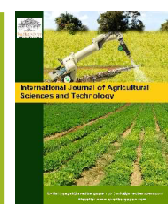




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## Impact of Access to Agricultural Credit on the Productivity of Togolese Farmers

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### Abstract

The objective of this paper is to measure the impact of access to agricultural credit on the productivity of farmers in Togo. The results show that there is a difference between farmers who have access to credit and those who do not. Also, farmers with access to credit have higher productivity than those without. Thus, access to credit is an essential factor in increasing agricultural productivity. Togolese decision-makers must, in the development of their agricultural policy, place greater emphasis on mechanisms to promote access to agricultural credit.

**Keywords:** *Access to credit, Agricultural productivity, Endogenous Switching Regression Model (ESRM)*

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### 1. Introduction

In the agricultural financing mechanism, credit is increasingly accepted as a powerful instrument to lift the rural poor out of extreme poverty. It plays a crucial role in increasing agricultural productivity through the creation of Amha and Narayana (2000) productive assets. It also enables small farmers to invest in land improvement and adopt new agricultural technologies such as high-yield seeds and fertilizers that increase their efficiency and income Zeller *et al.* (2000). Credit improves the welfare of the rural poor by financing consumption and reducing the opportunity cost of high-value assets and adopting labor-saving technologies Sharma and Zeller (1997). Also, credit helps to ensure the rural poor's vulnerability to shocks (floods, droughts and others) by reducing the costs incurred by the farmer in coping with these shocks.

Credit, in general, is essential for achieving rapid and sustainable development. Some authors (e.g., Mahmood *et al.*, 2009) note that agriculture is heavily dependent on credit, more than any other sector, due to seasonal variations in farm income and the shift to commercial agriculture. In their study in Pakistan, Mahmood *et al.* (2009) found that access to credit more than doubled family income per month (181%). Similarly, Iqbal *et al.* (2003) found a significantly positive relationship between institutional credit and agricultural GDP in Pakistan. Consistent with these findings, a study by Barslund and Tarp (2008) in Vietnam reported that households with access to credit were more likely to seek out promising but risky technologies and investments. On the other hand, several studies (e.g., Fletschner *et al.* 2010; Dohcheva, 2009; Chaves *et al.*, 2001) have reported the negative effects of credit constraints on rural farm households.

For Muayila and Tollens (2012), households with limited credit had lower (welfare) outcomes than households without constraints. However, some work has pointed out that access to credit still does not positively influence

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agricultural productivity. Indeed, in a study in Ghana, Quartey *et al.* (2012) argued that access to credit alone is not sufficient to boost agricultural production; agricultural profitability also needs to be improved through better pricing efficiency and marketing of agricultural production, ensuring that loans boost productivity and farmers do not end up in debt.

Agricultural insurance is another policy area being examined to help farmers manage production risks (Karlan, Osei, Osei-Akoto and Udry, 2014). Similarly, several studies have shown similar results (Garcia, 1985; Teixeira, 1986; Graber, 1978; Drummond, 1972; Taylor *et al.*, 1986). Although much work has stressed that access to credit plays a crucial role in increasing agricultural productivity, less work has been done on this issue in Africa in general and Togo in particular. Moreover, in the context of a dynamic agricultural sector, understanding the problems of agricultural credit will make it possible to identify the difficulties and find approaches for sustainable solutions to agricultural financing in Togo. It is in this perspective that the question arises as to what is the impact of access to credit on the productivity of Togolese farmers?

The objective of this paper is to measure the impact that accesses to credit could have on farmers' productivity in Togo using the Endogenous Switching Regression Model (ESRM) based on data from the Fourth National Agricultural Census (RNA) conducted in Togo in 2012. The contribution of this paper is twofold: firstly, empirical studies analyzing the impact of access to credit on agricultural productivity in WAEMU countries in general and Togo, in particular, are relatively rare. This work, therefore, fills this gap. The second contribution is methodological. Traditionally, previous studies that have attempted to identify the effect of credit on farmers' productivity have estimated separate production or supply functions for farmers with access to credit and those without and then compared the two estimates.

