

The Economics of Savings Groups*

Alfredo Burlando[†], *Andrea Canidio*[‡], and *Rebekah Selby*[§]

Abstract

Poor households worldwide rely on savings groups (SGs) to satisfy their financial needs, yet very little is known about these groups' ability to meet them. In this paper we develop a theoretical model illustrating the basic trade-offs in the functioning of SGs, and present stylized facts derived from the financial accounts of a sample of Ugandan SGs. The main conclusion from the theoretical model is that SGs lack a mechanism to ensure that supply of internal funds equals its demand. Empirically, we find that groups do generate a significant flow of funds between members and provide a high return on savings. However, we also confirm the main theoretical predictions by showing that loans are rationed for a large fraction of the lending cycle. We conclude by discussing ways in which this mismatch between demand and supply of funds can be improved.

JEL classification: O12, O16

Keywords: Savings groups, VSLA, Financial inclusion, Microfinance, Self-help groups.

*We are grateful to SCORE's chief of party Massimo Lowicki-Zucca, as well as to Patrick Walugembe, Noel Nakibuuka, John Paul Nyeko, Michael Muwairwa, Ramadhan Kirunda, and staff at FHI360, AVSI, CARE, and TPO for their field support. We received outstanding research assistance from Derek Wolfson, Biraj Bisht, and Attila Gaspar. We acknowledge the financial support of USAID (through project SCORE), CERGE-EI Foundation under a program of the Global Development Network (Regional Research Competition), Central European University (Research Support Scheme).

[†]Department of Economics, University of Oregon, Eugene, OR, USA, burlando@uoregon.edu.

[‡]Economics and Political Science Area, INSEAD, Fontainebleau, France, andrea.canidio@insead.edu

[§]Department of Economics, University of Oregon, Eugene, OR, USA, rebekahs@uoregon.edu

1 Introduction

Savings groups (SGs) are currently bringing financial inclusion to over 10 million poor households worldwide,¹ yet several important aspects of their functioning remain unclear. SGs are composed of twenty to thirty members who meet weekly, save with and borrow from the group over an operating cycle (usually lasting one year). At the beginning of the cycle, the group agrees on a set of rules which include the interest rate charged on disbursed loans. At the end of the cycle, the funds accumulated from savings and loan repayments are redistributed to group participants in proportion to how much each person saved, and the group may choose to start a new cycle.

Despite sharing some similarities with ROSCAs, credit unions, and microfinance, SGs have unique features distinguishing them from other group-based financial institutions. Savings groups participants, for instance, can utilize the funds available to smooth consumption, whereas ROSCA members are restricted to receiving a certain amount of funds at a specific date. In addition, for many of their members SGs are the only source of interest-bearing savings account and the only formal line of credit. Because SGs are designed to operate without outside support, they can reach a population not reached by traditional microfinance interventions. Savings groups thus serve as a savings and lending institution that operates in the space between ROSCAs and microfinance, and require a separate understanding from either.

In this paper, we carefully describe the functioning of SGs, discuss the different types of SGs currently existing, and argue that SGs differ from other types of financial groups such as ROSCAs and credit unions. We then develop a theoretical model of an SG, which we use to highlight its most salient feature: the lack of a mechanism to ensure that the supply of funds

¹ According to 2014 figures from the SEEP network, www.seepnetwork.org/filebin/docs/SG_Member_Numbers_Worldwide.pdf. This number considers only members of SGs formed and trained by large international NGOs, and does not include SGs formed by smaller organizations and independent agents, or spontaneously replicated groups.

equal its demand. Consequently lending may be rationed, in the sense that not all members wishing to borrow at a given interest rate may be able to do so. Importantly, when funds are scarce, there is no presumption that all members of the groups are affected equally: some members of the group may be able to fully satisfy their demand for loans while others are rationed out. It follows that groups may agree on rules that generate scarcity for a significant part of the cycle, provided that the “median” member is able to satisfy her demand for funds with these rules.

The possibility of scarcity gives rise to an externality problem, in that a member’s borrowing and savings decisions affect other group participants. For example, an additional unit of savings contributed to the group in periods in which funds are scarce generates a positive externality, because this additional unit can be used to meet the demand for loans of others. However, an additional unit saved in periods in which 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. Thus, shocks affecting the borrowing and saving decisions of members can hurt or benefit the overall group. Interestingly, shifting savings from later periods to earlier periods always generates a positive externality on the other members of the group. This happens because early savings can be lent out during the first part of the cycle, and these loans generate resources that can be lent out again in subsequent periods.

In the last part of the paper, we use data from newly formed Ugandan savings groups to show evidence of fund scarcity. Our analysis of the weekly activity records indicates that loans are rationed for the first 80% of the cycle. Therefore our paper points to the importance of encouraging early savings. Theoretically, saving early rather than later has an unambiguous positive effect on the group; empirically, we find that the first part of the cycle is when funds are more likely to be scarce.

The remainder of the paper is organized as follows. The next section provides some background information on savings groups. Section 3 reports some stylized facts about

	<i>Group Type*</i>		
	VSLA	SILC	SfC
Record Keeping System	Passbooks and balance reporting	Ledgers	Memorization or ledgers**
Member literacy essential?	No	No	No
Minimum ability for members and record keeper	Numeracy	Financial literacy	Numeracy
End of cycle distribution	Share-out based on amount saved	Share-out based on amount saved	Share-out based on amount saved
Social fund offered?	Yes	Yes	Yes
Security mechanism	Three-lock cashbox	Three-lock cashbox	Three-lock cashbox
Use of cashbox highly encouraged	Yes	Yes	Yes
Loan repayment time	Monthly	Monthly	Monthly
Application and approval process	Verbal	Verbal	Verbal
Number of members worldwide:	1,217,521	271,630	371,770
Number of countries:	26	26	5
Average members per country:	46828	10447	74354

Source: Allen and Panetta (2010)

* See below for a description of acronyms

VSLA: "Village Savings and Loan Association" groups operated by CARE, Plan, or AKF

SILC: "Saving and Internal Lending Communities" groups operated by Catholic Relief Services (CRS)

SfC: "Saving for Change" groups operated by Oxfam/Freedom from Hunger (FFH)

** Groups outside of Mali use ledgers and declining balance system

Tab. 1: Comparison of different types of savings groups.

savings groups from our sample of Ugandan groups. Section 4 describes a model of SG functioning. In section 5 we provide evidence that savings groups operate under long periods of scarcity. Section 6 concludes with a discussion of the policy relevance of our results.

2 Background information on savings groups

2.1 History and existing literature

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. The most popular are Savings and Internal Lending Communities (SILC) promoted by Catholic Relief Services and Oxfam's Saving for Change (SfC) groups. Despite the different names, all these savings groups operate under similar rules (see Table 1 for a comparison of the various models). Therefore, while the description of the functioning of savings groups in this paper most closely resembles VSLAs, we believe that our empirical and theoretical results apply to the most common types of SGs.

Overtime, millions of members have joined these savings groups. Allen and Panetta (2010) reports data from groups formed by CARE International, Catholic Relief Services, and Oxfam, which together serve 1.86 million members. These groups are composed by a majority of women (between 70 and 80%), and are fairly stable (the retention rate across cycles is above 90%). Their members save between \$12 and \$27 on average (between 2.3 and 8.5 percent of national income per capita).

The development literature suggested that savings groups are an effective tool for local development (see Ashe and Neilan, 2003). Randomized evaluations of savings groups have shown that savings groups do indeed cause an increase in savings and borrowing, and improve food security, livestock holding and overall consumption smoothing (Ksoll, Lilleør, Lønborg, and Rasmussen, 2015, Beaman, Karlan, and Thuysbaert, 2014, Gash and Odell, 2013). A more recent strand of the literature focuses on the mechanisms internal to savings groups. Greaney, Kaboski, and Van Leemput (2016) study the process of group formation, and compare the performance of groups formed and trained for free by NGO officers against the

performance of groups formed by private trainers who charge fees. Cassidy and Fafchamps (2015) study the allocation of capital within groups, and find evidence that, due to the endogenous membership process, capital moves from those who demand savings to those who demand credit. Burlando and Canidio (2015) 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.

2.2 Functioning

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 number 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.² Funds from

² In the savings groups we study, the value of the weekly insurance contribution is between one fourth of a share and one share.

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 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 .

2.3 Comparison to other financial institutions

It should be readily apparent that savings groups share many features with financial institutions common in developing and developed countries alike.

SACCOs Savings groups are most similar to credit unions (commonly known as Savings and Credit Cooperative Societies or SACCOS in sub-Saharan Africa), in that they facilitate formal lending among the membership. However, savings groups are significantly less flexible than credit unions. Savings groups operate on short-term cycles, which prevents a sizable accumulation of capital; members are not allowed to withdraw savings during the cycle; interest rates are fixed and predetermined for all loans during the cycle; and the membership is quite small. Given these limitations, it is perhaps surprising that participation in SACCOS has been much more limited than participation in savings groups. For instance, in Uganda SACCOS participation is 3% of the population while membership in informal savings groups is 61% (FinScope (2010)). Reasons for differences in popularity require further research, although we speculate that the active participation of all members of a SG to its management is responsible for the popularity of SGs relative to SACCOS (where decisions are delegated to professional managers).

ROSCAs Other than credit unions, savings groups are often compared (and confused) with ROSCAs and self help groups. Like ROSCAs, savings groups pool savings from the membership on a weekly or monthly basis, and make those savings available to the group. A key difference with ROSCAs is the availability of a storage technology (a metal safe) and an accounting technology (book-keeping). Thus savings groups are much more flexible in the accumulation and use of their funds over time: group members are not required to save the same amount every period, multiple borrowers can borrow at the same time, and loan sizes can vary.

Self-help groups Self-help groups developed in India independently from Savings Groups. Similarly to savings groups, they collect savings from its members and distribute loans. However, they do not follow the rules of functioning of SG. In particular, they do not liquidate at the end of a cycle. Rather, the group distributes profits or dividends over time, and membership is allowed to vary.³

3 Some stylized facts

We now turn to the empirical analysis of the functioning of 110 newly-formed Ugandan savings groups.⁴ This analyses is conducted using three primary sources of data. First, we collect *audit records* at shareout on all groups. These records contain: group-level characteristics; the cumulative amounts saved, borrowed, and repaid by each member; if the borrower was in arrears; and whether the member dropped out of the group during the evaluation period. This data set is the most comprehensive (includes information on all 110 groups). We then acquired *savings ledgers* recording the amount deposited by each member during each meeting and *cash-books* recording weekly cash inflows, outflows and balances from the same groups. These data sources turned out to be difficult to use (see Appendix 6 for more details), and we ended up with complete savings ledgers for 43 groups and complete cash books for 22 groups.⁵

We start by describing the end-of-cycle group savings and borrowing using the audit

³ For more details see Allen and Panetta (2010), Ashe (2009), Vanmeenen (2010). Note that the distinction between self-help groups and savings groups described here is gaining popularity but is not universally adopted. For example, Greaney, Kaboski, and Van Leemput (2016) study SILCs (which, according to our classification are savings groups) but call these groups “self-help groups”. Blattman, Green, Jamison, Lehmann, and Annan (2015) also follow the same terminology when referring to VSLAs.

