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Full Length Research Paper

Determinants analysis of loan use and repayment behaviour among farmers in Benin: A semi-nonparametric bivariate probit approach

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This paper analysed the determinants of the use and repayment behaviour of loans among farmers in Benin. Data were collected from 400 farmers randomly selected from twenty villages' representative of the country's seven Agricultural Development Hubs (ADH). The data were analysed using a semi-non parametric bivariate probit approach. The results indicated that there was a relationship between the decision to use the loans and the decision to repay them. In total, nine explanatory variables in the model were significant. Three of these variables (education level, membership of a farmer organization and income) determined with different levels of significance the use of q and default on loan repayment. Five of these variables (age, sex, household size, farm size and contact with extension services) influenced loan use, but had no significant effect on loan repayment. A single variable (asset value) had no effect on loan use, but had significantly affected the repayment of the loan. Based on these results from Benin, MFIs in developing countries should take into account significant variables when concluding contracts with borrowing farmers.

Keywords: Farmer, agricultural credit, repayment, bivariate probit model, sample selection, Benin

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INTRODUCTION

Agricultural credit, a potential solution to rural finance needs, has direct and indirect effects on agricultural production. Access to credit, on the one hand, allows poor farmers to access the inputs necessary for the adoption of new technologies in agricultural intensification, and on the other hand, strengthens the capacity of non-poor farmers to acquire agricultural equipment or to make long-term investments which are very costly to finance with their own resources (Fall, 2006; Guirkinger and Boucher, 2008). Despite the importance of credit for the development of economic activities, conventional banking institutions find it difficult to guarantee the supply of credit to small economic actors, in particular small farmers in rural areas. Indeed, the financing of any project, without discrimination, whatever the risk, would lead to low repayment rates and expose banks to a risk of insolvency and bankruptcy (Djogo, 1994; Gentil and Servet, 2002). The alternative solution found has been to promote good recovery rates, by imposing secure guarantees to minimize the risk of non-repayment. The reluctance of banks to offer loans to small businesses has led to the diversion of formal banking systems from a large number of economic actors

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with high growth potential, who are unable to fulfil the conditions required. In order not to leave these actors excluded from the traditional financial systems without funding or at the mercy of the informal sector, the economic space thus abandoned by traditional banks has been taken over by microfinance institutions (MFIs). The latter are forms of savings and/or credit institutions created for grassroots populations, with a view to ensuring their economic and social self-promotion, with or without the technical and/or financial support of external partners. To circumvent the asymmetry of information, the main problem of the efficient functioning of traditional financial systems, the main important innovation brought by MFIs is the substitution of mutual surveillance for material guarantees. The objective is to allow poor economic actors to have access to credit, while limiting the low repayment rates in the Microfinance institution (MFI). This strategy has produced encouraging results during the first years of its implementation. Globally in 2017, microfinance institutions (MFIs) reached 139 million customers for an estimated total loan of $ 114 billion, an annual growth of 15.6% in the credit portfolio and 5.6% of total number of borrowers compared to 2016 (BM, 2018). In Benin in 2017, MFIs had 2,197,393 clients, for a credit outstanding of 154.965 billion CFA francs ($1,910 billion) and a deposit in progress of 102.689 billion CFA francs ($ 169,733 million) (ANSSFD[1], 2018). However, despite this performance, MFIs face enormous challenges that threaten their survival. In 2017, outstanding debts reached 12.525 billion CFA francs ($ 20,702 million), or 8.2% of the loan amount, compared to a standard of 3% accepted in the sector (ANSSFD, 2018). These figures mask differences in performance from one year to the next or from one MFI to another. From the 2nd quarter of 2016 to the 2nd quarter of 2017, the rate of the portfolio at risk at 90 days for all MFIs in Benin went from 5.9% to 14.3% (ANSSFD, 2017). In 2004, the IMF ALIDE[2] experienced an unprecedented crisis, with arrears that reached 50% of the loan portfolio (Thys and Pouget, 2007). In June 2005, PADME’s portfolio at risk reached 6.7% (Kirkwood and Azokli, 2005). In the first quarter of 2017, only two MFIs (CECAC[3] and FESPROD[4]) posted a normal default rate (less than 3%). Eight MFIs (CPEC[5], PADME[6], PAPME[7], PEBCO-BETHESDA[8], ACFB[9], FIDEVIE[10], COMUBA[11] and AFRICA FINANCE) recorded a default rate varying between 3% and 5%. Ten MFIs (VITAL FINANCE, FECECAM[12], APHEDD FINANCE[13], CODES[14], CBEC[15], LE MUTUALISTE, COOPEC AD[16], CMMB[17], MODEC[18] and MSFP[19]) display a 90-day risk portfolio varying between 5% and 10% (ANSSFD, 2017). Faced with this high level of bad debts, which threatens the sustainability of microfinance institutions, the dilemma faced by Beninese MFIs is how to significantly reduce default rates without having to tighten the conditions for granting loans to small economic actors, farmers in particular? This article sought to answer this central question, by analysing the determinants of loan repayment default by farmers in Benin.

The rest of the article is as follows: we discuss the literature review in the next section. Section 3 describes the methodology. The empirical results and their discussion are presented in section 4 and the conclusion and implications in section 5.

Literature review

Various studies around the world and in Africa have analysed the factors determining loan repayment performance. Some studies have used a Logit model (Abdu *et al.*, 2015; Abdul-Mumin and Sulemana, 2014; Melese and Asfaw, 2020; Kefeni, 2018; Yeboah and Oduro, 2018; Ume *et al.*, 2018; Enimu *et al.*, 2017; Haile, 2015; Jote, 2018; Kamu, 2012; Kinyondo and Okurut, 2009; Lamboni, 2008; Mitei, 2017; Mokhtar *et al.*, 2012; Muthoni, 2016; Ojiako *et al.*, 2014; Oladeebo and Oladeebo, 2008; Pasha and Negese, 2014; Shu-Teng *et al.*, 2015; Wamalwa, 2016; Yibrie and Ramakrishna, 2017), while others used a Probit model (Bourlès *et al.*, 2018; Dadson, 2012; Godquin, 2006; Ibrahim and

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[3]Coopérative d'Epargne, de Crédit Agricole et Commercial de Bénin (Savings, agricultural and commercial credit cooperative of Benin)
[4]Femmes Solidaires pour la Promotion et le Développement (Women in Solidarity for Promotion and Development)
[5]Coopérative pour la Promotion de l'Epargne et du Crédit (Cooperative for the Promotion of Savings and Credit)
[6]Promotion de l’Appui au Développement des Micro-Entreprises (Promotion of Support for Micro-Enterprise Development)
[7]Promotion et l'Appui aux Petites et Moyennes Entreprises (Promotion and Support to Small and Medium Enterprises)
[8]Promotion de l'Epargne-Crédit à Base Communautaire (Promotion of Community-Based Credit Savings)
[9]Association des Caisses de Financement à la Base (Association of Funding Funders at the Base)
[10]Financement du Développement, de l'Environnement et de la Vie (Financing for Development, Environment and Life=
[11]Coopérative des Membres Unis Bethel Actions (Bethel Actions United Members Cooperative)
[12]Faîtière des Caisses d'Epargne et de Crédit Agricole Mutuel (Ridge of Mutual Agricultural Credit and Savings Banks)
[13]Association pour la Promotion de l’Homme, la Protection de l’Environnement pour un Développement Durable Finance (Association for the Promotion of Man, Environmental Protection for Sustainable Development Finance)
[14]Caisse des Opérateurs pour un Développement Economique et Social (Operators' Fund for Economic and Social Development)
[15]Caisse Béninoise d'Epargne et de Crédit (Beninese Savings and Credit Union)
[16]Coopérative d’Epargne et de Crédit des Assemblées de Dieu du Bénin (Beninese Savings and Credit Cooperative of the Assemblies of God)
[17]Caisse du Mouvement Mutualiste Béninois (Benin mutual fund)
[18]Mutuelle Organisée pour le Développement de l'Epargne et le Crédit (Organized Mutual for Savings and Credit Development)
[19]Mutuelle des Services Financiers pour la Prospérité (Mutual Financial Services for Prosperity)

Zareba, 2015; Modisagae and Ackermann, 2018) or Tobit (Deininger and Liu, 2009).

In Benin, Adégbola *et al.* (2011) and Honlonkou *et al.* (2006) analysed the determinants of repayment performance in MFIs and effective loan repayment mechanisms for food crops, using a Probit model and a Tobit model respectively.

These different studies have identified several variables as a determinant of loan repayment performance. We can cite: gender, age, social status, marital status, household size, number of dependents, level of education, literacy, waiting time for loan, size of loan, interest rate, loan duration, proximity of loan source, loan diversion, repayment period, training, supervision and advice visits, turnover, annual income, social network, group size, experience in the activity, asset value, type of activity, income from non-agricultural activities, size of farm, cash crop and geographic location.