This method of evaluation suffers from two major shortcomings. Firstly, this approach implicitly assumes that all farmers who have access to credit and their counterparts who do not have access are respectively identical in terms of their credit demand or supply situation, which is not obvious. Second, there is also a problem of endogeneity that arises from the fact that access to credit is voluntary or that some farmers are better placed than others to access credit. In this paper, we will use a new method based on the ESRM that allows us to simultaneously take into account the problems of anti-selection and endogeneity. The remainder of this paper is divided into four (4) sections. The first section presents the literature review, the second section presents the methodology used and the third section presents the results obtained. The conclusion and policy recommendations are presented in the last section.

## 2. Literature Review

Several empirical studies have reported on the impact of access to credit on farm households and its contribution to the national economy. According to Carter and Wiebe (1990), farmers need ex-ante and ex-post access to capital. On the one hand, ex-ante access to capital is necessary to finance vital production costs such as labor and purchase inputs that had to be paid ex-ante, i.e., before the actual production takes place. On the other hand, access to capital after completion of the production process, i.e., access to capital ex-post, is of particular importance where there is no insurance, as is often the case in low-income agrarian economies. Thus, in the event of fluctuations in production, ex-post access to capital is essential to stabilize household consumption from one year to the next.

Moreover, Feder *et al.* (1990) postulate that credit enables farmers to meet the cash flow needs to be induced by the production cycle that characterizes agriculture. Land preparation, planting, cultivation and harvesting generally take place over several months during which very little income is earned, while expenditures on materials, inputs and consumption must be made in cash. Access to credit can, therefore, affect agricultural productivity as farmers facing capital constraints will tend to use lower levels of inputs in their production activities than those not constrained Feder *et al.* (1989); Petrick (2004).

Access to credit is also seen as an important tool to increase consumption and promote production, especially for poor households (e.g., Swain *et al.* (2008); Beatriz and Morduch (2005); Robinson (2001)). This means that access to credit can significantly increase the ability of households to save little or no savings to meet their financial needs for agricultural inputs; particularly agricultural inputs that are much needed for weed, pest and disease control.

According to Boucher and Guirking (2007), the productivity of credit-constrained households depended on their endowment of productive assets and the credit obtained from informal lenders. Similarly, Holden *et al.* (2004) found that households with credit compensated for the increased risk of drought by reallocating their production in such a way that crop sales were worse in past years.

In the same vein, Amha (2010) demonstrates the importance of access to credit in agricultural development by arguing that access to credit allows risky farmers to venture into new areas of economic activity, expand their sources of capital and manage the shocks and stresses that will occur. He further stated that the majority of agricultural poor households need to develop the habit of saving, obtain loans for production and transfer money.

According to Oyateye (1980), the persistent case of low productivity leading to low income and savings capacity can only be compensated for when the poor farmer has access to a credit facility. He added that credit improves the smallholder’s ability to access labor. Low-income households could rise above the poverty line if they had reliable access to several microfinance activities to enhance their asset-creating capacity. Access to credit for them reinforces the need for households at risk to ensure food security.

### 3. Method of analysis

This study aims to measure the impact of access to credit by Togolese farmers on agricultural productivity by adopting the ESRM. Traditionally, previous studies that have attempted to identify the effect of credit on farmers’ productivity have estimated separate production or supply functions for farmers with and without access to credit and then compared the two estimates. However, this method of valuation suffers from two major shortcomings. Firstly, this approach implicitly assumes that all farmers who have access to credit and their counterparts who do not have access are respectively identical in terms of their credit demand or supply situation, which is not obvious. Second, there is also a problem of endogeneity that arises from the fact that access to credit is voluntary or that some farmers are better placed than others to access credit. For example, farmers who are wealthy, educated or more productive are more likely to have access to credit than others. Thus, self-selection in access to credit is the main source of endogeneity in this study.

