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Effect of Access to Credit on Agricultural Productivity: Evidence from Cassava Farmers in the Afigya-Kwabre District of Ghana

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Abstract

Credit is critical to agricultural production. However, most farmers in Ghana have limited access to credit. Even, among farmers who are able to access credit it is unclear whether it has any significant impact on their productivity and ultimately their general economic situation. This study therefore assessed the effect of access to credit on agricultural productivity. Primary data were collected from a random sample of 166 farm households who produce cassava. Descriptive statistics and logit model and PSM were employed to analyse the data. Results of the logit model showed that access to credit was significantly influenced by sex, age, household size, farming experience, level of education, farm size, hired labour, extension service and farmer-lender distance. Also, credit has a positive and significant effect on cassava productivity. The study recommends that interventions to raise agricultural productivity in the study area should consider access to credits as a key component

Keywords: *Access to credit, Agricultural productivity, Logit and PSM*

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Background to the Study

Apart from contributing about 40% to the Gross Domestic Product (GDP) of Ghana, the agricultural sector is the leading foreign exchange earner for the country (Nair and Faissha, 2010). However, workers in the agricultural sector are poor and live in the rural areas of the country (World Bank, 1995). Tefera (2004) has indicated lack of access to agricultural credit as one of the major factors which breed rural poverty. This is because these poor households do not have the needed collateral to secure loans from lenders. In most cases, collateral presented by agricultural households are often non-durable and perishable.

Extending financial services to the rural areas will go a long way to increase productivity and consequently reduce poverty. A study conducted by Diagne (2002) to analyse the impact of agricultural credit on farmers' output and yield revealed that agricultural credit has a significant positive impact on agricultural productivity. This stems from the fact that access to credit may enable farmers to acquire the necessary inputs such as improved seeds, fertilizers and labour in order to raise the productivity of farmers.

Cassava is one of the most common food staples in the rural world. Africa alone accounts for 54% of the total cassava production in the world (Alhassan, 1999). Ghana stands behind Nigeria and Democratic Republic of Congo as the third leading producer of cassava in Africa; producing 12, 260 MT annually (FAO, 2009).However, recent studies have revealed lack of access to credit among other factors responsible for the low productivity of cassava farmers in the Afigya-Kwabre District (Ghana Statistical Service, 2014).

Objective of the Study

This study therefore aims at analysing the effect of credit on the productivity of cassava farmers in the Afigya-Kwabre District of Ghana.

Literature Review

Access to Credit and Agricultural Productivity

Agriculture forms the backbone of any meaningful economic development in the developing countries and this explains why credit facilities should be made available and accessible to the rural areas in order raise productivity (Adera, 1995). Access to credit by the poor farmer enable them to obtain new machinery, improved seed fertilizers and other necessary inputs needed to expand the scale of production (Akwai-Sakyi, 2013). Likewise, Yu (2008) posits that beyond the ability to procure farm equipment, agricultural inputs, modern technologies and irrigation systems, smallholder farmers are able to obtain the needed storage facilities. Beyond increase in productivity and income, access to credit affords rural households the opportunity to improve their social well-being especially in the area of health and education (Miller and Ladman, 1983).

Access to rural credit has the capacity to raise the level of the national income distribution of the country (Miller, 1977). This assertion is informed by the perspective that the bulk of the people in the country are engaged in the area of agricultural and therefore if farmers are able to secure such financial support then it may go a long way to improve their economic contributions to the country. IFAD (2007) contends that during off farming seasons or after poor harvest, access to credit could raise the income status of the low income rural

households. Again, they further add that in situations of income disparities between smallholder farmers and large holder farmers, credit may be used as a tool to bridge such a poverty-widening gap.

Ahma (2010) argues that access to credit enables poor rural farmers to venture into new areas of economic activities, broaden their sources of capital and manage shocks and stress that are bound to occur. He further stated the poor farming households majority of who are impoverished have to develop the habit of saving, obtaining loans for production and transferring cash. Oyateye's (1980) position is no different as according to him, the persistent case of low productivity resulting in low income and saving capacity could only be offset when the poor rural farmer is guaranteed access to a credit facility. He added that credit improves the capacity of the smallholder farmer to have access to labour. Poor income households could lift above the poverty line provided they could reliably have access to a number of micro-finance activities in order to strengthen their asset building capacity. Access to credit, to them, strengthens the need for the poor rural households to achieve food security.

