Y)) of the representative farmer is assumed to be a function of two inputs, X and Y. The representative farmer's profit is given by

$$\Pi = pf(X,Y) - w_X X - w_Y Y \qquad (1)$$

Where, p is the output price and w_i are the input prices for i=X,Y.

Following Blancard et al. (2006), the study models an imperfect credit market by assuming that the credit-constrained farmer has C amount of credit available for financing input purchases. The value of credit C is a predetermined level of expenditure, which cannot be exceeded when purchasing inputs:

$$\alpha w_X X + \delta w_Y Y \leq C \qquad (2)$$

Where, α and δ are dummy variables that distinguish farm credit constraint between inputs.

If α = 1 and δ =1, this suggests a symmetric farm credit constraint for both inputs. A farmer may be more credit constrained with respect to some inputs

than others, implying an asymmetry in the credit constraint. For simplicity, the study assumed that the farmer is credit constrained with respect to either input X ($\alpha = 1$ and $\delta = 0$) or input Y($\alpha = 0$ and $\delta = 1$).

The farmer maximizes profits subject to credit constraint (1) in line with the Lagrange multiplier method we have the Lagrange function as;

$$\theta = pf(X,Y) - w_X X - w_Y Y - \lambda(\alpha w_X X + \delta w_Y Y - C) \quad \text{.....(3)}$$

Where, λ is the shadow price of the credit constraint. The optimal conditions for a credit constrained farmer are as follows:

$$pf_X > w_X \quad \text{.....(4)}$$

$$pf_Y = (1 + \lambda\alpha)w_Y \quad \text{.....(5)}$$

From equations (4) and (5) it follows that the marginal value product of both inputs is higher than the price of inputs in equilibrium if a farmer is symmetrically credit constrained (i.e. if $\alpha = 1$, $\delta = 1$ and $\lambda > 0$): $pf_X > w_X$ and $pf_Y > w_Y$, respectively. A farmer could potentially increase its profits by increasing input use but he cannot do so because of a binding credit constraint. If a farmer is asymmetrically credit constrained for the input X (i.e. if $\alpha = 1$, $\delta = 0$ and $\lambda > 0$), then only the marginal value product of input X exceeds its price, while the marginal value product of input Y is equal to the own price: $pf_X > w_X$ and $pf_Y = w_Y$ respectively. Conversely, if a farmer is asymmetrically constrained for input Y (i.e. if $\alpha = 0$, $\delta = 1$ and $\lambda > 0$), then it holds that $pf_X = w_X$ and $pf_Y > w_Y$. Finally, if the farmer's credit constraint (1) is non-binding (i.e. if $\lambda = 0$), then in equilibrium the marginal value product of both inputs is equalized with their respective prices: $pf_X = w_X$ and $pf_Y = w_Y$.

This method ensures that the two groups of subjects are matched equally on all factors even before determining what these factors may be.

- It is ideal for making casual inferences.

- It does not depend on conditioning on the observed covariates and can balance for both observed and unobserved covariates.

Model Specification for the Propensity Score

The propensity score model has a two stage estimation process. This study assumes that the error term has a logistic distribution considering that the response variable is binary and therefore intends in the first phase to consist of a logit regression while the second is to estimate the average treatment effect based on propensity score through matching or stratification. Some statistical packages

analyze it step by step, and are explained as such for better comprehension. The first phase has a dummy variable as dependent variable that represents credit access. That is, 1 if the household accesses credit and 0 if otherwise. The first stage is to estimate with a logit regression where the dependent variable is the dummy variable for credit access and the X's are the socio economic determinants of credit access. The determinants are age, sex, collateral securities, educational attainment, experience, per capita expenditure, marital status and other variables.

The first stage of the propensity score matching model, the logit model is expected to respond to the first objective of investigating the determinants of credit access for agricultural production. The model will measure the relationship between the characteristics of the individuals, and their level of credit access. The specifications help to define a probability to monitor credit access among households.

We hereby state our logit model thus:

$$\text{Logit}p_x = \log\left[\frac{P(Y=1)}{1-P(Y=1)}\right] = \sum_{k=1}^{k} \alpha_k X_k$$

.....(i)

The model above shows that there is a linear relationship between the logitp_x and the vector of explanatory variables X. Therefore, the study can state the probability of accessing credit as:

$$\Pr(Y=1) = \frac{\sum_{e}^{k=1} \alpha_k X_k}{\sum_{e}^{k=1} \alpha_k X_k}$$

.....(ii)

while the probability of accessing credit (which is 1 minus the probability of not accessing credit)is specified thus:

$$\Pr(Y = 0) = \frac{1}{\sum_{e}^{k=1} \alpha_k X_k}$$

.....(iii)