One of the best ways to explicitly explain this endogeneity is to use simultaneous models by Hausman (1983). More importantly, we adopt an ESRM Awotide *et al.* (2015) in this study because, beyond the endogeneity problem, this model also specifically corrects for any possible sample selection bias that may arise from other interventions that provide multiple services to farmers in addition to credit Lee (1978), Freeman *et al.* (1998), Freeman *et al.* (1998). Using the ESRM, one can assess the direction and degree of non-random selection of farmers with access to credit and the selection biases that are implicit in ordinary least squares (OLS) estimates of access to credit effects. The model used in this study is based on that of Feder *et al.* (1990), Alene and Manyong (2007), Nyangena and Köhlin (2009), Asfaw and Shiferaw (2010), and Lokshin and Sajaia (2004). We first specify the choice of the binary decision of producers’ access to credits as a function of the observed covariates using a probit model as follows:

$$P_i^* = \beta Z_i + \varepsilon_i$$

$$P_i^* = \begin{cases} P_i^*, & \text{Yes, if } P_i^* > 0 \\ P_i^*, & \text{Yes, if } P_i^* \leq 0 \end{cases} \quad \dots(1)$$

Due to selection bias, producers are supposed to be categorized into two regimes as follows:

$$\text{Regime 1 (Access to credit): } G_{1i} = \lambda_1 H_i + \phi_1 C_{1i} + v_{1i} \quad \dots(2a)$$

$$\text{Regime 2 (No access to credit): } G_{2i} = \lambda_2 H_i + \phi_2 C_{2i} + v_{2i} \quad \dots(2b)$$

where  $G_{1i}$  and  $G_{2i}$  are the productivities of farmers in schemes 1 and 2, respectively.  $H_i$  represents a vector of exogenous variables that are hypothetically assumed to determine the productivity function.  $\phi_1$  and  $\phi_2$  are the parameters to be estimated and  $v_1$  and  $v_2$  are the terms of error. Finally, the error terms are assumed to have a trivariate normal distribution, with a null and non-singular mean covariance matrix expressed as:

$$Cov(\varepsilon_i, v_1, v_2) = \begin{bmatrix} \sigma_1^2 & \sigma_{12} & \sigma_{1\varepsilon} \\ \sigma_{21} & \sigma_2^2 & \sigma_{2\varepsilon} \\ \sigma_{\varepsilon 1} & \sigma_{\varepsilon 2} & \sigma^2 \end{bmatrix} \quad \dots(3)$$

where:

$$\sigma_1^2 = Var(v_1); \sigma_2^2 = Var(v_2); \sigma^2 = Var(\varepsilon_1); \sigma_{12} = Cov(v_1, v_2); \sigma^2 = Var(\varepsilon_1); \sigma_{1\varepsilon} = Cov(v_1, \varepsilon_1); \sigma_{2\varepsilon} = Cov(v_2, \varepsilon_1)$$

represents the variance of the error term in the selection equation and  $\sigma_1^2$ ,  $\sigma_2^2$  and represents the variance of the error term in the result equations. According to Maddala (1983), when unobservable factors are associated with selection bias, the important implication of the error structure is that the error term ( $\varepsilon_i$ ) of the selection Equation (1) is correlated with the error terms ( $v_1, v_2$ ) of result functions 2a and 2b, the expected values of  $v_{1i}$ ,  $v_{2i}$  conditional on sample selection are non-zero:

$$E(v_{1i} / P_i = 1) = E(V_{1i} / \varepsilon_i > -Z_i\beta) = \sigma_{1\varepsilon} \left[ \frac{\theta(z_i\beta / \sigma)}{\varphi(z_i\beta / \sigma)} \right] = \beta_{1\varepsilon}\gamma_1 \quad \dots(4a)$$

$$E(v_{2i} / P_i = 0) = E(V_{2i} / \varepsilon_i \leq -Z_i\beta) = \sigma_{2\varepsilon} \left[ \frac{-\theta(z_i\beta / \sigma)}{1-\varphi(z_i\beta / \sigma)} \right] = \beta_{2\varepsilon}\gamma_2 \quad \dots(4b)$$

where:

$\theta$  and  $\varphi$  are the probability density and cumulative distribution functions of the standard normal distribution, respectively. The ratio of  $\theta$  and  $\varphi$  rated at  $\beta z_i$  represented by  $\gamma_1$  and  $\gamma_2$  in Equations (4a) and (4b) are called the Inverse Mills Ratio (IMR) which denotes selection bias terms.