Empirical Studies on effects of Credit on Agricultural Productivity

A number of empirical studies have been conducted to study the relationship between access to credit and agricultural productivity. They include the following;

In their studies to establish the relationship between access to credit and agricultural productivity in Ghana, Baffoe et al. (2015) analysed responses from 109 farm households of borrowers and non-borrowers concluded that the difference in productivity of borrowers and borrowers was statistically significant. The increase in productivity was attributed to the technical efficiency of borrowers.

In his analysis of the "Impact of agricultural credit on farm productivity" using the quintile regression and Stochastic Frontier Analysis techniques and responses from 654 farmers sampled from Mekong Delta region of Pakistan, Duy (2012) revealed that the rice yield and technical efficiency of farmers increased tremendously because of access to credit, educational levels of farmers and high level of technology. His study also showed that rice production was positively affected by the use of formal credit rather than informal credit.

According to Dong et al. (2010), credit access, the education and capabilities of rural farmers cannot be fully utilised. Using the endogenous switching regression model to analyse responses from 511 households in Heilongijang province of Northeast China, they indicated that productivity and income of credit unconstrained farmers are higher than credit constrained farmers. A study conducted by Kinkingninhoun et al. (2010) to determine the effect of agricultural credit participation on farmers' productivity revealed that agricultural credit has a positive significant effect on rice yield. The results revealed that credit users had 157.2 kg per hectare of paddy more than non-credit users. A similar conclusion was drawn by Diagne (2002) in his analysis of the impact of agricultural credit on farmers' output and yield. The results of his analysis concluded that agricultural credit has a significant positive impact on agricultural productivity.

The Nuru Kenya (NK) was a credit program which supplied participating farmers with farm inputs loan, among other benefits. The basic objective of the program was to improve agricultural productivity and food security among small holder farmers in Kenya. Analysing data from 467 participants and 506 non-participants, the results of Paris' (2014) work showed that the maize yield of the participating households improved to 765kg per acre as compared to 693kg per acre of the non-participating households. The conclusion of his research, however, showed no statistical difference between participants and non-participants of the credit program.

Nosiru (2010) undertook a research to determine the relationship between microcredit program participation and productivity of small holder farmers. The findings of this work revealed a significant difference between productivity of the participating farmers and non-participating farmers. He concluded that the participation of small holder farmers in micro credit programs could improve their livelihoods. Nzomo and Muturi (2004) studied the relationship between agricultural credit participation and productivity in Kenya. The analysis of data collected from 123 small holder farmers randomly selected from a cross-sectional data revealed that agricultural credit has the potential to increase income and productivity of farmers. In Tanzania, Girabi and Mwakaje (2013) studied the impact of micro credit participation on agricultural productivity of small holder farmers. Using data collected from a random sample 98 credit participants and non-participants; they concluded that participants in the micro credit program recorded higher crop productivity than the non-participants. Findings from the above studies have largely concluded that increasing agricultural producers access to credit has a significant and positive impact on productivity.

Methodology

Population and Sampling

The target population includes all the cassava farmers in the study area. Four of the cassava producing communities was randomly selected. A total of 166 cassava farmers comprising 76 with access to credit and 90 without access to credit were randomly selected from the four communities. Using a semi-structured questionnaire, primary data were collected from the respondents. Data collected included household and farm characteristics.

Data Analysis

Socio-economic characteristics of respondents were summarized using descriptive statistics. Propensity Score Matching (PSM) was used to analyse the effect of credit on the productivity of cassava farmers. The Nearest Neighbour Matching (NNM), Radius Matching (RM) and Kernel Based Matching (KBM) will be employed in order to determine the robustness of the results. Before using the NNM, RM and KBM, the logit model was used to determine the probability of access to credit.

The Logistic Regression Model

Due to the dichotomous nature of the independent variable, the logistic regression model was employed to assess how a set of independent variables such as sex, age, marital status, household size, level of education, farm size, farming experience etc. determine cassava farmers access to credit. Also known as the logit models, the logistic regression provides an indication of the adequacy of a set of predictors by assessing suitability and indicate the

relative importance of each predictor variable or interaction among predictor variables (Pallant, 2013). In the analysis of dichotomous outcome variable, the logit model is preferable to others, since it is extremely flexible and capable of generating meaningful interpretation (Yehuala, 2008). The logit model is mathematically expressed by Chauke et al (2013) as;

$$Y_i = \beta_0 + \beta_1(\boldsymbol{SEX}) + \beta_2(\boldsymbol{AGE}) + \beta_3(\boldsymbol{MRST}) + \beta_4(\boldsymbol{YRSFMEDU}) + \beta_5(\boldsymbol{HSESZE}) + \beta_6(\boldsymbol{FMEXP}) + \beta_7(\boldsymbol{FMSZE}) + \beta_8(\boldsymbol{HDLB}) + \beta_9(\boldsymbol{EXT}) + \beta_{10}(\boldsymbol{FBO}) + \beta_{11}(\boldsymbol{DIST}) + \mu$$