Therefore the logit model to be specified is given as:

$$\text{Logit}(P) = \ln\left[\frac{p}{1-p}\right] = \beta_0 + \beta_1 \text{age} + \beta_2 \text{sex} + \beta_3 \text{experience} + \beta_4 \text{educ} + \beta_5 \text{marstat} + \beta_6 \text{per-capita} + \beta_7 \text{collateral} + \mu$$

.....(iv)

Where, P = probability of accessing credit, educ = educational attainment, marstat = marital status, per-capita=per-capita expenditure. The variables were inspired by the empirical and theoretical literature that associates these variables to credit access. Given that it is also a deterministic investigation; the significant variables will clearly show amongst these variables, those that are the significant determinants of credit accessibility.

The propensity score approach will actually demonstrate in the second stage where it will estimate the average treatment effect of agricultural credit on agricultural output in Nigeria. This is the focus of the second objective; ascertain the effect (treatment effect) of credit accessibility on agricultural output. The probability of an individual's agricultural output being assigned to a particular treatment given a set of observed covariates. Propensity scores are used to reduce selection bias by equating groups based on these covariates. Suppose that there exist a binary treatment T, an outcome Y, and background variables X. The propensity score is defined as the conditional probability of treatment given background variables:

$$p(x) = Pr(T=1 \mid X=x) \quad \text{.....(v)}$$

Where Y(0) and Y(1) denote the potential outcomes under control and treatment, respectively. Then treatment assignment is (conditionally) un-confounded if treatment is independent of potential outcomes conditional on X. This can be written compactly as

$$T \perp Y(0), Y(1) \mid X \quad \text{.....(vi)}$$

Where⊥ denotes statistical independence. If un-confoundedness holds, then

$$T \perp Y(0), Y(1) \mid p(X) \quad \text{.....(vii)}$$

Hence T often referred to as the average treatment effect (ATT) shows to what extent credit accessibility has affected agricultural output. Given that, [18] opine that the effect of treatment on outcomes can be estimated by comparing outcomes directly between treated and untreated outcome.

RESULTS AND DISCUSSION

Presentation of the Logit Regression Results

The study therefore proceeded to analyze the results as presented below, with the STATA output

Table 1: First Stage Propensity Score – Logit Regression Results

Variables	Coefficient	Z	P > |z|
Collateral– Yes	2.594828	1.47	0.143
Education	0.3048324	1.87	0.061
Per capita Expenditure	2.802562	3.33	0.001
Experience	0.0002189	2.10	0.035
Sex – Female	-0.5630589	-2.11	0.035
Age	0.0902302	1.72	0.086
Marital Status – Married	0.1425114	0.81	0.417
Constant	1.948688	0.89	0.374
Log Likelihood	-35.824688		
Pseudo R^2	0.3323		
Prob> chi2	0.0000		

The results in table 1 show a relatively low Pseudo R^2, but a significant model at 1% level of significance given the chi^2 probability of 0.0000. This means that the overall model is significant and conforms to the Hosmer and Lemeshow's goodness of fit test that was explained above. However, the results suggest that out of 7 credit access determinants that were examined, there exist three significant determinants of access to agricultural credit in Nigeria. Possession of collateral security, education, age, and marital status were not significant determinants of agricultural credit access, while, sex, per capital expenditure and experience were significant determinants of agricultural credit access. The study examines access to agricultural credit as a sum total of formal and informal credit. This is in line with [19] that supported the fact that rural farmers source their credit from informal sources like friends, relatives, NGOs, personal savings, etc.

The first indicator considered was that of the possession of collateral that was designed as a dummy variable in the data set (0 for those who possessed and 1 for those who did not). For easy interpretation the study took into consideration the dummy effect that led to an omission of the first category (those who did not possess collateral). Surprisingly the study saw that there was no significant difference between those that had collateral and those that did not in increasing the log of odds that an individual had access to agricultural credit. According to the result of the

study, there exists a positive relationship as expected but not significant. In fact, the study opines that an increase in an individual that possesses collateral relative to those that do not increases the log of odds that an individual has access to agricultural credit by approximately 2.59. Though, it is not a significant determinant, given its z-value of 1.47 which is less than 1.96 and probability value of 0.143 which is greater than 0.05, hence not significant at 5% significance level. This is surprising when compared to literature that opines that collateral security is a strong determinant of agricultural credit. However, this result could be as such due to the fact that it considered other informal sources of credit that do not necessarily need collateral. These include informal savings groups, communal societies, and cooperatives, amongst others.