⁴ These groups were formed in 2013 and were geographically dispersed throughout Uganda. See Burlando and Canidio (2015) for detailed information on these groups and on the data collection protocol.

⁵ Groups also maintain loan ledgers, which keep record of all lending transactions and repayment histories. While we found that savings and cash ledgers are very standardized and were easily imported in an electronic database, loan ledgers were impossible to work with—we found that each group had their own recording standard for loans, and the records are often hopelessly confusing. For this reason, we have no individual level information on loans.

	<i>Ugandan Savings Groups</i>				<i>SAVIX Data*</i>	
	Mean	Std. Dev.	Min	Max	Uganda VLSAs	All Africa VSLAs
Total Savings (USD)	975.63	383.86	176.32	2205.64	1,146.50	694.95
Average Amount Saved Per Member (USD)	36.88	15.47	6.08	81.69	39.60	27.62
Total Loans (USD)	1480.97	882.53	159.02	4122.90	-	-
Average Loans per Member	2.62	1.32	0.96	9	-	-
Average Amount Borrowed per Member (USD)	56.08	35.10	5.48	158.57	-	-
Loans-to-Savings Ratio	1.50	0.68	0.43	4.46	-	-
Outstanding Loans-to-Savings Ratio	-	-	-	-	0.97	0.93
Fraction of members with outstanding loans at shareout	0.03	0.08	0.00	0.40	-	-
Rate of return of savings	12.83	6.63	1.74	37.87	-	-
Number of Groups	110				8,188	49,795

* SAVIX data acquired from <http://savingsgroups.com/analysis/>

Tab. 2: Summary statistics from Audit records of Ugandan Savings Groups and SAVIX

records for all 110 groups and how these figures compare to the Savix dataset (which is a repository of data from savings groups from all over the world). We then explore how the share price affects individual savings using the ledger data for the 43 groups. Lastly, we describe the evolution of funds over the course of a cycle using the cash-book data.

Savings Group savings and borrowing behavior is reported in Table 2.⁶ Average cumulative savings is about \$976 per group (\$37 per member). The typical group and member savings for all CARE International savings groups (again from SEEP data) are also reported in this Table. It is clear that the audited groups saved only slightly less on average than other groups in Uganda.

The amount of savings a member can accumulate is regulated by the share price. In our study groups, share values are quite low. All groups chose share values of 500, 1,000 or 2,000 UGX (approximately 19, 38 and 75 US cents in 2013 at the time). The implied ceiling of weekly savings is 93 cents, 1.88 dollars, and 3.75 dollars respectively. These small differences could amount to large differences in overall savings: Over a period corresponding

⁶ All estimates are reported in USD\$ using the conversion of 1 USD: 2,660 UGX.

	Mean	Std. Dev.	Min	Max	Number of Groups
<i>Price = 500</i>					
Total Savings (USD)	762.08	278.43	176.32	1171.81	28
Average Amount Saved Per Member (USD)	28.18	10.44	6.08	44.39	28
Total Loans (USD)	1406.72	953.79	159.02	4122.90	28
Average Loans per Member	3.02	1.61	1.04	9	28
Average Amount Borrowed per Member (USD)	51.85	35.51	5.48	158.57	28
Loans-to-Savings Ratio	1.75	0.78	0.57	3.79	28
Average Annualized Rate of Return	15.15	9.04	2.87	37.87	28
<i>Price = 1000</i>					
Total Savings (USD)	1027.42	389.03	280.08	2205.64	77
Average Amount Saved Per Member (USD)	38.41	15.11	7.78	81.69	77
Total Loans (USD)	1500.14	866.62	259.40	3644.74	77
Average Loans per Member	2.53	1.21	0.96	7	77
Average Amount Borrowed per Member (USD)	56.39	34.22	7.86	151.86	77
Loans-to-Savings Ratio	1.43	0.62	0.58	4.46	77
Average Annualized Rate of Return	12.10	5.32	1.74	26.37	77
<i>Price = 2000</i>					
Total Savings (USD)	1373.99	217.66	1212.03	1739.10	5
Average Amount Saved Per Member (USD)	62.07	9.16	47.73	72.14	5
Total Loans (USD)	1601.43	865.98	560.15	2599.25	5
Average Loans per Member	1.83	0.51	1.37	3	5
Average Amount Borrowed per Member (USD)	75.10	47.12	20.75	144.40	5
Loans-to-Savings Ratio	1.18	0.69	0.43	2.14	5
Average Annualized Rate of Return	10.89	7.52	3.56	21.45	5

Tab. 3: Summary statistics from Audit records of Ugandan Savings Groups by share value

to the median length of the cycle (47 meetings), a person who saves the maximum allowed would have been able to accumulate US\$133 less in a group with a share value of 500 UGX than in a group with a share value of 2,000 UGX (\$44 versus \$176).

Table 3 reports group statistics at shareout by share price. It is clear that outcomes vary significantly with this price. Average savings at the end of the cycle was USD\$28 (64% of the maximal limit) among 500 UGX groups, USD\$38 (39% of the limit) among 1,000 UGX groups, and USD\$62 (43% of the limit) among the 2,000 UGX groups.

We study in greater detail the constraints imposed by the share price by looking at

Share purchase	Share price =500		Share price=1,000		Share price=2,000	
	Freq.	Percent	Freq.	Percent	Freq.	Percent
none	3,294	21.51	8,422	23.94	1,275	24.23
1 share	374	2.44	4,474	12.72	1,422	27.02
2 shares	2,188	14.28	6,119	17.39	417	7.92
3 shares	529	3.45	2,823	8.02	286	5.44
4 shares	1,610	10.51	1,717	4.88	153	2.91
5 shares	7,315	47.76	10,488	29.81	1,237	23.51
Other amount	7	0.05	1,143	3.25	472	8.97
Total	15,317	100	35,186	100	5,262	100

Tab. 4: Tabulation of weekly share purchases of individual borrowers among 44 groups

person-meeting records from the 43 savings ledgers. In Table 4, we report the frequency that a particular number of shares was purchased in groups with a particular share price. The table reveals some interesting patterns. First, savings transactions often do not happen: members choose to save nothing 24% of the time in groups with “expensive” shares (2,000 UGX share value). The proportion is only slightly lower for groups with 500 UGX share value (21%), suggesting that the main difficulty facing participants is coming up with *any* savings for the meeting (or coming to the meeting itself), rather than meeting the minimum savings threshold. Secondly, the upper limit on savings imposes a real constraint on savings. This can be seen by the proportion of transactions that involve the purchase of 5 shares. In our sample, 48% of transactions in 500 UGX groups, 30% in 1,000 UGX groups, and to 23.5% for 2,000 UGX groups fall into this category. Finally, the table indicates that the distribution of savings is bimodal throughout. In 500 UGX groups, most transactions are either zero or 5 shares; at the other extreme, in 2,000 UGX groups transactions are either at zero or one share, or 5 shares.

Borrowing Table 2 also includes information on group borrowing. On average members took out about 2.6 loans totaling approximately USD\$56 over the course of the cycle (an average of \$1,480 per group). Clearly this is substantially more than savings per member and is the result of frequent repayment of these interest-bearing loans. By the end of the

cycle, individuals saw an average rate of return on savings of about 12.83% and a ratio of cumulative loans to cumulative savings of about 1.5.⁷ Finally, we note that defaults on loans are rare: only 3% of members were reported not having paid the whole loan by shareout.

As with savings, borrowing behavior and savings returns depend on the share price chosen by groups. As seen in Table 3, lower share prices tended to have slightly smaller but more frequent loans per member, lower total group borrowing. However, we see that the smallest share price (500 UGX) experienced the highest loans-to-savings ratio and return on savings which is suggestive that these groups are lending a larger portion of their available funds throughout the cycle.

Balances over time We finally provide a dynamic view of group operations by making use of the cashbook data. Figure 1 plots the evolution of cash balances, per-period savings and loans disbursed in a sample of 22 Ugandan savings groups. Saving contributions remain quite stable over the duration of the cycle, whereas loans grow over time and peak towards the end of the cycle. On average, balances remain close to zero for almost half of the cycle, suggesting that groups are unable to generate sufficient funds to meet the demand for loans of their members. We formally test for the presence of funds scarcity using these data in Section 5.

4 A model of Savings Groups

In this section we present a theoretical model of SG. Our goal is to discuss how SG rules determine the individual incentive to save and borrow, and to show that funds may be

⁷ Among a subsample of 780 study participants, the single most common use (44% of loans and 39% of share out) is the payment of school fees. In addition, 35% of loans and 40% of share out amounts are used for some type of productive investment, including starting a new business, purchasing of farm inputs such as livestock and land, or other business investment. Loans are somewhat more likely than share out to be used for emergencies, such as a health incident or unemployment (22% versus 16%). Conversely, and quite predictably, households are almost twice as likely to consume their share out (29%) than their loans (16%). See Burlando and Canidio (2015) for further details.