The AMT provides the correlation between access to credit and productivity. Previous studies have used a two-step method to estimate the endogenous switching model (e.g., Lee, 1978; Feder *et al.*, 1990; Fuglie and Bosch, 1995; Freeman *et al.*, 1998). In the first step, a Probit model of the criterion equation is estimated and the AMTs,  $\gamma_1$  and  $\gamma_2$  are derived according to the definitions of Equations (4a) and (4b). In the second step, these predicted variables are added to the appropriate Equation in (2a) and (2b), respectively, to yield the following sets of equations.

$$G_{1i} = \lambda_1 H_i + \beta_{1\varepsilon} \lambda_1 + \phi_1 P_{1i} + \eta_1 \quad \dots(5a)$$

$$G_{2i} = \lambda_2 H_i + \beta_{2\varepsilon} \lambda_2 + \phi_2 P_{2i} + \eta_2 \quad \dots(5b)$$

The coefficient of the variables  $\lambda_1$  and  $\lambda_2$  provides estimates of the terms of covariance  $\beta_{1\varepsilon}$  and  $\beta_{2\varepsilon}$  respectively. Since the variables  $\lambda_1$  and  $\lambda_2$  have been estimated, the residues  $\eta_1$  and  $\eta_2$  cannot be used to calculate standard errors for two-stage estimates. While Lee (1978) suggested a procedure for deriving consistent standard errors especially for the two-stage approach, Maddala (1983) argues that such a procedure requires a potentially cumbersome and complicated process that most studies have failed to implement.

Furthermore, according to Lokshin and Sajaia (2004), the Maximum Probability of Complete Information (MPCI) method is an effective method for analyzing ESRM. Thus, this study uses a one-step approach proposed by these two authors where the FIML method was estimated using the Movestay command available in the STATA 13 statistical software. The FIML method has been adopted by Alene and Manyong (2007) and Asfaw *et al.* (2010) among many others. The FIML simultaneously adjusts the selection equation (Equation 1) and the results Equations (2a) and (2b) to produce consistent standard errors, thereby  $\lambda_1$  and  $\lambda_2$  in Equations (5a) and (5b), respectively homoscedastic. The log-likelihood function of the FIML for the regression model change used in this study proposed by Lokshin and Sajaia (2004) is described below:

$$LnP_i = \sum_{i=1}^n \left\{ \begin{aligned} & P_i t_i \left[ LnF \left( \frac{(z_i\beta + \alpha_{1\varepsilon}(G_{1i} - H_{1i}\lambda / \pi_1))}{\sqrt{1-\alpha_{1\varepsilon}^2}} \right) + Ln(f(G_{1i} - H_{1i}\lambda / \pi_1)) \right] \\ & + (1 - P_i) t_i \left[ \frac{(Ln(1 - F(Z_i\beta + \alpha_{2\varepsilon}(G_{2i} - H_{2i}\lambda / \phi_2)))}{\sqrt{1-\alpha_{2\varepsilon}^2}} \right) + Ln(f(G_{2i} - H_{2i}\lambda) / \phi_2) \end{aligned} \right\} \quad \dots(6)$$

The sign of the correlation coefficients  $\alpha_{1\varepsilon}$ ,  $\alpha_{2\varepsilon}$  has economic interpretations Fuglie and Bosch (1995). If  $\alpha_{1\varepsilon}$ ,  $\alpha_{2\varepsilon}$  have alternative signs, individual farmers obtain credit based on their comparative advantage: farmers who have access to credit have higher than average yields than the average of access to credit and those who choose not to access credit have higher than average yields than those who do not. On the other hand, if the coefficient has the same sign, it indicates a hierarchical sorting: farmers with access to credit have above-average yields whether they have access to

credit or not, but they are better off with access to credit, whereas farmers without access to credit have below-average yields in both cases, but they have an incentive not to have access to credit. The ATT of farmers without access to credit can be calculated as follows:

$$ATT = E(G_{1i} - G_{2i}) / P_i = 1) = H_i(\lambda_1 - \lambda_2) + (\sigma_{1\mu} - \sigma_{2\mu})\gamma_1 \quad \dots(7)$$

