



Delving into the Determinants of Default Risk in Savings Groups: Empirical Evidence from Ecuador

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Abstract

Financial inclusion has been broadly recognized as critical in alleviating poverty and achieving inclusive economic growth. The capability of borrowers to repay their microcredit loans is a critical concern and is the first risk of Microfinance institutions sustainability. Exploring the determinants of credit risk is an issue of substantial importance in microfinance. The purpose of this research was to identify the savings group members' characteristics that have impact on default risk. We have used a multivariate regression model to identify the factors that affect default behaviour among microcredit borrowers from savings groups. We have analysed a sample of more than different 400 Savings Groups and 7251 active users of the “Saving and Learning” program in Ecuador. Empirical results demonstrated that factors such as seniority, accumulated savings and the number of members in the savings groups are determinant variables of default risk. The significant positive sign on variable “Gender” is consistent with the previous authors that indicate that the probability of having problems in loan repayment is higher for males than for females. The generalizability of our findings should, of course, be interpreted with caution, as they may be idiosyncratic of the sample, period or region. To contrast and contextualize these results, we had in-depth discussions with the Savinco managers and their field agent in Ecuador. There are many contributions. For practitioners, relevant factors that can affect savings groups default rates have been identified. For academics, the rich information provided by the Savinco mobile App could be a starting point for further quantitative research.

Keywords Formal and Informal sectors · Financial Markets: Savings and capital investments · Household savings, borrowing, debt and wealth · Technological Change · Latin America, Ecuador

JEL Classification G51 · 017 · 033 · 016 · 054

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Résumé

Il est largement reconnu que l'inclusion financière est essentielle pour réduire la pauvreté et parvenir à une croissance économique inclusive. La capacité des emprunteurs à rembourser leurs prêts de microcrédit est une préoccupation essentielle et constitue le premier risque pour la pérennité des institutions de microfinance. L'étude des déterminants du risque de crédit est une question d'une importance capitale en microfinance. Le but de cette étude est d'identifier les caractéristiques des membres de groupes d'épargne qui ont un impact sur le risque de défaut de paiement. Nous avons utilisé un modèle de régression multivariée pour identifier les facteurs qui affectent le comportement de défaut de paiement parmi les emprunteurs de microcrédit au sein de groupes d'épargne. Nous avons analysé un échantillon de plus de 400 groupes d'épargne différents et 7 251 utilisateurs actifs du programme « Épargne et apprentissage » en Équateur. Les résultats empiriques ont démontré que des facteurs tels que l'ancienneté, l'épargne accumulée et le nombre de membres dans les groupes d'épargne sont des variables déterminantes du risque de défaut de paiement. Sur la variable « Genre », le signe positif significatif est cohérent avec les études précédentes qui indiquent que la probabilité d'avoir des problèmes de remboursement de prêt est plus élevée chez les hommes que chez les femmes. Bien entendu, le caractère généralisable de nos résultats doit être interprété avec prudence, car ces résultats peuvent être uniques à l'échantillon, à la période ou à la région. Pour contraster et contextualiser ces résultats, nous avons eu des discussions approfondies avec les gestionnaires de Savinco et leur agent de terrain en Équateur. Les contributions sont nombreuses. Pour les praticiens, ont été identifiés les facteurs pertinents pouvant affecter le taux de défaut de paiement des groupes d'épargne. Pour les universitaires, les riches informations fournies par l'application mobile Savinco pourraient être un point de départ pour d'autres études quantitatives.

Introduction

Despite the important growth of microfinance over the last decades, there is a profound debate about its effectiveness as a development tool, the impact on the more vulnerable population, and the roles of the private and public sectors in poverty reduction (Karnani 2011, 2017; Mader 2013, 2017). Although there has been immense progress in the level of financial inclusion, measured by the number of accounts, there are still 1.7 billion adults (31% of the global adult population) excluded from the financial sector. The profile of the unbanked usually consists of low net-worth individuals, mainly woman, living in rural areas and with little or no collateral (Demirgüç-Kunt et al. 2018). In addition to this, financial inclusion must be measured not only by access to financial products but, more importantly, by their quality and use, placing the focus on financial health and not only on financial inclusion (Arellano et al. 2019; Karlan et al. 2017). Given the difficulty for formal microfinance institutions to reach the rural poor, money lenders are sometimes the only finance solution for this vulnerable population (Madestam 2014), therefore in the past few years, foundations and non-profit organizations (NPO) have placed efforts into promoting informal finance solutions such as Self-Help Groups (SHGs)



or Savings Groups (SGs) to help improve financial inclusion of the rural poor (Giné and Karlan 2014; Kodongo and Kendi 2013; Adusei 2013; Bouman 1983). The rationales of these type of models are such that members of the group simultaneously save, lend and apply for credit and since borrowers know each other, this mitigates adverse selection problem and repayment. In addition, group meetings facilitate education and training, helping members with small experience to improve their businesses financial performance (Armendáriz and Morduch 2005). Moreover, groups contribute to the empowerment of women helping them sustain their home-based microenterprises (Duflo 2012). Although group micro-lending has been a successful idea in many parts of the world, it can be expensive given the additional cost of group formation, training, group procedures and monitoring of regular meetings where instalments are paid (Savita 2007).

Recently, new actors have come into this market aiming to improve the model of traditional informal Savings Groups by the development and use of new Information and Communication Technologies (ICTs). One of these actors is Savinco Social Finance (Savinco) promoted by Expert Timing Systems (ETS)¹ a Spanish high-tech company specialized in quantitative finance. Savinco mission is to improve socio-economic inclusion of the most vulnerable population in Latin America by promoting community savings, a solution based on four pillars: self-financing through savings, self-management, financial education and technology. The technological pillar includes the development of an advanced cloud-mobile App, Qmobile, to monitor group financial transactions. The purpose of the App is to help group members to manage their monthly meetings more efficiently (savings, paid-in capital, loans, received and due interest) and to improve financial education by new innovative cost-effective teaching contents and methods.

In this paper, we analyse the information provided by one of the most active savings groups programs in Ecuador named “Saving and Learning” designed and managed by Savinco. The purpose of this research is to identify which variables determine the sustainability of savings groups and the profile of customers that could default on loan payments based on the information provided by the cloud-mobile App. Even though the meaning of Default and Non-performing loans are not exactly the same, we will be using both terms indistinctly throughout the paper. The database includes information of over 400 savings groups and 9000 customers during the period 2014–2020.