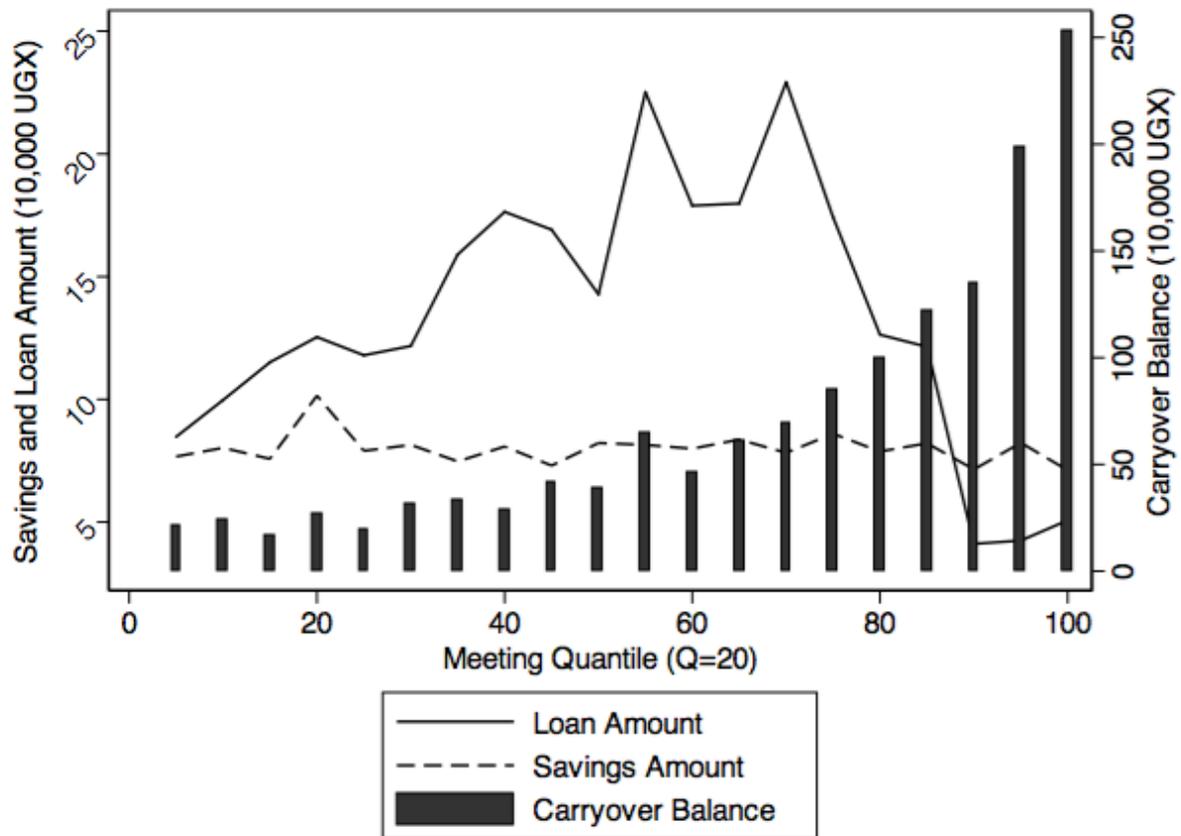


Fig. 1: Data from 22 savings groups with complete records of all financial transactions. Length of the cycle normalized to twenty quantiles (x axis). Left axis is the scale for flow variables (savings and loans per meeting); right axis is scale for stock variables (carryover balance), which we refer as "cash in the box".

in excess or fall short of the demand for loans. We abstract away from other potential sources of inefficiencies such as moral hazard, adverse selection, behavioral biases, voluntary or involuntary defaults (which, as we previously discussed, are a rare occurrence in our data).

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

- In period 0, the group meets and agrees on the interest rate that will be charged on loans r and on the maximum savings per period \bar{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 \bar{s} .
- In periods 1 to $k > 1$ each member i :
 - first receives $w_{i,t}$, which is a per-period wage (i.e. non-investment income generated outside of the group),
 - then saves $s_{i,t}$ with the group,
 - then borrows $b_{i,t}$ from the group,
 - then invest $y_{i,t}$ in an outside project,
 - then earns $f_{i,t}(y_{i,t})$ from the funds invested outside of the group, where $f_{i,t}()$ is continuous and strictly concave.⁸
 - repays $(1+r)b_{i,t}$ to the group, saves $a_{i,t} \geq 0$ outside of the group, and consumes the rest.

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

⁸ The assumption of concavity allows us to show the existence of the equilibrium of the game. The reason is that, if $f_{i,t}()$ is locally convex, then optimal savings and borrowing may be a non-convex correspondence, which prevents us from invoking standard fixed point theorems,

- In period $k + 1$, the money collected by the group is redistributed to members in proportion to the amount saved by each.

Both $f_{i,t}(y_{i,t})$ and $w_{i,t}$ are deterministic. Finally, by assuming that the return on the outside project $f_{i,t}(y_{i,t})$ is independent on the group composition, we are effectively ignoring other relevant channels through which the group may impact the return on investment, such as learning from peers, changes in the social network structure, and aspirations.

Independently on the rules agreed upon in period 1, no member is allowed to borrow more than 3 times the total amount saved with the group up until that period, and therefore

$$b_{i,t} \leq 3 \sum_{x=1}^t s_{i,x} \quad \text{for } t \in \{1, \dots, k\}, \quad (1)$$

which we call the *leverage constraint*. In addition, the agent can save with the group up to \bar{s} , so that:

$$s_{i,t} \leq \min\{w_{i,t} + a_{i,t-1}, \bar{s}\}, \quad (2)$$

where we assume $a_{i,0} = 0$, so that the resources available for saving are $w_{i,1}$ in period 1, $w_{i,1} + a_{i,1}$ in period 2, and so on.⁹ Note that the timing described above implies

$$y_{i,t} \leq b_{i,t} + w_{i,t} - s_{i,2} + a_{1,t-1} \quad \text{for } t \in \{1, \dots, k\}. \quad (3)$$

In other words, the resources available for investment are equal to own funds (either earned during that period $w_{i,t}$ or carried from the previous period $a_{1,t-1}$) minus the savings with the group, plus borrowing with the group. Finally, consumption at the end of each period is:

$$c_{i,t} = f_{i,t}(y_{i,t}) - y_{i,t} - rb_{i,t} + w_{i,t} + a_{i,t-1} - a_{i,t} - s_{i,t} \geq 0, \quad (4)$$

which is the agent's *budget constraint*.

⁹ We implicitly assume that the resources saved outside of the group do not generate any return.

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 $a_{i,t}$, and the savings previously accumulated with the group $\sum_{x=1}^{t-1} s_{i,x}$. This problem can be expressed in recursive form:

$$V_{i,t} \left(a_{i,t}, \sum_{x=1}^{t-1} s_{i,x} \right) = \max_{b_{i,t}, s_{i,t}, y_{i,t}, a_{i,t}} \left\{ u_i(c_{i,t}) + \beta_i V_{i,t+1} \left(a_{i,t+1}, \sum_{x=1}^t s_{i,x} \right) \right\}$$

$$\text{s.t.} \begin{cases} b_{i,t} \leq \tilde{C}_{i,t} & \text{aggregate resource constraint} \\ \text{equations 1 to 4} \end{cases}$$

with the utility at share out:

$$V_{i,k+1} \left(a_{i,k}, \sum_{x=1}^k s_{i,x} \right) = \left(\sum_{x=1}^{k-1} s_{i,x} + s_{i,k} \right) (1 + R) + a_{i,k}.$$

where $\beta_i \in (0, 1)$ is agent i discount factor, and $u_i(\cdot)$ is agent i utility from consumption, strictly increasing and strictly concave. Note that in the above specification implies that the agent's utility function is linear in the money received at share out.¹⁰

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

$$\tilde{C}_{i,t} = S_t + \sum_{x=1}^{t-1} (S_x - B_x) + (1 + r) \sum_{x=1}^{t-1} B_x - \sum_{j \neq i} b_{j,t} \quad (5)$$

where $B_x = \sum_i b_{i,x}$ and $S_x = \sum_i s_{i,x}$ are aggregate borrowing and savings in period x . 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

¹⁰ All results derived are robust to a utility function that is curved in money, provided that the curvature is not too strong.

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 other words, the group members fail to anticipate that by increasing the amount saved (or borrowed) they will affect the return on savings and the availability of funds for the entire group. As a consequence, we can treat the return on savings and the funds available to the group in each period as equilibrium quantities.¹¹

4.1 Individual saving and borrowing decision

Call $s_{i,t}(r, R, \tilde{C}_{i,t})$ the optimal savings and $b_{i,t}(r, R, \tilde{C}_{i,t})$ optimal borrowings of agent i in period t .

Lemma 1. *$s_{i,t}(r, R, \tilde{C}_{i,t})$ and $b_{i,t}(r, R, \tilde{C}_{i,t})$ are upper hemicontinuous in r , R and $\tilde{C}_{i,t}$. In addition, $s_{i,t}(r, R, \tilde{C}_{i,t})$ is weakly increasing in R . If the aggregate resource constraint is binding, $s_{i,t}(r, R, \tilde{C}_{i,t})$ and $b_{i,t}(r, R, \tilde{C}_{i,t})$ are weakly increasing in $\tilde{C}_{i,t}$. If the aggregate resource constraint is not binding, $s_{i,t}(r, R, \tilde{C}_{i,t})$ and $b_{i,t}(r, R, \tilde{C}_{i,t})$ are independent on $\tilde{C}_{i,t}$.*

¹¹ Given that the group is large, the incentives to influence the return on savings by setting a specific s_i or b_i are likely to be negligible. Note also that all our results are robust to assuming that the aggregate resource constraint is $b_{i,t} \leq \alpha_i s_{i,t} + \tilde{C}_{i,t}$, and $\tilde{C}_{i,t} = S_t + \sum_{x=1}^{t-1} (S_x - B_x) + (1+r) \sum_{x=1}^{t-1} B_x - \sum_{j \neq i} b_{j,t} + (1-\alpha) s_{i,t}$, where α_i is the amount of an agent's own savings that this agent expects to be able to borrow back from the group. The parameter α_i should depend on the rationing mechanism employed by the group (see Section 4.2).

We complement the above lemma with a remark that follows from inspecting the individual maximization problem:

Remark 1. *The cost of borrowing is decreasing in R . Conditional on being a borrower, $b_{i,t}(r, R, \tilde{C}_{i,t})$ is weakly increasing in R . However for R sufficiently large, the agent may set $b_{i,t}(r, R, \tilde{C}_{i,t}) = 0$ and only save.*

Because of the leverage constraint (Equation 1), a member who wishes to borrow must first save. Hence, as the return on these savings increases, the cost of borrowing decreases. This reduction on the cost of borrowing weakly increases the amount saved (by Lemma 1) and the amount that can be borrowed (by Equation 1). This is achieved by reducing the fraction of a project that is self financed, and increasing the scale of the investment. However, if R increases sufficiently, then the agent may switch from being a net borrower to being a net saver. This possible “jump” from borrower to saver is the reason why the amount borrowed and saved may be discontinuous in R . In case of discontinuity, $s_{i,t}(r, R, \tilde{C}_{i,t})$ and $b_{i,t}(r, R, \tilde{C}_{i,t})$ are nonetheless upper hemicontinuous: if two borrowing (savings) levels solve the utility maximization problem, then any convex combination of the two also solves the utility maximization problem. In other words, the savings and borrowing correspondences have no “holes”.

Figure 2 illustrates a possible $s_{i,t}(r, R, \tilde{C}_{i,t})$ and a possible $b_{i,t}(r, R, \tilde{C}_{i,t})$ for the same agent in two situation: one in which the aggregate resource constraint is never binding (left panel), the other when it sometimes is (right panel). For low and high R , the two panels are identical because borrowing is either too low or zero, so that the upper bound $\tilde{C}_{i,t}$ is not reached. For intermediate R 's instead, the two panels are different. Relative to the left panel, in the right panel borrowing is constrained by $\tilde{C}_{i,t}$ and, as a consequence, savings is also depressed.

