The Economics of Savings Groups*

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Abstract

Millions of households worldwide rely on savings groups (SG) to satisfy their financial needs, yet important gaps remain in our understanding of this novel financial institution. We show theoretically that, within a SG, the supply of funds could fall short or be in excess of its demand. Then, we use week-by-week records from 46 Ugandan SGs to show that most groups do not generate sufficient loanable funds. We conclude by proposing two interventions that, in light of our model, should ease credit rationing and improve the welfare of SG members: encouraging early savings and linking SGs with formal financial institutions.

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1 Introduction

Despite the recent dramatic increase in financial inclusion, to this day an estimated 1.7 billion adults worldwide lack access to formal financial services.[1] Many are ultra-poor, living under the equivalent of USD 1.90 per day. For them, any financial difficulty such as sickness or a bad harvest is a formidable challenge. For this reason, a large proportion of the unbanked turn to informal, community-based savings and credit groups such as ROSCAs and - most recently - savings groups (SGs).

The basic framework of a SG involves a group of people that save with and borrow from each other. The group meets weekly over the course of a cycle (typically a year). At the initial meeting, the group establishes its rules of operation, including the interest rate charged on loans. At subsequent meeting, those who wish to save have an opportunity to place their money in the group's safe, and those who need a loan can request to borrow from the group funds. At the end of each cycle, the money in the safe is redistributed among the members in proportion their total contributions in savings. Thus a return on savings is generated, as each member receives back his or her savings plus a fraction of the interest payments collected by the group. Because SGs are designed to operate without outside support, they can reach a population not reached by traditional microfinance interventions. Despite their novelty, SGs are quickly becoming extremely popular. In Uganda, for instance, 43% of the population belong to an SG, while only 9% report belonging to a ROSCA (FinScope, 2018). Global estimates of the number of participants range from 11.5 million participants to over 100 million.[2]

This paper contributes to the understanding of SGs in three ways. Firstly, we propose

[1] That is, they are "without an account at a financial institution or through a mobile money provider" (See `https://globalfindex.worldbank.org`).

[2] The first number comes from SEEP (2016) and includes only members of VSLAs (a particular variety of SG) established by international NGOs. The second number is from Greaney, Kaboski, and Van Leemput (2016, p. 1614).

a theoretical model of a SG that explicitly incorporates its rules of operation.[3] Next, we analyze the weekly financial records of a sample of Ugandan SGs. Doing so, we provide the most accurate description to date of the evolution of these groups throughout their cycle.[4] Lastly, using the results of the model and the empirical analysis, we then propose two changes to the rules of operation of SGs that, we believe, could significantly improve the welfare of their members.

The first result of the model is that multiple, Pareto-ranked equilibria may exist. The reason is that, in a SG, the amount each member can borrow is capped to three times the amount saved by the group member as of the date that the loan was requested. Consequently, a member that wishes to borrow must first save, which implies that the cost of borrowing *decreases* with the return on savings. If the return on savings is expected to be high, borrowing will be high, and so will be the rate of utilization of the available funds and the return on savings. But if the return on savings is expected to be low, so will be borrowings, the rate of funds utilization and the return on savings. It follows that groups' performance may be poor due to a coordination failure among its members.[5]

We also show that even the Pareto preferred equilibrium is inefficient. This is a consequence from the cost of borrowing being fixed and established by the group at the beginning of the cycle. The primary implication is that SGs lack a mechanism to equate supply and demand for funds; hence, funds may be either rationed (i.e., not all members wishing to borrow are able to do so) or may be abundant (i.e., funds remain in the group's safe and are not put to productive use).

[3] Greaney et al. (2016) also develop a formal model of SG, but focus on the process of selection into a SG, without modeling explicitly how the group operates once formed. We complement their analysis by studying how the groups operate once they form, abstracting away from the process of group's formation.

[4] The majority of study on SG look exclusively at end-of-cycle outcomes. To the best of our knowledge, the only exceptions are Salas (2014), Burlando and Canidio (2016), and Burlando and Canidio (2017) who collect data on individual cumulative savings and borrowing at roughly 4 months intervals.

[5] This is consistent with the observation that group outcomes can be influenced by seemingly irrelevant factors. For example, Deserranno, Stryjan, and Sulaiman (2017) show that the mechanism of selection of leadership positions in savings groups (secret ballot or open discussion) affects SGs outcomes in important ways.

The possibility of a mismatch between supply and demand for funds gives rise to an externality problem: a member's borrowing and saving decisions affect other group participants. For example, an additional unit of savings contributed to the group during periods where funds are scarce generates a positive externality, because this additional unit can be used to meet the demand for loans of others. Conversely, an additional unit saved during periods where funds are already abundant generates a negative externality, because this unit of savings is not lent out and only decreases the return on savings for all members.

Less obvious is how the *timing* of savings affects the rest of the group. Our main result (and the one that will be most relevant from the policy perspective) is that shifting savings from later periods to earlier on in the cycle generates a positive externality on the other members of the group. Anticipating savings may generate additional lending if these savings are moved to a period of scarcity, because they can be lent out, generate a return that can itself be lent out in the future. Importantly, anticipating savings does not change total savings and hence cannot decrease the return on savings of all other members, even if it fails to generate extra lending. We conclude the model by arguing that the mismatch between demand and supply of funds is robust to the fact that the interest rate is chosen by the group. The reason is that member's preferences over the interest rate ignore other members' ability to satisfy their demand for funds at those rates. Hence, individual preferences over the interest rate do not align with social welfare.

We then test empirically the main premise of the model: that there can be a mismatch between supply and demand for funds. We develop a method to identify loan rationing in SGs, and apply it on the detailed records of weekly transactions from 46 Ugandan groups, heterogeneous in terms of geographic dispersion and experience. We show that, for the vast majority of groups, funds are rationed for the first half of the cycle, and for about 60% of groups funds are rationed for most of the cycle. This provides empirical evidence that scarcity may be a defining feature of SGs. We also find that funds remain idle in the groups' safe during the second half of the cycle.

Despite the success of SGs in bringing financial services to unbanked populations, our results highlight that these institutions have important shortcomings. We discuss two simple policies that can improve SGs ability to satisfy the financial needs of its members. First, members should be allowed to shift savings from later periods to earlier periods. The second is to allow for formal financial institutions to provide joint liability loans to SGs, a practice already widespread and known as in sub-Saharan Africa. We prove that these joint liability loans, if appropriately constructed, can increase the welfare of all members of the group.

Relevant literature. The existing literature suggests that savings groups are a useful tool for local development (see Ashe and Neilan, 2003). Randomized evaluations of savings groups found a range of positive effects, including an increase in savings and borrowing, in food security, overall consumption smoothing, livestock holding, household business outcomes and women's empowerment (see Ksoll, Lilleør, Lønborg, and Rasmussen, 2015, Beaman, Karlan, and Thuysbaert, 2014, Gash and Odell, 2013, Karlan, Savonitto, Thuysbaert, and Udry, 2017 and the recent review of the evidence in Gash, 2017).

A more recent strand of the literature studies the functioning of SGs. Most closely related to our paper is the work by Greaney, Kaboski, and Van Leemput (2016), which develops a theoretical model of the group formation process and shows (theoretically and empirically) that charging a membership fee functions as a screening mechanism that improves the performance of the group. In their model, the authors assume that the savings group operates as a frictionless credit market. Here, we model in detail the rules determining the allocation of credit within a SG and, as a consequence, the return on savings, while abstracting away from group formation. Cassidy and Fafchamps (2018) also study the group formation process, and show that this process is able to match those who demand funds with those who supply funds over some dimensions (present bias) but not others (occupation). Burlando and

Canidio (2016) analyzes financial flows within the group and finds that wealthier members are more likely be net lenders to poorer members.

Some experimental studies involving SGs are directly relevant for our theoretical results. Burlando and Canidio (2017) randomly assign members to groups with varying composition, and find that groups that are wealthier are better able to generate loanable funds, which are then lent to their poorest members. The proposed mechanism for this result is scarcity of funds. Our paper provides more direct evidence for the presence of scarcity in SGs. Deserranno et al. (2019) randomly vary the procedure through which groups choose their leaders, which leads to variation in the leaders' characteristics. Strikingly, they measure treatment effects on lending outcomes, and indicate leader selection as the primary mechanism. This is consistent with a model of multiple equilibria. Burlando, Goldberg, and Etcheverry (2018) measure the impact of a linkage product in Uganda; consistent with the model, they find increases in internal lending following the bank loan. They also find increases in turnover within the group, indicating the importance of selection effects that fall outside of the scope of this paper.

Finally, our paper belongs to a large literature studying nonmarket credit institutions. For example, SGs are clearly related to ROSCAs because the funds distributed to its members originate within the group (see Besley, Coate, and Loury, 1993). SG funds are available to smooth consumption, whereas fixed ROSCA members are restricted to receiving a certain amount of funds at a specific date. Another related literature studies the use of collateral and joint liability to ease moral hazard or adverse selection, such as the seminal paper on credit cooperatives by Banerjee, Besley, and Guinnane (1994). Interestingly, Flatnes and Carter (2019) find that a combination of joint liability and collateral requirements is the most effective mechanism to reduce moral hazard in joint liability microfinance loans. SG loans are collateralized, and can be characterized as a type of joint liability (if an individual defaults, the other members have to forgo an amount equal to defaulted loan). Unlike credit unions, savings groups supply all loanable funds.

The remainder of the paper proceeds as follows. In Section 2 we provide a detailed description of how SGs work. Section 3 presents and solves a model of SG. In Section 4 we provide empirical evidence that savings groups operate under long periods of scarcity. In Section 5 we discuss policies that reduce funds scarcity. Section 6 concludes. All mathematical derivations missing from the text are in Appendix A.

2 Background information on savings groups

The first savings groups were created in the early 1990s in Niger by CARE International and were called "Village Savings and Loan Associations" (VSLAs). Shortly after, several NGOs began promoting savings groups inspired by the VSLA model, including Catholic Relief Services' Savings and Internal Lending Communities (SILC) and Oxfam's Saving for Change (SfC), which remain the most popular models together with VSLAs. Despite the different names, all these savings groups operate under similar rules (see Allen and Panetta, 2010). Therefore, while the description of the functioning of savings groups in this paper most closely resembles VSLAs, our empirical and theoretical results apply to the most common types of SGs.

Group formation Groups are typically formed through a guided process led by a trainer, or field officer. The trainer gathers a critical number of possible participants in a community, and then proceeds to explain the basic functioning of a SG. The community members who are interested in forming a SG undergo a training period, at the end of which a membership list is drawn and group operation starts. A group can have anywhere between 15 and 40 participants.

In many cases, trainers are employed by NGOs or by community-based organizations that specialize in financial intermediation. It is quite common to find that experienced savings groups members become trainers themselves, and start forming new groups in nearby communities.

Rule and leadership selection Operations of the group are governed by a *constitution*, which is typically adopted during the first meeting after the training period. This document specifies a set of rules, such as the length of the savings cycle, the interest rate charged on loans, the permissible savings amounts, the size and possible uses of an insurance fund. In addition, groups often adopt an extensive set of policies and procedures that govern how meetings are run, how collective decisions are taken or voted on, attendance policies, and a set of fines and fees sanctioning violators of rules.

The group also selects a number of group officials or representatives, which may include a chairperson and a treasurer. These officials ensure that accounts are kept correctly and group meetings proceed in an orderly fashion and according to the rules.

Savings At the beginning of each weekly meeting, each member saves with the group by *purchasing shares*. The share is a permissible and indivisible savings amount, and a member can typically purchase between zero and five shares per meeting. As such, the share value implicitly imposes an upper bound to the amount an individual can save within the group. Savings deposits are recorded in a group ledger and in an individual savings booklet. All cash deposits are pooled and kept in a metal safe box, which is opened only when the group is in session. Members are not allowed to withdraw their savings during the cycle.

Borrowing Funds that are accumulated in the safe box are made available to members of the group as interest bearing loans. Individual loans are extended to group members subject to three constraints: the group must agree on the stated purpose of the loan; loan sizes are restricted to three times the amount saved by the borrower until that point; and total loan disbursements should not exceed the amount available in the safe box. Within these conditions, multiple borrowers can obtain loans of varying sizes at the same time. Loans must be repaid within three months, and the interest on the principal compounds monthly. Once the loan is paid back, the borrower is eligible to borrow again. Borrowing starts three months after the beginning of the cycle. Three months before the end of the cycle, loan disbursements ends and all outstanding loans are repaid.

Insurance In addition to loan intermediation, most savings groups provide insurance as an additional financial service. Each member makes a required and fixed weekly contribution to an insurance pool. Typically, this contribution is small relative to savings.[6] Funds from the insurance pool are kept separate from the savings, and can be lent out to members in case of an emergency, such as funerals or severe illness. Standard repayment procedures are implemented, although no interest is collected on the emergency loan.

Accounting While individual members maintain their own passbooks, the group assigns a record keeper who maintains a log of individual savings, group cash in (savings, repayments, and fines), and loans serviced. The record keeper utilizes a *savings ledger* to record the total amount saved by each member in any given meeting. Also included in this ledger is a total savings balance amount. A *cash-book* is then updated with group-level balances at the end of the meeting (including carryover balances from previous meetings). All of these records are hand written and the record keeper is responsible for accurate calculations and reporting. This technique, however, does allow for human error (see Appendix A for a description of how we correct for these issues for the data used in this paper).