By using real user’s data, this paper defines the following research questions:

RQ1 What are the determinants of savings group members default risk?

RQ2 Does gender influence default on loan repayments?

This research has the following structure: In “[State of the Art](#)” section, we discuss the literature and contextualize the origin of Microfinance and Savings Groups

¹ <https://www.etsfactory.com/>.



followed by a description of the Savinco's "Saving and Learning" program in Ecuador. "[Sample and Model Specifications](#)" section presents the data, instrument and method used for the analysis. "[Results](#)" section provides the results. "[Findings Discussion](#)" section includes findings discussion and "[Conclusions](#)". As interesting results, we can highlight variables such as group seniority, accumulated savings, number of members and average loan term that can affect default risk. Additionally, as conclusions for academics can be that the rich information provided by the Mobile App, Qmobile, could be a starting point for further quantitative research. Finally, we highlight the importance of the use of technology to improve savings groups' efficiency and survival. Future lines of research include the design of a credit scoring for groups and individuals that will help them enter formal financial institutions together with a post-COVID impact analysis.

State of the Art

Microfinance Evolution

Financial inclusion has been broadly recognized as critical in alleviating poverty and achieving inclusive economic growth. Undeniably, there is a close relationship between economic development and financial inclusion (Deb and Kubzansky 2012). Demirgüç-Kunt et al. (2018) showed in the Global Findex 2017 that between 2011 and 2017 the number of people with a bank account grew by 1.2 billion worldwide. However, 1.7 billion adults (31% of the global adult population) remain unbanked, most of whom are women living in rural areas in developing countries. Other important results of the Global Findex 2017 are the most common reason for not having an account. The principal one is the lack of money, 66% of adults without an account identified this as the primary reason, and 20% said it was the only reason. Other reasons include (in order of diminishing importance) no necessity for an account; accounts are too expensive; financial institutions are located too far away; lack of enough credit information; lack of trust in financial institutions and religious reasons (Mookherjee and Motta 2016; Giné and Karlan 2014; Karlan et al. 2014). In other occasions, the problem is that they are excluded by other members of the group (Marr 2004; Hulme and Mosley 1996). However, there is also the case that although they are creditworthy, micro-entrepreneurs have no interest in borrowing from formal institutions because they do not understand or trust the banking system (Ciravegna 2006) or they do not have a "savings culture" (Adusei 2013; Ashraf et al. 2006; Benartzi and Thaler 2004; Duflo et al. 2006; Van Rooyen et al. 2012).

The absence of formal financial institutions in rural areas drove Yunus to develop the idea of microcredit in the early 80s in Bangladesh (Yunus 2003). In its original vision, the microfinance concept consisted of giving small loans, primarily to female entrepreneurs at the bottom of the pyramid, for productive and survival purposes. These women were unserved by the regular banks because of the lack of collateral or simply because they did not have easy access to banks. The primary purpose was to provide an alternative way of finance to the oppressive regime of traditional moneylenders, which was the only source of credit available to the most vulnerable



population. Moneylenders were viewed as exploitative of poor borrowers, often charging usurious interest rates (Mookherjee and Motta 2016; Pellegrina 2011). Yunus's proposal was based on the idea of the close relationship between economic development and financial inclusion (Deb and Kubzansky 2012). The final purpose of providing access to financial services to the unbanked population was to improve the quality of life of the more vulnerable and to promote entrepreneurship as a way out of poverty (Morris et al. 2018).

The core of Grameen's innovation was "the group". The group-based approach enables poor people to accumulate capital by way of small savings and facilitates their access to informal credit facilities. Borrowers at most Microfinance Institutions (MFIs) were organized into groups which have joint liability; if anyone in the group is unable to repay its loan each other member of the group should pay for some portion of the loan obligation. This system promotes close monitoring of individual behaviour by the group (Karlan 2007; Ghatak 2000). Group borrowers tend to be less delinquent than individual borrowers (Mokhtar et al. 2009).

The second Yunus's core purpose was the focus on women because they are more vulnerable. Worldwide women have been historically disadvantaged in terms of education, social exclusion, discrimination, and access to assets or other resources (Demirgüç-Kunt et al. 2018; Raihan and Uddin 2018; Fafchamps et al. 2011; Pitt and Khandker 1998). In addition, women are considered better administrators than men and are more concerned about their families. FMBBVA (2019) stated that supporting women means supporting the following generations. Although women's access to credit has improved in the last few years, there is still a strong gap between women and men (Demirgüç-Kunt et al. 2018). Currently, following the United Nations 2030 Sustainable Development Goals (United Nations 2015), various policies and support mechanisms are being implemented to elevate the status of women to fulfil international recommendations. Finally, Microcredit groups usually have weekly or monthly meetings where members repay their loan instalments and serve both as a social occasion and as an opportunity to receive financial literacy training.

MFIs have expanded rapidly all around the world, according to the Microfinance Barometer 2018, reaching 139 million low-income clients with a loan volume of US \$114 billion in 2017. Lately, MFIs have undergone a huge transformation, offering a wider range of financial products and services and many of them have become formal/regulated institutions (e.g. Gutierrez-Nieto and Serrano-Cinca 2019; Giné and Karlan 2014; Van Rooyen et al. 2012; Hermes and Lensink 2009 among others).

However, in the last decade, Yunus's vision has been questioned because of the proliferation of MFI's applying aggressive lending practices to extend the borrower base. As a result, there were "over-indebtedness" and "loan overlapping", meaning, borrowers taking loans from one MFI to pay back another (Haldar and Stiglitz 2016). In 2011, India's SKS Microfinance ambitious project produced a serious MFI's repayment crisis and trust on these institutions (Mader 2013, 2017; Ghosh and Ray 2016; Pole et al. 2014). Moreover, although much economic and financial literature has highlighted the importance of microfinance as a factor in development, there is an intense debate about its effectiveness as a development tool given the multidimensional components of poverty (Maity 2019; Ditcher 2007). Some researchers even suggest that microcredits may have a negative impact on the most



vulnerable (Cull et al. 2018; Bateman and Chang 2009; Vogelgesang 2003; Prahalad and Hammond 2002) with over-indebtedness and lack of financial education being some of the main problems (Bali and Varghese 2013; Berge et al. 2012). Authors like Gutiérrez-Nieto and Serrano-Cinca (2019) believe microfinance is a robust banking idea but not as an anti-poverty intervention on its own. Pollin and Feffer (2007) suggested that credit accessible to poor people is a laudable aim, however, as a tool against global poverty, microcredit should be judged by its effectiveness.