We conclude by pointing out two additional results. First, note that the scarcity of funds may not impact all group members equally. It may be the case that the aggregate resource

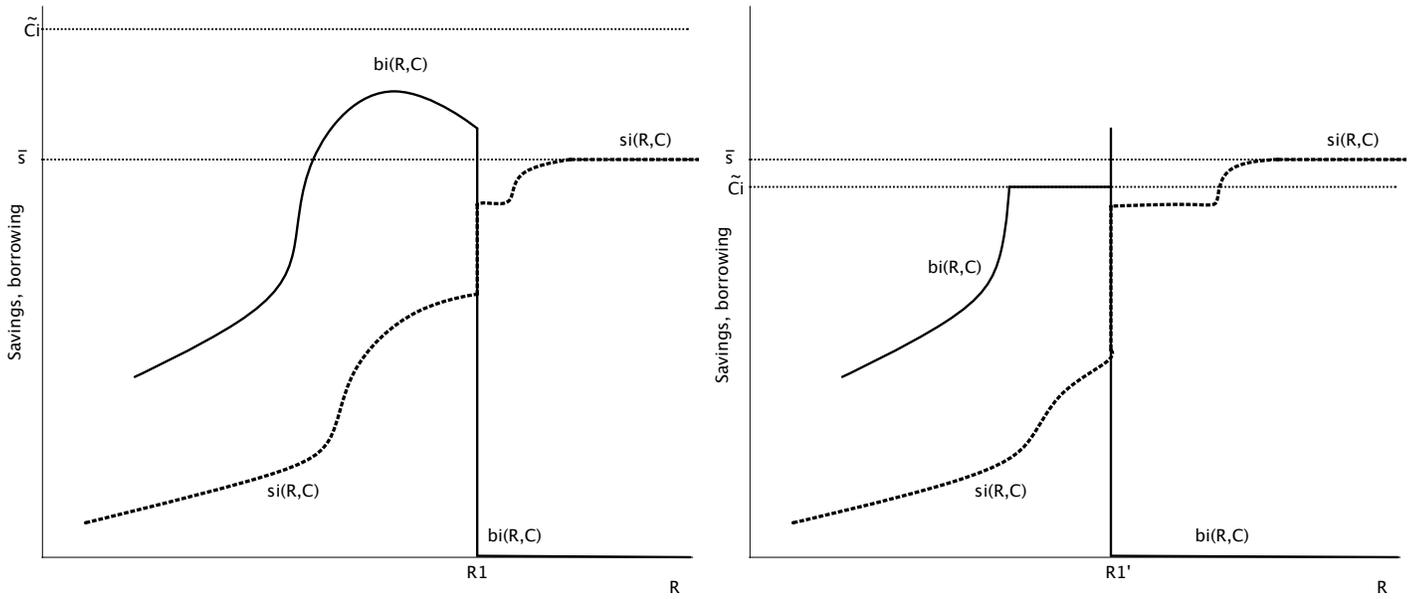


Fig. 2: **Individual savings and borrowing choices:** In the left panel, the aggregate resource constraint is never binding. In the right panel, the aggregate resource constraint may be binding. In both cases, demand b_i and supply s_i are initially increasing with the return on savings R , although savings $s_{i,t}$ is capped at \bar{s} . Below R_1 and R'_1 savings and borrowings are positive. Above R_1 and R'_1 the borrower switches to savings only. In addition, in the right panel, the amount that can be borrowed has an upper bound \tilde{C}_i . The constraint shifts the savings curve downward whenever it is binding, and savings and borrowing choices are now lower than when in the left panel. While the savings decision at high levels of savings is not affected by the constraint, whenever the constraint is binding the borrower may switch to zero borrowings at lower values of R . Hence $R_1 \geq R'_1$.

constraint is binding, but some members can fully meet their demand for loans while the burden of rationing falls disproportionately on others. We say that a member is *rationed out* in period t if her demand for loans is strictly increasing in $\tilde{C}_{i,t}$. Second, given the generality of the individual maximization problem, we do not link individual characteristics of each group member to a precise borrowing and savings behavior. In what follows, we characterize each member of the group directly by her $s_{i,t}(r, R, \tilde{C}_{i,t})$ and $b_{i,t}(r, R, \tilde{C}_{i,t})$, under the restriction that these functions satisfy Lemma 1 and Remark 1.

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

- Resource monotonic: for given r , \bar{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,
- Strategy-proof: no member has an incentive to misreport her demand for funds.

A large literature has investigated allocation mechanisms in the context of single peaked preferences. One mechanism often highlighted 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.¹² In our context, preferences are single peaked over $b_{i,t}$ (and the results in Kıbrıs, 2003, apply) because the return on the outside investment $f_{i,t}(y_{i,t})$ is strictly concave for all i and t .¹³

Note, however, that the uniform rule has very appealing properties *for given savings contributions*. It is unclear whether the uniform rule maintains its properties once we take into consideration that savings depend on the rationing rule. More theoretical work is needed to characterize the set of optimal rationing mechanisms in savings groups. For this reason, in what follows we simply assume that the rationing mechanism is resource monotonic, efficient and strategy-proof for given savings contribution. Hence, for the most part we will abstract away from the specific rationing mechanism employed by the group. An exception will be Section 4.5, where we solve for the period-0 choice of r and \bar{s} , because the “median” member of the group will depend on the rationing rule in use.

4.3 Equilibrium

Despite being taken as given by the group’s members, R and $\tilde{C}_{i,t}$ are determined in equilibrium. In particular, the equilibrium $R \equiv R^*$ solves:

$$R^* \sum_{t=1}^k S_t(R^*) = r \sum_{t=1}^k B_t(R^*) \quad (6)$$

where $S_t(R)$ and $B_t(R)$ are the aggregate demand and supply of funds in period t .

¹² 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. For a review of this literature and the formal definition of these properties, see Thomson (2014).

¹³ A second widely studied mechanism is *serial dictatorship*, in which members take turns in choosing their optimal borrowing amount until no funds are left. In Appendix B.1 we argue that this rationing rule may be resource monotonic, Pareto efficient and strategy-proof in situations in which the uniform rule fails to satisfy these properties.

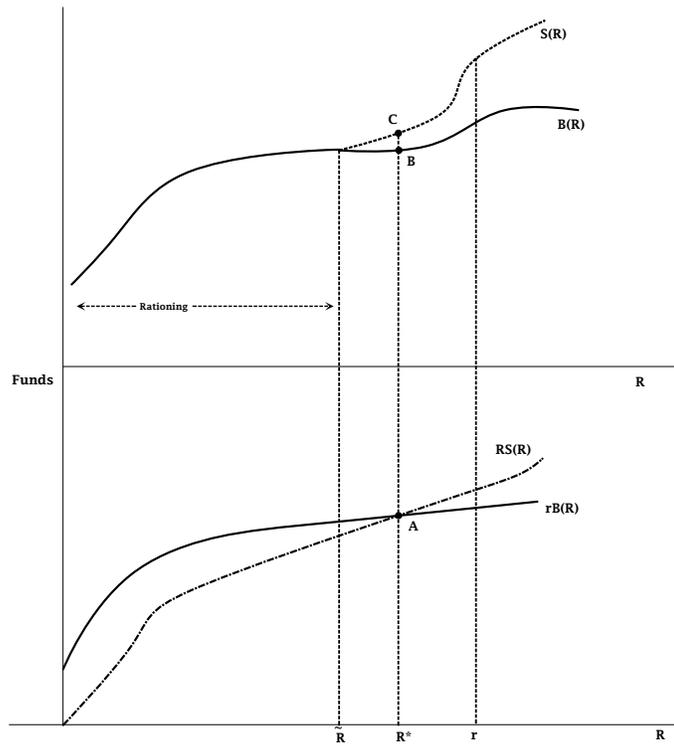
Note that, whereas the individual demand and supply of funds depend both on R and on $\tilde{C}_{i,t}$, the expressions for the aggregate demand and supply for funds only depend on R (we omit the dependency on r). The reason is that, in the individual maximization problem, $\tilde{C}_{i,t}$ matters only 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, in the aggregate 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 during a given period. Whenever the aggregate resource constraint is not binding, aggregate borrowing depends on aggregate savings only through the equilibrium R^* . Instead, in periods in which the aggregate resource constraint is binding, aggregate borrowing depends on aggregate savings directly. In particular, when the resource constraint is binding in a given period, $b_{i,t} = \tilde{C}_{i,t} \forall i$, and by Equation 5:

$$B_t(R) = r \sum_{x=1}^{t-1} B_x(R) + \sum_{x=1}^t S_x(R). \quad (7)$$

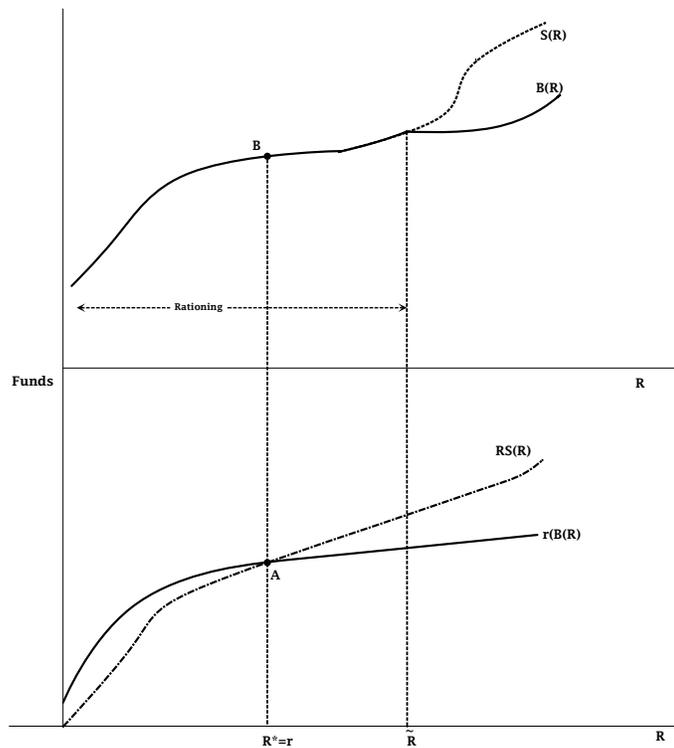
Hence, in periods in which funds are scarce, aggregate savings and aggregate borrowings are perfectly correlated. This observation will play a central role in the next section, where we empirically address the issue of funds scarcity.