Share out A unique feature of savings groups is their ability to provide positive returns on accumulated savings, which are realized at the end of the cycle in the process generally known as *share-out*. During share-out, the content of the safe box is emptied and divided

[6] For example, in Burlando and Canidio (2017) the value of the weekly insurance contribution is between one fourth of a share and one share.

among the members of the group in a way that is proportional to the amount each person saved. Hence, each member receives back everything he or she saved with the group, plus a fraction of the interest rate payments on loans. This fraction is equal to the amount saved by this person relative to total savings. More formally, if during weekly meeting t member i saves $s_{i,t}$, at share out she receives $(1+R)\sum_t s_{i,t}$, where R is the returns on savings,

$$R = r\frac{\sum_i \sum_t b_{i,t}}{\sum_i \sum_t s_{i,t}},$$

r is the interest rate on loans and b_i is the cumulative amount borrowed by participant i.

3 A model of Savings Groups

In this section we present a theoretical model of SG. We abstract away from potential sources of inefficiencies such as moral hazard, adverse selection, behavioral biases, voluntary or involuntary defaults.[7] Despite this, we show that the rules governing an SG can give rise to an inefficient outcome.

Before presenting the model, an important observation regarding the scope of the analysis. Under our assumptions, by the first welfare theorem the efficient mechanism to allocate funds within the group is a frictionless financial market in which, in every period, a Walrasian auctioneer determines the market-clearing interest rate. Understanding what prevents the existence of these markets in rural areas of the developing world is beyond the scope of this paper. We therefore cannot discuss the constrained optimal mechanism for financial intermediation. In Section 5 we present two modifications to the rules governing SG that are sufficiently minor to be considered as feasible, and at the same time generate a Pareto

[7] In line with the evidence from microfinance, also in the context of SGs defaults are rare occurrences. For example, Burlando and Canidio (2017) report that 97% of all loans are fully repaid by shareout. Note also that at share out the group can seize the savings of a borrower who has not repaid in full. Hence, the fraction of default (always partial) is likely much lower than 3%. In groups studied in Burlando et al. (2018), two thirds of groups reported no loans written off in the previous cycle. The median amount lost through default, conditional on some default, was 6% of the shareout value.

improvement relative to the standard rules of operation of SGs.

Consider a group composed of n individuals. The timing of the game is the following:

- In period 0, the group agrees on the interest rate r that will be charged on loans and on the maximum savings per period $\overline{s}$. As previously discussed, the maximum savings per period is implicitly determined by the share value chosen by the group. Here, we abstract away from the fact that savings are allowed only in multiples of the share values. As a consequence the only role of the share value is determining $\overline{s}$.

- In periods 1 to $k > 1$ each member i:

  - saves $s_{i,t} \in [0, \overline{s}]$ with the group.
  - then, borrows $b_{i,t}$ from the group. The amount borrowed cannot exceed three times the amount saved with the group, and hence $b_{i,t} \in [0,\ 3 \cdot \mathbf{s}_{i,t}]$, where $\mathbf{s}_{i,t} \equiv \sum_{x=1}^{t} s_{i,x}$.
  - then, repays $(1+r)b_{i,t}$ to the group, saves $a_{i,t}$ outside of the group, and consumes the remaining resources. We assume that assets saved outside of the group earn a return equal to zero.[8]

  Given this sequence of events, a single period of our model is best interpreted as 3 months, which is the duration of each loan.

- In period $k+1$, the money collected by the group is redistributed to its members, who each receive an amount proportional to the total amount saved with the group.

We call the per-period utility of consumption $v_{i,t}(\mathbf{a}_{i,t}, b_{i,t}, s_{i,t}, r)$, where $\mathbf{a}_{i,t} \equiv a_{i,0} + \sum_{x=1}^{t} a_{i,x}$ are total assets accumulated outside of the group and $a_{i,0}$ are assets owned by the

[8] All our results continue to hold if the return on funds stored outside of the group is negative (possibly because of the risk of theft), at the cost of the introduction of an additional parameter (the return on $a_{i,t}$). If this return is positive then an additional constraint emerges: if the equilibrium return on savings that the SG provides is too low, then the SG will not be in operation. Assuming a non-positive return on $a_{i,t}$ allows us to abstract away from this possibility.

agent at the start of the game.[9] This is an *indirect* utility, that is, the *maximum* utility level achievable during a period for given $\mathbf{a}_{i,t}, b_t, s_t, r$. It implicitly depends on a number of time- and individual-specific variables that are not related to savings groups: cash earned or lost during a period, investment opportunities available and their returns, seasonal elements (such as festivities) that may affect the marginal utility of consumption. Note also that there could be some feasibility constraints due to, for example, the fact that consumption must be non negative or that assets saved outside of the group must be non-negative. We say that a triplet $\{\mathbf{a}_{i,t}, b_{i,t}, s_{i,t}\}$ is feasible if it belongs to the set $\Gamma_{i,t}(r, \mathbf{a}_{i,t-1})$, assumed non empty, compact valued, and continuous (i.e., upper and lower hemicontinuous) in both its arguments.

Some properties of $v_{i,t}(\mathbf{a}_{i,t}, b_{i,t}, s_{i,t}, r)$ are straightforward. For tractability, we assume that it is continuous in all its arguments, twice differentiable, with continuous first and second derivatives. $v_{i,t}(\mathbf{a}_{i,t}, b_{i,t}, s_{i,t}, r)$ is also decreasing in $\mathbf{a}_{i,t}$ and $s_{i,t}$ because more money saved either with the group or outside the group implies lower consumption. It is also decreasing in r if $b_{i,t} > 0$ and constant in r if $b_{i,t} = 0$. However, in order to show the existence of the equilibrium of the game we also need to assume that $v_{i,t}(\mathbf{a}_{i,t}, b_{i,t}, s_{i,t}, r)$ is strictly concave in $b_{i,t}$, $\mathbf{a}_{i,t}$ and $s_{i,t}$.[10] For example, if the return on the investment opportunities available is strictly concave, then the return on $b_{i,t}$ is positive but decreasing with the scale of the investment, possibly turning negative when the return on the investment falls below the cost of borrowing r. In this case, $v_{i,t}(\mathbf{a}_{i,t}, b_{i,t}, s_{i,t}, r)$ is strictly concave in $b_{i,t}$. Similarly, if every dollar not saved (either inside or outside the group) is consumed, then $v_{i,t}(\mathbf{a}_{i,t}, b_{i,t}, s_{i,t}, r)$ is strictly concave in $\mathbf{a}_{i,t}$ and $s_{i,t}$ simply because of decreasing marginal utility of consumption.[11]

[9] Note that, at this point, we do not impose any restriction on the sign of $\mathbf{a}_{i,t}$ and $a_{i,0}$. Whether and to what extent $\mathbf{a}_{i,t}$ can be negative will be captured by the feasibility constraint, which we introduce below.

[10] If these restrictions are violated, then optimal savings and borrowing may be a non-convex correspondence, which prevents us from invoking standard fixed point theorems to show the existence of the equilibrium. Of course, as an alternative to these restrictions we could introduce a less-standard definition of equilibrium. Our results would be unchanged, but at the cost of more convoluted (and maybe opaque) derivations.

[11] To see this, note that if $v_{i,t}(\mathbf{a}_{i,t}, b_{i,t}, s_{i,t}, r)$ is decreasing and strictly concave in $\mathbf{a}_{i,t}$ and $s_{i,t}$, then

Of course, if this dollar is instead first used for productive activities and then consumed, then the shape of $v_{i,t}(\mathbf{a}_{i,t}, b_{i,t}, s_{i,t}, r)$ depends on the return generated by these activities relative to the change in the marginal utility of consumption. For our assumption to hold, it must be that the utility function is sufficiently curved.

Individual maximization problem At the beginning of each period of operation of the group, a member i decides how much to save and borrow with the group by maximizing her utility, taking as given the assets accumulated outside of the group $\mathbf{a}_{i,t}$, and the savings previously accumulated with the group $\mathbf{s}_{i,t}$. This problem can be expressed in recursive form:[12]

$$V_{i,t}\left(\mathbf{a}_{i,t-1}, \mathbf{s}_{i,t-1}\right) = \max_{b_{i,t}, s_{i,t}, a_{i,t}} \left\{ v_{i,t}(\mathbf{a}_{i,t}, b_{i,t}, s_{i,t}, r) + \beta_i V_{i,t+1}\left(\mathbf{a}_{i,t}, \mathbf{s}_{i,t}\right) \right\}$$

$$\text{s.t.} \begin{cases} \{a_{i,t}, b_{i,t}, s_{i,t}\} \in \Gamma_{i,t}(r, \mathbf{a}_{i,t-1}) & \text{feasibility constraint} \\ b_{i,t} \leq \tilde{C}_{i,t} & \text{aggregate resource constraint} \\ b_{i,t} \in [0, 3\mathbf{s}_{i,t}] & \text{leverage constraint} \\ s_{i,t} \in [0, \overline{s}] & \text{maximum-savings constraint} \end{cases}$$

with the utility at share out:

$$V_{i,k+1}\left(\mathbf{a}_{i,k}, \mathbf{s}_{i,k}\right) = (1+R)\mathbf{s}_{i,k} + \mathbf{a}_{i,k}.$$

where $\beta_i \in (0,1)$ is agent i discount factor. Note that the money received at share out enters linearly in the agent's utility function, which therefore is quasilinear.

increasing $\mathbf{a}_{i,t}$ and $s_{i,t}$ decreases utility at an *increasing* rate. If increasing $\mathbf{a}_{i,t}$ and $s_{i,t}$ decreases consumption, then this is equivalent to saying that decreasing consumption decreases utility at an increasing rate.

[12] Note that we are implicitly assuming a deterministic environment. Uncertainty could easily be introduced into the model by taking the expectation of $V_{i,t+1}\left(\mathbf{a}_{i,t}, S_{i,t}\right)$. All our results would go through unchanged. Note, however, that if there is uncertainty, the fact that there is a mismatch between supply and demand for funds (which, as we will see, is one of our main results) may be due to the some unexpected large shock. Considering a deterministic environment allows us to better highlight that this mismatch emerges due to the rules of operation of SG.

The term $\tilde{C}_{i,t}$ is the cash available to member i of the group at the beginning of each period, defined as

$$\tilde{C}_{i,t} = S_t + \sum_{x=1}^{t-1} (S_x - B_x) + (1+r) \sum_{x=1}^{t-1} B_x - \sum_{j \neq i} b_{j,t} \tag{1}$$

where $B_t = \sum_i b_{i,t}$ and $S_t = \sum_i s_{i,t}$ are aggregate borrowing and savings in period t. In other words, the cash available for borrowing to agent i in period t is given by the sum of all excess savings (aggregate savings minus aggregate borrowings) plus the loans repayments collected by the groups from period 1 to t, minus period-t loans given to all other members. The term R is the implicit return on savings, defined as

$$R = \frac{r \cdot \sum_{t=1}^{k} B_t}{\sum_{t=1}^{k} S_t}$$

We conclude the description of the model by introducing our main assumption:

Assumption 1. *The return on savings at the end of the cycle R and the funds available to each member of the group in each period $\tilde{C}_{i,t}$ are taken as given by the group members but are determined in equilibrium.*

In the same way in which agents in a competitive market take prices as given, here the group members take the return on savings and the availability of funds as given. This is justified by the observation that the group is large, and hence the incentives to influence the return on savings and the availability of funds by setting a specific s_i or b_i are likely to be negligible. As a consequence, we can treat R and $\tilde{C}_{i,t}$ as equilibrium quantities.

3.1 Individual saving and borrowing decision

Call $s_{i,t}(r, R, \tilde{C}_{i,t})$ the optimal savings and $b_{i,t}(r, R, \tilde{C}_{i,t})$ the optimal borrowings of agent i in period t, both continuous functions.[13] The next lemma derives some useful comparative statics.

Lemma 1 (Individual borrowings and savings). *$s_{i,t}(r, R, \tilde{C}_{i,t})$ and $b_{i,t}(r, R, \tilde{C}_{i,t})$ are:*

- *weakly increasing in R,*
- *weakly increasing in $\tilde{C}_{i,t}$ if the aggregate resource constraint is binding, and are independent of $\tilde{C}_{i,t}$ otherwise.*

The above results are quite intuitive, with the exception perhaps of the fact that borrowing is increasing in the return on savings. This results is a consequence of the leverage constraint, which implies that a member who wishes to borrow must first save. If an agent's leverage constraint is not binding, any change in R only affects the amount she saves with the group. But if her leverage constraint is binding, then increases in R also relax the leverage constraint, and thus increase borrowing. The leverage constraint is more likely to bind for low level of savings, which implies that for low R both savings and borrowings increase with R, but for R sufficiently large only savings should react to changes in R.

Finally, note that the scarcity of funds may not impact all group members equally: the burden of rationing may falls disproportionately on some, and not others. We say that a member is *rationed out* in period t if her demand for loans is strictly increasing in $\tilde{C}_{i,t}$.