Currently, a profound digital revolution is taking place, characterized by unstoppable technological advances (Ochoa et al. 2016). This digital revolution not only affects mobile communications and new ICT solutions, but also the microfinance industry. Mobile phones, and other technological devices, had an exponential increase in recent years; this is mainly due to the global investment in mobile network and the design of low-price devices. Seven out of ten homes belonging to the poorest 20% of the population have a mobile phone (GSMA 2019; Global Microscope 2019). Ontiveros et al. (2014) claim that increasing digitization of financial services provides enormous potential for improving financial inclusion with less-expensive financial services models, more accessible and efficient, such as branch-less banking models or mobile payment with simple text-based phones.

Microfinance Institutions can be classified in three different groups: deposit-taking institutions like commercial banks, credit-only non-deposit-taking institutions, and informal organizations. The latter category includes savings groups (SGs), club pools and financial services associations and this is the area where we are going to concentrate our research (Kodongo and Kendi 2013; Kirkpatrick and Maimbo 2002). The purpose of these informal organizations is to provide finance to the population that is excluded from the formal financial sector.

Savings Groups

In recent years and parallel to the development of the microfinance industry, many non-profit organizations (NPOs) and social enterprises have begun to promote savings-lending groups among the more vulnerable population. Nelson (2013) suggests that savings groups must be the starting point for financial inclusion. These savings groups (SGs) emulate and improve Yunus's original idea of voluntary formed groups of borrowers applying for credit with joint liability (Yunus 2003).

Foundations and development organizations have mobilized over 700,000 savings groups in vulnerable communities across 75 countries worldwide (Allen 2018). A systematic review of 53 studies conducted between 2004 and 2017, carried out by Gash (2013, 2017), concludes that SGs have a positive impact on household savings, access to credit, asset accumulation, consumption, business investment and social capital. Thus, SGs are considered a first step for unbanked customers to become formally financial included (Ballem et al. 2012). So, when SG's members demonstrate their capacity to repay their debts, bank loans can be accessible for them.

SGs were originated from the Rotating Savings and Credit Associations (ROSCA) that was described by Bouman (1983) as "the poor man's bank". ROSCA are created on informal appreciation among friends or family and tend to have



simple structures. Each SG acts as a financial institution owned and managed by the group members. The basic element is the group, and the most effective component is the “forced” saving element. Members regularly contribute money to a common pot that is assigned to each member in turn. Most of the time, the order is predetermined. The group meets regularly for the repayment of loans, and allocation of proceeds. Money is not idle for long but changes hands rapidly, satisfying both consumption and production needs (Gugherty 2007; Armendáriz and Morduch 2005). The risks of this system are the difficulty to increase the size of the resources, the impossibility to move resources across communities, the right allocation of resources when the pot is excessive and the high interest rates. The ROSCA concept has been adapted to the needs and characteristics of different countries (Gigante 2017; Umuhire 2013; Ardener 1964) so that some sort of short-term savings club can be found in most low-income communities around the world. For example, the denominated “Tontine” in rural Cameroon, where members contribute with a fixed amount that is assigned fully to one of its members (Nzemen 1988). In Asia, a “Hui” is organized in a way that members can bid for the pot (Ardener 1964). The system called “Likelemba”, mostly used in the Democratic Republic of Congo, is a common container or “pot” assigned to one of the group members, it works as a “turbine” where the money flows from one group member to the next in the following meeting (Urquía-Grande et al. 2017). In Latin America, the most common format is the mutuality which is called differently along the countries: for example, “Tanda” in Mexico and “Polla” in Chile. Mutualities are more organized and have more rigid structures than a family group (Armendáriz and Morduch 2005).

SGs are informal associations consisting of 10 to 20 members, usually women from similar social backgrounds, that have voluntarily come together with the purpose of improving their economic situation out of mutual help, solidarity and joint responsibility (Wydick et al. 2011). Some of the SGs characteristics are small-sized memberships, homogeneity of composition, cohesiveness and effective participation of members in the functioning of the group (Husain et al. 2010). Additionally, usually SGs offer poor women a platform to receive information regarding financial education, health, nutrition and governance (Shivaprasad 2020; Navajas et al. 2000). The majority of the SGs are promoted and driven by NPOs.

Most of these types of SGs follow the same three basic principles: joint liability, regular meetings and no grants in the common “pot”, only members’ savings. Joint liability means that if anyone in the group is unable or unwilling to repay, each member of the group should pay for some portion of the loan obligation. Joint liability increases repayment because borrowers know each other and try to avoid risky profiles. An incentive for the repayment of group loans is the joint liability. Repayment improves among borrowers with strong social ties and deteriorates among borrowers with weak social ties (de Quidt et al. 2016; Maria 2009; Conning 2005). In addition, group reputation could affect individual credit rating for future access to credit. Attanasio et al. (2013) suggest that joint liability will also prevent borrowers from using loans for non-investment purposes.

The second principle, and probably the most important, is the regular meetings. Initially conceived for screening the repayment of loans, they are also used for facilitating member training on financial and business skills and monitoring loan use.



Feigenberg et al. (2014) found out that an increase in the meeting frequency created social capital, which led to a subsequent improvement in repayment rates.

The third principle is that there are no grants in the common pot, only member's savings. All the money in the pot is put together and is allocated for different borrowers each time. This group-lending model is becoming more flexible in relation to the quantity of the contributions and the fact that participants could be entitled to the loan without waiting for their turn.

Dellien et al. (2005) discuss key differences between group lending and individual lending regarding screening and monitoring. In Savings groups, the group pressure, and social ties reduce repayment risk, while individual lending repayment discipline is created by strict enforcement of contracts.

SGs relational model is very intensive in terms of transactions, given the number and size of loans, and the number of repayment sessions, therefore transaction cost can be very high (Karlan 2007). As a result, it is necessary to promote the use of technology to maintain a proper bookkeeping and accounting system to help controlling the regular meetings transactions (receipts, vouchers, cash books, members individuals' books) as the time consumed in meetings.