Figure 3 provides an illustration of the equilibrium, for the case in which the aggregate borrowing and savings are continuous functions and the group is active in only one period (i.e., $k = 1$). The left graph presents the case where the resource constraint is binding, and the right graph the case where it is not binding. In each case, the top panel provides a description of the behavior of the supply curve $S(R)$ and demand curve $B(R)$ with respect to the realized rate R . The bottom panel describes the behavior of the two curves $RS(R)$ and $rB(R)$.

Distinguishing between periods in which the aggregate resource constraint is binding or not will be relevant when performing our comparative statics analyses. For example, assume



(a) **No rationing in equilibrium.** The equilibrium occurs at point A. As shown by points B and C $S(R^*) > B(R^*)$. It follows that $R^* < r$.



(b) **Rationing in equilibrium.** For $R < \tilde{R}$, funds are rationed and supply of funds is equal to demand: $S(R) = B(R)$. Because the equilibrium (point A) occurs on the rationing area, $S(R^*) = B(R^*)$ and $R^* = r$.

Fig. 3: Two examples of an unique equilibrium when $k = 1$. In both cases the equilibrium R^* is determined in the bottom panel by the intersection of $RS(B)$ and $rB(R)$.

that a member of the group drops out and is replaced by another person with a higher propensity to save in every period and at every R .¹⁴ If the resource constraint is never binding, we can solve for the new equilibrium simply by shifting upward $\sum_{t=1}^n S_t(R^*)$. If instead the aggregate resource constraint is binding in some periods, then aggregate borrowing in these periods will also respond to an increase in overall funds available to the group.

We now provide an important result of our framework: that an equilibrium R^* always exists. We also derive a sufficient condition for a unique equilibrium, which we will use in comparative statics.

Proposition 1. *An equilibrium R^* always exists. If β_i is sufficiently small for all i , then the equilibrium is unique. Assuming that at the unique R^* both $\sum_t S_t(R)$ and $\sum_t B_t(R)$ are functions, then the LHS of equation 6 crosses the RHS of equation 6 from below.*

Note that β_i determines the sensitivity of the borrowing decision to the return on savings. If this sensitivity is low the cost of borrowing is determined mostly by r and not by R . Hence, as β_i decreases, the elasticity of aggregate borrowing with respect to R decreases, and multiple equilibria disappear. In what follows, we always assume that R^* is unique for all r and \bar{s} .

4.4 Comparative statics

Using proposition 1 and assuming that the equilibrium is unique, we next analyze the effect of changes in the demand or the supply of funds in these groups.

Increase in aggregate savings Suppose that the aggregate savings increases in all periods.

This could be the case if a member of the group who only saves drops out of the group and

¹⁴ If the rules of the group are chosen by majority voting, then changing the composition of the group does not affect the rules adopted by the group as long as the median member of the group does not change. Hence, we can analyze changes in the demand and supply of funds due to a change in the group's composition keeping the rules adopted by the group constant.

is replaced by another agent who also only saves but has a larger propensity to save at every r , R and $\tilde{C}_{i,t}$. Clearly, if the resource constraint is never binding, then, for given R , the increase in aggregate savings has no effect on aggregate borrowing. Hence, the behavioral responses of the group members is driven by the fact that, by proposition 1, when $\sum_t S_t(R)$ shifts upward R^* decreases.

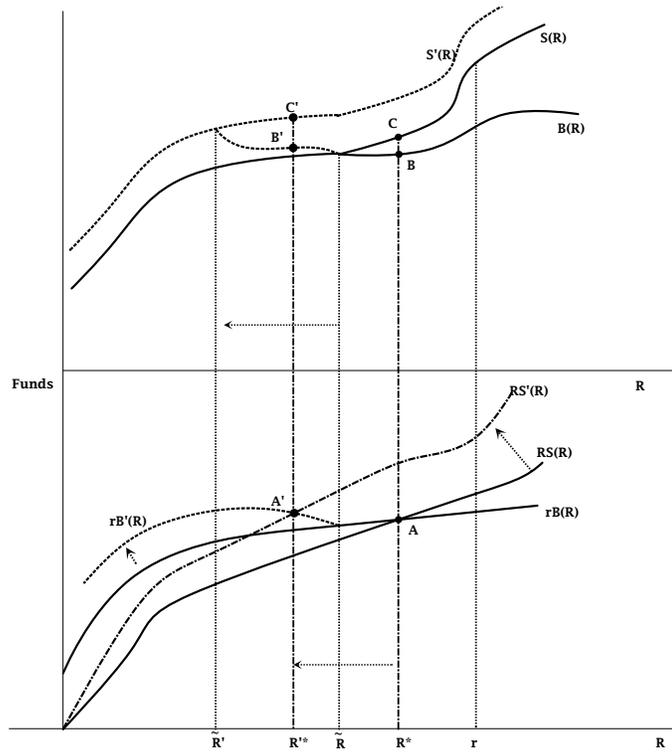
Corollary 1. *Suppose that the aggregate resource constraint is never binding. Furthermore, suppose that there is a change in the behavior of one of the group members, leading to an upward shift in $S_t(R)$ (for some t). As a consequence, R^* decreases and everybody else in the group is worse off.*

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.

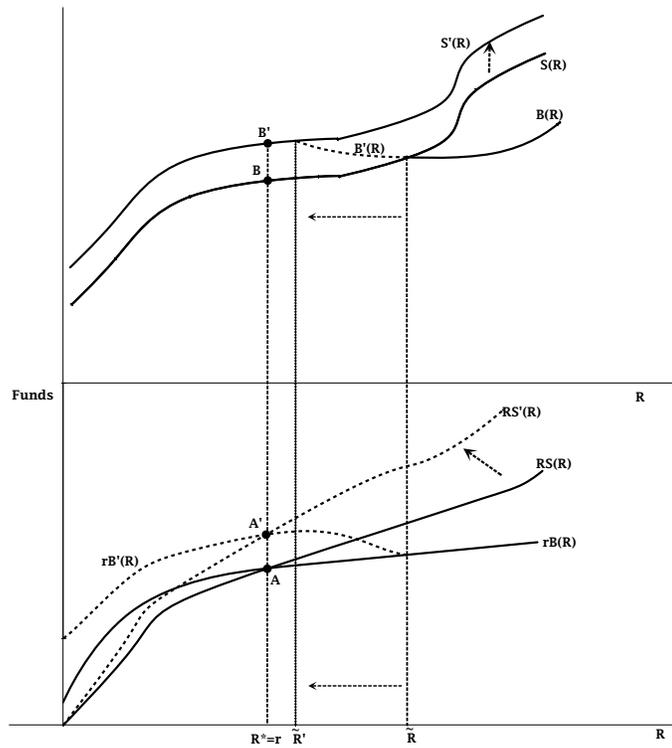
Corollary 2. *Suppose that the aggregate resource constraint is always binding. Furthermore, suppose that there is a change in the behavior of one of the group members, leading to an upward shift in $S_t(R)$ by the same factor in every period t . Each member's borrowing (weakly) increases and everybody else in the group 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 Remark 2). 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 one of the main results of the model: that exogenously increasing the funds available to the group (for example, by replacing one of the members of the group) will impose an externality on other participants. The key determinant of the



(a) **Initially non-binding resource constraint.** R^* drops to R'^* . Savings increase from C to C' , and loans increase from B to B' .



(b) **Initially binding resource constraint.** The new equilibrium remains rationed, R is unchanged and loans increase to B' .

Fig. 4: **Exogenous shift in aggregate savings:** In both cases, the initial equilibrium is determined by point A . Increasing savings to $S'(R)$ shifts the borrowing curve to $B'(R)$ (dotted line) for values of $R < \tilde{R}$ (i.e. when there is rationing).

sign of this externality is whether the group is resource constrained. Quite intuitively, when the resources within the group are scarce, adding more resources is beneficial to the others. More interestingly, when the group is not resources constrained, adding resources to the group hurts the group by decreasing the return on savings. These effects are demonstrated graphically in figure 4, which show the effect of a shift in the aggregate savings function assuming that $k = 1$, and that both $S(R)$ and $B(R)$ are continuous functions. The figure shows that loanable funds increase without affecting returns if borrowing remains rationed, but returns fall when funds are not rationed.

When the resource constraint is binding only in some periods, the overall welfare effect of adding resources to the group is ambiguous. All members are made worse off by the addition of extra funds because they decrease R^* . 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 the group composition changes in a way that shifts $B_t(R)$ up in every period, leaving unchanged the aggregate supply of funds $S_t(R)$. This would be the case if, for example, a net saver is replaced with a net borrower who saves the same amount in every period, but uses these savings to actually borrow funds from the group.

If the aggregate resource constraint is never binding, by proposition 1, the effect of an increase in aggregate borrowing is an increase in R^* , leading to the following corollaries (which we illustrate in Figure 5 for the case $k = 1$).

Corollary 3. *If the aggregate resource constraint is never binding, then an increase in $\sum_t B_t(R)$ leads to an increase in R^* , higher individual savings and borrowing. Everybody in the group is better off.*

If instead the aggregate resource constraint is always binding, then 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 the existing member of the group are indifferent to the increase in the demand for funds. If instead the addition of a borrower decreases the amount of funds available to the other borrowers, then the existing borrowers are made worse off by the increase in the demand for funds.

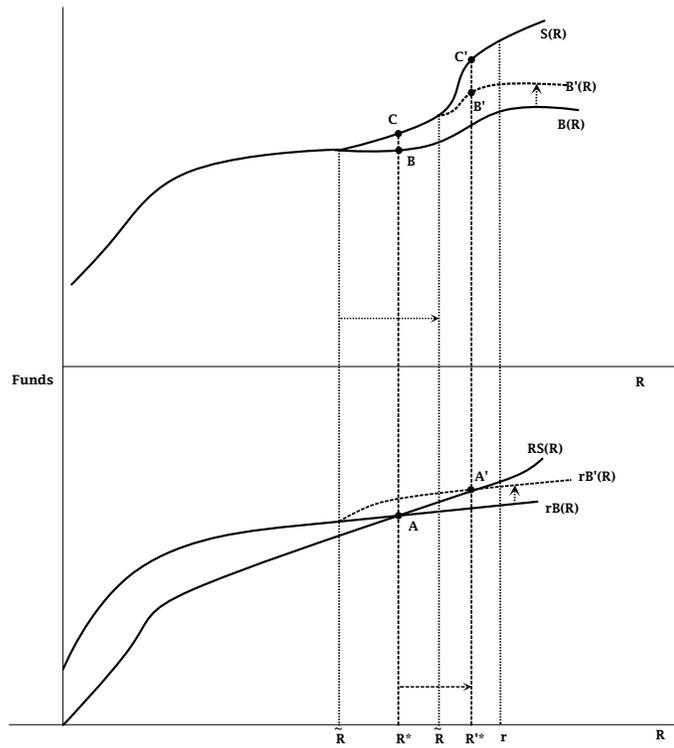
Corollary 4. *If the resource constraint is always binding, an increase in the demand for loans has no effect on R^* , but may make rationing worse for some group members. As a consequence, everybody in the group is weakly worse off.*

Similarly, if the resource constraint is binding in some periods but not the others, the welfare effect of increasing the demand for funds is ambiguous. On the one hand, R^* increases and everybody benefits. On the other hand, net borrowers may be hurt by the fact that rationing is now worse.