Where Y_i = (dependent variable is dichotomous which uses "1" to represent farmers with access to credit and "0" to represent farmers without access to credit). Access is used here to refer to cassava farmers who got credit for the 2016 production:β_0 = constant term: β_1(***SEX***) =Sex ("1" for male farmers and "0" for female (+)):β_2(***AGE***) = Age (years)(+/-): β_3(***MRST***)= (1 if married, 0 if unmarried(+/-)): β_4(***YRSFMEDU***) = (Years in formal education (+)): β_5(***HSESZE***) = (Household size (+/-):β_6(***FMEXP***) = Farm experience(years(+):β_7(***FMSZE***) = Farm size (Ha(+)):β_8(***HDLB***) = Hired labour (+):β_9(***EXT***) = Extension service(1 if visited, 0 if no visit(+)):β_{10}(***FBO***) =Farm Based Organisation (1 if member, 0 if not member(+)):β_{11}(***DIST***) =Distance (km(-)):μ= Error term.

Propensity Score Matching (PSM) Framework

PSM is a non-parametric technique which is used to evaluate the average effect of a particular treatment variable (Caliendo & Kopeinig, 2008). The PSM is employed to deal with the problem of self-selection bias which results from the non-random participation of a program. In order to analyze the effect of the treatment effectively, there is the need to establish the counterfactual (Baker, 2000). In other words, what would have happened to their productivity (Kg/Ha) had the cassava farmers had no access to credit. Under such circumstances, a comparison group with similar observable characteristics is used in order to estimate the appropriate counterfactual (Friedlander & Robins, 1995).

The outcome of the treatment can be compared by matching an ideal comparison group (no access to credit) to the treatment group (access to credit) on the bases of the propensity scores of X. X represent the set of observable characteristics that determine access to credit. By so doing, selection bias is largely eliminated. To use the PSM to estimate the effect of credit on productivity, the propensity scores (p scores) is calculated with the aid of a Probit Model. Subsequently, the Nearest Neighbor Matching (NNM) algorithm is used to match cassava farmers with access to credit to those without access to credit using the P Score values in order to estimate the ATT. Alternative matching algorithms; Radius Matching and Kernel Matching were also employed in order to establish the robustness of the results

To develop the PSM framework, let D*i* = 1 indicate access to credit and D*i* = 0, no access to credit. Suppose that the outcome of the cassava farmer with access to credit (D*i* = 1) is Y1*i*, and the outcome of cassava farmers without access to credit (D*i* = 0) is Yo*i*. Therefore, the treatment effect is Y1*i* - Yo*i*. The problem of evaluation arises because only one of the potential outcome, E (Y1*i*/D*i* = 1) is observed for each individual *i*. The unobserved outcome E (Yo*i*/D*i* = 1) is referred to as the counterfactual outcome. Since the treatment effect cannot be estimated for every cassava farmer, the major evaluation parameter of interest is the average treatment effect of the treated, ATT is specified as;

$$ATT = E(Y1i - Yoi/Di = 1) = E(Y1i/Di = 1) - E(Yoi/Di = 1) \quad 1$$

According to Rosenbaum & Rubin (1983), the propensity score can be evaluated as;

$$P(X) = P(Di = 1/X) \quad 2$$

On the basis of these assumptions, potential outcomes of the comparison group are independent of participation status (Rubin, 1977). Thus, after adjusting for observable differences, the mean of the potential outcome is the same for $Di = 1$ and $Di = 0$.

This implies that $E(Yoi/Di = 1, P(X)) = E(Yoi/Di = 0, P(X))$. This allows for using the comparison group to measure how cassava farmers with access to credit would have performed had they not had access to credit. The overlap assumption is $0 < P(X) < 1$. Thus, for all X there is a positive probability of either having access to credit ($Di = 1$) or not having access to credit ($Di = 0$). This implies that each participant has a counterpart in the comparison group (Friedlander & Robins, 1995)

The average treatment effect (ATT) can now be estimated as;

$$= E(Y1i - Yoi/Di = 1)$$
$$= E[E(Y1i - Yoi/Di = 1, P(X))]$$
$$= E[E(Y1i/Di = 1, P(X)) - E(Yoi/Di = 0, P(X))] \quad 3$$

Demographic Variables

The test of means of the demographic variables revealed some degree of similarity between the treatment group and the control group as the results showed no significant difference in terms of sex, marital status, farm experience and membership of FBO.