Using Logit, Probit or Tobit models, studies have suggested that the decision to repay the loan is made in one step. However, to repay a credit, you must have used it. This means that the decision is made in two stages, using the credit and paying it off. Van Nam and Duy (2016) studied the determinants of loan repayment among rural borrowers in the Mekong region of Vietnam, using a double-hurdle model, supplemented by a Probit model with an instrumental variable. According to Nduati (2012), the loan use is critical because it affects the loan repayment. He stressed that if the borrower diverts the funds for other purposes, he will not be able to generate sufficient income to repay them. However, the impact of use on the repayment of loans among farmers remains an area of study that has not been sufficiently covered in the existing literature. Ibrahim and Zareba (2015) in Sudan have addressed this aspect, using a bivariate Probit model, to show that the factors determining the use and repayment of the loans respectively are the same. Although this study used a two-step approach, the sample selection bias could not be corrected. No study has yet analysed the determinants of loan repayment, using a two-step approach with correction for sample selection bias. This study aims to contribute to the scientific debate, using a bivariate Probit model, in particular a semi-non-parametric bivariate Probit approach, to analyse the determinants of loan repayment performance among farmers in Benin. In other words, are loan usage and repayment decisions linked? What are the variables that determine each of them?

MATERIALS AND METHODS

Theoretical frame

Imperfection and asymmetry of information on the credit market

Credit markets in developing countries, such as those in Benin in West Africa, tend to fail mainly because of problems with contract management and information asymmetry. Contract management difficulties arise when borrowers are unable to repay the loan due to a legitimate inability to repay it (e.g. weather conditions that negatively affected production) or the deliberate refusal to repay the loan (Besley, 1994). Compliance with contracts is generally rare in the credit markets of developing countries, because of the prohibitive costs of enforcing them. Lenders lack sufficient information to be able to distinguish between high and low risk customers (Kohansal and Mansoori, 2009). For this reason, the lender places all borrowers in a risk group and charge the same interest rate. If the markets were perfect, the lender would separate them into two groups with two different interest rates, depending on the risks.

Faced with asymmetric information, lenders may end up under-offering credit and, in extreme cases, stop offering loans. Very common in the credit markets of developing countries, this situation of under-supply of credit is called "*market failure or imperfection*". Simtowe *et al.* (2008) reported that before the use of microcredit, farmers in developing countries faced the problems of credit rationing. At a given interest rate, a borrower wants to borrow more, but the lender refuses. Although a low interest rate seems to have a positive effect, credit rationing decreases the potential for poverty reduction, as it provides less credit than that required by market equilibrium. According to Guirkinger and Boucher (2008), to reduce information asymmetry, a farmer who has no money and who needs a loan to finance his production must offer a guarantee.

Credit rationing and the use of collateral are the two most common methods used by banks to deal with the problem of information asymmetry in the credit market (Stiglitz and Weiss, 1981). But these methods mechanically lead to the exclusion of poor borrowers from the credit market. Many theoretical models have been proposed to microfinance institutions in order to effectively resolve information asymmetry problems on the credit market without resorting to physical collateral. These models have been the subject of several literature reviews (see for example Ghatak and Guinanne, 1999 or Morduch, 1999). To explain how microfinance successfully offers loans to this poor clientele, a large number of studies use agency models to show that by lending to groups of borrowers in solidarity on the repayment of their loans, the contracts of microfinance helps to remedy anti-selection (Ghatak, 1999) as well as the problems of moral hazard (Stiglitz, 1990) linked to information asymmetry. Another class of models, such as that of Besley and Coates (1995), shows that the use of grouped loan contracts also improves repayment rates because social interactions make the non-repayment strategy more expensive (also called moral hazard ex post). Social connections (Besley and Coates, 1995) and the homogeneity of borrowers groups (Besley and

Coates, 1995; Stiglitz, 1990) also influence repayment performance, as they favour control of the borrower's actions (monitoring of pairs) and pressure for repayment (pressure of pairs). Group homogeneity and social connections are also indirectly associated with better repayment performance to the extent that they can indicate effective self-selection of loan group members.

Group credit is by far the most important feature of microfinance loan contracts, by institutions, the media and economic research. However, group loans are just one of the mechanisms that make microcredit special compared to conventional loan contracts. Most MFIs also use other mechanisms such as *frequent repayment terms* – the most common repayment frequency being weekdays and some institutions collect repayments daily.

De Aghion and Morduch (2000) show that adapting the frequency of repayments to household income flows can improve repayment performance, reducing the problems of temporal inconsistency of poor borrowers with a strong preference for the present. Jain and Mansuri (2003) propose another justification for using high repayment frequencies. According to these authors, the use of a weekly repayment frequency is a way for MFIs to extract information on borrowers. The argument being that in the presence of a developed informal financial sector, requiring a weekly repayment leads the borrower to borrow from the informal sector to meet the first repayment deadlines. This allows MFIs to take advantage of the capacity of informal lenders to monitor the use of loans.

Likewise, *dynamic incentive mechanisms* (Besley, 1995; De Aghion and Morduch, 2000) can be used by MFIs to increase their repayment performance. We are talking about dynamic incentive mechanisms to refer to the threat of no longer granting a loan to a borrower who has not respected the loan repayment schedule. Another form of dynamic incentive mechanism consists in conditioning the granting of a larger credit to the good repayment of the previous credit (this technique is commonly called the progressive loan).

A final common practice of MFIs is the *provision of non-financial services* in addition to savings and credit services (Edgcomb and Barton, 1998). These services increase the repayment capacity of borrowers while increasing the value they place on their relationship with MFIs.

All of the above mechanisms are considered to constitute financial innovations (Edgcomb and Barton, 1998) which allow MFIs to lend to the poor while respecting the objectives of financial sustainability. When the use of these mechanisms is insufficient to allow MFIs to reach a repayment rate of 100%, which corresponds to the first best optimum, and when borrowers do not all have the same probability of default on loan repayment, the MFI may seek to achieve a second best optimum where the total amount of loans repaid on time is maximized.

Corporate governance in MFIs

Microfinance, in its complex mission of promoting well-being and business logic and therefore market profitability, finds itself torn between standards and values (Hudon, 2008). Hudon (2008) offers an analysis of MFIs following a projection on two axes which are profit motivation, where MFIs are strictly governed by standards (such as the interest rate), rules and procedures clear and decision making style. This last axis emphasizes public governance, based on an inclusive decision-making style and tends to keep MFIs around the fundamental ethical values of original microfinance. According to one or other of the axes, a distinction will be made between profit-oriented and non-profit MFIs, both identified in the microfinance landscape in Benin. Corporate governance includes rules relating to the protection of minority actors, the prevention of internal conspiracies and conflicts of interest and the accountability facilitation (World Bank, 2002). The principle of collective action that underpins corporate governance can positively affect the conduct of loan provisioning processes, the internal management and performance of MFIs and probably the repayment of loans. The very special character of the client, the farmer, is that he has not sufficiently penetrated the credit market, especially since there is little credit history and therefore that adverse selection and moral hazard are more or less exaggerated by MFIs. This generates high credit costs for farmers and could increase default on loan repayment (Brosig and Hockmann, 2005). Better still, we would attribute a mutual adverse selection relationship to the MFI and to the farmer in a context where the latter has little training and his context exposes him to repeated fraud. In addressing the question of performance within the MFI, Macey and O'hara (2003) evoke the dual nature of incentives between the leaders of the MFI and its Board of Directors on the one hand and between the MIF and its clients on the other hand. In the second case, it is the external rules that govern customer relationships and the rules of the market and competition (Hart, 1983; Schmidt, 1997; Gorton and Winton, 2003). Linking his analysis to the question of repayment of credit, it is optimal to note that the default on loan repayment depends both on the existence and the respect of consistent internal rules and on a vision which would tend to build trust between providers agricultural microcredit services and farmers: once again, the principle of collective action is important.

Specification of the semi-nonparametric bivariate probit model

Following Ibrahim and Zareba (2015), we used a simultaneous bivariate Probit model to analyse the determinants of repayment performance among farmers. This choice assumes that loans use and loan repayment are variables of probability functions. The two dependent variables used to analyse binary results are loan usage and loan repayment. In this research, the first decision (Y_1^*) takes the value "1" if a farmer declares having requested for a loan during the 2018/2019 campaign and "0" otherwise. The second decision (Y_2^*) takes the value "1" if a farmer report default on loan repayment in the same campaign and "0" otherwise. These are a double-bounded dichotomous choices, in which the jth respondent is presented, as in the single bound approach, with the first decision (loan use) - but after responding, is presented the second decision (loan repayment). The second decision depends on the answer given for the first decision. Consequently, there are four pairs of possible answers: the answers to the two decisions are both yes (yes, yes), the two answers are no (no, no), the respondent accepts the first decision but rejects the second (yes, no) and the respondent rejects the first decision but accepts the second one (no, yes).