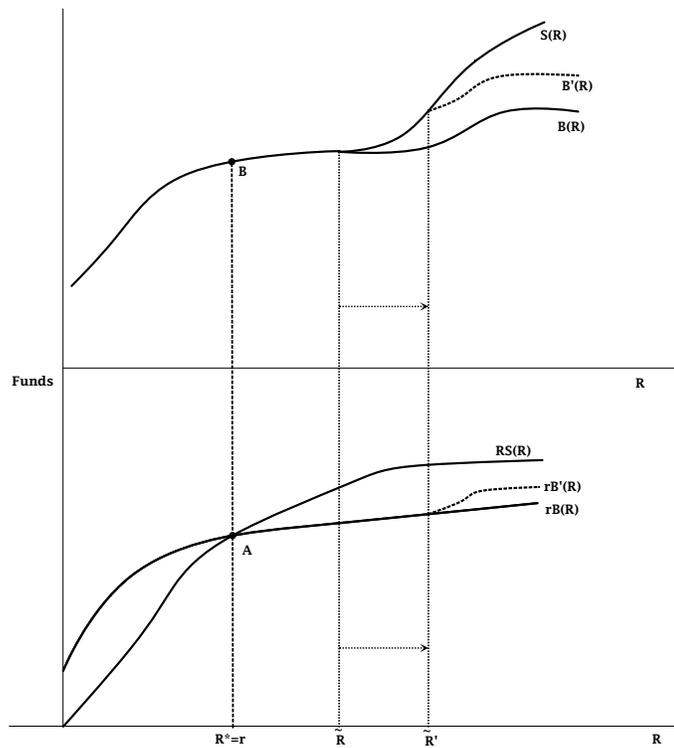
Overall, increasing aggregate borrowing and increasing savings have opposite effects on the group. When the aggregate resource constraint is binding, increasing savings makes the group better off while increasing borrowing makes the group (weakly) worse off. When the aggregate resource constraint is not binding, increasing savings makes the group worse off, while increasing borrowing makes the group better off.

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 the group can substitute one or more members, so that 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.

Instead, suppose that the aggregate resource constraints is binding in a given period $t < k - 1$, and savings are reallocated from period $t + 1$ to period t . If the period- t demand



(a) **Initially non-binding resource constraint.** The new equilibrium is the intersection point A' . R^* increases to R^* . Realized savings increase from C to C' , and realized loans increase from B to B' .



(b) **Initially binding resource constraint.** The group remains rationed. R , realized savings and realized loans are unchanged.

Fig. 5: **Shift in the demand for loans:** In both cases, the initial equilibrium is determined by point A . Increasing demand for loans shifts the borrowing curve to $B'(R)$ (dotted line) for values of $R > \tilde{R}$ (i.e. when there is no scarcity).

for loans is rationed, then this reallocation 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 $t+1$. Hence, if the resource constraint is binding also in period $t+1$, this reallocation eases rationing in period $t+1$ as well.

Remark 2. *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^* 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^* and no impact on the group members' welfare.*

Hence, contrary to changing the level of savings, changing the timing of savings has a unambiguous welfare effect.

4.5 Period 0: setting the rules

So far, we have treated the price of a loan r and the maximum savings \bar{s} as given. In reality, these values are chosen by the group at the beginning of the cycle, possibly through voting. Might an optimal selection of these values eliminate the mismatch of demand and supply?

In short, the answer is “no”. In Appendix B.2 we argue that the payoff at share out is far in the future relative to the moment in which the choice of r and \bar{s} are made, and hence plays a small role in deciding over r and \bar{s} . If we consider the limit case in which this payoff is completely disregarded by the the group members, then we can analyze the group's choice over r and \bar{s} as a voting game and a Condorcet winner exists. The important observation is that, in general, when funds are scarce, some members may still be able to satisfy their demand for loans. Hence, the groups will choose rules that induce scarcity of funds, provided that the “median” member of the group is able to satisfy its demand for funds at these rules.

5 Evidence

The main takeaway from the theoretical model is that, in any given period, the demand for loans may not match its supply, and therefore groups are either operating under rationing or generating low return on savings. Whether and to what degree groups operate under scarcity or excess funds is thus an important issue, which we explore in this section.

Here, we use information from the cashbooks of 22 savings groups. For each meeting, the records include loan repayments, deposits and collected fines as inflows, loan disbursement as outflows, and a running balance of the cash remaining in the box (See appendix A for further discussion of the data). We begin by studying the amount of funds available in savings groups at the end of each meeting. Figure 6 shows the proportion of meetings in any meeting quantile that ended with a low balance. 20 to 35 percent of groups had less than 15,000 UGX (\$5.60) available at the end of the day during the first half of the cycle. This proportion drops to less than 10 percent during the rest of the cycle. The graph is suggestive that groups may be operating under scarcity. However, it is possible that groups largely satisfy loan demand even if occasionally the box is empty. It is also possible that groups that have cash on hand may still be rationing loans if potential borrowers need loan amounts that surpass the group balance.

An alternative strategy is to use the variation of inflows and outflows *within* the group in a regression setting. As we argue in the theoretical section, if groups are indeed resource constrained at any given meeting, after controlling for the cost of borrowing the relationship between cash brought in (savings, repayments, and fines) and the amount lent out is close to one-to-one (see equation 7). That is, every dollar put in the box at the beginning of the meeting is lent out in the same meeting. This number can easily surpass one in magnitude if there are residual resources from previous meetings that are lent out. Groups are not resource constrained, on the other hand, if after controlling for the cost of borrowing the

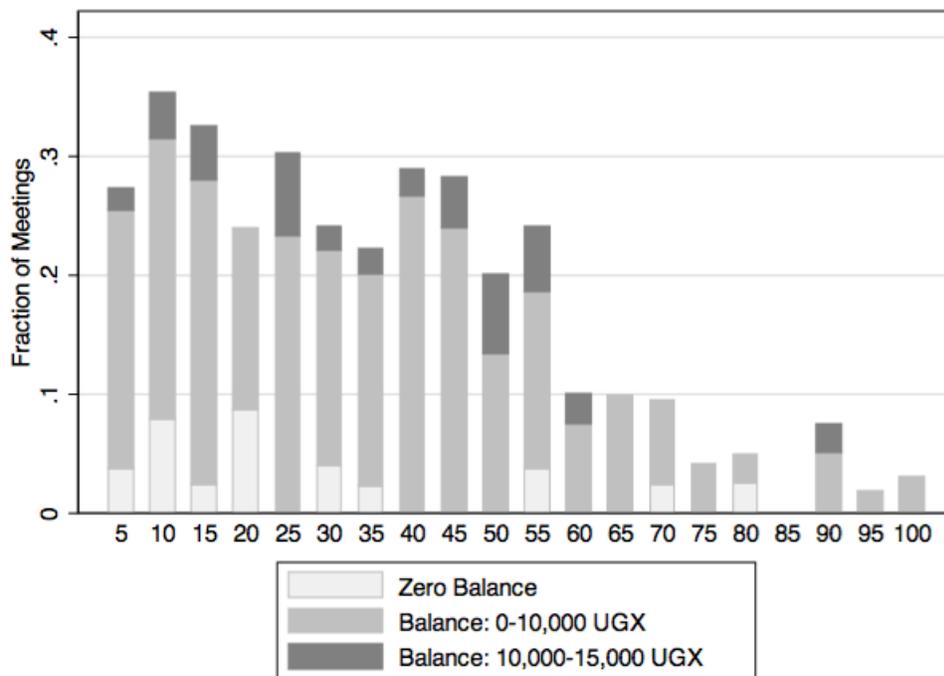


Fig. 6: Fraction of groups with low balances by meeting period

amount of loans disbursed does not depend on the cash put into the box that day.¹⁵

In order to identify whether groups are resource constrained across a lending cycle, we regress loans made at a particular meeting t in group g on the cash added to the box controlling for the cost of borrowing (captured by a group 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.¹⁶ Equation (8) is our base specification:

$$L_{gt} = \beta_0 + \beta_1 \text{CashIn}_{gt} + \sum_{q=2}^Q (\beta_q \text{CashIn}_{gt} * D_t^q) + \sum_{q=1}^Q D_t^q + \alpha_g + u_{gt}, \quad (8)$$

where L_{gt} are loans disbursed in group g during meeting t , CashIn_{gt} are savings, fines, and

¹⁵ Note that in a perfect credit market, the demand for loans depends on supply of funds only through the equilibrium interest rate. Hence, controlling for the cost of borrowing the demand for loans should not depend on the available cash.

¹⁶ Meeting quantiles were used because groups varied in the total number of meetings held. Twenty quantiles were chosen, so the first quantile corresponds to the first 5%, the second quantile corresponds to the second 5%, and so on.

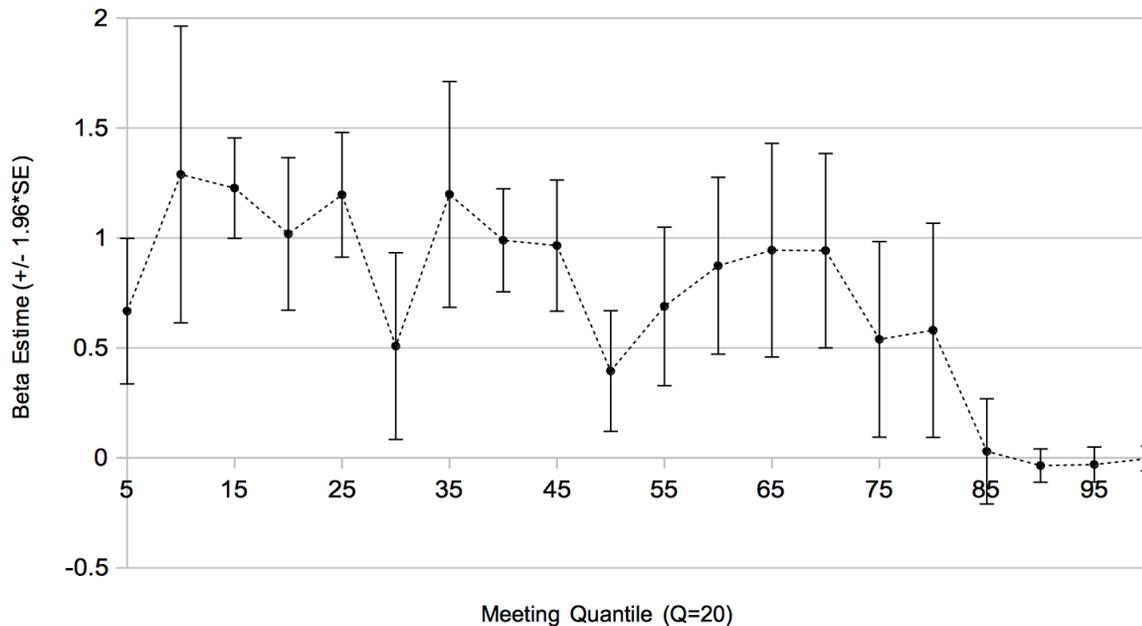


Fig. 7: Estimates of β_q .

loan repayments collected during that meeting, D^q is a dummy variable that takes on a value of one if the meeting falls in quantile q and zero otherwise, α captures group fixed effects (which controls for groups' characteristics and group's rules, including the cost of borrowing), and u_{gt} 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 $(q = 2, \dots, Q)$ is the fraction of cash inflows that is lent out in each subsequent quantile. 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. Periods where lending is not constrained should be characterized by saving and borrowing being uncorrelated: $\beta_1 + \beta_q = 0$.