Default Risk

The capability of borrowers to repay their microcredit loans is a very important issue and is the first risk of MFI's sustainability. Default is a failure to repay a debt including interest or principal on a loan or security and can occur when a borrower is unable to make timely payments, misses payments or stops making payments. Default not only causes a reputational effect on the group but also has an impact towards future borrowing capacity and group formation. Individuals and businesses can fall into default when they are not able to keep up with their debt obligations. A high rate of non-performing loans (NPL) is one of the main causes of bank failures. Exploring the determinants of ex-post credit risk is an issue of substantial importance for financial stability and for bank's management (Reinhart and Rogoff 2010). However, factors affecting loan delinquency in microfinance can be dramatically different from developed countries (Kodongo and Kendi 2013; Field et al. 2010). In contrast to commercial banks, microfinance institutions cannot secure loans with collateral or screen borrowers, given the lack of assets or reliable financial information. MFIs prefer to offer group-lending contracts when the size of the loan is high, transferring the monitoring role to the group of borrowers (Giné and Karlan 2014; Maria 2009).

Potential factors determining loan delinquency among microfinance customers have been widely covered in the literature (Baland et al. 2017; Beg and Bashir 2017; Muthoni 2016; Field and Pande 2008; Adongo and Stock 2005; Churchill 2004; Norell 2001 among others). These factors include interest rates, age, loan amount, repayment period and loan category (group or individual). In relation to loan category, Kodongo and Kendi (2013) suggest that group-lending programs are more effective than individual lending programs in mitigating the risk of default. Individual loans are three times more likely to default on their



microcredit obligations than group borrowers, the reason being that, although everyone is responsible for repaying their own loans, if any member defaults, other members will have to repay the loan (Baland et al. 2017). Al-Azzam et al. (2012) empirical analysis suggests that peer monitoring, group pressure and social ties reduce delinquency. In addition, group lending allows MFIs to identify individuals within the groups whose credit risk has improved and offer them progressive individual loans.

Another factor of discussion in loan default risk is group gender composition (Banerjee et al. 2015; Giné and Karlan 2014; Adusei 2013). A higher percentage of female clients in MFIs are associated with a lower portfolio risk, fewer write-offs and fewer provisions (D'Espallier et al. 2011). Eckel and Grossman (1998, 2002) find that women are more cooperative than men and their behaviour is less selfish. In theory, females have a stronger internalization of pro-social values than men; therefore, it would be expected that women might be less likely to default on their loan payments. Furthermore, repayment of loans represents one kind of cooperative behaviour. When tension exists between the individual interest and the welfare of the group, women are more likely to make choices that contribute to group welfare. In addition, people tend to behave in accordance with those around them even against their own interest (de Mel et al. 2009; Hermes and Lensink 2009; Anthony and Horne 2003). The influence of some members of other group can influence other members (Karlan et al. 2014, 2017; Prina 2015).

In relation to group sizes there are different theories. Ahlin (2015) highlights the benefits of larger group size based on the intragroup monitoring role, while other authors such as Conning (2005) argue that too large groups with loose social ties may not be able to enforce the cooperative agreements necessary for group repayment.

In terms of age, Mokhtar et al. (2009) and Bhatt and Tang (2002) suggest that older borrowers are more responsible and disciplined in repaying their loans than younger borrowers. The lack of experience in the business involved could be one of the reasons for younger borrowers not to repay their loans.

The amount of the loan and terms are other factors that can affect client delinquency (Norell 2001). Mirpourian et al. (2016) consider that repayment rates increase as borrowers get closer to the loan limit. Some authors like Field and Pande (2008) explain that a less rigid repayment schedule would decrease default rates. The problem is not the loan term but the repayment capacity. MFIs should consider lowering the weekly repayment amount and providing longer duration of payments in response (Mokhtar et al. 2009).

Many authors consider interest rates one of the most important factors in microfinance default risk (Le Polain et al. 2018). In fact, savings groups were born to serve the unbanked and to protect them from the abusive interest rates charged by moneylenders. Group-lending interest rates were lower than individual lending because group joint liability reduce default risk. Authors such as Kodongo and Kendi (2013) confirm that high interest rates increase the chances of client delinquency. Other authors consider that high interest rates are necessary for first time borrowers. There are also dynamic individual contracts that involve a “penalty” interest rate after default, and favourable rates after success (Ahlin and Waters 2014).



Ultimately, the lack of financial skills is one of the main problems for micro-entrepreneurs when managing their micro-business. It has been proven that financial education improves microcredit beneficiaries' financial outcomes (López-Sánchez et al. 2020; Drexler et al. 2014; de Mel et al. 2014; Deb and Kubzansky 2012; Karlan and Valdivia 2011). The impact of training programs improves when tuition is adapted to the micro-entrepreneur's needs.

Finally, other factors could be taken into account as determinants of default risk such as inflation rates (Owusu-Manu et al. 2016), weather conditions (Golden et al. 2007), financial, health (Ashraf 2020) or political crisis (Cuadra and Sapriza 2008) occurring in a country. However, in this research these will not be taken into account as they are considered too macroeconomic and volatile for the constructed model.

Ecuador

The economy of Ecuador is the eighth largest in Latin America with a GDP of 107.4 billion dollar and mainly lives from agriculture and oil. In the past few years, Ecuador has been facing serious economic and social problems, such as large inequality gaps, informal economy and low income. Likewise, access to credit, availability of ATMs or Internet access is very low in rural areas (ASOMIF Ecuador 2019).

The Global Microscope has been building for years a ranking of countries in relation to the enabling environment for financial inclusion, which consists of a weighted and dynamic model of assigning scores to a series of selected indicators. During the past few years, Ecuador has had a significant deterioration in the Global Microscope ranking. It has gone from a sixth outstanding position in the 2009 to the 26th position in 2019. The main cause of this deterioration is the lack of a political environment to ensure the provision of affordable and quality financial services in the country and that Ecuador does not have a national strategy for financial inclusion or concrete plans for the digital transformation of the country (Global Microscope 2019).

The difficulties to access formal credit in rural areas have led to the creation of informal intermediaries such as savings groups. Groups of people, mainly women, that save and periodically contribute a quantity of money to a common "pot" that will give loans among their own members. The effectiveness of savings groups is based mainly on the social sanctions that occur if a member of the group does not pay back its loan. A limitation of this model lies in the low amounts of savings and credit generated (Bicciato et al. 2020).

We chose Ecuador because of the dramatic economic situation together with the importance of Saving Groups in microfinance programs in the country.