To analyse double-bounded data, the traditional approach assumes that one is directly interested in the second decision (loan repayment) without being interested in the first decision (use of the loan). This approach is known in the literature as the interval data model (Hanemann *et al.*, 1991). Cameron and Quiggin (1994) relax this assumption and suggest that the respondent could refer to two separate decisions, one for each discrete choice question. Since both decisions can be made at the same time, a bivariate model for the analysis of double-bounded data is introduced. Let Y_{1j} and Y_{2j} be the jth equations of the respondent for the two decisions. Assuming a linear functional form in a manner analogous to a seemingly unrelated regression, the lack of independence between Y_{1j} and Y_{2j} can be described by the following system of bivariate equations:

$$\begin{cases} Y_{1j} \ = \ \beta_1 X_{1j} + \varepsilon_{1j} \\ Y_{2j} \ = \ \beta_2 X_{2j} + \varepsilon_{2j} \end{cases} \quad (1)$$

where X_{1j} and X_{2j} are vectors of independent variables, β_1 and β_2 are vectors of coefficients to be estimated, ε_{1j} and ε_{2j} are the error terms.

Let Y_{1j} and Y_{2j} be the responses of the jth respondent to the first and second decisions respectively. Y_{1j} and Y_{2j} are binary variables and can be related to the decisions defined in the following Equation:

$$\begin{cases} Y_{1j} \ = \ 1 \ il \ \beta_1 X_{1j} + \varepsilon_{1j} \geq \ \beta_1 X_{1j}, otherwise \ Y_{1j} \ = 0 \\ Y_{2j} \ = 1 \ if \ \beta_2 X_{2j} + \varepsilon_{2j} \geq \beta_2 X_{2j}, otherwise \ Y_{2j} \ = \ 0 \end{cases} \quad (2)$$

Equation (2) simply means that Y_{1j}= 1 if the respondent answers yes to the first decision (loan use) and 0 if he rejects it. Likewise, Y_{2j}= 1 if the respondent answers yes to the second decision (default on loan repayment), and 0 if he rejects it.

Let R be a sample of respondents, the log-likelihood function of the responses given by these respondents to the first and second decisions of the double-bounded dichotomous choice is:

$$LnL = \sum_{j=1}^{R} \Big[d_j^{YY} Ln\Big(1 - F_1(w_{1j}) - F_2(w_{2j}) - F_{12}(w_{1j}, w_{2j}; \rho_{12})\Big) + d_j^{NN} Ln\Big(F_{12}(w_{1j}, w_{2j}; \rho_{12})\Big) + d_j^{YN} Ln\Big(F_2(w_{2j}) - F_{12}(w_{1j}, w_{2j}; \rho_{12})\Big) + d_j^{NY} Ln\Big(F_1(w_{1j}) - F_{12}(w_{1j}, w_{2j}; \rho_{12})\Big)\Big] \quad (3)$$

where d_j^{YY}= 1 for a yes-yes answer and 0 otherwise; d_j^{NN}= 1 for a no-no answer and 0 otherwise; d_j^{YN}= 1 for a yes-no answer and 0 otherwise; d_j^{NY}= 1 for a no-yes answer and 0 otherwise; F_{12} is the joint Cumulative Distribution Function (CDF) of the error terms of loan use and repayment; for i = 1 and 2, Fi represents the marginal CDF and $w_{1j} = B_{ij} - \beta_i X_{ij}$; ρ_{12} is the correlation coefficient between ε_{1j} and ε_{2j}.

The formulation of the log-likelihood function in equation (3) depends on the CDF (F1, F2 and F12) of the loan use and repayment. In order to estimate the response to the first and second decisions using the maximum likelihood, existing applications of the double-bound approach have relied heavily on parametric hypotheses concerning the CDF of the error terms (for example Koss and Khawaja, 2001). Arbitrary distributions (normal, logistic, Weibull, etc.) are generally considered. However, if these hypotheses are incorrect, they will lead to biased and inconsistent estimates. Therefore, this article uses a semi-non parametric bivariate Probit (SNP biprobit) model, which relaxes the distribution hypotheses on the error terms, in order to analyse the double-bounded data. Following Gallant and Nychka (1987), we propose a SNP biprobit model which approaches the joint density function of non-normal densities using a Hermite form specified as follows:

$$f_{12}^*(\varepsilon_1, \varepsilon_2) = \frac{1}{\theta_k}\left[\Psi_k(\varepsilon_1, \varepsilon_2)\right]^2 \phi(\varepsilon_1)\phi(\varepsilon_2) \quad (4)$$

Where $\Psi_k(\varepsilon_1, \varepsilon_2) = \sum_{k_1=1}^{K_1} \sum_{k_2=1}^{K_2} \tau_{k_1 k_2} \varepsilon_1^{k_1} \varepsilon_2^{k_2}$ is a Hermite

polynomial in ε_1, and ε_2 of order K = (K1, K2), ϕ is the normal density function and

$$\theta_k = \int_{-\infty}^{\infty}\int_{-\infty}^{\infty}\left[\Psi_k(\varepsilon_1, \varepsilon_2)\right]^2 \phi(\varepsilon_1)\phi(\varepsilon_2)\, d_{\varepsilon_1} d_{\varepsilon_2}.$$

An advantage of the Hermite form (Equation 4) is that the non-negativity of the joint density function f_{12}^* is guaranteed by the square of the Hermite polynomial. Second, the factor θ_k ensures that f_{12}^* is an appropriate density (that is, it fits into 1). Finally, this family of non-normal densities nests the normal bivariate density if the correlation coefficient ρ_{12} is equal to zero (De Luca and Peracchi, 2007).

The integration of the joint density function (Equation 4) gives the following joint CDF:

$$F_{12}^{*}(\varepsilon_{1,}\varepsilon_{2}) = \frac{1}{\theta_k}\int_{-\infty}^{\infty}\int_{-\infty}^{\infty}\left[\Psi_k(\varepsilon_{1,}\varepsilon_{2})\right]^2\phi(\varepsilon_1)\phi(\varepsilon_2)\,d_{\varepsilon_1}d_{\varepsilon_2} \quad (5)$$

Similarly, the integration of the joint density function with respect to ε_1 and ε_2 gives the marginal CDF (F_1^* and F_2^*) of ε_1 and ε_2. The SNP biprobit estimators are therefore given by the maximization of the pseudo-likelihood function obtained by replacing the unknown CDF F1, F2 and F12 in Equation (4) by the final expression of F_1^*, F_2^* and F_{12}^*. As shown by Gabler *et al.* (1993), the resulting maximum likelihood estimator is consistent when the K order of the Hermite polynomial increases with the sample size. In practice, for a given sample size, the value of K is selected using a sequence of simple likelihood ratio tests. Integration of the joint density function gives the joint CDF. Similarly, integration of the joint density function with respect to the error terms gives the marginal CDF. In the empirical section, the SNP2S biprobit method is used to estimate the system of equations (2).

Data and variables

The data used come from a survey carried out in March 2019 in the seven Agricultural Development Hubs (ADH) of Benin. The study adopted a two-step stratification approach to improve its internal and external validity. Initially, 20 villages were selected among the 23 villages selected as Research-Development sites by INRAB (1997) in the seven ADHs and selected as Research and Development villages by INRAB (1997). Secondly, 20 farmers are randomly chosen from each of the villages, for a total of 400 farmers surveyed.
The main characteristics highlighted in the literature review to determine loan use and repayment performance are diverse. Those include in the models are fourteen: sex, age, household size, education, association/group membership, farming experience, experience in using the loan, income, farm size, contact with extension services, social status, marital status, literacy and asset value. However, the influence of these factors on loan use and repayment performance is not unanimous.

Sex (SEX): Binary variable which takes the value 1 if the respondent is a woman and 0 otherwise. Compared to men, women borrowers are more likely to experience repayment defaults (Fikirte, 2011; Modisagae and Ackermann, 2018; Muthoni, 2016; Nawai and Shariff, 2012; Van Nam and Duy, 2016; Yibrie and Ramakrishna, 2017). This contradicts the results of studies which indicate that women borrowers are more creditworthy than men and the probability of default decreases with their presence and is higher among men (Enimu *et al.*, 2017; Kamu, 2012; Lamboni, 2008; Modisagae and Ackermann, 2018; Mokhtar *et al.*, 2012). Given the creditworthiness of women, they are favoured by MFIs in the supply of loans, with a general orientation of credits to activity sectors such as trade and the processing of crops in rural areas (Belisle, 2012; Kodjo *et al.*, 2003). Therefore, women should have a higher probability of obtaining and using loans than men.