3.2 Rationing mechanism

Before solving for the equilibrium of the model, we need to discuss how $\tilde{C}_{i,s}$ is determined. We assume that in each period, after the savings decisions are made, each member of the

[13] Remember that, by the maximum theorem, if the objective function is strictly concave and continuous, and the constraints are compact valued, non empty and continuous (i.e., upper and lower hemicontinuous), then the solution to the maximization problem exists, is unique and is continuous.

group announces her demand for loans, and the group determines each $\tilde{C}_{i,t}$ according to a *rationing mechanism* that is:

- *Resource monotonic*: for given r, $\overline{s}$ and R, increasing the funds available to the group weakly increases the amount borrowed by each member,
- *Pareto efficient*: the allocation of funds induced by the mechanism is never Pareto dominated by another feasible allocation. In our context, this implies that if funds are scarce, then no agent is allocated more resources than her actual demand for loans, so that $b_{i,t}(r, R, \tilde{C}_{i,t}) = \tilde{C}_{i,t}$. Of course, a different issue is whether an agent would borrow more if she was allocated more resources. As already discussed, this is true only for agents who are rationed out, and not for the others.
- *Strategy-proof*: no member has an incentive to misreport her demand for funds.

One mechanism often highlighted in the literature is the so-called *uniform rule*. This rule amounts to imposing an upper bound on the level of borrowing achievable by each member. If any member borrows less than the upper bound announced (because her peak is below the upper bound), the remaining resources are distributed among the other members using again the same mechanism. Kıbrıs (2003) considers an allocation problem with single peaked preferences and free disposal (i.e. not all resources need to be allocated), and shows that the uniform rule is the only strategy-proof mechanism that satisfies efficiency, no-envy, and is resource monotonic.[14] In our context, preferences are single peaked over $b_{i,t}$ (and the results in Kıbrıs, 2003, apply) because $v_{i,t}(a_{i,t}, b_{i,t}, s_{i,t}, r)$ is strictly concave in $b_{i,t}$.

Hence, the uniform rule is strategy-proof, efficient, satisfies no-envy, and is resource monotonic *for given amount of loadable funds.* A different issue is whether the level of

[14] A rationing rule satisfies no-envy if for every announcement profile, the allocation implemented by the mechanism is such that no group member wants to swap what she received with what some other group member received. It implies strategy-proofness. For a review of this literature and the formal definition of these properties, see Thomson (2014).

savings and, as a consequence, loanable funds is efficient. The remainder of the section is devoted to exploring this issue.[15]

3.3 Aggregate savings and borrowings

The aggregate demand and supply of funds can be defined as $S_t(R^\star) \equiv \sum_{i=1}^{n} s_{i,t}(r, R, \tilde{C}_{i,t})$ and $B_t(R^\star) \equiv b_{i,t}(r, R, \tilde{C}_{i,t})$, both continuous functions increasing in R (by Lemma 1).

Note that, whereas the individual demand and supply of funds depend both on R and on $\tilde{C}_{i,t}$, the expressions for the aggregate demand and supply of funds only depend on R (we omit the dependency on r). The reason is that, in the individual maximization problem, $\tilde{C}_{i,t}$ matters only if the aggregate resource constraint is binding. Furthermore, because the rationing mechanism is Pareto optimal, the aggregate resource constraint is either binding for everybody or not binding for anybody. Therefore, when studying aggregate savings and aggregate borrowings within a given period, we can simply distinguish between R for which the aggregate resource constraint is binding and R for which the aggregate resource constraint is not binding.

For R for which the aggregate resource constraint is not binding, aggregate demand for funds $B_t(R)$ is independent of R, while $S_t(R)$ is increasing in R. Instead, for R such that the aggregate resource constraint is binding in a given period, we have $b_{i,t} = \tilde{C}_{i,t}\ \forall i$, and by Equation 1:

$$B_t(R) = S_t(R) + \sum_{x=1}^{t-1} (S_x(R) - B_x(R)) + (1+r) \sum_{x=1}^{t-1} B_x(R) \tag{2}$$

Hence, in periods in which funds are scarce, the funds collected by the group in a given period (either as savings or as repayment on past loans) are perfectly correlated with aggregate

[15] An interesting question is whether the group can do any better by auctioning off scarce funds, as in bidding Roscas. Indeed, the uniform rule is efficient assuming that no side transfers are possible. But if we move away from the SG model and introduce this possibility, then the uniform rule is not efficient anymore, while competitive bids are. Once again, however, this is conditioned on a specific amount of loanable funds. We show below that the level of these funds is, in general, inefficient. This result extends to the case in which the group uses bids to allocate scarce funds.

borrowings in that same period. This observation will play a central role in the next section, where we empirically address the issue of funds scarcity. We therefore summarize it in the following remark.

Remark 1. *In periods in which funds are scarce, the correlation between loans disbursed and funds collected by the group is 1. In periods in which funds are not scarce, loans disbursed and amount of funds collected are uncorrelated.*

3.4 Equilibrium

The equilibrium $R \equiv R^\star$ solves:

$$R^\star \sum_{t=1}^{k} S_t(R^\star) = r \sum_{t=1}^{k} B_t(R^\star) \tag{3}$$

We now provide an important result of our framework: that an equilibrium R^* always exists, but multiple equilibria are possible.

Proposition 1 (Equilibrium)**.** *An equilibrium $R^\star$ always exists. If multiple equilibria exist, the one with the highest possible $R^\star$ is the Pareto preferred equilibrium.*

The above proposition shows that multiple equilibria are possible, and that these equilibria can be Pareto ranked. This implies that there could be a coordination failures, because self-fulfilling beliefs could lead the group to achieve a low $R^\star$ while a high $R^\star$ also exists. This is, again, due to the fact that a borrower must first save, which implies that R plays a role also in determining the cost of borrowing. When R is low, the cost of borrowing is high, which may depress borrowing and reduce the return on savings. When R is high, instead, the cost of borrowing is low, which may increase borrowings and the return on savings.

Note that the above proposition allows for equilibria in which $R^\star = 0$ and, effectively, the group is not in operation. The following proposition provides sufficient conditions for having $R^\star > 0$ in the Pareto preferred equilibrium.

Proposition 2. *Suppose r is such that $\frac{\partial v_{i,t}(\mathbf{a}_{i,t}, b_{i,t}, s_{i,t}, r)}{\partial b_{i,t}}|_{b_{i,t}=0} > 0$ for at least one $i \in \{1, .., n\}$ and $t \leq k$ (that is, borrowing at r is beneficial for at least some agents in some periods). Suppose also that $S_t(R) > 0$ for all $R > 0$ and $t < k$ (that is, there are always positive savings for any positive R). Then there exists an equilibrium with $R^\star > 0$.*

Hence, the group will be in operation if r is not too large and if members are willing to contribute funds even for very small return on savings. The first of these conditions is quite intuitive, and will never bind to the extent that r is chosen initially by the group. The second one is also quite intuitive: as long as the return on group savings is larger than the return on outside savings, some members will save in the group. Under these conditions, at the Pareto preferred equilibrium the group is in operation and generates strictly positive return on savings.

In the remainder of the paper, we will always assume that the group can coordinate on the Pareto preferred equilibrium and that in this equilibrium $R^\star > 0$. Our goal is to show that this equilibrium is, in general, not efficient.

3.5 Comparative statics

We start with a Corollary that follows directly from the proof of Proposition 2.

Corollary 1. *At the Pareto preferred equilibrium $R^\star > 0$ the LHS of Equation* (3) *crosses the RHS of equation* (3) *from below.*

Knowing how aggregate borrowings and aggregate savings behave around the equilibrium $R^\star$ allows us to perform a number of comparative statics exercises.

Increase in aggregate savings Suppose that aggregate savings increases in all periods, perhaps because a pure saver member is hit by a shock (for example, an unexpected windfall) that increases her propensity to save at every r, R and $\tilde{C}_{i,t}$. If the resource constraint is never binding, the increase in aggregate savings has no effect on aggregate borrowing for given R. Hence, the behavioral responses of the other group members is driven by the fact that, by proposition 1, when $\sum_t S_t(R)$ shifts upward $R^\star$ decreases.

Corollary 2. *Suppose that the aggregate resource constraint is never binding. Furthermore, suppose that there is a change in the behavior of one of the group members, leading to an upward shift in $S_t(R)$ (for some t). As a consequence, $R^\star$ decreases and everybody else in the group is worse off.*

Proof. In the text. □

If, instead, the aggregate resource constraints is always binding, adding resources to the group has also a direct effect on the borrowing levels that are possible within the group.

Corollary 3. *Suppose that the aggregate resource constraint is always binding. Furthermore, suppose that there is a change in the behavior of one of the group members, leading to an upward shift in $S_t(R)$ by the same factor in every period t. Every member's borrowing (weakly) increases and is (weakly) better off.*

The above corollary considers only shifts in aggregate savings by the same factor in every period. We discuss later the fact that the time-profile of savings has an impact on the availability of funds for the group members. In particular, we will argue that shifting savings from later periods to earlier periods is always welfare improving to the group; while the opposite is welfare decreasing (see Corollary 6). Hence, the above corollary is true also when early savings increases more than later savings (in percentage terms), but may not hold if later savings increase less than early savings.

The two corollaries illustrate an important result of the model: exogenous increases in the funds available for lending will impose an externality on other participants. The key determinant of the sign of this externality is whether the group is resource constrained.

Quite intuitively, when the resources within the group are scarce (resp. abundant), adding more resources is beneficial (resp. hurtful) to the others.

When the resource constraint is binding only in some periods, the overall welfare effect of adding resources is ambiguous. All members are made worse off by the addition of extra funds because they decrease $R^\star$. However, net borrowers who are rationed out benefit from the availability of extra funds.

Increase in aggregate borrowing We can similarly analyze what happen when a group member increases her demand for loans due to an exogenous shock. The shock shifts $B_t(R)$ up in every period, leaving unchanged the aggregate supply of funds $S_t(R)$. Proposition 1 leads to the following corollary.

Corollary 4. *If the aggregate resource constraint is never binding, then an increase in* $\sum_t B_t(R)$ *leads to an increase in* $R^\star$*, higher individual savings and borrowing. Everybody in the group is better off.*

Proof. In the text. □

When the aggregate resource constraint is always binding, the impact of an increase in aggregate borrowings depends on how the funds are rationed among borrowers. For example, if the new demand for funds goes completely unmet, then existing members are indifferent to the increase in the demand for funds. If it decreases the amount of funds available to other borrowers, the latter are made worse off by the increase in the demand for funds.

Corollary 5. *If the resource constraint is always binding, an increase in the demand for loans has no effect on* $R^\star$*, but may make rationing worse for some group members. As a consequence, everybody in the group is weakly worse off.*

Proof. In the text. □

Similarly, if the resource constraint is binding in some periods but not others, the welfare effect of increasing the demand for funds is ambiguous. While everyone benefits from an increase in $R^\star$, net borrowers may be hurt by the increase in rationing.

Supply of funds over time There is an additional dimension that is relevant in determining the efficiency of the group: the timing of saving. Suppose that cumulative aggregate savings are constant, but that for exogenous reasons the timing of savings changes. In particular, assume that the reallocation leads to saving earlier. It is quite immediate to see that if the aggregate resource constraint is never binding, this reallocation of savings has no impact on the return on savings and no impact on the group members' welfare.

Next, suppose that the aggregate resource constraint is binding in period $t < k-1$ such that some loans are rationed. The reallocation of savings from period $t+1$ to period t increases the loans given out in period t. In addition, all these loans will be repaid at the end of period t. So, for every dollar that is reallocated from period $t+1$ to period t, $1+r$ dollars become available in period $t+1$. This reallocation eases any rationing that is present in period $t+1$ as well.

Corollary 6. *Suppose the resource constraint is binding in period t<k-1. Suppose that $S_t(R)$ increases and $S_{t+1}(R)$ decreases by the same amount. It follows that $R^\star$ increases, and all agents increase their level of borrowing and savings. All agents are better off. If instead the resource constraint in period t is not binding, reallocating funds from one period to the other has no impact on $R^\star$ and no impact on the group members' welfare.*

Proof. In the text. □

3.6 Period 0: setting the rules

So far, we have treated the price of a loan r and the maximum savings $\bar{s}$ as given. These values are chosen by the group at the beginning of the cycle, and are an important determinant of whether there will be a mismatch between demand and supply of funds.

To start, note that it is not possible to use standard social choice results to make a clear prediction regarding the rules chosen by the group. The reason is that preferences over r and $\overline{s}$ are not single peaked. For r sufficiently large an agent may anticipate that she will never borrow, and hence her preferred r is the one that maximizes the return on savings. But for sufficiently low r she may expect to borrow from the group, in which case she may prefer a lower r than the one that maximizes R^*. Hence an agent's preference have (at least) two peaks over r.[16]

When preferences are not single peaked, the collective decision over r and $\overline{s}$ depends on the details of the voting game being played, such as who can propose options for voting, how many voting rounds are allowed, how long can voting last, whether options that have previously been outvoted can be re-proposed, and so on. Because the voting procedure is not part of the rules of functioning of a SG, each group is likely to adopt a different procedure. In order to fully solve the model without specifying the voting game, we introduce the following assumption.