Sample and Model Specifications

Savinco designed a program called “Saving and Learning” based on the community lending groups model with the purpose of starting a trend of self-sustainable improvement in the quality of life of families living in poverty. Savinco applies a self-finance and self-managed socio-economic inclusion model, which starts by promoting community savings. This solution is based on four pillars: financial education, self-financing through savings, self-management and technology. The main beneficiary of SGs has been the most vulnerable population.

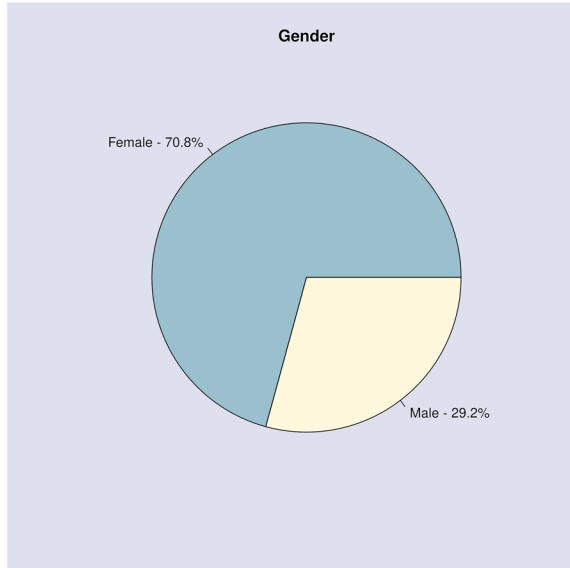
These types of programs are intensive in terms of human resources, given the high number of transactions in the regular meetings. As a result, Savinco decided to apply new ICTs to make the management of the meetings more accessible, convenient and safe and developed an advanced cloud-mobile technology called Qmobile. This online platform main purpose was to help group members to manage their regular meetings more efficiently, helping them recoding all financial transactions (savings, paid-in capital, loans, received and due interest). In addition, Qmobile is used to improve financial education, to monitor group-lending transactions and to evaluate impact on vulnerable populations. Savinco implemented the “Saving and Learning” program in Peru and Ecuador. Ecuador program is the largest one with over 400 savings groups and over 9000 active members managed by the groups themselves with the advice of coaches.

Savinco provided the authors with access to data already anonymized for the total “Saving and Learning” Ecuadorian program members in such a way that the data subjects would not be identifiable. Concretely, the only personal available data for each individual are their gender and age together with some of their financial history within the program, ensuring each individual’s privacy is protected.

Hence, using the data from the Ecuadorian cloud-mobile SAVINCO platform Qmobile from the year 2014 to 2020, we have tried to answer our research questions. The initial sample consisted of the 9392 active users of the Ecuadorian microcredit app Qmobile on the extraction date of 6 February 2020. However, there were some profiles with some missing data related to age and birth dates that could not be estimated, without a history of borrowing and/or with less than three or more months of seniority so they were not considered in the analysis. Hence, the working sample consisted on 7251 users. Gender distribution of those remaining 7251 users can be seen in Fig. 1. Most of those users were females (70.8%), which is common in this type of informal savings institutions.



Fig. 1 Distribution by gender



Model Specification: Dependent Variable

As it was stated before, we are interested in analysing the possibility of the users of this Ecuadorian microcredit app Qmobile to incur in non-performing loans (NPL). In banking, commercial loans are usually considered NPL if the borrower is 90–180 days past due, however, Qmobile classifies a loan as NPL as soon as the user fails to meet his/her monthly instalment. Nevertheless, most users regularize their situation in the following group meeting, so that the most usual term for NPL duration is the month between consecutive meetings. Among Qmobile Ecuador app users the NPL rate is quite small (see Table 1) as the users with no history of NPL behaviour are 94.79% of the total active users.

Due to our interest in studying whether microcredit borrowers incurred in NPL, we transformed this variable counting the number of times a user is past due into a binary one. Therefore, our dependent variable (NPL) represents the user’s credit status, with value 1 denoting existence of NPL and 0 standing for the on-time repayment of all previous loans.

Model Specification: Independent Variables

There are several aforementioned variables that the literature identifies for being the most prominent loan repayment determinants in the microfinance industry. The

Table 1 NPL frequencies and percentages

0	1	2	3	4	5	6	7	8	9	10	11	12
6873	241	67	25	17	11	6	5	1	2	1	1	1
(94.79%)	(3.32%)	(0.92%)	(0.34%)	(0.23%)	(0.15%)	(0.08%)	(0.07%)	(0.01%)	(0.03%)	(0.01%)	(0.01%)	(0.01%)



Table 2 Variables considered in the study

Code	Description	Possible values
X1. Gender	User's gender	Female Male
X2. Rural	Whether group area is rural or not	Yes No
X3. Received loans	User's number of previously received loans	Discrete variable
X4. Seniority	User's number of months in the group	Discrete variable
X5. Age	User's age measured in years	Discrete variable
X6. Average loan term	Average term of all the loans the user has had in the past measured in months	Discrete variable
X7. Average loan	Average amount (\$) of all the loans the user has had in the past	Continuous variable
X8. Total received amount	Total amount (\$) that the user has borrowed in the past	Continuous variable
X9. Accumulated savings	User's accumulated savings (\$)	Continuous variable
Z1. Current capital	Group capital at data extraction (\$)	Continuous variable
Z2. Initial capital	Group capital at founding (\$)	Continuous variable
Z3. Current female percent	Group percentage of females at data extraction	0–1
Z4. Initial female percent	Group percentage of females at group founding	0–1
Z5. Group life	Group life measured in months	Discrete variable
Z6. Current members	Group number of members at data extraction	Discrete variable
Z7. Initial members	Group number of members at group founding	Discrete variable

following variables will be included in our model as independent variables. A brief explanation of each variable is given in Table 2 and, to facilitate understanding and identification, codes X1 to X9 are assigned for variables related to users and Z1 to Z7 for variables related to groups.

Although interest rates are a determinant variable mentioned by several papers (e.g. Ahlin and Waters 2014; Kodongo and Kendi 2013), in our model they are not included, because in our sample all customers bear the same interest rate of 5 per cent per month that remains stable and affordable.

Model Specification: Methodology

We follow a quantitative and qualitative research methodology. A multivariate logistic regression model was fitted to the data to identify the factors that affect the NPL behaviour on Qmobile users in Ecuador.