Age (AGE): Continuous variable indicating the number of years of respondent's life. The likelihood of obtaining and using credit decreases with age (Aladejebi *et al.*, 2018). Indeed, older farmers are relatively more risk-averse and tend to get fewer loans to avoid default on repayment. The probability of default on loan repayment increases with the age of the respondents (Firafis, 2015; Fikirte, 2011; Godquin, 2006 ; Kamu, 2012;Ume *et al.*, 2018; Muthoni, 2016; Ojiako *et al.*, 2014; Oladeebo and Oladeebo, 2008; Pasha and Negese, 2014; Shu-Teng *et al.*, 2015). This result is contrary to that of other studies (Abdu *et al.*, 2015; Enimu *et al.*, 2017; Modisagae and Ackermann, 2018; Pasha and Negese, 2014) which reported that the probability of default on loan repayment decreases with age. For Wamalwa (2016), the relationship between the probability of default on repayment and age is not linear. The probability of default will decrease with age, up to the age of 32 (minimum point), then increase again. For Mokhtar *et al.* (2012), compared to other age groups, it is respondents aged 46 to 55 who have problems with default on repayment.

Education level (EDUC): Continuous variable which specifies the number of years of schooling attained. The probability of obtaining and using credits increases with the level of education (Aladejebi *et al.*, 2018). Indeed, a higher level of education allows borrowers to easily adopt new technologies, maintain business records and perform basic cash flow analysis and make good business decisions. This facilitates their access to credit. Similarly, the relative probability of being a defaulting client decreases with the level of education (Jote, 2018; Morning, 1997; Mulugeta, 2010; Oladeebo and Oladeebo, 2008; Van Nam and Duy, 2016; Yeboah and Oduro, 2018). In short, a high level of education would lead to a better performance in repaying loans or favour repayment, through a better awareness of beneficiaries on use and duty to repay credit (Enimu *et al.*, 2017; Kamu, 2012; Kefeni, 2018; Melese and Asfaw, 2020; Nawai and Shariff, 2012; Pasha and Negese, 2014; Ume *et al.*, 2018). In other words, individuals who have no formal education or who have a lower level of education are likely to lack the technical and management skills to run their business, and this could affect their income and repayment of loans. Individuals with a higher level of education are more likely to acquire know-how and certain management skills which could improve the profits of their business and enable them to repay the loans on time. Other work has shown that the probability of default on the loan repayment increases with the level of education (Wamalwa, 2016).

Household size (HSIZE): Continuous variable indicating the number of people in the respondent's household. The probability of using credit increases with household size (Aladejebi *et al.*, 2018; Ayele and Goshu, 2016). Indeed, the needs of the household increase with its size and, to meet them, the use of credit increases. However, the probability of default on loan repayment is positively affected by the household size (Enimu *et al.*, 2017; Haile, 2015; Godquin, 2006; Jote, 2018). Other study has reported a negative relationship between household size and the probability of default on loan repayment (Kamu, 2012; Ume *et al.*, 2018). In the first case, the explanation is that households are more composed of dependent members (children and elderly unable to work) whose number increases consumption and survival expenses. In the latter case, households are more composed of farm workers.

Association membership (ASSOC). Binary variable which takes the value 1 if the respondent belongs to at least one association / organization and 0 otherwise. Membership of an organized association or group reassures MFIs about the borrower's creditworthiness and therefore increases the probability that the loan will be granted and used (Adégbola *et al.*, 2009; Sossou *et al.*, 2017; Yehuala, 2008). The probability of default on loan repayment is low if the respondent belongs to at least one association / organization (Ume *et al.*, 2018) or if the loan is obtained through an association/ organization (Jote, 2018).

Farming experience (FEXP): Continuous variable indicating the number of years of experience since the respondent created his first farm. The probability of obtaining and using credit increases with experience (Aladejebi *et al.*, 2018). The most experienced farmers are expected to know the different challenges of farming, which allows them to improve their profitability and to have the means to be solvent. Thus, the probability of default on loan repayment decreases with experience (Adégbola *et al.*, 2011; Haile, 2015; Kamu, 2012; Kefeni, 2018; Modisagae and Ackermann, 2018; Oladeebo and Oladeebo, 2008; Ume *et al.*, 2018). For other studies, the probability of default on loan repayment is positively related to experience (Shu-Teng *et al.*, 2015).

Loan use experience (LUEXP): Continuous variable indicating the number of years of experience since the respondent obtained the first loan. The probability of using credit increases with experience in the use of credits (Aladejebi *et al.*, 2018). Likewise, borrowers with more experience in using credit are assumed to have a low probability of default on loan repayment. The borrowers' experience is supposed to give him more knowledge on the management and correct use of the loans with a positive effect on the profitability of the activity. Thus, those with little or no experience will have high default rates (Kefeni, 2018; Kinyondo and Okurut, 2009). Based on experiences, the borrower could make quality decisions regarding the costs and benefits of good management and use of funds and inputs. The experience of commercial operations helps to amplify the problem-solving capacity of borrowers, in particular by seizing the significant opportunities for growth of the business and their repayment capacities. This could have a positive effect on the profitability scale of the activity and finally on the loan repayment performance. According to Honlonkou *et al.* (2006), the relationship between experience in loan management and repayment performance is not linear. The probability of default on loan repayments will first decrease to a maximum age from which the probability will increase.

Annual income (INCOME): Continuous variable which specifies the amount in CFA francs obtained in turnover or income during the year. Indicating the borrower's solvency potential, the income generated increases the probability of obtaining credit for its use (Sossou *et al.*, 2017). The probability of being solvent increases with the amount of income. Consequently, the probability of default on loan repayment decreases with income (Enimu *et al.*, 2017; Jote, 2018; Melese and Asfaw, 2020; Mitei, 2017; Nawai and Shariff, 2012; Shu-Teng *et al.*, 2015; Yeboah and Oduro, 2018; Yibrie and Ramakrishna, 2017). The sale or the income is also considered as a sign of wealth and this result confirms that of others studies (Honlonkou *et al.*, 2006; Lamboni, 2008) which found a negative relationship between the level of wealth and the default. Muthoni (2016) contradicted this last result by pointing out a positive relationship between the probability of default on loan repayment and the size of the activity indicated by turnover.

Farm size (FSIZE): Continuous variable which specifies the land ownership (area in hectares) of the respondent. The probability of obtaining and using credit increases with the farm size (Aladejebi *et al.*, 2018; Ayele and Goshu, 2016). In fact, the larger the farm size, the higher the asset value (goods) that can be used as collateral for the loans. The increase in farm size increases the loan granted and use. Similarly, the probability of default on loan repayment decreases with the farm size (Dadson, 2012).

Contact with extension services (EXTSER): Binary variables which takes the value 1 if the respondent has contacts or received extension agents during a visit of supervision or agricultural advice. Contact with extension services would improve the likelihood of obtaining credit. In fact, contact with extension services allows farmers to benefit from training to improve their skills in farm and credit management (Yehuala, 2008). The probability of default on loan repayment is negatively linked to contact with extension agents (Pasha and Negese, 2014; Ume *et*

Table 1. Variables used in the SNP biprobit model and expected signs of the coefficients

Variables	Definition	Unit of measure	Nature	Expected sign	
				Model 1: loan use	**Model 2: default on loan repayments**
SEX	Respondent's gender	1 = female, 0 = male	Binary	+	+/-
AGE	Age of respondent	Years	Continuous	-	+/-
EDUC	Education level	Years	Continuous	+	+/-
HSIZE	Household size	Number	Continuous	+	+/-
ASSOC	Membership of an association or a group	1 if yes and 0 otherwise	Binary	+	-
FEXP	Number of years of farming experience	Years	Continuous	+	+/-
LUEXP	Number of years of experience in using credit	Years	Continuous	+	+/-
INCOME	Size of the activity or turnover or annual income of the activity	CFA Francs	Continuous	+	-
FSIZE	Farm size (total area available or owned)	Ha	Continuous	+	-
EXTSER	Contact with extension services or NGOs	1 if the respondent received extension services and 0 otherwise	Binary	+	-
SOSTAT	Social status in the village	1 = Native, 0 = Migrant	Binary		+/-
MASTAT	Marital status	1 = Married, 0 = Unmarried (single, divorced, widowed, etc.)	Discreet	+	+
ACLITER	Literacy	1 = Literate, 0 = Non-literate	Binary	+	+/-
ASSETV	Value of assets held by respondent	CFA Francs	Continuous	-	-

al., 2018).

Marital status (MASTAT): Binary variable which takes the value 1 if the respondent is married and 0 otherwise. The probability of obtaining and using credit is higher among married respondents than un-married ones (Aladejebi *et al.*, 2018). The probability of default on loan repayments is higher among married farmers than un-married ones (Kamanza, 2014; Muthoni, 2016). Because of their responsibility at home, married respondents cannot devote themselves entirely to their activity; which negatively affects their outcome.

Social status in the village (SOSTAT): Binary variable which takes the value 1 if the respondent is from the village and 0 otherwise. The probability of default on loan repayment is higher among farmers from the village or living in the village for many years (Enimu *et al.*, 2017). Being from the village or resident in the village for many years creates or strengthens social cohesion favourable to the loans repayment (Afolabi, 2010).

Literacy (ACLITER): Binary variable which takes the value 1 if the respondent is literate and 0 otherwise. Knowing how to read and write increases the probability of obtaining and using credit (Ayele and Goshu, 2016). Similarly, the probability of default on loan repayments is lower among literate farmers than non-literates (Godquin, 2006). Other studies have found a positive relationship between the probability of default on loan repayment and literacy (Adégbola *et al.*, 2011).