Table 1: Comparisons of socio-economic characteristics between cassava farmers with access to credit and those without access to credit

Access Variables	Freq%	Min	Max	Mean	No access Freq%	Min	Max	Meant-value
Sex	0.01							
Male	48	64	57	63.3				
Female	27	35			33	37		
Age	22	60	38.11		31	51	43.63	-5.53***
Marital status	-0.01							
Married	66	84			77	86		
Unmarried	34	37			23	35		
Yrs in Fmedu	3	12	6.47		2	9	4.79	1.69***
Farm experience	2	38	14.58		4	33	16.39	-1.81
Farm size	0.40	2.02	1.29		0.40	1.21	0.73	1.38***
Hired labour	4	15	9.76		2	11	6.06	3.73***
FBO								-0.02
Yes	24	32			30	33		
No	52	68			60	67		
Extension								0.13
Yes	52	68			50	56		
No	24	32			40	44		
Distance	1	8	3.26		1	10	6.16	-2.93***

Source: Field survey, 2017
Note: *** significant at 1%, ** significant at 5%, and * significant at 10% of significance levels.

The bulk of the farmers sampled were males (64%) with only 36% being females. This is an indication that cassava production in the study area is dominated by male farmers. The reason could be that factors of production such as land are owned and controlled by men. Male farmers with access to credit formed 65% as against and 63% of male farmers without access to credit. However, whereas female farmers with access to credit constitute 35% of the respondents, female farmers without credit access were 37%.

The difference in age is significant at 1%, the mean age of farmers with access to credit was 38.11 years whilst that of farmers without access to credit was 44 years. This indicated that farmers were in their productive years. Eighty-four percent (84%) of farmers with access to credit were married and 86% of the respondents without access to credit were also married. The two comparison groups had low levels of formal education, as farmers with access to credit have spent an average of 6.47 years in school as compared to 4.79 years of formal education by farmers without access to credit. The difference in the level of formal education is significant at 1% level.

The difference in household size shows 1% significant level, given the mean household size of farmers with access to credit was about 7 as against 8 for those without access to credit. The difference in farm experience between households with access to credit and those without access to credit is not significant as farmers in the control group (about 16 years) had more farm experience than those in the treatment group (about 15 years).

Whilst the mean farm size of farmers in the treatment group was 1.29Ha, the mean farm size of the farmers in the control group waso.73Ha. This indicated a significant difference at level 1%. Farmers with access to credit averagely hire about 3 labours as compared to 2 labours hired by those without access to credit at a 1% significant difference level. Thirty-two (32%) of farmers with access to credit were members of FBO whilst 33% of those without credit access were also members of FBO.

Majority of the farmers in the study area have access to extension services as 61.4% have had visits from extension officers as against 38.6% who have not had visits from extension officers. Whilst the average distance of households with access to credit location was 3.26km, the average of distance of households without access to credit was 6.16km at a level of 1% significant difference.

Determinants of Access to Credit

The results of the logistic regression model shows that sex, age, level of formal education, household size, farming experience, farm size, hired labour, extension contact and farmer-lender distance were significant factors which determine access to credit by the farmers. On the other hand, marital status and membership of FBO did not significantly influence access to credit in the study area.

Table 2: Logistic Regression of Determinants of Access to Credit

Variable	Co-efficient	Std Error	z-value	P>|z|
Sex	1.3063*	0.7074	1.85	0.065
Age	-0.0978**	0.0441	-2.21	0.027
Marital Status	-1.0530	1.0355	-1.02	0.309
Years of formal education	0.3057**	0.1203	2.54	0.011
Household size	-0.3121*	0.1727	-1.81	0.071
Farm experience	0.1045*	0.0588	1.78	0.076
Farm size	1.8871***	0.6702	2.82	0.005
Hired labor	0.2781**	0.1367	2.03	0.042
FBO Membership	-0.9267	0.7214	-1.28	0.199
Extension contact	1.6716***	0.6467	2.58	0.010
Distance to credit center	-0.7189***	0.1476	-4.87	0.000

Note: *** significant at 1%, ** significant at 5%, and * significant at 10% of significance levels.

In line with the apriori expectation, sex has a positive influence on access to credit and was significant at 10% level. This implies that male headed households are 130% likely to have access to credit. This is consistent with the findings of Awunyo-Vitor & Abankwa (2012).