Logistic regression models are commonly used to study effects of predictor variables on a categorical one, usually with binary outcomes, such as the present case where the variable of interest is whether a Qmobile user incurs in NPL. When there are multiple predictors (e.g. age, gender, accumulated savings...) that are hypothesized to influence the outcome, the model is referred to as a multivariable



logistic regression model. Logistic regression is more adequate than other techniques because it only assumes a binomial distribution for the prediction error, as well as the conditional mean of the binary outcome. Furthermore, logistic regression does not assume a multivariate normal distribution for the independent variables as, for example, discriminant analysis does. For a more extended explanation on logistic regression see, for example, Hosmer et al. (2013).

All calculations were carried out in R (R Core Team 2021), version 3.6.3 running on Xubuntu 20.04.

Our results were contrasted and contextualized with Savinco managers through various interviews, discussions and meetings to help us gain a deeper understanding of the results and correct the possible biases from unobserved individual situation.

Results

The current Qmobile users are organized in 409 active savings groups, with other 76 groups no longer active. The group life changes from three to 64 months, with the median group life being 24 months. The groups currently contain from 9 up to 88 members, with a median size of 20, and the median female percentage is currently 69.23%, with a variation from 33 to 100%. Finally, current group capital ranges from \$350 to \$88,070, with a median value of \$6450. The descriptives of these group variables are included in Table 3.

Table 3 Group descriptives

	Min	Mean	Median	Max	SD
Z1. Current capital	\$350	\$9865.00	\$6450.00	\$88,070	\$11,372.93
Z2. Initial capital	\$30	\$314.80	\$180.00	\$18,335	\$1043.89
Z3. Current female percentage	33	69.65	69.23	100	0.12
Z4. Initial female percentage	0	68.86	68.75	100	0.16
Z5. Group life (months)	3	26.5	24.0	64	17.35
Z6. Current members	9	27.44	24.00	88	12.60
Z7. Initial members	0	16.63	15.00	56	6.82

Table 4 User descriptives by NPL behaviour

	NPL behaviour	Min	Mean	Median	Max	SD
X6. Average loan term (months)	NPL=0	1.00	5.55	4.75	60.00	3.55
	NPL=1	1.00	7.26	6.00	52.00	5.25
X7. Average loan	NPL=0	\$5.00	\$344.50	\$250.00	\$6573.30	\$354.39
	NPL=1	\$44.78	\$421.30	\$302.33	\$4062.50	\$374.48
X8. Total received amount	NPL=0	\$5.00	\$2032.00	\$1174.00	\$72,233.00	\$2837.39
	NPL=1	\$94.00	\$2841.40	\$2056.00	\$35,048.00	\$2913.79
X9. Accumulated savings	NPL=0	\$0.00	\$342.90	\$235.00	\$9430.00	\$411.19
	NPL=1	\$0.00	\$336.90	\$267.50	\$2130.00	\$259.88



Table 5 Frequencies and percentages of user characteristics

Variable	Value	NPL=0 (%)	NPL=1 (%)	Total (%)	NPL rate (%)
	All	6875	378	7253	5.21
X1. Gender	Female	4885 (71.05)	247 (65.34)	5132 (70.76)	4.81
	Male	1990 (28.95)	378 (34.66)	2121 (29.24)	6.18
X2. Rural	Yes	2911 (42.34)	131 (34.66)	3042 (41.94)	4.31
	No	3964 (57.66)	247 (65.34)	4211 (58.05)	5.87
X3. Received loans	≤ 1	902 (13.12)	17 (4.50)	919 (12.67)	1.85
	2–5	3355 (48.80)	163 (43.12)	3518 (48.50)	4.63
	6–10	1718 (24.99)	121 (32.01)	1839 (25.36)	6.58
	11–20	792 (11.52)	62 (16.40)	854 (11.7)	7.26
	21–30	90 (1.31)	8 (2.12)	98 (1.35)	8.16
	30–40	13 (0.19)	7 (1.85)	20 (0.28)	35.00
	> 40	5 (0.07)	0 (0.00)	5 (0.07)	0.00
X4. Seniority (months)	≤ 12	2696 (39.21)	56 (14.81)	2752 (37.94)	2.03
	25–24	1834 (26.68)	83 (21.96)	1917 (26.43)	4.33
	25–36	1178 (17.13)	69 (18.25)	1247 (17.19)	5.53
	37–48	768 (11.17)	66 (17.46)	834 (11.50)	7.91
	49–60	228 (3.32)	69 (18.25)	297 (4.09)	23.23
	> 60	171 (2.49)	35 (9.26)	206 (2.84)	16.99
X5. Age (years)	≤ 18	103 (1.50)	4 (1.06)	107 (1.48)	3.74
	18–25	1016 (14.78)	53 (14.02)	1069 (14.74)	4.96
	25–40	2481 (36.09)	137 (36.24)	2618 (36.10)	5.23
	40–55	2108 (30.9)	107 (28.31)	2215 (30.54)	4.83
	55–70	968 (14.08)	55 (14.55)	1,023 (14.10)	5.38
	> 70	199 (2.89)	22 (5.82)	221 (3.05)	9.95

Descriptives by NPL behaviour for the individual user continuous variables are presented in Table 4. It is interesting to observe how the maximum values for all four variables are much higher than for those users with no NPL past behaviour (NPL=0). However, the median is in all four cases smaller than for those users with NPL behaviour (NPL=1), as it is the mean, except for the accumulated savings.

Finally, for a complete overview of the user's independent variables that are included in the model, a summary of the frequencies, percentages and default rates of the qualitative and discrete variables is presented in Table 5. Default rate is calculated by dividing the number of members that have defaulted (NPL=1) by total members.

Out of 7251 analysed users, there are only 378 with non-performing loans, a mere 5.21%, hence the NPL rate is quite small among the Qmobile users that had ever borrowed money. Furthermore, by examining Table 5 it appears that as age increases, the proportion of individuals with NPL increases. Something similar seems to happen both with seniority and with the number of received loans. Finally,



Table 6 Post-estimation VIF test

Variables	VIF
X1. Gender	1.111531
X2. Rural	1.218682
X3. Received loans	4.090211
X4. Seniority	4.764794
X5. Age	1.079317
X6. Average loans term	1.841376
X7. Average loan	3.169891
X8. Total received amount	4.565030
X9. Accumulated savings	2.447600
Z1. Current capital	4.941217
Z2. Initial capital	1.321156
Z3. Current female percent	2.202914
Z4. Initial females percent	2.088687
Z5. Group life	3.957181
Z6. Current members	3.863196
Z7. Initial members	1.542326

it also appears that being a male and not belonging to a rural area increases slightly the probability of NPL behaviour.