Asset value (ASSETV): Continuous variable which indicates the value in CFA francs of the assets held by the respondent. Assets are properties given as collateral for obtaining a loan. The higher the value of its assets, the higher the probability of obtaining the loan (Sossou *et al.*, 2017). But other studies have reported opposite results. According to these authors (Ibrahim and Zareba, 2015), the probability of obtaining and using credit decreases with the value of assets. The probability of default on loan repayments also decreases with the value of the assets (Ibrahim and Zareba, 2015; Modisagae and Ackermann, 2018).

Table 1 presents the summary of the variables used, as well as the expected signs of the coefficients in the decision models.

Table 2. Socio-economic characteristics of respondents

Variables	Loan Use	Loan use and repayment
Sex (% of Female)	24.36	22.94
Literacy (% of Yes)	25.21	26.15
Marital status (% of Married)	92.74	92.66
Social status (% of Native)	84.62	85.78
Contact with extension services (% of Yes)	60.26	59.63
Group membership (% of Yes)	67.52	68.35
Use of credit for agriculture (% of Yes)	88.89	95.41
Age (years)	41.56 (11.50)	41.16 (11.49)
School education (years)	3.02 (4.25)	2.90 (4.15)
Household size (persons)	8.58 (4.58)	8.63 (4.65)
Number of farm workers (workers)	2.97 (2.20)	3.06 (2.27)
Farming experience (years)	20.44 (12.97)	20.57 (12.95)
Loan use experience (years)	1.88 (4.29)	1.80 (4.35)
Farm size (ha)	12.18 (26.89)	12.69 (27.76)
Farm income (CFA francs)	716,435.9 (1,862,445)	739,678.9 (1,926,223)
Asset value (CFA francs)	607,873.3 (1,117,541)	575,167.5 (973,925.8)

( ) Standard deviation

RESULTS AND DISCUSSION

Socioeconomic characteristics of farmers and loan repayment performance

Socioeconomic characteristics of farmers

The main characteristics of the respondents are presented in Table 2. This table shows that 24.35% of the farmers who applied for loan were women. About 25.21% of them were literate, 92.74% were married and 84.62% were from the village. The majority of these farmers (67.52%) were members of a solidarity group and 60.26% of them were in contact with the extension services. Most of them (88.89%) used the loan for agricultural activities. They averaged 41.56 years of age, with an average of 3.02 years of school education. The average size of their households was 8.58 people, including 2.97 farm workers. They had an average of 20.44 years of experience in agricultural activities, and 1.88 years of experience in using loans. The average size of their farm was 12.18 ha which allows them to generate an average annual income of 716,435.9 CFA francs ($1,184.20). The average value of the assets held was 607,873.3 CFA francs ($ 1,004.75).

As for the farmers who used the loan, 22.94% were women, 26.15% were literate, 92.66% were married and 85.78% were from the village. Among them, 68.35% were members of a solidarity group and 59.63% had contacts with the extension services. The majority of them (95.41%) used the loan for agricultural activities. Farmers using credit had an average age of 41.16 years, with an average of 2.90 years of school education. Their household had an average of 8.63 people, including 3.06 farm workers. They had an average of 20.57 years of experience in agriculture and 1.80 years of experience in loan use. The average size of their farm was 12.69 ha, which allowed them to generate an average annual income of 739,678.9 CFA francs ($ 1,222.61). The average value of the assets held by these farmers was 575,167.5 CFA francs ($ 950.69).

Loan use and repayment performance

About 218 of the 400 respondents (54.50%) obtained a loan. Loans obtained ranged from 10,000 CFA francs ($ 16.69) to 3,300,000 CFA francs ($ 5,507.06). The majority of beneficiaries (64%) obtained small loans (10,000 to 200,000 CFA francs, or $16.69 to $333.76). The beneficiaries of large loans were in the minority, respectively 11%, 3%, 6%, 10% and 6% for loans of 200,001 CFA francs ($333.76) to 300,000 CFA francs ($ 500.64), 300,001 CFA francs (more than $ 500.64) to 400,000 CFA francs ($ 667.52), 400,001 CFA francs (more than $667,52) to 500,000 CFA francs ($ 834.40), 500,001 CFA francs (more than $ 834.40) to 1,000,000 CFA francs ($ 1,668.81) and more than 1,000,000 CFA francs (more than $ 1,668.81) (Figure 1).

Of the 218 who got the loan, only 11 experienced a loan repayment default (4.26%). The reasons for this repayment default were mainly: the lack of a market for the products (bad sales), the delay in disbursing the loan, the use of credit to finance other activities (fungibility), the low profitability due to climatic hazards, insufficient monitoring by the MFI.

Determinants of default on loan repayment

In order to avoid erroneous results, a multicollinearity test of the variables was previously carried out using the "Pairwise Correlation" command in version 15.0 of the

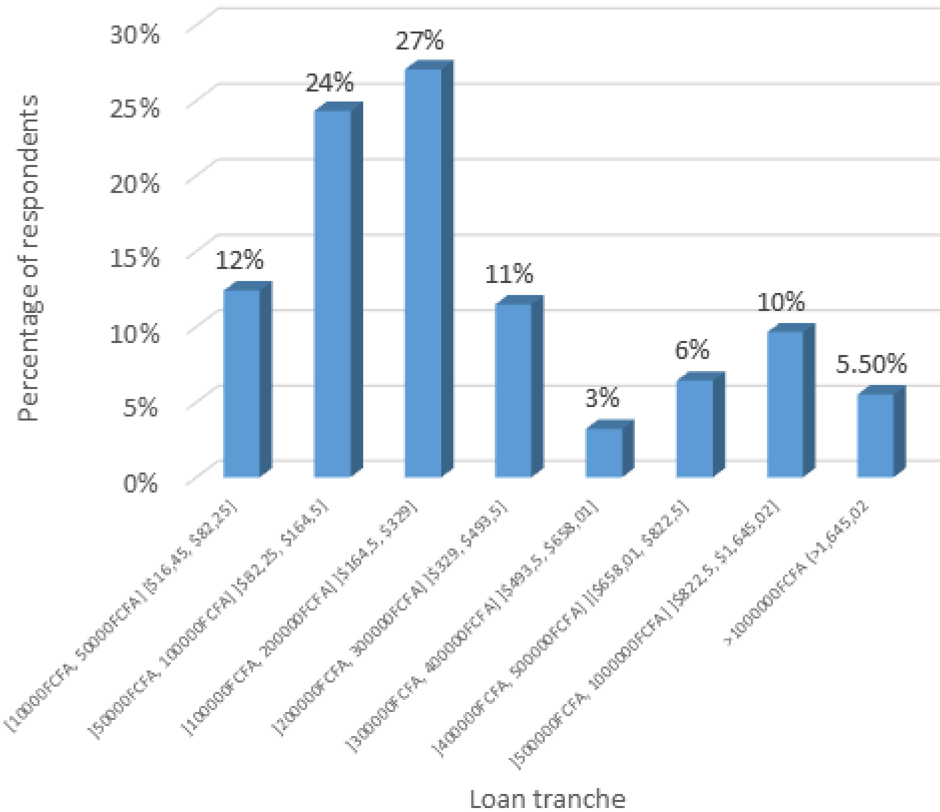

Figure 1. Distribution of borrowers by loan tranche

Stata software. In general, if the correlation coefficient between two variables is greater than 0.5, we can conclude that there is a problem of multicollinearity. On the basis of the multicollinearity test, certain variables such as off-farm income and the number of farm workers were excluded from two equations for loan use and repayment. In addition to the multicollinearity tests, other important tests such as normality and heteroscedasticity were also carried out and the appropriate corrective measures applied. Using the heckprob command from version 15.0 of the Stata software, we estimate the SNP biprobit and the results are presented in Table 3.

Likelihood ratio tests for the choice of Hermite polynomial orders show that the preferred estimate had the orders K1 = 3 and K2 = 1 (Table 3). At least two tests showed that the SNP estimate clearly rejected the assumption of normality of the error terms. First, the coefficient τ21 of the Hermite polynomial was statistically significant (Table 3). Moreover, the Wald test rejected at 5% level the null hypothesis according to which all the Hermite polynomial coefficients were jointly equal to zero. In addition, the SNP estimate of the marginal density function of the error terms did not show zero skewness values and kurtosis values lower than a standard normal density. Therefore, by relaxing the assumption of normality of the error terms, our results revealed the gain of consistency in the SNP2S biprobit estimation.

The value of Wald chi 2 (14) was equal to 428.91 and significant at 1% level. This indicated that the estimated SNP biprobit model was very significant. The interaction effect between the use and repayment of loans by farmers was very high, as shown by the robustness of the estimated coefficients. The signs of the two decision models generally met expectations.

In total, nine explanatory variables introduced into the models were significant. These were: age, sex, education, household size, group membership, income, farm size, contacts with extension services and asset value.