Education is equally a positive but non-significant determinant of agricultural credit access according to the results illustrated on table 1. This means therefore that the higher the educational level, the greater the log of odds that an individual will have access to agricultural credit, as expected apriori given that some who do not have access to credit lack information or shy away from exposing their inability to read and/or write(illiteracy). Education is therefore an eye-opener for many and a confidence booster to take credits as opportunities and possibilities when all the necessary conditions are satisfied. In line with other studies, education is not a significant determinant of agricultural credit access. This could be attributed to the fact that, both formal and informal credit sources are brought together. The informal credit sources that constitute the greater part of credit access do not necessarily need education for them to gain access. This therefore means that, in such cases education used to be a barrier, but now does not significantly limit individuals from accessing agricultural credit.

Per capita expenditure is the most significant and positive determinant of agricultural credit access. In fact, a unit increase in per capita expenditure significantly increases the log of odds or the probability that an individual gains access to credit by about 2.8. This implies that richer people have more access to agricultural credit than poorer individuals. This is worrisome especially given the fact that it is significant. This only widens the gap between the rich and the poor as poorer people who need the credit are denied access while richer individuals benefit. This may be one of the reasons for the widening inequality over the years in Nigeria, as income inequality index is said to have increased from 0.43 in 2004 to 0.49 in 2009 [20].

The results also suggest that experience is a significant and positive determinant of

agricultural credit access. Experience in this study was taken to be the number of years involved in agricultural activities. The findings show that a unit increase in experience significantly increases the log of odds that the individual gains access to agricultural credit by 0.0002189. It is a significant determinant of credit access given that its z-value is given as 2.10 (greater than 1.96) and its probability value as 0.035 (less than 0.05), hence significant at 5% significance level. This result is expected apriori given that overtime, the farmers turn to understand the operating systems, the various sources of credit, the conditions for accessing the credit and the connections and familiarity with the disbursement agents. These should go a long way to enhancing the probability of credit access as the farmers get older in the practice.

Furthermore, the results show that sex is equally a significant determinant of agricultural credit access in Nigeria. The sex variable was equally recorded as a dummy and was examined as such by the study. This led to the omission of the male category and was regarded as the bench category, and the female category stipulated to be interpreted with respect to their male counterparts. The result shows that, on the average, credit access is lower for female farmers than their male counterparts by about 0.56. This is in accordance with several related empirical works in Nigeria and Sub-Saharan Africa in general. However, the study opines that in the case of credit accessibility, other factors like women's lack of awareness, shyness to approach credit donors, lack of capital/collateral, lack of guidance, lack of interest to expand their horizon, amongst others, constitute a setback. Their male counterparts are determined to take their agricultural activities to professional levels, which are beyond subsistence level since the man is expected to bear the burden of family responsibilities. However there is need for conscious efforts to be made in encouraging women to access agricultural credit [21,22,23,24].

The study further shows that age is a positive but not a significant determinant of access to agricultural credit, given that its z-value is 1.72 which is less than 1.96 and a probability value of 0.086 which is greater than 0.05 hence not significant at 5% significance level. As age increases by one unit, the log of odds that an individual gets access to agricultural credit increases by about 0.09, though not significant. This therefore means that age does not respond as experience does. While experience is significant, age is not. This implies that the older you are does not necessarily increase the probability of accessing agricultural credit unless you have some experience in the field. This is the same scenario with the marital status variable. Marital status is equally not a significant determinant as married

individuals do not significantly differ from the singles in accessing agricultural credit [25, 26].

Presentation of the Average Treatment Result on the Treated

The second stage results show the treatment effect of the treated group (the group that had access to credit) on the agricultural output in Nigeria. The results below therefore illustrate the extent agricultural credit access impacted on agricultural output in Nigeria.

Table 2: Second Stage Propensity Score – Results of the Average Treatment Effect on the Treated (ATT)

No. Treated	No. control	ATT	Std. Err.	T
4,481	10,832	0.261	0.161	1.626

The results on table 2 suggest that there exists no significant impact of agricultural credit on agricultural output in Nigeria. This is implied due to the t-value of the Average Treatment Effect on the Treated (ATT) given as 1.626 which is less than 1.96 and hence not significant at the standard 5% significance level. This is in line with [27] who used error correction model to evaluate the impact of commercial banks' credit to agricultural sector under the Agricultural Credit Guarantee Scheme Fund (ACGSF) in Nigeria. The result suggests that the commercial banks' credit to agricultural sector for the period 1984 to 2007 has no significant positive impact on agricultural productivity in Nigeria. Though Obilor concentrated on commercial bank's credit, his findings suggest that formal credit has no significant impact on output. It however contradicts some other regional/specified studies like [28]. This study, however, goes beyond formal credit to ascertain even informal credit which constitutes a greater source of agricultural credit.