Assumption 2 ("Veil of ignorance")**.** *All agents are under a "veil of ignorance" in period* 0*. That is, they are identical in period* 0 *but heterogeneous from period* 1 *onward. Furthermore, in period 0 they know the set of "types" that will be revealed in period 1.*

We now move to studying the individual preferences over r. The next proposition considers a member who is primarily concerned with her ability to borrow, and shows that, despite this, her preferred r and $\overline{s}$ will prevent *herself* from fully meeting her own demand for loans once the group is in operation.

[16] There could be more than two peaks because there is a trade off between availability of funds (which is increasing in r), and cost of borrowing (decreasing in r). As a consequence, the overall effect of changes in r on the agent's utility need not be monotonic, even if we focus exclusively on r such that the agent is a borrower.

Proposition 3. *Consider a given agent i and assume that β_i^k is sufficiently small (that is, the utility at share out is small from period-0 viewpoint, either because k is large or because β_i is small). If given the option to choose a r and $\overline{s}$, agent i's choice is such that she will be rationed out of funds.*

The intuition for this result is based on a straightforward application of the envelope theorem. Suppose r is such that an agent can fully meet her demand for loans, but any smaller r will cause this agent to be rationed out of funds. If r decreases, then two things happen: the agent will decrease the amount borrowed, but at the same time borrowing becomes less expensive. By the envelope theorem, if the agent was already borrowing at the optimal level, any small reduction in the amount borrowed has only second-order effects. The first order effect is given by a reduction in the cost of borrowing. Hence the agent prefers an r such that she is rationed out of funds to a larger r.

Importantly, however, this does not mean that the effect of scarcity is, on aggregate, second order. To see this, note that if an agent is already rationed out of funds, then the envelope theorem will not apply: a further reduction in the ability to borrow will have first order effects on this agent's utility. This effect is totally disregarded if the choice of r is made by a different group member.

The above proposition together with Assumption 2 immediately imply the following corollary.

Corollary 7. *Assume β_i^k small for all i. If the choice of r and $\overline{s}$ is made under a "veil of ignorance" then there will be scarcity of funds.*

Note that if nobody is expected to be rationed out of funds, then again the envelope theorem applies: from period 0 view point reducing r has only second order effects. Hence it must be that at the r and $\overline{s}$ chosen by the "representative agent" in period 0 someone will be rationed out of funds. In what follows, we maintain both the assumption that β_i^k small and the "veil of ignorance" assumption.[17]

3.7 Discussion: the role of group composition

The model abstracts away from an important element of group's performance: the endogenous process of group's composition. Fully modeling this process is beyond the scope of this paper. We can, however, discuss whether we should expect our main result (i.e., the possibility of mismatch between supply and demand of funds) to hold even if group's members are allowed to self select into groups.

Standard matching theory predicts that matching patterns are efficient if utility is transferable, while they may not be efficient if utility is not transferable (see Legros and Newman, 2007). Utility is transferable if agents can use side payments to convince other agents to match with them.

This principle applies to our context as well. As already discussed, substituting a member of the group with a person having a different propensity to save or borrow generates an externality on the other members of the group, which could be positive or negative. Quite clearly, if side payments are allowed, then these payments can be used to internalize these externalities. For example, a group can use side payment to convince a particularly "beneficial" member to join. Similarly, a member who will generate a negative externality on the group can compensate the other members via side payments. The resulting matching pattern will be the one that maximize surplus, that is, the one that better matches supply and demand of funds.

Instead, if no side payments are possible, the decision to join a group will depend exclusively on the individual utility of joining and not on the externality generated. There is no presumption that the resulting matching pattern will be efficient. Note that this is

[17] Alternatively, we could have assumed that a given member is a dictator (that is, a prominent member of the group can impose her preferred rules) or that for some reason, a Condorcet winner exists (so that the r chosen by the group is the median favorite r). By Proposition 3, the result would be the same: the choice of r leads to scarcity. Assumption 2 seems, to us, a more reasonable way to close the model.

consistent with the empirical evidence in Cassidy and Fafchamps (2018). They show that present-biased individuals form SGs with individuals who are not present biased, indicating that SGs are able to act as financial intermediaries between savers and borrowers. The role of SGs as financial intermediary is, however, limited by the fact that individuals belonging to the same occupation tend to join the same groups, therefore exposing the groups to correlated shocks which could instead be smoothed out if people matched across occupations.

4 Empirical analysis

We complement the theoretical model with an empirical analysis of the weekly cashbook entries of 46 Ugandan savings groups, operating for a total of 66 cycles. Our goal is to show empirically that the mismatch between supply and demand for funds is a defining feature of SGs, so to validate the main premise of the model.

4.1 Data: group cashbooks

Group cashbooks record, for each meeting, the meeting date; total amounts deposited because of loan repayments, savings, and fines; total amount disbursed as loans; and a running balance of the cash remaining in the box (See Figure 1 for a picture of the raw data). Appendix B provides a detailed discussion of the processing of this hand-written data source.

22 groups in our sample are a subsample of the groups studied in Burlando and Canidio (2017) (BC). The remaining 24 groups are a subsample of groups studied in Burlando, Goldberg, and Etcheverry (2018) (BGE). BC groups were created in 2013, and the cashbook data are relative to their first cycle. They were formed under a policy that actively recruited very vulnerable participants. We refer to these groups as "newly formed." BGE groups instead were formed following "standard" VSLA procedures by a local NGO in the Central Region of Uganda, and were already operating at the time of the study. Thus, they are less

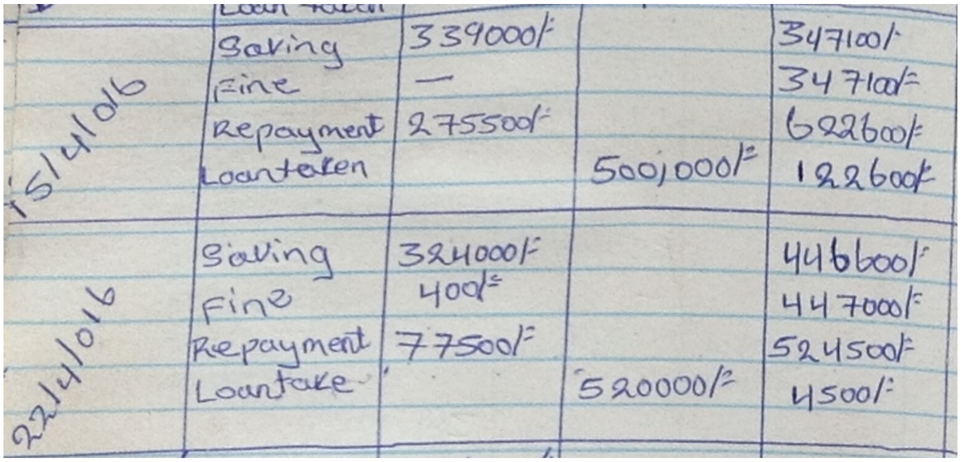


Fig. 1: An example of a hand-written ledger entry from a savings group cashbook. First column includes positive cash in from savings, fines and repayments; second column includes cash out; last column is the running balance after each transaction. The last entry for each week is the end of meeting balance.

poor than BC groups and more representative of SGs found in Uganda. We refer to them as "experienced groups." For 17 "experienced groups" we have information on more than one cycle available; in total, our sample consists of 66 completed cycles.

It is important to remark that neither newly formed groups nor experienced groups are a random draw from the groups in BC and BGE, respectively. Our goal was to collect week-by-week data for all groups in BC and BGE. However, pictures of cashbooks were not available for all groups, and not all pictures were sufficiently clear or complete. In Appendix C we show that newly formed groups produced more savings and more loans than the overall sample in BC. While a similar analysis is not available for the BGE groups, it is reasonable to expect that experienced groups are also positively selected from the sample in BGE.

Summary statistics Table 1 provides summary statistics from the cashbook records, both for the pooled sample and for the two subsamples of newly formed and experienced groups. Savings, loan repayments, and fines (levied against members who are tardy or otherwise break some internal rule) represent the sources of revenue or cash in. Loan are the sole

	Pooled sample		Newly formed groups		Experienced groups	
	mean	sd	mean	sd	mean	sd
Total Savings	757	519	343	140	964	516
Total Repayments	916	717	509	295	1,119	779
Total Fines	25	94	3	4	36	113
Total Loans	1036	799	505	284	1,302	843
Loan-to-Savings Ratio	1.40	0.57	1.46	0.57	1.37	0.57
Observations	66		22		44	

Each observation is a group cycle. Totals in 10,000UGX. Nelwy formed groups come from the BC sample. Experienced groups come from the BGE sample.

Tab. 1: End of cycle summary statistics of cashbook records.

source of cash out. Experienced groups generate larger volumes relative to the newly formed groups, consistent with the fact that they serve a wealthier population: total savings was over 9 million UGX (or $3,000 at the 3,000 UGX per dollar exchange rate prevalent in 2015) compared to 3.5 million UGX ($1,350 at a 2,600 UGX per dollar exchange prevalent in 2013) in newly formed groups; total loans was 13.02 million and 5 million UGX respectively. In both samples, each shilling saved was lent out multiple times (1.46 times in newly formed groups, 1.37 times in experienced groups). While repayments should be larger than total loans due to the interest rate accrual, this is not always the case. According to our observations, and consistent with Le Polain, Sterck, and Nyssens (2018), this may be explained by the fact that loans given out toward the end of the cycle are sometimes repaid at share out, so to avoid an excessive accumulation of funds in the group's cash box during a period in which no new loans can be given out.

While groups in the two subsamples appear to operate at very different scales, they share very similar patterns of behavior. In the next section we pool the data from the two subsamples, and refer the reader to the web appendix where we report results separately for the two samples.

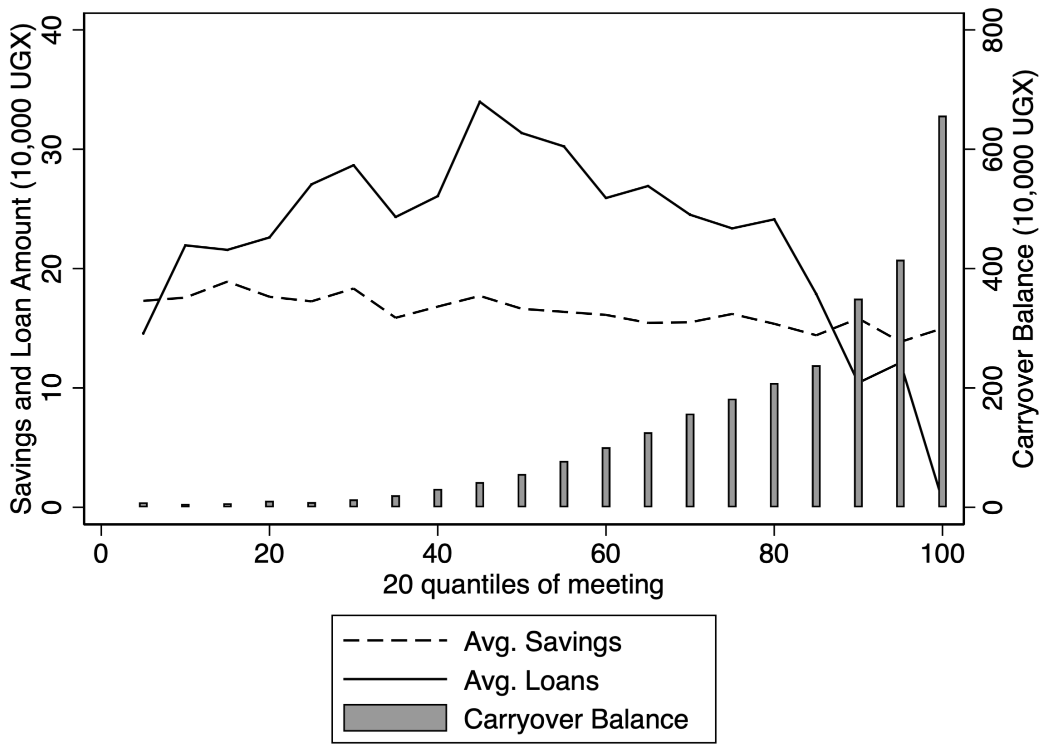


Fig. 2: Data from the 66 completed cycles in the sample. Length of the cycle normalized to twenty quantiles (x axis). Left axis is the scale for flow variables (savings and loans per meeting); right axis is scale for stock variables (carryover balance), which we refer as "cash in the box".

Savings and lending over the cycle Figure 6 plots the evolution of cash balances, per-period savings, and per-period loans disbursed over the duration of the cycle. Since groups operate for a different number of weeks, the length of the cycle has been normalized into twenty quantiles. Thus, the first quantile corresponds to the first 5% of meetings, the second quantile corresponds to the second 5%, and so on. It is notable that saving contributions remain quite stable over the duration of the cycle, whereas loans grow over time and peak in mid-cycle. Balances grow exponentially, but remain low until the latter part of the cycle. End of cycle balances reach 6.5 million UGX (2.5 million and 8 million for newly formed and experienced groups respectively).