In the first model (loan use), the age coefficient was significant at the 5% level, with a negative sign, indicating that the probability of obtaining and using a loan decreased with age, as revealed by Aladejebi *et al.* (2018). In fact, age is associated with a reluctance to risk and a tendency to apply for fewer loans to avoid defaults. In the second model (default on loan repayment), the age coefficient had a positive but not significant sign.

The gender coefficient in the first model (loan use) was significant at the 5% level, with a positive sign, indicating that the probability of using the loan increased from men to women, as shown by Belisle (2012) and Kodjo *et al.* (2003). In fact, compared to men, women were the most creditworthy and, therefore, were favoured by MFIs for granting loans. In the second model (default on loan

Table 3. Results of the SNP2S biprobit models estimation (double-bounded approach)

Variables	SNP2S Probit			
	Loan use		Default on loan repayment	
	Coefficient	Std. err	Coefficient	Std. err
Age	-0.043**	0.017	0.028	0.024
Gender	0.676**	0.314	0.317	0.520
Education	-0.116***	0.044	0.120*	0.066
Household size	0.078***	0.030	0.060	0.060
Membership of a g**roup**	0.555*	0.296	1.322**	0.578
Farming experience	0.004	0.015	-.0.030	0.020
Loan use experience	0.020	0.039	-0.070	0.097
Income	1.18e-06 ***	3.44e-07	- 1.61e-06*	8.91e-07
Farm size	0.038***	0.014	-0.062	0.046
Contact with extension services	1.107***	0.275	0.086	0.457
Social s**tatu**s **in the village**	-0.090	0.343	-0.070	0.556
Marital Status	-0.501	0.458	-0.507	0.691
Literacy	0.611	0.377	0.125	0.511
Log of a**sset value**	-0.025	0.051	0.235**	0.104
Constant	-6.668		0.391	
Hermite coef. (K**1=3,** K**2=2)**				
τ_{11}	-0.965 (0.625)			
τ_{21}	0.418 (0.202)**			
τ_{31}	0.259 (0.160)			
Standard deviation	1.691		1.341	
Skewness	0.356		-0.456	
Kurtosis	2.146		2.708	
Corr. coef. P31	-0.164			
Wald chi2 (df=14)	428.91***			
Log likelihood	-251.910			
Number of observations	400			

* Significant at 10% level, ** significant at 5% level and *** Significant at 1% level

repayment), the gender coefficient had a positive but not significant sign.

The education coefficient in the first decision (loan use) was significant at the 5% level, with a negative sign, indicating that the probability of using the loan decreased with the education level. This result is contrary to expectations. Indeed, a high level of education is an indicator of the borrower's ability to easily adopt new technologies, keep business records, perform basic financial analysis and make the right business decision. This should reassure MFIs to grant the loan (Aladejebi *et al.*, 2018). The education coefficient in the second model (default on loan repayment) was significant at the 10% level, with a positive sign, indicating that the probability of default increased with the education level, as Wamalwa (2016) revealed. But this last result contradicts those reported by numerous previous studies (Enimu *et al.*, 2017; Kamu, 2012; Kefeni, 2018; Melese and Asfaw, 2020; Nawai and Shariff, 2012; Pasha and Negese, 2014; Ume *et al.*, 2018) which have shown that a high level of education would lead to a better awareness of the borrowers on its use and the duty to repay it; which should reduce the default on loan repayment.

The household size coefficient in the first model (loan use) was significant at the 1% level, with a positive sign, indicating that the probability of using the loan increased with household size, as shown by the previous studies. In fact, household needs increase with the household size and, to meet them, credit needs increase (Aladejebi *et al.*, 2018; Ayele and Goshu, 2016). The household size coefficient in the second model (default on loan repayment) had a positive but not significant sign.

The coefficient of group membership in the first model (loan use) was significant at the 10% level, with a positive sign, indicating that the probability of using the loan increased if borrower was member of a group, as revealed by previous studies (Adégbola *et al.*, 2009; Sossou *et al.*, 2017; Yehuala, 2008). In fact, membership of a group reassures MFIs about the borrower's solvency and therefore increases the probability that the loan will be granted. In the second model (default on loan repayment), the group membership coefficient was significant at the 1% level, with a positive sign, indicating that group membership increased the probability of default on loan repayment. This result is contrary to expectations that the probability of default is low if the borrower belongs to an association / organization (Ume *et al.*, 2018) or if the loan is obtained through a group (Jote, 2018). According to Besley and Coates (1995), the advantage of group credit in terms of repayment behaviour is that a group member whose project has recorded high returns is, in accordance with group solidarity, obliged to contribute to the repayment of the loan of the member whose project went very badly. In addition, in group loans, the social sanctions imposed on members oblige them to repay the loans on time. Our results showed the downside of joint and several guarantees in Benin which no longer makes it possible to resolve the problem of asymmetric information on MFI clients. Indeed, relying on the solidarity of the group, some individuals no longer make an effort for good credit management and record bad results or decide squarely to divert the loan from its objective towards non-productive objectives, and end up being defaulting in the repayment. Improving the conditions for setting up solidarity groups is essential to enable groups to play their role effectively in the fight against asymmetric information for MFI clients.

The coefficient of income in the first model (loan use) was significant at the 1% level, with a positive sign, indicating that the probability of using the loan increased with income, in accordance with Sossou *et al.* (2017) who has reported that the income is a sign of the borrower's management skills and solvency and increases the probability of obtaining credit. The income coefficient in the second model (default on loan repayment) was significant at the 10% level, but with a negative sign, indicating that the probability of loan repayment default decreased with income, as have reported many studies (Enimu *et al.*, 2017; Jote, 2018; Melese and Asfaw, 2020; Mitei, 2017; Nawai and Shariff, 2012; Shu-Teng *et al.*, 2015; Yeboah and Oduro, 2018; Yibrie and Ramakrishna, 2017).

The coefficient of the farm size in the first model (loan use) was significant at the 1% level, with a positive sign, indicating that the probability of using the loan increased with the farm size, in accordance with previous studies (Aladejebi et al., 2018; Ayele and Goshu, 2016) which revealed that the larger the farm size, the more the value of assets (goods) that could be used as collateral for loans. Thus, increasing the farm size increases the probability that the loan will be granted and used. The farm size coefficient in the second model (default on loan repayment) had a negative but not significant sign.

The coefficient linked to contacts with extension services in the first model (loan use) was significant at the 1% level with a positive sign, indicating that the probability of using the loan was increased when the farmer has contacts with the extension services. This result was in line with expectations, since contacts with extension services have allowed farmers to benefit from training in order to improve their skills in farm and/or credit management (Yehuala, 2008). This reassures the MFIs to grant the loan. The coefficient linked to contacts with extension services in the second model (default on loan repayment) had a positive sign, but is not significant.

The coefficient associated with the value of assets in the first model (loan use) was negative, but not significant. In the second model (default on loan repayment), this coefficient was significant at the 5% level, with a positive sign, indicating that the probability of default on loan repayment increased with the value of assets held, as revealed by previous studies (Ibrahim and Zareba, 2015; Modisagae and Ackermann, 2018).

The non-significant variables in the first model (loan use) and in the second model (default on loan repayment) were: farming experience, experience of using loans, marital status, social status in the village and literacy. The signs of the coefficients were in line with expectations for the farming experience and the experience of using loans in the two decision models However, this was not the case for the other variables (education, marital status, social status and literacy). Marital status tended to reduce both the probability of using the loan and the default on loan repayment. This could be due to the fact that, compared to unmarried, married farmers devote less time to their activities, because of their responsibility at home, which negatively affects their performance (Kamanza, 2014; Muthoni, 2016). Being supposed to have bad results, they do not enjoy the confidence of MFIs which end up granting them little credit. Social status in the village tended to reduce both the loan use and default on loan repayment. Indeed, compared to foreigners (migrants), the natives are less assiduous at work. A migrant is often aware of the purpose of his migration (to have money) and invests all his time to achieve it. As a result, natives experience poorer results; which negatively affects their chances of getting a loan. Finally, literacy tended to increase both the use of the loan and the default on loan repayment. The tendency of literate farmers to repay their loans less could be due to the fact that the uneducated (non-formal education) are more literate, as revealed by Adégbola *et al.* (2011).

CONCLUSION AND IMPLICATIONS

Considered one of the most important tools for poverty reduction, microcredit has attracted the attention of governments and international donors around the world. Credit helps, on the one hand, the poor farmer to access the inputs necessary for the adoption of new agricultural intensification technologies, and on the other hand, to strengthen the capacity of non-poor farmers to acquire agricultural equipment or make very expensive long-term investments. However, inefficient use of loans and default on loan repayments are serious problems for Beninese MFIs. In order to highlight the causes of these problems in Benin, a semi-non parametric bivariate probit model was used. The results of econometric analyses indicate that there is a link between the two simultaneous loan use and repayment decisions. In total, nine explanatory variables of the model were identified as significant and should be considered in targeting and granting loans.