Presentation of Propensity Score Post Estimation Results

The logit model as stipulated in this study was used to address the objectives: To analyze the determinants of agricultural credit access in Nigeria and to ascertain the effect of agricultural credit on agricultural output in Nigeria. The study employed the Hosmer and Lemeshow's goodness of fit test, and the Link post estimation tests to ascertain the robustness of the results. The Hosmer and Lemeshow's goodness of fit test fits reasonably well. However, the number of covariate patterns is equal to the number of observations, making the applicability of the Pearson chi square test questionable but not necessarily

inappropriate. This is shown on Table below:

Table 3: Results of the Hosmer and Lemeshow's Goodness of Fit test.

Number of observations	**78**
Number of covariate patterns	78
Pearson chi2(71)	65.70
Prob> chi2	**0.6555**

The study went further to perform the link post estimation test to show if there exist specification errors. The linear predicted value (_hat) has a z value of 4.47 which is higher than 1.96 and a probability value of 0.000 which is less than 0.05 hence significant at the standard 5% significance level. The linear predicted value squared (_hatsq) has a z value of -1.15 and a probability value of 0.251 hence not significant at the 5% level of significance. Since the linear predicted value squared (_hatsq) is not significant, the linktest is not significant. This, therefore, implies that, there exist no omitted relevant variable(s) hence there exist no specification errors and the model is robust. The Results for the Link Test are equally illustrated below:

Table 4: Results of the Link post estimation test

Variables	Coefficient	Z	P > |z|
_hat	1.005073	4.47	0.000
_hatsq	-.0346508	-1.15	0.251
Cons	0.0635879	0.20	0.838

The two assumptions that need to be validated for the propensity score matching model to be robust are the conditional independent assumption and the common support assumption.

The choice of a logit model in the first stage is partly to validate the common support assumption, given that Preference for logit or probit models (compared to linear probability models and multi logit/probit models) is derived from the well-known shortcomings of the linear probability model, especially the un-likeliness of the functional form when the response variable is highly skewed and predictions are outside the [0; 1] bounds of probabilities [29,30].

RECOMMENDATIONS

Summary of Findings

The study employed the GHS data 2010 and used a propensity score matching method and descriptive statistics to analyze the specified objectives. The results from the propensity score matching shows that in the first stage, there exist three significant determinants of access to agricultural credit in Nigeria. While, the possession of collateral, education, age, and marital status were not significant determinants of agricultural credit access, sex, per capita expenditure and experience were significant determinants of agricultural credit access. All the variables had a positive relationship with access to credit except sex that showed a negative but significant relationship on access to credit. The second stage of the propensity score that examined the average treatment effect of the access to credit on output showed that agricultural credit does not have a significant impact on output given that its t-value of 1.626 is less than 1.96.

The results of the study therefore inferred several recommendations

i) The study shows that there is a significant difference between males and females with respect to accessing agricultural credit. The study recommends a strict follow-up of the recent Central Bank policy that gives privilege to female entrepreneurs in terms of access to loans.

ii) The study equally finds that per-capita expenditure has a positive and significant effect on access to credit. This implies that the richer a farmer is, the higher the access to credit. Implying that poorer people who need the credit more do not easily access credit. The study recommends all tiers of government to build up a reliable and trust worthy credit system that encourages entrepreneurs especially in the agricultural sector to take up credits and enhance production.

iii) The study also shows that about 71% of the farmers do not access credit, and this means that either they shy away from accessing credit or are not aware of it. Proper education and increased awareness therefore remains a vital issue, especially considering the fact that most of those in the agricultural sector might not be literate, and the fact that Information asymmetry might be a serious hindrance for them to exploit this opportunity. Therefore existing policies should be announced

in all local radio and TV stations as wells as the newspapers, to enable farmers exploit this opportunity.

iv) The results suggest that access to agricultural credit does not significantly impact on agricultural output. This might be because of the fact that, there is so much concentration on the formal financial institutions and negligence on the informal sector. Also, farmers are more comfortable with informal credit sources from the savings groups, cooperative societies (e.g. Isusu and Akawo). However, these groups might not give out substantial loans that might make a difference in expanding their horizon. Therefore, further measures need to be taken to back-up such informal groups to give out huge amount of loans since the farmers prefer these sources.

v) The fact that access to credit does not impact on agricultural output could also be as a result of the fact that the financial institutions are more concerned with making profits from the interests charged on credits and so limit the income and potential of the credit received. It is on this premise that [30 argued that local micro credit system is exploitative and does not guaranty increase in agricultural productivity. The study therefore recommends that the monitoring department of the central bank should ensure a friendly interest rates and easy access to credit.

vi) Bureaucratic bottlenecks need to be reduced as much as possible to attract more farmers to desire credit from financial institutions since they have the advantage of giving out very large amounts.

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