Figure 6 illustrates that many groups keep low balances. 25 percent of groups had less than 15,000 UGX ($5.60) available at the end of the meeting during the first half of the cycle. This proportion drops steadily to 10 percent or less in the last quarter the cycle. Cash balances increase steadily over the length of the cycle, eventually increasing above the average value of loans given out. This is suggestive that groups may be operating under scarcity during the first part of the cycle, while funds are left unused in the latter part.

4.2 Identification of scarcity

The empirical test for scarcity is based on Equation (2) and Remark 1. The intuition is that, absent scarcity, the demand for loans depends on the supply of funds only through the equilibrium cost of borrowing. Hence, groups are not resource constrained if the amount of loans disbursed does not depend on the cash put into the box that day. Groups are, instead, resource constrained whenever the relationship between cash brought in (savings, repayments, and fines) and the amount lent out is close to one-to-one (see equation 2). That is, controlling for the cost of borrowing, every dollar put in the box at the beginning of the meeting is lent out in the same meeting.

We operationalize this intuition by regressing loans made at a particular meeting t in

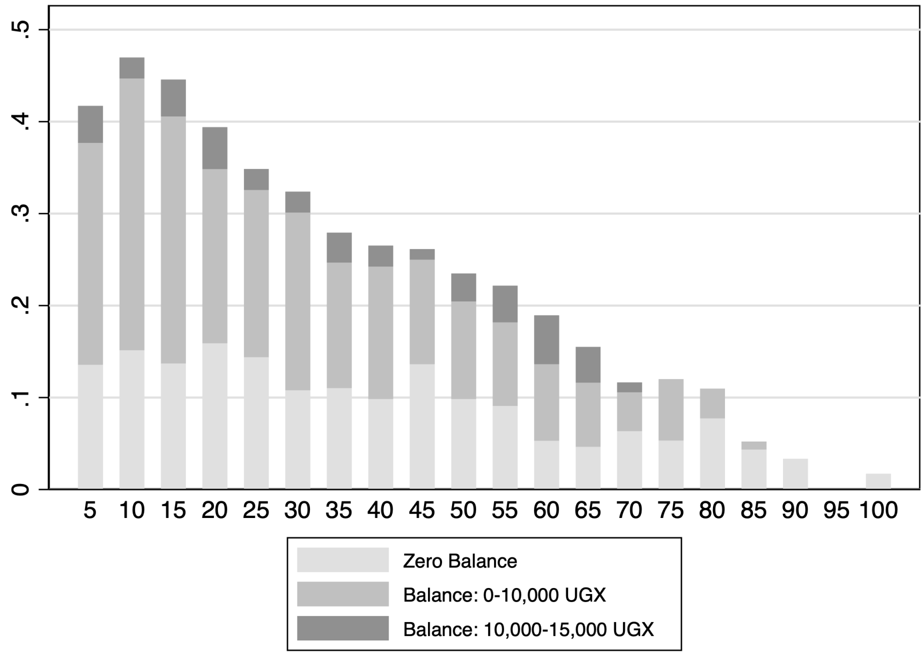


Fig. 3: Fraction of groups reporting balances close to zero, by meeting quantile.

cycle c for group g on the cash added to the box controlling for the cost of borrowing (captured by a group-cycle fixed effect). To allow for the relationship to change across time, we interact this cash-in measure with a series of dummy variables for the quantile of the meeting. Equation (4) is our base specification:

$$L_{gct} = \beta_0 + \beta_1 CashIn_{gct} + \sum_{q=2}^{Q} \beta_q \left(CashIn_{gct} * D_t^q\right) + \sum_{q=1}^{Q} \gamma_q D_t^q + \delta_{gc} + u_{gct}, \tag{4}$$

where L_{gt} are loans disbursed in group g during meeting t, $CashIn_{gct}$ are savings, fines, and loan repayments collected during that meeting, D_t^q is a dummy variable that takes on a value of one if the meeting falls in quantile q and zero otherwise, δ_{gc} captures group cycle fixed effects (which controls for groups' characteristics and group's rules, including the cost of borrowing), and u_{gct} is an error term.

By including dummy variables in this way, we can interpret β_1 to be the fraction of cash brought in that was distributed out in loans during the first five percent of meetings, and $\beta_1 + \beta_q$ for $(q = 2, ..., Q)$ is the fraction of cash inflows that is lent out in each subsequent quantile. Periods where lending is not constrained should be characterized by saving and borrowing being uncorrelated: $\beta_1 + \beta_q = 0$. Periods where $\beta_1 + \beta_q = 1$ correspond to periods where all cash inflows are lent out, which suggests that loans are being rationed and limited by the availability of funds. Note that, if there are residual resources from previous meetings that are lent out, it can be that $\beta_1 + \beta_q > 1$.

The method above also suggests a strategy to determine whether a specific group g is resource constrained in cycle c: if, on average, the correlation between cash inflows and outflows is close to one during the lending period, then we can say that the group is constrained in that cycle. This can be captured by regressing inflows and outflows one group-cycle at a time:

$$L_t^{gc} = \alpha_0 + \alpha_1 CashIn_t^{gc} + \alpha_2 CashIn_t^{gc} \times LoanPeriod_t + u_t^{gc}, \tag{5}$$

where $LoanPeriod$ is an indicator for meetings occurring between the 20th and and the 80th percentile of the cycle, when most lending occurs.[18] $\alpha_1 + \alpha_2$ captures the effect of introducing cash during the lending period. The test for scarcity in group g and cycle c is a simple t-test for $\alpha_1 + \alpha_2 = 1$, where scarcity is rejected if the test is rejected.

4.3 Results

Evidence of scarcity Figure 8 reports the parameter estimates $(\beta_1 + \beta_q)$ from regression (4) across the twenty meeting quantiles. Consistent with credit rationing, lending moves at a one-to-one rate with cash coming in the first part of the cycle. The correlation between cash in and cash out begins to decline around the 60th meeting percentile. Lending is shut down

[18] Many groups lend immediately after a new cycle begins, while others follow a rule that bans lending in the first few meetings.

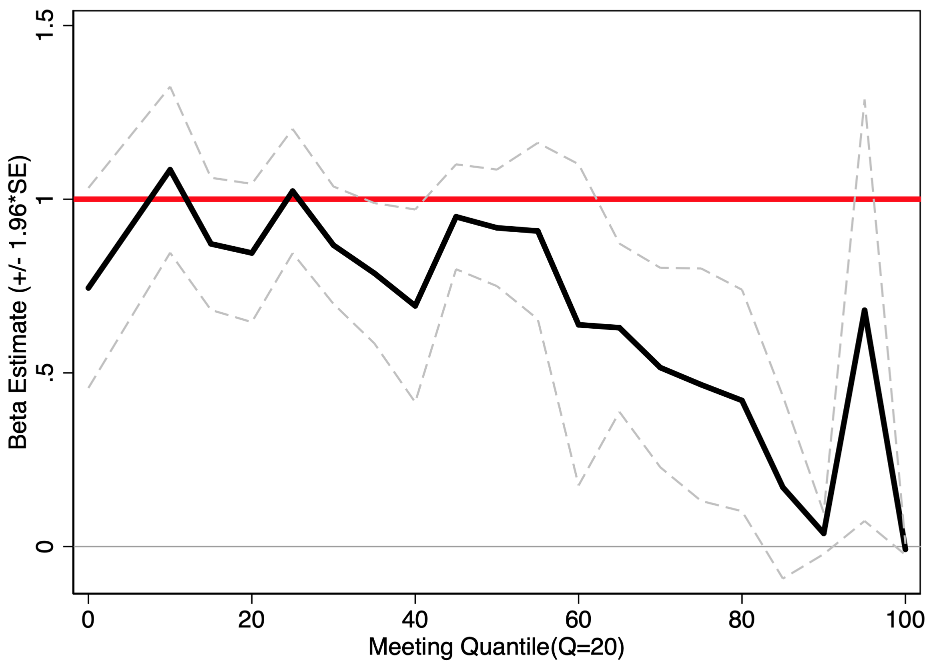


Fig. 4: Estimates of $\beta_1 + \beta_q$.

at the end of the cycle to allow repayments, and loans and cash in become uncorrelated[19]. The pattern is similar for groups with large and small savings amounts, suggesting that rationing is a defining feature of SGs.

We next report regression estimates of equation (4) in Table 2. Column 1 report the OLS estimate for the average fraction of cash brought in that is distributed as loans across the cycle (controlling for group-cycle fixed effects). Because at the end of the cycle groups end lending altogether, this estimate is averaging over a series of zeros and we can anticipate that it may be biased downward. Next, we interact the flow of cash in during a meeting with a dummy variable for the percentage of meetings that has passed (column 2), which and are the basis for Figure 8. The parameter estimate for "Meeting Cash In" is the fraction of cash during the first five percent of meetings that was lent out. Columns 3 include month fixed

[19] Notably, three groups appear to lend out most of the balance around the 95th meeting percentile. These account for the "spike" observed in the figure. Since these loans do not appear in the repayment, we speculate that security concerns led these groups to distribute their cash among their members

effects to accommodate seasonality in lending. The results from estimating Equation (4) do not change drastically with this adjustment.

In Table 3, we further address the remaining concern that an omitted variable influences contemporaneous cash in and cash out. Specifically, groups with a larger stock of outstanding loans may have a higher cash-in and a lower demand for loans. We replicate table 2 using the subsample of newly formed groups in columns 1-3. In column 4, we add interaction terms for outstanding loan balances with meeting quantiles to control for this correlation, with no effect on our conclusions. The analysis is done on newly formed groups, as the calculation of the outstanding balance requires the use of an unobservable variable in the experienced groups (the interest rate on loans).

As a final exercise, we regress (5) one group-cycle at the time, and define a group to suffer from rationing if $\alpha_1 + \alpha_2 = 1$; i.e., if the average correlation between cash deposits and cash withdrawals is 1 between the 20th and 80th percentile of meetings. Panel A of Table 4 tabulates the number of cycles that are rationed versus not rationed. 60% of the groups are indeed rationed by our measure. The rest of the table explores heterogeneity across groups. While the proportion of rationed group is higher among newly formed groups (68%), it is notable that rationing is also highly prevalent in experienced groups. This points to rationing as a defining feature of groups of all types. Panel B focuses on the 17 experienced groups for which we have complete information on two or three cycles. We compare the earliest cycles in our possession to the later cycles, and find some indication that the rationing eases somewhat over time: rationed cycles make up over 70% of the early sample, but only half of the late sample.

Excess funds A second inefficiency identified in our model the accumulation of resources that are not productively deployed. This can be seen in Figure 6, as well as in Figure 9 which plots three different quantiles (top 25%, median, bottom 25%) of the weekly carryover

Dep. Var: Loan Amount	(1)	(2)	(3)
Cash-in	0.191***	0.745***	0.864***
	(0.0609)	(0.147)	(0.152)
10%		0.340**	0.219
		(0.151)	(0.158)
15%		0.127	-0.0208
		(0.0974)	(0.124)
20%		0.101	-0.0114
		(0.0867)	(0.119)
25%		0.279**	0.154
		(0.120)	(0.133)
30%		0.123	0.0109
		(0.111)	(0.128)
35%		0.0424	-0.0949
		(0.114)	(0.122)
40%		-0.0516	-0.193
		(0.119)	(0.116)
45%		0.205	0.0607
		(0.135)	(0.147)
50%		0.173	0.0329
		(0.145)	(0.162)
55%		0.164	0.0306
		(0.131)	(0.119)
60%		-0.106	-0.245
		(0.249)	(0.256)
65%		-0.115	-0.237
		(0.177)	(0.184)
70%		-0.229	-0.342**
		(0.165)	(0.163)
75%		-0.279	-0.369
		(0.230)	(0.230)
80%		-0.324*	-0.432***
		(0.176)	(0.159)
85%		-0.574***	-0.681***
		(0.171)	(0.182)
90%		-0.707***	-0.809***
		(0.145)	(0.153)
95%		-0.0641	-0.164
		(0.289)	(0.236)
100%		-0.753***	-0.867***
		(0.144)	(0.154)
Observations	3,033	3,033	3,033
R-squared	0.198	0.359	0.367
Cycle f.e.	yes	yes	yes
Meeting Quantile f.e.	no	yes	yes
month f.e.	no	no	yes

Robust standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Tab. 2: Regression estimates of β_q on loans distributed.