Age was found to be significant at 5% but negatively affect access to credit among the farmers. This implies that as age increases by a year, the probability that a farmer would have access to credit decreases by about 10%. This is consistent with the findings of Mpuga (2004) The level of formal education was statistically significant at 5% and shows a positive influence on access to credit as was expected. The implication is that an additional year spent on formal education increases farmer's likelihood of credit access by 30%. This is supported by the conclusions of Nguyen (2008).

Household size was found to be significant at 10% but has a negative influence on access to credit. The indication is that a unit increase in the size of the household has the probability of reducing a cassava farmer's access to credit by 31%. The result is consistent with the findings of Oyedele et al (2009). This result confirms the apriori expectation as farming experience of the household has a positive effect on access to credit and was significant 10% level. An additional year to the experience of a farmer increases their probability of access to credit by 10%. This is in line with the findings of Njoku (1997).

As was expected farm size has a positive co-efficient and significant at 1%. This implies that a unit increases in the farm size increases the likelihood of household's access to credit by about 189%. This is in line with the findings of Binswanger et al. (1989). Hired labour was also significant at 5% level and influence access to credit positively. As hired labour increases by one unit, household's access to credit increases by the probability of 27%. This is supported by the apriori expectation and conclusions of Hofferman & Polland (1983).

This result is a confirmation of the apriori expectation that extension service contact positively and significantly affects access to credit. A unit increase in extension service visit increases a famer's probability of access to credit by 167%. The effect was highly significant at 1% level. This is in line with the findings of Hussein (2007) Farmer-lender distance was significant at 1% and showed a negative influence on access to credit. A unit increase in the distance from farm to the lender decreases the probability of a farmer to have access to credit. This supports the apriori expectation and the findings of Hussien (2007).

Effect of Credit on Productivity

Results of the Propensity Score Matching

The next step is to match households with access to credit with households without access to credit (control group) based on the propensity scores. The ATT which measures the effect of access to credit on the productivity of cassava farmers was estimated using the Nearest Neighbor Matching, Kernel Matching and the Radius Matching algorithms. Similar results generated by the different algorithms indicate the robustness of the results. As indicated by Table 1.3, productivity of households with access to credit increased by 1443.76kg/Ha using the NNM at significant level of 10%. Thus using the NNM, cassava farmers who did not have access to credit in the 2016 production year could have increased their productivity by 1443.76kg/Ha if they have had access to credit. The KM revealed an increase of 837.19kg/Ha in

productivity at 10% significant level. This also means that cassava farmers without access to credit could have increased productivity by 837.19kg/Ha as per the KBM estimator. The RM reported an increase of 1294.83kg/Ha in the cassava productivity of those who had access to credit. The difference in productivity was significant at 1% level. All the results of the three matching algorithms show significant difference in levels of cassava productivity. The difference is therefore attributable to the treatment variable which is credit. The results therefore indicate that access to credit has a significant effect on farm productivity. This is substantiated by the findings of Awunyo-Vitor and Abankwa (2012) that credit is a necessary tool required to raise farmers' production level. In line with the assertion of Jehan and Mohammed (2008), the cassava farmers who had access to credit had the capacity to acquire production inputs such as land and labour. Poor rural farmers lack access to credit facilities. As a result, they are unable to acquire the needed inputs of production. The resultant effect is that, the agricultural productivity of farmers is significantly declined (Hussain and Perera, 2004). Therefore on the basis of the results of the PSM, it can be concluded that credit has a significant effect on cassava production. This therefore confirms the hypothesis that credit has a significant influence on productivity.

Table 3 Estimated Effect of Credit on Productivity (kg/Ha)

	Mean Outcome				
Matching Algorithm	Access (n=76)	No Access (n=90)	ATT	t-value	Change (%)
NNM	4220.58	2776.79	1443.76	1.81*	128.47
KBM	4220.58	3383.39	837.76	1.60*	61.13
Radius	4220.58	2925.75	1294.83	4.06***	109.36

Source: Field survey, 2017
Note: *** significant at 1%, ** significant at 5%, and * significant at 10% of significance levels

Conclusions and Recommendations

This study therefore aims at analyzing the effect of credit on the productivity of cassava farmers in the Afigya-Kwabre District of Ghana. . A semi-structured questionnaire was used to collect primary data from 166 farm households(comprising 76 with access to credit and 90 without access to credit in the 2016 production year)randomly sampled. The results of the logitmodel, revealed that sex, age, household size, farm size, hired labour, level of formal education, farm experience, extension service visit and distance were the variables that significantly influenced access to credit. Marital status and FBO membership did not significantly affect access to credit. The results of the PSM showed that access to credit has a significant positive effect on productivity of cassava farmers. Therefore, it is recommended that interventions to raise agricultural productivity in the study area should consider access to credits as a key component.

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