Three variables (education level, group membership and income) significantly influence both the use of the loan and the default on loan repayment. Education level negatively affects loan use, but positively default on loan repayment. Group membership positively affects both loan use and default on loan repayment. Income positively affects loan use, but negatively affects the default on the loan repayment. The variables age, gender, household size, farm size and contacts with extension services significantly affect the first model (loan use), without having any significant effect on the second model (default on loan repayment). The effect on loan use is positive for gender, household size, farm size and contacts with extension services, while it is negative for age. Asset value is the only variable which has no significant effect in the first model (loan use), but which significantly and positively affects the decision to repay the loan. The variables farming experience, experience in using the loan, marital status, social status in the village and literacy were not significant in the first model (use of the loan) nor in the second model (default on loan repayment). This means that MFIs should not consider these characteristics when establishing contracts with borrowing farmers. Analysis of the coefficient signs in the two models shows that most of the signs were in line with expectations and implies that the lending mechanism adopted by the MFIs in the areas studied is linked to the borrower's repayment behaviour.

Implications and limitations of the research

Based on the results of this study, Microfinance Institutions (MFIs) in developing countries should consider variables identified as significant to facilitate the use and repayment of loans. Managers should also take into account the relationship between loan use and repayment when developing their microfinance policies. But the study considered globally the loan sources and the agricultural value chains. Consequently, the recommendations are general. Future studies could focus on the assessment of loan sources and specific agricultural value chains.

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REFERENCES

Abdu Z, Mohammed S, Sambo AS (2015). Socioeconomic Determinants of Loan Repayment among the Agric. Loan Scheme beneficiaries in Kaduna State. A Case Study of Unity Bank PLC. IOSR J. Econ. Fin. 6 (4): 63-67 www.iosrjournals.org

Abdul-Mumin A, Sulemana A (2014). Determinants of loan repayment in micro credit, the case of ghanaian danish community development programme (gdcp) in Savelugu/Nantong District of northern region of Ghana. Int. J. Cur. Res. 6 (09): 8558-8563, Retrieved from http://www.journalcra.com

Adégbola PY, Arouna A, Olou D, Hounhinto A (2011). Identification et analyse des mécanismes efficaces de remboursement de crédits sur vivriers au Bénin. Rapport d'étude, APRA / INRAB, Juin 2011, 85 p

Adégbola PY, Adekambi SA, Tidjani Serpos AA (2009). Micro finance et production agricole: cas de l'anacarde au Bénin. Rapport d'étude Protocole Fonds Compétitifs N° 05/07, PAPA/INRAB, Novembre 2009

Afolabi JA (2010) Analysis of loan repayment among small-scale farmers in Oyo state. J. Soc. Sc. 22(2):115–119

Aladejebi OJ, Omolehin R, Ajiniran E, Ajakpovi AP (2018). Determinants of Credit Acquisition and Utilization among Household farmers in the Drive towards Sustainable Output in Ekiti State, Nigeria. OIDA Int. J. Sust. Dev., 11:09

ANSSFD (2018). Mesures d'assainissement du secteur de la microfinance du Bénin, Octobre 2018, 28 p.

ANSSFD (2017). Note trimestrielle de conjoncture de la Microfinance. Bulletin trimestriel n° 34, Avril-Juin, 2017, Juillet 2017.

Ayele A, Goshu D (2016). Determinants of microfinance loan utilization by smallholder farmers: The case of Omo Microfinance in Lemo District of Hadiya Zone, Southern Ethiopia. J. Dev. Agri. Eco. 10(7) : 246-252. DOI: 10.5897/JDAE2016.0726

BM (Baromètre de la Microfinance) (2018). Quelle rentabilité pour la microfinance ? 9ème Edition. 16p

Belisle M (2012). Accessibilité financière des individus et rôle de la microfinance au Ghana et en Tanzanie. Mémoire présenté en vue de l'obtention du grade de maître ès science (M. Sc.), option Sciences de la gestion (Affaires Internationales), École des Hautes Études Commerciales (HEC), Université de Montréal, Juin 2012, 114 p

Besley T (1994). How do market failures justify interventions in rural credit markets? The World Bank Research Observer, 9 (1):27–47.

Besley T (1995). Nonmarket institutions for credit and risk sharing in low-income countries. J. Econ. Persp. 9 (3): 115-27.

Besley T, Coates S (1995). Group lending, repayment incentives and social collateral. J. Dev. Econ. 46: 1-18.

Bourlès R, Cozarenco A, Henriet D, Joutard X (2018). Business Training and Loan Repayment: Theory and Evidence from Microcredit in France.2018. Working paper, March2018, halshs-01774320.

Brosig S, Hockmann H (2005). How Effective is the Invisible Hand? Agricultural and Food Markets in Central and Eastern Europe. Studies on the Agricultural and Food Sector in Central and Eastern Europe,

No. 31. 373 p. DOI:10.22004/ag.econ.93018.
Cameron TA, Quiggin J (1994). Estimation using contingent valuation data from a “Dichotomous Choice with Follow-up” questionnaire. J. Env. Econ. Man., 27 (3): 218–234.
Dadson AV (2012). Determinants of loan repayment default among farmers in Ghana. J. Dev. Agric. Econ. 4(13): 339-345, DOI: 10.5897/JDAE12.053
De Aghion BA, Morduch J (2000). Microfinance beyond group lending. Econ. Trans., 8 (2): 401-420.
Deininger K, Liu Y (2009). Determinants of Repayment Performance in Indian Micro-Credit Groups. Policy Research Working Paper 4885. The World Bank, Washington DC; March 2009, 18 p
De Luca G, Peracchi F (2007). A sample selection model for unit and item nonresponse in cross-sectional surveys. CEIS Tor Vergata Research Paper Series, 33 (99): 1–44.
Djogo A (1994). ‘Analyse rétrospective de la politique de financement de l’agriculture ivoirienne’; CIRES, Cellule d’Analyse de Politique Economique, Document de Travail N4. Abidjan, Côte d’Ivoire. Décembre.
Edgcomb E, Barton L (1998). Social intermediation and microfinance programs: A literature review. Washington, DC: USAID, Microenterprise Best Practices. tel-00140516
Enimu S, Eyo EO, Ajah EA (2017). Determinants of loan repayment among agricultural microcredit finance group members in Delta state, Nigeria. Financial Innovation (2017) 3:21, DOI 10.1186/s40854-017-0072-y
Fall AA (2006). Impact du crédit sur le revenu des riziculteurs de la vallée du fleuve Sénégal. Thèse soutenue pour obtenir le diplôme de doctorat, Spécialité : Economie et Gestion du Développement Agricole, Agro-alimentaire et Rurale à l’Ecole Nationale Supérieure Agronomique de Montpellier
Fikirte KR (2011). Determinants of loan repayment performance: a case study in the Addis Credit and Saving Institution, Addis Ababa, Ethiopia (Master’s thesis, Wageningen University).
Firafis H (2015). Determinant of loan repayment performance: Case study of Harari Microfinance Institutions. J. Agric. Ext. Ru. Dev. 7(2): 56-64. DOI:10.5897/JAERD14.0622.
Gabler S, Lasiney F, Lechner M (1993). Semi-nonparametric estimation of binary-choice models with an application to labor-force participation. J. Bus. Econ. Stat. 11: 61–80.
Gallant A, Nychka D (1987). Semi-nonparametric likelihood estimation. Econometrica, 55: 363–390.
Gentil D, Servet JM (2002). « Entre « localisme » et mondialisation : la microfinance comme révélateur et comme levier de changements socioéconomiques » in Microfinance: petites sommes, grands effets ?, Revue Tiers Monde n° 172 : 737–760.
Ghatak M (1999). Group lending, local information and peer selection. J. Dev. Econ. 60: 27-50.
Ghatak M, Guinnane TW (1999). The economics of lending with joint liability: theory and practice, J. Dev. Econ. 60 (1): 533-556.
Godquin M (2006). Finance rurale au Bangladesh et aux Philippines. Thèse de Doctorat de l'Université de Paris I, Discipline : Sciences Economiques, 337 p
Gorton G, Winton A (2003). Financial intermediation in *Gary Gorton and Andrew Winton* (eds.), Handbook of the Economics of Finance, vol 1, Part 1, Elsevier.
Guirkinger C, Boucher SR (2008). Credit constraints and productivity in Peruvian agriculture. Agric. Econ. 39 (3): 295–308.
Haile F (2015). Determinants of loan repayment performance: Case study of Harari microfinance institution. J. Agric. Ext. Ru. Dev. 7 (2): 56-64.
Hanemann M, Loomis J, Kanninen B (1991). Statistical efficiency of double-bounded dichotomous choice contingent valuation. Am. J. Agric. Econ. 73 (4), 1255–1263.
Hart O (1983). The Market Mechanism as an Incentive Scheme, Be. J. Econ. 14 (2): 366-382.
Honlonkou AN, Acclassato DH, Quenum CVC (2006). Déterminants de la performance de remboursement dans les institutions de microfinance au Bénin. An. Pub. Coop. Econ. 77(1): 53–81
Hudon M (2008). Norms and values of the various microfinance institutions. Int. J. Soc. Econ. 35: 35-48. DOI: 10.1108/03068290810843828
Ibrahim AH, Zareba SAFE (2015). Determinants of Loan Utilization and Repayment Behaviour among Small Farmers in North Kordofan of Sudan. Gl. Ad. Res. J. Agric. Sc. 4(9): 533-648. Retrieved from http://garj.org/garjas/home.
INRAB (2017). Caractérisation et évaluation des milieux homogènes des zones agro écologiques du Bénin. Rapport d’étude. Avril 2017, 324 p
Jain S, Mansuri G (2003). A little at a time: The use of regularly scheduled repayments in microfinance programs. J. Dev. Econ. 72: 253-279.
Jote GG (2018). Determinants of Loan Repayment: The Case of Microfinance Institutions in Gedeo Zone, Ethiopia. Univ. J. Acc. Fin. 6(3): 108-122, DOI: 10.13189/ujaf.2018.060303
Kamanza RM (2014). Causes of Default on Micro-credit among women Micro Entrepreneurs in Kenya. A Case Study of Women Enterprise Development Fund (WEDF) Msambweni Constituency. J. Econ. Fin. 3(6): 32 - 47.
Kamu KNG (2012). Major determinants of loan repayment in small scale enterprises in Kariobangi Division, Nairobi County. A research project submitted in partial fulfilment of the requirement for the aw ard of the degree of masters in business administration, University of Nairobi, November 2012. 63 p
Kefeni K (2018). Determinants of loan repayment performance in project financing: a case study in