In the equation,  $E(G_{1i} / P_i = 1) = H_i\lambda_1 - \sigma_{1\mu}\gamma_1$ , represents the expected outcome for households that would have had access to credit if they had chosen to access credit.  $E(G_{2i} / P_i = 1) = H_i\lambda_2 - \sigma_{2\mu}\gamma_1$  represents the expected productivity for farm households with access to credit, if they had chosen not to have access to credit. The ESRM empirical equation to be estimated is the demand side of the credit function, which is a Probit regression and a production function. The access equation for the credit decision, which is equivalent to Equation (1), is specified as follows:

$$ACCESCRED = f(AGE, AGE2, SUP, SEXE, NIVINSTR, SITMAT, STATENC, STATPROFON, \\ CULVIV, REG, POSSANIM) \quad \dots(8)$$

The separate productivity function for producers who had access to credit and those who did not, similar to Equation (5), is as follows:

$$\ln(PRODUCT) = f(AGE, AGE2, SUP, SEX, NIVINSTR, SITMAT, STATENC, \\ STATPROFON, CULVIV, REG, POSSANIM) \quad \dots(9)$$

The definition and description of the variables included in the model are presented in Table 1 in the Appendix. The data that fed our models are derived from the Fourth National Agricultural Census (RNA) carried out in Togo in 2012 which covers the five (5) regions of the country. The data covered a sample of 1,312 farmers according to our variables of interest.

<b>Table 1: Definition of Variables</b>		
<b>Variables</b>	<b>Definitions and Measurement</b>	<b>Expected Sign</b>
<b>Dependent Variables</b>		
ACCESCRED	1 if the farmer has access to credit	
PRODUCT	Value of total production on the area (FCFA/ha)	
<b>Independent Variables</b>		
SUP	Farm size in ha	
CULVIV	Food crops	+
AGE	Age of head of household in years	-/+
SEX	1 if the head of the household is a man	-/+
NIVINSTR	In years of education: 0 "No level of education"; 1 "Primary level" and 2 "Secondary/Higher level".	+
SITMAT	0 If the head of household is single, 1 if the head of household is married and 2 if the head of household is divorced/widowed	-/+
STATENC	1 if there is a managerial structure and 0 if not	+
POSSANIM	1 if the head of the household raises animals, 0 if not	+
STATPROFON	0 if the head of the household has no land security, 1 if the head of the household has a land title, a land purchase contract or is a landowner	+

Table 1 (Cont.)		
Variables	Definitions and Measurement	Expected Sign
REG	1 if the farmer is from the Savannah region, 2 if the farmer is from the Kara region, 3 if the farmer is from the Central region, 4 if the farmer is from the Plateaux region, 5 if the farmer is from the Maritime region.	

*Source: Author, 2020*

## 4. Analysis of the Results

### 4.1. Descriptive Analysis

According to the analyses, the descriptive statistics of the explained variable show that out of the 1,312 farmers, only 451 were able to access credit, i.e., about 34%, compared to 861 who did not have access, i.e., 66% (Table 2, in Appendix). Access to credit means that regardless of the amount requested, a part of the total amount of the loan was granted, while for non-access the loan was refused. This leads us to the conclusion that all operators are then in a situation of credit rationing or not by the MFIs.

Table 2: Number of Farms With or Without Access to Credits			
	Staff	Percentage	Cumulative Percentage
NO ACCESS	861	65,62%	65,62%
ACCESS	451	34,38%	100%
TOTAL	1312	100%	–

*Source: Author's calculation, based on data from the 4th RNA (2011/2014), 2020.*

Descriptive statistics for the explanatory variables are presented in Table 3 in the Appendix.

Table 3: Descriptive Statistics of the Explanatory Variables Used		
Variables	Access to Credit	No Access to Credit
Gender (% males)	52,99	56,21
Marital status (% Married)	51,16	25,24
Age	41,73	45,89
Level of education (% at least primary school)	58,31	48,71
Land ownership status (% YES)	83,57	75,40
Animal possession (% of YES)	10,26	4,87
Management status (% management)	1,77	00,00
Region:		
- Maritime	23,10	15,10
- Trays	15,86	11,59
- Central	16,41	13,15
- Kara	16,67	26,04
- Savane	37,95	34,11



Table 3 (Cont.)		
Variables	Access to Credit	No Access to Credit
Food crops	87,75	90,53
Area	66,88	51,73
Productivity	18,55	16,27

Source: Author's calculation, based on data from the 4th RNA (2011/2014), 2020.