The degree of multicollinearity among the explanatory variables has been tested using variance inflation factor (VIF) test and the post-estimation model results presented in Table 6 show that the value of variance inflation factor ranges between 1.08 and 4.94 (all of them below 5), implying that the data have no multicollinearity problems among explanatory variables used in the multivariate logistic regression model (James et al. 2013).

Maximum likelihood estimates of the parameters in the logistic regression model characterizing the NPL behaviour of Qmobile users are presented in Table 7. It must be noted that the estimated coefficients do not directly indicate the effect of change in our explanatory variable of NPL behaviour. Those estimated coefficients indicate the effect of each individual explanatory variable on the probability of the NPL behaviour occurring. Particularly, a positive (negative) coefficient means that the log of odds $\{\ln [\text{Probability}/(1 - \text{Probability})]\}$ increases (decreases) as the corresponding variable increases.

The result of the Hosmer–Lemeshow test (chi square = 7253; df = 8; $p < 2.2e-16$) indicates no evidence of poor fit. Hence, it is confirmed that the model fits the data. The estimated logit model is given by the following expression:

$$\begin{aligned} \text{Logit}\{\text{NPL} = 1/\text{independent variables}\} = & -3.85081 + 0.21182 X1 - 0.13206 X2 \\ & - 0.02789 X3 + 0.04884 X4 + 0.00238 X5 \\ & + 0.04237 X6 + 0.00071 X7 + 0.00008 X8 - 0.00282 X9 \\ & - 0.00003 Z1 - 0.00016 Z2 + 0.06146 Z3 - 0.91763 Z4 \\ & + 0.03200 Z5 - 0.02823 Z6 + 0.03736 Z7 \end{aligned}$$



Table 7 Parameters in the logistic regression model

	Estimate	SE	z value	Pr(> z)		Odds ratio
(Intercept)	- 3.85081	0.44602	- 8.634	< 2e-16	***	0.0213
X1. Gender [T. male]	0.21182	0.12571	1.685	0.09199	*	1.2359
X2. Rural [T. yes]	- 0.13206	0.12914	- 1.023	0.30649		0.8763
X3. Received loans	- 0.02789	0.01922	- 1.451	0.14680		0.9725
X4. Seniority	0.04884	0.00676	7.218	5.26e-13	***	1.0500
X5. Age	0.00238	0.00396	0.602	0.54699		1.0024
X6. Average loans term	0.04237	0.01689	2.507	0.01217	**	1.0433
X7. Average loan	0.00071	0.00032	2.221	0.02636	**	1.0007
X8. Total received amount	0.00008	0.00004	1.794	0.07283	*	1.0001
X9. Accumulated savings	- 0.00282	0.00041	- 6.776	1.24e-11	***	0.9972
Z1. Current capital	- 0.00003	0.00001	- 2.023	0.04304	**	0.9999
Z2. Initial capital	- 0.00016	0.00024	- 0.657	0.51107		0.9998
Z3. Current female percent	0.06146	0.65754	0.093	0.92553		1.0634
Z4. Initial females percent	- 0.91763	0.48893	- 1.877	0.06054	*	0.3995
Z5. Group life	0.03200	0.00604	5.295	1.19e-07	***	1.0325
Z6. Current members	- 0.02823	0.00846	- 3.335	0.00085	***	0.9722
Z7. Initial members	0.03736	0.00813	4.595	4.32e-06	***	1.0381

Signif. codes: * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$

Overall, most of the explanatory variables had expected signs. Particularly, gender, seniority (individual), total received amount, average loan, average loan term, group life and initial members had a consistently positive and significant effect (at 10% level) on NPL behaviour. Accumulated savings, current capital (group), number of current members (group) and initial female's percentage (group) have also a significant effect on defaulting, but negative, meaning the higher the value of the variables, the lower the probability of NPL behaviour. However, neither age nor the number of received loans, rural, group initial capital or the current female percentage (group) have any significant effect on NPL behaviour.

It is of special importance gender (male) and initial female's percentage because of their odds ratio deviation from 1. Concretely, the odds of a male incurring in NPL behaviour are 1.2359 times greater than the odds for females. Additionally, for each point increase on the initial percentage of female in the group, the odds of the members of that group incurring in NPL behaviour decrease from 1 to 0.3995.

Findings Discussion

In our research, we have analysed the relative importance of several factors on the probability of default using a sample of 7251 active users of the "Saving and Learning" Program developed in Ecuador by SAVINCO from 2014 to 2020. All these



users had been with the organization for at least three months. In this section, we will discuss our findings.

SGs are being used in many parts of the world as a strategy to give access to financial services to the population in the bottom of the pyramid with the final objective of reducing poverty. Nevertheless, the inherent risk attached to these small loans is a major concern for MFIs and NPOs. Understanding SGs member's characteristics could play an important role in reducing loan default rates.

The potential factors determining microcredit default have been analysed in line with Adongo and Stock (2005); Field et al. (2010); Kodongo and Kendi (2013) and Muthoni (2016). Most of these studies have been performed for specific countries and years limiting the generalizations to other countries or situations. Nevertheless, there are some borrower's characteristics examined in the present research that are significant in most of these studies. These factors include gender, age, numbers of loans, loan amount and repayment period.

It is very interesting to observe that the average default rate in our sample is 5.21% which is relatively low in comparison with Ecuador default rate of Microcredits issued by Cooperativas (Savings and Loan Associations) which was 5.88% in September 2019, and much lower than public banks with a microcredit default rate of 7.76% (Ocaña 2018). A possible explanation for this fact might be that traditional banks have a higher percentage of individual loans that are associated with higher default rates than group lending (Kodongo and Kendi 2013; Mokhtar et al. 2009) and that financial education improves savings and the responsible use of the loan.

The significant positive sign on "Gender (Male)" is consistent with previous authors that indicate that the probability of having problems in loan repayment is higher for males than for females. A higher percentage of female's clients in MFIs is associated with a lower portfolio risk, fewer write-offs and fewer provisions (Adusei 2013; Banerjee et al. 2015; D'Espallier et al. 2011; Giné and Karlan 2014). Although the gender variable was significant only at a 10% level, the odds of a male incurring default are 1.24 times greater than the odds for females.