	New Groups only			
Dep. Var.: Loan Amount	(1)	(2)	(3)	(4)
Cash - in	0.26***	1.16***	1.29***	1.22***
	(0.07)	(0.38)	(0.41)	(0.40)
(Cash-in * Meeting Quantile)				
10%		0.40	0.35	0.37
		(0.34)	(0.38)	(0.35)
15%		0.19	0.08	0.14
		(0.32)	(0.36)	(0.33)
20%		-0.12	-0.25	-0.17
		(0.39)	(0.42)	(0.40)
25%		0.09	-0.06	0.04
		(0.34)	(0.37)	(0.36)
30%		0.28	0.16	0.22
		(0.42)	(0.45)	(0.44)
35%		-0.44	-0.59	-0.50
		(0.36)	(0.40)	(0.39)
40%		-0.12	-0.28	-0.18
		(0.48)	(0.50)	(0.50)
45%		-0.17	-0.33	-0.24
		(0.37)	(0.40)	(0.40)
50%		-0.74**	-0.86**	-0.81**
		(0.35)	(0.38)	(0.39)
55%		-0.64	-0.77*	-0.70
		(0.43)	(0.46)	(0.45)
60%		-0.83**	-0.99**	-0.89**
		(0.39)	(0.42)	(0.41)
65%		-1.00***	-1.16***	-1.06***
		(0.38)	(0.41)	(0.40)
70%		-0.98***	-1.10***	-1.03***
		(0.36)	(0.40)	(0.38)
75%		-0.52	-0.63	-0.58
		(0.44)	(0.47)	(0.45)
80%		-0.80*	-0.93*	-0.86*
		(0.44)	(0.48)	(0.46)
85%		-0.55	-0.67	-0.61
		(0.41)	(0.44)	(0.43)
90%		-1.17***	-1.27***	-1.23***
		(0.38)	(0.41)	(0.41)
95%		-1.30***	-1.40***	-1.35***
		(0.37)	(0.41)	(0.40)
100%		-1.17***	-1.29***	-1.22***
		(0.37)	(0.41)	(0.40)
Outstanding Loans				0.01
				(0.01)
N	947	947	947	947
Cycle f.e.	X	X	X	X
Meeting Quantile f.e.		X	X	X
month f.e.			X	

Robust standard errors in parentheses
* $p < 0.10$ ** $p < 0.05$ *** $p < 0.01$

Tab. 3: Balances vs. loan requests, newly formed groups only

Panel A: Number of cyles rationed (all groups)

		Count	Percent
Pooled sample	Not Rationed	27	40.91
	Rationed	39	59.09
Newly formed Groups from BC study	Not Rationed	7	31.82
	Rationed	15	68.18
Groups from BEG study	Not Rationed	20	45.45
	Rationed	24	54.54

Panel B: experienced groups with two or more cycles

		Count	Percent
Earlier cycle	Not Rationed	5	29.41
	Rationed	12	70.59
Later cycles	Not Rationed	10	50.00
	Rationed	10	50.00

Tab. 4: Count of groups for which the estimate $\alpha_1 + \alpha_2 = 1$ in regression (5).

Rationed cycle: cycle for which we fail to reject $\alpha_1 + \alpha_2 = 1$ using a two-sided T-test and a confidence internal of 90%. Non-rationed cycle: cycle for which we reject $\alpha_1 + \alpha_2 = 1$.

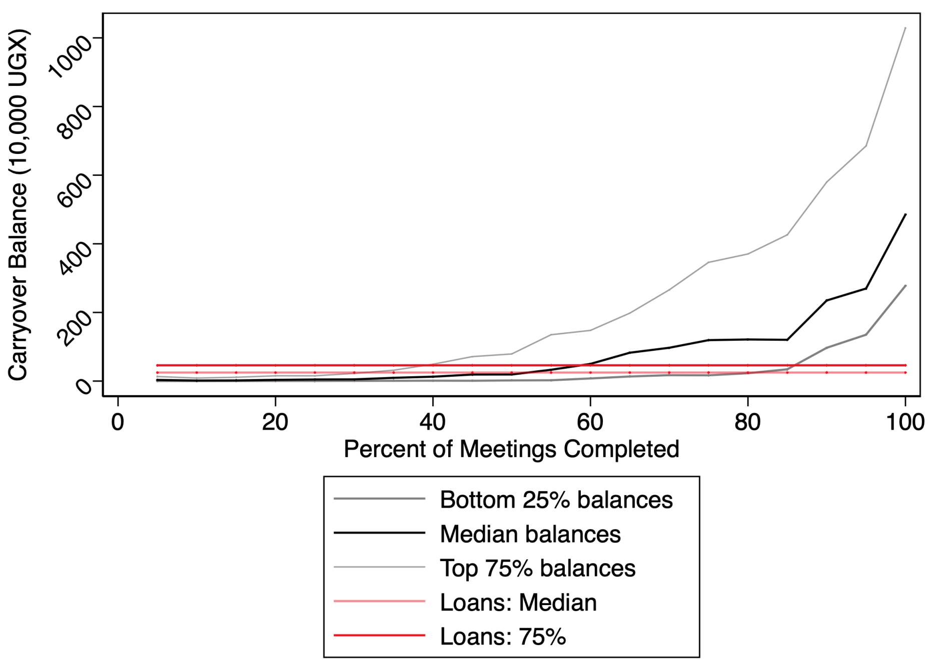


Fig. 5: Balances vs. loan requests

balance. These figures show that there is accumulation of unused funds starting from roughly the middle of the cycle until the end of the cycle.

There are, of course, a number of reasons why allowing funds to remain idle may be efficient. First, there might be constraints on the minimum loan sizes that can be given out by the groups. This is unlikely to be the most important factor: figure 9 plots median and top quartile of loans disbursed against balances, and clearly the majority of groups have higher balances than loan disbursements for about half of their cycle. A second possibility is that the accumulation of unused funds is a form of precautionary savings: cash is left in the box because, with some probability, better investment opportunities may arise in the future. Although this mechanism certainly plays a role, we should expect it to become less relevant as the group approaches its share-out date, which is not what happen in the data.

5 Policy implications

Using the theoretical insights gained from the model, we can now turn to the question of what can be done to improve the workings of savings groups. We show earlier that group's performance will depend strongly on the group's ability to coordinate on the Pareto preferred equilibrium. This may be related to the quality of training provided to the group, the level of competence of the field officer helping the group in their operations, or the quality of the leaders elected by the groups (as in Deserranno et al., 2019). This suggests that improving all these operational aspects should be a primary policy objective.

With respect to the possible mismatch between supply and demand for funds, here we discuss two possible changes to the functioning of SGs: allowing the groups members to anticipate their savings, and linking SGs with formal financial institutions.

5.1 Anticipation of savings

One of the main theoretical results of the paper is that a member who, for some exogenous reasons, anticipates her savings generates a positive externality on the other members. Here we discuss changes to the rules that can induce such member to save early.

Suppose we knew that, under standard SG functioning, member i will save $\bar{s}$ in period t. Under a policy of anticipation of savings, such member is allowed to save $\bar{s}+\tilde{s}$ in any period before t, provided that she saves $\bar{s}-\tilde{s}$ in period t.[20] If members i chooses to anticipate savings, then by revealed preferences she is better off than under standard SG rules. By Corollary 6, all other members of the group must also be weakly better off. This also implies that those who save early could be rewarded by the group. For example, savings shifted to earlier periods could generate higher return than "normal" savings.

Note, however, that if member i was planning to save less than $\bar{s}$ in period t, such policy may lead to an increase of total savings. This is because member i can "accept" to anticipate savings, while simply saving more in a period before t without decreasing what she was planning to save anyway in period t. In that case, cumulative savings would increase and by Corollary 6, the result may not be Pareto improving. A practical solution to this problem is to only allow to shift savings from the last few meetings of the cycle, because close to share out there is a strong incentive to save the maximum level. Thus, shifting savings from those meetings is unlikely to generate an increase in aggregate savings. Such policy will reduce scarcity at every r and $\overline{s}$ chosen by the group, and therefore make everybody better off for given r and $\overline{s}$.

Finally, the policy may also have an effect also on the rules chosen by the group. Remember that lowering r allows to borrow more cheaply but may exacerbate scarcity and reduce each member's ability to borrow. Because anticipating savings decreases scarcity, if member

[20] In practice, groups could "stamp" the anticipated savings in the section of the savings booklet devoted for savings in period t, even if these savings occur during an earlier period. This would allow the group to easily keep track of anticipated savings.

i had a preferred interest rate r_i^* before the policy, she will have a preferred interest rate ${r^*}'_i \leq r_i^*$ after the policy. The interest rate chosen by the group will therefore be (weakly) lower then absent the policy. Under our assumptions, the policy will make everybody better off also from period-0 viewpoint.

5.2 Financial linkages

A second intervention we consider is the possibility of borrowing from formal financial institutions such as commercial banks. Such services, broadly known as *linkages* in the financial industry, are already marketed in a number of countries. According to the *State of Linkage Report 2016*, there were close to one hundred financial service providers offering financial services to SG in 27 countries; 40% of these financial service providers offer loans to groups (Barclays et al., 2016). In sub-Saharan Africa, the report lists 25 institutions offering credit to savings groups in nine separate countries, with six institutions in Uganda alone; terms of loans vary by institution.

In our model, linking SG with existing financial institutions can, indeed, lead to a Pareto improvement. For given $\bar{s}$ and r the argument is straightforward. Consider a set of rules $\bar{s}$ and r such that there is scarcity of funds at some point during the cycle. Suppose an external financial institutions contributes x to the group on condition of receiving $(1+\mu)x$ at share out. If x is sufficiently small (so that the group does not become cash abundant) and $\mu < r$, then everybody in the group is strictly better off: the extra funds will be lent out at least once, allowing some of the group member to meet (at least partially) their demand for loan, generating a return of at least r, and generating at least $(r-\mu)x$ to be shared among the group members at share out. Of course, this mechanism is feasible for some $\mu > 0$ only if r is above the cost of funding faced by the financial institution.

Consider now period 0, in which $\bar{s}$ and r are chosen. Assume, first, that the terms of the agreement with the financial institution (i.e., x and μ) have already been set, so that the financial institution can either participate with x and μ or walk away. The basic trade off in the choice of r is, again, that lowering r allows to borrow more cheaply but may exacerbate scarcity. The introduction of the financial institution affects this tradeoff because, now, for given $r \geq \mu$ there is an additional x to borrow in each period, which, by the uniform rule, will benefit everybody in the group. The interest rate chosen by the group will therefore be (weakly) lower when the group is linked than when the group is not linked.

Suppose now that the group chooses $\bar{s}$ and r, and only afterward the financial institution will offer x and μ. Call the cost of borrowing for the financial institution $\tilde{r}$, such that it will be willing to supply any x at a $\mu \geq \tilde{r}$. Anticipating this, the group can completely eliminate scarcity by setting r such that the return on x is exactly $\tilde{r}$[21]. This way, the group adopts internally the prevailing, external interest rate $\tilde{r}$ and completely eliminates scarcity.

In both cases, creating a linkage with a financial institution should lead to a decrease in the interest rate charged by the group and a decrease (or elimination) of scarcity. Under the assumption made in Section 3.6, it is Pareto improving because all members can now borrow more and more cheaply.

6 Conclusion

Savings groups are quickly becoming an important component of financial portfolios of millions of people in low income countries, especially in sub-Saharan Africa. Given this, it is crucial to study their inefficiencies and propose remedies. In this paper, we discuss two policies that, based on our theoretical model and our empirical results, could improve the functioning of SGs. These policies require empirical verification, and it is our hope that our paper can provide the motivation for future evaluations in the field.

The model we propose can be extended in important directions. For example, we assume

[21] If x is lent out only once, this is would $r \geq \tilde{r}$. If instead x is lent out multiple times, this can be achieved also by some $r < \tilde{r}$.

away moral hazard, behavioral biases, asymmetric information, and all other potential source of inefficiencies. We did so to better show that the rules of functioning of SGs may lead to inefficient outcomes. It is however well known that introducing a second source of inefficiency to a world that is already second best may generate a welfare gain. For example, it may as well be that, if agents are present biased and hence prone to overindebteness, the fact that funds are rationed may actually be quite beneficial. Exploring the interaction between SG rules and other potential sources of inefficiencies is left for future work.

A Mathematical derivations

Proof of Lemma 1. Note that $s_{i,t}$ and R are complements in the objective function. Therefore by Topkis's theorem $s_{i,t}(r, R, \tilde{C}_{i,t})$ is weakly increasing in R. But an increase in $s_{i,t}(r, R, \tilde{C}_{i,t})$ relaxes the leverage constraint, allowing for higher level of borrowings. So also $b_{i,t}(r, R, \tilde{C}_{i,t})$ is weakly increasing in R.

Finally, $b_{i,t}(r, R, \tilde{C}_{i,t})$ is weakly increasing in $\tilde{C}_{i,t}$ because increasing $\tilde{C}_{i,t}$ relaxes the aggregate resource constraint and allows for higher borrowing. At the same time, increasing $\tilde{C}_{i,t}$ may make the leverage constraint binding (instead of the aggregate resource constraint). When this is the case, the incentive to save increases because increasing savings relaxes the leverage constraint. To say it differently: as $\tilde{C}_{i,t}$ increases, the amount that can be borrowed increases, and with it the amount that needs to be saved in order to reach a given level of borrowing.

□

Proof of Proposition 1. We start by discussing existence. To start, note that that each $S_t(R)$ is bounded above by $\sum_i \min_i\{w_i, \overline{s}\}$. It follows that each $B_t(R)$ is also bounded above.

Hence, for R sufficiently large:

$$R\sum_t S_t(R) > r\sum_t B_t(R)$$

At $R = 0$ instead it must be

$$R\sum_t S_t(R) \leq r\sum_t B_t(R)$$

which, by continuity, implies that an $R^\star$ must exist.

For multiplicity, note that aggregate demand for savings and aggregate demand for loans inherit the properties of the individual demand for savings and loans derived in Lemma 1. Hence, both aggregate loans and aggregate savings are increasing in R, which implies that $R\sum_t S_t(R)$ and $r\sum_t B_t(R)$ are both increasing and may cross multiple times. Finally, all members of the groups prefer equilibria with high R^*, because both savers and borrowers receive a higher return on their savings, and more funds are disbursed by the groups.