Descriptive analysis of the explanatory variables shows that in the group of farmers without access to credit, about 44% of the heads of households are headed by women against 56% headed by men. As for the farmers who had access to credit, about 47% of the heads of households are headed by women against 53% for men. These figures show that, in the Togolese context, Microfinance Institutions (MFIs) trust men more than women in granting loans. The proportions of farmers who own a land title vary significantly according to whether or not they have access to credit. For example, 84% of farmers with land or other titles have access to credit, compared to 75% of those without access to credit. As for the level of education, we find about 42% without any level of education among farmers who have had access to credits. As for the farms that did not have access to credits, more than 51% did not receive any education.

Concerning the status of supervision, the analysis shows that only 2% of farmers with access to credit are supervised by a supervision structure, whereas none of the farmers without access to credit have benefited from supervision. Is the practice of growing food crops a condition for access to credit?

Indeed, more than 88% of farmers who grow food crops have access to credit. And for those who do not have access to credit, this proportion corresponds to about 91%. It can be seen that the proportion of farmers who grow food crops does not vary significantly according to access to credit. The average age of farmers is 44 years. There is no significant difference in the age of farmers. Thus, the average age of farmers who have had access to credit is 42, compared to 46 for farmers who have been refused credit. The proportions of households whose heads are married vary significantly according to access to credit.

51% of farmers who have access to credit are married compared to 25% of their counterparts who do not have access. Farmers' cultivated area varies significantly depending on whether or not the household has access to credit, with 66.88 ha and 51.73 ha respectively for farmers who had access and those who did not. It is also noted that farmers with access to credit have higher productivity than those without access. At the regional level, the savannah region has the highest proportion (38%) of farmers with access to credit compared to the other regions. This is also true for farmers who do not have access to credit.

#### 4.2. Impact of Access to Credit on Productivity

This section presents the empirical assessment of the impact assessment. The basic impact model adopted is the ESRM, which is capable of controlling for all possible biases that could skew our results. The estimation results are presented

Table 4: Endogenous Switching Regression Model Estimates			
Variables	(3) Credit Access	(2) Credit Access = 1	(1) Credit Access = 0
AGE	0.787 (0.166) ***	-0.715 (0.171) ***	0.480 (0.148) ***
LSUP	0.0171 (0.0288)	-0.0431	-0.0145
CULVIV	0.0350 (0.0573)	0.0211 (0.0528)	-0.0992 (0.0559) *
SEX	-0.00319 (0.0834)	0.0385 (0.0831)	-0.0281 (0.0721)

Table 4 (Cont.)			
Variables	(3) Credit Access	(2) Credit Access = 1	(1) Credit Access = 0
NIVINST	0.0217 (0.0501)	0.0296 (0.0498)	-0.0428 (0.0442)
SITMAT	-0.268 (0.0908) ***	-0.175 (0.0883) **	0.214 (0.0858) **
STATENC	-0.657 (0.103) ***	-0.344 (0.118) ***	0.435 (0.0722) ***
POSSANIM	0.498 (0.0839) ***	-0.388 (0.0857) ***	0.318 (0.0745) ***
REG	0.0613 (0.0259) **	0.0862 (0.0250) ***	-0.0193 (0.0225)
AGEsq	0.394 (0.0743) ***	0.333 (0.0766) ***	-0.238 (0.0652) ***
STATPROFON	-0.00504 (0.0318)	-0.0319 (0.0310)	0.0654 (0.0274) **
Constant	0.263 (0.181)	2.085 (0.172) ***	1.439 (0.170) ***
/lns_0	-0,042 (0,0301)		
/lns_1	-0,063 (0,0461)		
r0	-2,380 (0,1581) ***		
r1	2,207 (0,131) ***		
Sigma_0	0,959 (0,0288)		
Sigma_1	0,9387 (0,0433)		
rho_0	-0,9830 (0,0053)***		
rho_1	0,976 -0,0062) ***		
LR test of indep. eqns. $\chi^2(2) = 254.11$ , Prob > $\chi^2(2) = 0, 0000$			
<b>Note:</b> Standard errors in parentheses, *** $p < 0.01$ , ** $p < 0.05$ , * $p < 0.1$ Source: Author's calculation, based on our data, 2020.			

in Table 4 in the Appendix. The estimation result is composed of three (3) parts, one part of which is the Probit model of the determinants of access to credit. The result of the Probit model reveals that the variables age, marital status, management status region and animal ownership have the expected sign and are statistically significant in determining farmers' access to credit.