Although "Age" is not statistically significant in our model, the NPL rate of customers over 55 years is higher than the average NPL rate (see Table 5). These results are not consistent with the research carried out by Mokhtar et al. (2009) and Bhatt and Tang (2002). Both suggest that older borrowers have more experience and would be more responsible in repaying their loans than younger borrowers.

"Seniority" and "Group Life" coefficients are both positive and significant at a 0.1 level. Savinco managers pointed out that the "Seniority" result might be logical, as they have observed that users tend to be less risk adverse after years being part of a savings group and may become over-indebted. Consequently, a similar consequence might happen with "Group Life". We recommend that before granting a new loan, records of borrowers' financial obligations in other institutions should be required.

Accumulated savings is inversely related to NPL, and significant at a 0.1 level. Accumulated savings represents individual savings, therefore it is expected that borrowers with a high level of savings have less of a chance of default, since it would be against their own interest.

Furthermore, results suggest that Average loan and Average loan term are significant factors (both at 5% level) influencing directly the chance of default. This result



is opposite to authors such as Mokhtar et al. (2009) who defend that the lower the loan amount, the higher the chance of default since low loan amounts are mostly extended to first business beginners who lack experience and larger amounts are mostly granted to more experienced borrowers. They also suggest that a weekly loan repayment schedule posed problems for borrowers who generate a lower revenue cycle and suggested that MFIs should consider lowering the weekly repayment amount and providing a longer duration of payments in response. Furthermore, Kodongo and Kendi (2013) suggest that larger loan amounts are associated with fewer incidents of delinquency. Moreover, Savinco managers explained that the average loan term is not an important factor in client delinquency but the size of the regular payments, and suggest that regular instalments should not be higher than a 30% of their salary. Savinco managers affirm that the problem is not the loan term but the regular repayment capacity.

Initial and Current Members are both significant (at 0.1%) but in opposite directions. Initial Members is positively related to default, while Current Members is inversely related to default. SAVINCO managers explain that large initial members relationship with higher default rates might be due to the fact that members do not know each other well enough and there is not a clear leader and group procedures, in line with Conning (2005) that suggests that broad initial groups may not be able to enforce the cooperative agreements necessary for group repayment. On the contrary, the result that Current Members is inversely related to default is consistent with the literature that suggest that after some time, larger groups know each other well and can take greater advantage of local information reducing adverse selection and moral hazard (Ahlin 2015). It is also well known that diversification can reduce risk and sufficiently large groups can attain first-best lending.

Finally, SAVINCO managers are concerned about financial training and are implementing more active leanings methodologies using the mobile platform and quality control measures. They stated that it is important to observe the beneficiaries' behaviour in relation to debt recurrence to prevent them from over-indebtedness. As hypothesized, given the financial education provided in the regular repayment meetings, the higher number of attended sessions the better prepared microcredit beneficiaries are to make appropriate decisions regarding loan size and repayment period.

Conclusions

Savings groups programs have expanded rapidly all around the world providing an alternative way of financing excluded population. Although there is abundant literature about microfinance impact, outreach and sustainability (Gutierrez-Nieto and Serrano-Cinca 2019; Van Rooyen et al. 2012; Hermes and Lensink 2009), there is scarce research about the determinants of loan-repayment in microcredit savings groups. The purpose of this research was to identify the savings group members' characteristics that minimize default risk. We have analysed a sample of more than 400 SGs and 7253 active users of the "Saving and Learning" program, developed by



SAVINCO in Ecuador from 2014 to 2020. The information was extracted from the cloud-mobile App Qmobile that records all group-lending transactions.

We have used a binary logistic regression model to identify the factors that affect the non-performing loan or default behaviour among microcredit borrowers from savings groups in Ecuador, which led to interesting findings. Overall, most of the explanatory variables had expected behaviours. Particularly, gender, seniority, total received amount, average loan, average loan term, group life and initial members had a positive and significant effect on default. Accumulated savings, group current capital, number of current members and initial females' percentage have also a significant effect but inverse, meaning the higher value of the variables, the lower the probability of default. However, neither age nor the number of received loans, rural area, group initial capital or current female percentage has any significant effect on NPL behaviour.

As a result, our first conclusion is the necessity of these groups to control over-indebtedness. We recommend a break period between loans, since after years of continuously borrowing SGs members could tend to be less risk adverse. In addition, before granting a new loan records of borrowers' financial obligations at other institutions should be required. Regarding the loan size and term, we consider that the important factor is the regular repayment instalments. They should not be more than 30% of their regular income as SAVINCO managers suggested. In relation to group size, too broad initial groups could be a factor of concern since joint liability might not work well if members do not know each other or do not have strong family ties.

Furthermore, the use of technology in SGs should be promoted. Although the main purpose of the platform was to help group members efficiently manage their monthly meetings, the online data allow users and managers to perform a continuous follow-up and quality control of the program. In addition, an App is a perfect channel to provide financial education to SGs members. The challenge is to generate long-term saving habits and management skills that will allow users to improve their financial health and consequently improve their life conditions.

The contributions of this paper could be classified in contributions for practitioners, academics and development institutions. For practitioners, based on the results of this study, we have identified relevant factors that can affect SGs default rates. For academics, the rich information provided by the Mobile App could be a starting point for further quantitative research once the financial education App is designed. Finally, for international development institutions, we suggest that all the actors involved such as the government, NPOs and MFIs should work together to provide the necessary framework to promote the use of technologies for financial inclusion and education. Cooperation among the different actors is the only way to achieve economic growth in a sustainable and inclusive way.

No study is without limitations. First of all, the generalizability of our findings might be restricted by our focus on one saving group platform in Ecuador. These results should, of course, be interpreted with caution, as they may be idiosyncratic of the period and region. A second potential limitation is that the information used was not complete, additional group members qualitative and socio-economic information will be needed to complete the borrower profile in order to produce comprehensive



credit scoring. Last but not least, the information was extracted before the COVID-19 pandemic that has greatly affected all levels of society worldwide.

Finally, the present results legitimize the authors to continue exploring on this area. There is a need for more research that can assist both lenders and borrowers achieve jointly economic growth in a sustainable and inclusive way. Future research lines include the design of a complete borrower's profile and credit scoring, together with other variables such as inflation, weather conditions, political, financial or health crisis (COVID-19) impact on savings groups programs defaults.

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