□

Proof of Proposition 2. There are two cases to consider. The first one is when savings are strictly positive at $R = 0$ (possibly because some agents want to borrow in the future). At $R = 0$, we have

$$R\sum_t S_t(R) < r\sum_t B_t(R)$$

and hence it must be that $R^\star > 0$.

Suppose instead that savings and borrowing are zero at $R = 0$. Compute

$$\frac{\partial\left[R\sum_t S_t(R)\right]}{\partial R} = S(R) + R\frac{\sum_t S_t(R)}{\partial R}$$

which is equal to zero at $R = 0$ if savings are zero at $R = 0$. On the other hand, note that

$r\frac{\partial \sum_t B_t(R)}{\partial R} > 0$. The reason is that, under our assumption, the group is constrained at $R = 0$ in at least one period. In this period, as savings increase with R so do borrowings. This implies that for $R \to 0$ we have

$$R \sum_t S_t(R) < r \sum_t B_t(R).$$

We showed in the proof of Proposition 1 that for R sufficiently large:

$$R \sum_t S_t(R) > r \sum_t B_t(R)$$

By continuity, then, an $R^\star > 0$ must exist. Not only, but at the largest $R^\star > 0$ it must be that $R \sum_t S_t(R)$ crosses $r \sum_t B_t(R)$ from below. □

Proof of Proposition 3. If β_i^k is arbitrarily small, the only determinant of the choice over r and $\overline{s}$ is the ability to borrow. Hence, everybody agrees that $\overline{s}$ should maximize the availability of funds.[22]

With respect to r, suppose that, at a given r, agent i is able to fully meet her demand for loans. By the envelope theorem, the effect of a change in r on her utility is

$$\sum_{x=1}^{k-1} \beta_i^x \frac{\partial v_{i,x}()}{\partial r} + \beta_i^k \mathbf{s}_{i,k} \frac{\partial R^\star}{\partial r}$$

Under our assumptions, the last term of the above expression can be ignored. The first term of the above expression is negative. Hence the agent benefits from decreasing r below the level at which she can fully meet her own demand for loans. □

[22] Note the amount of cash available for borrowing may not be monotonic in $\overline{s}$. For example, if the person saving the most is actually a net borrower, constraining this person in the amount she can save may generate more resources to the remaining members of the group.

B Data Cleaning Procedure

The paper made use of meeting-level data from handwritten registries of a number of Ugandan savings groups from two studies: Burlando et al. (2018) and Burlando and Canidio (2017). The data cleaning process was similar for both sets. Of the 110 groups that were part of the Burlando and Canidio (2017), 70 groups submitted photographs of their cashbooks for their first cycle in 2015. For 29 groups their cashbooks had missing or illegible parts. Of the remaining 41 groups, 22 were thoroughly cleaned and reconciled, with the rest being disqualified because problems with reconciliation, missing data, missing cycles, or unusual and non-standard accounting methods. Of the 154 groups that were part of the Burlando et al. (2018) study, 83 groups submitted photographs of their cashbooks for one or more cycle in 2016. Many of these pictures had missing pages, poor focus, or were otherwise difficult (if not impossible) to digitize. We then digitized 50 groups that looked complete. Of these groups, 24 were thoroughly cleaned and reconciled, with the rest being disqualified because problems with reconciliation, missing data, non-standard accounting methods, or missing cycles.

In order to determine whether there was an error in any particular record, we reconstructed the cash-in-the-box balance from meeting to meeting (cash-in minus cash-out plus balance from previous period). We then looked at the difference between the reported balance with our calculated balance and found that 59.2% of the observations required an edit. The primary reason for these edits were omissions and typos due to the digitization of the picture data which was easily corrected for by looking at the photos and inputting the correct amounts. Occasionally, there was a miscalculation or written error by the record keeper for the group which could be correctly interpolated from correct data. Even through our careful cleaning, 44.1% of observations retained some level of discrepancy in reported balances relative to our calculated balances. These discrepancies were generally quite small.

It should be noted that our high rejection rate of groups and cycles was largely driven by our need to reduce discrepancies between hand-written end of meeting balances and computed balances; i.e., like traditional auditors, we needed to “balance the books”. Without such balancing, we are unable to generate Figures 6 and 7. Such balancing is almost impossible with simple mistakes affecting only a few entries, such as creases in the photos that obscure parts of the record; missing pages; or unclear handwriting. On the other hand, balancing the books is not necessary when implementing the test for scarcity implied in regressions (4) and (5). Unbiased test results can be obtained from a subset of the data, and any mistakes in reported cash inflows and outflows will create a downward bias.

C Comparison of "new groups" sample with Burlando and Canidio (2017) sample

In this section we compare all groups studied in Burlando and Canidio (2017) with the subsample from Burlando and Canidio (2017) for which we have week-by-week data (the "new groups"). Specifically, we use the entire sample to run regression (2) in Burlando and Canidio (2017), with the main independent variable being an indicator for whether we have cashbook records. We report the results in the same format as table 7 of Burlando and Canidio (2017) . These results are presented in table A1. It is clear that the groups in our sample differ from the groups in the study: they generate on average more loans, both early in the cycle and later in the sample. They also generate more savings early and late in the sample, although panel B seems to indicate that they generate fewer savings in the middle of the cycle.

In results not shown, we also find that members of the sampled groups have lower vulnerability profiles than members of the remaining groups, again indicating that sampled groups are different. Finally, while sampled groups include both treated and control SGs (as described in the Burlando and Canidio, 2017), the two treatment arms are not balanced along baseline characteristics.

Dep var: row title Coefficient on indicator for groups with cashbook records	(1)	(2)	(3)
Panel A: Wave I			
Cumulative savings	278,664	228,810	233,138**
	(223,000)	(153,533)	(91,770)
Cumulative loans	1,109,400***	402,087	467,593**
	(315,761)	(314,514)	(232,894)
Number of groups	115	115	115
Panel B: Wave II			
Cumulative savings	98,315	-434,835*	-411,560*
	(190,389)	(237,704)	(241,299)
Cumulative loans	1,795,799**	735,327	656,337
	(720,841)	(755,227)	(743,991)
Number of groups	102	102	102
Panel C: End of cycle			
Cumulative savings	710,369**	397,574	448,372*
	(305,774)	(294,620)	(228,926)
Cumulative loans	821,507	664,930	698,104
	(711,299)	(758,753)	(732,232)
Return on savings	-1.475	-0.362	0.076
	(1.583)	(1.657)	(1.725)
Number of groups	110	110	110

Table reports coefficients on the indicator for groups that had cashbook records, from group level regressions including all VSLAs in Burlando and Canidio (2017). Refer to Burlando and Canidio (2017) for a description of the data and analysis. Each cell is a separate regression. Cumulative savings and cumulative loans in UGX, aggregated from individual savings and loans. Return on savings (panel C) calculated at shareout. Rules fixed effects include dummies for the interest rate and the share price. Number of groups differ in each wave because not all groups were audited in each wave. Heteroskedasticity robust standard errors in parentheses. *** p<0.01, ** p<0.05, * p<0.1

Tab. A1: Comparison of group outcomes between new groups in the cashbook sample and groups not in the cashbook sample

References

Allen, H. and D. Panetta (2010). Savings groups: What are they. *SEEP Network*.

Ashe, J. and K. J. Neilan (2003). *In Their Own Hands: How Savings Groups are Revolutionizing Development*. Berrett-Koehler Publishers, Inc.

Banerjee, A. V., T. Besley, and T. W. Guinnane (1994). Thy neighbor's keeper: The design of a credit cooperative with theory and a test. *The Quarterly Journal of Economics 109*(2), 491–515.

Barclays, C. International, and P. UK (2016). State of linkage report.

Beaman, L., D. Karlan, and B. Thuysbaert (2014). Saving for a (not so) rainy day: A randomized evaluation of savings groups in mali. Technical report, National Bureau of Economic Research.

Besley, T., S. Coate, and G. Loury (1993). The economics of rotating savings and credit associations. *The American Economic Review*, 792–810.

Burlando, A. and A. Canidio (2016). The allocation of capital in rural credit markets. *Journal of International Development 28*(8), 1381–1395.

Burlando, A. and A. Canidio (2017). Does group inclusion hurt financial inclusion? evidence from ultra-poor members of ugandan savings groups. *Journal of Development Economics 128*, 24–48.

Burlando, A., J. Goldberg, and L. Etcheverry (2018). Borrowing constraints in savings groups: Evidence from uganda.

Cassidy, R. and M. Fafchamps (2018). Banker my neighbour: Matching and financial intermediation in savings groups. Technical report, CEPR Discussion Papers.

Deserranno, E., M. Stryjan, and M. Sulaiman (2017). Leader selection and service delivery in community groups: Experimental evidence from uganda.

Deserranno, E., M. Stryjan, and M. Sulaiman (2019). Leader selection and service delivery in community groups: Experimental evidence from uganda. *American Economic Journal: Applied Economics 11*(4), 240–67.

FinScope (2018). Topline findings report.

Flatnes, J. E. and M. R. Carter (2019). A little skin in the game: reducing moral hazard in joint liability lending through a mandatory collateral requirement. *Journal of Economic Behavior & Organization 164*, 199–214.

Gash, M. (2017). Understanding the impact of savings groups. Technical report, SEEP Network.

Gash, M. and K. Odell (2013). The evidence-based story of savings groups: A synthesis of seven randomized control trials. Technical report, SEEP Network.

Greaney, B. P., J. P. Kaboski, and E. Van Leemput (2016). Can self-help groups really be "self-help"? *The Review of Economic Studies 83*(4), 1614–1644.

Karlan, D., B. Savonitto, B. Thuysbaert, and C. Udry (2017). Impact of savings groups on the lives of the poor. *Proceedings of the National Academy of Sciences*, 201611520.

Kıbrıs, Ö. (2003). Constrained allocation problems with single-peaked preferences: an axiomatic analysis. *Social Choice and Welfare 20*(3), 353–362.

Ksoll, C., H. B. Lilleør, J. H. Lønborg, and O. D. Rasmussen (2015). Impact of village savings and loans associations: evidence from a cluster randomized trial. *Journal of Development Economics 120*, 70 – 85.

Le Polain, M., O. Sterck, and M. Nyssens (2018). Interest rates in savings groups: Thrift or threat? *World Development 101*, 162–172.

Legros, P. and A. F. Newman (2007). Beauty is a beast, frog is a prince: Assortative matching with nontransferabilities. *Econometrica 75*(4), 1073–1102.

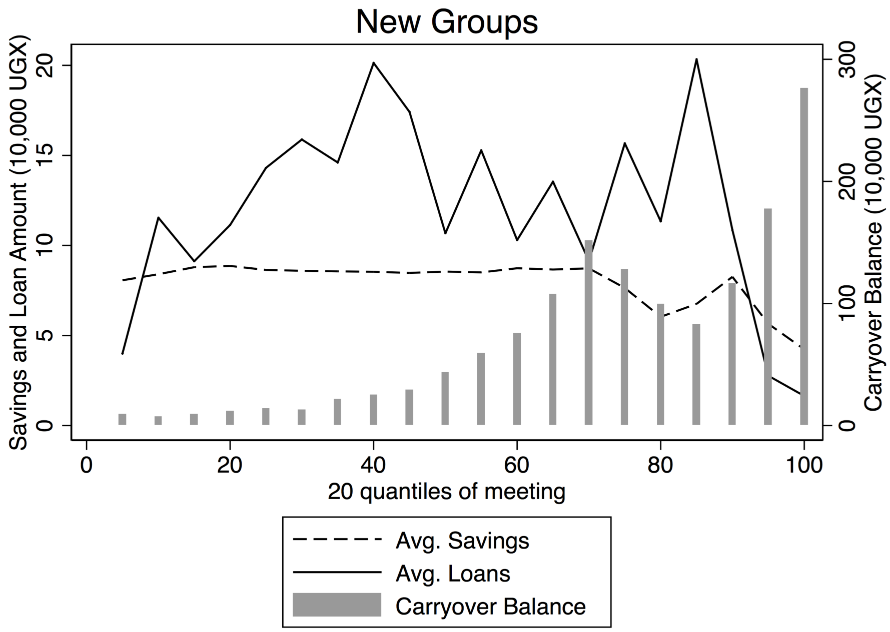
Salas, L. M. (2014). Public vs. private mental accounts: experimental evidence from savings groups in colombia. *Working paper*.

SEEP (2016). The state of linkage report. Technical report, SEEP Network.

Thomson, W. (2014). Fully allocating a commodity among agents with single-peaked preferences. *Working paper*.

D Web Appendix

We reproduce in this appendix the main figures of the paper. The data is split between newly formed groups that were part of the Burlando and Canidio (2017) study (BC) and the experienced groups that were part of the Burlando et al. (2018) study (BGE).