Figure 7 reports the parameter estimates ($\beta_1 + \beta_q$) across twenty meeting quantiles. Initially, the group does not lend out all the cash brought in, possibly because each member

needs to save with the group before being able to borrow. By the second quantile of meeting (10%) they appear to be lending at a nearly one-to-one rate with cash coming in, and that rate remains high for the first half of the cycle. Occasionally this estimate exceeds one, suggesting that residual balances may be compiling early in the cycle. Twice during the cycle, groups appear to loan only a fraction of the cash brought in during those meetings (at 30 and 50 percent of meetings). This may indicate a desire to accumulate funds for future lending of large loans. By three quarters of the meetings completed, groups are beginning to lend less (many stop lending all together) and cash brought in no longer affects lending decisions. Lending is shut down at the end of the cycle to allow repayment, and loans and cash in become uncorrelated.

Regression estimates for this figure can be found in Table 5. The first column of this table reports the OLS estimate for the average fraction of cash brought in that is distributed as loans across the cycle (controlling for group level difference in lending behavior). 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. To accommodate for changes across the cycle, we interact the flow of cash in during a meeting with a dummy variable for the percentage of meetings that has passed.

Column (2) presents these results and are the basis for Figure 7. The first five percent of meetings are held as the base, so the parameter estimate for “Meeting Cash In” is the fraction of cash during the first five percent of meetings that was lent out. The following estimates report the difference in lending behavior from those first meetings. We find that during the first half of meetings, the fraction of cash brought in that is lent out increases compared to the first five percent of meetings. One exception to this is at the 30% meeting quantile where there appears to be a pause in the relationship.

This fluctuation between resource constraints and brief moments where groups have excess cash may be indicative of periods of savings, potentially for large loan amounts in

subsequent meetings. As shown in Figure 1, loans do grow more frequent during the latter part of the cycle, so this sort of time rationing is plausible.

Robustness One potential concern that arises from this specification is that there may be an omitted variable influencing contemporaneous cash brought in during a meeting (savings, repayments and fines) and loans disbursed during that meeting. In particular, repayments on past loans are going to depend on the stock of outstanding loans in a particular period. Because each member can have only one outstanding loan at the time, groups with a larger stock of outstanding loans may have a higher cash-in and a lower demand for loans. Column (3) of Table 5 includes an interaction term for outstanding balance with the meeting quantile but the results do not appear to be sensitive to his change (the magnitudes and linear combinations are robust).

Seasonality may also affect how groups decide to loan out cash. This is a concern if the majority of the groups have meetings in roughly the same time of the year, and if groups face increased demand for loans at similar times (perhaps tied to agricultural planting and harvesting needs). In this setting, groups started the cycle at different periods of time. Moreover, to account for potential seasonality, we include dummy variables for month of meeting and report the estimated in Column (4). In general, the results from estimating Equation (8) do not change drastically with this adjustment.

6 Conclusion

In this paper we provided a theoretical framework for the analysis of supply and demand for loans within savings groups. The main result from the theory is that there is no mechanism to ensure that demand and supply of funds are in equilibrium, and that consequently groups either face excess supply of funds or rationing of loans. In this context, shocks to individual demand or supply curves create a spillover effect: they affect the availability of funds to

Fraction of Cash Distributed as Loans

Dependent Variable = Cash Out in Loans

VARIABLES	(1)	(2)	(3)	(4)
Meeting Cash In	0.393*** (0.0867)	0.667*** (0.169)	0.631* (0.339)	0.726*** (0.180)
<i>Cash In*Meeting Quantile:</i>				
10%		0.621* (0.335)	0.626 (0.444)	0.712** (0.339)
15%		0.559*** (0.172)	0.615* (0.361)	0.516*** (0.186)
20%		0.351* (0.192)	0.305 (0.429)	0.289 (0.184)
25%		0.529*** (0.190)	0.730* (0.373)	0.475** (0.206)
30%		-0.159 (0.239)	-0.0507 (0.427)	-0.248 (0.240)
35%		0.531* (0.286)	0.716 (0.543)	0.339 (0.302)
40%		0.322* (0.193)	0.412 (0.366)	0.240 (0.203)
45%		0.298 (0.213)	0.363 (0.364)	0.220 (0.234)
50%		-0.272 (0.200)	-0.316 (0.348)	-0.371* (0.215)
55%		0.0216 (0.260)	-0.192 (0.395)	-0.0532 (0.278)
60%		0.207 (0.248)	0.267 (0.406)	0.148 (0.256)
65%		0.277 (0.273)	0.631 (0.451)	0.196 (0.289)
70%		0.275 (0.272)	0.515 (0.417)	0.230 (0.278)
75%		-0.128 (0.270)	-0.192 (0.397)	-0.181 (0.283)
80%		-0.0870 (0.285)	-0.0110 (0.404)	-0.133 (0.294)
85%		-0.638*** (0.198)	-0.337 (0.382)	-0.681*** (0.207)
90%		-0.702*** (0.161)	-0.628* (0.332)	-0.759*** (0.179)
95%		-0.698*** (0.162)	-0.672** (0.327)	-0.757*** (0.178)
100%		-0.670*** (0.173)	-0.637* (0.341)	-0.731*** (0.184)
Outstanding Loan Balance			-0.000434 (0.246)	
Constant	3,741 (30,187)	-32,837 (22,929)	-35,790 (27,247)	-46,991 (40,002)
Observations	782	764	764	764
R-squared	0.331	0.476	0.525	0.481
VSLA f.e.	YES	YES	YES	YES
Meeting Quantile f.e	NO	YES	YES	YES
Outstanding Balance*Meeting Quantile	NO	NO	YES	NO
Month f.e.	NO	NO	NO	YES

Robust standard errors in parentheses

*** p<0.01, ** p<0.05, * p<0.1

Tab. 5: Regression estimates of β_q on loans distributed.

rationed borrowers, or the return of savings.

We use the model to perform some comparative statics analyses. Most notably, we find that shifting savings from late to early in the cycle is always Pareto improving, because it eases scarcity in periods when the demand for loans exceeds the supply for loans without reducing the return on savings. Furthermore our empirical analysis shows that groups face binding resource constraints in the first part of the operating cycle. Hence, overall, the paper points at the importance of encouraging early savings.

From a policy perspective, encouraging early savings may be achieved by adjusting the rules of operation of savings groups. For example, decreasing the number of shares that can be purchased (starting from a relatively large number) could successfully shift savings from later periods to early periods. Alternatively, early savings could earn a higher return than later savings. For example, shares could be sold at a discount during the initial period of operation of the group, under the condition that each share receives the same payout at share-out. Finally, programs that temporarily fund savings groups early in a cycle through a microfinance loan may also encourage early lending without necessarily hurting savings returns.

References

- Allen, H. and D. Panetta (2010). Savings groups: What are they. *SEEP Network*.
- Ashe, J. (2009). Saving for change: Low cost, mass-scale, self-replicating and profitable microfinance for the rural poor. *Oxfam america*.
- Ashe, J. and K. J. Neilan (2003). *In Their Own Hands: How Savings Groups are Revolutionizing Development*. Berrett-Koehler Publishers, Inc.
- 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.

Blattman, C., E. P. Green, J. C. Jamison, M. C. Lehmann, and J. Annan (2015). The returns to microenterprise support among the ultra-poor: A field experiment in post-war Uganda. *American Economic Journal: Applied Economics* 8(2), 35–64.

Burlando, A. and A. Canidio (2015). Does group inclusion hurt financial inclusion? evidence from ultra-poor members of ugandan savings groups. *working paper*.

Cassidy, R. and M. Fafchamps (2015). Can community-based microfinance groups match savers with borrowers? evidence from rural malawi. *working paper*.

FinScope (2010). Results of a national survey on demand, usage and access to financial services in uganda.

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

Greaney, B., J. P. Kaboski, and E. Van Leemput (2016). Can self-help groups really be “self-help”? *The Review of Economic Studies*, forthcoming.

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.

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

Vanmeenen, G. (2010). Savings and Internal Lending Communities (SILC), voices from Africa: The benefits of integrating SILC into development programming.

Total groups with any cashbook records	70
Number of groups dropped due to incomplete records	29
Number of groups with complete cashbook records (unvetted)	19
Number of groups with complete cashbook records (vetted)	22
Total number of observations	944
Percent of observations corrected*	59.2 (49.169)
Percent of observations with residual discrepancy	44.068 (49.673)
Average size of discrepancy (in absolute value, UGX)	43541.450 (226170)

Standard deviation in parentheses

* Corrections include: missing data from data entry (frequent), typos in data entry (frequent), miscalculations of record keeper (rare), and differences in accounting procedure (moderate frequency).

Tab. 6: Description of cashbook cleaning process.

A Ledger data cleaning

The paper made use of meeting-level data from handwritten registries of a number of Ugandan savings groups (see table 6). Of the 110 groups that were part of the study, 70 groups submitted photographs of their cashbooks for their first cycle. Many of these pictures had missing pages, poor focus, or were otherwise difficult (if not impossible) to digitize. We found that 29 groups had substantial portions of their cashbooks missing or were in formats that were illegible. Of the remaining 41 groups, 22 were thoroughly cleaned and reconciled.

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 (but we minimized this amount as much as possible). On average the size of this discrepancy was about 972 UGX, but the range of this amount was quite substantial¹⁷.