The coefficient of the variable STATENC is negative contrary to the expected sign but significant at the 1% threshold. This result indicates that whether or not the farmer is supervised by an agronomy structure does not determine the decision to grant credit. This can be explained by the scarcity of management structures, especially public ones, in Togo in recent years. The POSSANIM variable has a positive sign coefficient following the expected sign and is significant at the 1% threshold. This indicates that the possession of animals by the farmer influences the decision to grant credit. Thus, the fact of owning animals is a sign of wealth and increases the chance of access to credit among farmers.

The estimated coefficients of the second stage ERSM model for farmer productivity (output per hectare) are presented in the second and third columns of Table 4. The results of the regression of productivity for farmers with access to credit are reported in the column credit access = 1 and those without access in the column credit access = 0.

At the same time, the variables animal ownership, land ownership status, management status and age have negative coefficients and are statistically significant in explaining productivity variations among farmers with access to credit. This could be because for the livestock ownership variable, the more livestock farmers have, the less likely they are to be engaged in agricultural production. Livestock could have the capacity to take resources out of farmers' production and thus contribute to reducing productivity. Similarly, for the age variable, it is often assumed that the productivity of



older farmers is lower than that of middle-aged farmers. This hypothesis corresponds to an analysis of age as a factor of decline: decline in physical capacities, cognitive capacities, among others. Thus, advanced age could contribute to a decline in farmers' productivity. In terms of management status, this could be because farmers who are not supervised do not have new techniques to improve their productivity. The descriptive analysis above shows that in Togo less than 5% of farmers benefit from supervision or support. The case of the variable landowner status would be justified by the fact that most Togolese farmers do not have the security of tenure.

The correlation coefficients  $\rho_0$  and  $\rho_1$  have alternating signs ( $-0.983$  and  $0.976$ ) and are statistically significant. This implies that individual farmers obtain credit based on their comparative advantage: farmers with access to credit have higher than average returns than those without access to credit and those who choose not to access credit have higher than average returns than those without access to credit. Since the correlation coefficient  $\rho_0$  is negative and significantly different from zero, the model assumes that those who choose to access credit have higher productivity than a random farmer could obtain. The likelihood ratio for joint independence of the three equations is significant at the 1% threshold. This indicates that these three models are not jointly independent and cannot be estimated separately.

Table 5 in the Appendix shows that the mean treatment effect on treatment (TAT) is equal to 2.5211 and the  $t$ -stat of TAT ( $-0.36$ ) shows that it is statistically and significantly different from zero. This indicates that those who have access to credits have higher productivity than those who do not.

Variable	Obs	Mean	Pte Err	$t$ -Stat
ATT	1095	2,52109613	0,077149204	-0,36

Source: Author's calculation, based on our data, 2020.

## 5. Conclusion

This study has made it possible to measure the impact of access to credit on the productivity of Togolese farmers. Therefore, we used the Endogenous Commutation Regression model. The results of the first step of the estimation of the ERSM model show that the variables age, marital status, management status, region and animal ownership have the expected sign and are statistically significant in determining farmers' access to credit. The results of the second step indicate that the variables animal ownership, land ownership status, management status and age have negative coefficients and are statistically significant in explaining productivity variations among farmers with access to credit. There is, therefore, a significant difference between farmers who have access to credit and those who do not. Thus, farmers who have access to credit have higher productivity than those who do not. Ultimately, access to credit is a crucial factor in the search for increased agricultural productivity. This study, therefore, recommends that Togolese decision-makers include access to credit and all techniques aimed at promoting access to credit in all agricultural development policies in Togo.

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