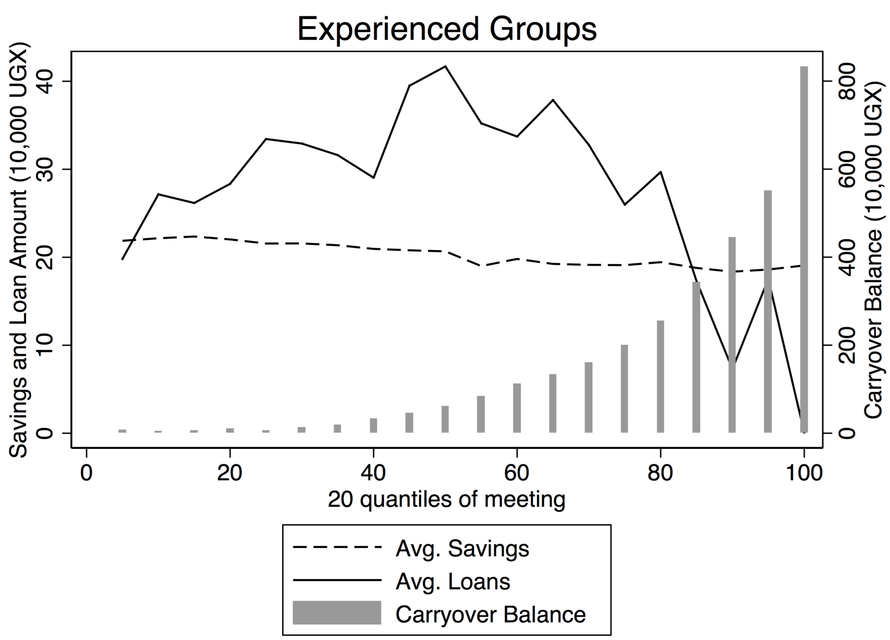


Fig. 6: This figure corresponds to figure 2 in the main text. Left axis is the scale for flow variables (savings and loans per meeting); right axis is scale for stock variables (carryover balance), which we refer as "cash in the box".

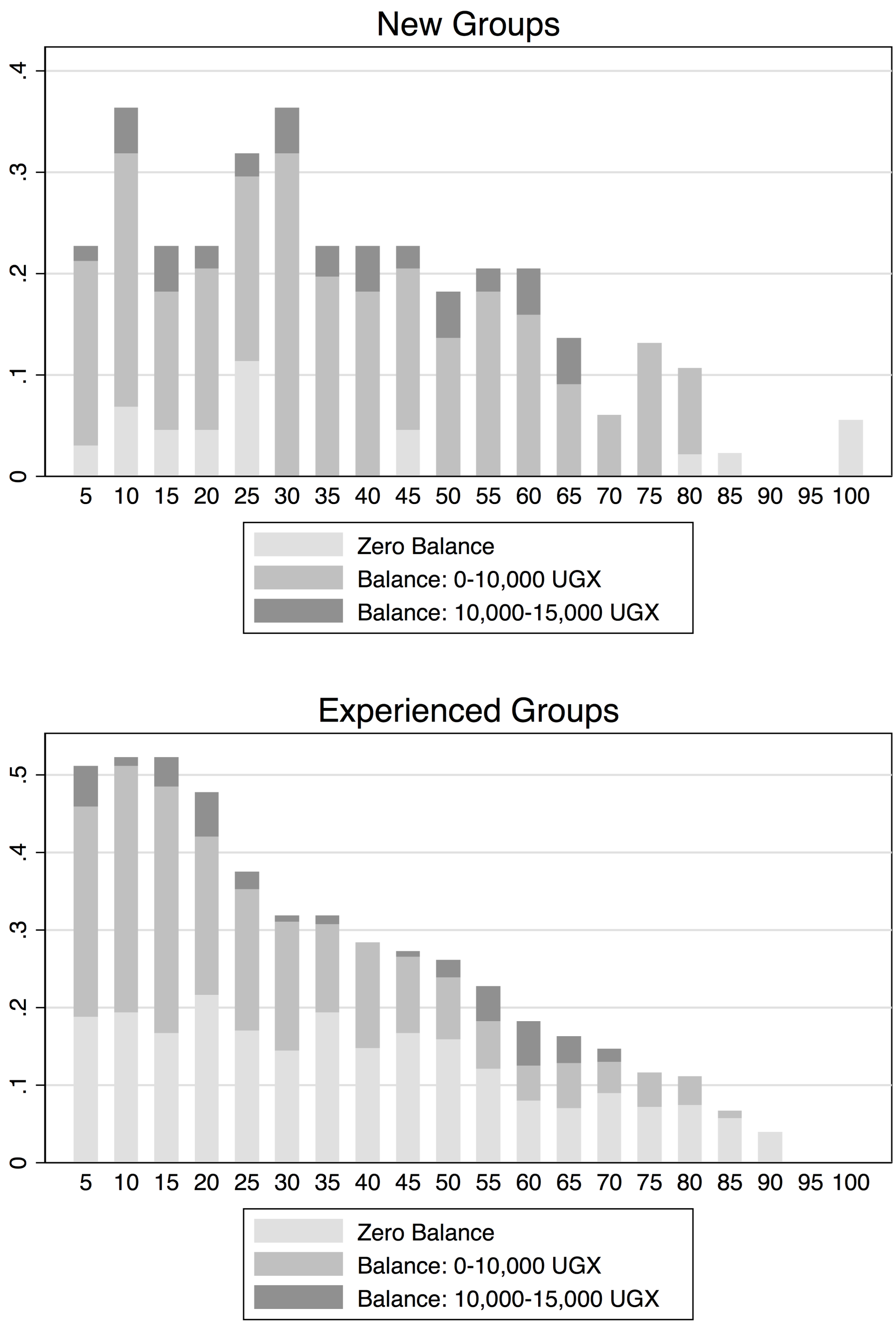


Fig. 7: This figure corresponds to figure 3 in the main text. Fraction of groups with low balances by meeting period

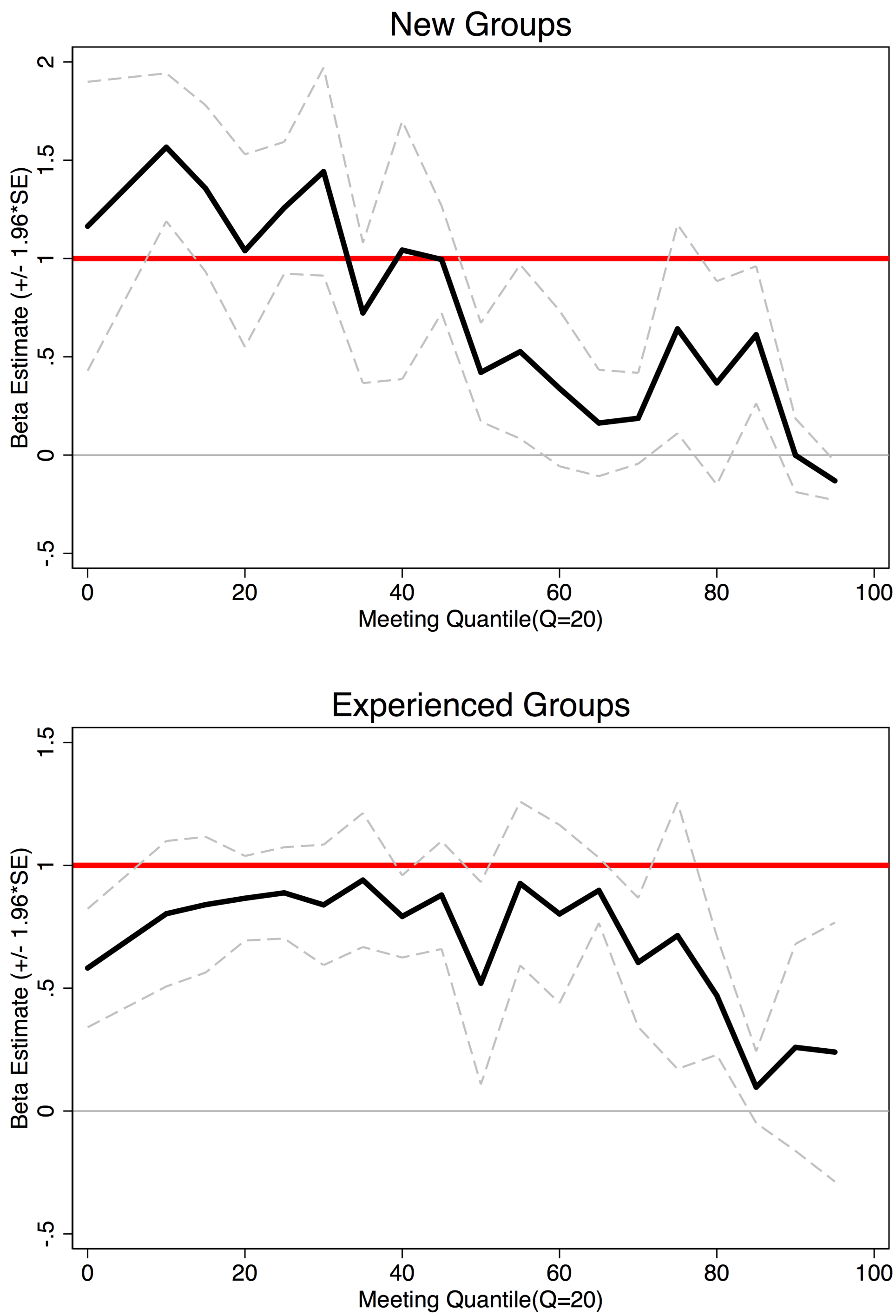


Fig. 8: This figure corresponds to figure 4 in the main text. Estimates of β_q.

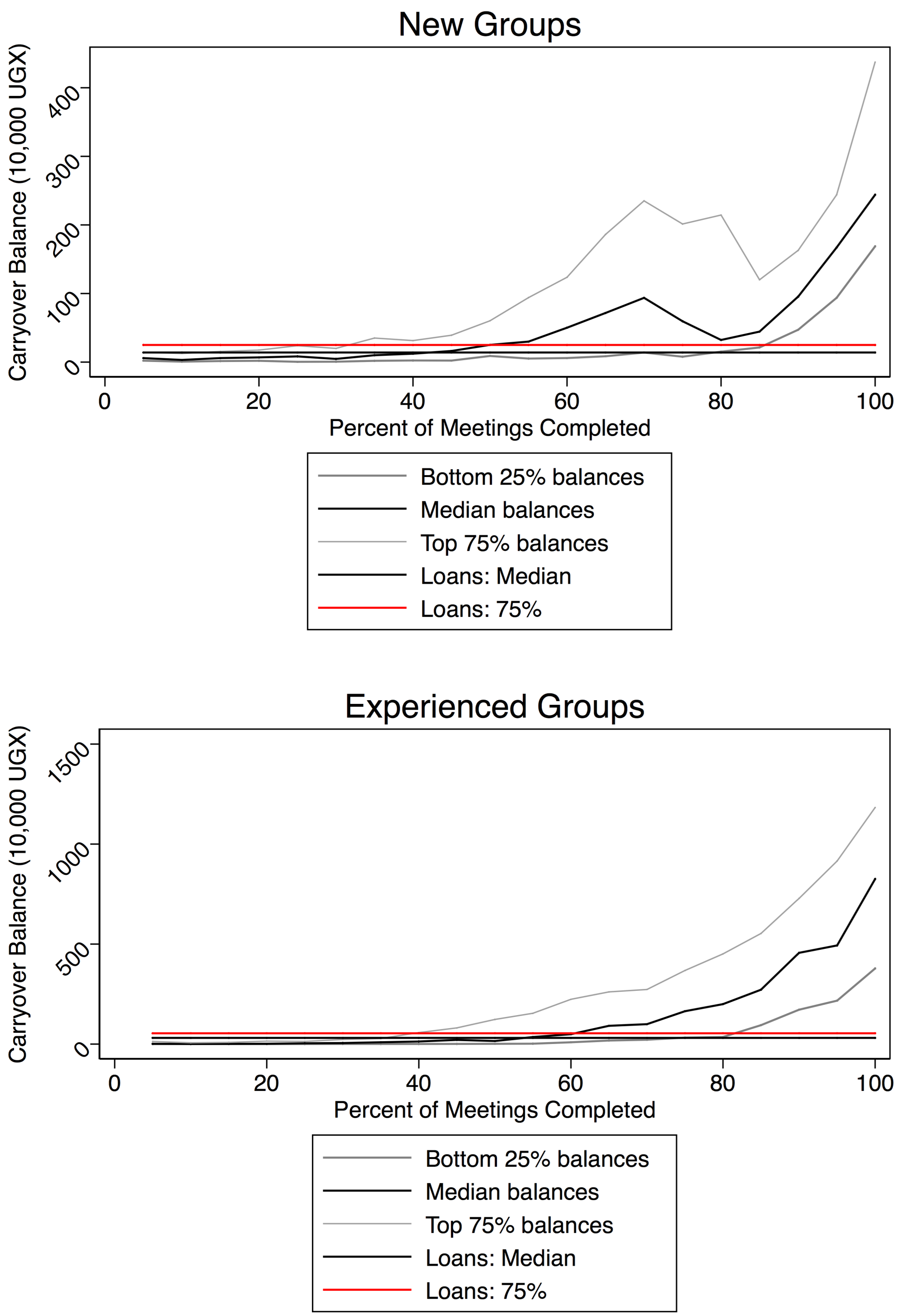


Fig. 9: This figure corresponds to figure 5 in the main text. Balances vs. loan requests