B Theoretical Extensions

B.1 More on rationing

It is interesting to note that, if we allow some convexities in the outside investment, the uniform rule may fail to be either efficient or resource monotonic. For example, suppose that all investment opportunities are discrete, in the sense that they require a fixed investment level to deliver a given return. It follows that an agent's utility may have local maxima, which emerge whenever extra funds allocated to the agent are not sufficient to start a new investment opportunity, but need nonetheless to be repaid with interest. When resources are scarce, an agent may borrow little and settle for a local maximum. As aggregate resources increase, some agents may discretely increase the amount borrowed with the group, potentially decreasing the resources available to other members of the group.

Motivated by this observation, we consider here a second widely-studied rationing rule: *serial dictatorship*, in which all agents are ordered and each of them can, in turn, choose how much to receive from the available funds. Serial dictatorship is appealing because it is efficient, strategy proof and satisfies resources monotonicity whenever two conditions are met:

- when indifferent between multiple borrowing levels, members demand the lowest level.
- consider the list of dictators, $1, 2, \dots, k$, where dictator 1 chooses before all other dictators (and so on). If the k^{th} dictator borrows a positive amount, then all $k - 1$ dictators fully meet their demand for loans. i.e. they would not borrow more even if more resources were available.

¹⁷ A lot of these discrepancies occurred on observations in the middle of the cycle which were corrected for by audits throughout and there was fewer discrepancies during the latter parts of the cycle.

To understand better the last point, suppose that an earlier dictator leaves funds to the following dictator, who then uses these funds. The above condition rules out situations in which an earlier dictator can only invest in projects requiring an upfront investment larger than the available funds (and therefore leaves funds on the table), while the later dictator can invest in projects that require an upfront investment lower than the available funds. This condition is always satisfied if the return on investment is continuous, smooth and concave. It is also satisfied if all investment opportunities faced by all agents have the same minimum investment level (but may deliver different returns).

Hence, the uniform rule has very appealing properties if all $f_i()$ are smooth and concave, but it fails to be resource monotonic in other cases. Serial dictatorship has less appealing properties (in particular, it does not satisfy the no-envy condition), but remains efficient, strategy proof and resource monotonic also for some $f_i()$ that are not convex.

B.2 Rules setting

In period 0, the choice of r and \bar{s} is determined by two basic trade-offs. For given R^* and given available funds, a higher r or a lower \bar{s} will make everybody in the group weakly worse off. However, a higher r or a lower \bar{s} may actually increase R^* , benefiting everybody in the group. Furthermore, r and \bar{s} have an additional effect on the availability of funds and on whether some borrowers will be rationed out. Crucially, each group member will solve these trade offs differently depending on their demand for funds and on the rationing mechanism.

For this reason a voting game over the rules r, \bar{s} may not have a Condorcet winner. A group member may have a preferred r and \bar{s} in case she is a borrower and a preferred r and \bar{s} in case she is a pure saver (i.e. no borrowing). If a borrower, an agent is facing a trade off between availability of funds (which is increasing in r), and cost of borrowing. In general, an agent prefers the smallest r such that her demand for loans is fully met to any larger r (but may, in fact, prefer an even smaller one). If a pure saver, the agent prefers the r and \bar{s} that maximize R^* . Hence, an agent's utility may be first decreasing and then increasing with r if the agent switches between being a borrower to being a saver.

When preferences are not single peaked, the collective decision over r and \bar{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 model, each group is likely to have adopted a different voting game. Despite these difficulties, we can show that, under some strong assumptions, the voting game has a Condorcet winner. We assume here a uniform rule for allocating scarce funds.

Proposition 2. *Suppose that $\beta_i = 0$ for all i , so that, in period 0, each group member maximizes $u_1(c_{i,1})$. Call r_i^* the preferred r of agent i (if it exists). There exists a Condorcet winner of the game, which is the median r_i^* (which we call r_m^*) and the \bar{s} maximizing the availability of funds for this r .*

It is reasonable to assume that, in period 0, all members of the group discount heavily the payoff at share out relatively to the instantaneous payoffs earned while the group is operating, because the share-out date is sufficiently far in the future while the date at which each agent may borrow from the group is much closer. The proposition considers the limit case $\beta_i = 0$ for all i , in which the utility at share out is completely ignored and the only determinant of the choice over r and \bar{s} is the ability to borrow cheaply in period 1. Hence, for every r , everybody agrees that \bar{s} should maximize the availability of funds.¹⁸ When choosing over r , conditioned on the agent being a borrower, preferences are single peaked, because a higher r reduces rationing but makes borrowing more expensive. In case an agent does not expect to borrow, she will be indifferent over r and \bar{s} . A Condorcet winner exists if agents break their indifference in favor of the option closer to their peak.

Finally, some agents are never borrowers and therefore do not have a peak r . The Condorcet winner is the median peak if these agents abstain. However, other Condorcet winners may exist, depending on the number of agents who never borrow and on how these agents break their indifference. For example, if only one agent in the group is always a saver, there are two other Condorcet winners. Assuming that the agent who is always a saver always votes for the largest r , then the

¹⁸ Note the amount of cash available for borrowing may not be monotonic in \bar{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.

peak just above the median peak is a Condorcet winner. Similarly, assuming that the agent who is always a saver always votes for the smallest r , then the peak just below the median peak is a Condorcet winner.

Despite being based on fairly strong assumptions, the above proposition is relevant because it shows that the outcome of the voting game will, in general, not reflect the "preferences" or "welfare" of the group, but rather the preferences of the median member of the group. In particular, note that if $r_i^* > r_m^*$ for at least one i , then the interest rate chosen by the group will generate rationing, because some of the group's member will not be able to borrow as much as they want at the chosen r_m^* .

C Mathematical derivations

Proof of Lemma 1

Proof. Because the objective function of the utility maximization problem is quasiconcave, and all constraints are continuous and convex valued, by the theorem of the maximum $s_{i,t}(r, R, \tilde{C}_{i,t})$ and $b_{i,t}(r, R, \tilde{C}_{i,t})$ are upper hemicontinuous, closed and convex for all r , R and $\tilde{C}_{i,t}$. In addition, note that $s_{i,t}$ and R are complements in the objective function. Therefore by Topkins's theorem $s_{i,t}(r, R, \tilde{C}_{i,t})$ is weakly increasing in R (if $s_{i,t}(r, R, \tilde{C}_{i,t})$ is a correspondence, then lower and upper bound of this correspondence are 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, because of Equation 1, an agent may save to borrow. When the resource constraint is binding, $b_{i,t}(r, R, \tilde{C}_{i,t}) = C_{i,t}$. Hence, as $C_{i,t}$ increases, the amount that can be borrowed increases, and with it the amount that may need to be saved in order to reach a given level of borrowing. \square

Proof of Proposition 1

Proof. Note that the aggregate demand for savings and aggregate demand for loans inherit the properties of the individual demand for savings and loans derived in Lemma 1 and remark 1. Note also that each $S_t(R)$ is bounded above by $\sum_i \min_i \{w_i, \bar{s}\}$. 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 $R = 0$ members are indifferent between saving inside or outside of the group. Whenever savings inside of the group are positive, also borrowings can be positive and $r \sum_t B_t(R) \geq 0$. Hence, it must be the case that

$$R \sum_t S_t(R)|_{R=0} = 0 \leq r \sum_t B_t(R)|_{R=0}$$

Together with the fact that all functions are upper hemicontinuous and compact valued, these results imply that an equilibrium exists.

Finally, as β_i decreases, each $B_t(R)$ becomes progressively flat, because the borrower's behavior becomes independent on R (and depends exclusively on r). At the same time, by Lemma 1 $S_t(R)$ is always (weakly) increasing. Therefore, as β_i decreases for all i , $r \sum_t B_t(R)$ becomes flat, while $R \sum_t S_t(R)$ is strictly increasing and diverges to infinity. It follows that the equilibrium must be unique. It also follows that at the unique equilibrium $R \sum_t S_t(R)$ must cross $r \sum_t B_t(R)$ from below. \square

Proof of Corollary 2

Proof. If all aggregate resource constraints are binding, then at $R = R^*$:

$$R \sum_t^k S_t(R) = r \sum_t^k S_t(R) \sum_s^{k-t} (1+r)^s$$

Which implies that increasing all $S_t(R)$ by the same factor does not change R^* . At the same time, higher $S_t(R)$ relax the aggregate resource constraint. Net savers and borrowers who are not

rationed out are indifferent, while borrowers who are rationed out increase their borrowing and are better off. \square

Proof of Proposition 2

Proof. We start by making few preliminary observations. First, the availability of funds within the group is increasing in r . An increase in r causes three responses. Those who did not borrow at all do not change their behavior. Some of the borrowers will decrease the amount borrowed, but continue borrowing. Finally, some of the borrowers will switch from being borrowers to being savers. It follows that increasing r always (weakly) increases the availability of funds to those who remain borrowers. Second, because the individual demands and supplies of funds are upper hemicontinuous in r (by the theorem of the maximum), also the funds available for borrowing are upper hemicontinuous in r . Third, for r sufficiently large, nobody will want to borrow and, quite trivially, the demand for loans of the entire group is satisfied.

For every agent i , call r_i^* this agent's preferred r , which is computed solving for the trade off between borrowing cheaply and being able to access funds. Note that this r_i^* may not exist for all group members, but will exist for some member as long as $f'_{i,1}(0) > 0$ for some i . The reason is that, by the uniform rule, as long as the group has some funds to distribute (i.e. as long as there is one saver in the group), then everybody who demands funds will receive some. On the other hand, if the agent expects to be a saver for every r , then r_i^* does not exist because this agent is indifferent among all r .

If $r' > r_i^*$, $r'' > r_i^*$, $r' > r''$, and assuming that the agent is a borrower at r'' , the agent prefers r'' to r' , because conditionally on being able to meet his demand for loans, this agent strictly prefers lower r . Similarly, if $r' < r_i^*$, $r'' < r_i^*$, $r' > r''$, and assuming that the agent can borrow a positive amount at r' , this agent prefers r' to r'' , because this agent will be able to access more funds (remember that, by the uniform rule, more funds for the group imply more funds available for each member of the group). Furthermore, this agent always prefers an r at which she is a borrower to an r at which she is a saver, and is indifferent between all r for which she is a net saver.

Hence, preferences are single peaked over r (and a Condorcet winner exists) as long as we impose

the following tie breaking rule: in case of indifference, an agent will vote for the option that is closer to her peak. Note, however, that agents who are always savers do not have a peak r . Depending on how these agents break their indifference, we may have different Condorcet winner. Here we assume here that, if indifferent among all options, these agents do not vote, so that the Condorcet winner is the median peak r . To conclude, note that every borrower prefers the \bar{s} that generates more funds to any other \bar{s} , because it allows to maintain the same level of rationing but at lower r 's.

□