development bank of Ethiopia. A Thesis Submitted to the School of Graduate Studies of St.Merry University in Partial Fulfillment of the Requirements for the Award of the Degree of Master of Art (MA) in Business Administration, Faculty of Business, St. Mery`s University, mai 2018.

Kinyondo AA, Okurut N (2009). Determinants of loan repayment performance in microcredit institutions: Evidence from Tanzania. Bepress. 14 p. Retrieved from: https://works.bepress.com/abel_kinyondo/1/

Kirkwood C, Azokli R (2005). PADME-Bénin, 2ème Rating. MicroRate, Juin 2005, 20 p

Koss P, Khawaja MS (2001). The value of water supply reliability in California: a contingent valuation study. Water Policy, 3 (2): 165–174.

Lamboni D (2008). Les Déterminants du Remboursement de Crédits Agricoles au sud-est du Togo : Le Cas de la COOPEC-Afagnan. Mémoire présenté à la Faculté des Études Supérieures de l'Université Laval dans le cadre du programme de Maîtrise en Économie Rurale pour l'obtention du grade de Maître es Sciences (M.Sc.). Département d'Economie Agroalimentaire et des Sciences de la Consommation, Faculté des Sciences de l'Agriculture et de l'Alimentation Université Laval, Québec, 2008, 101 p

Kodjo KZ M, Abiassi EH, Allagbe MC (2003). Le financement de l'agriculture béninoise dans un contexte de libéralisation: contribution de la microfinance, FSA, Université d'Abomey-Calavi, Bénin. Cahier de Recherche ELIFID 03-5. 51p p

Kohansal M, Mansoori H (2009). Factors affecting on loan repayment performance of farmers in Khorasan-Razavi Province of Iran. Conference on International Research on Food Security, Natural Resource Management and Rural Development. University of Hamburg, 6 – 8 October, 2009. 40p.

Macey JR, O'Hara M (2003). The Corporate Governance of Banks, Econ. Pol. Rev. 9 (1).

Melese M, Asfaw M (2020). Determinants of Loan Repayment Performance of Omo Microfinance Institution: In the Case of Mizan Aman Town, Southwest Ethiopia. Res. J. Bu. Man. 14: 7-14. DOI: 10.3923/rjbm.2020.7.14

Mitei A (2017). Determinants of loan default by savings and credit co-operative societies' (SACCOs members in Baringo County, Kenya. A Thesis submitted to Graduate School in Partial Fulfillment of the Requirement for the Award of Degree in Master of Business Administration of Egerton University Egerton University, January 2017. 73 p

Modisagae K, Ackermann C (2018). Determinants of defaulting by collateral lending groups in microfinancing: A probit regression approach, Acta Commercii – Ind. Res. J. Man. Sc. 18(1). DOI:10.4102/AC.V18I1.562

Mokhtar SH, Nartea G, Gan C (2012). Determinants of microcredit loans repayment problem among microfinance borrowers in Malaysia. Int. J. Bus. Soc. Res. 2 (7). DOI: http://dx.doi.org/10.18533/ijbsr.v2i7.118

Morduch J (1999). The microfinance promise. J. Econ. Lit. 37(4): 1569-1614.

Mulugeta S (2010). The Determinants of Agricultural Loan Repayment Performance. Unpublished Master's Thesis, Hramaya University.

Muthoni M P (2016). Assessing Borrower's and Business' Factors Causing Microcredit Default in Kenya: A Comparative Analysis of Microfinance Institutions and Financial Intermediaries. J. Educ. Pr. 7 (12): 97-118

Nawai N, Shariff MNM (2012). Factors affecting repayment performance in microfinance programs in Malaysia. Procedia – Soc. Be. Sc., 62: 806 – 811.

Nduati L (2012). Modules 3 Entrepreneurship lesson 5 for credit management. Transcript of „Farmer's Agribusiness Training course.

Ojiako IA, Idowu AO, Ogbukwa BC (2014). Determinants of Loan Repayment Behaviour of Smallholder Cooperative Farmers in Yewa North Local Government Area of Ogun State, Nigeria: an Application of Tobit Model. J. Econ. Sus. Dev. 5 (16): 144-153.

Oladeebo JO, Oladeebo OE (2008). Determinants of loan repayment among smallholder farmers in Ogbomoso agricultural zone of Oyo State, Nigeria. J. Soc. Sc. 17(1): 59-62.

Pasha SAM, Negese T (2014). Performance of Loan Repayment Determinants in Ethiopian Micro Finance – An Analysis. Eras. J. Bus. Econ. 7 (13): 29-49

Schmidt KM (1997). Managerial Incentives and Product Market Competition. Rev. Econ. St. 64(2):191-213. DOI: 10.2307/2971709

Shu-Teng L, Zariyawati MA, Suraya-Hanim M, Annuar MN (2015). Determinants of Microfinance Repayment Performance: Evidence from Small Medium Enterprises in Malaysia. Int. J. Econ. Fin. 7 (11): 110-120. doi:10.5539/ijef.v

Simtowe F, Diagne A, Zeller M (2008). Who is credit constrained? Evidence from rural Malawi. Agri. Fin. Rev. 68: 255 – 272.

Sossou CH, Dogot T, Adjovi G, Lebailly P, Coulibaly O (2017). Analyse des déterminants de l'accès au crédit des exploitations agricoles au Bénin. Bulletin de la Recherche Agronomique du Bénin (BRAB) Numéro spécial Technologie Alimentaire & Sécurité Alimentaire (TA&SA) – Décembre 2017 BRAB en ligne (on line) sur le site web http://www.slire.net ISSN

Stiglitz JE (1990). Peer monitoring and credit markets. The WB. Econ. Rev. 4 (3): 351-366.

Stiglitz J, Weiss A (1981). Credit Rationing in Markets with Imperfect Information. Am. Econ. Rev., 71: 393–410.

Thys G, Pouget P (2007). ALIDE-Bénin. MicroRating International, Décembre 2007, 13 p.

Ume SI, Ezeano CI, Obiekwe NJ (2018). Analysis of Determinant Factors to Loan Repayment among Broiler

Farmers in Enugu State, Nigeria. Int. J. Env. Agric. Res. 4 (6): 11.
Van Nam M, Duy VQ (2016). Determinants Repayment Performance Of Borrowers In Rural Mekong Delta Of Vietnam. IJISET – Int. J. In. Sc., Eng. Tech. 3 (1).
Wamalwa WN (2016). Determinants of Loan Repayment by Borrowers from Micro-Financial Institutions in Nakuru County Kenya. J. Inv. Man. 5 (5): 64-69. doi: 10.11648/j.jim.20160505.14
World Bank (2002). Report on the observance of standards and codes (ROSC) Corporate governance country assessment (Mauritius) n° 35111, October 2002, 30 p
Yeboah E, Oduro IM (2018). Determinants of Loan Defaults in Some Selected Credit Unions in Kumasi Metropolis of Ghana. Op. J. Bus. Man. 6: 778-795.
Yehuala S (2008). Determinants of Smallholder Farmers Access to Formal Credit: the Case of Metema Woreda, North Gondar, Ethiopia, Haramaya University, 125 p
Yibrie O, Ramakrishna R (2017). Determinants of loan repayment performance in ACSI. Int. J. Ad. Res. Man. and Soc. Sc. 6 (4): 151-170